Model, Properties, and Applications of Context-Aware Web Services

Stephen J.H. Yang¹, Jia Zhang², Angus F.M. Huang¹

Abstract Context-aware Web services is a seamless interaction between service requestors and services considering both contextual requirements of services and contextual conditions of the service requestors. We envision that providing context-aware Web services is the first step toward the ultimate goal of e-services by delivering right services from right partners at right time. This chapter aims for the models, properties, and applications of context-aware Web services by developing an ontology-based context model, and identifying context-aware applications as well as their properties. We have developed an ontology-based context model to enable formal description and acquisition of contextual information pertaining to service requestors and services. The context model is supported by context query and phrased acquisition techniques. We will also report three context-aware applications built on top of our context model as a proof-of-concept to demonstrate how our context model can be used to enable and facilitate in finding right services, right partners (collaborators), and right information (content presentation).

12.1. Introduction

One of the essential goals of the Web services technology is to help service requestors dynamically discover and locate desired services. However, the lack of taking contextual information into account usually leads to low-recall, low-precision and irrelevant results using current services discovery techniques. For example, if a service requestor is using a wireless phone as a receiver, delivering a desktop-based application may not be appropriate; if a service requestor is in a meeting, delivering an audio-based application may also be undesirable.

¹ Department of Computer Science and Information Engineering, National Central University, No. 300, Jhongda Rd., Jhongli City, Taoyuan County 320, Taiwan
² Department of Computer Science, Northern Illinois University, 1425 W. Lincoln Hwy., DeKalb, IL 60115-2825, USA

The objective of context-aware Web services provision is to enhance Web services provision a step further from providing services at anytime anywhere toward at the right time and right place with right services. As people are constantly on the move in nowadays heterogeneous working environment, resources (e.g., computational devices and communication network coverage) are more frequently prone to change due to physical location changes. Therefore, in the process of a service consumption, a service requestor may need to smoothly switch to different levels of services or even different services to adapt to the ever-changing environment (i.e., context), especially when a gross mismatch between resource requirements and supplies occurs. Meanwhile, people tend to continue to work on the move. Thus, more and more handheld devices (e.g., Personal Digital Assistants (PDAs) and mobile phones) have been used to access Web services via mobile communication. Nevertheless, most of the existing Web services are not originally designed for handheld devices. As a result, tools and mechanism are needed to provide users opportunities to experience transparent and seamless services provision.

Context-aware services provision is a mechanism enhancing Web service accesses based on users’ varying characteristics and situated environments. In a mobile environment, users usually work with handheld devices, which are featured with good mobility but limited computational capabilities and display sizes. In addition, users’ access conditions change more frequently in a mobile environment than in a traditional Web-based environment [1]. For example, users may need to access Web services while they are driving or in a meeting. Therefore, to achieve the goal of context-aware Web services, it is essential to provide personalized and adaptive services according to users’ situated environments. In this chapter, the two terms “users’ situated environment” and “context” are used interchangeably, both referring to surrounding information, from either service requestors or services, which may impact service execution including computational devices, communication network, lighting, noise level, location, activity, and time [2][3]. We summarize the characteristics of context-aware Web services and their requirements in the following eight aspects: mobility, location awareness, interoperability, seamlessness, situation awareness, social awareness, adaptability, and pervasiveness.

1. **Mobility**: The continuousness of computing capability while moving from one position to another. Requirements include mobile computing on portable devices with embedded software.

2. **Location awareness**: The capability of detecting and identifying the locations of persons and devices. Requirements include outdoor positioning and indoor positioning.

3. **Interoperability**: The capability of interoperable operation between various standards of resource exchange and services composition and integration. Requirements include standards of content, services, and communication protocols.