Chapter 15
Electronic Payment Systems and Their Security

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ABSTRACT

Electronic commerce (or e-commerce) can be defined as any transaction involving some exchange of value over a communication network. This broad definition includes: Business-to-business transactions, such as EDI (electronic data interchange); Customer-to-business transactions, such as online shops on the Web; Customer-to-customer transactions, such as transfer of value between electronic wallets; Customers/businesses-to-public administration transactions, such as filing of electronic tax returns. Business-to-business transactions are usually referred to as e-business, customer-to-bank transactions as e-banking, and transactions involving public administration as e-government. A communication network for e-commerce can be a private network (such as an interbank clearing network), an intranet, the Internet, or even a mobile telephone network. In this chapter, the focus is on customer-to-business transactions over the Internet and on the electronic payment systems that provide a secure way to exchange value between customers and businesses.

INTRODUCTION

Electronic Commerce

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Electronic Payment Systems

Electronic payment systems have evolved from traditional payment systems, and consequently the two types of systems have much in common. Electronic payment systems are much more powerful, however, especially because of the advanced security techniques that have no analogs in traditional payment systems. An electronic payment system in general denotes any kind of network (e.g., Internet) service that includes the exchange of money for goods or services. The goods can be physical goods, such as books or CDs, or electronic goods, such as electronic documents, images, or music. Similarly, there are traditional services, such as hotel or flight booking, as well as electronic services, such as financial market analyses in electronic form.

A typical electronic payment system is shown in Figure 1. In order to participate in a particular electronic payment system, a customer and a merchant must be able to access the Internet and must first register with the corresponding payment service provider. The provider runs a payment gateway that is reachable from both the public network (e.g., the Internet) and from a private interbank clearing network. The payment gateway serves as an intermediary between the traditional payment infrastructure and the electronic payment infrastructure. Another prerequisite is that the customer and the merchant each have a bank account at a bank that is connected to the clearing network. The customer's bank is usually referred to as the issuer bank. The term issuer bank denotes the bank that actually issued the payment instrument (e.g., debit or credit card) that the customer uses for payment. The acquirer bank acquires payment records (i.e., paper charge slips or electronic data) from the merchants (O'Mahony et al, 1997). When purchasing goods or services, the customer (or payer) pays a certain amount of money to the merchant (or payee). Let us assume that the customer chooses to pay with his debit or credit card. Before supplying the ordered goods or services, the merchant asks the payment gateway to authorize the payer and his payment instrument (e.g., on the basis of his card number). The payment gateway contacts the issuer bank to perform the authorization check. If everything is fine, the required amount of money is withdrawn (or debited) from the customer's account and deposited in (or credited to) the merchant's account. This process represents the actual payment transaction. The payment gateway sends notification of the successful payment transaction to the merchant so that he can supply the ordered items to the customer. In some cases, especially when low-cost services are ordered, the items can be delivered before the actual payment authorization and transaction have been performed.

An electronic payment system can be online or off-line. In an off-line system, a payer and a payee are online to each other during a payment transaction, but they have no electronic connection to their respective banks. In this scenario the payee has no possibility to request an authorization from the is-

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