Issues of Applying Lightweight Semantic Web Services to Context Aware Services

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Abstract. Context-aware systems, which collect sensor data and provide useful information, have much potential as the sensors are increasingly used in various domains. In order to increase the availability of context-aware services, the services should be provided on the Web. Semantic Web Services provide a chance to increase the level of automation of the discovery and selection of services. This paper shows why lightweight Semantic Web Services, which are based on RESTful services, are appropriate for brokering context-aware services on the Web.

Keywords: Context-Aware Services, Lightweight Semantic Web Services, RESTful Services

1. Introduction

Context-aware systems, which collect sensor data and provide useful information, have much potential as the sensors are increasingly used in various domains. However, the lack of integration between the sensor networks often isolates important data streams [1]. Existing works of context-aware middleware focus on the collection and process of context within limited areas and platforms, and the protocol is also limited. Although some works provide compatibility, it is hard to overcome the problem of isolated sensor data and context. In order to overcome the problems, a new framework that enables access in the Web is required. That is, the bridge between physical sensor networks and the online world of the Web is essential in order to make context-aware services widely available. Moreover, the protocols used in service access and data exchange should be designed within the Web standards. Sensor Web is the representative research endeavor for connecting sensor networks and the Web. Among the research works of the Sensor Web, service oriented Sensor Web is designed to simplify the publication of, and access to, sensor resources [2]. However, there are still problems that it is heavy and complex.

In this paper, we want to explain the problems of current service oriented approach for context-aware services, and suggest requirements of a context-aware service brokering framework on the Web. Also, we show why lightweight Semantic Web Services are appropriate for context-aware services.

2. Issues of Applying Lightweight Semantic Web Services to Context-Aware Services

Semantics is required in order to enable software applications to automatically understand and process context data and services. Existing works are using semantics for only context data, not context services. Therefore, the automation of service discovery, integration and execution is not allowed. For example, semantic sensor web uses semantic metadata on sensor observations, but it does not support semantic metadata on context services.

In order to automatically discover and access context data provided as the form of services in the Web, we can use the Semantic Web Services [3] framework that is an extension of Web services. However, there are problems in implementing context-aware service brokering system based on the traditional Semantic Web Services approaches such as OWL-S [4] and WSMO [5]. Firstly, the existing approaches based on SOAP [6] are heavy. Coding and encoding of header and body are essential in the exchange of messages with SOAP, and this process is a burden on the context-aware systems which require fast responses. Secondly, implementation is a complex and tedious job. WSDL [7] for Web services description and ontology languages such as OWL-S and WSMO for semantic annotation of Web services are complex and hard to understand. Thirdly, the existing approaches are top-down modeling, so they require the definition of high-level ontologies providing expressive frameworks for describing Web services. In order to start from the various context-aware services in the Web, the bottom up approach is appropriate.

Based on the above problems, we suggest requirements of a context-aware brokering framework which provides context-aware services in the Web with automatic discovery and access of the services through semantics as follows:

First, the semantics should be annotated on the existing services on the Web without modifying the services. Second, the framework should support heterogeneous platforms by using Web standards. Third, implementation should be simple and intuitive. Fourth, software applications should be able to automatically discover and process context-aware data by supporting semantics. Fifth, it should support mash-up by enabling applications to automatically integrate through semantics.

In order to satisfy the above requirements, we suggest that context-aware brokering framework should deploy lightweight Semantic Web Services, which is an appropriate framework for the requirements. Firstly, it supports RESTful services [8] that are light and appropriate for context-aware systems. Secondly, hRESTS and MicroWSMO [9] simplify semantic annotation based on the minimal service model, so the implementation is also simple and intuitive. Moreover, they minimize the

modification of existing service and HTML description because they are built on HTML description. Another merit of lightweight Semantic Web Services is that it is a bottom-up model, which adopts an incremental approach to adding semantics to existing Web services standards.

3. Conclusion

We explained the problems of current service oriented approaches for context-aware services. Also, we suggested requirements of context-aware services on the Web, and showed why lightweight Semantic Web Services were appropriate for brokering context-aware services on the Web.

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