Enabling ad-hoc collaboration between mobile users in the MESSENGER project

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Abstract This paper discusses how ad-hoc collaboration boosts the operation of a set of messengers. This discussion continues the research we earlier initiated in the MESSENGER project, which develops data management mechanisms for UDDI registries of Web services using mobile users and software agents. In the current operation mode of messengers, descriptions of Web services are first, collected from UDDI registries and later, submitted to other UDDI registries. This submission mode of Web services descriptions does not foster the tremendous opportunities that both wireless technologies and mobile devices offer. When mobile devices are “close” to each other, they can form a mobile ad-hoc network that permits the exchange of data between these devices without any pre-existing communication infrastructure. By authorizing messengers to engage in ad-hoc collaboration, collecting additional descriptions of Web services from other messengers can happen, too. This has several advantages, but at the same time poses several challenges, which in fact highlight the complexity of ad-hoc networks.

Keywords Ad-hoc · Collaboration · UDDI · Messenger · Software agent · Web service

1 Introduction

In [14], we described our MESSENGER project that aims at developing mechanisms for supporting data management among a set of distributed UDDI registries. Unlike other initiatives on Web services, the MESSENGER project’s concerns are as follows:

– Several UDDI registries are deployed across various regions. A registry is aware of the existence of other peers, but does not perform any direct exchange of content with them. The UDDI registries may belong to different institutions and have different use policies.
– There is no pre-defined communication infrastructure between the distributed UDDI registries. An infrastructure of type wired or wireless for direct interactions can be set up after assessing the importance of exchange between the UDDI registries.
– Absence of a central component for managing and coordinating the UDDI registries. Each UDDI registry is independent in defining the announcements of providers it accepts and the retrieval requests of users it satisfies.

The MESSENGER project’s objective is to integrate users and software agents [4] into what we refer to as messengers. Initially, software agents reside in users’ mobile devices (i.e., handheld) and cache the descriptions of the Web services that satisfied these users’ needs. Whenever a user is in the vicinity of an UDDI registry her software agent interacts with that UDDI registry, so details stored in her mobile device regarding the used Web services are submitted. These details feed the content of the UDDI registries. Hereafter data and details mean the description of a Web service.

Web services are among the technologies that help organizations connect their business processes to other peers’ processes [12]. In a typical Web services scenario, a UDDI
registry performs two operations. The first operation is to receive the announcements of Web services from providers. The second operation is to search the UDDI registry’s content for the Web services that satisfy users’ needs. However, since the providers’ announcements of Web services are submitted to separate UDDI registries, this results in a different content among them. The development of mechanisms to support the exchange of content among UDDI registries is required.

Targeting the data management challenge of several UDDI registries has some similarities with the challenge of data replication in a distributed environment. Sun et al. highlight that as the community using Web services grows, the UDDI registry is a crucial entry point that needs to provide high throughput, low response times, high availability, and access to accurate data. Replication is often used to satisfy such requirements [18]. An immediate solution to achieve data management of separate UDDI registries is to flood the communication infrastructure with the new content of any UDDI registry that has lately been subject to changes. Changes in UDDI registries may become frequent as the number of announced Web services continues to grow [18]. Though the flooding solution fits quite well a wired environment, the lack of a reliable and permanent connection in a wireless environment, as with the MESSENGER project, is an obstacle to this solution.

In the current operation mode of messengers [14], descriptions of Web services are first, collected from UDDI registries and later, distributed to other UDDI registries subject to satisfying multiple policies (Sect. 3.3). This distribution mode of Web services descriptions does not foster the tremendous opportunities that both wireless technologies and mobile devices offer [5]. For instance, when mobile devices are in the vicinity of each other (i.e., reachable), they can on the spot form a mobile ad-hoc network (i.e., unplanned), which enables the exchange of data between these devices without any pre-existing communication infrastructure. In such a network devices serve as routers for others, which permits data to flow from one device to another according to a specific routing protocol [9].

In this paper we discuss the way ad-hoc collaboration between messengers happens and the way this collaboration is integrated into the operation of messengers. By authorizing messengers to engage their peers in collaboration situations, the exchange of data among UDDI registries is boosted. This not only allows collecting descriptions of Web services from UDDI registries as it is currently happening [14], but also permits collecting additional descriptions of Web services from other messengers. This way of doing has several advantages, but at the same time raises various issues that highlight the complexity introduced by the dynamic and volatile nature of ad-hoc networks.

The rest of this paper is organized as follows. Section 2 presents the MESSENGER project. Section 4 describes the ad-hoc collaboration among messengers. Section 5 presents how messengers are rewarded in ad-hoc collaboration sessions. Prior to concluding in Sect. 7, some related research projects are discussed in Sect. 6.

2 Some definitions

Software Agent. It is a piece of software that autonomously acts to carry out tasks on the users’ behalf [4]. In agent-based applications, it is accepted that users only need to specify high-level goals instead of issuing explicit instructions, leaving the decisions of how and when to their respective agent. A software agent exhibits a number of features that make it different from other traditional components including autonomy, goal-orientation, collaboration, flexibility, self-starting, temporal continuity, character, communication, adaptation, and mobility. It should be noted that not all these characteristics need to embody an agent.

Web service. For the World Wide Web Consortium (W3C), a Web service is a software application identified by a URI, whose interfaces and binding are capable of being defined, described, and discovered by XML artifacts and supports direct interactions with other software applications using XML-based messages via Internet-based applications. The development pace of Web services has been spectacular [6]. Several standards have been developed and several projects have been initiated. Some of these standards concern Web services definition, discovery, and security. Some of these projects concern Web services composition, personalization, and provisioning.

Universal Description, Discovery, and Integration. The UDDI specifications define a way to publish and discover information on Web services. At a conceptual level, the information provided in a UDDI business registration consists of three components [19]. First, the white pages component includes address, contact, and known identifiers. Second, the yellow pages component includes industrial categorization based on standard taxonomies. Finally, the green pages component includes the technical information about Web services that a business exposes. At a business level, the UDDI business registry can be used for checking whether a given partner has particular Web service interfaces, finding companies in a given industry with a given type of Web service, and locating information about how a partner or intended partner has exposed a Web service. The objective is to be aware of the technical details required for interacting with that Web service.