Evaluation of the Smart Space Approach in Mobile Data Processing

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Abstract

The next generation of applications will involve many mobile participants as end users with multiple devices from multiple vendors. Lausanne Data Collection Campaign provided a rich mobile phone data set on which such applications can be evaluated. This demo implements a scenario that operates with these data. We focus on the data processing performance of Smart-M3 platform. Our experiments evaluate the appropriateness of the smart spaces approach for application development.

Index Terms: Smart-M3, Mobile phone data, Performance evaluation.

The smart spaces approach states that the next generation of applications can be constructed on the basis of a common informational environment where heterogeneous participants dynamically share multi-source multi-domain data [1]. This approach is implemented in the Smart-M3 platform [2]. There exist "proof-of-concept" applications that show the architectural eligibility of Smart-M3 [3]. In this demo, we focus on performance evaluation of Smart-M3 applications when they have to operate with huge collections of dynamic user data.

The Lausanne Data Collection Campaign collected behavior traces of people in their everyday lives [4]. It suits as comprehensive test data for Smart-M3 applications. Smart-M3 requires that data of instant interest are transformed into ontological (RDF) representation and shared in the smart space. Over the time different data can be of interest, changing the smart space content dynamically. For mobile services, the data flows and their Smart-M3 processing include collecting data from the users, analyzing the recent data sets to derive new knowledge, and feeding these abstractions back to the service users, see Figure 1.

We investigate the following recently open questions. (A) Is it possible to apply ontological (RDF/OWL) approach of Smart-M3 to operate with huge multi-person data amounts? (B) Is it possible with the Smart-M3 SDK to effectively implement such applications (rapid development in problem-domain terms)?

We tackle question (A) with the multi-ontology interoperability property of Smart-M3. Application needs a small part of huge data. It can be described with a small ontology. Question (B) is a consequence of (A). The application code becomes ontology-dependent. Hand-made solutions with customized data structures and methods are inefficient. We apply the ontology library code generation approach of SmartSlog [5]. The code is generated for a given OWL ontology; the application logic is programmed on top of the generated code in ontology terms. Both questions need a set of test applications (as simple as possible for our first-look study) that play a role of benchmarks for the performance and demos for evaluating the possibility of operative deductive reasoning in large-scale smart environments.

We develop a demo "proximity meetings". Many mobile users publish their context information in the smart space. The demo implements Smart-M3 agents (KP clients) that imitate

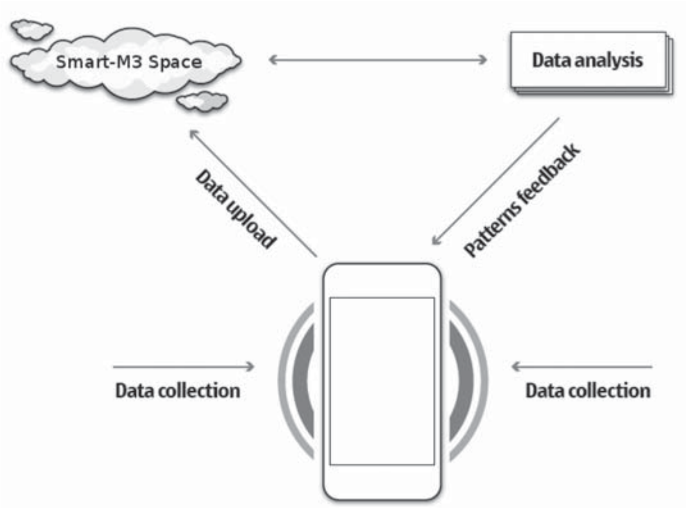

Fig. 1. Data flows and their processing in a Smart-M3 application.

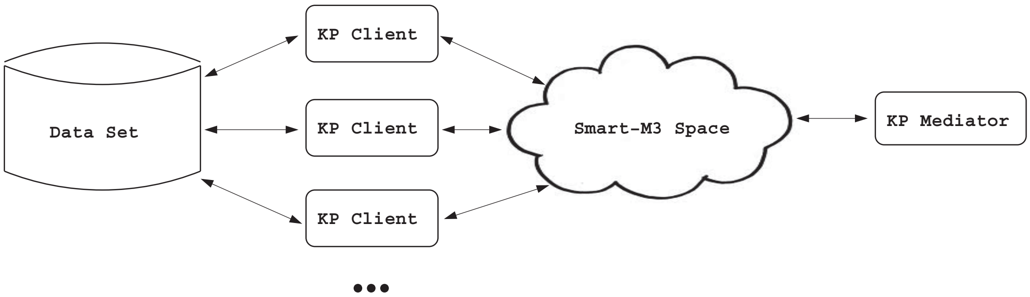

Fig. 2. High-level architecture a demo "proximity meetings".

the user activity over the time. Additional Smart-M3 agent (KP mediator) tracks the data in the space of detects when some users become close. In addition, other user information can be used, e.g., tracking users within a certain group. The data set (Lausanne Data Collection) provides complete information for this scenario: timestamps, GPS coordinates, gender, age, kinship, etc. The architecture is shown in Figure 2.

Our demo provides an extensive test set due to the large amount of data and their diversity. Since each KP client operates with small data set and ontology, the communication with the smart space is not expensive. The mediator performance depends on the reasoning complexity in the smart space (by Smart-M3 Semantic Information Broker) and the SmartSlog ontology library complexity in the data transformation between the low-level representation of Smart-M3 space and high-level representation of KP logic.

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