

Chapter 9

Peer-to-Peer Service Sharing on Mobile Platforms

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ABSTRACT

True ubiquitous computing requires peer-to-peer service sharing on mobile platforms, with application entities communicating and providing services to each other and to users. In order to enforce this paradigm to devices with limited processing and storage resources, lightweight middleware components are required. In this chapter, we define a theoretical model for autonomic and altruistic computational entities, and we use it to build a framework for peer-to-peer service-oriented infrastructures, focusing on three key aspects: overlay scheme, dynamic service composition and self-configuration of peers. Based on this framework, JXTA-SOAP Mobile Edition is a software component that completes the Sun Microsystems's JXTA platform, supporting peer-to-peer sharing of Web Services.

INTRODUCTION

The emergence of compact albeit powerful devices is giving users the ability to access, anytime and anywhere, globally available applications. For challenging contexts such as ambient intelligence and emergency management, requiring highly efficient, pervasive and dependable solutions, we envision a synergetic approach based on ubiquitous computing models and service-oriented technologies.

Moreover, to improve scalability, we support the shift from traditional client/server architectures to systems based on the peer-to-peer (P2P) paradigm, completed by the self-organization and the self-adaptation principles.

The peer-to-peer paradigm enables two or more entities to collaborate spontaneously in a network of equals (peers) by using appropriate information and communication systems without the necessity for central coordination. Furthermore, a peer-to-peer system is a complex system, because it is composed of several interconnected parts that as a whole ex-

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hibit one or more properties (i.e. behavior) which cannot be easily inferred from the properties of the individual parts.

At the beginning of the P2P era, Barkai (2002) proposed the following requirements for a general-purpose P2P middleware:

- portability
- interoperability
- security
- local autonomy
- persistence
- scalability
- extensibility

With these objectives in mind, in recent years some researchers have focused on designing robust overlay schemes (with respect to bootstrapping, connectivity, message routing) and distributed security / trust mechanisms, while others have targeted application-specific problems. Next step is to create decentralized and self-organizing infrastructures, being able to provide services to users according to their availability and the network status, and also supporting the spontaneous creation of services provided by heterogeneous nodes, such as mobile devices interacting through ad hoc connections without any prior planning (Gaber, 2007).

This chapter introduces the *Networked Service-oriented Autonomic Machine (NSAM)*, which is a theoretical model of an hardware/software entity that is programmed to be altruistic in sharing its resources. In particular, we focus on special kinds of resources, i.e. services, offered to and by mobile devices. Based on NSAM, we present a framework for peer-to-peer service sharing, based on three key aspects: overlay scheme, dynamic service composition and self-configuration of peers.

In section 2 we provide a survey on mobile devices and platforms. In section 3 we focus on peer-to-peer service-oriented infrastructures, discussing design issues, defining the NSAM theoretical model, and illustrating the formal framework.

In section 4 we illustrate its implementation in the mobile edition of JXTA-SOAP, a software component that completes JXTA middleware in order to support peer-to-peer sharing of Web Services in mobile networks. In section 5 we illustrate the objectives for future work. Finally, in section 6 we conclude the chapter with a summary and a discussion of the achieved results.

BACKGROUND

Due to digital convergence, mobile industry is facing a significant disruption in these years. Multifunctional products are emerging for consumers, and diversification is introducing a new set of requirements for architectures and platforms, such as flexibility, scalability and modularity. Mobility is considered a strategic component of enterprise business, and deploying mobile applications provides great productivity improvements. Mobility is complex, because it involves multiple back-end systems, some legacy, some newly deployed, and a collection of mobile devices with an increasing number of mobile operating systems (BlackBerry OS, Windows Mobile, Symbian OS, Mac OS X, Palm OS, Android and mobile Linux). A great variety of wireless technologies is also available in a global workplace, from current cellular networks with CDMA and GSM standards, to WiFi, WiMax, and future next-generation 4G networks.

Mobile Platforms

Most portable devices (PDAs, smart phones, digital media and music players, handheld gaming units, and calculators) are built on ARM², a 32-bit RISC processor architecture developed by ARM Limited that is widely used in embedded designs. Because of their power saving features, ARM CPUs are dominant in the mobile electronics market, where low power consumption is a critical design goal. Prominent branches in this family include Marvell's XScale, the ST-Ericsson's

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