Certified Ethical Hacker (CEH) Version 9 Cert Guide

Second Edition

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PEARSON

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About the Author

Michael Gregg (CISSP, SSCP, CISA, MCSE, MCT, CTT+, A+, N+, Security+, CCNA, CASP, CISA, CISM, CEH, CHFI, and GSEC) is the founder and president of Superior Solutions, Inc., a Houston, Texas-based IT security consulting firm. Superior Solutions performs security assessments and penetration testing for Fortune 1000 firms. The company has performed security assessments for private, public, and governmental agencies. Its Houston-based team travels the country to assess, audit, and provide training services.

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Michael has been quoted in newspapers such as the *New York Times* and featured on various television and radio shows, including NPR, ABC, CBS, Fox News, and others, discussing cyber security and ethical hacking. He has created more than a dozen IT security training classes. He has created and performed video instruction on many security topics, such as cyber security, CISSP, CISA, Security+, and others.

When not consulting, teaching, or writing, Michael enjoys 1960s muscle cars and has a slot in his garage for a new project car.

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Dedication

In loving memory of my mother-in-law, Elvira Estrello Cuellar, who always stood behind me, encouraged me, and prayed that all my dreams would come true.

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As the reader of this book, *you* are our most important critic and commentator. We value your opinion and want to know what we're doing right, what we could do better, what areas you'd like to see us publish in, and any other words of wisdom you're willing to pass our way.

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Introduction

The EC-Council Certified Ethical Hacker (CEH) exam has become the leading ethical hacking certification available today. CEH is recognized by both employers and the industry as providing candidates with a solid foundation of hands-on security testing skills and knowledge. The CEH exam covers a broad range of security concepts to prepare candidates for the technologies that they are likely to be working with if they move into a role that requires hands-on security testing.

Let's talk some about what this book is. It offers you the information for what you need to know to pass the exam. It's highly recommend that you spend time with the tools and software discussed in the book. You should also complete a number of practice tests to become more comfortable with the type of questions that you will see on the exam and get used to completing 125 questions in four hours. Depending on your personal study habits or learning style, you might benefit from buying this book *and* taking a class.

Cert Guides are meticulously crafted to give you the best possible learning experience for the particular characteristics of the technology covered and the actual certification exam. The instructional design implemented in the Cert Guides reflects the nature of the CEH certification exam. The Cert Guides provide you with the factual knowledge base you need for the exams, and then take it to the next level with exercises and exam questions that require you to engage in the analytic thinking needed to pass the CEH exam.

EC-Council recommends that the typical candidate for this exam have a minimum of 2 years of experience in IT security. In addition, EC-Council recommends that candidates have preexisting knowledge of networking, TCP/IP, and basic computer knowledge.

Now let's briefly discuss what this book is not. It is not a book designed to teach you advanced hacking techniques or the latest hack. This book's goal is to prepare you for the CEH 312-50 exam, and it is targeted to those with some networking, OS, and systems knowledge. It provides basics to get you started in the world of ethical hacking and prepare you for the exam. Those wanting to become experts in this field should be prepared for additional reading, training, and practical experience.

How to Use This Book

This book uses several key methodologies to help you discover the exam topics on which you need more review, to help you fully understand and remember those details, and to help you prove to yourself that you have retained your knowledge of those topics. Therefore, this book does not try to help you pass the exams only by memorization but by truly learning and understanding the topics.

The book includes many features that provide different ways to study so you can be ready for the exam. If you understand a topic when you read it but do not study it any further, you probably will not be ready to pass the exam with confidence. The features included in this book give you tools that help you determine what you know, review what you know, better learn what you don't know, and be well prepared for the exam. These tools include

- **"Do I Know This Already?" Quizzes:** Each chapter begins with a quiz that helps you determine the amount of time you need to spend studying that chapter. The answers are provided in Appendix A, "Answers to the 'Do I Know This Already?' Quizzes and Review Questions," available for download on the companion website.
- **Foundation Topics:** These are the core sections of each chapter. They explain the tools, hacking concepts, and their configuration for the topics in that chapter.
- **Exam Preparation Tasks:** This section lists a series of study activities that you should complete after reading the "Foundation Topics" section. Each chapter includes the activities that make the most sense for studying the topics in that chapter. The activities include
  - **Review All Key Topics:** The Key Topic icon appears next to the most important items in the "Foundation Topics" section of the chapter. The Review All Key Topics activity lists the key topics from the chapter and their page numbers. Although the contents of the entire chapter could be on the exam, you should definitely know the information listed in each key topic. Review these topics carefully.
  - **Define Key Terms:** Although certification exams might be unlikely to ask a question such as "Define this term," the CEH 312-50 exam requires you to learn and know a lot of tools and how they are used. This section lists some of the most important terms from the chapter, asking you to write a short definition and compare your answer to the Glossary.
  - **Complete the Tables from Memory:** Like most certification guides from Pearson IT Certification, this book purposefully organizes information into tables and lists for easier study and review. Rereading these tables can prove very useful before the exam. However, it is easy to skim over the tables without paying attention to every detail, especially when you remember having seen the table's contents when reading the chapter.

    Instead of simply reading the tables in the various chapters, Appendix B, "Memory Tables," and Appendix C, "Memory Tables Answer Key," provide another review tool. Appendix B lists partially completed versions of many of the tables from the book. You can open Appendix B (a PDF on

the companion website page to this book) and print the appendix. For review, attempt to complete the tables.

Appendix C, also a PDF located on the companion website page, lists the completed tables to check yourself. You can also just refer to the tables as printed in the book.

- **Exercises:** One or more sample exercises at the end of each chapter list a series of tasks for you to practice, which apply the lessons from the chapter in a real-world setting.
- **Command Reference to Check Your Memory:** Chapters 3, 4, and 5 each include a command table that lists commonly used tools and their corresponding commands and descriptions.
- **Review Questions:** Each chapter includes review questions to help you confirm that you understand the content you just covered. The answers are provided in Appendix A, "Answers to the 'Do I Know This Already?' Quizzes and Review Questions."

Companion Website

This book's companion website gives you access to the Pearson Test Prep software (both online and Windows desktop versions) with two full practice exams, a PDF of the Glossary, and PDFs of Appendixes A, B, and C. To access the companion website, simply follow these steps:

1. Register your book by going to http://www.pearsonitcertification.com/register and entering the ISBN: **9780789756916**.
2. Respond to the challenge questions.
3. Go to your account page and click the **Registered Products** tab.
4. Click the **Access Bonus Content** link under the product listing.

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This book comes complete with the Pearson Test Prep practice test software containing two full exams. These practice tests are available to you either online or as an offline Windows application. To access the practice exams that were developed with this book, please see the instructions in the card inserted in the sleeve in the back of the book. This card includes a unique access code that enables you to activate your exams in the Pearson Test Prep software.

Accessing the Pearson Test Prep Software Online

The online version of this software can be used on any device with a browser and connectivity to the Internet, including desktop machines, tablets, and smartphones. To start using your practice exams online, simply follow these steps:

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3. Enter your email/password for your account. If you don't have a Pearson IT Certification account, you will need to establish one by going to http://www.pearsonitcertification.com/join.
4. In the **My Products** tab, click the **Activate New Product** button.
5. Enter the access code printed on the insert card in the back of your book to activate your product.
6. The product will now be listed in your My Products page. Click the **Exams** button to launch the exam settings screen and start your exam.

Accessing the Pearson Test Prep Software Offline

If you wish to study offline, you can download and install the Windows version of the Pearson Test Prep software. There is a download link for this software on the book's companion website, or you can just enter this link in your browser:

http://www.pearsonitcertification.com/content/downloads/pcpt/engine.zip

To access the book's companion website and the software, simply follow these steps:

1. Register your book by going to: http://www.pearsonitcertification.com/register and entering the ISBN: **9780789756916**.
2. Respond to the challenge questions.
3. Go to your account page and click the **Registered Products** tab.
4. Click the **Access Bonus Content** link under the product listing.
5. Click the **Install Pearson Test Prep Desktop Version** link under the Practice Exams section of the page to download the software.
6. After the software finishes downloading, unzip all the files on your computer.
7. Double-click the application file to start the installation, and follow the on-screen instructions to complete the registration.
8. When the installation is complete, launch the application and click the **Activate Exam** button on the My Products tab.

9. Click the **Activate a Product** button in the Activate Product Wizard.
10. Enter the unique access code found on the card in the sleeve in the back of your book and click the **Activate** button.
11. Click **Next** and then click **Finish** to download the exam data to your application.
12. You can now start using the practice exams by selecting the product and clicking the **Open Exam** button to open the exam settings screen.

Note that the offline and online versions will synch together, so saved exams and grade results recorded on one version will be available to you on the other as well.

Customizing Your Exams

Once you are in the exam settings screen, you can choose to take exams in one of three modes:

- Study Mode
- Practice Exam Mode
- Flash Card Mode

Study Mode allows you to fully customize your exams and review the answers as you are taking the exam. This is typically the mode you would use first to assess your knowledge and identify information gaps. Practice Exam Mode locks certain customization options, as it is presenting a realistic exam experience. Use this mode when you are preparing to test your exam readiness. Flash Card Mode strips out the answers and presents you with only the question stem. This mode is great for late-stage preparation when you really want to challenge yourself to provide answers without the benefit of seeing multiple-choice options. This mode will not provide the detailed score reports that the other two modes will, so it should not be used if you are trying to identify knowledge gaps.

In addition to these three modes, you will be able to select the source of your questions. You can choose to take exams that cover all of the chapters or you can narrow your selection to just a single chapter or the chapters that make up specific parts in the book. All chapters are selected by default. If you want to narrow your focus to individual chapters, simply deselect all the chapters and then select only those on which you wish to focus in the Objectives area.

You can also select the exam banks on which to focus. Each exam bank comes complete with a full exam of questions that cover topics in every chapter. The two exams printed in the book are available to you as well as two additional exams of unique

questions. You can have the test engine serve up exams from all four banks or just from one individual bank by selecting the desired banks in the exam bank area.

There are several other customizations you can make to your exam from the exam settings screen, such as the time of the exam, the number of questions served up, whether to randomize questions and answers, whether to show the number of correct answers for multiple-answer questions, or whether to serve up only specific types of questions. You can also create custom test banks by selecting only questions that you have marked or questions on which you have added notes.

Updating Your Exams

If you are using the online version of the Pearson Test Prep software, you should always have access to the latest version of the software as well as the exam data. If you are using the Windows desktop version, every time you launch the software, it will check to see if there are any updates to your exam data and automatically download any changes that were made since the last time you used the software. This requires that you are connected to the Internet at the time you launch the software.

Sometimes, due to many factors, the exam data may not fully download when you activate your exam. If you find that figures or exhibits are missing, you may need to manually update your exams.

To update a particular exam you have already activated and downloaded, simply click the **Tools** tab and click the **Update Products** button. Again, this is only an issue with the desktop Windows application.

If you wish to check for updates to the Pearson Test Prep exam engine software, Windows desktop version, simply click the **Tools** tab and click the **Update Application** button. This will ensure you are running the latest version of the software engine.

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End-of-Chapter Review Tools

Chapters 1 through 12 each have several features in the "Exam Preparation Tasks" and "Review Questions" sections at the end of the chapter. You might have already worked through these in each chapter. However, you might also find it helpful to use these tools again as you make your final preparations for the exam.

Goals and Methods

The most important and somewhat obvious goal of this book is to help you pass the CEH exam. In fact, if the primary objective of this book was different, the book's title would be misleading; however, the methods used in this book to help you pass the CEH exam are designed to also make you much more knowledgeable about how penetration testers do their job. While this book and the practice tests together have more than enough questions to help you prepare for the actual exam, the method in which they are used is not to simply make you memorize as many questions and answers as you possibly can.

One key methodology used in this book is to help you discover the exam topics and tools that you need to review in more depth. Remember that the CEH exam will expect you to understand not only hacking concepts but also common tools. So, this book does not try to help you pass by memorization, but helps you truly learn and understand the topics and when specific tools should be used. This book will help you pass the CEH exam by using the following methods:

- Helping you discover which test topics you have not mastered
- Providing explanations and information to fill in your knowledge gaps
- Supplying exercises and scenarios that enhance your ability to recall and deduce the answers to test questions
- Providing practice exercises on the topics and the testing process via test questions in the practice tests

Who Should Read This Book?

This book is not designed to be a general security book or one that teaches network defenses. This book looks specifically at how attackers target networks, what tools attackers use, and how these techniques can be used by ethical hackers. Overall, this book is written with one goal in mind: to help you pass the exam.

So, why should you want to pass the CEH exam? Because it's one of the leading entry-level hacking certifications. It is also featured as part of DoD Directive 8140, and having the certification might mean a raise, a promotion, or other recognition. It's also a chance to enhance your résumé and to demonstrate that you are serious about continuing the learning process and that you're not content to rest on your laurels. Or one of many other reasons.

Strategies for Exam Preparation

Although this book is designed to prepare you to take and pass the CEH certification exam, there are no guarantees. Read this book, work through the questions and exercises, and when you feel confident, take the practice exams and additional exams provided in the test software. Your results should tell you whether you are ready for the real thing.

When taking the actual certification exam, make sure that you answer all the questions before your time limit expires. Do not spend too much time on any one question. If you are unsure about the answer to a question, answer it as best as you can, and then mark it for review.

Remember that the primary objective is not to pass the exam but to understand the material. When you understand the material, passing the exam should be simple. Knowledge is a pyramid; to build upward, you need a solid foundation. This book and the CEH certification are designed to ensure that you have that solid foundation.

Regardless of the strategy you use or the background you have, the book is designed to help you get to the point where you can pass the exam with the least amount of time required. For instance, there is no need for you to practice or read about scanning and Nmap if you fully understand the tool already. However, many people like to make sure that they truly know a topic and therefore read over material that they already know. Several book features will help you gain the confidence that you need to be convinced that you know some material already, and to help you know what topics you need to study more.

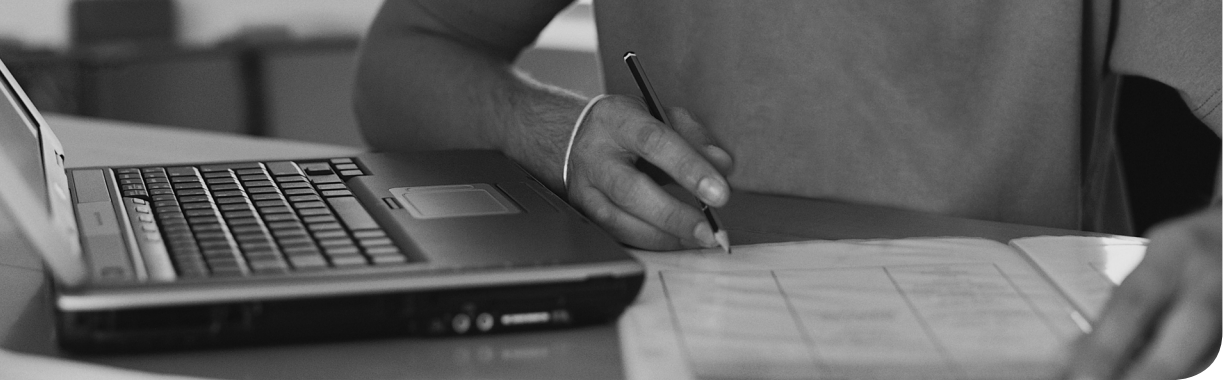
How This Book Is Organized

Although this book could be read cover to cover, it is designed to be flexible and allow you to easily move between chapters and sections of chapters to cover just the material that you need more work with. Chapter 1 provides an overview of ethical hacking and reviews some basics. Chapters 2 through 12 are the core chapters. If you do intend to read them all, the order in the book is an excellent sequence to use.

The core chapters, Chapters 2 through 12, cover the following topics:

- **Chapter 2, "The Technical Foundations of Hacking"**—This chapter discusses basic techniques that every security professional should know. This chapter reviews TCP/IP and essential network knowledge.
- **Chapter 3, "Footprinting and Scanning"**—This chapter discusses the basic ideas behind target selection and footprinting. The chapter reviews what type of information should be researched during footprinting and how passive and active footprinting and scanning tools should be used.

- **Chapter 4, "Enumeration and System Hacking"**—This chapter covers enumeration, a final chance to uncover more detailed information about a target before system hacking. System hacking introduces the first step at which the hacker is actually exploiting a vulnerability in systems.
- **Chapter 5, "Malware Threats"**—This chapter examines all types of malware, including Trojans, worms, and viruses, and examines how malware is analyzed. This can include both static and dynamic analysis of malicious code.
- **Chapter 6, "Sniffers, Session Hijacking, and Denial of Service"**—This chapter covers sniffing tools such as Wireshark. The chapter examines the difference in passive and active sniffing. It also reviews session hijacking and DoS, DDoS, and botnet techniques.
- **Chapter 7, "Web Server Hacking, Web Applications, and Database Attacks"**—This chapter covers the basics of web hacking, application attacks, and how SQL injection works.
- **Chapter 8, "Wireless Technologies, Mobile Security, and Attacks"**—This chapter examines the underlying technology of wireless technologies, mobile devices, Android, iOS, and Bluetooth.
- **Chapter 9, "IDS, Firewalls, and Honeypots"**—This chapter discusses how attackers bypass intrusion detection systems and firewalls. This chapter also reviews honeypots and honeynets and how they are used to jail attackers.
- **Chapter 10, "Physical Security and Social Engineering"**—This chapter covers the fundamentals of social engineering attacks and introduces the concept that not all attacks are technical in nature. Attacks can be technical, social, or even physical. Finally, this chapter reviews important concepts of penetration testing.
- **Chapter 11, "Cryptographic Attacks and Defenses"**—This chapter covers the fundamentals of attacking cryptographic systems and how tools such as encryption can be used to protect critical assets.
- **Chapter 12, "Cloud Computing and Botnets"**—This chapter covers the fundamentals of cloud computing and reviews common cloud modeling types. The chapter reviews common cloud security issues and examines penetration testing concerns. The chapter also examines botnets and examines how they are used, detected, and dealt with.



This chapter covers the following topics:

- **Security Fundamentals:** You need to understand the security triad—confidentiality, integrity, and availability—because they form the basis on which all security is built.
- **Security Testing:** It is important to realize that ethical hackers differ from hackers in that ethical hackers perform activities only after obtaining written permission from the client that different types of tests can be performed.
- **Hacker and Cracker Descriptions:** Hackers can be known by many names. You should know these and what motivates various types of hacking attacks.
- **Ethical Hackers:** Ethical hackers perform security tests to strengthen the organization for which they work. You need to know the standards by which they work to perform their jobs ethically and effectively.
- **Test Plans—Keeping It Legal:** Test plans and deliverables usually include reports and data that detail the types of vulnerabilities discovered.
- **Ethics and Legality:** Knowledge of the legal environment is critical because you must ensure and maintain proper legal standing. In the United States, federal laws 18 U.S. Code Sections 1029 and 1030 are two such laws.

This chapter introduces you to the world of ethical hacking. Ethical hacking is a form of legal hacking done with the permission of an organization to help increase its security. This chapter discusses many of the business aspects of penetration (pen) testing. How should a pen test be performed, what types can be performed, what the legal requirements are, and what type of report should be delivered are all basic items that you need to know before you perform any type of security testing. However, first, you need to review some security basics. That's right, as my mom always said, "You must walk before you can run!" This chapter starts with a discussion of confidentiality, integrity, and availability. Next, it moves on to the subject of risk analysis, and it finishes up with the history of hacking and a discussion of some of the pertinent laws.

An Introduction to Ethical Hacking

CAUTION Nothing contained in this book is intended to teach or encourage the use of security tools or methodologies for illegal or unethical purposes. Always act in a responsible manner. Make sure you have written permission from the proper individuals before you use any of the tools or techniques described in this book. Always obtain permission before installing any security tools on a network.

"Do I Know This Already?" Quiz

The "Do I Know This Already?" quiz allows you to assess whether you should read this entire chapter thoroughly or jump to the "Exam Preparation Tasks" section. If you are in doubt about your answers to these questions or your own assessment of your knowledge of the topics, read the entire chapter. Table 1-1 lists the major headings in this chapter and their corresponding "Do I Know This Already?" quiz questions. You can find the answers in Appendix A, "Answers to the 'Do I Know This Already?' Quizzes and Review Questions."

Table 1-1 "Do I Know This Already?" Section-to-Question Mapping

Foundation Topics Section	Questions
Security Fundamentals	1
Security Testing	8–10
Hacker and Cracker Descriptions	3, 4, 7
Ethical Hackers	5
Test Plans—Keeping It Legal	6
Ethics and Legality	2

CAUTION The goal of self-assessment is to gauge your mastery of the topics in this chapter. If you do not know the answer to a question or are only partially sure of the answer, you should mark that question as wrong for purposes of the self-assessment. Giving yourself credit for an answer you incorrectly guess skews your self-assessment results and might provide you with a false sense of security.

1. What are the three main tenants of security?
   a. Confidentiality, integrity, and availability
   b. Authorization, authentication, and accountability
   c. Deter, delay, and detect
   d. Acquire, authenticate, and analyze

2. Which of the following laws pertains to accountability for public companies relating to financial information?
   a. FISMA
   b. SOX
   c. 18 U.S.C. 1029
   d. 18 U.S.C. 1030

3. Which type of testing occurs when individuals know the entire layout of the network?
   a. Black box
   b. Gray box
   c. White box
   d. Blind testing

4. Which type of testing occurs when you have no knowledge of the network?
   a. Black box
   b. Gray box
   c. White box
   d. Blind testing

5. Which form of testing occurs when insiders are not informed of the pending test?
   a. Black box
   b. Gray box
   c. White box
   d. Blind testing

6. How is ethical hacking different from simple hacking?
   a. Ethical hackers never launch exploits.
   b. Ethical hackers have written permission.
   c. Ethical hackers act with malice.
   d. Ethical hackers have permission.

7. Which type of hacker is considered a good guy?
   a. White hat
   b. Gray hat
   c. Black hat
   d. Suicide hacker

8. Which type of hacker is considered unethical?
   a. White hat
   b. Gray hat
   c. Black hat
   d. Brown hat

9. Which type of hacker will carry out an attack even if the result could be a very long prison term?
   a. White hat
   b. Gray hat
   c. Black hat
   d. Suicide hacker

10. Which type of hacker performs both ethical and unethical activities?
    a. White hat
    b. Gray hat
    c. Black hat
    d. Suicide hacker

Foundation Topics

Security Fundamentals

Security is about finding a balance, as all systems have limits. No one person or company has unlimited funds to secure everything, and we cannot always take the most secure approach. One way to secure a system from network attack is to unplug it and make it a standalone system. Although this system would be relatively secure from Internet-based attackers, its usability would be substantially reduced. The opposite approach of plugging it in directly to the Internet without any firewall, antivirus, or security patches would make it extremely vulnerable, yet highly accessible. So, here again, you see that the job of security professionals is to find a balance somewhere between security and usability. Figure 1-1 demonstrates this concept. What makes this so tough is that companies face many more different challenges today than in the past. Whereas many businesses used to be bricks and mortar, they are now bricks and clicks. Modern businesses face many challenges, such as the increased sophistication of cyber criminals and the evolution of advanced persistent threats.

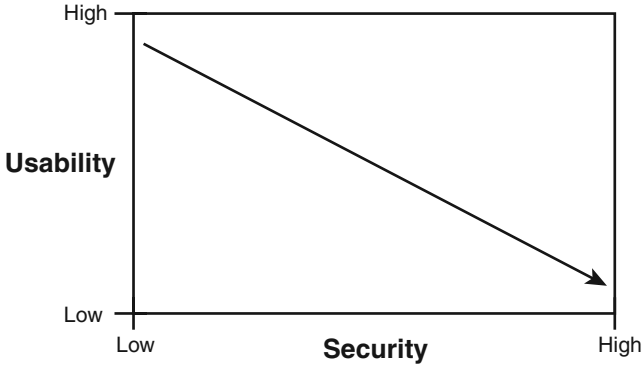


Figure 1-1 Security Versus Usability

To find this balance and meet today's challenges, you need to know what the goals of the organization are, what security is, and how to measure the threats to security. The next section discusses the goals of security.

Key Topic

Goals of Security

There are many ways in which security can be achieved, but it's universally agreed that the security triad of confidentiality, integrity, and availability (CIA) form the basic building blocks of any good security initiative.

Confidentiality addresses the secrecy and privacy of information. Physical examples of confidentiality include locked doors, armed guards, and fences. In the logical world, confidentiality must protect data in storage and in transit. For a real-life example of the failure of confidentiality, look no further than the recent news reports that have exposed how several large-scale breaches in confidentiality were the fault of corporations, such as Yahoo's loss of a billion passwords that occurred in the 2012 and 2013 timeframe and was reported in 2016 or the August 2016 revelation that more than 68 million Dropbox users had their usernames and passwords compromised in 2012. The graphic shown in Figure 1-2 from www.informationisbeautiful.net shows the scope of security breaches over the past several years. It offers a few examples of the scope of personally identifiable information (PII) that has been exposed.

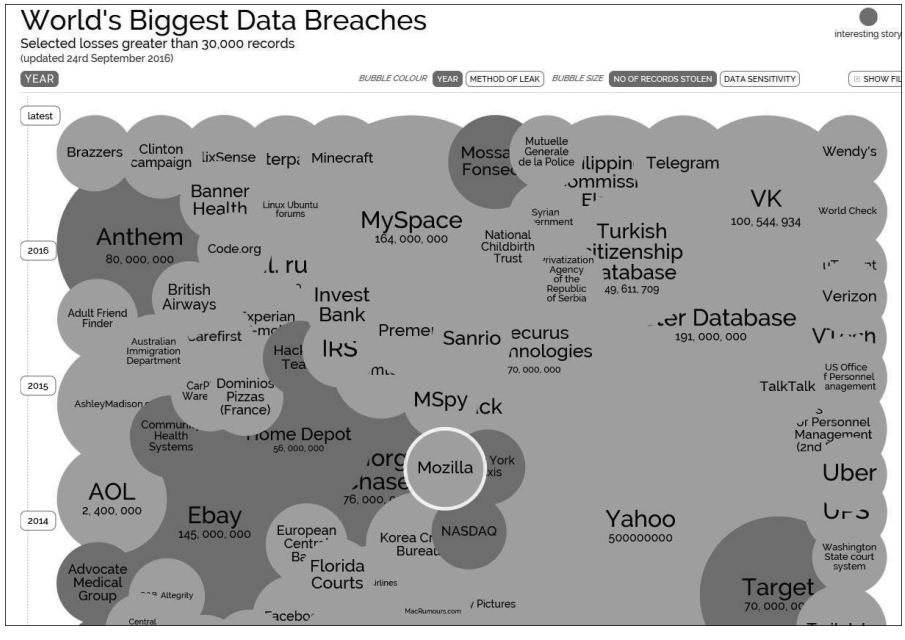


Figure 1-2 World's Biggest Data Breaches as of September 2016

Integrity is the second piece of the CIA security triad. Integrity provides for the correctness of information. It allows users of information to have confidence in its correctness. Correctness doesn't mean that the data is accurate, just that it hasn't been modified in storage or transit. Integrity can apply to paper or electronic documents. It is much easier to verify the integrity of a paper document than an electronic one. Integrity in electronic documents and data is much more difficult to protect than in paper ones. Integrity must be protected in two modes: storage and transit.

Information in storage can be protected if you use access and audit controls. Cryptography can also protect information in storage through the use of hashing algorithms. Real-life examples of this technology can be seen in programs such as Tripwire, MD5Sum, and Windows Resource Protection (WRP). Integrity in transit can be ensured primarily by the protocols used to transport the data. These security controls include hashing and cryptography.

Availability is the third leg of the CIA triad. Availability simply means that when a legitimate user needs the information, it should be available. As an example, access to a backup facility 24×7 does not help if there are no updated backups from which to restore. Similarly, cloud storage is of no use if the cloud provider is down. Service-level agreements (SLA) are one way availability can be ensured, and backups are another. Backups provide a copy of critical information should files and data be destroyed or equipment fail. Failover equipment is another way to ensure availability. Systems such as redundant array of inexpensive disks (RAID) and services such as redundant sites (hot, cold, and warm) are two other examples. Disaster recovery is tied closely to availability, as it's all about getting critical systems up and running quickly. Denial of service (DoS) is an attack against availability. Figure 1-3 shows an example of the CIA triad.

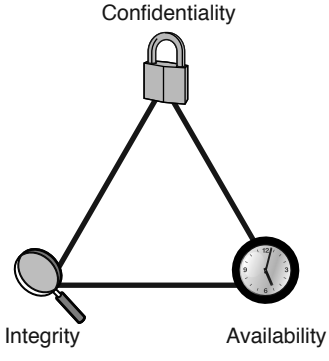


Figure 1-3 The CIA Triad

Risk, Assets, Threats, and Vulnerabilities

As with any new technology topic, to better understand the security field, you must learn the terminology that is used. To be a security professional, you need to understand the relationship between risk, threats, assets, and vulnerabilities.

Risk is the probability or likelihood of the occurrence or realization of a threat. There are three basic elements of risk: assets, threats, and vulnerabilities. To deal with risk, the U.S. federal government has adopted a risk management framework (RMF). The RMF process is based on the key concepts of mission- and risk-based, cost-effective,

and enterprise information system security. NIST Special Publication 800-37, "Guide for Applying the Risk Management Framework to Federal Information Systems," transforms the traditional Certification and Accreditation (C&A) process into the six-step Risk Management Framework (RMF). Let's look at the various components that are associated with risk, which include assets, threats, and vulnerabilities.

An asset is any item of economic value owned by an individual or corporation. Assets can be real—such as routers, servers, hard drives, and laptops—or assets can be virtual, such as formulas, databases, spreadsheets, trade secrets, and processing time. Regardless of the type of asset discussed, if the asset is lost, damaged, or compromised, there can be an economic cost to the organization.

NOTE No organization can ever be 100 percent secure. There will always be some risk left over. This is known as residual risk, the amount of risk left after safeguards and controls have been put in place to protect the asset.

A threat sets the stage for risk and is any agent, condition, or circumstance that could potentially cause harm, loss, or damage, or compromise an IT asset or data asset. From a security professional's perspective, threats can be categorized as events that can affect the confidentiality, integrity, or availability of the organization's assets. These threats can result in destruction, disclosure, modification, corruption of data, or denial of service. Examples of the types of threats an organization can face include the following:

- **Natural disasters, weather, and catastrophic damage:** Hurricanes, such as Matthew (which hit Florida and the U.S. East Coast in 2016), storms, weather outages, fire, flood, earthquakes, and other natural events compose an ongoing threat.
- **Hacker attacks:** An insider or outsider who is unauthorized and purposely attacks an organization's components, systems, or data.
- **Cyberattack:** Attackers who target critical national infrastructures such as water plants, electric plants, gas plants, oil refineries, gasoline refineries, nuclear power plants, waste management plants, and so on. Stuxnet is an example of one such tool designed for just such a purpose.
- **Viruses and malware:** An entire category of software tools that are malicious and are designed to damage or destroy a system or data. Cryptowall and Sality are two example of malware.
- **Disclosure of confidential information:** Anytime a disclosure of confidential information occurs, it can be a critical threat to an organization if that disclosure causes loss of revenue, causes potential liabilities, or provides a competitive advantage to an adversary.

- **Denial of service (DoS) or distributed DoS (DDoS) attacks:** An attack against availability that is designed to bring the network or access to a particular TCP/IP host/server to its knees by flooding it with useless traffic. Today, most DoS attacks are launched via botnets, whereas in the past tools such as the Ping of Death or Teardrop may have been used. Like malware, hackers constantly develop new tools so that Storm and Mariposa are replaced with other more current threats.

NOTE If the organization is vulnerable to any of these threats, there is an increased risk of successful attack.

A vulnerability is a weakness in the system design, implementation, software, or code, or the lack of a mechanism. A specific vulnerability might manifest as anything from a weakness in system design to the implementation of an operational procedure. Vulnerabilities might be eliminated or reduced by the correct implementation of safeguards and security countermeasures.

Vulnerabilities and weaknesses are common mainly because there isn't any perfect software or code in existence. Vulnerabilities can be found in each of the following:

- **Applications:** Software and applications come with tons of functionality. Applications may be configured for usability rather than for security. Applications may be in need of a patch or update that may or may not be available. Attackers targeting applications have a target-rich environment to examine. Just think of all the applications running on your home or work computer.
- **Operating systems:** This operating system software is loaded in workstations and servers. Attacks can search for vulnerabilities in operating systems that have not been patched or updated.
- **Misconfiguration:** The configuration file and configuration setup for the device or software may be misconfigured or may be deployed in an unsecure state. This might be open ports, vulnerable services, or misconfigured network devices. Just consider wireless networking. Can you detect any wireless devices in your neighborhood that have encryption turned off?
- **Shrinkwrap software:** The application or executable file that is run on a workstation or server. When installed on a device, it can have tons of functionality or sample scripts or code available.

Vulnerabilities are not the only concern the ethical hacker will have. Ethical hackers must also understand how to protect data. One way to protect data is through backup.

Backing Up Data to Reduce Risk

One way to reduce risk is by backing up data. While backups won't prevent problems such as ransomware, they can help mitigate the threat. The method your organization chooses depends on several factors:

- How often should backups occur?
- How much data must be backed up?
- How will backups be stored and transported offsite?
- How much time do you have to perform the backup each day?

The following are the three types of backup methods. Each backup method has benefits and drawbacks. Full backups take the longest time to create, whereas incremental backups take the least.

- **Full backups:** During a full backup, all data is backed up, and no files are skipped or bypassed; you simply designate which server to back up. A full backup takes the longest to perform and the least time to restore when compared to differential or incremental backups because only one set of tapes is required.
- **Differential backups:** Using differential backup, a full backup is typically done once a week and a daily differential backup is completed that copies all files that have changed since the last full backup. If you need to restore, you need the last full backup and the most recent differential backup.
- **Incremental backups:** This backup method works by means of a full backup scheduled for once a week, and only files that have changed since the previous full backup or previous incremental backup are backed up each day. This is the fastest backup option, but it takes the longest to restore. Incremental backups are unlike differential backups. When files are copied, the archive bit is reset; therefore, incremental backups back up only changes made since the last incremental backup.

Defining an Exploit

An *exploit* refers to a piece of software, a tool, a technique, or a process that takes advantage of a vulnerability that leads to access, privilege escalation, loss of integrity, or denial of service on a computer system. Exploits are dangerous because all software has vulnerabilities; hackers and perpetrators know that there are vulnerabilities and seek to take advantage of them. Although most organizations attempt to find and fix vulnerabilities, some organizations lack sufficient funds for securing their networks. Sometimes you may not even know the vulnerability exists, and that is

known as zero day exploit. Even when you do know there is a problem, you are burdened with the fact that a window exists between when a vulnerability is discovered and when a patch is available to prevent the exploit. The more critical the server, the slower it is usually patched. Management might be afraid of interrupting the server or afraid that the patch might affect stability or performance. Finally, the time required to deploy and install the software patch on production servers and workstations exposes an organization's IT infrastructure to an additional period of risk.

NOTE If you are looking for a good example of exploit code, consider the Mirai botnet. This exploit allowed hackers to take control of Internet of Things (IoT) devices with default usernames and passwords. While not the biggest botnet, it was able to exploit over 500,000 IoT devices in a very short period of time. Read more about it at http://www.computerweekly.com/news/450400311/Mirai-IoT-botnet-code-release-raises-fears-of-surge-in-DDoS-attacks.

Risk Assessment

A risk assessment is a process to identify potential security hazards and evaluate what would happen if a hazard or unwanted event were to occur. There are two approaches to risk assessment: qualitative and quantitative. Qualitative risk assessment methods use scenarios to drive a prioritized list of critical concerns and do not focus on dollar amounts. Example impacts might be identified as critical, high, medium, or low. Quantitative risk assessment assigns a monetary value to the asset. It then uses the anticipated exposure to calculate a dollar cost. These steps are as follows:

Step 1. **Determine the single loss expectancy (SLE):** This step involves determining the single amount of loss you could incur on an asset if a threat becomes realized or the amount of loss you expect to incur if the asset is exposed to the threat one time. SLE is calculated as follows: SLE = asset value × exposure factor. The exposure factor (EF) is the subjective, potential portion of the loss to a specific asset if a specific threat were to occur.

Step 2. **Evaluate the annual rate of occurrence (ARO):** The purpose of evaluating the ARO is to determine how often an unwanted event is likely to occur on an annualized basis.

Step 3. **Calculate the annual loss expectancy (ALE):** This final step of the quantitative assessment seeks to combine the potential loss and rate per year to determine the magnitude of the risk. This is expressed as annual loss expectancy (ALE), which is calculated as follows: ALE = SLE × ARO.

CEH exam questions might ask you to use the SLE and ALE risk formulas. As an example, a question might ask, "If you have data worth $500 that has an exposure

factor of 50 percent due to lack of countermeasures such as antivirus, what would the SLE be?" You would use the following formula to calculate the answer:

SLE × EF = SLE, or $500 × .50 = $250

As part of a follow-up test question, could you calculate the annualized loss expectance (ALE) if you knew that this type of event typically happened four times a year? Yes, as this would mean the ARO is 4. Therefore:

ALE = SLE × ARO or $250 × 4 = $1,000

This means that, on average, the loss is $1,000 per year.

Because the organization cannot provide complete protection for all of its assets, a system must be developed to rank risk and vulnerabilities. Organizations must seek to identify high-risk and high-impact events for protective mechanisms. Part of the job of an ethical hacker is to identify potential vulnerabilities to these critical assets, determine potential impact, and test systems to see whether they are vulnerable to exploits while working within the boundaries of laws and regulations.

TIP Although it's important to know the steps involved in hacking, it's just as important to know the formulas used for risk assessment. These include: SLE = AV × EF and ALE = SLE × ARO.

Key Topic

Security Testing

Security testing is the primary job of ethical hackers. These tests might be configured in such way that the ethical hackers have no knowledge, full knowledge, or partial knowledge of the target of evaluation (TOE).

NOTE The term *target of evaluation* is widely used to identify an IT product or system that is the subject of an evaluation. The EC-Council and some security guidelines and standards use the term to describe systems that are being tested to measure their CIA.

The goal of the security test (regardless of type) is for the ethical hacker to test the TOE's security controls and evaluate and measure its potential vulnerabilities.

No-Knowledge Tests (Black Box)

No-knowledge testing is also known as black box testing. Simply stated, the security team has no knowledge of the target network or its systems. Black box testing simulates an outsider attack, as outsiders usually don't know anything about the network or systems they are probing. The attacker must gather all types of information about

the target to begin to profile its strengths and weaknesses. The advantages of black box testing include the following:

- The test is unbiased because the designer and the tester are independent of each other.
- The tester has no prior knowledge of the network or target being examined. Therefore, there are no preconceptions about the function of the network.
- A wide range of reconnaissance work is usually done to footprint the organization, which can help identify information leakage.
- The test examines the target in much the same way as an external attacker.

The disadvantages of black box testing include the following:

- Performing the security tests can take more time than partial- or full-knowledge testing.
- It is usually more expensive because it takes more time to perform.
- It focuses only on what external attackers see, whereas in reality many attacks are launched by insiders.

Full-Knowledge Testing (White Box)

White box testing takes the opposite approach of black box testing. This form of security test takes the premise that the security tester has full knowledge of the network, systems, and infrastructure. This information allows the security tester to follow a more structured approach and not only review the information that has been provided but also verify its accuracy. So, although black box testing will usually spend more time gathering information, white box testing will spend that time probing for vulnerabilities.

Partial-Knowledge Testing (Gray Box)

In the world of software testing, gray box testing is described as a partial-knowledge test. EC-Council literature describes gray box testing as a form of internal test. Therefore, the goal is to determine what insiders can access. This form of test might also prove useful to the organization because so many attacks are launched by insiders.

Types of Security Tests

Several different types of security tests can be performed. These can range from those that merely examine policy to those that attempt to hack in from the Internet

and mimic the activities of true hackers. These security tests are also known by many names, including the following:

- Vulnerability testing
- Network evaluations
- Red-team exercises
- Penetration testing
- Host vulnerability assessment
- Vulnerability assessment
- Ethical hacking

No matter what the security test is called, it is carried out to make a systematic examination of an organization's network, policies, and security controls. Its purpose is to determine the adequacy of security measures, identify security deficiencies, provide data from which to predict the effectiveness of potential security measures, and confirm the adequacy of such measures after implementation. Security tests can be defined as one of three types:

NOTE Although the CEH exam focuses on one type of security test, you should be aware of the different types so that you are fully able to meet any challenge presented to you.

- **High-level assessment/audit:** Also called a level I assessment, it is a top-down look at the organization's policies, procedures, and guidelines. This type of vulnerability assessment or audit does not include any hands-on testing. The purpose of a top-down assessment is to answer three questions:
  - Do the applicable policies, procedures, and guidelines exist?
  - Are they being followed?
  - Is their content sufficient to guard against potential risk?
- **Network evaluation:** Also called a level II assessment, it has all the elements specified in a level I assessment, and it includes hands-on activities. These hands-on activities include information gathering, scanning, vulnerability-assessment scanning, and other hands-on activities. Throughout this book, tools and techniques used to perform this type of assessment are discussed.
- **Penetration test:** Unlike assessments and evaluations, penetration tests are adversarial in nature. Penetration tests are also referred to as level III

assessments. These events usually take on an adversarial role and look to see what the outsider can access and control. Penetration tests are less concerned with policies and procedures and are more focused on finding low-hanging fruit and seeing what a hacker can accomplish on this network. This book offers many examples of the tools and techniques used in penetration tests.

Just remember that penetration tests are not fully effective if an organization does not have the policies and procedures in place to control security. Without adequate policies and procedures, it's almost impossible to implement real security. Documented controls are required. If none are present, you should evaluate existing practices.

Security policies are the foundation of the security infrastructure. There can be many different types of polices, such as access control, password, user account, email, acceptable use, and incident response. As an example, an incident response plan consists of actions to be performed in responding to and recovering from incidents. There are several slightly different approaches to incident response. The EC-Council approach to incident response follows the steps shown in Figure 1-4.

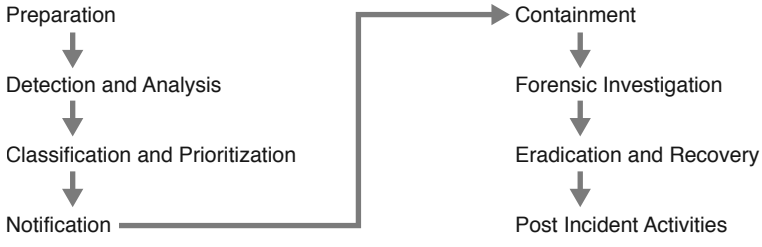


Figure 1-4 The Incident Response Process

You might be tasked with building security policies based on existing activities and known best practices. Good and free resources for accomplishing such a task are the SANS policy templates, available at http://www.sans.org/security-resources/policies/. How do ethical hackers play a role in these tests? That's the topic of the next section.

Hacker and Cracker Descriptions

To understand your role as an ethical hacker, it is important to know the players. Originally, the term *hacker* was used for a computer enthusiast. A hacker was a person who enjoyed understanding the internal workings of a system, computer, and computer network. Over time, the popular press began to describe hackers as individuals who broke into computers with malicious intent. The industry responded by

developing the word *cracker*, which is short for criminal hacker. The term cracker was developed to describe individuals who seek to compromise the security of a system without permission from an authorized party. With all this confusion over how to distinguish the good guys from the bad guys, the term *ethical hacker* was coined. An ethical hacker is an individual who performs security tests and other vulnerability-assessment activities to help organizations secure their infrastructures. Sometimes ethical hackers are referred to as white hat hackers.

Hacker motives and intentions vary. Some hackers are strictly legitimate, whereas others routinely break the law. Let's look at some common categories:

Key Topic

- **White hat hackers:** These individuals perform ethical hacking to help secure companies and organizations. Their belief is that you must examine your network in the same manner as a criminal hacker to better understand its vulnerabilities.
- **Black hat hackers:** These individuals perform illegal activities.
- **Gray hat hackers:** These individuals usually follow the law but sometimes venture over to the darker side of black hat hacking. It would be unethical to employ these individuals to perform security duties for your organization because you are never quite clear where they stand. Think of them as the character of Luke in *Star Wars*. While wanting to use the force of good, he is also drawn to the dark side.
- **Suicide hackers:** These are individuals that may carry out an attack even if they know there is a high chance that they will get caught and serve a long prison term.

NOTE Sometimes security professionals have crossed the line between ethical and unethical and not even known it. For example, in 2012, Andrew Auernheimer, who believed he was acting as an ethical hacker, exposed security flaws at AT&T and was charged with one count under the Computer Fraud and Abuse Act (CFAA). While he was convicted and sentenced to 41 months in prison, he argued on appeal that the techniques used were the same as those of ethical hackers. In April 2014, the U.S. Court of Appeals for the Third Circuit issued an opinion vacating Auernheimer's conviction, and while the judges did not address the substantive question on the legality of the site access, they were skeptical of the original conviction, noting that no circumvention of passwords had occurred and that only publicly accessible information was obtained. You can read more at http://www.techworm.net/2014/04/notorious-at-hacker-andrew-weev.html.

Hackers usually follow a fixed methodology that includes the following steps:

1. **Reconnaissance and footprinting:** Can be both passive and active.
2. **Scanning and enumeration:** Can include the use of port scanning tools and network mappers.
3. **Gaining access:** The entry point into the network, application, or system.
4. **Maintaining access:** Techniques used to maintain control, such as escalation of privilege.
5. **Covering tracks:** Planting rootkits, backdoors, and clearing logs are activities normally performed at this step.

Now let's turn our attention to who these attackers are and what security professionals are up against.

TIP Although it's important to know the steps involved in hacking, it is just as important to know what tools are used at a specific step. Questions on the CEH exam may ask you what tools are used at a specific step.

Who Attackers Are

Ethical hackers are up against several types of individuals in the battle to secure the network. The following list presents some of the more commonly used terms for these attackers:

- **Phreakers:** The original hackers. These individuals hacked telecommunication and PBX systems to explore the capabilities and make free phone calls. Their activities include physical theft, stolen calling cards, access to telecommunication services, reprogramming of telecommunications equipment, and compromising user IDs and passwords to gain unauthorized use of facilities, such as phone systems and voicemail.
- **Script kiddies:** A term used to describe often younger attackers who use widely available freeware vulnerability-assessment tools and hacking tools that are designed for attacking purposes only. These attackers usually do not have programming or hacking skills and, given the techniques used by most of these tools, can be defended against with the proper security controls and risk-mitigation strategies.
- **Disgruntled employees:** Employees who have lost respect and integrity for the employer. These individuals might or might not have more skills than the script kiddie. Many times, their rage and anger blind them. They rank as a

potentially high risk because they have insider status, especially if access rights and privileges were provided or managed by the individual.

- **Software crackers/hackers:** Individuals who have skills in reverse engineering software programs and, in particular, licensing registration keys used by software vendors when installing software onto workstations or servers. Although many individuals are eager to partake of their services, anyone who downloads programs with cracked registration keys is breaking the law and can be a greater potential risk and subject to malicious code and malicious software threats that might have been injected into the code.
- **Cyberterrorists/cybercriminals:** An increasing category of threat that can be used to describe individuals or groups of individuals who are usually funded to conduct clandestine or espionage activities on governments, corporations, and individuals in an unlawful manner. These individuals are typically engaged in sponsored acts of defacement: DoS/DDoS attacks, identity theft, financial theft, or worse, compromising critical infrastructures in countries, such as nuclear power plants, electric plants, water plants, and so on. These attacks may take months or years and are described as advanced persistent threats (APT).
- **System crackers/hackers:** Elite hackers who have specific expertise in attacking vulnerabilities of systems and networks by targeting operating systems. These individuals get the most attention and media coverage because of the globally affected malware, botnets, and Trojans that are created by system crackers/hackers. System crackers/hackers perform interactive probing activities to exploit security defects and security flaws in network operating systems and protocols.

Now that you have an idea who the adversary is, let's briefly discuss ethical hackers.

Ethical Hackers

Ethical hackers perform penetration tests. They perform the same activities a hacker would but without malicious intent. They must work closely with the host organization to understand what the organization is trying to protect, who they are trying to protect these assets from, and how much money and resources the organization is willing to expend to protect the assets.

By following a methodology similar to that of an attacker, ethical hackers seek to see what type of public information is available about the organization. Information leakage can reveal critical details about an organization, such as its structure, assets, and defensive mechanisms. After the ethical hacker gathers this information, it is evaluated to determine whether it poses any potential risk. The ethical hacker further probes the network at this point to test for any unseen weaknesses.

Penetration tests are sometimes performed in a double-blind environment. This means that the internal security team has not been informed of the penetration test. This serves an important purpose, allowing management to gauge the security team's responses to the ethical hacker's probing and scanning. Did they notice the probes, or have the attempted attacks gone unnoticed?

Now that the activities performed by ethical hackers have been described, let's spend some time discussing the skills that ethical hackers need, the different types of security tests that ethical hackers perform, and the ethical hacker rules of engagement.

Key Topic

Required Skills of an Ethical Hacker

Ethical hackers need hands-on security skills. Although you do not have to be an expert in everything, you should have an area of expertise. Security tests are usually performed by teams of individuals, where each individual has a core area of expertise. These skills include the following:

- **Routers:** Knowledge of routers, routing protocols, and access control lists (ACLs). Certifications such as Cisco Certified Network Associate (CCNA) and Cisco Certified Internetworking Expert (CCIE) can be helpful.
- **Microsoft:** Skills in the operation, configuration, and management of Microsoft-based systems. These can run the gamut from Windows 7 to Windows Server 2012. These individuals might be Microsoft Certified Solutions Associate (MCSA) or Microsoft Certified Solutions Expert (MCSE) certified.
- **Linux:** A good understanding of the Linux/UNIX OS. This includes security setting, configuration, and services such as Apache. These individuals may be Fedora or Linux+ certified.
- **Firewalls:** Knowledge of firewall configuration and the operation of intrusion detection systems (IDS) and intrusion prevention systems (IPS) can be helpful when performing a security test. Individuals with these skills may be certified as a Cisco Certified Network Associate Security Professional (CCNA) or Check Point Certified Security Administrator (CCSA).
- **Programming:** Knowledge of programming, including SQL, programming languages such as C++, Ruby, C#, and C, and scripting languages such as PHP and Java.
- **Mainframes:** Although mainframes do not hold the position of dominance they once had in business, they still are widely used. If the organization being assessed has mainframes, the security teams would benefit from having someone with that skill set on the team.

- **Network protocols:** Most modern networks are Transmission Control Protocol/Internet Protocol (TCP/IP). Someone with good knowledge of networking protocols, as well as how these protocols function and can be manipulated, can play a key role in the team. These individuals may possess certifications in other operating systems or hardware or may even possess a CompTIA Network+, Security+, or Advanced Security Practitioner (CASP) certification.
- **Project management:** Someone will have to lead the security test team, and if you are chosen to be that person, you will need a variety of the skills and knowledge types listed previously. It can also be helpful to have good project management skills. The parameters of a project are typically time, scope, and cost. After all, you will be defining the project scope when leading a pen test team. Individuals in this role may benefit from having Project Management Professional (PMP) certification.

On top of all this, ethical hackers need to have good report writing skills and must always try to stay abreast of current exploits, vulnerabilities, and emerging threats, as their goal is to stay a step ahead of malicious hackers.

Modes of Ethical Hacking

With all this talk of the skills that an ethical hacker must have, you might be wondering how the ethical hacker can put these skills to use. An organization's IT infrastructure can be probed, analyzed, and attacked in a variety of ways. Some of the most common modes of ethical hacking are described here:

- **Information gathering:** This testing technique seeks to see what type of information is leaked by the company and how an attack might leverage this information.
- **External penetration testing:** This ethical hack seeks to simulate the types of attacks that could be launched across the Internet. It could target Hypertext Transfer Protocol (HTTP), Simple Mail Transfer Protocol (SMTP), Structured Query Language (SQL), or any other available service.
- **Internal penetration testing:** This ethical hack simulates the types of attacks and activities that could be carried out by an authorized individual with a legitimate connection to the organization's network.
- **Network gear testing:** Firewall, IDS, router, and switches.
- **DoS testing:** This testing technique can be used to stress test systems or to verify their ability to withstand a DoS attack.

- **Wireless network testing:** This testing technique looks at wireless systems. This might include wireless networking systems, RFID, ZigBee, Bluetooth, or any wireless device.
- **Application testing:** Application testing is designed to examine input controls and how data is processed. All areas of the application may be examined.
- **Social engineering:** Social engineering attacks target the organization's employees and seek to manipulate them to gain privileged information. Employee training, proper controls, policies, and procedures can go a long way in defeating this form of attack.
- **Physical security testing:** This simulation seeks to test the organization's physical controls. Systems such as doors, gates, locks, guards, closed circuit television (CCTV), and alarms are tested to see whether they can be bypassed.
- **Authentication system testing:** This simulated attack is tasked with assessing authentication controls. If the controls can be bypassed, the ethical hacker might probe to see what level of system control can be obtained.
- **Database testing:** This testing technique is targeted toward SQL servers.
- **Communication system testing:** This testing technique examines communications such as PBX, Voice over IP (VoIP), modems, and voice communication systems.
- **Stolen equipment attack:** This simulation is closely related to a physical attack because it targets the organization's equipment. It could seek to target the CEO's laptop or the organization's backup tapes. No matter what the target, the goal is the same: extract critical information, usernames, and passwords.

Every ethical hacker must abide by the following rules when performing the tests described previously. If not, bad things can happen to you, which might include loss of job, civil penalty, or even jail time:

- **Never exceed the limits of your authorization:** Every assignment will have rules of engagement. This document includes not only what you are authorized to target but also the extent that you are authorized to control such system. If you are only authorized to obtain a prompt on the target system, downloading passwords and starting a crack on these passwords would be in excess of what you have been authorized to do.
- **Protect yourself by setting up damage limitations:** There has to be a nondisclosure agreement (NDA) between the client and the tester to protect them both. You should also consider liability insurance and an errors and omissions policy. Items such as the NDA, rules of engagement, project scope, and

resumes of individuals on the penetration testing team may all be bundled together for the client into one package.

- **Be ethical:** That's right; the big difference between a hacker and an ethical hacker is the word *ethics*. Ethics is a set of moral principles about what is correct or the right thing to do. Ethical standards sometimes differ from legal standards in that laws define what we must do or not do, whereas ethics define what we should do or not do.

In the Field: The OSSTMM—An Open Methodology

In January 2001, the Institute for Security and Open Methodologies (ISECOM) released the Open Source Security Testing Methodology Manual (OSSTMM). Hundreds of people contributed knowledge, experience, and peer review to the project. Eventually, as the only publicly available methodology that tested security from the bottom of operations and up (as opposed to from the policy on down), it received the attention of businesses, government agencies, and militaries around the world. It also scored success with little security start-ups and independent ethical hackers who wanted a public source for client assurance of their security testing services.

The primary purpose of the OSSTMM is to provide a scientific methodology for the accurate characterization of security through examination and correlation in a consistent and reliable way. Great effort has been put into the OSSTMM to ensure reliable cross-reference to current security management methodologies, tools, and resources. This manual is adaptable to penetration tests, ethical hacking, security assessments, vulnerability assessments, red-teaming, blue-teaming, posture assessments, and security audits. Your primary purpose for using it should be to guarantee facts and factual responses, which in turn ensures your integrity as a tester and the organization you are working for, if any. The end result is a strong, focused security test with clear and concise reporting. The main site for the nonprofit organization, ISECOM, that maintains the OSSTMM and many other projects is http://www.isecom.org.

This In the Field note was contributed by Pete Herzog, managing director, ISECOM.

- **Maintain confidentiality:** During security evaluations, you will likely be exposed to many types of confidential information. You have both a legal and a moral duty to treat this information with the utmost privacy. You should not share this information with third parties and should not use it for any unapproved purposes. There is an obligation to protect the information sent between the tester and the client. This has to be specified in an NDA.

- **Do no harm:** It's of utmost importance that you do no harm to the systems you test. Again, a major difference between a hacker and an ethical hacker is that an ethical hacker should do no harm. Misused security tools can lock out critical accounts, cause denial of service, and crash critical servers or applications. Take care to prevent these events unless that is the goal of the test.

Test Plans—Keeping It Legal

Most of us make plans before we take a big trip or vacation. We think about what we want to see, how we plan to spend our time, what activities are available, and how much money we can spend and not regret it when the next credit card bill arrives. Ethical hacking is much the same minus the credit card bill. Many details need to be worked out before a single test is performed. If you or your boss is tasked with managing this project, some basic questions need to be answered, such as what's the scope of the assessment, what are the driving events, what are the goals of the assessment, what will it take to get approval, and what's needed in the final report.

Before an ethical hacking test can begin, the scope of the engagement must be determined. Defining the scope of the assessment is one of the most important parts of the ethical hacking process. At some point, you will be meeting with management to start the discussions of the how and why of the ethical hack. Before this meeting ever begins, you will probably have some idea what management expects this security test to accomplish. Companies that decide to perform ethical hacking activities don't do so in a vacuum. You need to understand the business reasons behind this event. Companies can decide to perform these tests for various reasons. The most common reasons include the following:

- **A breach in security:** One or more events have occurred that highlight a lapse in security. It could be that an insider was able to access data that should have been unavailable, or it could be that an outsider was able to hack the organization's web server.
- **Compliance with state, federal, regulatory, or other law or mandate:** Compliance with state or federal laws is another event that might be driving the assessment. Companies can face huge fines and executives can face potential jail time if they fail to comply with state and federal laws. The Gramm-Leach-Bliley Act (GLBA), Sarbanes-Oxley (SOX), and Health Insurance Portability and Accountability Act (HIPAA) are three such laws. SOX requires accountability for public companies relating to financial information. HIPAA requires organizations to perform a vulnerability assessment. Your organization might decide to include ethical hacking into this test regime. One such standard that the organization might be attempting to comply with is ISO/IEC 27002. This information security standard was first published in

December 2000 by the International Organization for Standardization and the International Electrotechnical Commission. This code of practice for information security management is considered a security standard benchmark and includes the following 14 main elements:

- Information Security Policies
- Organization of Information Security
- Human Resource Security
- Asset Management
- Access Control
- Cryptography
- Physical and environmental security
- Operation security
- Communication security
- System acquisition, development, and maintenance
- Supplier relationships
- Information security incident management
- Information security aspects of business continuity management
- Compliance

- **Due diligence:** Due diligence is another reason a company might decide to perform a pen test. The new CEO might want to know how good the organization's security systems really are, or it could be that the company is scheduled to go through a merger or is acquiring a new firm. If so, the pen test might occur before the purchase or after the event. These assessments are usually going to be held to a strict timeline. There is only a limited amount of time before the purchase, and if performed afterward, the organization will probably be in a hurry to integrate the two networks as soon as possible.

Test Phases

Security assessments in which ethical hacking activities will take place are composed of three phases: scoping the project, in which goals and guidelines are established, performing the assessment, and performing post-assessment activities, including the report and remediation activities. Figure 1-5 shows the three phases of the assessment and their typical times.

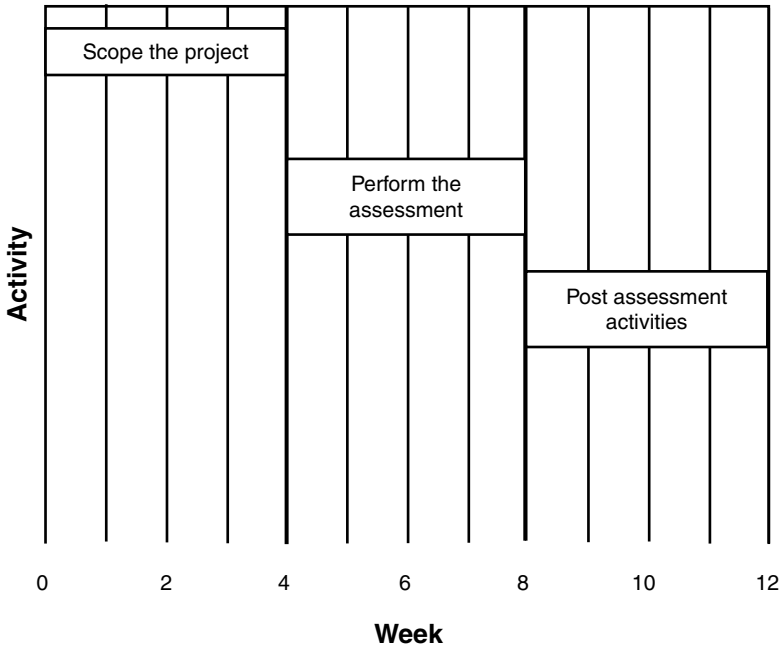


Figure 1-5 Ethical hacking phases and times.

Establishing Goals

The need to establish goals is critical. Although you might be ready to jump in and begin hacking, a good plan will detail the goals and objectives of the test. Common goals include system certification and accreditation, verification of policy compliance, and proof that the IT infrastructure has the capability to defend against technical attacks.

Are the goals to certify and accredit the systems being tested? Certification is a technical evaluation of the system that can be carried out by independent security teams or by the existing staff. Its goal is to uncover any vulnerabilities or weaknesses in the implementation. Your goal will be to test these systems to make sure that they are configured and operating as expected, that they are connected to and communicate with other systems in a secure and controlled manner, and that they handle data in a secure and approved manner.

If the goals of the penetration test are to determine whether current policies are being followed, the test methods and goals might be somewhat different. The security team will be looking at the controls implemented to protect information being stored, being transmitted, or being processed. This type of security test might not

have as much hands-on hacking but might use more social engineering techniques and testing of physical controls. You might even direct one of the team members to perform a little dumpster diving.

The goal of a technical attack might be to see what an insider or outsider can access. Your goal might be to gather information as an outsider and then use that data to launch an attack against a web server or externally accessible system.

Regardless of what type of test you are asked to perform, you can ask some basic questions to help establish the goals and objectives of the tests, including the following:

- What is the organization's mission?
- What specific outcomes does the organization expect?
- What is the budget?
- When will tests be performed: during work hours, after hours, on weekends?
- How much time will the organization commit to completing the security evaluation?
- Will insiders be notified?
- Will customers be notified?
- How far will the test proceed? Root the box, gain a prompt, or attempt to retrieve another prize, such as the CEO's password?
- Whom do you contact should something go wrong?
- What are the deliverables?
- What outcome is management seeking from these tests?

Key Topic

Getting Approval

Getting approval is a critical event in the testing process. Before any testing actually begins, you need to make sure that you have a plan that has been approved in writing. If this is not done, you and your team might face unpleasant consequences, which might include being fired or even facing criminal charges.

NOTE Written approval is the most critical step of the testing process. *Never* perform tests without written approval.

If you are an independent consultant, you might also get insurance before starting any type of test. Umbrella policies and those that cover errors and omissions are

commonly used in the field. These types of liability policies can help protect you should anything go wrong.

To help make sure that the approval process goes smoothly, ensure that someone is the champion of this project. This champion or project sponsor is the lead contact to upper management and your contact person. Project sponsors can be instrumental in helping you gain permission to begin testing and to provide you with the funding and materials needed to make this a success.

NOTE Management support is critical if a security test is to be successful.

Key Topic

Ethical Hacking Report

Although you have not actually begun testing, you do need to start thinking about the final report. Throughout the entire process, you should be in close contact with management to keep them abreast of your findings. There shouldn't be any big surprises when you submit the report. While you might have found some serious problems, they should be discussed with management before the report is written and submitted. The goal is to keep management in the loop and advised of the status of the assessment. If you find items that present a critical vulnerability, stop all tests and immediately inform management. Your priority should always be the health and welfare of the organization.

The report itself should detail the results of what was found. Vulnerabilities should be discussed, as should the potential risk they pose. Although people aren't fired for being poor report writers, don't expect to be promoted or praised for your technical findings if the report doesn't communicate your findings clearly. The report should present the results of the assessment in an easily understandable and fully traceable way. The report should be comprehensive and self-contained. Most reports contain the following sections:

- Introduction
- Statement of work performed
- Results and conclusions
- Recommendations

Because most companies are not made of money and cannot secure everything, rank your recommendations so that the ones with the highest risk/highest probability appear at the top of the list.

The report needs to be adequately secured while in electronic storage. Use encryption. The printed copy of the report should be marked *Confidential*, and while it is in

its printed form, take care to protect the report from unauthorized individuals. You have an ongoing responsibility to ensure the safety of the report and all information gathered. Most consultants destroy reports and all test information after a contractually obligated period of time.

NOTE The report is a piece of highly sensitive material and should be protected in storage and when in printed form.

Vulnerability Research—Keeping Up with Changes

If you are moving into the IT security field or are already working in IT security, you probably already know how quickly things change in this industry. That pace of change requires the security professional to keep abreast of new/developing tools, techniques, and emerging vulnerabilities. Although someone involved in security in the 1990s might know about Code Red or Nimda, that will do little good to combat ransomware or a Java watering hole attack. Because tools become obsolete and exploits become outdated, you want to build up a list of websites that you can use to keep up with current vulnerabilities. The sites listed here are but a few you should review:

- **National Vulnerability Database:** http://nvd.nist.gov/
- **Security Tracker:** http://securitytracker.com/
- **HackerWatch:** http://www.hackerwatch.org/
- **Dark Reading:** http://www.darkreading.com/
- **Exploit Database:** http://www.exploit-db.com/
- **HackerStorm:** http://hackerstorm.co.uk/
- **SANS Reading Room:** http://www.sans.org/reading_room/
- **SecurityFocus:** http://www.securityfocus.com/

NOTE At the end of each chapter is a more complete list of websites and URLs you should review.

Ethics and Legality

The word *ethics* is derived from the Greek word *ethos* (character) and from the Latin word *mores* (customs). Laws and ethics are much different in that ethics cover the gray areas that laws do not always address. Most professions, including EC-Council,

have highly detailed and enforceable codes of ethics for their members. Some examples of IT organizations that have codes of ethics include

- **EC-Council:** https://www.eccouncil.org/code-of-ethics
- **(ISC)^2:** https://www.isc2.org/ethics/default.aspx
- **ISACA:** http://www.isaca.org/Certification/Code-of-Professional-Ethics/Pages/default.aspx

To become a CEH, you must have a good understanding of ethical standards because you might be presented with many ethical dilemmas during your career. You can also expect to see several questions relating to ethics on the CEH exam.

Recent FBI reports on computer crime indicate that unauthorized computer use has continued to climb. A simple review of the news on any single day usually indicates reports of a variety of cybercrime and network attacks. Hackers use computers as a tool to commit a crime or to plan, track, and control a crime against other computers or networks. Your job as an ethical hacker is to find vulnerabilities before the attackers do and help prevent the attackers from carrying out malicious activities. Tracking and prosecuting hackers can be a difficult job because international law is often ill-suited to deal with the problem. Unlike conventional crimes that occur in one location, hacking crimes might originate in India, use a system based in Singapore, and target a computer network located in Canada. Each country has conflicting views on what constitutes cybercrime. Even if hackers can be punished, attempting to prosecute them can be a legal nightmare. It is hard to apply national borders to a medium such as the Internet that is essentially borderless.

TIP Some individuals approach computing and hacking from the social perspective and believe that hacking can promote change. These individuals are known as hactivists ("hacker activists") and use computers and technology for hi-tech campaigning and social change. They believe that defacing websites and hacking servers is acceptable as long as it promotes their goals. Regardless of their ethics and motives, hacking remains illegal, and hackers are subject to the same computer crime laws as any other criminal.

Overview of U.S. Federal Laws

Although some hackers might have the benefit of bouncing around the globe from system to system, your work will likely occur within the confines of the host nation. The United States and some other countries have instigated strict laws to deal with hackers and hacking. During the past 10 to 15 years, the U.S. federal government has taken a much more active role in dealing with computer crime, Internet activity,

privacy, corporate threats, vulnerabilities, and exploits. These are laws you should be aware of and not become entangled in. Hacking is covered under the U.S. Code Title 18: Crimes and Criminal Procedure: Part 1: Crimes: Chapter 47: Fraud and False Statements: Sections 1029 and 1030. Each section is described here:

- **Section 1029, Fraud and related activity with access devices:** This law gives the U.S. federal government the power to prosecute hackers who knowingly and with intent to defraud produce, use, or traffic in one or more counterfeit access devices. Access devices can be an application or hardware that is created specifically to generate any type of access credentials, including passwords, credit card numbers, long-distance telephone service access codes, PINs, and so on for the purpose of unauthorized access.
- **Section 1030, Fraud and related activity in connection with computers:** The law covers just about any computer or device connected to a network or Internet. It mandates penalties for anyone who accesses a computer in an unauthorized manner or exceeds one's access rights. This is a powerful law because companies can use it to prosecute employees when they use the capability and access that companies have given them to carry out fraudulent activities.

The Evolution of Hacking Laws

In 1985, hacking was still in its infancy in England. Because of the lack of hacking laws, some British hackers believed that there was no way they could be prosecuted. Triludan the Warrior was one of these individuals. Besides breaking into the British Telecom system, he also broke an admin password for Prestel. Prestel was a dialup service that provided online services, shopping, email, sports, and weather reports. One user of Prestel was His Royal Highness, Prince Phillip. Triludan broke into the prince's mailbox, along with various other activities, such as leaving the Prestel system admin messages and taunts.

Triludan the Warrior was caught on April 10, 1985, and was charged with five counts of forgery, as no hacking laws existed. After several years and a $3.5 million legal battle, Triludan was eventually acquitted. Others were not so lucky because in 1990, parliament passed the Computer Misuse Act, which made hacking attempts punishable by up to 5 years in jail. Today, the United Kingdom, along with most of the Western world, has extensive laws against hacking.

TIP 18 U.S. Code Sections 1029 and 1030 are the main statutes that address computer crime in U.S. federal law. You want to understand their basic coverage and penalties.

The punishment described in Sections 1029 and 1030 for hacking into computers ranges from a fine or imprisonment for no more than 1 year up to a fine and imprisonment for no more than 20 years. This wide range of punishment depends on the seriousness of the criminal activity and what damage the hacker has done and whether you are a repeat offender. Other federal laws that address hacking include the following:

- **Electronic Communication Privacy Act:** Mandates provisions for access, use, disclosure, interception, and privacy protections of electronic communications. The law encompasses U.S. Code Sections 2510 and 2701. According to the U.S. Code, *electronic communications* "means any transfer of signs, signals, writing, images, sounds, data, or intelligence of any nature transmitted in whole or in part by a wire, radio, electromagnetic, photo electronic, or photo optical system that affects interstate or foreign commerce." This law makes it illegal for individuals to capture communication in transit or in storage. Although these laws were originally developed to secure voice communications, they now cover email and electronic communication.
- **Computer Fraud and Abuse Act of 1984:** The Computer Fraud and Abuse Act (CFAA) of 1984 protects certain types of information that the government maintains as sensitive. The Act defines the term *classified computer*, and imposes punishment for unauthorized or misused access into one of these protected computers or systems. The Act also mandates fines and jail time for those who commit specific computer-related actions, such as trafficking in passwords or extortion by threatening a computer. In 1992, Congress amended the CFAA to include malicious code, which was not included in the original Act.
- **The Cyber Security Enhancement Act of 2002:** This Act mandates that hackers who carry out certain computer crimes might now get life sentences in prison if the crime could result in another's bodily harm or possible death. This means that if hackers disrupt a 911 system, they could spend the rest of their days in prison.
- **The Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism (USA PATRIOT) Act of 2001:** Originally passed because of the World Trade Center attack on September 11, 2001, it strengthens computer crime laws and has been the subject of some controversy. This Act gives the U.S. government extreme latitude in pursuing criminals. The Act permits the U.S. government to monitor hackers without a warrant and perform sneak-and-peek searches.
- **The Federal Information Security Management Act (FISMA):** This was signed into law in 2002 as part of the E-Government Act of 2002, replacing the Government Information Security Reform Act (GISRA). FISMA was

enacted to address the information security requirements for government agencies other than those involved in national security. FISMA provides a statutory framework for securing government-owned and -operated IT infrastructures and assets.

- **Federal Sentencing Guidelines of 1991:** Provides guidelines to judges so that sentences are handed down in a more uniform manner.
- **Economic Espionage Act of 1996:** Defines strict penalties for those accused of espionage.

NOTE Ethical hackers need to know that U.S. laws are not the only legal guidelines. Most nations have cybercrime laws on the books that address using a computer or network in the commission of a crime or the targeting of another computer or network.

Compliance Regulations

Although it's good to know what laws your company or client must abide by, ethical hackers should have some understanding of compliance regulations, too. In the United States, laws are passed by Congress. Regulations can be created by executive department and administrative agencies. The first step is to understand what regulations your company or client needs to comply with. Common ones include those shown in Table 1-2.

Table 1-2 Compliance Regulations and Frameworks

Name of Law/ Framework	Areas Addressed or Regulated	Responsible Agency or Entity
Sarbanes-Oxley (SOX) Act	Corporate financial information	Securities and Exchange Commission (SEC)
Gramm-Leach-Bliley Act (GLBA)	Consumer financial information	Federal Trade Commission (FTC)
Health Insurance Portability and Accountability Act (HIPAA)	Established privacy and security regulations for the healthcare industry	Department of Health and Human Services (HHS)
ISO/IEC 27001:2013	Operates as a risk management standard and provides requirements for establishing, implementing, and maintaining an information security management system	International Organization for Standardization (ISO)

Name of Law/ Framework	Areas Addressed or Regulated	Responsible Agency or Entity
Children's Internet Protection Act (CIPA)	Controls Internet access to pornography in schools and libraries	Federal Trade Commission (FTC)
Payment Card Industry Data Security Standard (PCI-DSS)	Controls on credit card processors	Payment Card Industry (PCI)

Typically, you will want to use a structured approach such as the following to evaluate new regulations that may lead to compliance issues:

Step 1. Interpret the law or regulation and the way it applies to the organization.

Step 2. Identify the gaps in the compliance and determine where the organization stands regarding the mandate, law, or requirement.

Step 3. Devise a plan to close the gaps identified.

Step 4. Execute the plan to bring the organization into compliance.

Let's look at one specific industry standard that CEH candidates should be aware of because it is global in nature and is a testable topic.

Payment Card Industry Data Security Standard (PCI-DSS)

PCI-DSS is a standard that most security professionals must understand because it applies in many different countries and to industries around the world. It is a proprietary information security standard that addresses credit card security. It applies to all entities that handle credit card data, such as merchants, processors, acquirers, and any other party that stores, processes, or transmits credit card data. PCI-DSS mandates a set of 12 high-level requirements that prescribe operational and technical controls to protect cardholder data. The requirements follow security best practices and are aligned across six goals:

- Build and maintain a secure network that is PCI compliant
- Protect cardholder data
- Maintain a vulnerability management program
- Implement strong access control measures
- Regularly monitor and test networks
- Maintain an information security policy

For companies that are found to be in noncompliance, the fines can range from $5,000 to $500,000 and are levied by banks and credit card institutions.

Summary

This chapter established that security is based on the CIA triad of confidentiality, integrity, and availability. The principles of the CIA triad must be applied to IT networks and their data. The data must be protected in storage and in transit.

Because the organization cannot provide complete protection for all of its assets, a system must be developed to rank risk and vulnerabilities. Organizations must seek to identify high-risk and high-impact events for protective mechanisms. Part of the job of an ethical hacker is to identify potential threats to these critical assets and test systems to see whether they are vulnerable to exploits.

The activities described are security tests. Ethical hackers can perform security tests from an unknown perspective (black box testing) or with all documentation and knowledge (white box testing). The type of approach to testing that is taken will depend on the time, funds, and objective of the security test. Organizations can have many aspects of their protective systems tested, such as physical security, phone systems, wireless access, insider access, and external hacking.

To perform these tests, ethical hackers need a variety of skills. They not only must be adept in the technical aspects of networks but also must understand policy and procedure. No single ethical hacker will understand all operating systems, networking protocols, or application software. That's okay, though, because security tests typically are performed by teams of individuals, with each person bringing a unique skill or set of skills to the table.

So, even though god-like knowledge isn't required, an ethical hacker does need to understand laws pertaining to hackers and hacking and understand that the most important part of the pretest activities is to obtain written authorization. No test should be performed without the written permission of the network or service. Following this simple rule will help you stay focused on the legitimate test objectives and avoid any activities or actions that might be seen as unethical/unlawful.

Exam Preparation Tasks

As mentioned in the section "How to Use This Book" in the Introduction, you have a couple of choices for exam preparation: the exercises here, Chapter 13, "Final Preparation," and the exam simulation questions in the Pearson Test Prep Software Online.

Review All Key Topics

Review the most important topics in this chapter, noted with the Key Topic icon in the outer margin of the page. Table 1-3 lists a reference of these key topics and the page numbers on which each is found.

Key Topic

Table 1-3 Key Topics for Chapter 1

Key Topic Element	Description	Page Number
Section	Goals of security	6
Section	Security testing	13
List	Categories of hackers	17
Section	Required skills of an ethical hacker	20
Section	Getting approval	27
Section	Ethical hacking report	28
Section	Ethics and legality	29

Define Key Terms

Define the following key terms from this chapter and check your answers in the glossary:

asset, availability, black box testing, confidentiality, denial of service (DoS), exploit, gray box testing, integrity, RAID, risk, target of engagement (TOE), threat, vulnerability, and white box testing

Hands-On Labs

As an ethical hacker, it is important to not only be able to test security systems but also understand that a good policy structure drives effective security. While this chapter discusses policy, laws, and rules of engagement, now is a good time to review the SANS Information Security Policy Templates page. These templates should be useful when you are helping an organization promote the change to a more secure setting.

Equipment Needed

A computer and Internet connection

Estimated Time: 15 minutes

Lab 1-1 Examining Security Policies

Step 1. Go to the SANS Information Security Policy Templates page located at https://www.sans.org/security-resources/policies.

Step 2. Click the **Network Security** category, and then click the **Acquisition Assessment Policy** hyperlink.

Step 3. Click the **PDF** hyperlink and review the Acquisition Assessment Policy. It defines responsibilities regarding corporate acquisitions and the minimum requirements of an acquisition assessment to be completed by the information security group.

Step 4. Return to the main Policy Templates page, click the **Old/Retired** category, click the **Risk Assessment Policy** hyperlink, click **PDF**, and review the template. This policy template defines the requirements and provides the authority for the information security team to identify, assess, and remediate risks to the organization's information infrastructure associated with conducting business.

Step 5. Return to the main Policy Templates page, click the **General** category, click the **Ethics Policy** hyperlink, click **PDF**, and review the template. This template discusses ethics and defines the means to establish a culture of openness, trust, and integrity in the organization.

Review Questions

1. You have been asked to perform a penetration test for a local company. You have had several meetings with the client and are now almost ready to begin the assessment. Which of the following is the document that would contain verbiage which describes what type of testing is allowed and when you will perform testing and limits your liabilities as a penetration tester?
   a. Nondisclosure agreement
   b. Rules of engagement
   c. Service-level agreement
   d. Project scope

2. Which of the following addresses the secrecy and privacy of information?
   a. Integrity
   b. Confidentially
   c. Availability
   d. Authentication

3. You are part of a pen testing team that has been asked to assess the risk of an online service. Management is concerned as to what the cost would be if there was an outage and how frequent these outages might be. Your objective is to determine whether there should be additional countermeasures. Given the following variables, which of the following amounts is the resulting annualized loss expectancy (ALE)?

   Single loss expectancy = $2,500

   Exposure factor = .9

   Annual rate of occurrence = .4

   Residual risk = $300

   a. $960
   b. $120
   c. $1,000
   d. $270

4. Who are the individuals who perform legal security tests while sometimes performing questionable activities?

   a. Gray hat hackers
   b. Ethical hackers
   c. Crackers
   d. White hat hackers

5. Which of the following is the most important step for the ethical hacker to perform during the pre-assessment?

   a. Hack the web server.
   b. Obtain written permission to hack.
   c. Gather information about the target.
   d. Obtain permission to hack.

6. Which of the following is one primary difference between a malicious hacker and an ethical hacker?
   a. Malicious hackers use different tools and techniques than ethical hackers use.
   b. Malicious hackers are more advanced than ethical hackers because they can use any technique to attack a system or network.
   c. Ethical hackers obtain permission before bringing down servers or stealing credit card databases.
   d. Ethical hackers use the same methods but strive to do no harm.

7. This type of security test might seek to target the CEO's laptop or the organization's backup tapes to extract critical information, usernames, and passwords.
   a. Insider attack
   b. Physical entry
   c. Stolen equipment
   d. Outsider attack

8. Which of the following best describes an attack that altered the contents of two critical files?
   a. Integrity
   b. Confidentially
   c. Availability
   d. Authentication

9. Which individuals believe that hacking and defacing websites can promote social change?
   a. Ethical hackers
   b. Gray hat hackers
   c. Black hat hackers
   d. Hactivists

10. After the completion of the pen test, you have provided the client with a list of controls to implement to reduce the identified risk. What term best describes the risk that remains after the controls have been implemented?
    a. Gap analysis
    b. Total risk
    c. Inherent risk
    d. Residual risk

11. This type of security test usually takes on an adversarial role and looks to see what an outsider can access and control.
    a. Penetration test
    b. High-level evaluation
    c. Network evaluation
    d. Policy assessment

12. Assume you performed a full backup on Monday and then an incremental backup on Tuesday and Wednesday. If there was on outage on Thursday, what would you need to restore operations?
    a. The full backup from Monday
    b. Both incremental backups from Tuesday and Wednesday
    c. The full backup from Monday and Wednesday's incremental backup
    d. The full backup from Monday and both incremental backups from Tuesday and Wednesday

13. During a security review you have discovered that there are no documented security policies for the area you are assessing. Which of the following would be the most appropriate course of action?
    a. Identify and evaluate current practices
    b. Create policies while testing
    c. Increase the level of testing
    d. Stop the audit

14. Your company performs PCI-DSS audits and penetration testing for third-party clients. During an approved pen test you have discovered a folder on an employee's computer that appears to have hundreds of credit card numbers and other forms of personally identifiable information (PII). Which of the following is the best course of action?
    a. Contact the employee and ask why they have the data.
    b. Make a copy of the data and store it on your local machine.
    c. Stop the pen test immediately and contact management.
    d. Continue the pen test and include this information in your report.

15. During which step of the incident response process would you be tasked with building the team, identifying roles, and testing the communication system?
    a. Containment
    b. Recovery
    c. Preparation
    d. Notification

16. Clark is a talented coder and as such has found a vulnerability in a well-known application. Unconcerned about the ethics of the situation, he has developed an exploit that can leverage this unknown vulnerability. Based on this information, which of the following is most correct?
    a. Clark is a suicide hacker.
    b. Clark has violated U.S. Code Section 1027.
    c. Clark has developed a zero day.
    d. Clark is a white hat hacker.

17. Your ethical hacking firm has been hired to conduct a penetration test. Which of the following documents limits what you can discuss publicly?
    a. Nondisclosure agreement
    b. PCI-DSS
    c. Memorandum of understanding
    d. Terms of engagement

18. Which of the following is a common framework applied by business management and other personnel to identify potential events that may affect the enterprise, manage the associated risks and opportunities, and provide reasonable assurance that objectives will be achieved?
    a. NIST SP 800-37
    b. Qualitative risk assessment
    c. PC-DSS
    d. Risk management framework

19. Your ethical hacking firm has been hired to conduct a penetration test. Which of the following documents limits the scope of your activities?
    a. Nondisclosure agreement
    b. PCI-DSS
    c. Memorandum of understanding
    d. Terms of engagement

20. Which of the following is a proprietary information security standard that requires organizations to follow security best practices and use 12 high-level requirements, aligned across six goals?
    a. SOX
    b. FISMA
    c. PCI-DSS
    d. Risk Management Framework

Suggested Reading and Resources

https://www.eccouncil.org/programs/certified-ethical-hacker-ceh: EC-Council CEH certification details

http://www.informationisbeautiful.net/visualizations/worlds-biggest-data-breaches-hacks/: Top IT security breaches

http://searchnetworking.techtarget.com/tutorial/Network-penetration-testing-guide: Guide to penetration testing

https://www.rapid7.com/resources/how-to-respond-to-an-incident/: Incident response methodologies

http://securityaffairs.co/wordpress/49624/hacking/cyber-red-team-blue-team.html: Description of hacking teams including pen testers, blue teams, and red teams

http://www.hackerlaw.org/?page_id=55: U.S. hacker laws

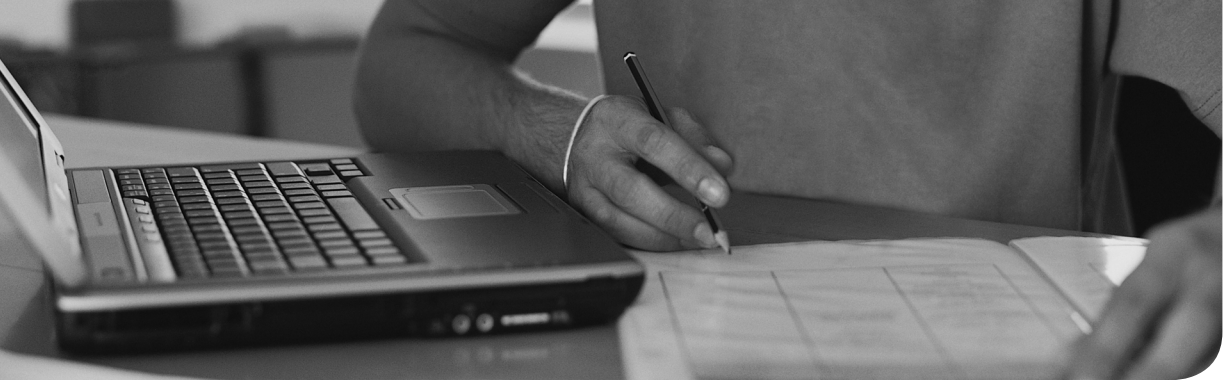
https://tools.ietf.org/html/rfc1087: Ethics and the Internet

https://www.owasp.org/index.php/Main_Page: The Open Web Application Security Project

https://www.owasp.org/index.php/Penetration_testing_methodologies: Various pen testing methodologies

http://blogs.getcertifiedgetahead.com/quantitative-risk-assessment/: Quantitative risk assessment

https://www.pcisecuritystandards.org/documents/PCI%20SSC%20Quick%20Reference%20Guide.pdf: A guide to PCI-DSS



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