SLOVENSKI STANDARD
SIST EN 62551:2013

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Tehnike analize zagotovljivosti - Tehnike Petrijeve mreže

Analysis techniques for dependability - Petri net techniques

Techniques d'analyse de sûreté de fonctionnement - Techniques des réseaux de Petri

Ta slovenski standard je istoveten z: **EN 62551:2012**

ICS:

21.020	Značilnosti in načrtovanje strojev, aparatov, opreme	Characteristics and design of machines, apparatus, equipment

SIST EN 62551:2013 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

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English version

Analysis techniques for dependability - Petri net techniques (IEC 62551:2012)

Techniques d'analyse de sûreté de fonctionnement -
Techniques des réseaux de Petri
(CEI 62551:2012)

Analysemethoden für Zuverlässigkeit -
Petrinetze
(IEC 62551:2012)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Management Centre: Avenue Marnix 17, B - 1000 Brussels

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Foreword

The text of document 56/1476/FDIS, future edition 1 of IEC 62551, prepared by IEC/TC 56 "Dependability" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62551:2012.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2013-08-06
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2015-11-06

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In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61508 Series	NOTE	Harmonised as EN 61508 Series (not modified).
IEC 61508-4:2010	NOTE	Harmonised as EN 61508-4:2010 (not modified).
IEC 61508-1:2010	NOTE	Harmonised as EN 61508-1:2010 (not modified).
IEC 61165:2006	NOTE	Harmonised as EN 61165:2006 (not modified).
IEC 60812:2006	NOTE	Harmonised as EN 60812:2006 (not modified).
IEC 61025:2006	NOTE	Harmonised as EN 61025:2007 (not modified).
IEC 61078:2006	NOTE	Harmonised as EN 61078:2006 (not modified).
IEC 61511-3:2003	NOTE	Harmonised as EN 61511-3:2004 (not modified).
IEC 61703:2001	NOTE	Harmonised as EN 61703:2002 (not modified).

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60050-191	1990	International Electrotechnical Vocabulary (IEV) - Chapter 191: Dependability and quality of service	-	-

IEC 62551

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colour inside

Analysis techniques for dependability – Petri net techniques

Techniques d'analyse de sûreté de fonctionnement – Techniques des réseaux de Petri

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ANALYSIS TECHNIQUES FOR DEPENDABILITY – PETRI NET TECHNIQUES

FOREWORD

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International Standard IEC 62551 has been prepared by committee 56: Dependability.

The text of this standard is based on the following documents:

FDIS	Report on voting
56/1476/FDIS	56/1484/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This International Standard provides a basic methodology for the representation of the basic elements of Petri nets (PNs) [1][1] and provides guidance for application of the techniques in the dependability field.

The inherent power of Petri net modelling is its ability to describe the behaviour of a system by modelling the relationship between local states and local events. Against this background, Petri nets have gained widespread acceptance in many industrial fields of application (e.g. information, communication, transportation, production, processing and manufacturing and power engineering).

The conventional methods are very limited when dealing with actual industrial systems because they are neither able to handle multi-state systems, nor able to model dynamic system behaviour (e.g. fault tree or reliability Block diagrams), and can be subject to the combinatory explosion of the states to be handled (e.g. Markov process). Therefore, alternative modelling and calculating methods are needed.

Dependability calculations of an industrial system intend to model the various states of the system and how it evolves from one state to another when events (failures, repairs, periodic tests, night, day, etc.) occur.

Reliability engineers need a user-friendly graphical support to achieve their models. Due to their graphical presentation, Petri nets are a very promising modelling technique for dependability modelling and calculations.

Analytical calculations are limited to small systems and/or by strong hypothesis (e.g. exponential laws, low probabilities) to be fulfilled. A qualitative increase is needed to deal with industrial size systems. This may be done by going from analytical calculation to Monte Carlo simulation.

This standard aims at defining the consolidated basic principles of the PNs in the context of dependability and the current usage of Petri net PN modelling and analysing as a means for qualitatively and quantitatively assessing the dependability and risk-related measures of a system.

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1 Figures in square brackets refer to the bibliography.

ANALYSIS TECHNIQUES FOR DEPENDABILITY – PETRI NET TECHNIQUES

1 Scope

This International Standard provides guidance on a Petri net based methodology for dependability purposes. It supports modelling a system, analysing the model and presenting the analysis results. This methodology is oriented to dependability-related measures with all the related features, such as reliability, availability, production availability, maintainability and safety (e.g. safety integrity level (SIL) [2] related measures).

This standard deals with the following topics in relation to Petri nets:

a) defining the essential terms and symbols and describing their usage and methods of graphical representation;

b) outlining the terminology and its relation to dependability;

c) presenting a step-by-step approach for

   1) dependability modelling with Petri nets,

   2) guiding the usage of Petri net based techniques for qualitative and quantitative dependability analyses,

   3) representing and interpreting the analysis results;

d) outlining the relationship of Petri nets to other modelling techniques;

e) providing practical examples.

This standard does not give guidance on how to solve mathematical problems that arise when analysing a PN; such guidance can be found in [3] and [4].

This standard is applicable to all industries where qualitative and quantitative dependability analyses is performed.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-191:1990, *International Electrotechnical Vocabulary – Chapter 191: Dependability and quality of service*

3 Terms, definitions, symbols and abbreviations

For the purposes of this document, the terms and definitions given in IEC 60050-191, as well as the following terms and definitions, apply.

3.1 Terms and definitions

3.1.1
component
constituent part of a device which cannot be physically divided into smaller parts without losing its particular function

[SOURCE: IEC 60050-151:2001, 151-11-21] [5]

3.1.2
event
something that happens in time

Note 1 to entry: In pure physics, an event is considered as a point in space-time.

[SOURCE: IEC 60050-111, Amendment 1:2005, 111-16-04] [6]

3.1.3
system
set of interrelated elements considered in a defined context as a whole and separated from their environment

Note 1 to entry: A system is generally defined with the view of achieving a given objective, e.g. by performing a definite function.

Note 2 to entry: Elements of a system may be natural or man-made material objects, as well as modes of thinking and the results thereof (e.g. forms of organization, mathematical methods, programming languages).

Note 3 to entry: The system is considered to be separated from the environment and the other external systems by an imaginary surface, which cuts the links between them and the system.

Note 4 to entry: The term 'system' should be qualified when it is not clear from the context to what it refers, e.g. control system, colorimetric system, system of units, transmission system.

[SOURCE: IEC 60050-351:2006, 351-21-20] [7]

3.1.4
safety integrity level
SIL
discrete level (one out of a possible four) corresponding to a range of safety integrity values, where safety integrity level 4 has the highest level of safety integrity and safety integrity level 1 has the lowest

Note 1 to entry: The target failure measures (see 3.5.17 of IEC 61508-4:2010) [8] for the four safety integrity levels are specified in Tables 2 and 3 of IEC 61508-1:2010 [9].

[SOURCE: IEC 61508-4:1998, 3.5.8, modified]

3.1.5
Petri net
PN
bipartite graph with two kinds of nodes, places and transition, and directed arcs, to model local states and local events, respectively

Note 1 to entry: Petri-net are often used to model the behaviour of distributed systems.

3.1.6
directed arc
oriented connection of a pair of nodes depicted by a line with arrow

Note 1 to entry: In general, the arcs in Petri nets are directed. They can only connect two different types of nodes.

Note 2 to entry: In addition to directed arcs. alternative representations exist.

3.1.7
place
type of node in a Petri-net to model local states or conditions