

# Petri nets standardisation: state of the art and future challenges

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# Motivation and goals

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- 1 tools **interoperability** aiming at a unified verification approach:
  - **easy and unambiguous** models exchange
  - transfer of **verification results**
  - **sequencing** verification tools use
- 2 explicit **semantic correspondence** among **Petri nets types**

## Main issues: heterogeneity

- 1 **of types and extensions**
- 2 unformalised semantic compatibility, hence **ambiguous**
- 3 proprietary **formats** for nets representation
- 4 **types** defined according to the verification goals, and syntactical sugar

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## Petri nets standardisation: ISO/IEC 15909

- 1 semantic and syntactic unification of Petri nets types
- 2 reference interchange format
- 3 formal framework for models structuring and extensions

## Issues

- 1 abstract representation (semantics  $\leftrightarrow$  syntax)
- 2 reuse of shared concepts
- 3 choice of an interchange technology
- 4 manage tool specific information
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# Outline

- 1 ISO/IEC 15909 standard
- 2 Part 1: formal definitions
- 3 Conceptual choices in part 2
- 4 Standardised nets metamodels hierarchy
- 5 Building standardised nets metamodels
- 6 Implementation and diffusion
- 7 Perspectives

# ISO/IEC 15909

## Part 1 (2000–2004): definitions

- formal definition of place/transition and high-level nets
- published in December 2004
- Amendment defining symmetric nets in the publication phase

## Part 2 (2003–2009): interchange format

- design of an interchange format, PNML
- published in November 2009
- implemented and supported by the PNML Framework

## Part 3 (2010–2014?): extensions

- define new types of nets, nodes and arcs
- provide a modular structuring mechanism
- extension of the PNML interchange format and companion tool

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# Part 1: formal definitions

- High-Level Petri Nets (HLPNG)
- Symmetric Nets (SN)
- Place/Transition Nets (PT-Nets)

# Conceptual choices in part 2

## Abstract representation and interchange technology

- **Metamodelling** : UML to express abstract syntax
- **Semantic mapping** to formal definitions
- **Petri Net Markup Language** (PNML) defined as a concrete syntax

## Adequate reuse of common concepts

- structured design, both **modular and incremental**
- net type = **set of elementary concepts**  
TPN = P/T + time, FIFO-Nets = P/T + queues, etc.

## Tool-specific information and extensions management

- advanced metamodel structuring
- black box and pattern discovery mechanisms

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**Model Engineering  
Techniques**

# Standardised nets metamodels hierarchy

PNML Core Model

- algebraic extensions

- labels definition

- algebraic data types

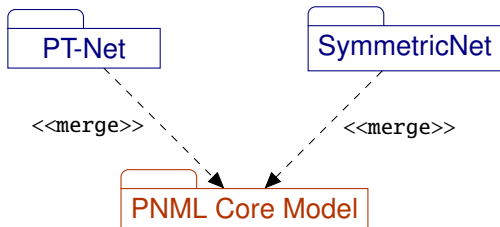
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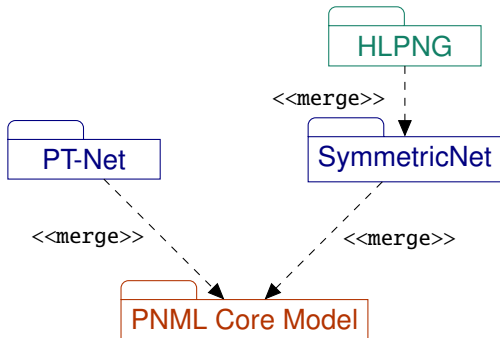


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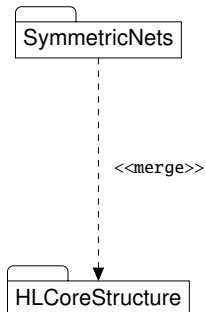
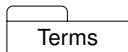
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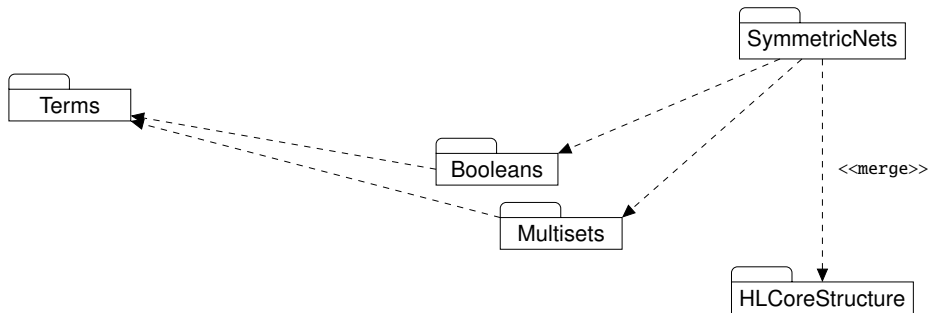
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algebraic data types for symmetric nets



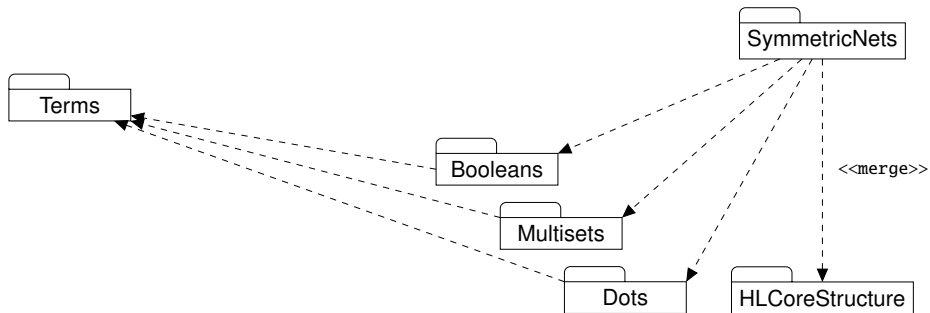
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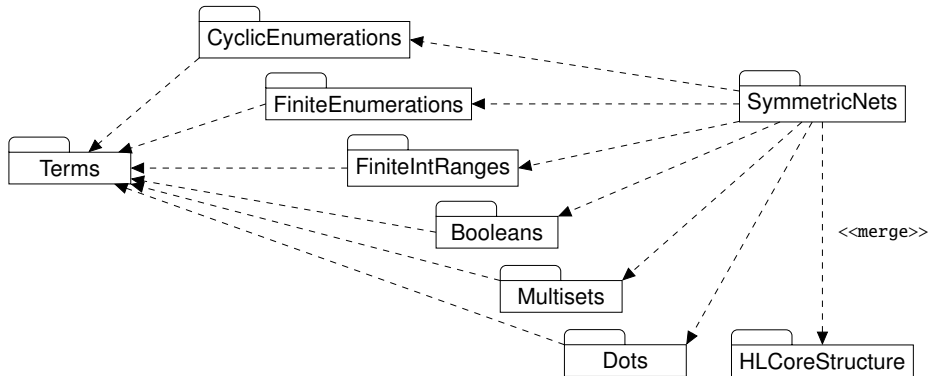
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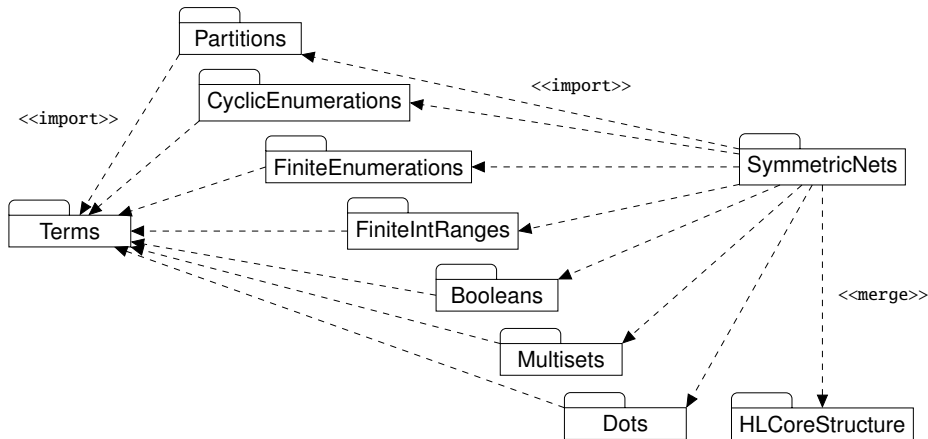
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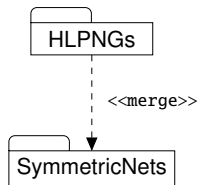
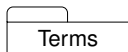
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# Building high-level nets metamode

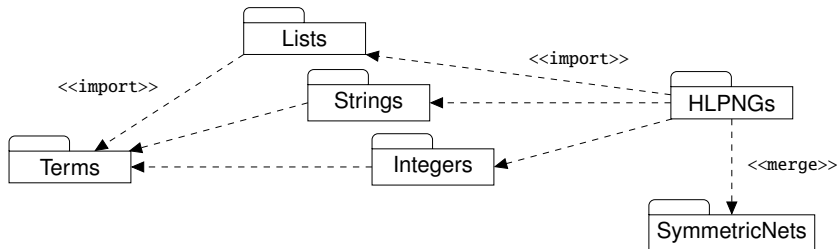
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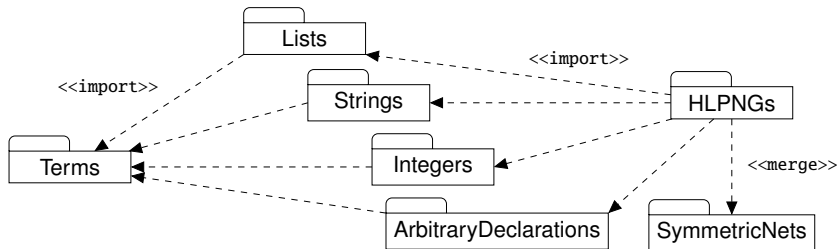
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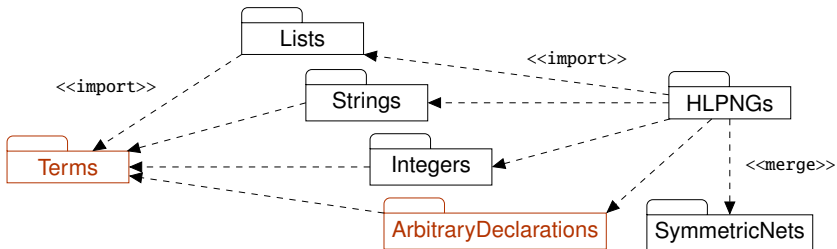
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## Algebraic extensions for high-level nets



## PNML definition of metamodel elements

| Model element                        | PNML element  | PNML attributes    |
|--------------------------------------|---------------|--------------------|
| Terms::UserSort                      | usersort      | declaration: IDREF |
| Terms::UserOperator                  | useroperator  | declaration: IDREF |
| ArbitraryDeclarations::ArbitrarySort | arbitrarysort |                    |
| ...                                  |               |                    |

# Implementation and diffusion

PNML Framework: <http://pnml.lip6.fr>

- 1 **companion tool**: implements part 2 of the standard
- 2 based on **Eclipse Modeling Framework** (EMF)
- 3 **generated code**: 400 000 lines (only 2% written by hand)
- 4 usable as an **Eclipse plugin** or as a **standalone library**
- 5 tutorials et applications examples

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# Perspectives: part 3 of ISO/IEC 15909

## Structuring mechanisms

- cater for most mechanisms found in the literature
- module definition together with an interface
- import/export nodes and types
- possibility to instantiate and parameterise modules
- organise a hierarchy of modules
- determine policies for labels aggregation

## Extensions

- design a general mechanism
- net elements: inhibitor arcs, capacity places, ...
- net types: time, priorities, stochastic, ...

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