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Introduction to the special issue of the 16th ACM workshop on Adaptive and Reflective Middleware (ARM)

Computation is now progressively integrated into the physical networks in a seamless way that enables cyber-physical systems (CPS) and the Internet of Things (IoT) to provide a fabric of smart devices around us. In this new paradigm of social dispersed computing, the boundaries between the network node, the sensor and the actuator are blurring, driven primarily by the computational power of IoT nodes and smartphones [1]. A crucial requirement for these systems is that they must tailor and adapt their behavior and properties to increasing levels of dynamism and unprecedented scales ranging from smart home systems to smart traffic lights to Industry 4.0. The foundation of these systems is being built upon middleware technology ranging from communication middleware like DDS, MQTT, OPC/UA, KAFKA, etc., and computation middleware like SPARK or STORM, among others.

Applying reflective techniques opens up these middleware and related software platforms for interoperability and one-to-many deployment. Such adaptability has proven particularly successful and influential in the past. However, there are still open challenges, such as scalability and decentralized management as well as resilient real-time operations that require further investigation to address new use cases in large deployment contexts, especially in diverse domains as transportation and smart grids.

In this special issue, we include three publications that are extended versions of papers, which appeared in the 2017 instance of the Adaptive and Reflective Middleware (ARM) workshop. These papers provide a sample of critical research going on in this community.

The first paper “An Adaptive IoT Platform on Budgeted 3G Data Plans” [2] describes the constraints and adaptations that an online middleware has to support as we deploy these systems in geographically dispersed areas. Special attention paid in this paper about reducing the communication costs is crucial to urban planners and city governments. The second paper “InfraComposer: Policy-driven Adaptive and Reflective Middleware for the Cloudification of Simulation & Optimization Workflows” [3] fills in the important gap of answering questions related to the design and deployment of engineering analytics that might be required to make sense of the large data sets being collected from our communities. The third paper, “Lightweight Formalisation of Adaptive Middleware” [4] presents formal semantics which can be used to generalize the concept of adaptive middleware and provide a theoretical framework to compare the different implementations that are available.

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