A primer on the Petri Net Markup Language and ISO/IEC 15909-2

Lom Hillah[1] Ekkart Kindler[2] Fabrice Kordon[1]
Laure Petrucci[3] Nicolas Trèves[4]

[1]LIP6, Université Pierre et Marie Curie, Paris, France

[2]Technical University of Denmark (DTU), Lyngby, Denmark

[3]LIPN, University Paris 13, Villetaneuse, France

[4]CEDRIC, CNAM, Paris, France

Genesis of ISO/IEC 15909

Part 1 (2000–2004)

- formal definition of high-level and place/transition nets
- International Standard since December 2004
- an amendment defining symmetric nets is in final stages of discussion

Part 2 (2003–2010)

- aims at defining an exchange format, PNML
- is accompanied by tool support
- should become an international standard by mid-2010

Part 3 (2009–2013?)

- concerned with extensions of nets
  - how to define new types of nets, nodes, arcs
  - include structuring mechanisms
  - extension of the PNML exchange format

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1. easily and unambiguously exchange models between tools
2. establish semantical correspondence among Petri net types

Key issues

1. choice of exchange technology (aim 1)
2. support tool specific information (aim 1)
3. share common concepts (aim 2)
4. manage extensions and variants (aim 2)

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Outline

Choices & Underlying Technologies

Key issue 1: exchange technology

- XML technology (static definition of concepts: XML-Schema, Relax-NG, etc.)

Key issues 2 and 4: tool specific information, extensions and variants

- key issue 4 refines key issue 2: it deals with semantics
- requires structured meta-models to handle these extensions

Key issue 3: common concepts

- Petri net type = assembly of elementary concepts
  TPN = PTN + time, FIFO-Nets = PTN + queues, etc.
- requires advanced structuring of meta-models to handle these compositions

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Model-Driven Engineering techniques

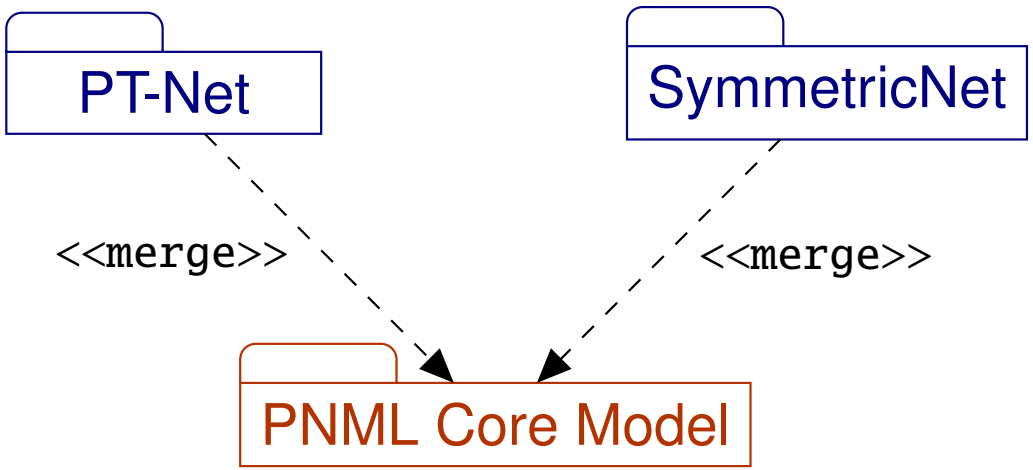
Meta-model Hierarchy and Essential Ingredients

- pages, nodes, arcs
- no labels but names
- basic graphics

- definition of labels
- definition of algebras

- algebra extensions

Meta-model Hierarchy and Essential Ingredients



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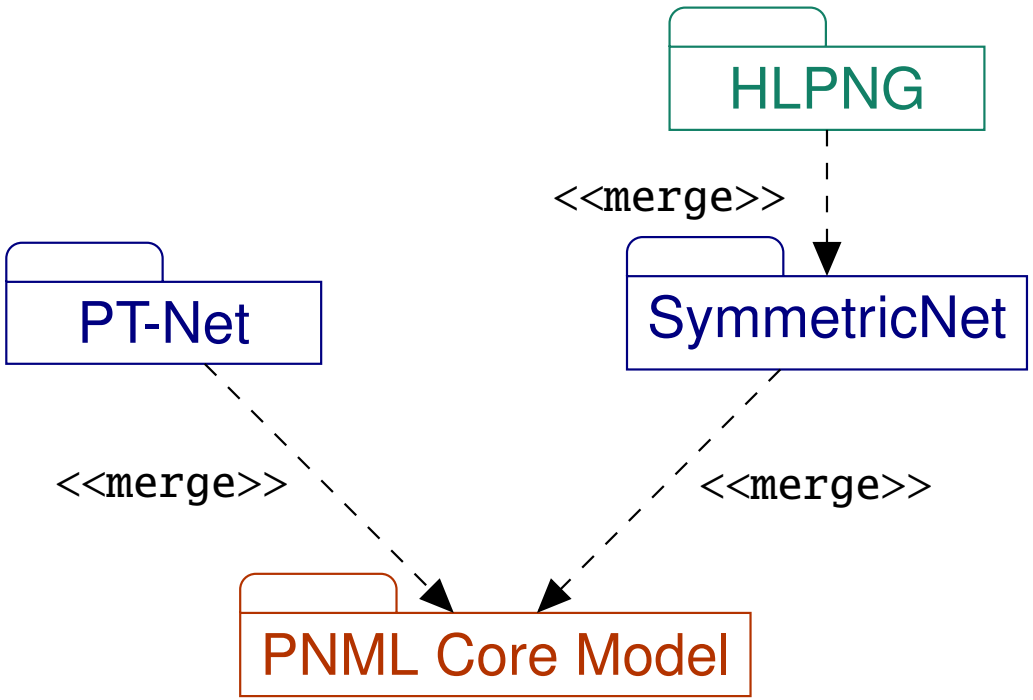

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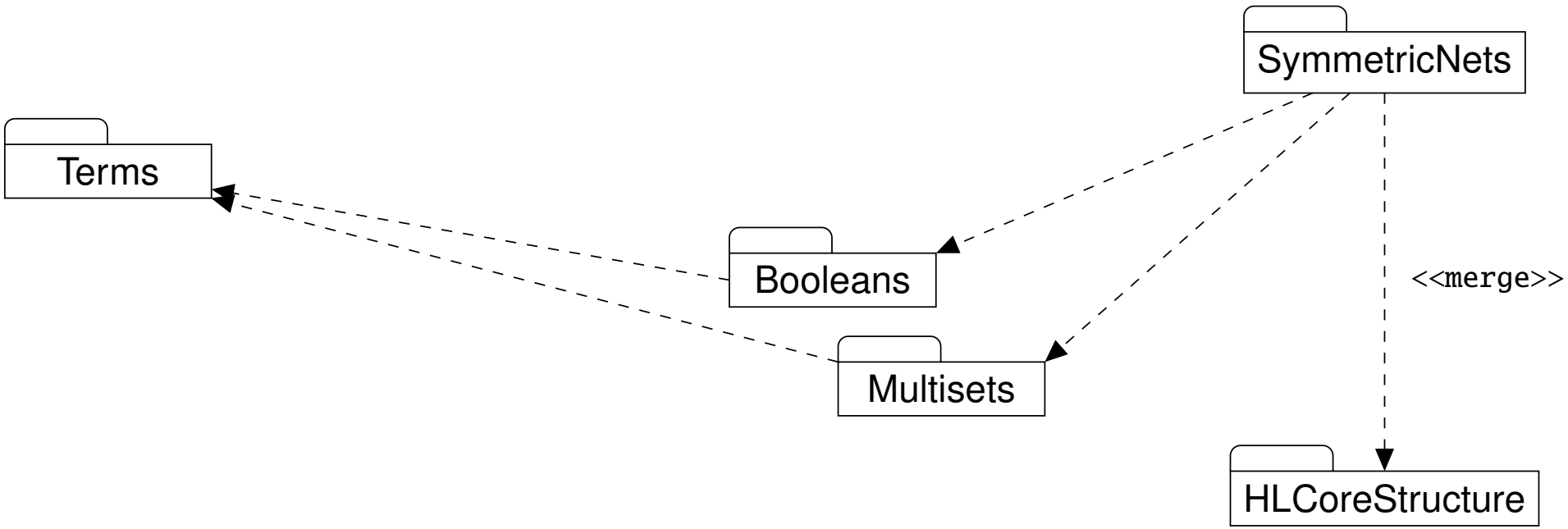

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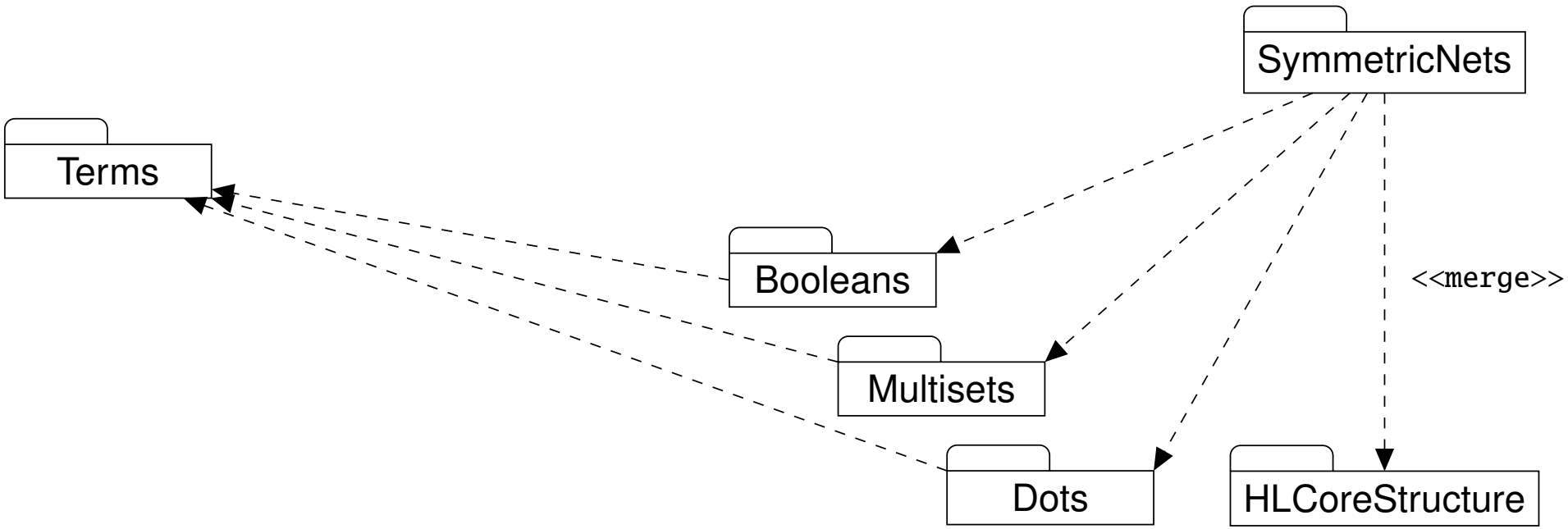

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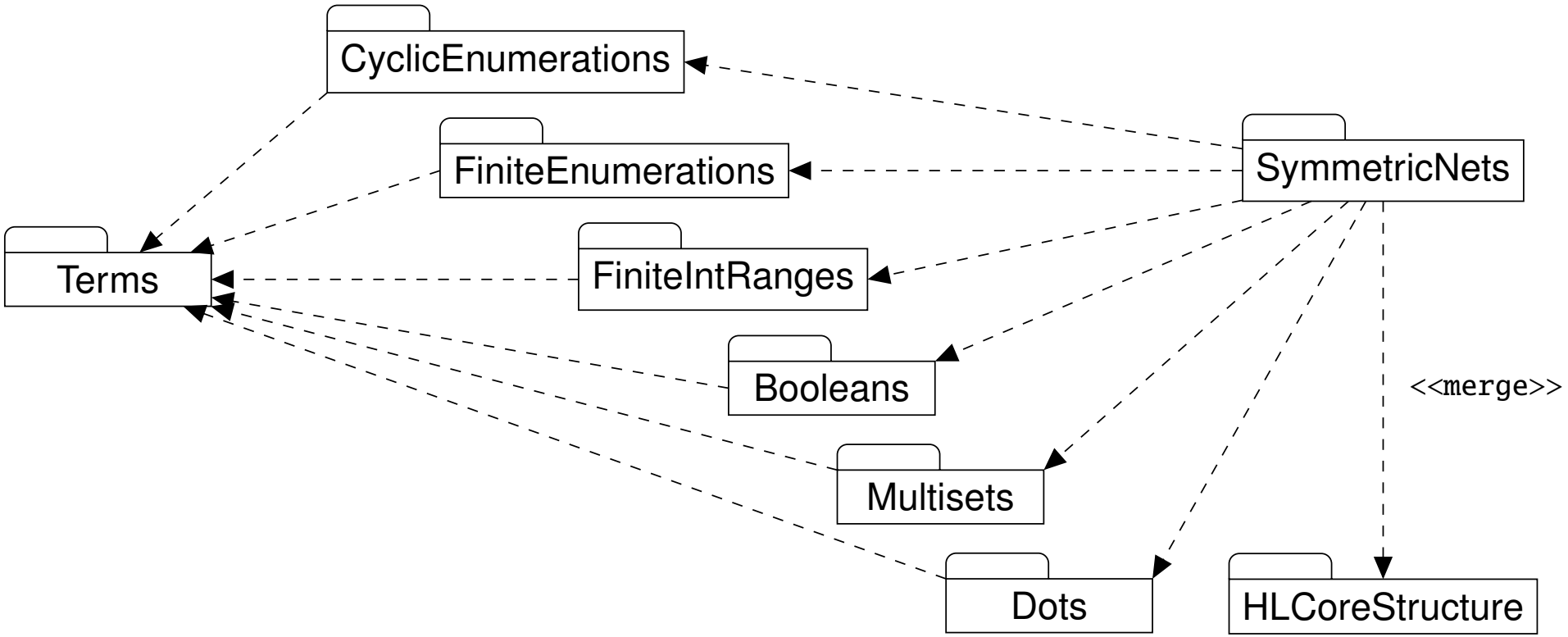

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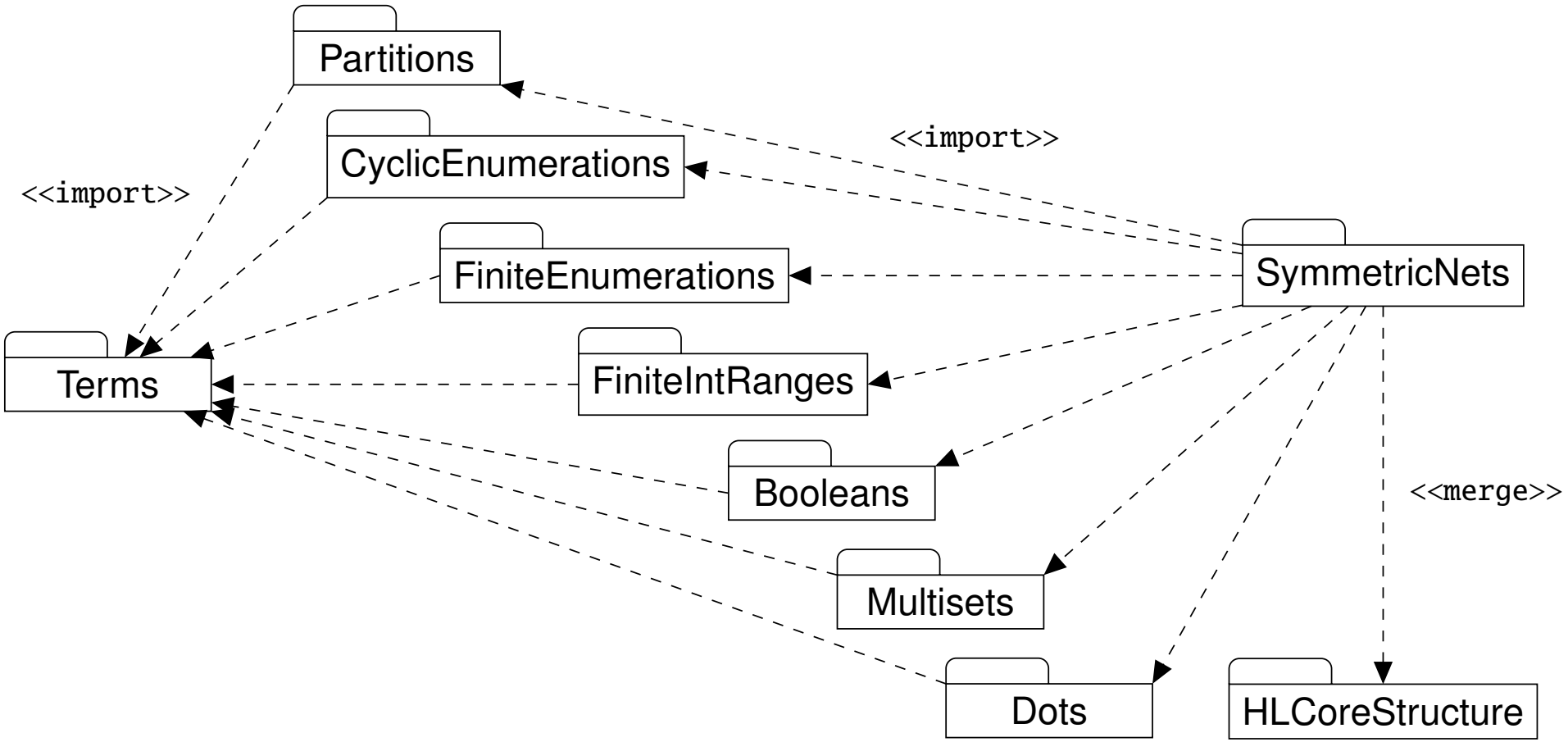

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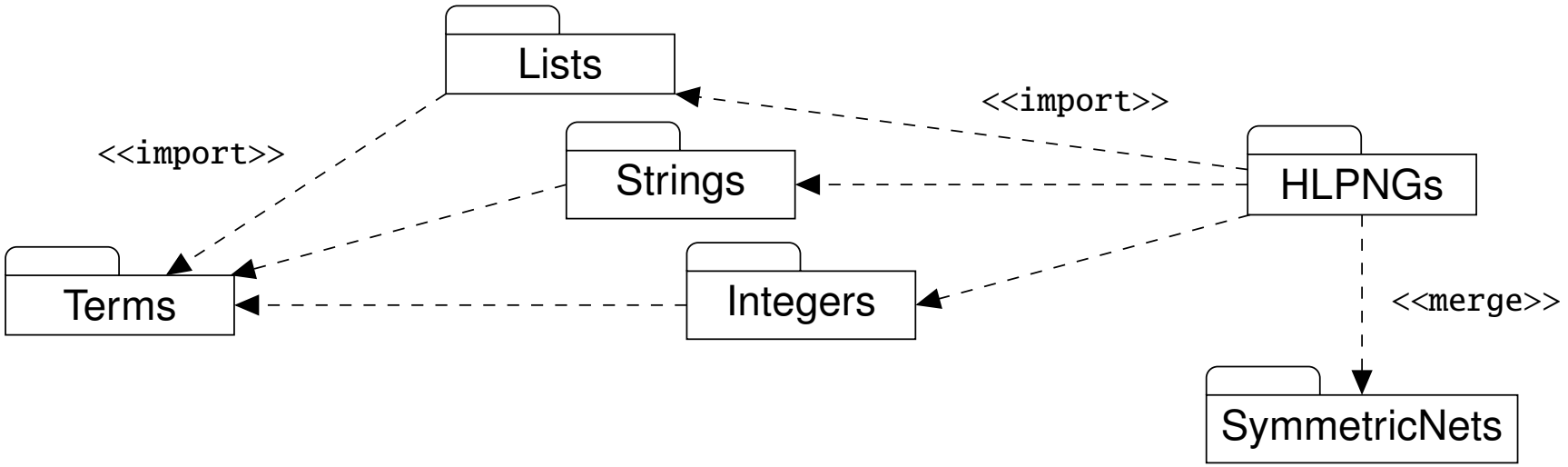

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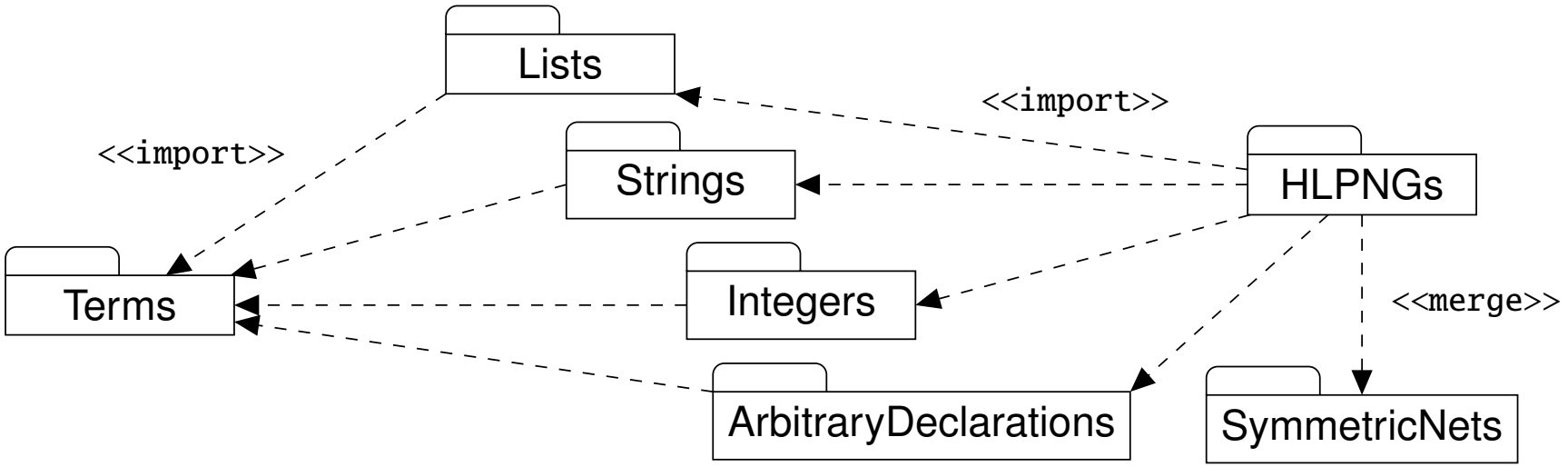

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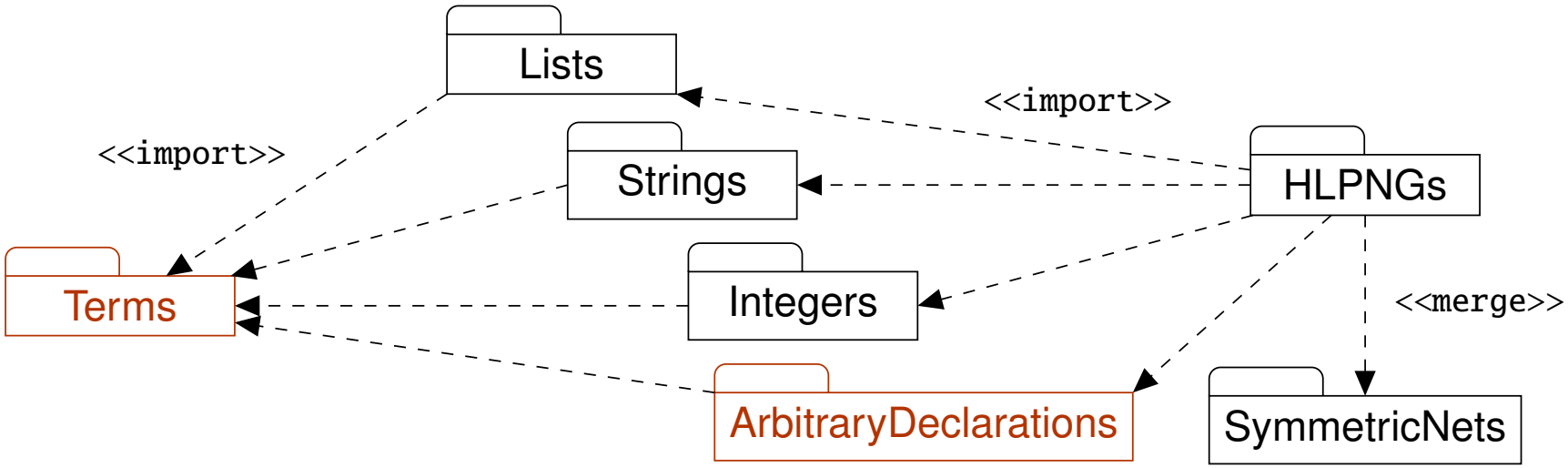
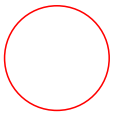


High-level meta-model elements and their PNML constructs

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

PNML syntax: an example



```
<place id="p1">
    <graphics>
        <position x="20" y="20"/>
    </graphics>
    <name>
        <text>ready</text>
        <graphics>
            <offset x="0" y="-10"/>
        </graphics>
    </name>
    <initialMarking>
        <text>3</text>
        <toolspecific tool="org.pnml.tool" version="1.0">
            <tokengraphics>
                <tokenposition x="-2" y="-2" />
                <tokenposition x="2" y="0" />
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PNML syntax: an example


```
<transition id="t1">
    <graphics>
        <position x="60" y="20"/>
    </graphics>
</transition>
<arc id="a1" source="p1" target="t1">
    <graphics>
        <position x="30" y="5"/>
        <position x="60" y="5"/>
    </graphics>
    <inscription>
        <text>2</text>
        <graphics>
            <offset x="0" y="5"/>
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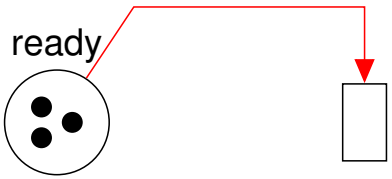


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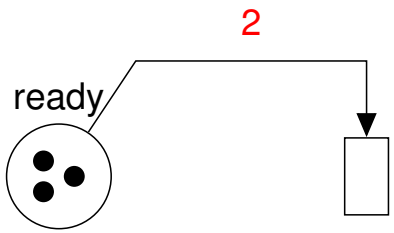


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Conclusion

- Petri Net types tackled:
  - P/T nets (also in high-level notation)
  - Symmetric nets
  - High Level Petri net graphs
- reference implementation of APIs companion to the standard: PNML Framework
  - relies on mature MDE technology: Eclipse/EMF
  - automatic generation of APIs from the meta-models in the standard
  - assessment of choices
- MDE techniques require enrichment-based inheritance
  - bottom-up approach of Petri net types design

Perspectives

- the standard needs to spread out
  - use by more tools
  - actualisation of current support
- Challenges raised by part 3
  - more variability in Petri net types
  - guided support of hierarchy
  - handling of several dimensions (time, stochastics, etc.)
    - bottom-up approach of Petri net types design really required here

The Standard NEEDS You