

Modeling Lifecycles for the Establishment of the Machine-to-Everything (M2X) Economy

Type	Master Thesis
Credits	30

Description

The M2X economy is emerging and can be defined as the result of interactions, transactions, collaborations and business enactments among humans, autonomous and cooperative smart devices, software agents, and physical systems. The corresponding ecosystem is formed by automated, globally available, heterogeneous socio-technical e-governance systems with loosely coupled, P2P-resembling network structures and is characterized by its dynamic, continuously changing, interoperable, open and distributed nature. Thereby, the M2X Economy employs concepts such as cyber-physical systems, the Internet of Things, and wireless sensor networks. Current lifecycle models to manage such cases of an M2X economy are given in a so called Colored Petri Nets (CPNs) that have deficiencies in that ontological clarifications are missing. On the other hand, other modeling notations could be more suitable at this point than CPNs, e.g., Discrete Event Process Modelling Notation (DPMN) models. Based on a list of capabilities that are desirable for modeling, simulating and analyzing M2X economy scenarios, both approaches are to be compared with each other. In addition to protocol specification and safety analysis, also the design of specific M2X economy systems and the analysis of their performance characteristics are of interest.

The recent position paper about the M2X economy [1.] is preceded by a corresponding PhD thesis [2.] that contains the CPN lifecycle models. Furthermore, a book about DPMN [3.] is also backed by ongoing research work.

The models underlying the lifecycle management for the M2X economy are currently given in CPN, which may pose to be a bottleneck for future developments. Instead, conducting M2X economy related research using alternative modeling notations such as DPMN, may open new opportunities for novel research results. In particular, a modeling and simulation methodology tailored to M2X economy systems is needed for designing specific systems and analyzing their performance characteristics.

This master thesis focuses on a comparative modeling effort to explore with alternative notation means the lifecycle management for the M2X economy. Consequently, the benefits and disadvantages of employing different modeling notations such as DPMN versus the pre-existing CPN models must be studied

diagnostically for advancing the core concepts of the M2X economy, such as the inherent lifecycle management and a methodology for designing M2X economy systems.

With the results of the master thesis, we aim to provide more suitable modeling representations for the M2X economy versus the currently only CPN-models based version. This way, the master thesis also aims to generate tangible contributions to the emerging research domain, aka the circular economy.

Prerequisites

1. Colored Petri Nets (CPNs)
2. A general understanding of Blockchain technology

Tasks

1. Understand the lifecycle models expresses in CPN for the M2X economy and choose a focus subset model.
2. Express in DPMN the chosen CPM subset model.
3. Critically compare the advantages and disadvantages of CPN versus DPMN.
4. Express a methodology for rapidly designing with DPMN systems for the M2X economy.

Resources

1. Leiding, Benjamin, Priyanka Sharma, and Alexander Norta. "The Machine-to-Everything (M2X) Economy: Business Enactments, Collaborations, and e-Governance." *Future Internet* 13, no. 12 (2021): 319. <https://doi.org/10.3390/fi13120319>
2. Leiding, Benjamin. "The M2X Economy-Concepts for Business Interactions, Transactions and Collaborations Among Autonomous Smart Devices." PhD diss., Georg-August-Universität Göttingen, 2019. [eDiss](#)
3. Wagner, Gerd. "Business Process Modeling and Simulation with DPMN." (2021). [Research Gate](#), <https://dpmn.info>

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