

Chapter 20

Schedule-Aware Transactions for Ambient Intelligence Environments

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ABSTRACT

In this paper, the authors investigate the concept of designing user-centric transaction protocols toward achieving dependable coordination in AmI environments. As a proof-of-concept, this paper presents a protocol that takes into account the schedules of roaming users, which move from one AmI environment to another, avoiding abnormal termination of transactions when users leave an environment for a short time and return later. The authors compare the proposed schedule-aware protocol against a schedule-agnostic one. Findings show that the use of user-centric information in such situations is quite beneficial.

INTRODUCTION

The rapid emergence of novel technologies in the fields of mobile computing and networking fostered the transition from conventional distributed systems to mobile computing systems that consist of fixed and mobile devices (such as PDAs, Pocket PCs, smart-phones), which collaborate through wireless networking infrastructures. Going one

step further, the vision of *Ambient Intelligence (AmI)* investigates the possibility of realizing mobile computing environments that are aware and responsive to the presence of people (Aarts, Harwig, & Schuurmans, 2003; Weber et al., 2003). AmI is based on Weiser's pioneer work on ubiquitous computing (Weiser, 1991), which evolved later on to the concept of pervasive computing. Pervasive computing aims at a digital world, consisting of interconnected electronic devices that support the quotidian activities of people. AmI is

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particularly concerned by the users' experience in such a digital world. In other words, AmI puts a specific focus on the users and targets the development of *user-centric digital environments* that account for the users' needs, habits and satisfaction, while offering support that allows them to perform their everyday activities.

The vision of AmI motivates research towards coordination protocols that involve both mobile and fixed entities. In this paper, we particularly investigate the need for designing *user-centric transaction protocols* to achieve dependable coordination in AmI environments. *User-centric information can be exploited while coordinating a set of transaction participants towards avoiding abnormal transaction terminations.*

In this context, we focus on the abnormal ending of a transaction that takes place within an AmI environment, due to the fact that *one or more participating users leave the environment*. Leaving the environment means that the users' devices are no longer reachable, via the networking infrastructure that supports the transaction coordination. The idea behind our approach is that *if there is a certain level of knowledge behind the schedule of each participating user (i.e., the way the user moves from one environment to another), then we can exploit it to avoid abnormal transaction terminations, where a roaming user leaves the environment for short, only to return later.*

Taking a simple example, consider a conference that takes place in a number of conference rooms. Several researchers attend a technical session in conference room A (i.e., environment A). In this situation, a number of colleagues want to arrange a meeting for dinner or work after the technical session. One of them browses, using his Pocket-PC, information regarding available meeting places. His goal is to book a place at a certain time and insert a dinner meeting in the agenda applications that execute on his colleagues' laptops or Pocket-PCs. Obviously, setting up the dinner meeting involves performing a distributed transaction amongst the mobile devices that host

the agenda applications. The transaction requires each participant's agenda application to execute a local transaction and verify that there are no other obligations of the participant at the meeting time. This task might take a certain amount of time to complete. Assume now that during this time period, one of the participants leaves the gathering before the transaction completes, because his talk starts at conference room B (i.e., environment B). In such a situation, typical transaction protocols would abort the transaction, wasting thus the energy resources that were spent up to this point. Nevertheless, the transaction may have a chance for successful completion if we consider that the colleagues shall reunite after the coffee break. Hence, if the transaction protocol could be enriched with such kind of user-centric information (i.e., the users schedules) and reason with respect to this information, all the work that has been performed for fixing the dinner meeting would not be wasted.

Based on the previous discussion, *the contribution of this paper consists of designing a schedule-aware protocol and comparing it against a schedule-agnostic one.* Specifically, in Section 2 we present the necessary background and state-of-the art for this paper. In Section 3 we detail the proposed protocol. In Section 4, we present our experimental results. Finally, in Section 5 we summarize our contribution and provide insights for future work.

1. RELATED WORK AND BACKGROUND

The overall idea of user-centric transaction protocols and the particular protocol discussed in this paper fall in the general field of mobile transactions (Pitoura & Samaras, 1998; Serano-Alvarado, Roncancio, & Adiba, 2004). Until now there have been various approaches for mobile transactions that can be classified with respect to the system model that they assume into 3 different categories

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