EUROPEAN INSTITUTE FOR ENERGY RESEARCH

Hochschule Karlsruhe
Technik und Wirtschaft
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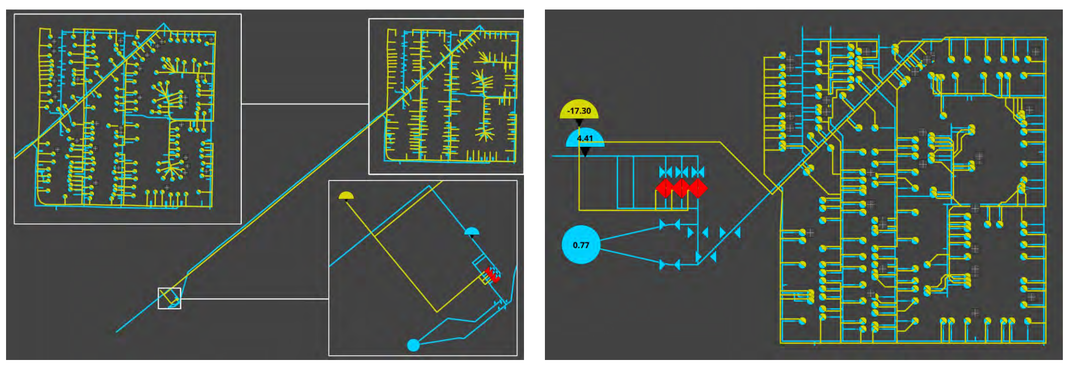
Näher dran.

Utility Network Modelling with CityGML

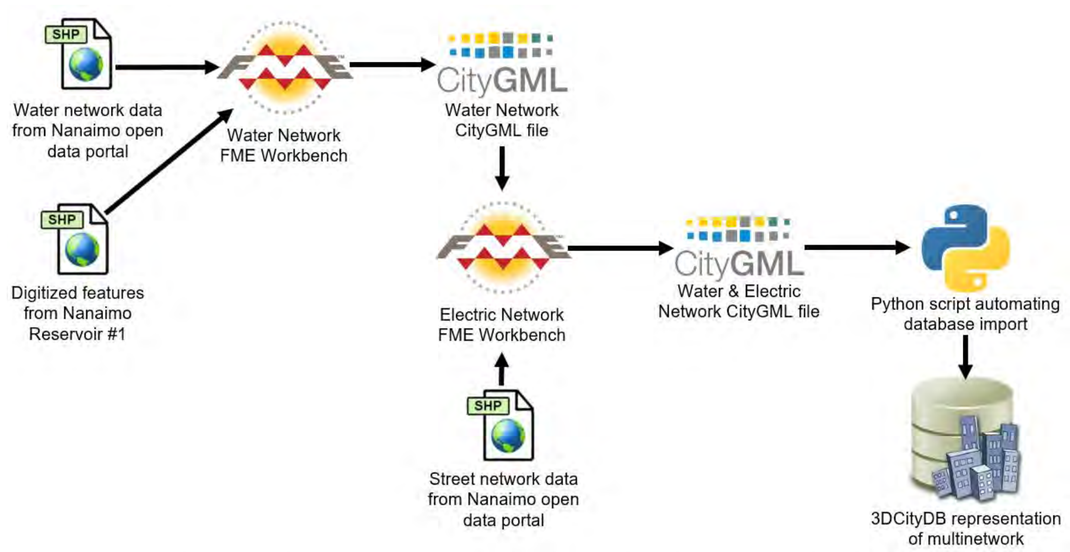
Demonstration of model development using the UtilityNetwork Application Domain Extension

CityGML is a popular choice for storage and exchange of city models. It is, however, limited to modelling only visible and physical elements in a city. Using an “Application Domain Extension” (ADE), the CityGML model can be extended to model elements and semantical properties pertaining to a specific theme. One such ADE, the UtilityNetwork ADE, is intended for the modelling of network features such as pipes, cables, canals and their associated functional elements such as pumps, valve, switchboxes, etc. Furthermore, the dynamic properties of elements such as flow and storage capacity are able to be modelled, as well as dependencies between networks, such as an electrical network depending on a water network by means of a hydroelectric generation facility. The UtilityNetwork ADE is still in active development and so there is a need for exploratory modelling to test its capabilities.



Dual representations of water and electrical networks (Left: topographical, right: topological)

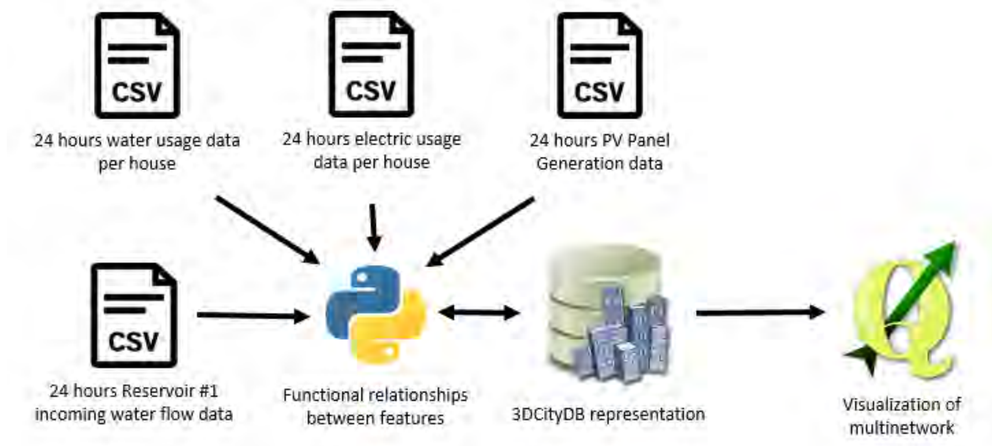
A case study of a hydroelectric generation facility in the city of Nanaimo, Canada was used as the basis for construction of a model that models the dependency of an electrical network on the dynamics of a water network. Using Safe Software’s “Feature Manipulation Engine” (FME) software, a combination of open data from the city and some assumed data, a sample dataset was created containing these two networks in CityGML UtilityNetwork ADE format. This sample dataset was subsequently imported into a PostgreSQL-based 3DCityDB instance that had been extended to accommodate the UtilityNetwork ADE schema.



Process of creating water and electrical network data sample

The database was then visualized in Quantum GIS (QGIS) using two representations: A topographical one which prioritizes locational accuracy of network elements, and a topological one which prioritizes understanding of the connectivity of elements at the cost of locational accuracy.

The behavioural model consisted of a Python script which defines relationships between functional elements in the networks, and reads and writes to the 3DCityDB to modify the properties of elements according to a set of rules. This model simulates 24 hours of network operation, taking into account network interruptions that may occur at selected network elements. Such interruptions may induce cascading effects in their own or another network, for instance a turbine shutting off because it lost its supply of incoming water. The pgRouting extension for PostgreSQL was used to evaluate the connectivity of elements in the networks using routing functions.



Architecture of the developed behavioural model

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