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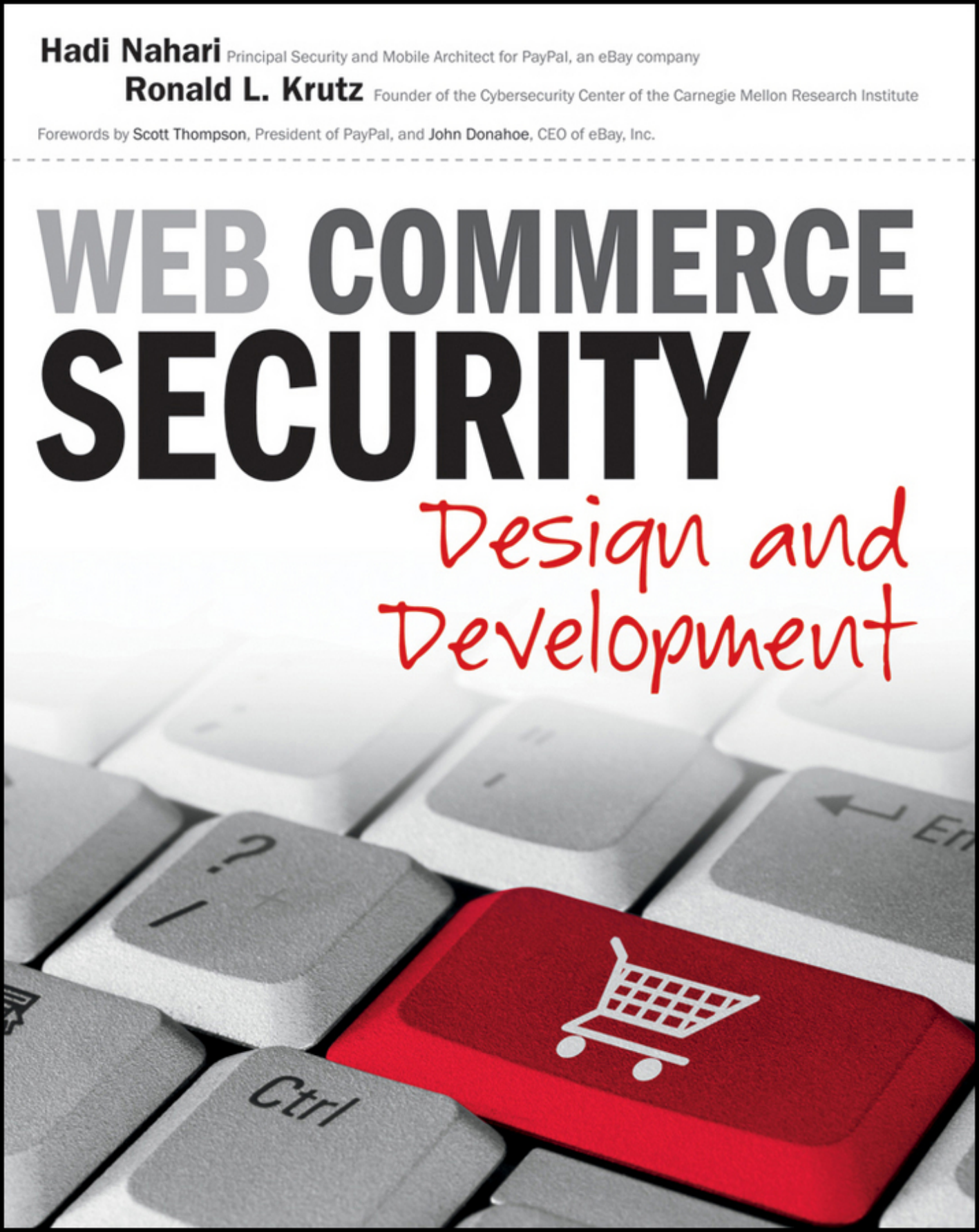
WEB COMMERCE SECURITY

Design and Development



Web Commerce Security Design and Development

Hadi Nahari
Ronald L. Krutz

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I dedicate this book to my mom, Alieh, and to my late dad, Javad, for they brought me in this world without consulting me first, showed by example how to never give up, and trusted that I would make it.

— Hadi Nahari

To the saying, "Life is God's gift to you. What you do with it is your gift to Him."

— Ronald L. Krutz

About the Authors

Hadi Nahari is a security professional with 20 years of experience in software development, including extensive work in design, architecture, verification, proof-of-concept, and implementation of secure systems. He has designed and implemented large scale, high-end enterprise solutions, as well as resource-constrained embedded systems with the primary focus on security, cryptography, vulnerability assessment and threat analysis, and complex systems design. He is a frequent speaker in the U.S. and international security conferences and has led and contributed to various security projects for Netscape Communications, Sun Microsystems, Motorola, eBay, and PayPal, among others.

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He is also the author of *Securing SCADA Systems* and of three textbooks in the areas of microcomputer system design, computer interfacing, and computer architecture. Dr. Krutz has seven patents in the area of digital systems and has published over 40 technical papers.

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— Hadi Nahari

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— Ronald L. Krutz

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Foreword

Technology-driven innovation is changing the way consumers around the world shop and pay. E-commerce is evolving rapidly and traditional distinctions between online and offline shopping are blurring. Four trends are helping to shape new ways people shop: the emergence of mobile commerce, the influence of social media, the growth of digital goods, and the potential of technology to create more convenient and accessible local shopping options. Increasingly, we can find whatever we want, whenever we want, wherever we are.

In this extraordinarily exciting and dynamic global commerce environment, Hadi Nahari and Ron Krutz's book is both timely and topical. Web commerce security is fundamental to the future of how we will shop and pay. The Web is becoming integral to more aspects of our lives. In a world where consumers will move seamlessly across screens and devices to shop, pay, and connect, security is paramount.

At eBay, how we design, manage and scale our global commerce and payment platforms to ensure that security is embedded in a compelling user experience is critical to our success. And it should be top of mind for any company competing in today's wired, digital world.

Our global platforms at eBay and PayPal support nearly 190 million active accounts and users. Buyers and sellers transact $60 billion of gross merchandise volume on eBay worldwide each year. In 2010, consumers transacted nearly $2 billion of gross merchandise volume through our eBay mobile applications. And we expect that number to double to $4 billion in 2011. PayPal processes more than $92 billion of payment volume annually around the world. And PayPal handled more than $750 million of mobile payment volume in 2010; we expect that to double in 2011.

At that global scale and volume, security is something we take very seriously. Entrepreneurs, merchants, and consumers around the world rely every day on the security of our platforms. Scalability and security go hand-in-hand, data protection and privacy are critical, and ensuring reliability is paramount. All of this complexity has to be managed while delivering highly interactive, real-time 24/7 global commerce and payment experiences in a convenient, easy-to-use environment.

To compete and grow, companies must deeply understand and manage Web commerce security. Hadi Nahari and Ron Krutz are two of the best in this space, and they are sharing their knowledge and insight in this book. That's a gift, and this is a must-read for anyone serious about playing and winning in today's global e-commerce world.

John Donahoe
President and CEO
eBay, Inc.

Foreword

The Internet has been changing our lives at a staggering pace. Thanks to the continuous stream of innovations in software the changes are only accelerating. In this era of global connectivity the new generation can hardly imagine the wide world without the Web.

The ubiquity of the Web has also enabled us to deliver services in ways inconceivable in the past. The breadth of what can be accomplished on the Web makes it the perfect and the most convenient platform to carry out commerce, pay, and get paid. The scale of electronic commerce growth is astonishing: PayPal transacted $3,380 every single second of the fourth quarter in 2010, a 28 percent yearly increase from the previous year!

With this growth comes the uncompromising consumer expectation for convenience, availability, and security of the services that they receive. It is the core mandate of any responsible company to facilitate a viable, reliable, and secure user experience: Hadi Nahari and Ron Krutz's book shows you how to create such a system.

At PayPal, we believe that in this highly integrated world our services must be provided the same way and irrespective of access channels: Whether it is a personal computer, mobile phone, tablet computer, Internet-connected television, or any other consumer electronic device, PayPal users are guaranteed an impeccable, easy, and safe experience. We design our solutions and deliver our services with those core values in mind: We believe our users deserve nothing less.

In 2010, PayPal's net Total Payment Volume, the total value of transactions, was about 18 percent of global e-commerce. With an annual revenue of $3.4 billion, our cross-border trade now accounts for approximately 25 percent of the total transactions. Mobile commerce is another area of explosive growth: By 2014, the mobile payment market across the world is expected to reach $633 billion.

This is an exciting time and we are fully prepared to grow our business to support e-commerce and m-commerce the PayPal way: easy, usable, and secure.

We delight global consumers by empowering them to control their money — securely and easily. We do it by providing a scalable, reliable, and secure infrastructure that is simple and secure for our consumers and merchants to use. In this book, Hadi Nahari and Ron Krutz, internationally recognized experts in e-commerce and m-commerce security, show you how to do it the right way.

Scott Thompson
President
PayPal

Introduction

Performing electronic or e-commerce activities online is ubiquitous; we all engage in it on a daily basis whether or not we are aware of it. Consumer electronics devices in general and mobile phones in particular are also becoming an integral part of our lives. Devices are becoming more powerful, extensively interconnected, much easier to use, and therefore capable of performing more and more tasks better, faster, and more reliably. Devices are becoming gatekeepers for our interaction with the digital world; they are entrusted to be the de facto means to live our digital life. Now if we combine the two trends mentioned, you will see the next digital wave that is taking place: interacting with our social networks, performing electronic commerce activities such as banking, ordering goods online, and so on, all using our consumer electronics devices. All these activities have one important element in common: They touch and use our identity. In other words, our digital security now depends on the security of our devices and the systems that they interact with. When there is identity, there must be reliable mechanisms in place to manage it safely and securely.

From the system designers' vantage point, the task of securing such a complex system is overwhelming, to say the least. There are different elements of this ecosystem that need to operate in synchrony, although many of them have not been originally designed to work together. From the end user's perspective, however, the need is much simpler; it must be safe and secure to use the system! In this book, we describe what it means to make such a system secure and thus safe for consumers to use, with a specific focus on e-commerce and its various forms, such as mobile commerce.

Even though the fundamental information system security principles are applicable across a variety of domains, e-commerce security provides special challenges to the information security professional. The technologies involved are advancing at a breakneck pace, both in terms of hardware and software. The hackers as well as the service providers have large amounts of computing power available to them at lower and lower costs. For example, with the availability of cloud computing, an individual can utilize tremendous computer resources at rates around a dollar per hour or less. This capability can be used for beneficial activities or for malicious purposes such as discovering encryption keys used to protect critical personal and financial transaction information stored in e-commerce databases. Also, in many countries today, cell phones provide credit card functionality that is used in hands-free scanning transactions. RFID reading capability in mobile devices opens the door to a variety of e-commerce paradigms in addition to novel attack methods. Therefore, understanding the e-commerce approach to information system security is necessary to appreciate the security threats and countermeasures associated with this business sector.

This book explains the steps necessary to analyze and understand system security from both holistic and atomic perspectives. It defines risk-driven security, protection mechanisms and how to best deploy them, and presents ways to implement security in a usable and user-friendly manner. The theme of all topics will be e-commerce, although they apply to m-commerce as well. The following are some important topics covered in this book:

- Users, users, users. Security that is difficult to use, albeit bullet-proof, will not be adopted by users, so it's important to know how to design and implement a strong security that is also user-friendly.
- What makes e- and m-commerce (electronic and mobile, respectively) secure; how to design and implement it.
- Techniques to implement an adaptive, risk-driven, and scalable security infrastructure.
- Fundamentals of architecting e- and m-commerce security infrastructure with high availability and large transactional capacity in mind.
- How to identify weak security in a large-scale, transactional system.

This book provides a systems architect or a developer with the information needed to design and implement a secure e-commerce or m-commerce solution that satisfies consumers' needs. Familiarity with security technologies, vulnerability assessment and threat analysis, transactional and scalable systems design, development, maintenance, as well as payment and commerce systems by the reader is a plus.

How This Book Is Organized

The book is organized into nine chapters and four appendices, with the chapters sequentially developing the important background information and detailed knowledge of e-commerce and e-commerce security issues. The appendices provide a review of important technical and compliance topics to support the material in the chapters.

The material in the chapters begins with the introduction of the era of e-commerce and its effect on consumer buying habits and norms. The subsequent chapters focus on the important qualities a robust and secure e-commerce system must possess and then lead into the fundamental building blocks of e-commerce. Using this information as a foundation, the middle chapters provide a detailed look at the tools available to implement a robust e-commerce environment and the means to secure such an environment. The final chapters explore methods and approaches to certify the assurance posture of e-commerce implementations.

Chapter 1 reviews the basic concepts of distributed computing and explains the unique characteristics of e-commerce as opposed to "conventional" commerce. It also covers digital goods, hard goods, payment methods, and introduces mobile or m-commerce.

Chapter 2 discusses consumer electronic devices and delves into the differences between e-commerce and m-commerce. The chapter then goes into great detail about mobile hardware, operating systems, and stacks. It also explores thin versus thick clients, application warehousing, and the characteristics of different mobile carrier networks.

In Chapter 3, the important "ilities" such as availability, interoperability, reliability, scalability, and so on are defined and developed in the context of their applicability to e-commerce systems.

With the background provided by the previous chapters, Chapter 4 focuses on e-commerce security, including what makes an e-commerce system secure, risk management, and the scalability of computing systems and corresponding security measures. It concludes with valuable material on how to secure e-commerce transactions.

Chapter 5 discusses a variety of e-commerce protection measures including cryptography, access control types and mechanisms, system hardening, and Web server security. It further explores host-level and network-level security measures applicable to e-commerce systems.

Chapter 6 describes the critical e-commerce system security components and principles that have to be applied to support secure and reliable transactions. These topics include authentication types, authorization, privacy, data classification, and system and data audit. Then, the chapter explores the principles of defense in depth, least privilege, trust, and communication security.

In order to implement the proper security controls, it is important to understand the vulnerabilities extant in an e-commerce implementation. Chapter 7 covers vulnerability assessment, intrusion detection and prevention, scanning tools, reconnaissance software, and penetration testing.

The threats to e-commerce systems are discussed in Chapter 8 through the topics of Web applications, attack trees, spamming, phishing, data harvesting, cross-site scripting, Web services attacks, rootkits, and a variety of other critical threat topics.

The book chapters conclude with Chapter 9, which presents certification issues, such as evaluation types, standards, assurance, documentation, and certification types such as MasterCard CAST, the Common Criteria, the GlobalPlatform Card Composition Model, and so on.

Appendix A presents an overview of e-commerce history and fundamental e-commerce concepts. Hardware, software and virtualization issues are explored as well as the importance of secure isolation. Operating system, networking, storage, and middleware topics are discussed in terms of their application in e-commerce systems.

Appendix B provides explanatory material on e-commerce standardization and regulatory bodies.

Appendix C is a glossary of important terms.

Appendix D is a bibliography of resources that we consulted for this book and recommend you read as well.

Who Should Read This Book

The primary audience for this book are architects and developers, systems engineers, project managers, senior technical managers, corporate strategists, and technical marketing staff.

The ideal reader for this book would be a systems architect or a developer who requires technical understanding of how to design and implement a secure e-commerce or m-commerce solution that satisfies the consumers' needs. The reader should have moderate knowledge of security technologies, vulnerability assessment and threat analysis, transactional and scalable systems design, development, maintenance, as well as payment and commerce systems. No special tools are needed.