Scalable Mobile Agents Supporting Dynamic Composition of Functionality

In-Gyu Kim¹, Jang-Eui Hong¹, Doo-Hwan Bae¹, Ik-Joo Han¹, and Cheong Youn²

¹ Dept. of Electrical Engineering & Computer Science, KAIST, 373-1, Kusong-dong, Yusong-gu, Taejon 305-701, Korea
{igkim, jehong, bae, ijhan}@salmosa.kaist.ac.kr
² Dept. of Computer Science, Chung-Nam National University, 220, Kung-dong, Yusong-gu, Taejon 305-764, Korea
cyoun@cs.chungnam.ac.kr

Abstract. Mobile agents are increasingly used in various Internet-based applications such as electronic commerce, network management, and information retrieval. If mobile agents can dynamically add, delete, and change their functionalities at run-time, they can sufficiently satisfy characteristics such as scalability, dynamicity, robustness, and performance, which are important in Internet-based applications. In this paper, we introduce Dynamic Composition of Functionality (DCF) based on code mobility, which enables mobile agents to dynamically compose their functionalities at run-time. In order to realize DCF based on code mobility, we propose necessary language constructs and implement a platform for scalable mobile agents, called DC-AOP. We also present a case study using DC-AOP to show the usefulness of our proposal.

1 Introduction

As the Internet has grown explosively, the demand of Internet-based applications is growing rapidly. Some of Internet-based applications such as electronic commerce, network management, and information retrieval are developed by using mobile agents, which are mobile objects that are capable of navigating through the network autonomously and performing tasks at the nodes they visit.

Since these Internet-based applications often need to be scalable and are operational on dynamic and unreliable Internet environments, they are required to possess characteristics such as scalability, dynamicity, robustness, performance, etc.

Mobile agents supporting DCF based on code mobility give us a great benefits for satisfying these characteristics. Dynamic Composition of Functionality¹ (DCF) for mobile agents means the capability of adding, deleting, and changing dynamically functionalities at run-time. DCF based on code mobility is capable

¹ Functionality means a unit of computation such as a method or an object
of adding functionalities in remote nodes into their own behaviors by code mobility at run-time. How mobile agents supporting DCF based on code mobility satisfy the characteristics of Internet-based applications, is shown as follows.

- **Scalability**: Since scalable mobile agents can add their functionalities at run-time, they can expand their functionalities. For example, when a scalable mobile agent does not have a functionality for printing as it visits a node and needs to print a message at the node, it can add a functionality for printing in a remote node into its behavior and use the functionality at run-time.

- **Dynamicity**: Each node in the Internet has different environments (for example, memory size and CPU power). Since scalable mobile agents are able to add or change their functionalities at run-time, they can provide services at each node in different ways according to the characteristics of each node.

- **Robustness**: When faults occur in a node, scalable mobile agents can add functionalities for exception handling in remote nodes into their behaviors and use the functionalities to overcome the faults at run-time. Thus, scalable mobile agents can continue their works robustly.

- **Performance**: Scalable mobile agents do not need to have all functionalities initially which are used by them. They can initially have only necessary functionalities at first time. And when they need to use other functionalities such as exception handling functionalities, they can add the functionalities at run-time. In addition, when they do not use existing functionalities any more, they can delete the functionalities and move fast to other nodes. Thus, scalable mobile agents can reduce network traffic and enhance their performance by adding or deleting functionalities at run-time.

In order to satisfy above characteristics, there are many aspects to consider. However, we satisfy the characteristics only in aspect of DCF based on code mobility.

There exists some research on DCF based on code mobility for mobile agents [1, 14, 16]. However, they only partially address DCF based on code mobility. For example, mobile agents in existing researches lack the capability of adding functionalities in remote nodes by code mobility. Thus, they do not provide all benefits obtained through code mobility [5].

This paper addresses DCF based on code mobility for mobile agents. We, first, introduce DCF based on code mobility in detail. Second, in order to realize DCF based on code mobility, we propose the language constructs and introduce a platform for scalable mobile agents, called DC-AOP. Third, we present a case study to show the usefulness of our proposal.

The rest of this paper is organized as follows: In Section 2, we give related works and show features of each work. We also evaluate DCF based on code mobility of each work and compare the related works with respect to various features. In Section 3, we show the motivation of DCF based on code mobility and describe DCF based on code mobility in detail. In Section 4, in order to realize DCF based on code mobility, we propose the language constructs and