Towards Integration of Uncertain Sensor Data into Context-aware Workflows

Matthias Wieland¹, Uwe-Philipp Käppeler², Paul Levi³,
Frank Leymann¹, Daniela Nicklas³

¹Institute of Architecture of Application Systems, Universität Stuttgart
Universitätsstraße 38, 70569 Stuttgart, Germany

²Institute of Parallel and Distributed Systems, Universität Stuttgart
Universitätsstraße 38, 70569 Stuttgart, Germany

³Department of Computer Science, Carl von Ossietzky Universität Oldenburg
Escherweg 2, 26121 Oldenburg, Germany

The integration and usage of uncertain sensor data in workflows is a difficult problem. In this paper, we describe these difficulties that result from the combination of very distinct areas. On the one hand, applications from area of measurement engineering manage sensors that capture data and annotate the data with technical meta data. On the other hand, context-aware workflows from the BPM area place high-level requirements for the quality of context data that is derived from the sensor data. Between those two areas exists a gap that has to be closed by a context management and mediation system, supporting the handling of Quality of Context (QoC). The straightforward solution would be to use the sensor data and QoC meta data directly in the workflow. However, this is not a practical solution because workflows are typically modeled by domain experts and not by technical experts. Despite the fact that sensor quality descriptions are often complex and hard to understand, domain experts would prefer to use simple percentage values for the attributes they are interested in (e.g., actuality, correctness, ...), or even only want to specify an overall required minimum quality for the used context data in the workflow.

To achieve the integration of uncertain sensor data in workflows, our paper presents a QoC aware architecture based on an extension of the existing Nexus Platform and a first approach for matching the workflow requirements with the sensor annotations. Furthermore, we present a multi-level architecture that first gathers and processes uncertain sensor data, second matches the available data with the declared needs of a workflow execution (expressed by policies), and last executes quality of context-aware workflows on the top-most level. By Web Service conventions, non-functional requirements are typically expressed by the service requester using policies. In addition, the service provider expresses its capabilities with policies. Then a middleware, e.g., an enterprise service bus intersects both policies and calculates the effective policy. If both partners (the workflow and sensor-service) agree on that effective policy, this is like a contract between them and every following interaction has to adhere to that contract. We adapt this general approach for our solution.