Chapter 18
A Use Case for Ontology Evolution and Interoperability: The IEC Utility Standards Reference Framework 62357

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EXECUTIVE SUMMARY

Within this chapter, the authors provide two use cases on semantic interoperability in the electric utility industry based on the IEC TR 62357 seamless integration architecture. The first use case on semantic integration based on ontologies deals with the integration of the two heterogeneous standards families IEC 61970 and IEC 61850. Based on a quantitative analysis, we outline the need for integration and provide a solution based on our framework, COLIN. The second use case points out the need to use better metadata semantics in the utility branch, also being solely based on the IEC 61970 standard. The authors provide a solution to use the CIM as a domain ontology and taxonomy for improving data quality. Finally, this chapter outlines open questions and argues that proper semantics and domain models based on international standards can improve the systems within a utility.
BACKGROUND

In the electric utility domain, several changes impose new requirements on the IT infrastructure of companies. In the past, the generating structure used to be very close aligned to the communication infrastructure. Electric energy was delivered top-down from the high voltage grid having large-scale generation attached to the lower voltage grid and the households. The corresponding communication infrastructure was arranged similar, as steering information be mainly passed down the vertical supply chain while data points from the field level were submitted to the SCADA (Supervisory Control and Data Acquisition System).

With the upcoming distributed power generation respectively the legal requirements imposed by federal regulation and the resulting unbundling, things have changed a lot. On the one hand, deploying new generation facilities like wind power plants or fuel cells, energy is fed into the grid at different voltage levels and by different producers – former customers having their own power generation can now both act as consumers and producers, which feed into the utilities’ grid. Therefore, the communication infrastructure has to be changed. On the other hand, the legal unbundling leads to separation of systems, which have to be open to more market participants. Hence, this results in more systems that have to be integrated and more data formats for compliance with the market participants - the overall need for standards increases. This problem must be addressed by an adequate IT-infrastructure within the utility, supported by architectures like SOA (Service-oriented Architectures). Regarding this scope, the IEC (International Electrotechnical Commission) has developed data models, interfaces and architectures (Robinson, 2002) for both running the power-grid and automating the attached substations. Unfortunately, those standards have been developed by different working groups and therefore lack some harmonization although they have to be used in context (Uslar, 2006). Furthermore, the semantic techniques imposed by the CIM are not properly used. This contribution shows a possible solution for an integration based on semantic techniques for two use cases we would like to address, first general semantic ontology integration and second data quality management based on meta annotation.

The following contribution is as structured as follows. First, we give a brief introduction into the IEC TC 57 standards framework in Section 2 with a special focus on the two biggest domain ontologies available in the IEC TC 57 reference framework, the IEC 61970 family for IT integration with SCADA and the IEC 61850 family dealing with substation and distributed energy generation automation. We show the basic metrics for the two ontologies and excerpts on how they were developed and how their OWL serializations look like.