

# The Integrator

INCOSE North Star Chapter



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## North Star Newsletter

*INCOSE North Star Newsletter Communication*

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Systems Engineering at its Best!

### ***An Overview of the SysML-Modelica Transformation Specification***

The objective of the SysML-Modelica Transformation Specification (OMG SE DSIG SysML-Modelica Working Group, 2009) is to provide a bi-directional mapping between OMG SysML™ (Object Management Group, 2008) and Modelica (Modelica Association, 2009) and to leverage the benefits of both languages. By integrating SysML and Modelica, SysML's strength in descriptive modeling can be combined with Modelica's formal executable modeling capability to support analyses and trade studies.

SysML is a general-purpose systems modeling language that can be used to create and manage models of systems using well-defined, graphical constructs with underlying semantics (Object Management Group, 2008). SysML reuses a subset of UML 2 (Object Management Group, 2009) constructs and extends them by adding new modeling elements and two new diagram types. These SysML diagrams are shown in Figure 1. The set of behavioral and structural diagrams combined with the requirements diagram and parametric diagram provide an integrated view of a system. But SysML represents much more than just a set of diagrams. Underlying the diagrams, there is an abstract syntax model repository that formally represents all the modeling constructs. The graphical model provides a mechanism to organize, enter, retrieve, and view the system-descriptive data contained in the model repository. The diagrams provide multiple views of the same system model; these multiple views can be maintained consistently due to the semantic underpinning of the modeling

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## Chapter President's Corner

**Paul Frenz, General Dynamics-AIS  
INCOSE North Star Chapter 2011 President**

The North Star Chapter is off to a great start in 2011. Through the first four months we have had meetings hosted by 3M, Boston Scientific, PaR Systems, and Goodrich. Excellent programs at each. Thank you to our presenters and meeting sponsors. We appreciate your hospitality and the chance to get insight into your business.

The spring tutorial is just weeks away - May 6th and 7th on CSEP Prep Training taught by John Clark, a Chief Engineer at Northrop Grumman. I used John when I studied for my CSEP and I found him to be a knowledgeable and engaging instructor (and I passed). Limited space is still available. Medtronic in Fridley will be hosting.

\* Save the Date: Sunday, June 12th 5:30 PM. Our summer social has been finalized with a dinner cruise on the St. Croix with Andiamo in Stillwater. Details forth coming.

The International Symposium will take place in Denver this year from June 20-23, 2011. Continue your professional development by being on the cutting edge of Systems Engineering technology. There are 35 paper sessions with 96 papers (including invited papers from SoS experts & IEEE colleagues), 6 panels debating various unresolved issues, 16 practical tutorials and 4 leading keynote speakers and so much more. Several of us will be attending from the North Star Chapter. I invite you to join us in attending.

INCOSE 2011 Symposium website:

<https://www.incose.org/symp2011/>

**Paul Frenz at <[paul.frenz@gd-ais.com](mailto:paul.frenz@gd-ais.com)>**

**North Star Chapter Website  
<http://www.incose.org/northstar>**

language. In the context of SysML, the structure view primarily refers to the hierarchy and interconnections among the parts of the system, and the interconnections between the system and its external systems. The behavior view describes the sequence of events and activities that the system must execute. The requirements diagram captures text requirements in the model, and enables them to be linked to other parts of the model, to provide unambiguous traceability between the requirements and system design. Parametrics provide the bridge between the system descriptive model in SysML and other simulation and engineering analysis models. While structure and behavior are heavily based on UML, both requirements and parametrics are unique to SysML. Through these extensions, SysML is capable of representing the specification, analysis, design, verification and validation of systems.

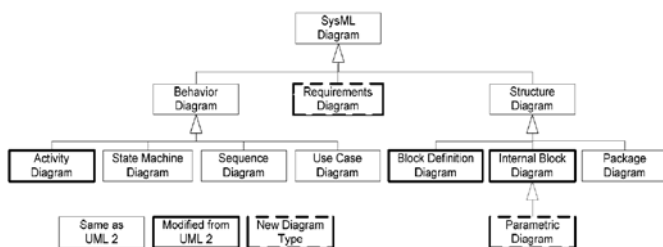


Figure 1: An overview of the SysML diagrams and their relation to UML diagrams.

As indicated above, the system behavior in SysML is captured through a combination of activity diagrams, state machine diagrams, and/or sequence diagrams and the associated semantics. The Foundational Subset of the UML specification (Object Management Group, 2008) provides the additional semantics to enable SysML activity diagrams to be executed in a standard way. In addition, SysML includes parametric diagrams to capture models of constraint-based behavior, such as continuous-time dynamics in terms of energy flow. However, the syntax and semantics of such behavioral descriptions in parametrics have been left open to integrate with other simulation and analysis modeling capabilities to support the execution of these models. Additional information on SysML can be found at <http://www.omg.sysml.org>.

Modelica is an object-oriented language for describing differential algebraic equation (DAE) systems combined with discrete events (Fritzson, 2004). Such models are ideally suited for representing the flow of energy, materials, signals, or other continuous interactions between system components. It is similar in structure to SysML in the sense that Modelica models consist of compositions of sub-models connected by ports that represent energy flow (undirected) or signal flow (directed). The models are acausal, equation-based, and declarative. The Modelica Language is defined and

maintained by the Modelica Association ([www.modelica.org](http://www.modelica.org)), which publishes a formal specification (Modelica Association, 2009) but also provides an extensive Modelica Standard Library, which includes a broad foundation of essential models covering domains ranging from (analog and digital) electrical systems, mechanical motion and thermal systems, to block diagrams for control (Modelica Association, 2009). Finally, it is worth noting that there are several efforts within the Modelica community to develop open-source solvers, such as in the OpenModelica Project (The Open Source Modelica Consortium, 2009).

In conclusion, SysML and Modelica are two complementary languages supported by two active communities. By integrating SysML and Modelica, we combine the very expressive, formal language for differential algebraic equations and discrete events of Modelica with the very expressive SysML constructs for requirements, structural decomposition, logical behavior and corresponding cross-cutting constructs. In addition, the two communities are expected to benefit from the exchange of multi-domain model libraries and the potential for improved and expanded commercial and open-source tool support.

Sanford Friedenthal.

## WELCOME, NORTH STAR NEW MEMBERS!

Name	Company	Title
Dennis Burke	Burke Cnstg LLC	Owner
Jim Cunningham	Textron Sys	SE
Rosamond Dolid	MTS	Sen Project Eng
Kenneth Enstrom	GD AIS	SW Sys Eng
John Heitzman	GDC4 Sys	Mgr, Prog Eng
Kyle Iverson	GD AIS	Test Engineer
Sean McCoy	Trane	SE
Jim Mullaney	Cray Inc	Sr Proj Mgr
Peter Rech	Eaton Corp Ictr	Sen eng spclst
Robert Ruhland	Alliant Techsys	SE Mgr
David Sellnow	Alliant Techsys	Sys Rqrmts Eng
Bryan Stoddard	BAE Systems	Sen SE
Michael Stoner	Eaton Corp	Engineer
Rod Templen	Goodrich S & IS	SE
John Uittenbogaard	LMC	Eng Mgr
Dolores Wiercinski	LMC	SE