7

Ubiquitous Computing, Customer Tracking, and Price Discrimination

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7.1 Introduction

The availability and cost-efficiency of modern information and communication technology have made “interactive marketing” and individual customer addressability not only possible but economical. In 1991, Blattberg and Deighton [5] defined the new frontiers for marketing opened by interactive computer technologies as the “age of addressability.” Today, ubiquitous computer systems make it possible for consumers and providers of services and goods to engage in repeated, seamless interactions regardless of their respective physical locations.

Ubiquitous computing refers to methods of enhancing computer use by making networks of sensors and computers available and embedded in the physical environment [31]. The technologies on which ubiquitous computing applications are based span automatic identification (Auto-ID), such as Radio Frequency Identification (RFID); (wireless) communication systems, such as Global Standard for Mobile Communication (GSM); positioning services, such as Global Positioning System (GPS); and sensor networks. Together, these technologies are making new or improved business models, services, and products possible, and attention in the academic literature is naturally growing towards the business opportunities of ubiquitous computing. The volume of ubiquitous commerce, in particular (“any transaction with a monetary value that is conducted using ubiquitous computing technology” [21]) is expected to increase significantly in the coming years as e-commerce and wireless technologies continue to expand (the m-commerce or mobile commerce market alone is expected to be worth over $50bn by 2009 [7]). Ubiquitous commerce involves transactions as diverse as mobile phone based purchases, “intelligent” shopping carts, context-aware wallets, and other applications that have only started being explored. In commerce scenarios, ubiquitous computing devices will act as channels for sellers’ services, as sensors of environmental and customers’ conditions, and as “effectors” mediating between the customer’s needs and the provider’s services (see also [14] and Chapter 6 of this volume).
Advancements in information and communication technologies give companies better tools to study their customers, perfect their marketing strategies, and dynamically change their value propositions based on the information collected. In ubiquitous computing environments, customers may be uniquely identified and recognized by ubiquitous computing sensors because of the devices they are carrying. Based on the analysis of individual data, sellers in industries adopting these technologies may offer to each individual a different service — depending on factors such as previous purchase history, location, or other personal or environmental traits. Customers may receive “on the spot” personalized promotions, discounts, as well as targeted products, differentiated content, and individualized information — on their own mobile computing devices, based on the information they are revealing through their presence in a network of sensors.

These scenarios open new revenue opportunities for technologically savvy sellers but also raise new trade-offs for buyers.

On the seller’s side, of particular interest to this chapter’s analysis is the possibility of combining context, historical, location, and other personal data to dynamically alter the price of a product for each consumer — a form of price discrimination also known as dynamic pricing. On the Internet there have been accounts of attempts at dynamic pricing in the past (see [25] and [26]). Pervasive computing environments, because of their ubiquitousness and invisibility, offer sellers new powerful tools to quietly implement such pricing strategies.

On the consumer’s side, ubiquitous computing technologies offer promises and opportunities and also some risks — notably, privacy invasions and, in fact, price discrimination [1]. Nobody likes to pay more for the same product than the other person spent. Faced by intrusive information policies and price discriminating strategies, however, consumers can decide to bypass the seller’s tracking attempts through privacy enhancing and anonymizing technologies, or to avoid the seller altogether.

In prior work on intertemporal price discrimination [4], we addressed some of the pricing issues associated with generic tracking technologies. We used models of repeated interactions between sellers and their customers in which sellers use various information technologies to track customers over time (such as Internet “cookies” in online shopping), and customers use strategies (such as delaying purchases, selecting a different vendor, or adopting anonymizing or privacy technologies) to avoid being tracked. The models highlighted the conditions under which sellers find it optimal to use tracking data about their customers for price discrimination, and the conditions under which customers find it optimal to reveal or hide their identities.

In this chapter we apply and extend that analysis to ubiquitous computing scenarios, in which sellers may use customer personal, history, or context data for price discrimination. To this goal, we first discuss the features of ubiquitous computing technologies of interest to commerce (Section 7.2). We then focus on the application of ubiquitous computing technologies for customer tracking