AixLib

Goals, targets and current developments

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Overview AixLib

- Goals
  - Consolidation
  - Quality Management
  - Extension
  - Reusage of existing work
  - Advertising using Modelica or in collaboration with the institute
  - Of models in the institute's Modelica library AixLib

- Target user
  - Scientists
    - At the institue
    - At other institutes
    - At institute's partners

Overview AixLib

- Target applications
  - HVAC simulations coupled with building physics
  - Development and testing of control strategies (EMS)
  - Hardware-in-the-Loop experiments
  - City district simulations for design and operation of energy supply systems

- Expectations to Project 1
 - Continuation of collaboration and exchange of knowledge and Modelica models
  - Closer collaboration on MPC

- Contributions to Project 1
  - Extension, e.g.
    - Heat pumps
    - Controller
    - AHU
  - Maintenance
  - Of MIL

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Heat pump: Object oriented architectural approach

- **Goal modularity:**   Variable number of interconnecting components

- **Goal scalability:**   Easily adaptable component sizes

Application layer

Interconnection layer

Component layer
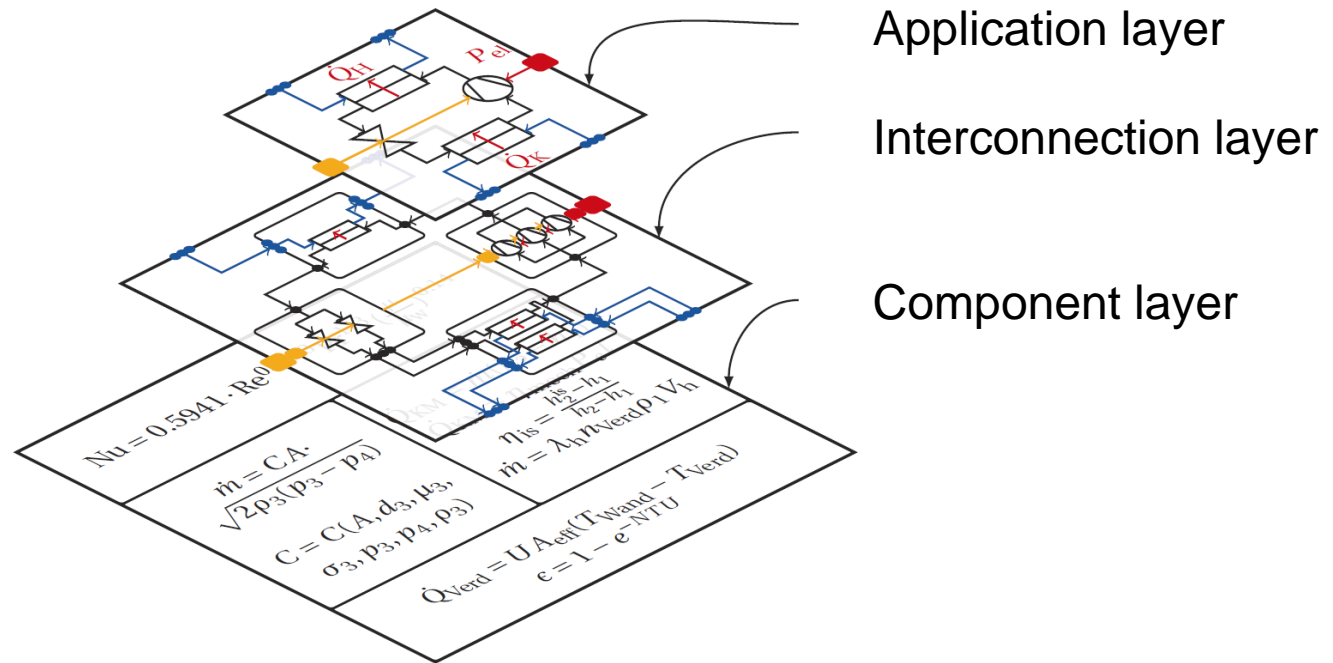
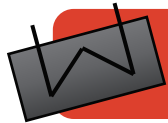**Trade-off**

Simulation Speed ⟷ **Accuracy**

Heat Pump: Component based modeling

Refrigerant

Compressor

Condenser

Expansion valve

Evaporator

Control bus
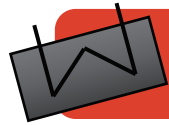
System modeling

Heat Pump: Component based modeling of Refrigerants

Refrigerant

Compressor

Condenser

Expansion valve

Evaporator

Control bus

System modeling

Fluid model development
- R134a
- R410A
- R290
- …

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Standard Modules HVAC: Overview

- Develop standard modules for HVAc system and circuits

➤ Identified modules:

- Mixed heating/cooling
- Unmixed heating/cooling
- Heating/cooling component with admix
- Heating/cooling with injection
- Circulating heat exchangers
- Domestic hot water
- Circulation of DHW
- Heat/Cool generation
- Heat source/sink
- Exhaust heat
- Distribution
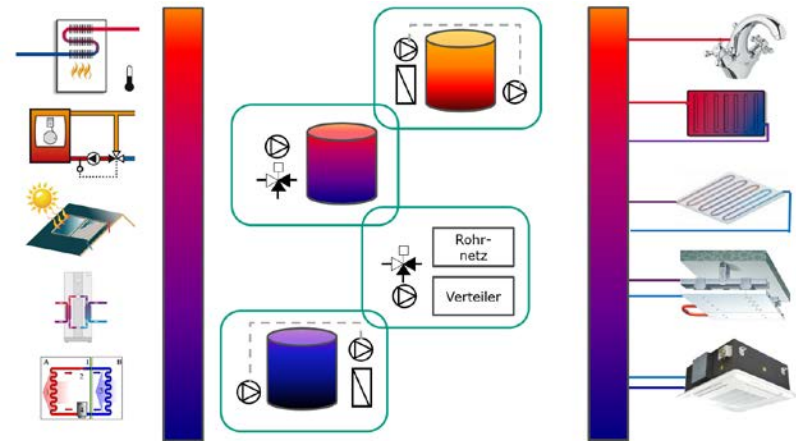
Standard Modules HVAC: Modelica

- Hydraulic modules: Pumps, pipes, valves, …

- Control separated from physics
  - Bus-Connector für data exchange
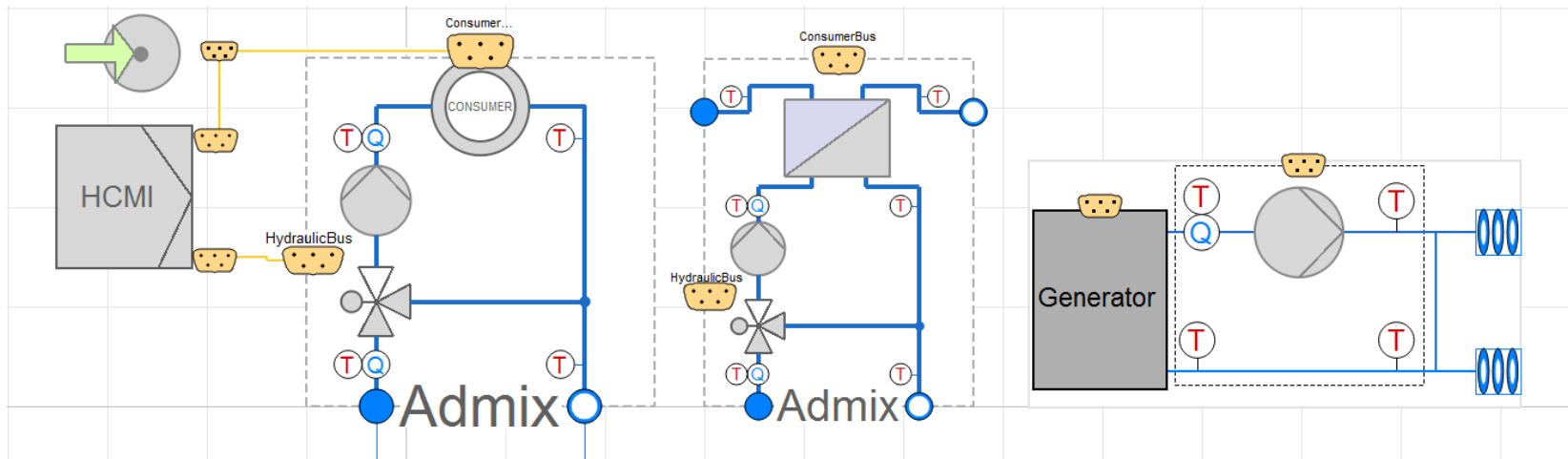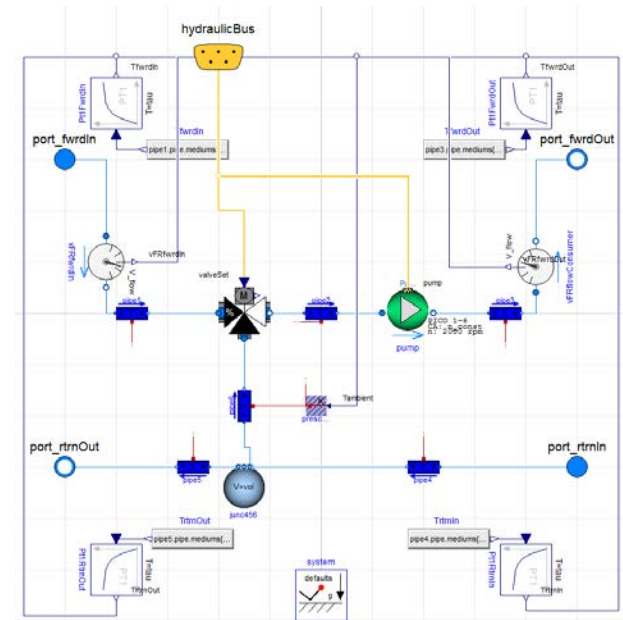
AHU: Modelling Approach

Heating

- Energy balance:
  $\Delta h = (\vartheta_2 - \vartheta_1) \cdot (c_{p,L} + x \cdot$

Cooling

- Only cooling:
  $\Delta h = (\vartheta_1 - \vartheta_2) \cdot (c_{p,L} + x \cdot c_{p,D})$
  mit $\vartheta_1 > \vartheta_2$
- Cooling and dehumidification:
  $$\Delta h = (\vartheta_1 - \vartheta_2) \cdot (c_{p,L} + x_1 \cdot c_{p,D}) + (x_1 - x_2) \cdot \Delta hv$$
  mit $\vartheta_1 > \vartheta_2$
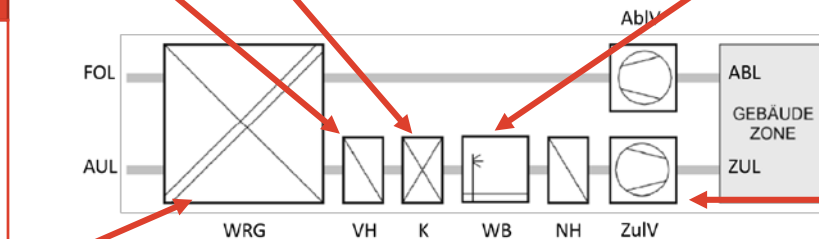
Humidification

- Adiabatic
- Humidification
  $$\Delta h = (x_2 - x_1) \cdot h_d$$

Heat recovery

- Recuperation
  $$\Phi_{AU} = \frac{\vartheta_{AU,A} - \vartheta_{AU,E}}{\vartheta_{AB,E} - \vartheta_{AU,E}}$$
- Regeneration
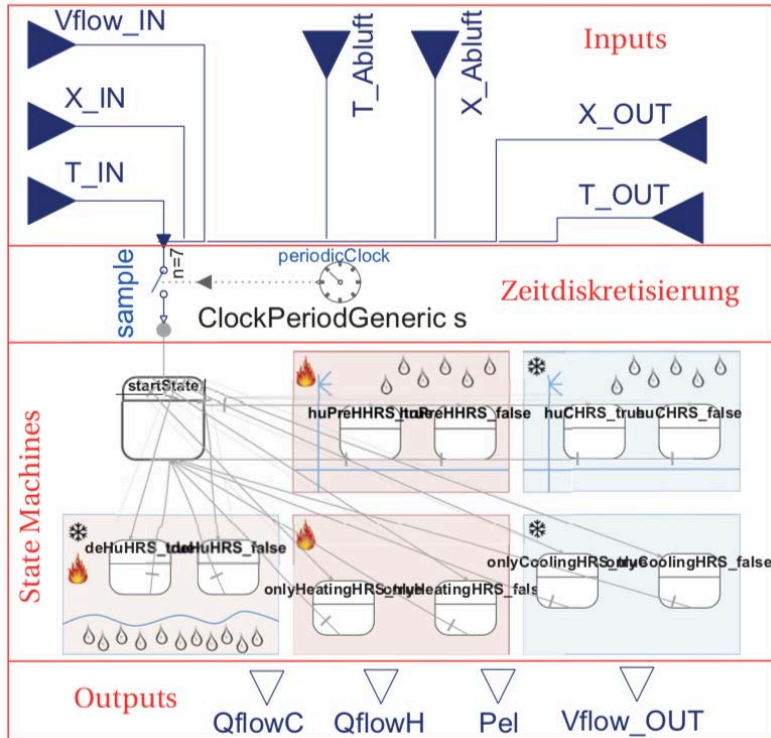 $$\Psi_{AU} = \frac{x_{AU,A} - x_{AU,E}}{x_{AB,E} - x_{AU,E}}$$

FOL — AUL — WRG — VH — K — WB — NH — ZulV — AblV — ABL — GEBÄUDE ZONE — ZUL

Ventilation

- Power:
  $$P_{el} = \frac{\dot{V} \cdot \Delta p}{\eta}$$
- Thermal:
  $$\Delta T = \frac{P_{el}}{\dot{m} \cdot c_p}$$

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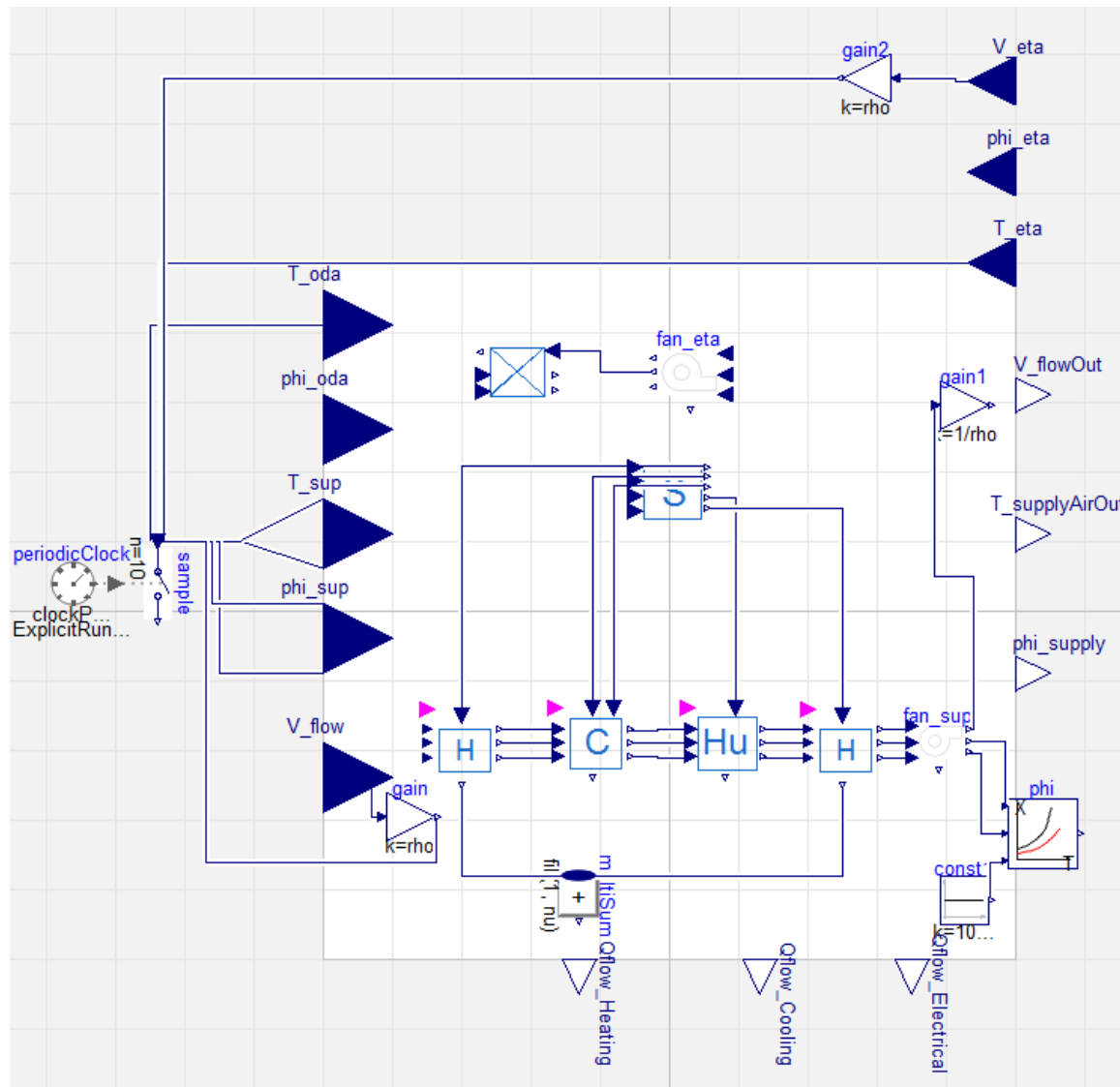
AHU: Existing models in AixLib

- Simple AHU-model [Mehrfeld, P.]

- Detailed model [Menerga, Behm, C.]
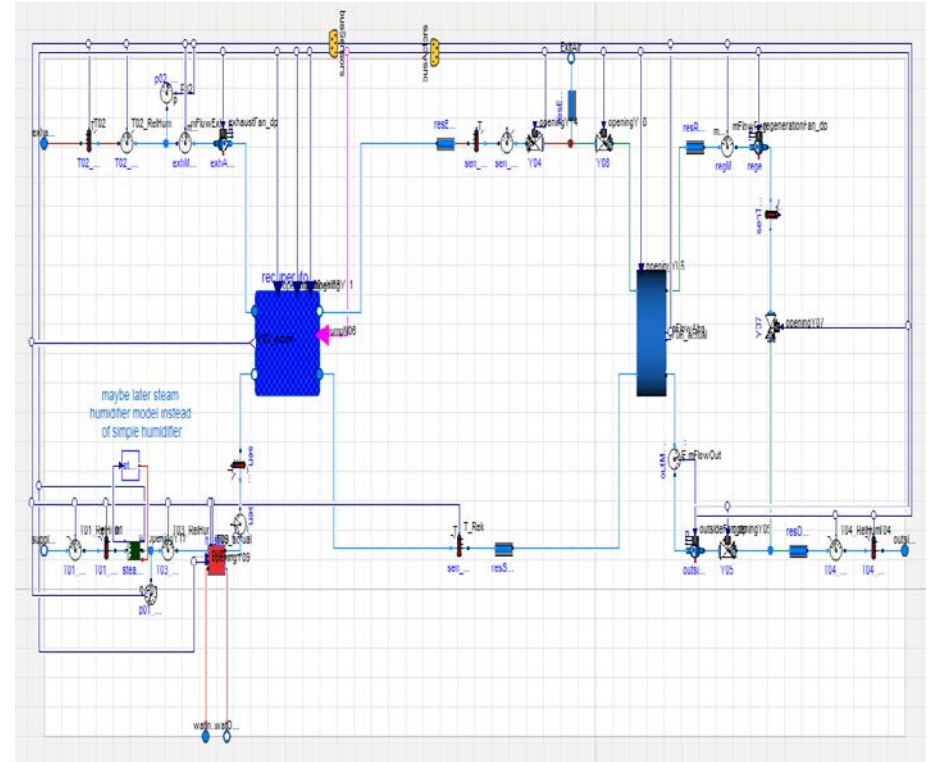
AHU: Current model

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