

E-Commerce Systems Architecture and Applications

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The man who can make hard things easy is the educator.
—Ralph Waldo Emerson

*To all my mentors . . .
especially the very first ones, my parents.*

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Preface

E-commerce initiatives are proliferating in virtually all aspects of the socioeconomic environment. Innovation in computing technologies has extended the reach of e-commerce transactions into business-to-business, business-to-consumer, and intraorganization business processes. Engaging in e-commerce initiatives requires enterprises to embrace intelligent IT-enabled solutions to reengineer their business processes. These systems cohesively integrate an organization's customers, suppliers, distributors, retailers, partners, and employees to further various e-commerce business propositions. E-commerce systems draw customers closer to an enterprise's services and thus strengthen customer relationships, streamline internal processes to deliver cost efficiencies, and enable intelligent collaboration between enterprises.

An e-commerce system is a conglomerate of applications powered by the Internet, the World Wide Web, and other innovations. These applications employ various information appliances, offer various backend transaction processing and information access services, and run on a web of interconnected private and public networks. Complex interfaces between various applications interplay to fulfill a discrete e-commerce business objective. For example, various applications work in conjunction with each other to shape a shopping Web site that lets customers browse through various items, order online, and engage in online customer service interactions. The various applications that materialize this e-commerce business objective collectively constitute an e-commerce system. Similarly, a bank's bill payment e-commerce system on the Internet could enable customers to log on to the bank's Web site using any Internet-enabled device (PCs, handheld devices, etc.) and transfer funds from their checking account to the payee's account. Numerous applications interact to facilitate the execution of this simplistic transaction over a multitude of public and private

networks. These include applications that process registering of payees and their respective information, building of an Internet site to enable the customers to process such transactions, settlement applications that settle funds from the bank to the payees' accounts through settlement houses, and so on.

Numerous factors contribute to the effective design and deployment of e-commerce systems. These include managing the technical complexities inherent in the technologies of e-commerce systems, innovative interorganizational synergies, leasing of various e-commerce services, refurbishing one's technology infrastructure to support operations of e-commerce systems, and managing various e-commerce specific risks. This book presents an e-commerce systems architecture that identifies all the major building blocks of an e-commerce system and describes the interaction of these building blocks to shape effective e-commerce systems. For each building block, the book highlights issues that influence the design of e-commerce systems for various e-commerce business domains.

The primary building blocks of e-commerce systems architecture are information appliances, computing networks, e-commerce services and applications, e-commerce core services, organizational technology infrastructure, and networks of electronic payment systems. Information appliances facilitate access to enhanced e-commerce services and access these services through a web of public and private computing networks. E-commerce services and backend applications make up the core component of the e-commerce systems architecture and provide various e-commerce services to various users.

Intelligent integration of e-commerce systems depends upon various e-commerce services, which is the next architectural component shaping e-commerce systems. E-commerce services are usually available from external organizations that provide specialized services such as e-commerce hosting, a certificate authority infrastructure, portal functionality, domain name registration, and others. Finally, an appropriate internal technology infrastructure provides services such as groupware, systems management, and so on, to augment and control the other architectural components discussed earlier.

Plan of the Book

This book provides the readers with a thorough understanding of the various components that shape e-commerce systems. The book delves into the components' inherent technologies, discusses pertinent design and development issues, and presents management strategies that collectively shape e-commerce systems. The various issues presented in this book will provide the readers with insight into the design, development, and operations of e-commerce systems

corresponding to all e-commerce business domains (business-to-business, business-to-consumer, and intra-business).

Chapter 1: E-Commerce–Enabled Business Paradigm

This chapter introduces the reader to the various e-commerce value propositions and provides examples of e-commerce systems that fulfill those propositions. The chapter demonstrates how e-commerce initiatives affect an organization's IT strategy. Three e-commerce business domains and respective business requirements are identified. The chapter then highlights characteristics of e-commerce systems that fit each of the identified e-commerce business domains. Finally, the chapter introduces the readers to the primary components of e-commerce systems. Subsequent chapters address these components.

Chapter 2: Information Appliances

Chapter 2 delves into the details of information appliances. Information appliances constitute the architecture's client component. These appliances provide users with access to various local and remote network computing services. Information appliances extend beyond the dumb terminal of the first computing era and the PC of the client/server era to encompass intelligent devices such as pagers, cellular telephones, handheld computers and many others. This chapter describes the various types of information appliances and inherent technologies required for connecting to enterprise computing services. The chapter also analyzes business requirements that drive the choice of information appliances for business processes and analyzes strategies to "e-commerce enable" an organization's technology infrastructure.

Chapter 3: E-Commerce Systems Computing Networks

Computing networks enable users equipped with various information appliances to connect to backend enterprise computing services. Though the Internet and Web are the prominent networks enabling various e-commerce services, other networks such as the PSTN, GSM, and other cellular networks and pager networks play an active role in integrating diverse e-commerce services. This chapter illustrates the structure and architecture of popular computing networks and describes the network services that these networks provide to enable the design of e-commerce systems. The chapter also describes strategies and issues related to bridging an enterprise network to these networking backbones in order to formulate a virtual network.

Chapter 4: E-Commerce Services and Application Repositories

Chapter 4 discusses the technical details of the design and implementation of backend e-commerce applications and services. The chapter presents an e-commerce application architecture that consists of access gateways, middleware, and backend services. It identifies three types of applications (consultative, transactional, and inquiry types of applications) that fit the e-commerce application architecture. The chapter then delves into the application development facets of the various types of applications. This chapter also discusses intricacies inherent in integrating new e-commerce services with legacy applications.

Chapter 5: Establishing E-Commerce Application Access Infrastructure

This chapter introduces the reader to various technologies and strategies that enable enterprises to maximize the value of their IT infrastructures by providing users with intelligent systems access. Extranets and portals are various means that enterprises can exploit to enable intelligent access to information and enterprise services. This chapter discusses those concepts in detail. The chapter also sheds light on the network and systems management issues that enable maximum availability for enterprise IT-enabled services.

Chapter 6: E-Commerce Systems Technology Infrastructure

The design of various types of e-commerce systems requires the rejuvenation of internal enterprise technology infrastructures. Chapter 6 describes the various technologies and services required for the design and operation of e-commerce systems. These services and technologies include middleware technologies, groupware, directory services, domain name systems, and technologies related to application development.

Chapter 7: E-Commerce Payment Infrastructure

E-commerce services have triggered requirements for new forms of electronic payments. Chapter 7 introduces the various types of electronic payment systems and processes. More specifically, the chapter discusses the various process flows for using electronic cash, electronic checks, and credit cards. The chapter discusses the implementation details of the prominent electronic instruments and inherent technologies that enable e-commerce systems with various forms of electronic payments. Finally, this chapter addresses various issues relevant to

the integration of various types of electronic payment instruments with e-commerce systems.

Chapter 8: E-Commerce Systems Security

This chapter introduces the reader to information security issues that prevail in the implementation of e-commerce systems. After summarizing the popular technologies relevant to various security controls, the chapter covers security issues relevant to all tiers (client and server) of e-commerce systems. The chapter presents strategies that an organization can use to assess the cost and security-related business risks associated with the implementation of e-commerce systems. Finally, the chapter presents various procedural controls pertinent to the security of e-commerce systems.

Chapter 9: Managing E-Commerce Systems Implementation Risks

The last chapter identifies certain e-commerce systems implementation and operational risks, and proposes appropriate strategies for managing those risks. The strategies include aligning internal processes with the new forces of e-commerce and properly understanding customer requirements before rolling out e-commerce services through diverse information appliances to external customers. Because the integration of e-commerce systems requires the leasing of certain e-commerce services from external service providers, this chapter discusses the need to formulate appropriate Service Level Agreements (SLAs) to manage and share those risks. The chapter also discusses legal and regulatory issues surfacing from engaging in e-commerce services through e-commerce systems. Finally, the chapter highlights the merits of formulating and enforcing various policies to control technology implementation risks.

1

E-Commerce–Enabled Business Paradigm

Welcome to the new business era, where the letter *e* seems to have become a prefix to all business terminology. These terms include *e*-business, *e*-commerce, *e*-marketing, *e*-sales, and many more. Ranging from high-level business models to low-level firm activities, most frameworks, technologies, and business processes are freely using the “*e* word” to signify the new way of doing business and transacting commerce. This phenomenon is indicative of a trend that goes beyond introducing new words into the English language and involves the weaving of a universal and integrated web of processes and activities using electronic and information technologies.

Much has been said, discussed, and theorized about the power hidden in this *e* word. However, as organizations move toward materializing these theoretical strategies and business models into real systems and processes, they face new challenges. These challenges are embedded both in the intricacies of new technologies that seek to revolutionize and reface past innovations and in the integration of these new technologies with the legacy platforms and systems that power today’s systems and business processes. Furthermore, competing in this new era compels an organization to build appropriate business and technological capabilities to respond to the new business frenzy.

This book refers to the new breed of information technology (IT) systems that are revolutionizing such a change as e-commerce systems. The Internet, powerful networking technologies, sophisticated information appliances, and power-packed applications are appealing to enterprises and public audiences alike. The novel characteristics of these systems and their inherent technologies are reengineering the business processes for business-to-business, business-to-consumer, and intrabusiness commerce. To maximize an enterprise’s return on

investment (ROI) in IT technologies, an enterprise should equally exploit opportunities in all of three business domains.

E-commerce is about selling, buying, and conducting other ancillary activities through electronic channels. These ancillary activities encompass a wide array of functions that include establishing the means to sell, establishing incentives to sell, and collaborating with staff, partners, and customers through electronic channels in an interactive and noninteractive fashion. Together, all these activities both enable e-commerce and provide enterprises with the means to achieve the appropriate ROI on IT initiatives.

E-commerce systems primarily fit into three categories. First, a business-to-business e-commerce system leverages the Internet to streamline an organization's processes by cost-effectively chaining them with other strategic partners' systems. An e-commerce system that enables an organization to transact with other organizations for its business activities (e.g., corporate procurement) is an example of a business-to-business e-commerce system.

An e-commerce system fitting the business-to-consumer domain represents the second type of system, which involves commerce activities between the public domain customers and the organization. An e-commerce system that enables an organization to sell goods and services through the Internet to public domain customers is an example of such a system. Finally, intraenterprise e-commerce systems streamline an organization's internal activities and enable staff members to work effectively and efficiently through remote connectivity technologies, enhanced information sharing, team collaboration, and other similar means.

1.1 E-Commerce Business Drivers

Engaging in e-commerce through investment in e-commerce systems is becoming a competitive necessity while also providing opportunities for seeking competitive advantage. The following paragraphs describe the external market drivers that are pushing enterprises in the realm of e-commerce.

- *New customer/partner/regulatory business requirements:* New business requirements have a profound impact on an enterprise's IT strategy. For example, an organization may require its suppliers to engage in business transactions through special extranets. This drives the supplier to design appropriate e-commerce systems to transact with its customer organization. Similarly, the government requires some of its contractors to build technology capabilities to receive electronic

checks. This in turn is driving the contractors to build e-commerce systems to engage in such transactions.

- *Customer empowerment:* A firm needs to recognize its customers' empowerment in order to build required capabilities in its e-commerce systems for offering its products and services. For example, by recognizing that a wide range of its customers are equipped with wireless telephones, an organization can build capabilities into its systems to offer its products and services to customers on wireless telephone displays. Consumers empowered with personal computers and other information appliances have come to expect certain services from their service organizations (through various electronic channels, such as Web sites and WebTV). This, in turn, is driving enterprises to deliver their products and services through various electronic channels. Recognizing customer empowerment compels organizations to further scrutinize and analyze customer behaviors, preferences, and needs in the online world. This requires the deployment of intelligent e-commerce systems that meet customers' requirements.
- *Competitive necessities:* A gap analysis of an organization's systems against its competition may highlight deficiencies that affect an organization's bottom line. This could compel the organization to deliver appropriately competitive products and services. For example, an organization may provide electronic bill presentment capabilities to its customers with no accompanying features for electronic bill payment, which a competitor may be providing to its customers.
- *Competitive advantage opportunities:* An organization can identify sources of competitive advantage by deploying appropriate e-commerce systems. For example, an organization may enable its systems to let its customers contact the organization's customer service department through the Internet using various channels such as Voice over IP (VoIP), and so on.
- *One-to-one marketing:* One-to-one marketing involves targeting an organization's products and services to individual customers as opposed to aggregate markets. This is pushing enterprises to invest in appropriate e-commerce systems. Building customer profiles enables organizations to target individual customers based on their demographic information and offer customized and personalized products and services. Customization enables organizations to shift from the traditional norms of delivering standardized products and services to delivering customer-specific products and services. For example,

customization and personalization features enable customers to view customized content. Additionally, when ordering through the Internet, customers can specify their preferences in shipping products. For example, customers can specify the type of gift-wrap to be used, personalized messages, and so on.

- *Global competition:* The global presence of the Internet is facilitating easier access to global markets. Organizations can offer merchandise on their Web sites and expect global penetration overnight. Because the Internet is the only channel that provides an overnight global presence, an organization not venturing into e-commerce can be uprooted by its competition.
- *Branding:* The Internet and cyberspace in general present new opportunities for organizations to brand their products and services. The medium also threatens existing brand names within the traditional business landscape. Establishing an early presence on the Internet therefore is vital to establish a brand. Yahoo.com is an example of a public portal service that established its presence on the Internet early on and has become a popular portal brand among millions of users. Amazon.com, a company with no brick-and-mortar and no pre-Internet presence, branded itself by an early offering of an Internet bookstore, and it outperformed traditional brand names such as Barnes and Noble and Borders.

1.2 E-Commerce Value Propositions

There is a reason for the e-commerce mania. E-commerce systems purport to push enterprises into the new realm of doing business. E-commerce-related technologies provide firms with opportunities to reengineer their value chains' business processes. The term *reengineer* rightly fits this phenomenon, because the gains that a firm achieves as a result of these new business systems are tremendous. The gains come as a result of an exponential increase in customers, streamlining an organization's processes, and an associated increase in a firm's revenues.

Internet-enabled e-commerce has evolved through various phases. The first phase emerged with the dawn of the Internet in the 1970s and continued well into the 1980s. Entities on the Internet in this phase primarily focused on educational and research activities. The second phase started in the 1990s when government and industry recognized the Internet's power to influence the commercial sector. Numerous organizations established an online presence with