Security Threats in Web-Powered Databases and Web Portals

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INTRODUCTION

It is a strongly held view that the scientific branch of computer security that deals with Web-powered databases (Rahayu & Taniar, 2002) than can be accessed through Web portals (Tatnall, 2005) is both complex and challenging. This is mainly due to the fact that there are numerous avenues available for a potential intruder to follow in order to break into the Web portal and compromise its assets and functionality. This is of vital importance when the assets that might be jeopardized belong to a legally sensitive Web database such as that of an enterprise or government portal, containing sensitive and confidential information. It is obvious that the aim of not only protecting against, but mostly preventing from potential malicious or accidental activity that could set a Web portal's asset in danger, requires an attentive examination of all possible threats that may endanger the Web-based system.

BACKGROUND

Security incidents have been bound to the Internet since the very start of it, even before its transition from a government research project to an operational network. Back in 1988, the ARPANET, as it was referred to then, had its first automated network security incident, usually referred to as "the Morris worm." A student at Cornell University (Ithaca, NY), Robert T. Morris, wrote a program that would connect to another computer, find and use one of several vulnerabilities to copy itself to that second computer, and begin to run the copy of itself at the new location (CERT Coordination Center Reports, 2006). In 1989, the ARPANET officially became the Internet and security incidents employing more sophisticated methods became more and more apparent. Among the major security incidents were the 1989 WANK/OILZ worm, an automated attack on VMS systems attached to the Internet, and exploitation of vulnerabilities in widely distributed programs such as the sendmail program (CERT Coordination Center Reports, 2006).

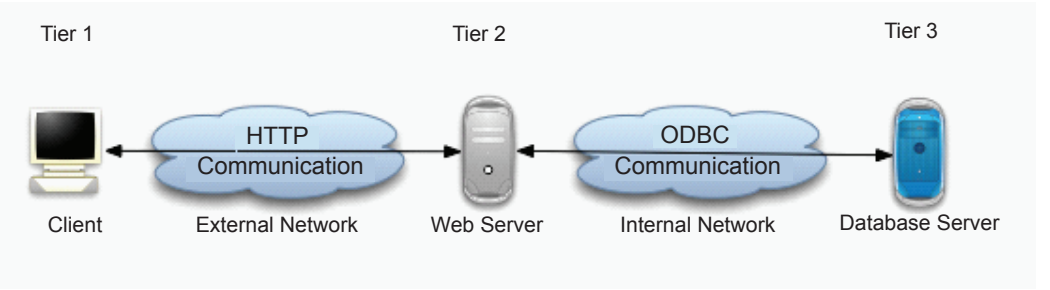
However, without underestimating the impact that such incidents of the past had to all involved parties, analysts support that the phenomenon has significantly escalated not only with respect to the amount of incidents but mostly to the consequences of the latter. The most notorious representative of this new era of cyber crime is the CardSystems incident (Web Application Security Consortium, 2006). In that crime scheme, hackers managed to steal 263,000 credit card numbers, expose 40 million more and proceed to purchases worth several million dollars using these counterfeit cards. CardSystems is considered by many the most severe publicized information security breach ever and it caused company shareholders, financial institutes and card holders damage of millions of dollars. The latest security incident occurred on April 25, 2006 when a hacker successfully managed to abuse a vulnerability in the Horde platform to penetrate the site owned by the National Security Agency of the Slovak Republic, jeopardizing sensitive information (Web Application Security Consortium, 2006).

LEGALLY SENSITIVE WEB-POWERED DATABASES

Even though legally sensitive portals, in other words, Web portals containing legally sensitive data, have been included in the Web portal family no sooner than the late 1990s (Wikipedia.org, 2006), the specific addition signaled the beginning of a new era in the Web portal scientific field. More specifically, portals took a converse approach with respect not only to the nature of services that they offered but also to the target group to which these services were offered. The end user from the perception of the Web portal was no longer exclusively the anonymous user, but could also be a very specific individual whose personalization data were frequently hosted inside the portal itself.

These types of portals, while often operating like ordinary Web portals serving millions of unaffiliated users, utilised some of its privately accessed aspects to harmonise the communications and work flow inside the corporation. This innovative approach proved to be both a money and labour saving initiative (Oracle Corporation, 2003). On the other hand, government portals that aimed at supporting

Figure 1. Three-tier architecture



instructing and aiding citizens to various socially oriented activities proved to be an important step towards the information society era.

It is obvious that these kinds of portals playing such an important role in the social or the enterprise context could not operate without information of equivalent potential and importance. As a result, the aforementioned Web portals were powered by databases hosting information of extreme fragility and sensitivity, a fact that inescapably attracted various nonlegitimate users, driven by ambition, challenge, or malice and who aimed to compromise the information, mangling the Web portal and making it non-operational. To impede all possible attacks against the Web portal and the hosted information, it is considered wise to identify all possible actions that could threaten and distort their functionality. The most ordinary Web portal architecture is examined and a threat area is defined, partitioned into four different sections, every one of which relates to a corresponding point of breaking-into the Web portal's normal operation.

System's Architecture

Web portals of all types have been designed to take advantage of a Web server and, through it, to retrieve all data hosted in a database which in turn is accessed by a database server (Microsoft Corporation, 2003). The term "Web application" is commonly used to represent the set of servers the combined operation of which is perceived as the service requested by the end user. An application of this philosophy is usually called a three-tier application, that is, the database tier that contains the database server and is responsible for writing data in and out of the database; the Web tier where the Web server is found and it is accountable for establishing connections and data transmission with the database server; and the client tier in which the leading role is played by the client's Web browser, that is an interface which allows the user to receive an answer to her/his request from the Web portal. From a protocol point of view, communications between the client and the Web server are labeled under the HTTP protocol. On the other hand, communication between the Web and database server is achieved through the application programming interface ODBC. This architecture is illustrated by the diagram in Figure 1.

THREATS

Information hosted in, and distributed by, a Web portal, not necessarily legally sensitive, during a transaction session between the end user and the organization's systems, flows back and forth from client through the network, usually the Internet, to the organization's respective server or servers that constitute the Web portal. A precondition for the latter's undisturbed and optimal operating is the absolute protection of the information both stored and in propagating form (Splain, 2002). Protecting a legally sensitive portal requires ensuring that no attack can take place on the database server, the Web server, the Web application, the external network and the underlying operating systems of the host computers.

Network Level Threats

The most important network level threat for the Web-powered database server and for the Web portal's operation is sniffing (Splain, 2002). Sniffing is the act of capturing confidential information such as passwords, using special hardware and/or software components that are transmitted through an unsafe external network such as the Internet.

Another significant threat is the so-called spoofing attack (Zdnet.com, 2002). This form of attack aims at hiding the true identity of a computer system in the network. Utilising this form of attack, a malicious individual can use as her/his own IP address that belongs to a legitimate user's computer in order to gain unauthorised access to the Web portal's resources.

An equally significant threat is the so-called session high-jacking (Zdnet.com, 2002) or the man-in-the-middle attack. Through this technique, the Web server is deceived,