

Investigating Potential Alignments Between Modelica Standard Library and SAREF Ontologies

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MSL and SAREF Ontologies

Modelica Standard Library (MSL)

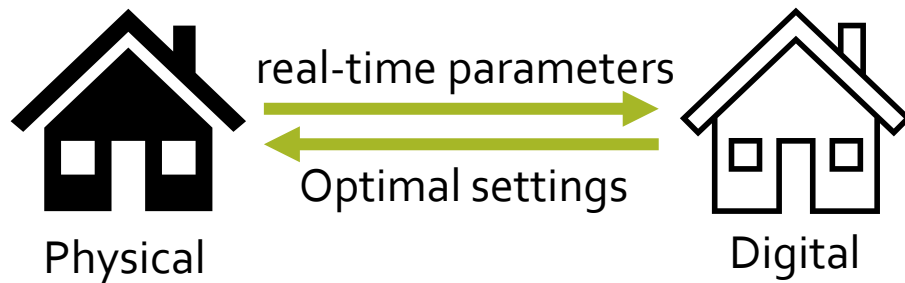
- Modelica - Modelling language
 - Exchanging and reuse modelling knowledge
 - Equation-based modelling
- Multi-domain models based on standardised interface definitions
- Compatible with Modelica-based simulation environments
 - e.g OpenModelica, Dymola, and Simplorer

Smart Applications REFerence (SAREF)

- Ontology development
 - 2015 - SmartM2M ETSI Technical Committee
 - Now - ETSI standard
 - Future - ETSI Specialist Task Force 578
- Concept of Device
 - Consists of a list of basic functions
 - Properties, service, function
- Extension – SAREF₄BLDG
 - Based on IFC standard for building information ISO 16739:2013
 - Design to support seamless communication of buildings' IFC data model appliances

Why investigate?

Digital Twin-Based Optimisation



Digital Twins

- There is a need for **interoperability** of the tools used in engineering practices
- Mathematically modelled building system(s)
- Computer-based numerical simulations

- Enriched with real-time parameters
- Algebraic optimisation
- Enhance the physical system's performance
- Find an optimal solution for the simulated model

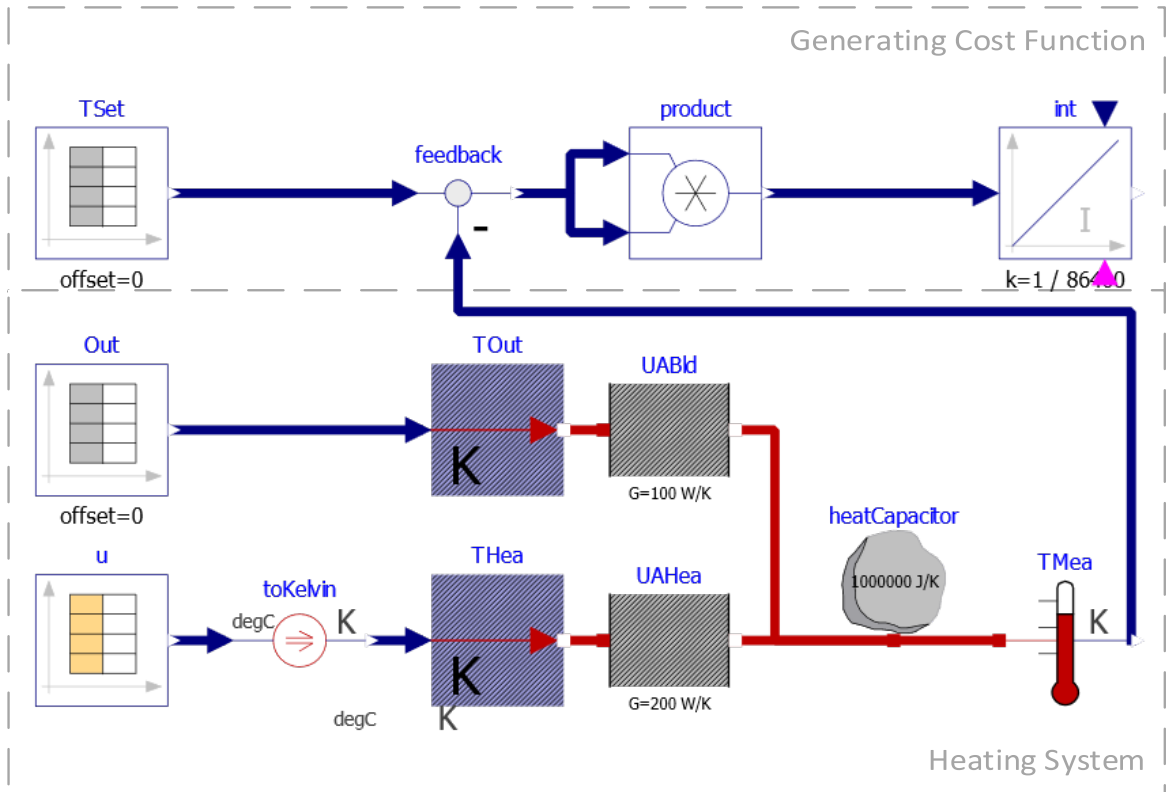
Aim

Investigates the potential alignments between MSL and SAREF

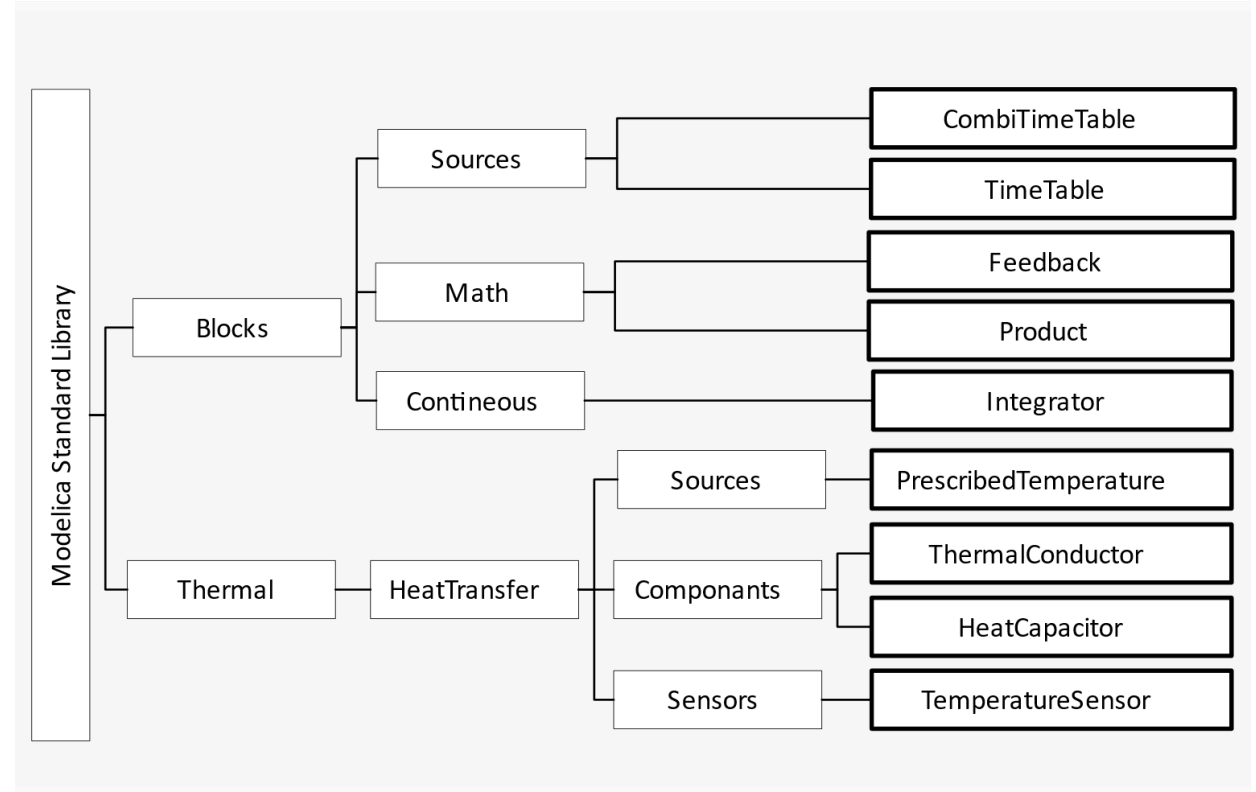
Previous study: MSL translated into OWL

(Pop and Fritzson, 2004)

Method



OpenModelica



Linking MSL with SAREF and SAREF₄BLDG

Modelica Concept	Predicate	SAREF ₄ BLDG*
(Source)TimeTable	skos:narrower	s4ehaw:TimeSeriesMeasurement
Thermal	rdfs:subClassof	s4bldg:DistributionDevice
HeatTransfer	rdfs:subClassOf	s4bldg:HeatExchanger
Component	rdfs:subClassOf	s4bldg:HeatExchanger
HeatCapacitor	rdfs:subClassOf	s4bldg:HeatExchanger
(Thermal)Sensors	rdfs:subClassOf	s4bldg:Sensor, saref:Sensor
TemperatureSensor	owl:equivalentConcept	saref:TemperatureSensor

* The corresponding namespaces are:

Smart Applications REference Ontology - **saref**: <https://w3id.org/saref#>

SAREF extension for building - **s4bldg**: <https://w3id.org/def/saref4bldg#>

SAREF extension for eHealth Ageing Well domain - **s4ehaw**: <https://saref.etsi.org/saref4ehaw/>

Discussion

Remark 1 - Terms from the MSL that could appear related to SAREF concepts but according to their definition (thus intended meaning) should be mapped as SAREF properties.

Remark 2 – In Modelica, different entities is made using only a 'connect' command. The semantics behind such a connection must be further specified as several extensions of SAREF to provide properties that appear pertaining to annotate such connections.

Remark 3 - The MSL is only one of the many libraries used in Modelica-based simulation environments. Other libraries such as the Buildings or BuildSysPro libraries contain more specific components to model building systems.

Remark 4 - The idea behind this attempt to align and assess SAREF ontologies and MSL is to benefit from existing alignments to the IFC standard, as defined in S4BLDG. Links to IFC elements missing from S4BLDG or SAREF can also be defined for MSL entities.

Conclusion

- Mainly focuses on the modelling of the system, with less attention being given to the simulation of the created model.
- Preliminary findings highlight that further research and additional specifications must be defined to link a pertaining portion of Modelica Libraries and SAREF.

Future works

- Defining and annotating Modelica Libraries ontology.
- Explore the alignments – simulation and optimisation process
- Exploring other Modelica Libraries
- Additional case studies

Thank you!

Any Questions?

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