Ubiquitous Service-Oriented Architecture

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Introduction

The personal mobile devices enable people to work or entertain themselves while on the move. The portable nature of mobile devices offers anywhere, anytime access to the functionality provided by the device. In addition, computers have been recently embedded in the user's physical environment and integrate seamlessly with their everyday tasks. We believe that by establishing collaborative relationships between mobile computing devices and environmental computing devices, it becomes possible for users to obtain the best of both worlds. They get the advantages of mobile devices, such as the portability, sole ownership and privacy, as well as the advantages of the richer set of capabilities of non-mobile environmental devices, such as large display sizes, better input devices, and access to abundant computing, storage and communication resources. In this paper, we propose a pattern, that we called ubiquitous service-oriented architecture (U-SOA), to enable users to establish collaborative relationships between their personal mobile devices and environmental devices available for their use. The proposed service oriented architecture enables mobile users find themselves in environments rich in services that their mobile devices can leverage.

Architecture Overview

Central to the U-SOA is the concept of ubiquitous service zone, which is a physical space where several environmental devices and their services are available for use by mobile devices. The ubiquitous service zone can be assumed to consist of computing devices that are much more powerful compared to the mobile devices that people carry. Examples of such spaces may be a meeting room, a bus/train station, a section of an airport, or a shopping/entertainment mall complex, etc. The ubiquitous service zones can be configured in controlled and relatively stable environments, such as homes, or public areas that experience a high density of mobile users.

Discovering and using the services should be intuitive and readily apparent to users. As users continue to use a Web browser to look at and interact with all the information on the World Wide Web for long time they become more familiar with the placement and the operation of the input controls on their Web browser. We would like to leverage this acquired familiarity on the part of the users to give them easier access to other devices in their environment. In such a device collaboration environment, a mobile user should be able to discover services that she wants to use in her vicinity via Web browser. In the legacy Web infrastructure, to retrieve a particular Web resource, the Web browser attempts to communicate over the Internet directly to the Web server farm housed in Content Service Provider. However, in the U-SOA environment, a mobile user should be able to access and consume the services provided by the legacy Web and the environmental devices in a seamless manner.

Figure 1 shows the proposed deployment of the U-SOA. As shown in Figure, the U-SOA is based on the interactions between three primary elements: zone service proxy, environmental device cluster, and mobile devices. The zone service proxy can be thought of as an intermediate system offering a collection of services listed below to the mobile devices that transit a service zone.

- Service registration and query

  Registration and discovery of services in a ubiquitous service zone is simplified by the existence of the zone service proxy. The zone service proxy provides a centralized registration service where different environmental services register themselves. Mobile devices can query the zone service proxy to discover these services.

- Session management

When the user of a mobile device discovers that there are services in the zone that are value to it, and that these services are currently available, she can request the zone service proxy to enable her device to use these services. When requested by a mobile device, the zone service proxy sets up a session where the requested subset of the zone services is reserved for the requesting mobile device.

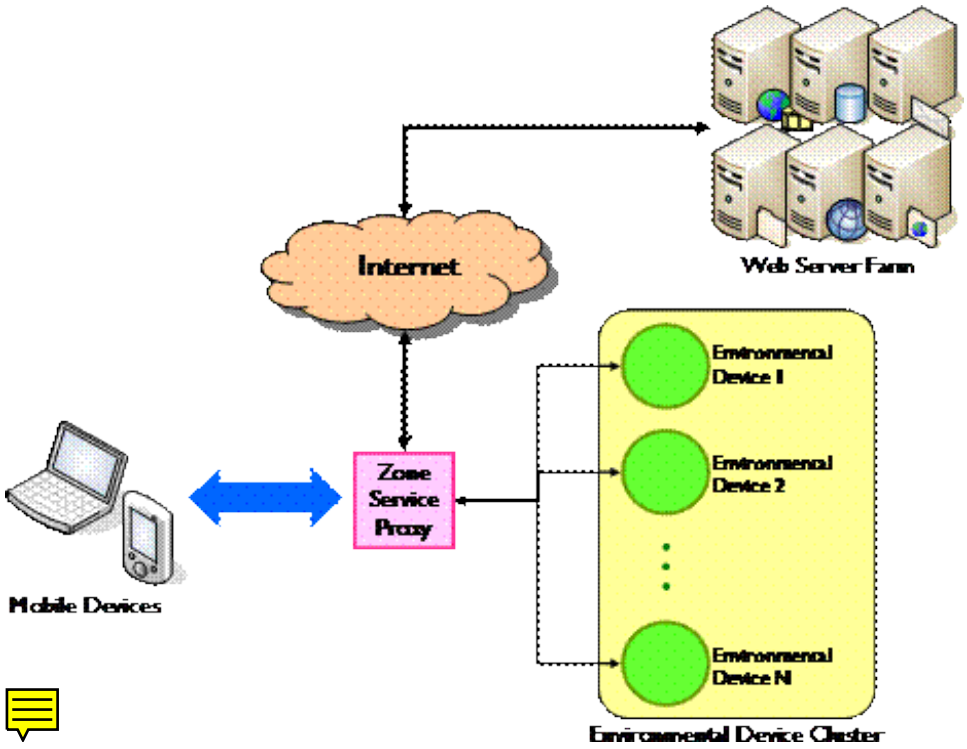

Fig 1. Ubiquitous service-oriented architecture

In the U-SOA, all functional units that are deployed in an environmental device and visible for mobile devices to invoke or consume over the network are modeled as services. That is, all the device capabilities that can be shared with other devices are designed as services to be consumed over a network. Therefore, the focus of design is the service's interface. Because U-SOA is focused on building services using components with well-defined interfaces, it allows devices to be loosely coupled with each other. To realize this, we propose to use Web Services for inter-device communication and XML-based description languages for describing device capabilities and other elements of the U-SOA.

Concluding Remarks

We have presented the importance of introducing a service-oriented architecture in ubiquitous device collaboration environment. As discussed earlier, the focus of the U-SOA is on the creation of flexible and extensible interfaces that are agnostic to networking technologies and runtime frameworks. We believe that the U-SOA should be made an integral part of Ubiquitous Web technology.