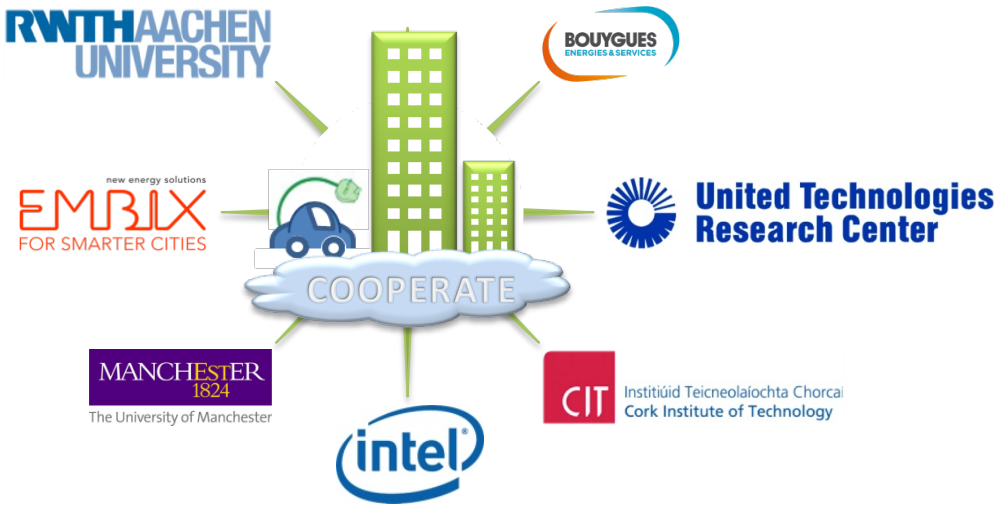
CONTROL AND OPTIMISATION FOR ENERGY POSITIVE NEIGHBOURHOODS

COOPERaTE

Deliverable D1.7

Report detailing the final Neighbourhood Information Model architecture



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Author(s)	:	Markus Look (RWTH), Timo Greifenberg (RWTH)
Contributors	:	Keith Ellis (INTEL), Peter Matthes (RWTH)
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Abstract This report describes the final Neighbourhood Information Model (NIM) under task 1.3 “Neighbourhood Information Model development (semantic/ontology level)”, for COOPERaTE neighbourhoods. Task 1.3 focused on the development of a NIM, which models a selection of interconnected buildings, any energy generation facilities within the neighbourhood, the physical infrastructure used to connect the buildings, properties associated with energy supply and demand and properties associated with energy transfer within the neighbourhood. The report presents the final NIM, the final generic NIM as well as an implemented NIM service.

Keyword list Neighbourhood information model, Meta-model, Modelling, Mapping, Adaptation, Integration, City district

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1 Executive Summary

This report represents a description of the Neighbourhood Information Model (NIM) and its semantics used within the COOPERaTE project. It is the outcome of Task 1.3 belonging to Deliverable 1.7 *"Report detailing the final Neighbourhood Information Model architecture"*.

The report itself and the NIM have a public dissemination level.

Throughout this document we use the following wording, as already used in the preceding deliverables:

Generic NIM	The generic data model underlying the NIM, describing mainly the structure of entries and relationships between them.
NIM	The concrete data model used within the COOPERaTE project.
NIM format	The JSON representation of the generic NIM used for communication purposes.
NIM service	The prototype implementation of the generic NIM as well as the NIM and the necessary data transformation tools.
NIM data format	The DSL used to configure the NIM service.

As already mentioned in D1.2 (D1.2 Report detailing Neighbourhood Information Model Semantics, 2013) three different design principles where followed while designing the NIM:

- reuse and extension of existing information models
- design of a flexible and extensible NIM
- adaptation and integration of already existing BIMs

The NIM and its underlying generic NIM serve as a common data model throughout several tasks in the project. Using such a data model facilitates interoperability between systems and the integration of heterogeneous data models. Thus, existing services and systems can collaborate within the system-of-systems (SoS) approach posited by COOPERaTE.

It is the common basis of the services developed in task 3.2 "Development of analytical infrastructure & services", which are based on Deliverable 1.1 (D1.1 Report on Requirements and Use Cases Specification, 2013).

With Deliverable 1.2 (D1.2 Report detailing Neighbourhood Information Model Semantics, 2013) a first approach to the NIM and the generic NIM has been provided. During the course of the project that approach was refined in order to represent the extensions and refinements necessary for connecting and integrating the validation sites. Typed values, as well as security and privacy aspects have been incorporated. Additionally, a NIM service was introduced making use of models in the NIM data format in order to specify the data to be integrated.

The final generic NIM, the NIM and the NIM service are presented within this deliverable.

2 Introduction

This section introduces Deliverable 1.7 of Work Package 1 of the COOPERaTE project. The aim of work package is the development of the COOPERaTE Neighbourhood Information Model (NIM) for energy positive neighbourhoods and to specify the respective semantics.

Task 1.3, focussed on the development of a NIM which models a selection of interconnected buildings, any energy generation facilities within the neighbourhood, the physical infrastructure used to connect the buildings, properties associated with energy supply and demand and properties associated with energy transfer within the neighbourhood. The model is also able to cover different kinds of information like actual values, forecast values or allowed value ranges. Furthermore, historical data for all kind of information types can be maintained. Such a NIM serves as a central point of information enabling the COOPERaTE SoS approach.

Within Deliverable D1.2 (D1.2 Report detailing Neighbourhood Information Model Semantics, 2013) a requirement analysis for a Neighbourhood Information Model as well as an overview of existing data models was presented. Based thereon a first version of a NIM meta-model was proposed. On top of this meta-model the COOPERaTE Neighbourhood Information Model, based on the Semanco data model was defined. Additionally, first approaches to integrate the validation sites were outlined.

Subsequently, Deliverable D1.5 (D1.5 Report on validation site refined Neighbourhood Information Model, 2014) provided refinement to the overall NIM, based on the experiences gained while integrating the validation sites. It extended the notion of values within the NIM and added important security aspects. Furthermore, a prototype version was outlined.

This deliverable D1.7 presents the final NIM meta-model and the COOPERaTE Neighbourhood Information Model with all refinements included. The refinements of D1.5 (D1.5 Report on validation site refined Neighbourhood Information Model, 2014) could be successfully applied into the running system within the last year. Thus, there are no further model refinements.

Section 3 presents the final NIM meta-model as well as the final COOPERaTE Neighbourhood Information Model. It gives a comprehensive overview of the concepts and available data and makes use of references to preceding deliverables where necessary to detail the information.

Section 4 provides the refinement of the prototype NIM service.

Section 5 concludes the deliverable.

3 The Neighbourhood Information Model

Within the third year of the COOPERaTE project we have been able to connect all validation sites to the NIM service using the NIM format. Within Deliverable D1.2 (D1.2 Report detailing Neighbourhood Information Model Semantics, 2013) we presented a first version of the generic NIM and the NIM itself. Additionally, we introduced an initial approach to a mapping domain specific language in order to integrate heterogeneous data models. Within Deliverable D1.5 (D1.5 Report on validation site refined Neighbourhood Information Model, 2014) we refined the generic NIM as well as the NIM based on experiences during the integration of the validation sites and were able to elaborate more on the mapping language in (Greifenberg, Look, Rumpe, & Ellis, 2014). A JSON representation of the NIM serves as a common data exchange format within the COOPERaTE SoS approach and could be applied within all validation sites. Thus, the following sections conclude the insights gained and present the final generic NIM and the final NIM based on the refinements shown in Deliverable 1.5 (D1.5 Report on validation site refined Neighbourhood Information Model, 2014).

The next sections will outline the final generic NIM as well as the NIM. They give a comprehensive overview of the concepts and available data and make use of references to preceding deliverables, Deliverable D1.2 (D1.2 Report detailing Neighbourhood Information Model Semantics, 2013) and Deliverable D1.5 (D1.5 Report on validation site refined Neighbourhood Information Model, 2014) where necessary to detail the information. It starts out with presenting the generic NIM, its data fields and its features, including security and privacy aspects. Subsequently the NIM is presented.

3.1 The Final Generic NIM

For enabling a SoS approach within COOPERaTE we designed the generic NIM as a meta-model for integrating different heterogeneous data sources. We started out with the generic NIM described in Deliverable 1.2 (D1.2 Report detailing Neighbourhood Information Model Semantics, 2013), where we introduced the overall structure of such a meta-model. The final structure of the generic NIM is shown in Figure 1 .

The generic NIM allows us to easily describe the NIM and the implementation of the generic NIM allows the seamless integration of data formats and data sources. In general the generic NIM consists of the *NIM* element as the data model root. To distinguish several NIMs in different neighbourhoods the NIM contains an identifier. The NIM itself consists of several *NIMComponents*. These components have a name and are either categories or entries, denoted by the two subclasses *Category* and *Entry*. The categories may contain other categories or entries via the subcomponents association. Additionally soft links to other not hierarchically structured categories are possible. This is necessary for grouping entries into semantically meaningful categories and to enable different scopes of available data.

The entries are used to store the actual data occurring in a neighbourhood. Thus the entries contain several fields and values for storing the data. We described the overall meta-model in Deliverable 1.2 (D1.2 Report detailing Neighbourhood Information Model Semantics, 2013) in detail and the final entry structure in the following.

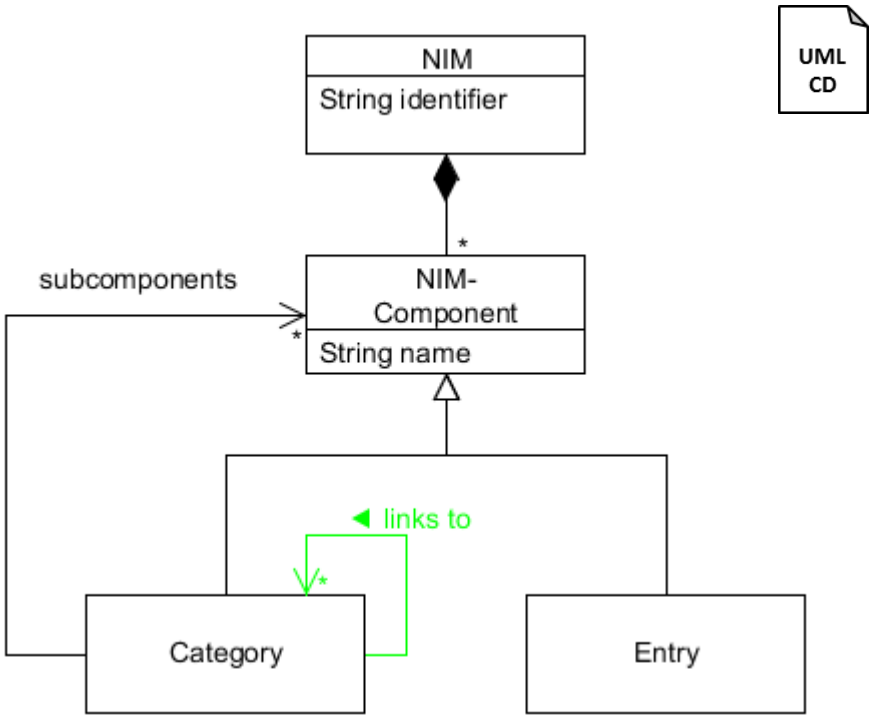

Figure 1: The Final Generic NIM

The *Entry* class and its associated classes are more detailed in Figure 2. The entry itself has several data fields, such as

- *name*, representing a short name of the entry,
- *unique identifier*, representing a unique id used internally to identify the entry,
- *long name*, representing a long name of the entry,
- *description*, representing a detailed description of the entries content,
- *author*, representing the origin of the entry,
- *contact name*, representing the name of the person that can be contacted about the entries content,
- *URL*, representing the unique resource locator under which the entry can be found,
- *domain*, representing the broader topic of the entry
- *tags*, representing additional grouping information
- *license information*, representing on which license base the entry may be used
- *reuse options*, representing if and how the entry might be reused in order to process it multiple times,
- *physical location*, representing “the geographical, physical location where entries or values are allowed to be stored” (Greifenberg, Look, Rumpe, & Ellis, 2014)
- *permissions*, representing who may access the data
- *agreed usages*, representing what may be done with the data.

These fields provide general meta-data as well as security and privacy information. A more detailed explanation of these common entry fields and especially a detailed discussion on the benefits for security and privacy issues can be found in (D1.5

Report on validation site refined Neighbourhood Information Model, 2014) and (Greifenberg, Look, Rumpe, & Ellis, 2014).

The entry also has an association to several values, a value range and several forecasts, which again have multiple values. A *Value* has a timestamp and an expiry date. There are multiple different subclasses serving as value types within the generic NIM, such as

- *NumericValue*, that stores either an integer or decimal value,
- *BooleanValue*, that stores an Boolean value, either true or false,
- *StringValue*, that stores an arbitrary character sequence,
- *EnumValue*, that stores a selected value out of a set of possible values,
- *DateValue*, that stores a date as a long value in elapsed milliseconds since January 1st 1970 00:00:00.000 GMT,
- *SensorValue*, that stores weak references to time series data.
- *UnitValue*, that stores the unit of the entry.

Furthermore the *NumericValue* has a *NumericType*, that represents the floating point precision in case a decimal value is stored, and the *EnumValue* has an *EnumType*, that specifies the set of possible values. A detailed explanation of these fields is given in Deliverable 1.5 (D1.5 Report on validation site refined Neighbourhood Information Model, 2014).

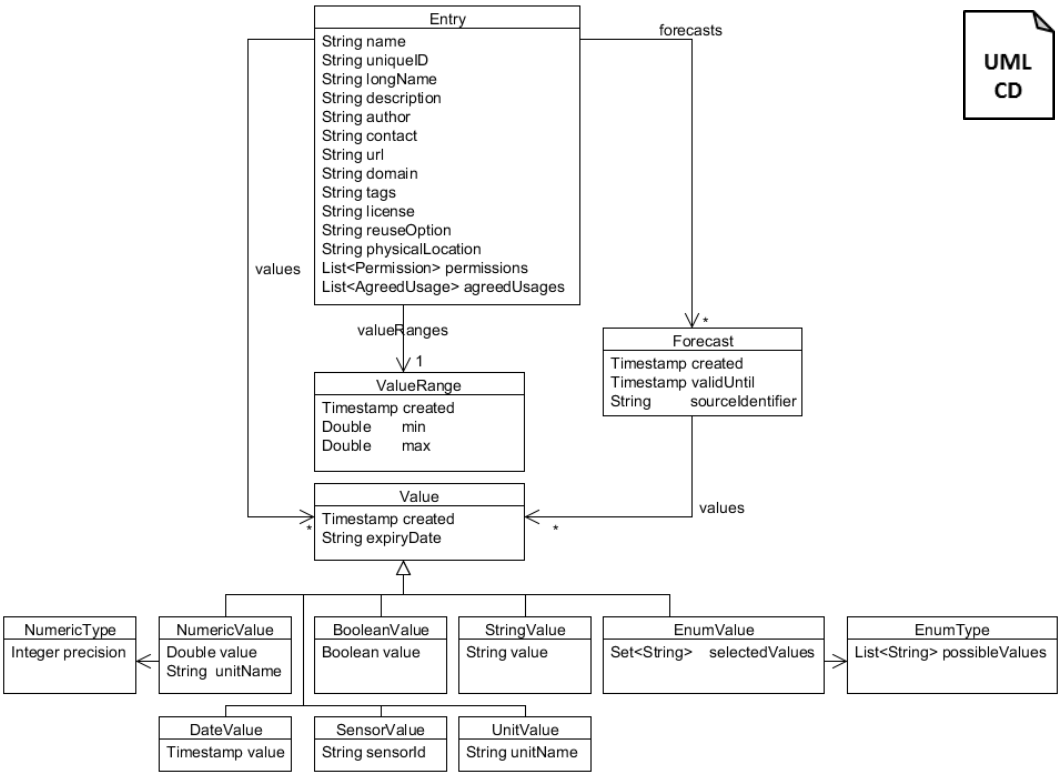

Figure 2: The detailed entry, its values, value ranges and forecasts

Since each entry has multiple values with different timestamps, historical data is also available for each entry, if necessary. The *ValueRange* contains information on the minima and maxima of possible values. These ranges are only valid for numeric values. A single forecast also has a timestamp and is only valid until a certain date. Additionally it contains an identifier that uniquely identifies the source of the forecast. The associated values are the forecast values for the time of the forecast. A more detailed discussion on value ranges, forecast data and historical data can be found in (D1.2 Report detailing Neighbourhood Information Model Semantics, 2013).

This meta-model structure as well as the contained fields and values fulfil several requirements, based on the requirements analysis done in Deliverable 1.1 (D1.1 Report on Requirements and Use Cases Specification, 2013) and Deliverable 1.2 (D1.2 Report detailing Neighbourhood Information Model Semantics, 2013), necessary for such a neighbourhood data model:

- *Extensibility*, through its generic nature and the possibility to add new entries at runtime of the system,
- *Integration of heterogeneous data models*, through dedicated domain specific languages defining the mapping between heterogeneous data models,
- *Historical Data*, through the multiple associated values with timestamps,
- *Value Ranges*, through the associated value ranges,
- *Forecast Data*, through the forecasts that enable multiple forecasts for the same point in time with different values
- *Interconnectivity*, through the links to association,
- *Hierarchy*, through the compositional nature of the NIM component meta-model,
- *Security and Privacy*, through the newly introduced fields in the entry as well as the expiry date defining when a value cannot be used anymore (Greifenberg, Look, Rumpe, & Ellis, 2014).

A detailed explanation and examples are given in Deliverable 1.2 (D1.2 Report detailing Neighbourhood Information Model Semantics, 2013) and Deliverable 1.5 (D1.5 Report on validation site refined Neighbourhood Information Model, 2014).

3.2 The Final NIM

On top of the generic NIM we designed a concrete COOPERaTE data model, which is based on the data model defined by the Semanco project. We presented a first version of such a concrete data model in Deliverable D1.2 (D1.2 Report detailing Neighbourhood Information Model Semantics, 2013). During the course of the project we extended the Neighbourhood Information Model using concepts necessary for integrating and mapping the validation sites to the NIM.

Figure 3 shows an overview of the categories available within the COOPERaTE Neighbourhood Information Model. We added the notion of meta data for time series, that contains information on

- the first value date, storing the date of the first value,
- the last value date, storing the date of the last value,
- whether the data is equally spaced, indicating whether the values and the timestamps are equally spaced,
- the reference date, being used if the data is equally spaced to compute the deltas to other timestamps,
- the quantization, storing the information on how many values per interval are stored, e.g. four values per hour,
- the actual minimum, storing the smallest value of the time series,
- the actual maximum, storing the largest value of the time series.

Furthermore the notion of points, lines and polygons have been added in order to integrate geometrical data available from the CIT Nimbus building. More detailed information on the additional fields can be found in Deliverable D1.5 (D1.5 Report on validation site refined Neighbourhood Information Model, 2014).

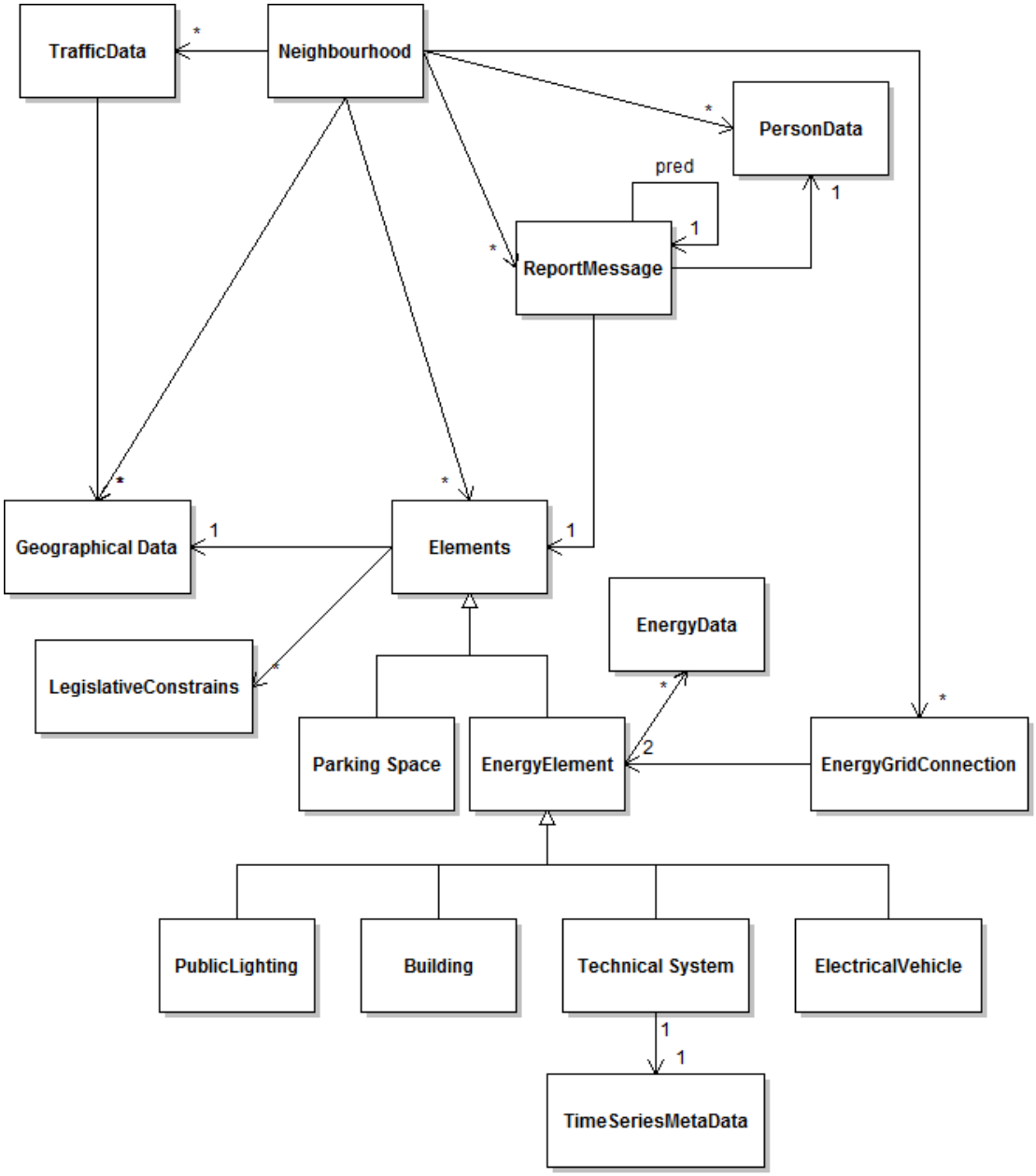

Figure 3: The Final NIM

The following table shows all available categories and data fields available within the NIM. The table is based on the table included in Deliverable D1.2 (D1.2 Report detailing Neighbourhood Information Model Semantics, 2013) and extended by the newly added concepts.

Category	Subcategory	Data Name	Value Range	Forecast Data	Source	Data-Type
Energy Data		Auxiliary Energy	No	Yes	Measured	Numeric
		CO2 emission coeffcient	No	No	Manual	Numeric
		CO2 emissions	No	Yes	Measured	Numeric
		Delivered Energy	No	Yes	Measured	Numeric
		Energy Demand	Yes	Yes	Measured	Numeric
		Energy Supply	Yes	Yes	Measured	Numeric
		Guaranteed Energy Demand	No	Yes	Manual	Numeric
		Guaranteed Energy Supply	No	Yes	Manual	Numeric
		Exported Energy	No	Yes	Measured	Numeric
		Final Energy	No	Yes	Measured	Numeric
		Primary Energy	No	Yes	Measured	Numeric
		Produced renewable thermal/electrical power/energy	No	Yes	Measured	Numeric
		RES coverage	Yes	Yes	Measured	Numeric
		Energy Carrier (electricity, natural gas)	No	No	Manual	Enum
		Energy source (wind, sun)	No	No	Manual	Enum
		Energy generation	Yes	Yes	Measured	Numeric
		Energy generation potential	Yes	Yes	Calculated	Numeric
		Energy storage	Yes	Yes	Measured	Numeric
		Energy storage capacity	Yes	Yes	Calculated	Numeric
		Flexibility	No	No	Link	
Energy Cost Data		energy cost	No	Yes	Calculated	Numeric
		investment cost	No	No	Calculated	Numeric
		pricing data	No	Yes	Extern	Numeric
		Time of Use	No	No	Extern	Text
	Flexibility	Absolute Price (per kWh)	No	No	Calculated	Numeric
		Relative Price – A change in the price per kilowatt-hour	No	Yes	Extern	Numeric
		Load amount – A fixed amount of load to shed or shift	No	Yes	Extern	Numeric
		Load percentage – The percentage of load to shed or shift	No	Yes	Extern	Numeric
		Time start	No	No	Extern	Text
		Time end	No	No	Extern	Text

General Data		age	No	No	Manual	Numeric
		typology	No	No	Manual	Enum
Use		crowding index	No	No	Calculated	Numeric
		occupancy profile	No	Yes	Calculated	Numeric
		percentage of occupation	Yes	Yes	Calculated	Numeric
External Surroundings		ground p-value	No	No	Manual	Numeric
		ground α-value	No	No	Manual	Numeric
		external obstructions	No	No	Manual	Text
Geometry		gross / net area	No	No	Manual	Numeric
		GeographicalData	No	No	Link	
TimeSeries-MetaData		firstValueDate	No	No	Calculated	Text
		lastValueDate	No	No	Calculated	Text
		equallySpaced	No	No	Manual	Boolean
		referenceDate	No	No	Manual	Text
		quantization	No	No	Manual	Text
		actualMinimum	No	No	Calculated	Numeric
		actualMaximum	No	No	Calculated	Numeric
Elements	Buildings	BIM	No	No	Link (contains the complete list specified in the SEMANCO project (D3.1 Report on the Accessible Energy Data, 2012).	
		GeographicalData	No	No	Link	
		Energy Data	No	No	Link	
	Parking	occupied spaces	Yes	Yes	Measured	Numeric
		parking fee	No	Yes	Manual	Numeric
		GeographicalData	No	No	Link	
	Technical Systems	type	No	No	Manual	Enum
		category	No	No	Manual	Enum
		efficiency	No	No	Manual	Numeric
		Value Reference	No	No	Manual	Text
		Material	No	No	Manual	Text
		Centre point	No	No	Manual	Point
		GeographicalData	No	No	Manual	GeoData
		Energy Data	No	No	Link	
		TimeSeries-	No	No	Link	

		MetaData				
		Technical-Systems	No	No	Link	
	Electrical Vehicle	Energy Data	No	No	Link	
		Power	No	No	Manual	Numeric
		Charging type	No	No	Manual	Text
	Public Lighting	Energy Data	No	No	Link	
		Geographical Data	No	No	Link	
Legislative Constraints		Energy Data	No	No	Link	
		Neighbourhood Elements	No	No	Link	
Geographical Data	geometric data	point	No	No	Manual	Point
		line	No	No	Manual	Line
		polygon	No	No	Manual	Polygon
	topologic data	connection	No	No	Manual	Text
		adjacency	No	No	Manual	Text
		inclusion	No	No	Manual	Text
	informative data	numerical	No	No	Manual	Numeric
		text	No	No	Manual	Text
Land Registry Data	land parcels	location	No	No	Manual	Text
		boundaries	No	No	Manual	Text
		coordinates	No	No	Manual	Text
		total surface	No	No	Manual	Numeric
		built surface	No	No	Manual	Numeric
	land tenure	property rights	No	No	Manual	Text
		ownership	No	No	Manual	Text
		leases	No		Manual	Numeric
		property regime	No	No	Manual	Text
	land value	land quality	No	No	Manual	Text
		land classification	No	No	Manual	Text
		economic value	No	Yes	Manual	Numeric
		tax value	No	Yes	Manual	Numeric
		value of improvements	No	Yes	Manual	Numeric
Urban Planning Data		terminology (A - N according to ISIC)	No	No	Manual	Enum
Socio-economic data	housing	occupancy status	No	Yes	Calculated	Numeric
		number of rooms	No	No	Calculated	Numeric
		number of occupants	No	Yes	Calculated	Numeric
		type of ownership(owns outright, with mortgage or load, …)	No	No	Calculated	Text
		property price	No	Yes	Calculated	Numeric

		social rented(general, from Local Authority)	No	No	Calculated	Text
		private rented (landlord, letting agency)	No	No	Calculated	Text
		rental	No	Yes	Calculated	Numeric
		rental fee	No	Yes	Calculated	Numeric
	families and households	#nuclear families	No	No	Calculated	Numeric
		size of nuclear family	No	No	Calculated	Numeric
		type of nuclear family	No	No	Calculated	Text
		#households	No	No	Calculated	Numeric
		size of households	No	No	Calculated	Numeric
		type of household	No	No	Calculated	Text
	economic activity	employment	Yes	Yes	Calculated	Numeric
		unemployment	Yee	Yes	Calculated	Numeric
		occupations	Yes	Yes	Calculated	Numeric
		earnings	Yes	Yes	Calculated	Numeric
		hours worked	Yes	Yes	Calculated	Numeric
	income and poverty	income	Yes	Yes	Calculated	Numeric
		poverty (e.g. fuel poverty)	No	No	Calculated	Text
demographic data	population	size	Yes	Yes	Calculated	Numeric
		gender	No	No	Calculated	Text
		age	Yes	Yes	Calculated	Numeric
		birth date	Yes	No	Calculated	Numeric
		density	No	Yes	Calculated	Numeric
		language	No	No	Calculated	Text
	learning and education	learning level	No	No	Calculated	Text
		education level	No	No	Calculated	Text
Climatic Data		Air temperature	Yes	Yes	Extern	Numeric
		Diffuse solar irradiance	Yes	Yes	Extern	Numeric
		Direct solar irradiance	Yes	Yes	Extern	Numeric
		Global solar irradiance	Yes	Yes	Extern	Numeric
		Gust wind speed	Yes	Yes	Extern	Numeric
		Mixing ratio	Yes	Yes	Extern	Numeric
		Rainfall total	Yes	Yes	Extern	Numeric
		Reference wind speed	Yes	Yes	Extern	Numeric
		Relative humidity	Yes	Yes	Extern	Numeric
		Solar declination	Yes	Yes	Extern	Numeric
		Water vapour pressure	Yes	Yes	Extern	Numeric
		Wind direction	Yes	Yes	Extern	Numeric

		Wind speed	Yes	Yes	Extern	Numeric
Environmental Data		Total Suspended particulate matter	Yes	Yes	Calculated	Numeric
		sulphur dioxide	Yes	Yes	Calculated	Numeric
		nitrogen oxides	Yes	Yes	Calculated	Numeric
		carbon monoxide	Yes	Yes	Calculated	Numeric
		ozone	Yes	Yes	Calculated	Numeric
		lead	Yes	Yes	Calculated	Numeric
Person Data		username	No	No	Manual	Text
		password	No	No	Manual	Text
		active	No	No	Manual	Text
		registeredSince	No	No	Manual	Text
		type	No	No	Manual	Text
		role	No	No	Manual	Text
		Preferences	No	No	Manual	Text
		Physical Position	Yes	No	Measured	GeoData
Citizen Report Message Data		Assignee	No	No	Link	
		Pictures	No	No	Manual	Image
		Feedback	No	No	Manual	Text
		Reporter	No	No	Link	
		Incentive	Yes	No	Manual	Text
		Type	No	No	Manual	Enum
		Neighbourhood Element	No	No	Link	
Traffic Data		Type	No	No	Extern	Enum
		Delay	Yes	No	Extern	Numeric
		GeographicalData	No	No	Extern	GeoData
Energy Grid Connection		ConnectionType	No	No	Manual	Enum
		Elements	No	No	Link	

4 The Neighbourhood Information Model Service

In Deliverable D1.5 (D1.5 Report on validation site refined Neighbourhood Information Model, 2014) and in (Greifenberg, Look, Rumpe, & Ellis, 2014) we presented a first approach to a prototype of a future Neighbourhood Information System (NIS). The prototype can be configured by a DSL called NIM Data Format (NDF). The model corresponding to the NDF contains the data types and structures of the NIM. Thus, the NIM Service is able to store and read NIM Data transform it to the generic NIM and store it in a data base.

As introduced in detail in D1.5 (D1.5 Report on validation site refined Neighbourhood Information Model, 2014), the prototype has the following features and properties:

- *Extensibility @ runtime*: The prototype can be configured at runtime by adding new models in the NDF or changing existing ones.
- *Model Versions*: The prototype is able to manage different models of the same version
- *Mappings*: The prototype is able to map entities modelled in different NDF models
- *Access Control*: A role base access control mechanism is used to prevent unauthorized access to the neighbourhood data.

As mentioned before, the NIM service is based on this prototype. It uses the generated concrete services adapters (web services) to input the data, the provided data base functionality to persist the data and the generic NIM adapter, which is also a web service to access the stored data in the NIM format.

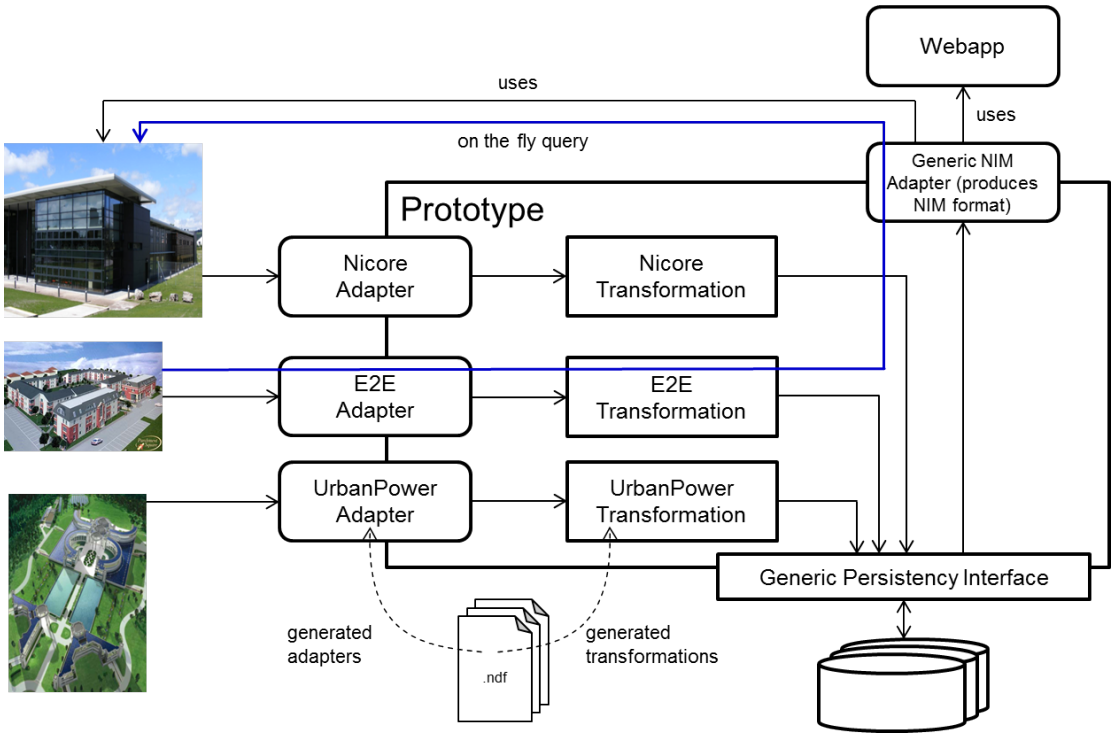

Figure 4: Overview of the NIM Service Components

Beyond using the prototype several extensions have been additionally implemented within COOPERaTE. The first extension is the necessary glue code, which enables querying the data from trial site platforms and forwarding it to the prototype using the generated trial site adapters.

Moreover, we provided a web GUI, introduced in D3.4 (D3.4 Report detailing integrated Services for Neighbourhood Management, 2014), for the purpose of demonstration. Developers of value added neighbourhood services can get an impression on how the trial site data looks after the conversion into the NIM format. The GUI uses the generic NIM Adapter to access the stored and transformed data and can display the data on demand.

The last additional feature the NIM service was extended to provide on the fly transformation of trial site data. The generic NIM Adapter was extended to provide the possibility to trigger the on the fly transformation. Moreover, a restructuring of the components was performed to enable on the fly transformation within the prototype. Thus, the available transformations could be reused, which has the advantage that already tested code is used in another scenario. This led to code in higher quality and reduced development and test effort for the integration of the new feature. In Figure 4 the on the fly variant of the service is marked as blue arrow. The service queries data from E2E and returns data in the NIM format that is read and further processed from the management system of parchment square.

5 Conclusion

As a subsequent deliverable of Deliverable 1.2 (D1.2 Report detailing Neighbourhood Information Model Semantics, 2013) and Deliverable 1.5 (D1.5 Report on validation site refined Neighbourhood Information Model, 2014) the outcome presented here is the outcome of a refinement process throughout the project. Thus the final model versions have been presented

Section 3 gave a comprehensive overview of the NIM meta-model as well as the COOPERaTE Neighbourhood Information Model. References have been provided to detail certain design decisions and discussions that occurred during the refinement process.

Section 4 presented an implemented prototype serving as an idea of a future NIS. The prototype can handle on the fly queries, as well as queries resolving persistent data. Additionally adapters can be generated out of certain models.

Summarizing we presented a data model that is easily extensible, able to integrate different data sources via a mapping language and enables the COOPERaTE SoS approach.

6 References

D1.1 Report on Requirements and Use Cases Specification. (2013). *COOPERaTE Control and Optimisation for energy positive Neighbourhoods.*

D1.2 Report detailing Neighbourhood Information Model Semantics. (2013). *COOPERaTE Control and Optimisation for energy positive Neighbourhoods.*

D1.2 Report detailing Neighbourhood Information Model Semantics. (2013). *COOPERATE Control and Optimisation for energy positive Neighbourhoods.*

D1.5 Report on validation site refined Neighbourhood Information Model. (2014). *COOPERaTE Control and Optimisation for energy positive Neighbourhoods.*

D3.1 Report on the Accessible Energy Data. (2012). *SEMANCO Semantic Tools for Carbon Reduction in Urban Planning, Project ICT 287534.* http://semanco-project.eu/index_htm_files/SEMANCO_D3.1_20120921-1.pdf. Retrieved from Deliverable 3.1: http://semanco-project.eu/index_htm_files/SEMANCO_D3.1_20120921-1.pdf

D3.4 Report detailing integrated Services for Neighbourhood Management. (2014). *COOPERaTE Control and Optimisation for energy positive Neighbourhoods.*

Greifenberg, T., Look, M., Rumpe, B., & Ellis, K. (2014, 09). Integrating Heterogeneous Building and Periphery Data Models at the District Level: The NIM Approach. *3rd Workshop on eeBuilding Data Models (eeBDM)*. Vienna, Austria (to appear).

7 List of Figures