Chapter 1.27
Mobile Agents

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INTRODUCTION

The concept of mobile agent is not new; it comes from the idea of *OS process migration* firstly presented by *Xerox* in the 1980's. The term *mobile agent* was introduced by White & Miller (1994), which supported the mobility as a new feature in their programming language called *Telescript*.

This new research topic has emerged from a successful meeting of several sub-sciences: computer networks, software engineering, object-oriented programming, artificial intelligence, human-computer interaction, distributed and concurrent systems, mobile systems, telematics, computer-supported cooperative work, control systems, mining, decision support, information retrieval and management, and electronic commerce. It is also the fruit of exceptional advances in distributed systems field (Hirano 1997; Holder, Ben-Shaul, & Gazit 1999; Lange et al., 1999).

The main idea of the mobile agent technology is to replace the old approach of the client-server Remote Procedure Call (RPC) paradigm, by a new one consisting of transporting and executing programs around a network. The results of the programs execution are then returned back to the sending entity. Figure 1 illustrates this new approach.

Mobile agents are dynamic, non-deterministic, unpredictable, proactive, and autonomous entities. They can decide to exercise some degree of activities without being invoked by external entities. They can watch out for their own set of internal responsibilities. Agents can interact with their environment and other entities. They can support method invocation as well as more complex degree of interaction as for example the observable events reaction within their environment. They can decide to move from one server to another in order to accomplish the system global behavior.

BACKGROUND

As the information technology moves from a focus on the individual computer system to a situation in which the real power of computers is realized through distributed, open and dynamic systems, we are faced with new technological challenges. The characteristics of dynamic and open environments in which heterogeneous sys-

Figure 1. RPC vs. mobile agent approach
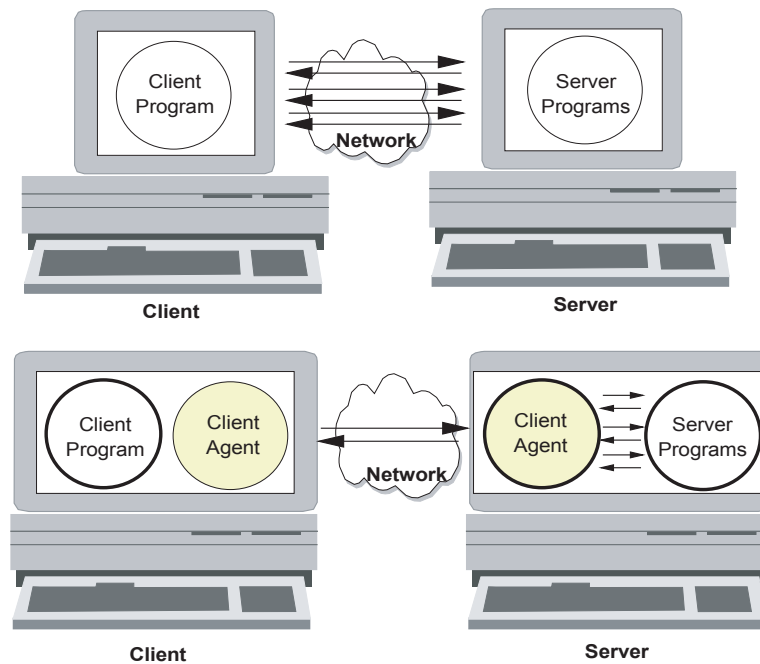
tems must interact require improvements on the traditional computing models and paradigms. It is clear that these new systems need some degree of intelligence, autonomy, mobility, and so on. The mobile agent concept is one of the new system environment that has emerged from this need. Several researches have proposed a definition of mobile agents (Bradshaw, Greaves, Holmback, Jansen, Karygiannis, Silverman, Suri, & Wong, 1999; Green & Somers, 1997; White 1997). Until now, there is neither standard nor a unique consensus on a unique definition. In general, a mobile agent can be defined using its basic attributes: the mobility, the intelligence and the interactivity. Based on these attributes, we can propose the following definition:

A mobile agent is a computational entity which acts on behalf of other entities in an intelligent way

(autonomy, learning, reasoning, etc.). It performs its tasks in software open and distributed environment with some level of mobility, co-operation, proactivity, and/or reactiveness.

This attributes based definition gives an abstract view of what a mobile agent does, but it doesn't present how it does it. This definition doesn't mean that mobility, interactivity, and intelligence are the unique attributes of mobile agents. Effectively, a large list of other attributes exists such as: application field, communication, delegation, and so on.

This definition shows that a mobile agent doesn't exist without a software environment called a mobile agent environment (see Figure 2).

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