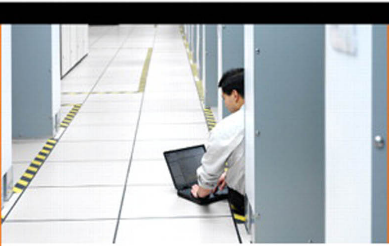

SECURITY

Penetration Testing and Network Defense

The practical guide to simulating, detecting, and responding to network attacks

Andrew Whitaker
Daniel Newman

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Penetration Testing and Network Defense

Andrew Whitaker, Daniel P. Newman

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Penetration Testing and Network Defense

Andrew Whitaker and Daniel P. Newman

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Dedications

Andrew Whitaker:

I dedicate this book in memory of Dr. Bill R. Owens and Dr. Charles Braak. Your legacies continue to inspire me to pursue higher levels of excellence.

And to my amazing wife, Jennifer.

-BFF-

Daniel Newman:

I dedicate this book to my beautiful wife, Clare. No matter how close you are, there is never a moment that you are not in my thoughts and never a time that my heart is not missing you. You are the light of my life that never stops shining brighter and brighter as time goes on. I just wish forever were not so short, because I'll miss you when it comes.

—Your husband, Daniel

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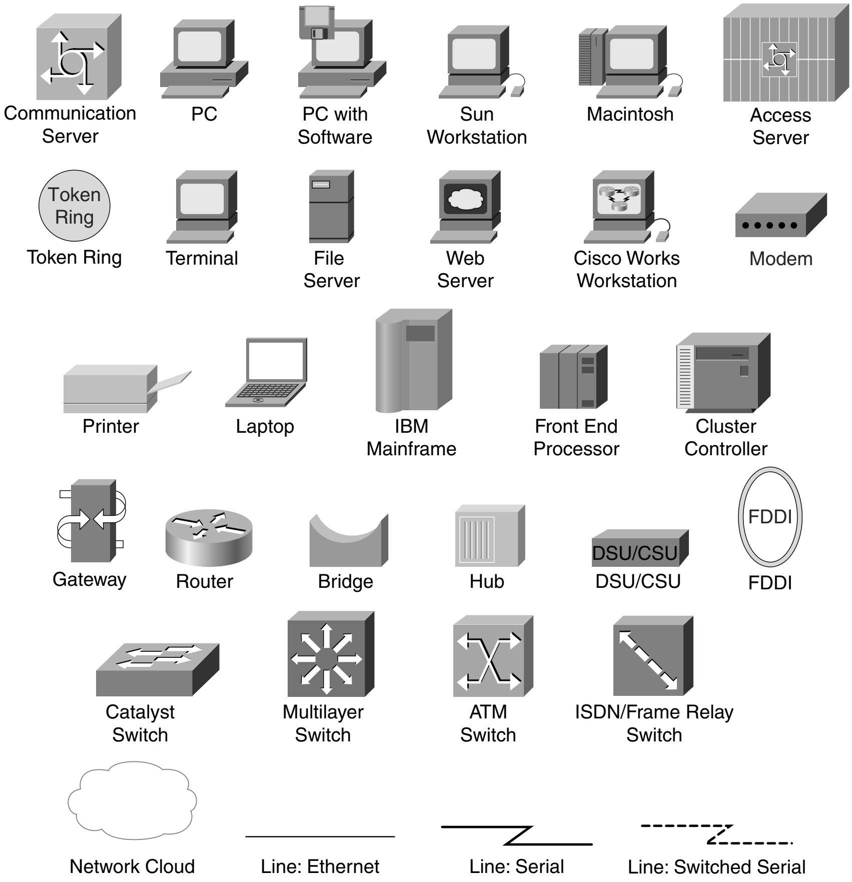


Command Syntax Conventions

The conventions used to present command syntax in this book are the same conventions used in the IOS Command Reference. The Command Reference describes these conventions as follows:

- **Boldface** indicates commands and keywords that you enter literally as shown. In actual configuration examples and output (not general command syntax), boldface indicates commands that are manually input by the user (such as a **show** command).
- *Italic* indicates arguments for which you supply actual values.
- Vertical bars (|) separate alternative, mutually exclusive elements.
- Square brackets [ ] indicate optional elements.
- Braces { } indicate a required choice.
- Braces within brackets [{ }] indicate a required choice within an optional element.

Foreword

Pen testing, ethical hacking, posture assessment, vulnerability scans… the list of names goes on and on. There are as many names for simulating an attack and testing the security of an information system as there are approaches and techniques to be utilized in this endeavor.

While it is quite simple to log onto the web and gain access to tools, information, scripts, etc. to perform these types of tests, the key to doing this work responsibly, and with desirable results, lies in understanding how to execute a pen test the right way. Case studies have shown that a testing exercise designed to identify and improve security measures can turn sour and result in obvious or inaccurate recommendations, or in the worst case scenario, become disruptive to business operations.

This book goes to great lengths to explain the various testing approaches that are used today and gives excellent insight into how a responsible penetration testing specialist executes his trade.

Penetration testing is very dynamic field and requires a continuous investment in education and training to ensure that the tester has the requisite knowledge to do this well. And there is a certain elegance to the analysis involved in a truly successful test. While considered a science steeped in the world of technology, the highest form of penetration testing contains quite a lot of art. By applying creativity in the interpreting and analysis of results, then determining the optimal next steps, often by intuition and feel, the sophisticated pen tester creates a new level of evaluation and brings a stronger, more valuable result to the exercise.

There was a time 10-15 years ago when this type of exercise was questioned as to its validity, its value, and its interpretation. In today's modern technology-driven world, where we experience a ceaseless number of threats, vulnerabilities, DDOS attacks, and malicious code proliferation, penetration tests are one of many standard best practices essential to strong security governance. Most sound security approaches highlight these tests as an integral component of their programs. They are viewed as essential to understanding, evaluating, measuring, and then most importantly, establishing a cost effective set of remediation steps for improving the security of information assets.

What is of particular note and interest in this book is the extensive time devoted to the many new and innovative techniques required to properly test and evaluate new advanced technologies. It's an ever changing field and you will find great value in delving into these new domains, expanding your scope, and understanding the possibilities. There does not seem to be any limit to the potential damage that those with malicious intent can invoke. Deep exploration of their techniques helps us to establish proactive preventive and detective measures – and help in the ongoing tasks of staying a step ahead.

So when you do become involved in penetration testing projects – whether that be in contracting for services, overseeing their execution, reviewing their results, or even executing them yourself – it is essential to understand the concepts described within to ensure you have an evolved and sophisticated view of the world of penetration testing. Or was that ethical hacking?

Bruce Murphy
Vice President, World Wide Security Services
Cisco Systems, Inc.
September 2005

Introduction

The first “hackers” emerged from the Massachusetts Institute of Technology (MIT) in 1969. The term originally described members of a model train group who would “hack” the electric trains to increase the speed of their trains.

Today, the term has quite a different meaning. When people think of computer hackers, they think of computer experts who are adept at reverse engineering computer systems. They might think of malicious hackers who aspire to break into networks to destroy or steal data, or of ethical hackers who are hired to test the security of a network. Often, these ethical hackers, or penetration testers, mimic the same techniques as a malicious hacker.

The need for penetration testing is simple. The best way to stop a criminal is to think the way a criminal thinks. It is not enough to install burglar alarms and fences and assume that you are safe from burglary; to effectively stop a burglar, you must predict the moves a burglar would make. Likewise, to prevent against malicious hackers, you must think like a malicious hacker. One of the best ways that companies are assessing their security against attacks is by hiring outside security firms to attempt to penetrate their networks.

Companies are no longer falling victim to the “Titanic” syndrome. When the Titanic was built, its engineers never thought the ship would sink; companies now realize that just because their staff stamps their approval that the network is secure, you just do not know for sure until it is tested.

This book arises out of this need to know how to perform a thorough and accurate assessment of the network security for an organization. Although other books describe some of the tools that malicious hackers use, no book offered a definitive resource for penetration testers to know how to perform a full security assessment of a computer network for an organization. This book is written to fill this need.

Who Should Read this Book

The scope of this book is to provide a guide for those who are involved in the field of penetration testing, and for security professionals who daily face the need to know how to detect and protect against network attacks. It is specifically targeted toward three audiences:

- Those interested in hiring penetration testers
- Those employed as penetration testers
- Those responsible for securing their network against malicious hackers

Ethical Considerations

It should be noted at the onset that this book is designed as a guidebook for ethical hacking. This book does not endorse unethical or malicious use of the tools and techniques mentioned. Many of the techniques described in this book are illegal without prior written consent from an organization. The authors of this book want you to curb any curiosity you might have to try out these techniques on live systems without legitimate and ethical reasons. Used properly, the tools and techniques described in this book are an excellent resource for anyone who is involved in securing networks.

How This Book Is Organized

This book aids you in securing your network by examining the methods of penetration testing as a means of assessing the network of an organization. It also shows how to detect an attack on a network so that security professionals can spot an intruder and react accordingly. This book offers suggestions on how to go about protecting against the exploits discussed in each chapter. Numerous case studies are included throughout the book, and a complete case study chapter outlines a step-by-step example of the entire process.

This book is divided into three parts:

- Part I: Overview of Penetration Testing

  Before you can begin penetration testing, you must first comprehend the definition, purpose, and process of penetration testing. The first three chapters are devoted to meeting this objective.

  — Chapter 1: Understanding Penetration Testing

  This introductory chapter defines the scope and purpose behind penetration testing. Through the numerous examples of real-world security breaches coupled with statistics on the rise of security concerns, you learn the urgent need for this type of testing.

  — Chapter 2: Legal and Ethical Considerations

  Here you learn of the ethics, laws, and liability issues revolving around penetration testing. Mimicking the behavior of an attacker is a dangerous assignment; testers should understand what is permissible so that they do not step over the boundaries into unethical or illegal behavior.

  — Chapter 3: Creating a Testing Plan

  Because penetration testing requires such caution, it is imperative that the tester develop a step-by-step plan so that he can stay within his contracted boundaries. This chapter outlines the basic steps in performing a penetration test, which is further explained throughout the remainder of this book. Chapter 3 culminates with documentation guidelines for writing a synopsis report.

- Part II: Performing the Test

  The second part of this book focuses on the particulars of testing. Because the purpose of penetration testing is ultimately to assist administrators in securing their network, chapters include three essential components. First, the steps are given to perform a simulated attack using popular commercial and open-source applications. Only through a live test can one assess whether company security measures are effective. Second, when applicable, each chapter illustrates how to detect the attack through the use of the Cisco Intrusion Detection Sensor. Finally, each chapter concludes with some brief suggestions on how to go about hardening a system against attacks. All three components are essential in grasping the methods behind security breaches and how to prevent them from happening.

  — Chapter 4: Performing Social Engineering

  Social engineering is a component of testing that is often overlooked. It is the human element of the security assessment. Topics in this chapter include impersonations of technical support representatives, third-party companies, and e-mail messages.

— Chapter 5: Performing Host Reconnaissance

Host reconnaissance is the stake-out portion of testing. Often, a burglar patrols a street for several nights before his crime to determine which house might be the easiest to burglarize. During his stake-out, he examines each house closely, peeking in the windows. He is watching the behavior of its residents and evaluating the worth of goods inside. In the same way, a hacker performs reconnaissance to discover the hosts on a network and what applications and services are running.

In this chapter, you learn various reconnaissance techniques and software tools, besides how to spot and prevent a scan from being done on a network using the Cisco Intrusion Detection Sensor.

— Chapter 6: Understanding and Attempting Session Hijacking

In some secure environments, employees must swipe a card into a reader before being admitted through a door into their building. Although an intruder could certainly attempt to break in via a window, it would be easier to walk directly behind another employee as she walks into the building, thus bypassing its security.

Computer hacking has a similar technique called session hijacking. Here, a hacker monitors the traffic on a network and attempts to hijack a session taking place between a host and a server. By impersonating the identity of the host, the hacker is able to take over the session. As far as the server knows, it is still an authorized user accessing its services.

This chapter details the various methods that an attacker would use to hijack a session and how to detect and prevent session hijacking on a network.

— Chapter 7: Performing Web-Server Attacks

Nowadays it is rare for a company not to have some type of web presence. Whether it is just a simple static web page or a complex e-commerce site, companies know that if they want to compete in the market today, they must be accessible on the World Wide Web. Such a presence comes at a cost, however, because it leaves a potential opening for an attacker to enter a network of a corporation. Even if a malicious hacker cannot penetrate past the web server, he might be able to deface the website. If a customer sees that the website has been hacked, he might decide that he cannot trust the security of the company and take his business elsewhere.

This chapter walks you through exploiting web server vulnerabilities and how to detect and prevent against such attacks.

— Chapter 8: Performing Database Attacks

Before the age of computers, company files were often stored in locked file cabinets. Now they are stored in electronic databases. Unlike a locked file cabinet, however, a database is often not protected against curious intruders. Many times, databases are built with little or no security. The aim of this chapter is to show how to detect an attempt to breach database security through intrusion detection systems. It also instructs you on how to test the vulnerability of a database by emulating an intruder.

— Chapter 9: Cracking Passwords

Face it: Passwords are everywhere. You have to remember passwords for voice mail, e-mail, Internet access, corporate access, VPN access, and ATMs. With the number of passwords users have to remember, it is no wonder that they choose simple passwords and use the same one for multiple purposes. When users make the passwords simple, though, crackers (people who cracks passwords) can guess them easily through password-cracking tools. When users employ passwords repeatedly, if a cracker is able to crack one password, he then has access to all the services using the same password.

By the end of this chapter, you will know how to use some of the more popular password crackers to assess any easily guessed passwords on a network. You also will learn how to spot the signs of someone performing password cracking, and methods to prevent against it.

— Chapter 10: Attacking the Network

Historically, malicious hackers went after hosts on a network. Nowadays, the network itself can be a target, too. You can circumvent intrusion detection systems (IDSs), penetrate and bypass firewalls, and disrupt the service of switches and routers. This chapter covers these topics and provides a detailed examination of how to protect against such attacks through Cisco technology and proper network design.

— Chapter 11: Scanning and Penetrating Wireless Networks

Wireless networks are being implemented at a faster pace than ever before. The ease of being able to take your computer anywhere in an office building is attractive to most people, except, of course, the one in charge of IT security. Wireless networks, if not protected adequately, pose significant security threats. To secure a wireless network, an administrator should know the process by which an attacker would breach a wireless network, how to detect breaches, and how to prevent them. This chapter covers these topics.

— Chapter 12: Using Trojans and Backdoor Applications

It seems like every month, a new virus comes out. Virus protection software companies make a fortune in helping users protect against lethal viruses. Yet how do these viruses actually work? How do they enter a network? This chapter discusses Trojan horses, viruses, and other backdoor applications from the angle of a penetration tester who tries to mimic an attacker. It also points out preventative measures and how to detect suspicious behavior on a network that might reflect the existence of these malware programs on a network.

— Chapter 13: Penetrating UNIX, Microsoft, and Novell Servers

Administrators are fighting a never-ending war over which operating system is the most secure. Yet the inherent security in a default installation of popular server operating systems is not the real concern; the real concern is educating administrators on how to breach such operating systems. This chapter aids in this cause, taking a neutral stance among vendors and educating its readers in how to test their servers for vulnerabilities and protect against intruders.

— Chapter 14: Understanding and Attempting Buffer Overflows

A cargo ship only has so much capacity. If you have more items to transport than your cargo ship can handle, you may exceed its weight capacity and sink the ship. A buffer stack overflow operates in the same way. If an attacker is able to exceed the buffer's allocated memory, the application will crash. This chapter explains what a buffer overflow is, how to cause them, and methods for preventing them.

- Chapter 15: Denial-of-Service Attacks

  An attacker does not always want to read or alter confidential information. Sometimes an attacker wants to limit the availability of a host or network. He commonly does this through denial-of-service (DoS) attacks. This chapter describes some of the more common methods of performing such attacks, how to detect them, and how to prevent them.

- Chapter 16: Case Study: A Methodical Step-By-Step Penetration Test Example

  Using a mock organization, this concluding chapter outlines the steps that a penetration tester takes as he performs reconnaissance, gains access, maintains that access, and captures valuable intellectual property. The fictitious tester then covers his tracks by erasing logs to prevent detection.

- Part III: Appendixes

  The final part of this book includes supplementary material that covers the next step to take after completing a penetration test.

  - Appendix A: Preparing a Security Policy

    Any security weaknesses discovered during testing are not a reflection on poor technology, but on weak security policies. This appendix provides a basic example of a security template that you can use as a template for developing your own policy.

  - Appendix B: Tools

    Every ethical hacker has a favorite software “toolkit” containing his preferred applications used in testing or auditing. Numerous commercial and noncommercial software tools are mentioned throughout this book. This appendix consolidates all descriptions of the prominent tools in one easy location. Each tool is referenced alphabetically by chapter and contains a website reference for the software. You can also find a hyperlinked PDF version of this appendix at http://www.ciscopress.com/title/1587052083 to easily launch your web browser to the URLs listed.

  - Glossary

    The glossary defines a helpful list of terms used commonly in various facets of penetration testing practice.

We believe you will find this book an enjoyable and informative read and a valuable resource. With the knowledge you gain from studying this book, you will be better fit to secure your network against malicious hackers and provide a safer place for everyone to work.

Failing to prepare is preparing to fail.

—John Wooden (Former head coach, UCLA men's basketball team)

CHAPTER 3

Creating a Test Plan

As with all great projects, success comes with having a solid methodical plan. Penetration testing is not about jumping into a security assessment project by running several tools at random. Penetration testing is about creating a methodical, step-by-step plan that details exactly what you are going to do, when you are going to do it, and how.

This chapter outlines the steps needed to create a methodical plan, from narrowing the scope of the project, to using the Open-Source Security Testing Methodology Manual (OSSTMM), and finally to writing up the testing report.

Step-by-Step Plan

Every good penetration test involves the following steps:

1. **Reconnaissance**—The initial stage of collecting information on your target network
2. **Enumeration**—The process of querying active systems to grab information on network shares, users, groups, and specific applications
3. **Gaining access**—The actual penetration
4. **Maintaining access**—Allowing the tester a backdoor into the exploited system for future attacks
5. **Covering tracks**—The process of deleting log file entries to make it appear that you were never on the exploited system

Chapter 5, “Performing Host Reconnaissance,” addresses the reconnaissance step. The last four steps, which are typically done in sequence, are covered in the remaining chapters.

Before you can perform the first step, however, you and the client (or management, if you are doing an internal test) must do the following:

- Narrow the scope of the project
- Determine if social engineering will be employed
- Decide if session hijacking attempts will be allowed
- Agree on the use of Trojan and backdoor software

Defining the Scope

Penetration testing is a lot like a pirate looking for buried treasure. The pirate does not know exactly where the buried treasure is, but he knows it is valuable enough to go looking for it. A pirate has a treasure map full of clues all geared to direct him toward the buried treasure. In the same way, penetration testers are on a quest to infiltrate a client network. The testers do not know in advance how they are to go about infiltrating the network, but in the end, the results of the test have to be worthwhile to the client. If a client is most concerned with the security of their Internet presence, then you should not devote your time to trying to break into the internal network. Likewise, if the client is concerned only about the security of his accounting department, it does not make sense to devote your time to other departments.

The first step, then, is to narrow the scope of your test to what is meaningful to the client. Ask the client what he hopes to achieve through this testing. Perhaps he only wants to assess whether he is vulnerable to having account information stolen, or the scope might extend to any type of attack. Ideally, all possible means of attacks should be allowed to provide the most realistic scenario of a real malicious attack, but this is seldom the case. Budget constraints, concerns over denial of service (DoS) attacks disrupting daily information, and the protection of employee privacy are often deterrents that prevent organizations from authorizing all forms of attacks.

Social Engineering

Social engineering, described in more detail in Chapter 4, "Performing Social Engineering," is the process of human-based manipulation to achieve access. Some organizations permit the use of social engineering, and some do not. You need to discuss this with the client (and have it in writing) before you begin testing.

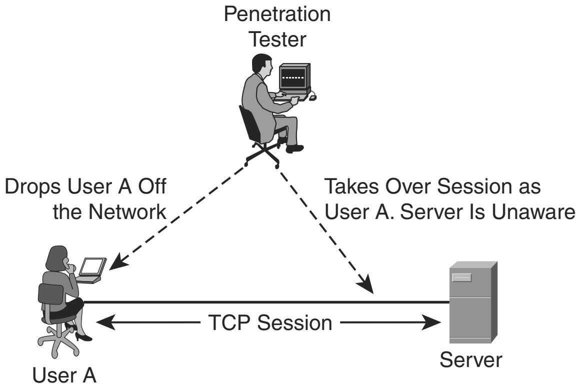
Session Hijacking

Session hijacking, described in more detail in Chapter 6, "Understanding and Attempting Session Hijacking," is the process of taking over a TCP session between two machines to gain access to an unauthorized system, as illustrated in Figure 3-1.

In Figure 3-1, the penetration tester is listening to network traffic being sent from User A to the server. The penetration tester takes over the session and appears to the server as that user. To make this work, the penetration tester has to drop User A off the network (usually through sending a TCP reset packet). This can be disruptive to day-to-day operations and it is often not permissible to perform these tests.

An alternative is to create a lab environment that contains equivalent network equipment.

Figure 3-1 *Session Hijacking*


Penetration Tester
Drops User A Off the Network
Takes Over Session as User A. Server Is Unaware
TCP Session
User A
Server

Trojan/Backdoor

Another factor requiring authorization before performing tests is whether the use of Trojans or other backdoor software is to be allowed. Encourage the client to allow this. Many of the more cunning attacks use backdoor applications and Trojans. If you want to have accurate results, you need authorization to use these applications.

If you do agree on the use of Trojan applications and other backdoor applications, be careful about what tools you use. Some websites give you the option of downloading Trojan and backdoor tools such as Netcat, but they contain their own virus embedded in the program. These viruses, when put on a client machine, can propagate throughout the network, causing havoc on servers and end user computers.

Open-Source Security Testing Methodology Manual

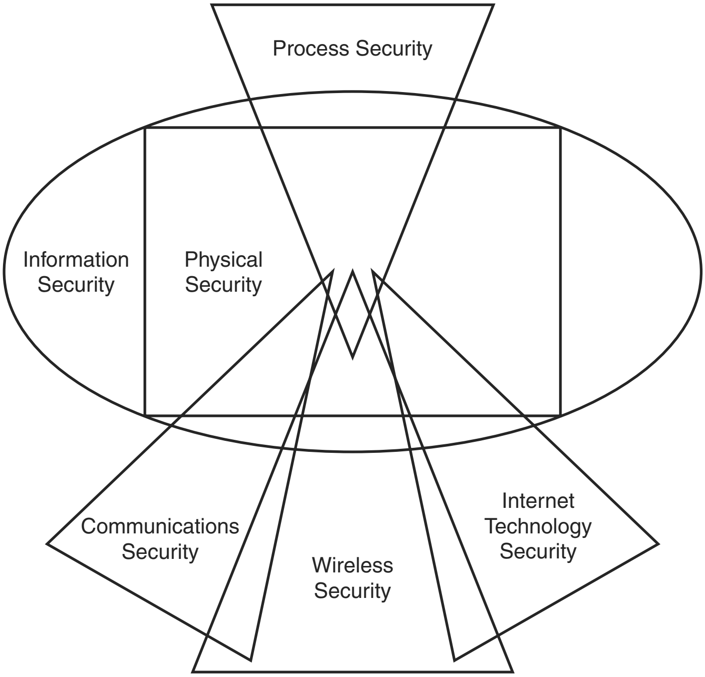
As you know, it is pointless to reinvent the wheel if it has already been made. Peter Herzog, at the Institute for Security and Open Methodologies (http://www.isecom.org), along with 30 contributors from various security organizations, has created the Open-Source Security Testing Methodology Manual (OSSTMM) so that penetration testers do not have to reinvent the wheel when designing a methodology for security auditing.

The OSSTMM addresses the following areas of security assessment, as illustrated in Figure 3-2:

- Information security
- Process security
- Internet technology security
- Communications security

- Wireless security
- Physical security

Figure 3-2 *OSSTMM Security Map*



©2000–2003 Peter Herzog, ISECOM

NOTE A Spanish version of the OSSTMM is available for free download at http://www.osstmm.org.

Each of the areas of security assessment is further broken down into specific modules. For example, the wireless security area (page 71 in the OSSTMM document) is broken down into eleven modules:

- Electromagnetic radiation testing
- 802.11 wireless network testing
- Bluetooth testing
- Wireless input device testing

- Wireless handheld testing
- Cordless communications testing
- Wireless surveillance device testing
- Wireless transaction device testing
- RFID testing
- Infrared testing
- Privacy review

Each of these modules is further broken down to detail what a security auditor should test. For example, under Bluetooth testing (page 75), the auditor should do the following:

1. Verify that there is an organizational security policy that addresses the use of wireless technology, including Bluetooth technology.

2. Perform a complete inventory of all Bluetooth wireless devices.

3. Perform brute force attacks against Bluetooth access points to discern the strength of the password. Verify that passwords contain numbers and special characters. Bluetooth access points use case-insensitive passwords, which makes it easier for attackers to conduct a brute force guessing attack due to the smaller space of possible passwords.

4. Verify the actual perimeter of the Bluetooth network.

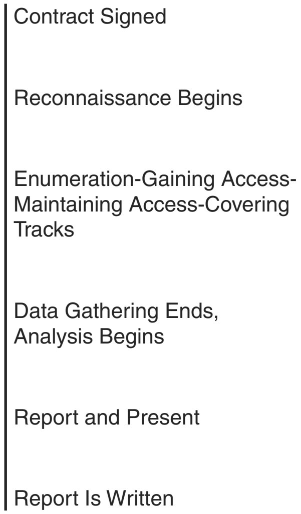
5. Verify that the Bluetooth devices are set to the lowest power setting to maintain sufficient operation that will keep transmissions within the secure boundaries of the organization.

The OSSTMM, although broader than just penetration testing, serves as a good framework to start with.

NOTE Anyone can contribute to the OSSTMM project. If you want to contribute to it, go to http://www.isecom.org/contact.shtml.

After you have collected the data, you can begin your assessment. Figure 3-3 illustrates the complete process from the point of signing the contract to the point of writing the report.

Figure 3-3 *Penetration Testing Life Cycle*


Contract Signed
Reconnaissance Begins
Enumeration-Gaining Access-Maintaining Access-Covering Tracks
Data Gathering Ends, Analysis Begins
Report and Present
Report Is Written

After you have collated and analyzed all data, it is time to write your report.

Documentation

A penetration test is useless without something tangible to give to a client or executive officer. A report should detail the outcome of the test and, if you are making recommendations, document the recommendations to secure any high-risk systems.

The report should contain the following sections:

- Executive Summary
- Project Scope
- Results Analysis
- Summary
- Appendixes

Executive Summary

The Executive Summary is a short high-level overview of the test. It is written for key executives who want to know the bottom line about how this affects their company but probably do not care much about the technical details. A sample Executive Summary would read as follows:

Executive Summary

This report details a recent intrusion test on <client name> as performed by <testing firm> between the dates of <dates>. <Client> contracted <testing firm> on <date of signed contract> to assess the security of <client>'s [public/private] network by emulating the techniques of a malicious attacker. A combination of tests was executed against <client name> [public/private] network, including port scans, exploit tests, ICMP scans, and other means to be detailed later in the report.

After reviewing the results of the tests, <testing firm> recommends the following to improve network security:

<bulleted list of suggestions>

Included in this report is a brief introduction about intrusion testing and an explanation of the scope of tests performed. This is followed by the complete results of the test and assessments of the results.

As the sample demonstrates, you should keep the Executive Summary brief. It is usually only a page long. You might encounter executive officers who stay only long enough for a brief five-minute introduction and overview of the Executive Summary followed by a question and answer period. Therefore, you should keep your Executive Summary brief and to the point within the context of how the results impact the business as a whole.

Your Executive Summary should also include a business case detailing the impact of your findings and any associated costs in fixing discovered vulnerabilities. You can use charts to support your case and make the report easier to read.

As a penetration tester, you are considered a specialist. You are hired to give not just your findings but also an analysis. You should include in your Executive Summary information on how your client compares with other companies you have performed tests on. To preserve confidentiality, you should not offer the names of any other clients, but instead provide generic statements as to whether the security of the company falls short or excels when compared to other companies in the same industry.

TIP Because some of the officers might be unfamiliar with the need or purpose of penetration testing, the best practice is to include a one-page description after the Executive Summary explaining why penetration testing is important and what it entails. Include statistics and define common terms that you will use throughout the remainder of the report. This piques the interest of the readers and illustrates the importance of your work.

Project Scope

The Project Scope should include the IP address range tested against and the boundaries defined in the contract. The boundaries include such things as whether you employed social engineering, whether you tested the public (Internet-facing) or private networks, and whether you permitted Trojans and backdoor software applications such as Back Orifice. Although the timeframe for the test is included in the Executive Summary, you should include it here, too, because it relates to the Project Scope.

You should also include an estimate of the number of exploits attempted and their type. For example, the report might say this:

> More than 230 tests were performed against hosts. These included, but were not limited to, the following:
>
> - Backdoor application vulnerabilities
> - CGI vulnerabilities
> - FTP server vulnerabilities
> - Game server vulnerabilities
> - Mail server vulnerabilities
> - Other server vulnerabilities
> - Network-based services vulnerabilities
> - Firewall vulnerabilities
> - Remote administration vulnerabilities
> - Web server vulnerabilities
> - CERT/CC advisory testing
> - BugTraq advisory testing
> - Dictionary attacks
> - CGI scanner
> - Port scanner
> - ICMP tests

Results Analysis

The Results Analysis is the meat of the report. The length of this section can vary from as few as ten pages to as many as several hundred pages, depending on the scope and detail of the tests. You should use a base template for this section, including the following:

- IP address and domain name of host
- Listening TCP and UDP ports

- Service description
- Tests performed
- Vulnerability analysis

The following is a sample results analysis.

IP: 172.16.22.199 Name: CorpWebSrvr1

Port	Service	Description
80	HTTP (Web)	Host appears to be running Microsoft Internet Information Server 5.0. Attempts to penetrate included the following: 1) msadc exploit, 2) codebrw.asp exploit, 3) showcode.asp exploit, 4) cgi exploits, 5) webhits.dll / webhits.htw exploits, 6) $data exploit, 7) ASP dot bug exploit, 8) ISM.dll buffer truncation exploit, 9) .idc and .ida exploits, 10) +htr exploits, 11) adsamples exploit, 12) /iisadmnpasswd, 13) dictionary password cracking, 14) brute force password cracking, and 15) SQL injection.
443	HTTPS (Secure Web)	A 1024-bit digital certificate is used that will expire December 15, 2005. The certificate is encrypted using RSA Sha1 encryption and is signed by VeriSign.

Vulnerability Analysis

Vulnerability: Unicode Directory Traversal
Risk: High
Description: A flaw in IIS allows for a malicious hacker to execute code on a target system. During testing, the following was entered into the URL string in a Microsoft Internet Explorer web browser:

```
http://www.hackmynetwork.com/scripts/..%co%af%../..%co%af%../..%co%af%../
  ..%co%af%../..%co%af%../..%co%af%../..%co%af%../..%co%af%../winnt/system32/
  cmd.exe?/c+dir+c:
```

This resulted in getting a complete directory listing of the target server. You can use this same syntax to execute code on a target system. Attackers can use this exploit to steal confidential information, launch another attack, or perform DoS attacks on the target network.

Vulnerability: IIS Sample Codebrws.asp
Risk: Medium
The codebrws.asp sample file is shipped with Microsoft IIS server and can be used to remotely read arbitrary files. This might reveal sensitive information or code that can be used for further exploits.

Summary

The Executive Summary at the beginning of the report is directed toward key decision makers; the final Summary is directed toward technical personnel. This section should contain a bulleted list of technical recommendations for the client.

Appendixes

Finally, your report should include appendixes that include the following:

- Contact information
- Screen shots
- Log output

Screen shots and log output are especially important. You should document everything you do during the test to prove your work to the client.

When you present your client with the report, he should sign a receipt for it to acknowledge that you have turned over your only copy of it and that you cannot be expected to reproduce copies of the report without doing the work again. Your report should be digitally signed and presented in a form that prevents editing, such as PDF files. The footer of each page should state that the information is confidential.

After you have presented your report, you need to agree with your client as to what to do with your copy of it. Recommended practice is to shred any hard copies you have and delete any soft copies using disk wiping software such as PGP.

Summary

This chapter presented an introduction to the process of creating a test plan for performing a penetration test. Penetration testing includes the following steps:

1. Reconnaissance
2. Enumeration
3. Gaining access
4. Maintaining access
5. Covering tracks

Before you get started, you should devise a methodical plan on how you are to perform your test. You can use the Open-Source Security Testing Methodology Manual (OSSTMM) as a starting guide.

After you finish the test, you construct a report. The report should contain each of the following:

- Executive Summary
- Project Scope
- Results Analysis
- Summary
- Appendixes

After you present the report, the next step is to discuss policies. Any vulnerability that exists on a network of an organization is either because the organization is not following its security policies or because an important component is missing from its security policy. You can read more about security policies in Appendix A, “Preparing a Security Policy.”

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