# E-Commerce Agents and Payment Systems



**Sheng-Uei Guan**
*National University of Singapore, Singapore*

## INTRODUCTION

An emerging outcome of the popularization of the Internet is the electronic commerce and payment systems, which present great opportunities for businesses, reduce transaction costs, and provide faster transaction time. Research has been conducted with new technologies, like mobile Internet used by business models (Baek & Hong, 2003). However, before using the Internet, it is essential to provide security in transferring monetary value over the Internet. Quite a number of protocols have been proposed for these secure payment systems, including NetBill, NetCheque, Open Market, iKP, Millicent, SET (Sherift & Serhrouchni, 1998), E-Cash (Brands, 1995), NetCash, CAFÉ (Mjolsnes & Michelson, 1997), EMV cards (Khu-Smith & Mitchell, 2002), and so forth. These systems are designed to meet diverse requirements, each with particular attributes.

Automation and intelligence is another issue that poses challenges in the development of e-commerce. Agent technology has been incorporated into the area of e-commerce to provide automation and intelligence for the e-trade process. Agent is a software program, which is capable of accomplishing tasks autonomously on behalf of its user. Agents must provide highly trustworthy consistency and fault tolerance to avoid eavesdropping and fraud. Also, they should have roaming capability so as to extend their capabilities well beyond the limitations of owners' computers. This article will discuss some related components under the Secure Agent Fabrication, Evolution, and Roaming (SAFER) architecture (Guan & Hua, 2003; Guan & Yang, 2004; Guan & Zhu, 2002; Ng, Guan, & Zhu, 2002; Zhu, Guan, Yang, & Ko, 2000) and propose an agent-based payment scheme for SAFER.

Different types of electronic payment systems have been developed to meet their diverse requirements, which generally include integrity, authorization, confidentiality, availability, and reliability for security requirements (Asokan & Johnson, 1997). Payment systems can be classified in a variety of ways according to their characteristics (Dahab & Ferreira, 1998), such as the exchange model (cash like, check like or hybrid), central authority contact (online or offline), hardware requirements (specific or general), payment amount (micropayment), and so forth.

Among all the available payment schemes in the market, e-cash is one of the best in terms of security, flexibility, and full anonymity. E-cash is a cash-like online system that uses electronic coins as tokens. E-cash has its unique advantages, such as flexibility, integrity, and full anonymity that cannot be found in electronic check and credit card-based systems. It uses cryptographic techniques to provide full anonymity. The agent based payment scheme for SAFER adopts some similar principles and concepts of e-cash.

## Software Agents in E-Commerce

### Attributes of Agent-Based Systems for Electronic Commerce

Agents are bits of software performing routine tasks, typically in the background, on behalf of the user. Gathering, filtering, and presenting information are some of the small and well-defined tasks given to simple agents. An agent distinguishes itself from any other software by its intelligence. Intelligent agents are capable of "thinking" and producing intelligent feedback (Guan & Yang, 1999; Guan, Zhu, & Maung, 2004). Agents are increasing in the degree and sophistication of automation, on both the buyer's and the seller's sides, commerce becomes much more dynamic, personalized, and context sensitive. These changes can be beneficial to both the buyers and sellers (He, Jennings, & Leung, 2003).

The requirement for continuity and autonomy derives from the desire that an agent be able to carry out activities in a manner that is responsive to changes in the environment, without requiring constant human guidance or intervention. According to (Bradshaw, 1997), agents have the following attributes, as shown in Table 1.

There are several software agent prototypes under development, which will be capable of doing even more on behalf of buyers and sellers. One is Kasbah, wherein agents would proactively seek out potential sellers and negotiate with them on the buyer's behalf, making the best possible deal, based on a set of constraints specified by the buyer, including the highest acceptable price and a transaction completion date. (Chavz & Maes, 1996). A disadvantage of this software agent is that it always accepts the first offer that can meet its asking price, when

*Table 1. Attributes of software agents*

| Attribute | Description |
|---|---|
| Reactivity | The ability to selectively sense an act |
| Autonomy | Goal-directness, proactive, and self-starting behavior |
| Collaborative behavior | Can work in concert with other agents to achieve a common goal |
| Communication ability | The ability to communicate with persons and other agents |
| Personality | The capability of manifesting the attributes of a believable character such as emotion |
| Temporal continuity | Persistence of identity and state over long periods of time |
| Adaptivity | Being able to learn and improve with experience |
| Mobility | Being able to migrate in a self-directed way from one host platform to another |

there might be even better offers. This disadvantage is resolved by AuctionBot, which is a general-purpose Internet auction server. *AGENTics* is another agent prototype, which develops what is referred to as "*online catalog integration for e-commerce*." AGENTics products shield the user from the technicalities of "where" and "how" the information was gathered, while synthesizing many information pieces into a coherent whole (Mougayar, 1997). Some agents can select desired items based on preferences, search databases to look for selected pieces of information, and conduct transactions. An example of such adaptive agent is the SAFER architecture for e-commerce.

SAFER is a Web-based distributed infrastructure to serve agents to query, buy, and sell goods in e-commerce and establishes necessary mechanisms to transport, manufacture, and evolve all different types of agents. The goal of SAFER is to construct open, dynamic, and evolutionary agent systems for e-commerce (Zhu & Guan, 2000). There will be SAFER-compliant and noncompliant communities coexisting in the whole e-commerce network. Each SAFER community consists of several mandatory components: owner, butler, agent, agent factory, community administration center, agent charger, agent immigration, clearinghouse, and bank. Agent community is the basic unit in SAFER e-commerce, which offers virtual regions and vehicles to host and administrate mobile agents during roaming, transaction, and evolution. An owner is in charge of all his or her agents, and making respective authorizations to mobile agents and his or her agent butler, which is a 24-hour online watcher who would handle most of the tasks on behalf of the owner. When agents are sent out roaming in the network, the butler has the responsibility of keeping track of agents activities and locations by sending and receiving messages with agents. At least one financial institution, usually a bank, which can link all value-representation to real money, must also be involved. The payment scheme designed for SAFER is expected to fulfill flexibility and interoperability, which means diverse representations of value will have the possibility to emerge in one framework for users' convenience. Given that, it is important that funds represented by one mechanism be easily converted into funds represented by others (Neuman & Medvinsky, 1995).

## DESCRIPTION OF E-PAYMENT SCHEME

The payment module in the agent-mediated SAFER e-commerce architecture must contain several essential components: the market place, agents (including mobile agents, static agents, and agent butlers), financial institutions, and users. In SAFER, a community will offer virtual regions, factories, administration tools, vehicles to manipulate and administrate mobile agents during any activity and provide security so that users can trust it. Different types of agents fabricated by an agent factory of SAFER are running under the payment scheme for respective functions and tasks. They are briefly described in Figure 1.

In this scheme, a subsystem called "agency" is mentioned. Similar to the definition given by Dr. Larry Kerschberg in his DPSC project (Kerschberg & Banerjee, 1997), an agency can be thought as a multilayered agent group or a federation of agents with specific goal and functional role in the architecture. It is also like a collection of cooperating intelligent agents with particular expertise.

If the owner is interested in some items, he will assign tasks to his or her butler and agents. The agent butler will then send out information agents from agency, taking