A model-driven approach for data-centric IoT applications

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Abstract. IoT data requires a formal modelling and implementation process to ease its integration, analysis and exploitation in Business Intelligence and Big Data systems. Consequently, we present STS4IoT in this work, a model-driven approach to design and develop data-centric IoT applications proposed in Plazas et al. (2022).

1 STS4IoT Proposal

The Internet of Things (IoT) has become a valuable data source for Business Intelligence (BI) and Big Data systems. It can collect, process and provide digital samples of relevant objects and phenomena in different spatial and temporal dimensions. BI and Big Data systems can exploit this data to extract valuable insights and improve decision-making (Saggi and Jain, 2018). However, IoT usually produces highly variable, heterogeneous and stream data that challenges traditional data analysis systems (Qin et al., 2016).

In this context, model-driven frameworks such as the Model-Driven Architecture (MDA) can define a standard design and implementation process for IoT data to ease its integration into BI and Big Data systems (Teixeira et al., 2017). Consequently, we proposed an MDA-based approach for modelling and developing data-centric IoT applications named STS4IoT (Plazas et al., 2022). STS4IoT models IoT systems in two abstraction levels separating the data requirements from the implementation choices and generating implementable code to provide the designed data.

STS4IoT considers three sets of concepts in its constructions:

1. **Data representation at sensor-level:** The *type of sensed variable* (*e.g.* temperature) since each variable has particular usage purposes and sources. The *temporal validity* of the data since new values are always sensed and transmitted. In this sense, the temporal validity depends on the *sensing* and *sending frequencies* . The *temporal transformations* that alter raw data (*e.g.* aggregations, conversions or filters) in a single sensor.

The *temporal windows* on which the operations can compute a finite set of data Gao et al. (2005).

2. **Data representation at network-level:** The capacity to define *composition associations* of data from different sources. The explicit representation of the *Join* of data streams from external (and internal) sources. The *spatial aggregations* that consider data from multiple locations for analysis. And the abstract representation of the *connected objects* to represent the data multiple points.
3. **MDA compliance:** *Focus on IoT data*. Additional concepts reduce readability and increase complexity. *Separation into different abstraction levels*, enabling each expert to focus on their systems' definition and implementation. Providing scope for *classical and IoT data integration* at the high-abstraction level, *i.e.* integrating IoT data into BI data models. Finally, an *automatic and error-free code-generation* process for different implementation options of the same data.

Different quality and implementation tests prove that STS4IoT can produce understandable models and executable code for various IoT platforms (Plazas et al., 2022). In this way, STS4IoT eases the generation, understanding and use of IoT data in BI and Big Data systems.

References

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Résumé

Les données IoT nécessitent un processus formel de modélisation et de mise en œuvre pour faciliter leur intégration, leur analyse et leur exploitation dans les systèmes de Business Intelligence et de Big Data. Par conséquent, nous présentons STS4IoT dans ce travail, une approche basée sur les modèles pour concevoir et développer des applications IoT centrées sur les données proposées dans Plazas et al. (2022).