Simulation Package

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CityGML Utility Network ADE Workshop

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Project IntegrCiTy

- Full title: **Decision-support environment for planning and integrating multi-energy networks and low-carbon resources in cities**
- Duration: 3 years, Spring 2016 - Spring 2019
- Coordination: EPFL, Switzerland
- Members:
  - 17 partners: academic institutions, city- and region-level energy authorities, multi-energy utilities, an equipment manufacturer and a software start-up company
  - Cities in the project: Stockholm (S), Vevey (CH), Geneva (CH)
- www.integrcity.epfl.ch

Project IntegrCiTy: Partners

Coordination

Energy Center (CEN)

AEE – Institute for Sustainable Technologies (AEE INTEC)

Hoval Austria (Hoval AT)

Industrial Process and Energy Systems Engineering Group (IPESE)

Royal Institute of Technology (KTH)

Romande Energie SA (RE)

City of Vevey (Vevey)

Centre de Recherches Energétiques et Municipales (CREM)

Haute Ecole Spécialisée de Suisse Occidentale Valais-Wallis (HES-SO Valais-Wallis)

Austrian Institute of Technology (AIT)

République et Canton de Genève (CT GE)

Services Industriels de Genève (SIG)

Europe Power Solutions AB (EPS)

Veolia Sverige AB (VS)

Holdigaz SA (HSA)

Riksbyggen (RB)

ElectriCITY (EC)

City of Stockholm

Project IntegrCiTy: Goals

- Development of an integrated **decision-support environment for city planners and energy providers to improve efficiency and resilience of energy supply infrastructures**, focusing on deployment, extension and retrofitting

- Application of the **decision-support platform and embedded tools in selected cities, for local utilities and city administrations**, focusing on thermal and electrical networks linked to low-carbon resources

Evaluation of interoperability and synergies for existing and future multi-carrier energy infrastructure, through integrated modelling and multi-network simulation.

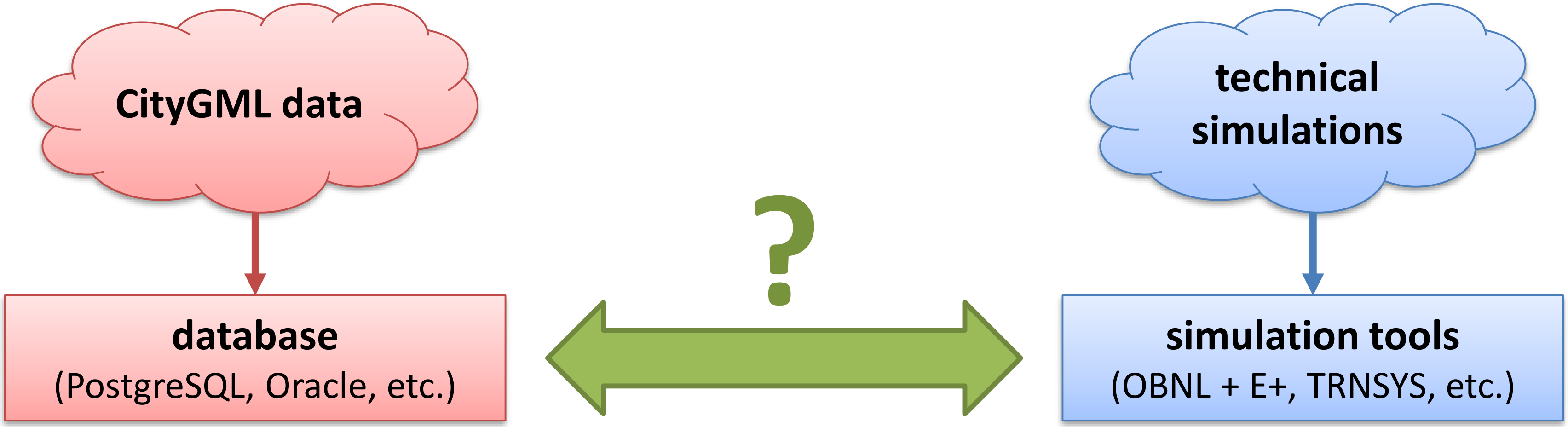
Project IntegrCiTy: Test Case Vevey

- Help the City of Vevey in developing a new DHC network
- Propose and analyse DHC network designs
  - temperature levels (high vs. low temperature)
  - heat pump integration (centralized vs. decentralized)
- Assess impact on other networks
  - power grid
  - natural gas network

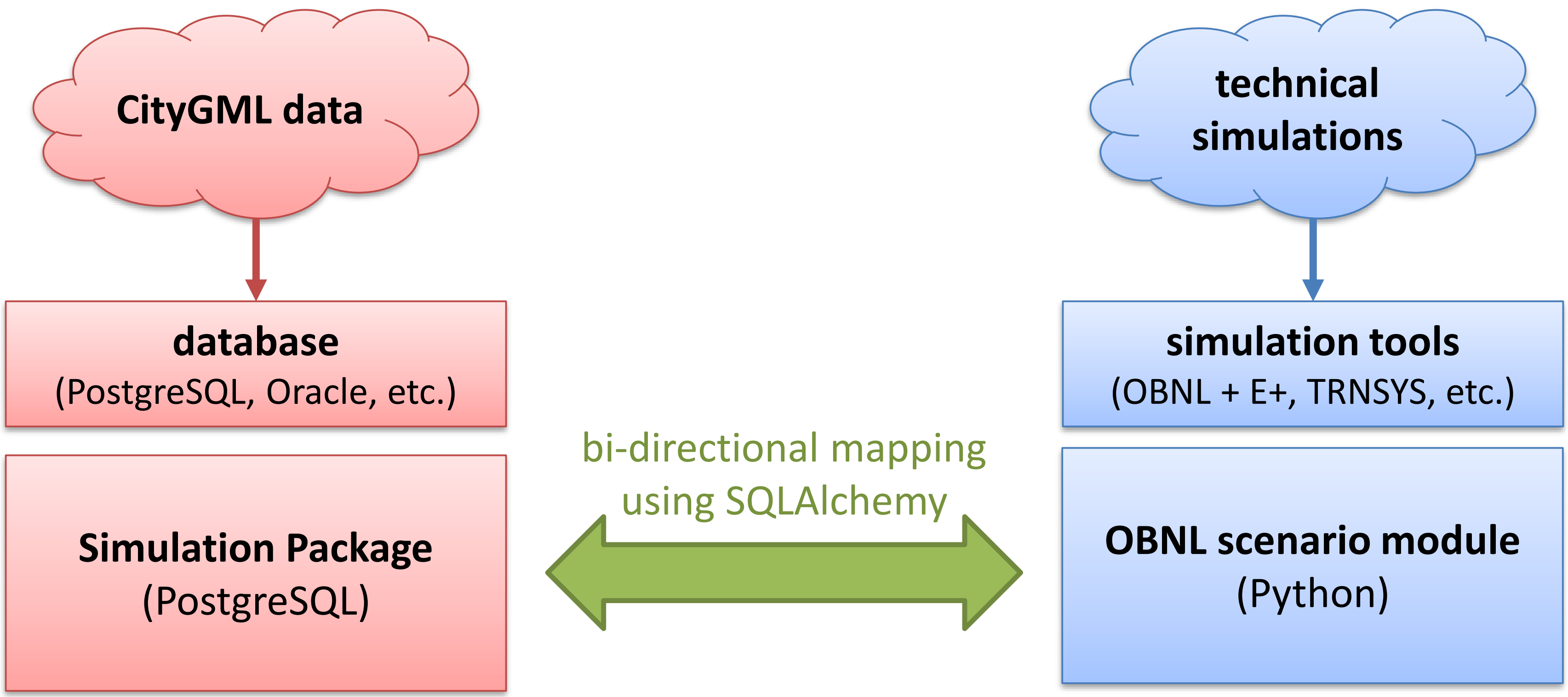
Motivation: Simulation Package

- availability of high-quality data → crucial prerequisite for the creation of meaningful simulations models
- CityGML data model & domain extensions enable a coherent approach for storing geospatial and semantic information
- in addition to domain-specific data:
  - add metainformation required to execute a co-simulation
  - individual simulator configurations
    - integrator steps sizes, initial conditions, etc.
  - extra information for co-simulation
    - coupling and orchestration of several simulator instances.
- logical next step: persistency schema for this type of information that integrates into the CityGML framework

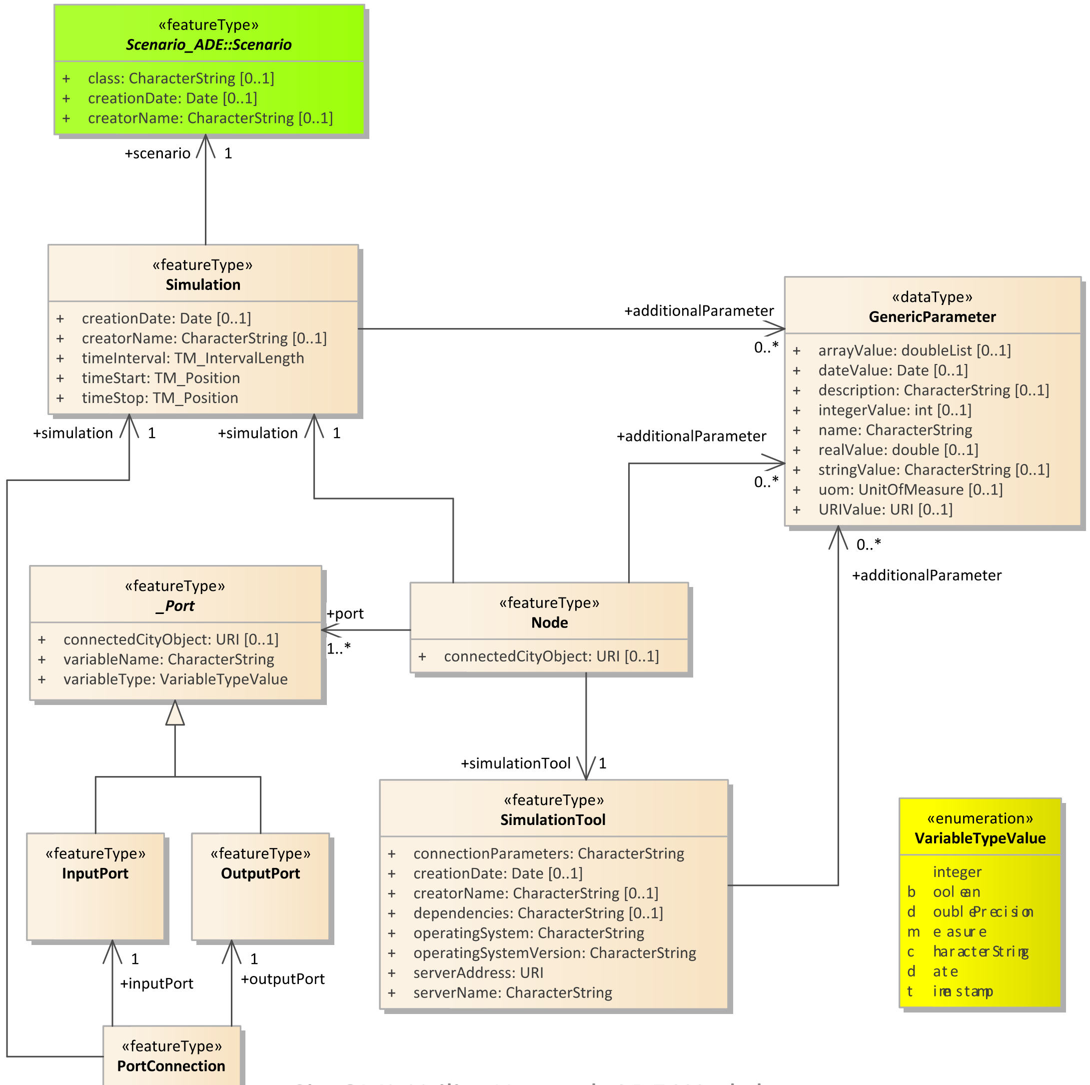
Bridging the gap



Bridging the gap

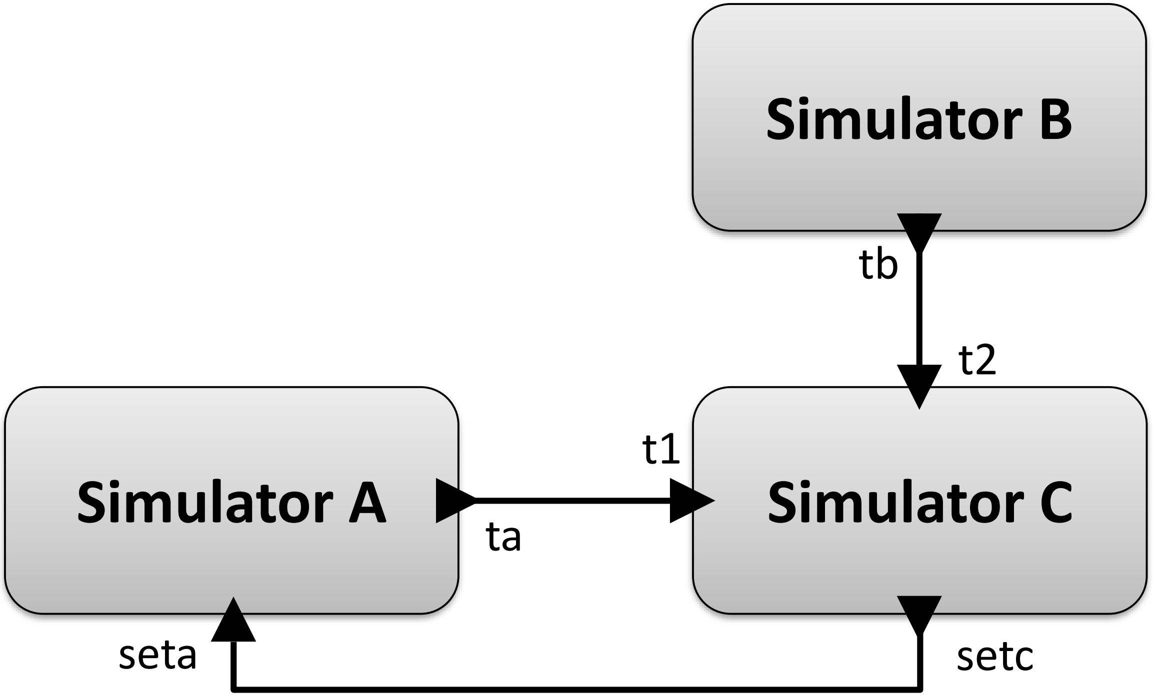


Simulation Package



Example

- Simple example of co-simulation setup:



Example

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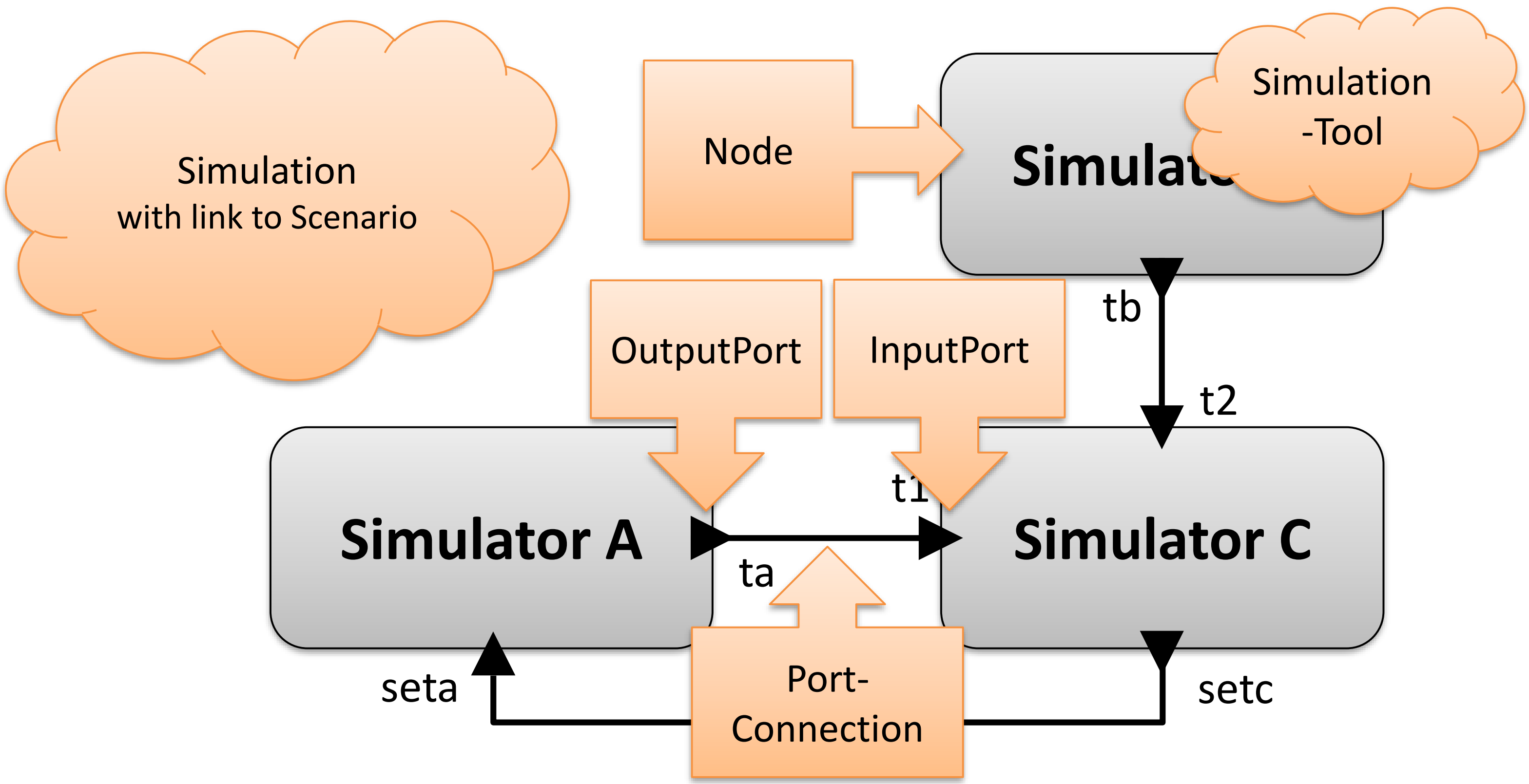
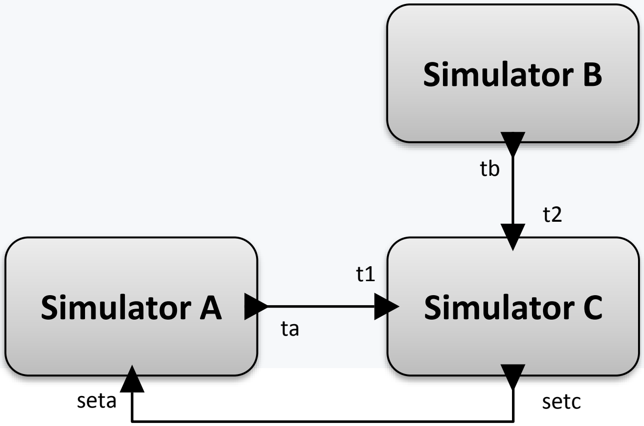


OBNL scenario module

- object-oriented representation of co-simulation graph
  - internally consistent with data model from Simulation Package
- intuitive and simple way to define a OBNL co-simulation graph
  - can be stored to (and read from) 3D City database
  - can be translated to OBNL input file
- not implemented yet:
  - simulation tool setups
  - links to CityGML scenarios and objects
    - relevant for retrieval of model parameters, time series data, input data for automated model generation, etc.

Example

```
from scenario import *

nodeA = Node( 'A', input_variable_names = [ 'seta' ], output_variable_names = [ 'ta' ] )
nodeB = Node( 'B', output_variable_names = [ 'tb' ] )
nodeC = Node( 'C', input_variable_names = [ 't1', 't2' ], output_variable_names = [ 'setc' ] )

link1 = Link( 'l1', from_node = nodeA, output_variable_name = 'ta', to_node = nodeC, input_variable_name = 't1' )
link2 = Link( 'l2', from_node = nodeB, output_variable_name = 'tb', to_node = nodeC, input_variable_name = 't2' )
link3 = Link( 'l3', from_node = nodeC, output_variable_name = 'setc', to_node = nodeA, input_variable_name = 'seta' )

scenario = Scenario( 'TestScenario' )

scenario.add_node( nodeA )
scenario.add_node( nodeB )
scenario.add_node( nodeC )

scenario.add_link( link1 )
scenario.add_link( link2 )
scenario.add_link( link3 )
```



A possible user story

initialization

- retrieve initial conditions, model parameters, time series, etc.
- select or generate individual simulation models
- define co-simulation graph (nodes, links, etc.) and schedule

- semantic representation of data
- store / retrieve scenarios

co-simulation

- run simulation
- no interaction with CityGML database needed (no storage of intermediate results)

data post-processing

- retrieve selected simulation results

- store data (incl. semantic relations)
- use a format that is usable for visualization

3DCityDB

Conclusions

- briding the gap between GIS data modelling and technical simulations:
  - Simulation Package (plus Scenario ADE)
  - OBNL scenario module
- first “fast and dirty prototype” available
  - still missing features (e.g., link to Scenario ADE)
  - some interfaces to co-simulation environment still need to be implemented
- as soon as details are clear, a first example will be implemented

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