

**INTERNATIONAL
STANDARDIZATION PROCESS
&
ISO/IEC 15909 STATUS**

**“HIGH-LEVEL PETRI NETS -
CONCEPTS, DEFINITIONS AND
GRAPHICAL NOTATION”**

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**XML/SGML based
INTERCHANGE FORMATS FOR
PETRI NETS MEETING, AARHUS**

27 June 2000



**University of South Australia
School of Electrical and Information Engineering**

ISO

International Organization for Standardization (ISO)

- HQ in Geneva
- comprises National Standards orgs as member bodies
- produces a wide range of standards by consensus
- currently over 15,000 standards
- harmonises with ITU-T for IT related standards
- ‘iso’ prefix meaning “same”
- has a large number of Technical Committees (TCs)

Two main TC’s of interest:

- ISO TC176 Quality Systems Standards
- ISO/IEC [JTC1/SC7 Software Engineering](#)



ISO/IEC Membership

Status

Members of ISO/IEC subcommittees are from National Standards bodies.

Members can be

- Participating, **P** Members
- Observing, **O** Members
- Liaison, **L** Members

P Members

- actively contribute
- obliged to vote on Standards
- receive working group documentation and draft standards

O Members

- Receive SC documents
- Don't receive WG documentation
- May vote - but vote not counted



ISO/IEC Procedures

<http://www.iso.ch/infoe/tcinfo.html>

ISO/IEC Directives specify the accepted procedure

- for developing International Standards
- approving International Standards

The Process: 5 Stages

1. **Proposal stage** - a new work item (NWI) is prepared and sent out to all members to be voted on. Simple majority required.
2. **Preparatory stage** - a working draft (WD) is prepared and voted on for registration as a Committee Draft (CD).
3. **Committee stage** - CD is revised to take into account member body comments and voted on for registration as a Final Committee Draft (FCD).
FCD revised and voted on for registration as a Final Draft International Standard (FDIS).
4. **Approval stage** - FDIS is revised and voted on (Yes/No vote) for approval as an International Standard (IS). 2/3 majority, less than 1/4 against.
5. **Publication stage** - IS is published.

The procedure can fail at any stage due to lack of support or agreement. Sometimes there needs to be more than one ballot at a particular stage.



ISO/IEC JTC1/SC7

Software Engineering

General

- Chairman: Mr. F. Coallier, Canada
- Secretariat: Standards Council of Canada (Mr. J-N Drouin)
- 28 'P' Members as of August 97
- 17 'O' Members
- 12 Working Groups
- Full SC7 meeting once a year in May/June.

Term of Reference

‘Standardization of process, supporting tools and supporting technologies for the engineering of software products and systems.’

For example: MIS, Embedded Software

Web: http://saturne.info.uqam.ca/Labo_Recherche/Lrg1/sc7/

also mirror site

<http://www.iso.ch>



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SC7 Organisations: WGs

- WGs normally meet twice a year in May/June and October/November
- Are the forum for producing the various drafts of standards
- minutes are distributed as SC7 docs
- majority of I/Ps and O/Ps only published as WG docs
- WG docs only obtained by registered 'P' members
- WD normally distributed via SC7 before vote

Annual Secretariat Report

Provide a summary of SC7 administration, meetings, personnel and work. (see 07N2099 on the SC7 web page).

The following information has been taken form the annual Sc7 secretariat reports. The latest secretariat report [07N1935, May 1998](#), can be downloaded from the SC7 web page given previously. Just click on List of Documents button. The activities of WG1 and WG3 are too new to be reported in that document.



BACKGROUND

ISO/IEC JTC1/SC7/WG11:

‘Software Engineering Data Description and Representation’

- Project 7.19 Diagrams for Software Engineering
- Project 7.28 SEDDI “**CDIF**”

Project 7.19

- State Transition Diagrams
- Diagram Exchange Language
- [Petri nets 7.19.3](#)



History of Petri Net Standard (Project 7.19.3)

- Subdivision Proposal Ballot - 3Q 1995
- Baseline discussed at Aomori Meeting, Japan, October 1995
- [March 1996](#), Ballot result:
 - 12 countries in favour
 - 1 abstention
 - 1 against (late) USA
- Major Revision of Baseline to form Working Draft (WD) (October 1996)
- Revised again for circulation to SC7 (February 1997)
- [Committee Draft](#) balloted in October 1997
 - Most countries in favour, USA, Italy and Israel against
 - 75 comments received and resolved
 - new draft produced
- [Final Committee Draft](#) balloted in June 1998.
 - 21 voted: 17 for, 1 against, 3 abstain
 - only Germany against - for the first time
 - 84 comments received
 - negotiating final text
 - draft disposition of comments - almost finalised.
(Curitiba meeting, May 99)



AIMS

- Reference Definition common understanding
- Facilitate Petri net tool
 - development
 - interoperability
- Facilitate distributed systems development



BENEFITS

- Mandate in contracts
 - independent of language and culture
 - unambiguous specifications
- unification of control flow and data flow
- transfer of specifications and designs between Petri net tools
- development of standard analysis techniques
- standard Petri net building blocks for re-use
- debugging specifications and designs at earliest opportunity
 - saving costs
 - increasing quality
- facilitate tool support and market for Petri net tools
- rapid specification prototyping



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Semantic Model - 1

A HLPN is a structure

$HLPN = (P, T, D; Type, Pre, Post, M_0)$ where

- P is a finite set of elements called Places.
- T is finite set of elements called Transitions disjoint from P ($P \cap T = \emptyset$).
- D is a finite set of non-empty domains where each element of D is called a type.
- $Type : P \cup T \rightarrow D$ is a function used to assign types to places and to determine transition modes.
- $Pre, Post : TRANS \rightarrow \mu PLACE$ are the pre and post mappings with
 - $TRANS = \{(t, m) \mid t \in T, m \in Type(t)\}$
 - $PLACE = \{(p, g) \mid p \in P, g \in Type(p)\}$
- $M_0 \in \mu PLACE$ is a multiset called the initial marking of the net.

A Marking of the HLPN is a multiset, $M_0 \in \mu PLACE$



Semantic Model - 2

Enabling of Transition Modes

A finite multiset of transition modes, $T_\mu \in \mu TRANS$, is *enabled* at a marking M iff

$$Pre(T_\mu) \leq M$$

where the linear extension of Pre is given by

$$Pre(T_\mu) = \sum_{tr \in TRANS} mult(tr, T_\mu) Pre(tr)$$

Transition Rule

Given that a multiset of transition modes, T_μ , is enabled at a marking M , then a *step* may occur resulting in a new marking M' given by

$$M' = M - Pre(T_\mu) + Post(T_\mu).$$

where the linear extension of $Post$ is used.



HLPN Graph - Informal

- A Net Graph
 - places
 - transitions, and
 - arcs
- Place Types
- Place Marking comprising *tokens*.
- Arc Annotations: expressions comprising
 - constants
 - variables and
 - functions (eg $f(x)$).
- Transition Condition
- Declarations:
 - Place Types,
 - typing of variables, and
 - function definitions



HLPN Graph Definition

A HLPN is a structure

$HLPN = (NG, Sig, H; Type, AN, M_0)$ where

- $NG = (P, T; F)$ is called a net graph, with
 - P a finite set of nodes, called Places;
 - T a finite set of nodes, called Transitions, disjoint from P ($P \cap T = \emptyset$); and
 - $F \subseteq (P \times T) \cup (T \times P)$ a set of directed edges called arcs, known as the flow relation;
- $Sig = (S, O, V)$ is a Natural-Boolean signature with variables, defined in Annex A.
- $H = (S_H, O_H)$ is a many-sorted algebra for the signature Sig , defined in Annex A.
- $Type : P \rightarrow S_H$ is a function which assigns types to places.



HLPN Graph (cont)

- $AN = (A, TC)$ is a pair of net annotations.
- $TC : T \rightarrow TERM(O \cup V)_{\text{Bool}}$ is a function that annotates transitions with Boolean expressions. $TERM(O \cup V)$ is defined in Annex A.
- $M_0 : P \rightarrow U_{p \in P} \mu Type(p)$ such that $\forall p \in P$, $M_0(p) \in \mu Type(p)$, is the initial marking function which associates a multiset of tokens of correct type with each place.

Marking

A marking, M , of the HLPNG is defined in the same way as the initial marking.

$M_0 : P \rightarrow U_{p \in P} \mu Type(p)$ such that for all $p \in P$, $M(p) \in \mu Type(p)$.



HLPN Graph (cont)

Enabling

A transition $t \in T$ is enabled in a Marking, M , for a particular assignment to its variables, α , (that satisfies the transition condition, $assign_{bool}(TC(t)) = true$) known as a *mode* of t , iff

$$\forall p \in P Val_{\infty}(\overline{p, t}) \leq M(p)$$

where for $(u, v) \in (P \times T) \cup (T \times P)$,

- $\overline{u, v} = A(u, v)$, for $(u, v) \in F$,
- $\overline{u, v} = \Phi$, for $(u, v) \notin F$

where Φ is a symbol that represents the empty multiset, \emptyset , at the level of the signature, so that $Val_{\infty}(\Phi) = \emptyset$.



HLPN Graph (cont)

Transition Rule

If $t \in T$ is enabled in *mode* ∞ . When t occurs in mode ∞ , the marking of the net is transformed to a new marking M' , denoted $M[t, \infty > M'$, according to the following rule:

$$\forall p \in P \quad M'(p) = M(p) - Val_{\infty}(\overline{p}, t) + Val_{\infty}(\overline{t}, p)$$



Scope of Standard

Currently

- semantics
- abstract syntax
- graphical notation

Later

- Transfer Syntax
- Structuring techniques (eg hierarchies)
- Time extensions



Current Issues

1. Separation of syntax and semantics
2. Conformance and Basic Syntax



Current Status and Schedule

Project	WD	CD	FCD	FDIS	IS
7.19.03	97-02	97-10	98-06	00-12	01-6



Information Sources

Conferences

- Annual conference: ICATPN
- Biennial workshop: PNPM

Email list

- PetriNets-request@daimi.au.dk

World-wide web pages

- <http://www.daimi.au.dk/PetriNets/>
- http://www.itr.unisa.edu.au/tsec/pn_standard/



Conclusions

Initially

- Rapid progress made on Standard
 - FDIS to be agreed after Curitiba Meeting.
- Web pages established
- Subdivision proposal on Transfer Syntax?

- World wide recognition of the maturity of High-level Petri Nets as a useful specification (and verification) technique for a wide range of systems
- Increased visibility of the technique to Industry and Government Agencies.



DISCUSSION SESSION

1. INTERNATIONAL STANDARD

2. REQUIREMENTS

3. FUTURE MEETING



INTERNATIONAL STANDARD

1. **PROCEED** √ **YES** **NO**
2. **CONTRIBUTORS (need 5 countries)**
AUSTRALIA (J. Billington)
DENMARK (CPN group)
GERMANY (E. Kindler, M. Webber ...)
FRANCE (R. Bastide, ...)
UK (A. Koelmans)
NETHERLANDS (W. Van der Aalst)
3. **EDITOR (to be decided)**
4. **SUBDIVISION PROPOSAL**
(Draft written: J. BILLINGTON)
5. **BASELINE Current proposals?**



FUTURE MEETING

1. Yes/No

2. Purpose:

3. When/Where

4. Interested?

**Contact reception by Wednesday
lunchtime.**

