Chapter 7.10
Web Services Security in E–Business:
Attacks and Countermeasures

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ABSTRACT

Web services enable the communication of application-to-application in a heterogeneous network and computing environment. The powerful functionality of Web services has given benefits to enterprise companies, such as rapid integrating between heterogeneous e-business systems, easy implementation of e-business systems, and reusability of e-business services. While providing the flexibility for e-business, Web services tend to be vulnerable to a number of attacks. Core components of Web services such as simple object access protocol (SOAP), Web services description language (WSDL), and universal description, discovery, and integration (UDDI) can be exploited by malicious attacks due to lack of proper security protections. These attacks will increase the risk of e-business that employs Web services. This chapter aims to provide a state-of-the-art view of Web services attacks and countermeasures. We examine various vulnerabilities in Web services and then followed by the analysis of respective attacking methods. We also discuss preventive countermeasures against such attacks to protect Web services deployments in e-business. Finally, we address future trends in this research area.

INTRODUCTION

As the use of the Internet and the World Wide Web (WWW) is expanding rapidly, more and more companies are implementing e-business using Web technologies to replace the traditional business model. Conventional Web application is human-centric, which relies on lots of time-consuming human intervention. The development

of Web services technology has changed this computing paradigm to application-centric.

A Web service is any piece of software that supports interoperable program-to-program interaction over a network (Booth, Haas, McCabe, Newcomer, Champion, Ferris, et al., 2004). This technology is not tied to any specific operating systems and programming languages. Thus, it enables the communication of application-to-application in a heterogeneous network and computing environment. This allows enterprise companies to implement and integrate their e-business systems rapidly. Also, reusability of e-business services becomes easy. All of these benefits are a great attraction for enterprise companies to adopt Web services in their e-business environment.

While Web services provide the flexibility for e-business, they introduce security issues that are less known in the e-business communities. The objective of this chapter is to address security challenges presented in Web services and explain which types of solutions are plausible for countering Web services attacks. In the following sections, we review current Web services technology, present different attacks against Web services, discuss some of the security countermeasures, suggest directions for future research, and present a conclusion of this chapter.

WEB SERVICES ARCHITECTURE

A Web services architecture (Booth et al., 2004) is a set of systems and protocols that facilitate application-to-application communication over a network. There are many technologies that are related to the Web services architecture. The main building blocks (Figure 1) that we describe here are extensible markup language (XML) (Bray, Paoli, Sperberg-McQueen, Maler, & Yergeau, 2004), simple object access protocol (SOAP) (Gudgin, Hadley, Mendelsohn, Moreau, & Nielsen, 2003a, 2003b; Mitra, 2003), Web services description language (WSDL) (Booth, & Liu, 2005; Chinnici,

Haas, Lewis, Moreau, Orchard, & Weerawarana, 2005; Chinnici, Moreau, Ryman, & Weerawarana, 2005), and universal description, discovery, and integration (UDDI) (Clement, Hately, Riegen, & Rogers, 2004).

XML

XML defines documents in a structured format (Bray et al., 2004). This format can represent the data to be exchanged as well as the metadata of the data contents. An XML file contains labels of different parts of the document. These labels are specified in a tag format. For example, Listing 1 shows an XML document that contains the address of Multimedia University. The document has a root element <address>. Each piece of data is described by a pair of tags, such as <> and </>, that identify the start and end of the data. The nature of XML documents enable exchange of information between application to application becomes easy. It is the foundation for Web services building blocks. Other Web services components are encoded in the XML format.

SOAP

SOAP describes how XML messages exchange in a decentralized, distributed environment (Mitra, 2003). SOAP provides a stateless and one-way message exchange framework that can be extended to request/response, request/multiple responses, and other more complex message exchange ways. SOAP messages can be carried by various network protocols, such as HTTP (hypertext transfer protocol), SMTP (simple mail transfer protocol), and raw TCP/IP (transmission control protocol/ Internet protocol). SOAP messaging framework is independent of any particular programming language or platform. The basic structure of a SOAP message contains the following four parts (Figure 2):

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