POSTER

Adaptive OSGi-Based Context Modeling for Android

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Abstract. Although contextual information is recognized as a foundation of self-adapting software, context modeling middleware is often prohibitively complex and limited to small-scale deployments. To mitigate this complexity, we are developing Dynamix, a wide-area context modeling approach for Android. Dynamix simplifies context-aware application development through an extensible, OSGi-based framework that runs as a background service on a user’s Android-based device, modeling context information from the environment using the device itself as a sensing, processing and communications platform. Context modeling is performed by a tailored set of plug-ins, which are dynamically provisioned to the device over-the-air during runtime. User privacy is maintained by a user-configurable context firewall. This poster introduces Dynamix’s OSGI-based context modeling approach.

Keywords: Ubiquitous computing, Context-awareness, Middleware, OSGi, Android, Component integration, Reusability, Over-the-air provisioning.

1 Introduction

The rapid adoption of smart-phones, tablet computers and net-books has paralleled a dramatic increase in the usage of mobile data applications (or “apps”). As apps become unmoored from the preconceptions of conventional desktop computing, mobile users expect them to adapt intelligently and fluidly across a broad range of everyday situations, execution environments and device platforms. However, although contextual information is widely recognized as an essential foundation of self-adapting software, context modeling and management middleware is often prohibitively complex and limited to small-scale deployments [1, 2]. As a consequence, mobile app developers transitioning from enterprise and desktop scenarios face significant (and often prohibitive) complexity when creating context-aware apps.

Over the last decade, a variety of approaches have been devised to help insulate developers from the demands of context modeling and management [3]. Recently, interest in wide-area context-awareness has generated a variety of techniques that model preexisting sources of environmental information using the capabilities of the user’s mobile device [4]. In such scenarios, adaptive middleware is often used to provide various functionality [5], including sensor abstraction; context modeling and representation; service discovery and binding; and others. Unfortunately, existing
adaptive middleware technologies (e.g., OSGi [6]) have been difficult to deploy on most mobile platforms.

The explosive rise of Google’s Android platform is providing a foundation for domain-specific mobile middleware based on OSGi. Briefly, OSGi defines a comprehensive dynamic module system for Java, whereby software functionality is encapsulated within distinct logical units – called Bundles – that contain both executable software and metadata. In an OSGi-based application, Bundles are dynamically woven together at runtime using an OSGi Framework implementation (OSGi container). In terms of OSGi deployment, Android overcomes previous mobile platform limitations though a software stack that supports multitasking (including long-lived background processes), a comprehensive inter-process communication model and broad Java compatibility. Several recent projects [7-9] have demonstrated that Android can be effectively used as the foundation of context-aware applications. These projects benefit from Android’s broad device support and extensive user base; however, Android developers still lack comprehensive, wide-area support for sensing, modeling, representing and provisioning context information.

Towards this end, we’re developing a wide-area context modeling approach for Android, called Dynamix. The foundation of Dynamix is an extensible middleware framework, which runs as a background service on a user’s device, modeling context information from the environment using the device itself as a sensing, processing and communications platform. Context modeling is performed by a tailored set of plug-ins, which are packaged as OSGi Bundles and provisioned to the device over-the-air (OTA) during runtime. Context plug-ins are used to insulate app developers from the complexities of context modeling, which often involve specialized domain knowledge. Figure 1 provides a high level overview of the Dynamix infrastructure.

Fig. 1. Overview of the Dynamix Infrastructure