Deployment Experience Toward Core Abstractions for Context Aware Applications

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Abstract. Despite progress in the development of context aware applications and supporting systems, there is still significant diversity in the models and abstractions they expose. This work describes an effort to gain a better understanding of the situation and develop a core set of abstractions by deploying several context aware applications, using a rapid prototyping platform. From this experience we propose and demonstrate a set of abstractions shown to be useful for a range of context aware applications. Combined with a survey and analysis reported elsewhere [1] we then provide an analysis toward providing a core set of abstractions that we argue can be used as the basis for modeling many context aware systems, including not only context, but other aspects such as entities, their relationships and associated events, services and content. We then provide several practical lessons learned from the use of our model and abstractions during analysis and our iterative platform development process.

1 Introduction

Despite significant experimentation and deployment of context aware platforms and applications over the last 15 years, there is surprisingly little agreement on core abstractions and models for such systems. Individual research groups have developed abstractions suited to their application or research target [2-5] and often built bespoke systems to implement these [6-12]. While there is some overlap in the models and abstractions they have developed, there is also significant diversity. In an attempt to understand this situation, and in particular to try and develop a core set of common abstractions for context aware applications, we have, over the last two years, taken a dual research approach. First, we have surveyed and analyzed a set of key ubicomp systems with a goal of identifying abstractions and models in support of context aware applications. Secondly, and in parallel, we have implemented and deployed a set of context aware applications using a rapid prototyping platform with a goal of using practical experience to design, experiment with and validate core abstractions and models suitable for a range of context aware services. We have reported on the survey and analysis elsewhere [1]. This paper reports on our experiences developing
and deploying four context aware applications and the underlying evolution of our platform as we improve our abstractions and model.

Our work has been carried out within the framework of the Mobile Multimedia urban shared experience (MUSE) project, a multi-disciplinary research project focused on exploring mobile multi-media services suitable for an urban environment. A key aspect of this project is its use of context aware services and its focus on real-world deployments [13]. To date Mobile MUSE has explored a variety of services deployed using traditional carrier networks as well as experimental WiFi based infrastructure and WiFi enabled cell phones. These include location aware games [14, 15] context aware tourist guides [16], tagging and folksonomy applications [17] as well as local event support services such as location based film festival services. Although Mobile MUSE has a strong technology and deployment focus it also includes significant research on business and sociological aspects of context aware services [18]. Within Mobile MUSE, the work of the MAGIC lab at the University of British Columbia (UBC) has primarily been to explore advanced services that exploit broadband wireless networks. As a basis for this research, we have developed the MUSE context aware platform (MUSEcap) and deployed a variety of services across the UBC WiFi network, one of the largest campus WiFi networks in North America with over 1700 access points.

1.1 Background and Motivation

While there have been many research applications and systems developed for places such as tourist destinations [19], campuses [20], meeting rooms [21], homes [9], and hospitals [22], there has been little consensus on the high level abstractions exposed to context aware applications from supporting platforms. With the wide variety of research and commercial systems available, using the same system for all context aware application domains is not realistic. One environment may differ significantly from another in terms of the entities (people, places and things) and the capabilities such as context, and services available. Researchers have justifiably proposed and built systems deemed important for different context aware application types and paradigms.

That said, when the same systems are used in different situations, practitioners have shown it is possible to seamlessly move user tasks between domains allowing them to make use of resources there [11]. However, given the variety of systems available and their specialization for different domains, using the same system in all places is not realistic. To address this, practitioners have demonstrated that data and control level interoperability can be achieved using various techniques. For example, the use of an intermediary such as the Patch Panel [23] to transform control messages as they flow through the iROS Event Heap [3] has been shown to be useful in addressing control flow interoperability. Component oriented systems like Obje/SpeakEasy [5] and the Equip Component Toolkit [24] have shown that the use of a small, standard set of component interfaces with mobile code or the use of component properties can allow users to configure components to interoperate. Friday et al [25] demonstrated the provision of an abstraction layer on top of heterogeneous