CEH – Certification: Final Review: Updated 7-30-21

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Overview

Schedule

Weeks	Activities
Week 1: 7/26/21	**1. Review ExamTopics Questions** a. Part 1: Questions 1 to 52 b. Part 2: Questions 53 to 86 c. Part 3: Questions 87 to 122 **2. Review Testout Course Material** a. Chapter 1: Introduction to Penetration Testing b. Chapter 2: Social Engineering and Physical Security c. Chapter 3: Reconnaissance
Week 2: 8/1/21	**3. Review ExamTopics Questions** a. Part 3: Questions b. Part 4: Questions c. Part 6: Questions **4. Review Testout Course Material** a. Chapter 4: b. Chapter 5: c. Chapter 6:
9/25/21	Take the exam

CEH Testout Course Outline

2. Introduction to Penetration Testing

2.1 Penetration Testing Process and Types

- ✓ 2.1.1 Penetration Test Process and Types
- ✓ 2.1.2 Penetration Test Process and Types Facts
- ✓ 2.1.3 Practice Questions

2.2 Threat Actors

- ✓ 2.2.1 Threat Actor Types
- ✓ 2.2.2 Threat Actor Type Facts
- ✓ 2.2.3 Practice Questions

2.3 Target Selection

- ✓ 2.3.1 Choose a Target
- ✓ 2.3.2 Additional Scoping Considerations
- ✓ 2.3.3 Target Selection Facts
- ✓ 2.3.4 Practice Questions

2.4 Assessment Types

- ✓ 2.4.1 Assessment Types
- ✓ 2.4.2 Special Considerations
- ✓ 2.4.3 Assessment Type Facts
- ✓ 2.4.4 Practice Questions

2.5 Legal and Ethical Compliance

- ✓ 2.5.1 Legal Compliance
- 2.5.2 Ethics
- ✓ 2.5.3 Authorization and Corporate Policies
- ✓ 2.5.4 Legal and Ethical Compliance Facts
- ✓ 2.5.5 Engagement Contracts
- ✓ 2.5.6 Engagement Contract Facts
- ✓ 2.5.7 Practice Questions

2.3.3. Target Selection Facts

2.3.3 Target Selection Facts

Before beginning a penetration test, there are a lot of details that must be worked out. These details include the type of test being performed and any test limitations. After the

initial plans and details for a penetration test have been put together, there are some additional details that should be considered. These include performing a risk assessment, determining tolerance, scheduling the test, and identifying security exceptions that may be applied to the penetration tester.

This lesson covers the following topics:

- Penetration test planning
- Security exceptions
- Risk assessment
- Determine tolerance
- Scope creep

Penetration Test Planning

Detail	Description
How	One of the first items to consider is the type of test to be performed, internal or external. An internal test focuses on systems that reside behind the firewall. This would probably be a white box test. An external test focuses on systems that exist outside the firewall, such as a web server. This would, more than likely, be a black box test.
Who	Determine if the penetration tester is allowed to use social engineering attacks that target users. It's common knowledge that users are generally the weakest link in any security system. Often, a penetration test can target users to gain access. You should also pre-determine who will know when the test is taking place.
What	The organization and the penetration tester need to agree on which systems will be targeted. The penetration tester needs to know exactly which systems are being tested, and as they cannot target any area that isn't specified by documentation. For example, the organization may have a website they do not want targeted or tested. Some other systems that need to look at include wireless networks and applications.
When	Scheduling the test is very important. Should the test be run during business hours? If so, this may result in an interruption of normal business procedures. Running the tests when the business is closed (during weekends, holidays, or after-hours) may be better, but might limit the test.
Where	Finally, will the test be run on site, or remotely? An on-site test allows better testing results but may be more expensive than a remote test.

Security Exceptions

A security exception is any deviation from standard operating security protocols. The type of test (white box, black box, grey box) will determine what, if any, security exceptions the penetration test will be given.

Risk Assessment

The purpose of a risk assessment is to identify areas of vulnerability within the organization's network. The risk assessment should look at all areas, including high value data, network systems, web applications, online information, and physical security (operating systems and web servers). Often, the penetration test is performed as part of a risk assessment.

Once vulnerabilities have been determined, the organization needs to rank them and figure out how to handle each risk. There are four common methods for dealing with risk:

1. Avoidance: whenever you can avoid a risk, you should. This means performing only actions that are needed, such as collecting only relevant user data.
2. Transference: the process of moving the risk to another entity, such as a third party.
3. Mitigation: this technique is also known as risk reduction. When the risk cannot be avoided or transferred, steps should be taken to reduce the damage that can occur.
4. Acceptance: sometimes the cost to mitigate a risk outweighs the risk's potentially damaging effects. In such cases, the organization will simply accept the risk.

Determine Tolerance

After the risk assessment has been performed and vulnerable areas are identified, the organization needs to decide its tolerance level in performing a penetration test. There may be areas of operation that absolutely cannot be taken down or affected during the test. Areas of risk that can be tolerated need to be placed in the scope of work, and critical areas may need to be placed out of the test's scope.

Scope Creep

In project management, one of the most dangerous issues is scope creep. This is when the client begins asking for small deviations from the scope of work. This can cause the project to go off track and increase the time and resources needed to complete it. When a change to the scope of work is requested, a change order should be filled out and agreed on. Once this is done, the additional tasks can be completed.

2.4.3 Assessment Type Facts

An organization's purpose for completing a penetration test will dictate how the test will be carried out. Depending on the penetration test's goals, the ethical hacker may have specific rules and regulations that need to be observed. There are scenarios that will result in special considerations being made.

This lesson covers the following topics:

- Goal-based penetration test
- Objective-based penetration test
- Compliance-based penetration test
- Special considerations

Goal-Based Penetration Test

A goal-based penetration test will focus on the end results. The goals must be specific and well-defined before the test can begin. The penetration tester will utilize a wide range of skills and methods to carry out the test and meet the goals. When you determine the goals of the exam, you should use S.M.A.R.T. goals.

- S – Specific
- M – Measurable
- A – Attainable
- R – Relevant
- T – Timely

Objective-Based Penetration Test

An objective-based test focuses on the overall security of the organization and its data security. When people think of a penetration test, this is often what they think of. The scope of work and rules of engagement documents specify what is to be tested.

Compliance-Based Penetration Test

Ensuring that the organization is in compliance with federal laws and regulations is a major purpose for performing a penetration test. Some of the main laws and regulations include the following:

Regulation	Description

Payment Card Industry Data Security Standards (PCI-DSS)	Defines the security standards for any organization that handles cardholder information for debit cards, credit cards, prepaid cards, and other types of payment cards.
Health Insurance Portability and Accountability Act (HIPAA)	A set of standards that ensures a person's health information is kept safe and only shared with the patient and medical professionals that need it.
ISO/IEC 27001	Defines the processes and requirements for an organization's information security management systems.
Sarbanes Oxley Act (SOX)	A law enacted in 2002 with the goal of implementing accounting and disclosure requirements that would increase transparency in corporate governance and financial reporting and formalizing a system of internal checks and balances.
Digital Millennium Copyright Act (DMCA)	Enacted in 1998, this law is designed to protect copyrighted works.
Federal Information Security Management Act (FISMA)	Defines how federal government data, operations, and assets are handled.

Special Considerations

There are a few scenarios where extra or special considerations need to be considered, such as mergers and establishing supply chains. During a merger, a penetration test may be performed to assess physical security, data security, company culture, or other facets of an organization to determine if there are any shortcomings that may hinder or cancel the merger. When establishing a supply chain, a penetration test needs to be performed to determine if there are any security issues or violations that could affect everyone involved. The organizations need to ensure that their systems can talk to each other and their security measures align. For these tests, companies may employ red teams and blue teams. They may also utilize purple team members.

2.5.4 Legal and Ethical Compliance Facts

An ethical hacker's role is to break the rules and hack into an organization's network and systems. Before this is done, both the penetration tester and organization must know and agree to everything being done. Once the scope of work is finalized, there may be additional laws that need to be looked at and followed.

This lesson covers the following topics:

- Federal laws
- Cloud-based and third-party systems
- Ethical scenarios
- Corporate policies

Federal Laws

There are two key federal laws that apply to hacking: Title 18, Chapter 47, Sections 1029 and 1030. One thing that stands out in these laws is in most of the statements, the words unauthorized or exceeds authorized access are used. These keywords are what apply to the ethical hacker. The ethical hacker needs to ensure they access only the systems to which they have explicit permission and only to the level they have authorized access.

- Section 1029 refers to fraud and related activity with access devices. An access device is any application or hardware that is created specifically to generate access credentials.
- Section 1030 refers to fraud and related activity with computers or any other device that connects to a network.

In addition to the above two laws, the Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies was amended in 2013 to include intrusion software. This agreement is between 41 countries that generally hold similar views on human rights. The update in 2013 has led to a lot of issues and confusion in the cybersecurity field, as many of the tools used in the penetration testing process can also be used by black hat hackers for malicious purposes.

In 2018, the Wassenaar Arrangement was updated to clarify some of these policies. This will hopefully make things easier for some penetration testers involved in international testing.

Cloud-Based and Third-Party Systems

When dealing with cloud-based systems or other third-party systems, special considerations need to be made. If an organization is using a cloud-based system, that means the organization doesn't own the system and cannot legally provide permission for a penetration test to be carried out on that system. The penetration tester must make sure to get the explicit permission from the cloud provider before performing any tests.

Third-party systems can also cause some issues for the penetration tester. If systems are interconnected, such as in a supply chain, the penetration tester needs to ensure they do not accidentally access the third party's systems at all. The penetration tester may also run across vulnerabilities that can affect the third party. In this scenario, the penetration tester needs to report findings to the client and let the client handle the reporting.

Ethical Scenarios

Aside from the laws and regulations, the ethical hacker must be aware of scenarios where ethical decisions need to be made. One particular instance that can cause an issue is when the penetration tester resides in one state and the organization is in another state. The laws that govern computer usage and hacking can vary from state to state. When this occurs, the penetration tester and the organization need to agree on which set of laws they will adhere to. Whenever there are any questions or concerns regarding laws and regulations, a lawyer should be consulted.

There will be instances where the ethical hacker will run across data and may not be sure what to do with it. There are instances, such as child pornography, that is considered a mandated report - these sorts of findings must always be immediately reported, no exceptions. In any other situation where data is discovered that is not a mandated report, the data should be disclosed to the client. As always, when there is doubt about which course of action to take, a lawyer should be consulted.

Corporate Policies

Corporate policies also play a role in how a penetration test is carried out. Corporate policies are the rules and regulations that have been defined and put in place by the organization. As part of the risk assessment and penetration test, these policies should be reviewed and tested. Some common policies that most organizations have defined are password polices, update frequency, handling sensitive data, and bring your own devices. The organization needs to determine which, if any, of these policies will be tested during an assessment.

2.5.6 Engagement Contract Facts

2.5.6 Engagement Contract Facts

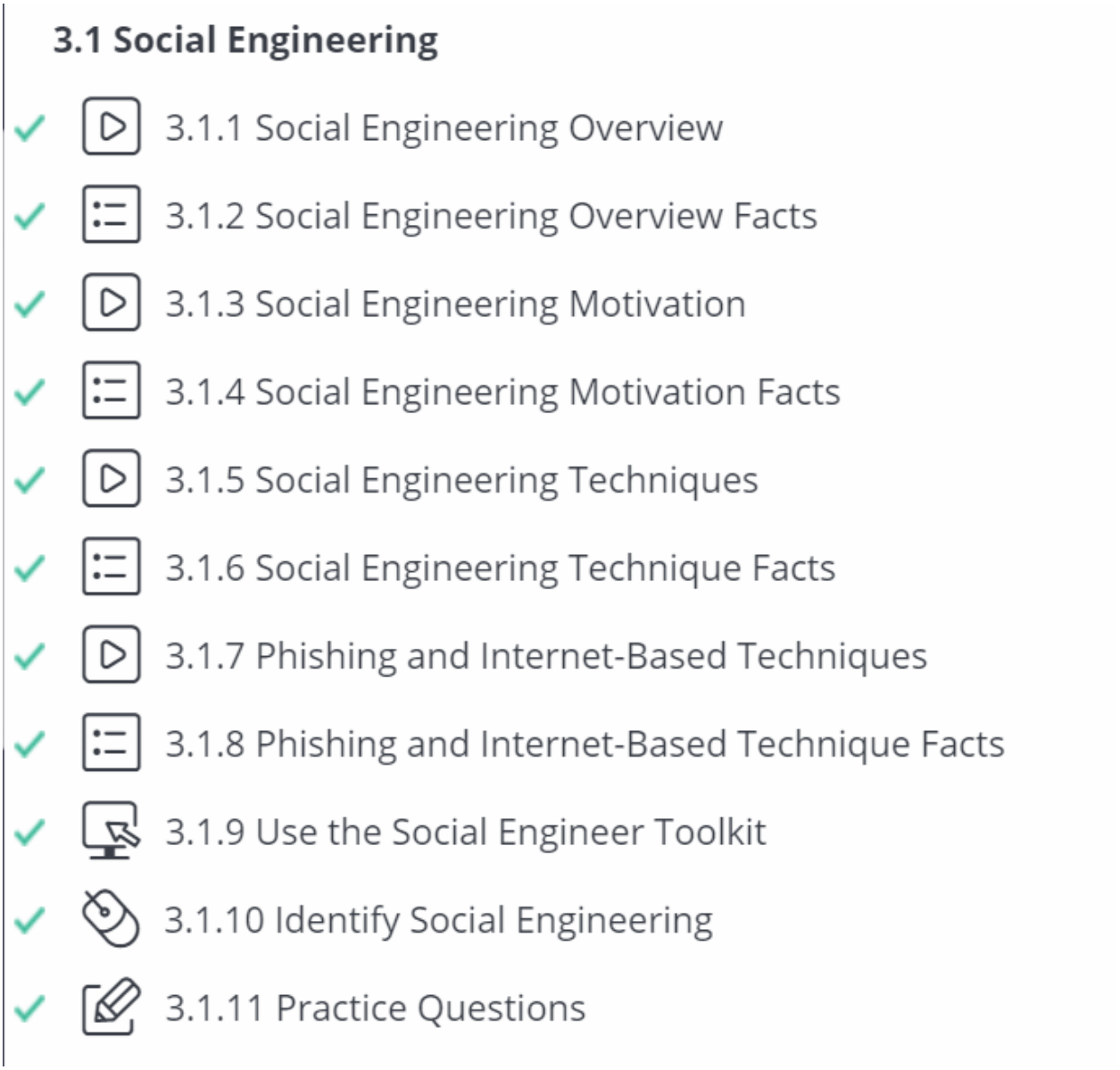
Before a penetration test can begin, there are a few key documents that must be completed and agreed on. These documents are designed to protect both the organization and the penetration tester.

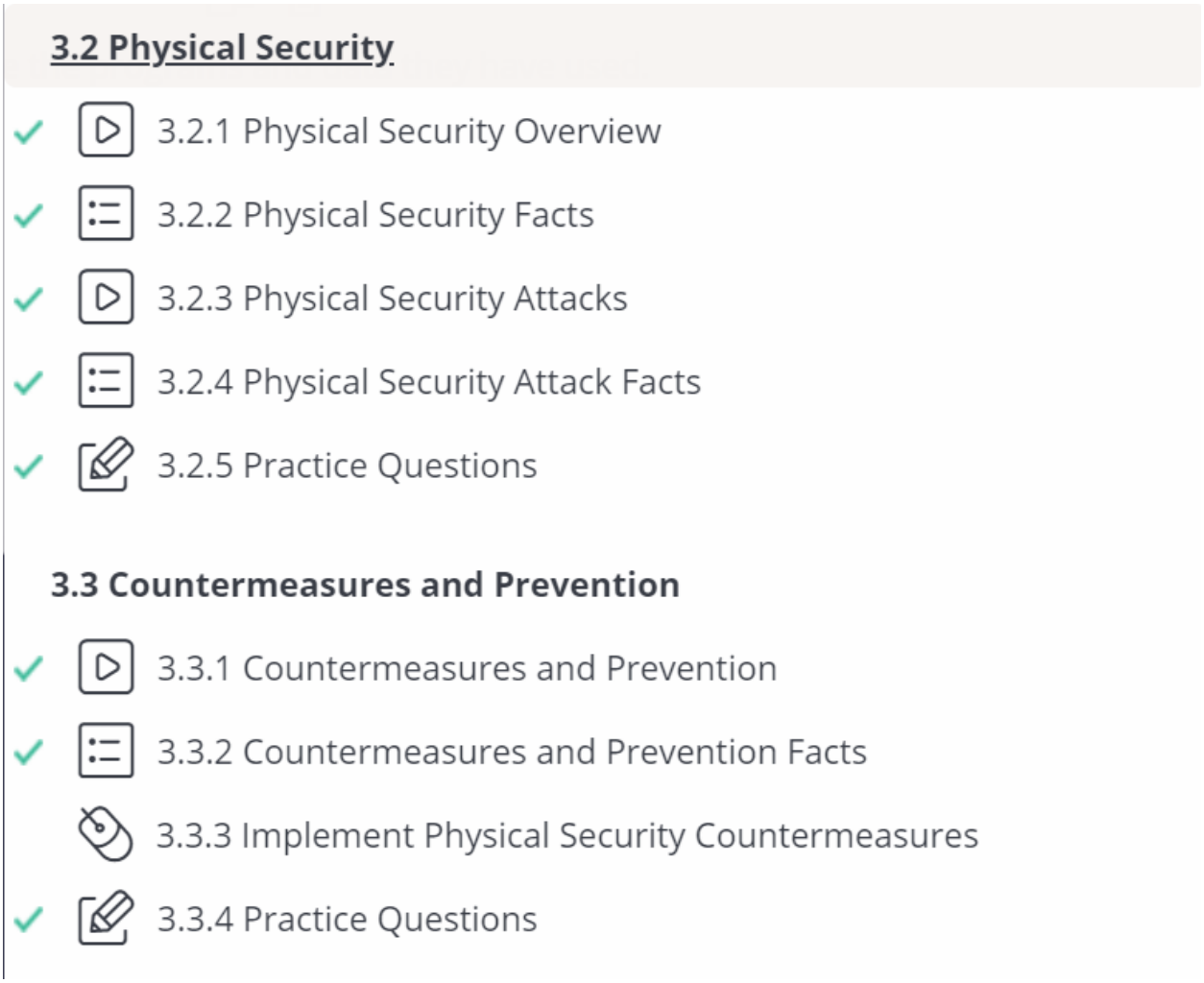
Even though much of this information could be put into a single document, it makes things much clearer when all the details are separated out into the documents described in this table.

Document	Description
Scope of Work	The Scope of Work is one of the more detailed documents for a project. This document spells out in detail the who, what, when, where, and why of the penetration test. Explicitly stated in the Scope of Work are details of all system aspects that can be tested, such as IP ranges, servers, and applications. Anything not listed is off-limits to the ethical hacker. Off-limit features should also be explicitly stated in the Scope of Work document to avoid any confusion. This document will also define the test's time frame, purpose, and any special considerations.
Rules of Engagement	The Rules of Engagement document defines how the penetration test will be carried out. This document defines whether the test will be a white box, gray box, or black box test. Other details, such as how to handle sensitive data and who to notify in case something goes wrong, will be listed in the document.
Master Service Agreement	It is very common for companies to do business with each other multiple times. In these situations, a Master Service Agreement is useful. This document spells out many of the terms that are commonly used between the two companies, such as payment. This makes future contracts much easier to complete, as most details are already spelled out.
Non-Disclosure Agreement	This is a common legal contract outlining confidential material or information that will be shared during the assessment and the restrictions placed on it. This contract basically states that anything the tester finds cannot be shared, with the exception of those people stated in the document.
Permission to Test	This document is often referred to as the get-out-of-jail-free card. Since most people in the client's organization will not know about the penetration test occurring, this document is used if the penetration tester gets caught. This document is used only as a last resort but explains what the penetration tester is doing and that the work is fully authorized.

3. Social Engineering and Physical Security

3.1 Social Engineering





3.1.2 Social Engineering Overview Facts

Social engineering refers to enticing or manipulating people to perform tasks or relay information that benefits an attacker. Social engineering tries to get a person to do something the person wouldn't do under normal circumstances.

This lesson covers the following topics:

- Manipulation tactics
- Social engineering process

Manipulation Tactics

Social engineers are master manipulators. The following table describes some of the most popular tactics they use on targets.

Manipulation Type	Description
Moral obligation	An attacker uses moral obligation to exploit the target's willingness to be helpful and assist them out of a sense of responsibility.
Innate human trust	Attackers often exploit a target's natural tendency to trust others. The attacker wears the right clothes, has the right demeanor, and speaks words and terms the target is familiar with so that the target will comply with requests out of trust.
Threatening	An attacker threatens when they intimidate a target with threats convincing enough to make them comply with the attacker's request.
Offering something for very little to nothing	Offering something for very little to nothing refers to an attacker promising huge rewards if the target is willing to do a very small favor or share what the target thinks is a very trivial piece of information.
Ignorance	Ignorance means the target is not educated in social engineering tactics and prevention, so the target can't recognize social engineering when it is happening. The attacker knows this and exploits the ignorance to his or her advantage.

Social Engineering Process

The social engineering process can be divided into three main phases: research, development, and exploitation. The following table describes each phase.

Phase	Description
Research	In the research phase, the attacker gathers information about the target organization. Attackers use a process called Footprinting, which is using all resources available to gain information, including going through the target organization's official websites and social media; performing dumpster diving; searching sources for employees' names, email addresses, and IDs; going through an organization tour; and other kinds of onsite observation. Research may provide information for pretexting. Pretexting is using a fictitious scenario to persuade someone to perform an unauthorized action such as providing server names and login information. Pretexting usually requires the attacker to perform research to create a believable scenario. The

	more the attacker knows about the organization and the target, the more believable a scenario the attacker can come up with.
Development	The development phase involves two parts: selecting individual targets within the organization being attacked and forming a relationship with the selected targets. Usually, attackers select people who not only will have access to the information or object they desire, but that also show signs of being frustrated, overconfident, arrogant, or somehow easy to extract information from. Once the targets are selected, the attacker will start forming a relationship with them through conversations, emails, shared interests, and so on. The relationship helps build the targets' trust in the attacker, allowing the target to be comfortable, relaxed, and more willing to help.
Exploitation	In the exploitation phase, the attacker takes advantage of the relationship with the target and uses the target to extract information, obtain access, or accomplish the attacker's purposes in some way. Some examples include disclosing password and username; introducing the attacker to other personnel, providing social credibility for the attacker; inserting a USB flash drive with a malicious payload into a organization's computer; opening an infected email attachment; and exposing trade secrets in a discussion. If the exploitation is successful, the only thing left to do is to wrap things up without raising suspicion. Most attackers tie up loose ends, such as erasing digital footprints and ensuring no items or information are left behind for the target to determine that an attack has taken place or identify the attacker. A well-planned and smooth exit strategy is the attacker's goal and final act in the exploitation phase.

3.1.4 Social Engineering Motivation Facts

3.1.4 Social Engineering Motivation Facts

There are many different social engineering techniques, attackers, and types of motivation techniques.

This lesson covers the following topics:

- Social engineering attacks
- Types of attackers
- Types of motivation techniques

Social Engineering Attacks

The following table describes a few social engineering attacks.

Attack	Description
Shoulder surfing	Shoulder surfing involves looking over someone's shoulder while they work on a computer or review documents. This attack's purpose is to obtain usernames, passwords, account numbers, or other sensitive information.
Eavesdropping	Eavesdropping is an unauthorized person listening to private conversations between employees or other authorized personnel when sensitive topics are being discussed.
USB and keyloggers	When on site, a social engineer also has the ability to stealing data through a USB flash drive or a keystroke logger. Social engineers often employ keystroke loggers to capture usernames and passwords. As the target logs in, the username and password are saved. Later, the attacker uses the username and password to conduct an exploit.
Spam and spim	When using spam, the attacker sends an email or banner ad embedded with a compromised URL that entices a user to click it. Spim is similar, but the malicious link is sent to the target using instant messaging instead of email.
Hoax	Email hoaxes are often easy to spot because of their bad spelling and terrible grammar. However, hoax emails use a variety of tactics to convince the target they're real.

Types of Attackers

The following table describes different types of attackers.

Type	Description
Insider	An insider could be a customer, a janitor, or even a security guard. But most of the time, it's an employee. Employees pose one of the biggest threats to any organization. There are many reasons why an employee might become a threat. The employee could: • Be motivated by a personal vendetta because they are disgruntled. • Want to make money.

	• Be bribed into stealing information. Sometimes, an employee can become a threat actor without even realizing it. This is known as an unintentional threat actor. The employee may create security breaches doing what seems to be harmless day-to-day work. An unintentional threat actor is the most common insider threat.
Hacker	Generally speaking, a hacker is any threat actor who uses technical knowledge to bypass security, exploit a vulnerability, and gain access to protected information. Hackers could attack for several different reasons. Some types of hackers are: • Those motivated by bragging rights, attention, and the thrill. • Hacktivists with a political motive. • Script kiddies, who use applications or scripts written by much more talented individuals. • A white hat hacker, who tries to help a company see the vulnerabilities that exist in their security. • Cybercriminals, who are motivated by significant financial gain. They typically take more risks and use extreme tactics. Corporate spies are a sub-category of cybercriminal.
Nation state	Attacks from nation states have several key components that make them especially powerful. Typically, nation state attacks: • Are highly targeted. • Identify a target and wage an all-out war. • Are extremely motivated. • Use the most sophisticated attack techniques of all the attackers. This often includes developing completely new applications and viruses in order to carry out an attack. • Are well financed.

Types of Motivation Techniques

The following table describes types of techniques a social engineer uses to motivate an employee to provide information.

Technique	Description
Authority and fear	Authority techniques rely on power to get a target to comply without questioning the attacker. The attacker pretends to be a superior with enough power that the target will comply right away without question.

	The attacker could also pretend to be there in the name of or upon the request of a superior. Authority is often combined with fear. If an authority figure threatens a target with being fired or demoted, the target is more likely to comply without a second thought.
Social proof	Social proof means the attacker uses social pressure to convince the target that it's okay to share or do something. In this case, the attacker might say, "If everybody is doing it, then it's okay for you to do it, too."
Scarcity	Scarcity appeals to the target's greed. If something is in short supply and will not be available, the target is more likely to fall for it.
Likeability	Likeability works well because humans tend to do more to please a person they like as opposed to a person they don't like.
Urgency	To create a sense of urgency, an attacker fabricates a scenario of distress to convince an individual that action is immediately necessary.
Common ground and shared interest	Common ground and shared interest work because sharing a hobby, life experience, or problem instantly builds a connection and starts forming trust between two parties.

3.1.6 Social Engineering Techniques Facts

3.1.6 Social Engineering Technique Facts

Not all attackers are the same. They all have different motives, attributes, and attack characteristics. Hackers may also employ several different techniques to obtain what they want from the target.

This lesson covers the following topics:

- Attack types
- Elicitation
- Pretexting, preloading, and impersonation
- Interview and interrogation

Attack Types

A single hacker trying to exploit a vulnerability is going to have a completely different attack profile than an organized crime group waging an assault on your network. The following table describes the differences between the two.

Attack	Description
Opportunistic	An opportunistic attack is typically automated and involves scanning a wide range of systems for known vulnerabilities, such as old software, exposed ports, poorly secured networks, and default configurations. When one is found, the hacker will exploit the vulnerability, steal whatever is easy to obtain, and get out.
Targeted	A targeted attack is much more dangerous. A targeted attack is extremely methodical and is often carried out by multiple entities that have substantial resources. Targeted attacks almost always use unknown exploits, and the hackers go to great lengths to cover their tracks and hide their presence. Targeted attacks often use completely new programs that are specifically designed for the target.

Elicitation

Elicitation is a technique that tries to extract information from a target without arousing suspicion. The following table describes some elicitation tactics.

Tactic	Description
Compliments	Attackers may give a target a compliment about something they know the target did in hopes that the target will take the bait and elaborate on the subject. Even if the target downplays the skill or ability involved, talking about it might give the attacker valuable information.
Misinformation	Attackers might make a statement with the wrong details. The attacker's intent is that the target will give the accurate details that the attacker wanted to confirm. The more precise the details given by the attacker, the better the chance that the target will take the bait.
Feigning ignorance	Attackers might make a wrong statement and then admit to not knowing much about the subject. This statement will hopefully get the target to not only correct the attacker, but also explain why the attacker is wrong in detail. The explanation might help the attacker learn, or at least have a chance to ask questions without looking suspicious.

Being a good listener	An attacker may approach a target and carefully listen to what the target has to say, validate any feelings they express, and share similar experiences (which may be real or fabricated). The point is to be relatable and sympathetic. As the target feels more connected to the attacker, barriers go down and trust builds, leading the target to share more information.

Pretexting, Preloading, and Impersonation

All the social engineering techniques involve some pretexting, preloading, and impersonation. The following table describes these steps.

Step	Description
Pretexting	Pretexting is doing research and information gathering to create convincing identities, stories, and scenarios to be used on selected targets.
Preloading	Preloading is used to set up a target by influencing the target's thoughts, opinions, and emotions.
Impersonation	Impersonation is pretending to be trustworthy and having a legitimate reason for approaching the target to ask for sensitive information or access to protected systems.

Interview and Interrogation

Another technique social engineers use often is the concept of interviews and interrogation. The following table describes some of the most important aspects of conducting a successful interview and interrogation.

Concept	Description
Interview vs interrogation	In the interview phase, the attacker lets the target do the talking while the attacker mostly listens. In this way, the attacker has the chance to learn more about the target and how to extract information from them. Then the attacker leads the interview phase into an interrogation phase. It's most effective when done smoothly and naturally and when the target already feels a connection and trust with the attacker. In the interrogation phase, the attacker talks about the target's statements. At this point, the attacker is mostly leading the conversation with questions and statements that will flow in the direction the attacker has in mind to obtain information.

Environment	The environment the attacker chooses for conducting an interview and interrogation is essential to setting the mood. The location should not be overly noisy or overly crowded. It should be a relaxing and stress-free environment that puts the target at ease. The attacker shouldn't sit between the target and the door. The target should never feel trapped in any way. Lighting should be good enough for both parties to see each other clearly. This will allow the attacker to better read the target's micro expressions and movements. It will also inspire trust in the target.
Observation	During these interviews and interrogations, the hacker pays attention to every change the target displays. This allows the attacker to discern the target's thoughts and topics that should be investigated further. Every part of the human body can give a clue about what is going on inside the mind. Most people don't even realize they give many physical cues, nor do they recognize these cues in others. A skilled observer pays close attention and puts these clues together to confirm another person's thoughts and feelings.

3.1.7 Phishing and Internet-Based Technique Facts

3.1.8 Phishing and Internet-Based Technique Facts

Users interfacing with the internet either through email or browsing websites can pose substantial security threats to an organization. Attacks that entice users to provide sensitive information or click a link that installs malware are called social engineering attacks. Increasing user awareness of the types of threats and how to successfully avoid them is critical to an organization's overall security.

This lesson covers the following topics:

- Phishing
- Other social engineering attacks

Phishing

One of the most successful social engineering attacks is called a phishing attack. In a phishing attack, the social engineer masquerades as a trustworthy entity in an electronic communication. The following table describes a few variations of phishing attacks.

Attack	Description

Spear phishing	In spear phishing, an attacker gathers information about the victim, such as their online bank. The attacker then sends a phishing email to the victim that appears to be from that bank. Usually, the email contains a link that sends the user to a site that looks legitimate but is intended to capture the victim's personal information.
Whaling	Whaling is another form of phishing that targets senior executives and high-profile victims.
Vishing	Vishing is like phishing, but instead of an email, the attacker uses Voice over IP (VoIP) to gain sensitive information. The term is a combination of voice and phishing.
SMS phishing	In SMS phishing (smishing), the attacker sends a text message with a supposedly urgent topic to trick the victim into taking immediate action. The message usually contains a link that will either install malware on the victim's phone or extract personal information.

Other Social Engineering Attacks

The table below describes other common social engineering attacks.

Attack	Description
Pharming	Pharming involves the attacker executing malicious programs on the target's computer so that any URL traffic redirects to the attacker's malicious website. This attack is also called phishing without a lure. The attacker is then privy to the user's sensitive data, like IDs, passwords, and banking details. Pharming attacks frequently come in the form of malware such as Trojan horses, worms, and similar programs. Pharming is commonly implemented using DNS cache poisoning or host file modification. • In DNS cache poisoning, the attacker launches the attack on the chosen DNS server. Then, in the DNS table, the attacker changes the IP address of a legitimate website to a fake website. When the user enters a legitimate URL, the DNS redirects the user to the fake website controlled by the attacker. • In host file modification, the attacker sends malicious code as an email attachment. When the user opens the attachment, the malicious code executes and modifies the local host file on the user's computer. When the user enters a legitimate

	URL in the browser, the compromised host file redirects the user to the fraudulent website controlled by the attacker.
Social networking	Many attackers are turning to applications such as Facebook, Twitter, Instagram, to steal identities and information. Also, many attackers use social media to scam users. These scams are designed to entice the user to click a link that brings up a malicious site the attacker controls. Usually, the site requests personal information and sensitive data, such as an email address or credit card number.

#Lab 3.1.10 Identify Social Engineering (Emails)

3.2.2 Physical Security Facts

3.2.2 Physical Security Facts

Physical security is the protection of corporate assets (including property, facilities, equipment, and personnel) from damage, theft, or harm. Physical security inspections should be performed quarterly. Violations should be addressed in a formal manner, with warnings and penalties.

This lesson covers the following topics:

- Security factors
- Security aspects
- Physical controls
- Security sequence
- Layered defense

Security Factors

There are three factors to keep in mind with physical security:

- *Prevention* is taking safeguards to protect property, facilities, equipment, and personnel. The safeguards should deter an attack.
- *Detection* is identifying the extent of damage, theft, or harm.
- *Recovery* is the implementation of security procedures to minimize the impact of an attack and repair any damage in order to get the organization operational again. It also involves hardening the physical security of the organization against future problems.

Security Aspects

Important aspects of physical security include:

- Restricting physical access to facilities and computer systems.
- Preventing interruptions of computer services caused by problems such as loss of power or fire.
- Preventing unauthorized disclosure of information.
- Disposing of sensitive material.
- Protecting the interior and exterior of the facility.

Physical Controls

The following table lists physical control measures and characteristics.

Control Measure	Characteristics

Perimeter barriers	The first measure in physically securing a building is to secure the perimeter and restrict access to only secure entry points. Methods for securing the perimeter include:
	• Fences to provide an environmental barrier that prevents easy access to the facility.
	  ○ A low fence (3-4 feet) acts as a deterrent to casual intrusion.
	  ○ A higher fence (6-7 feet) acts as a deterrent unless the trespasser has a specific intent to violate security.
	  ○ A fence 8 feet or higher topped with barbed wire is an effective deterrent.
	• Barricades and bollards can be erected to prevent vehicles from approaching the facility.
	• Signs should be posted to inform individuals that they are entering a secured area.
	• Guard dogs are generally highly reliable, but are appropriate only for physical perimeter security. They can be expensive to keep and maintain. Their use might raise issues of liability and insurance.
	• Lighting deters casual intruders, helps guards see intruders, and is necessary for most cameras to monitor the area. To be effective, lights should be placed to eliminate shadows or dark spots.
	• Security guards offer the best protection for perimeter security because they can actively respond to a variety of threat situations. Security guards can also reference an *access list,* which explicitly lists who can enter a secure

	facility. However, guards are expensive, require training, and can be unreliable or inconsistent.

Closed-circuit television (CCTV)	Closed-circuit television can be used as both a preventative tool (when monitoring live events) or as an investigative tool (when events are recorded for later playback). Camera types include the following:
	• A *bullet* camera has a built-in lens and is long and round in shape. Most bullet cameras can be used indoors or outdoors.
	• A *c-mount* camera has interchangeable lenses and is typically rectangular in shape with the lens on the end. Most c-mount cameras require a special housing to be used outdoors.
	• A *dome* camera is a camera protected with a plastic or glass dome. These cameras are more vandal-resistant than other cameras.
	• A pan tilt zoom (PTZ) camera can dynamically move the camera and zoom in on specific areas. Cameras without PTZ capabilities are manually set looking toward a specific direction. *Automatic* PTZ mode automatically moves the camera between several preset locations; *manual* PTZ lets an operator remotely control the position of the camera.
	When selecting cameras, be aware of the following characteristics:
	• The *focal length* measures the magnification power of a lens. The focal length controls the distance that the camera can see, as well as how much detail can be seen at a specific range.
	  ○ The focal length is expressed in millimeters (mm). A higher focal length lets you see more detail at a greater distance.
	  ○ Most cameras have a 4 mm lens with a range of 30-35 feet, allowing you to see facial features at that distance.
	  ○ A *fixed* lens camera has a set focal length. A *varifocal* camera lens lets you adjust the focus (zoom).
	• A 70-degree view angle is the largest view angle possible without image distortion.
	• The *resolution* is rated in the number of lines (such as 400) included in the image. In general, the higher the resolution, the sharper the image.

	• LUX is a measure of the sensitivity to light. The lower the number, the less light is necessary for a clear image. • Infrared cameras can record images in little or no light. Infrared cameras have a range of about 25 feet in no light and further in dimly-lit areas. When CCTV is used in a preventative way, you must have a guard or other person available who monitors one or more cameras. The cameras effectively expand the area that can be monitored by the guard. Cameras can detect only security breaches. Guards can prevent and react to security breaches.

Doors	Doors can enhance security if they are properly implemented. Specific door types include the following:
	
	• A *mantrap* is a specialized entrance with two doors that create a security buffer zone between two areas.
	  ○ Once a person enters into the space between the doors, both doors are locked.
	  ○ To enter the facility, authentication must be provided. Authentication may include visual identification and identification credentials.
	  ○ Mantraps should permit only a single person to enter, and each person must provide authentication.
	  ○ If authentication is not provided, the intruder is kept in the mantrap until authorities arrive.
	• A *turnstile* is a barrier that permits entry in only one direction.
	  ○ Physical turnstiles are often used to control entry for large events such as concerts and sporting events.
	  ○ Optical turnstiles use sensors and alarms to control entry.
	  ○ Turnstiles are often used to permit easy exit from a secure area. Entry is controlled through a mantrap or other system that requires authentication for entry.
	• A *double-entry door* has two doors that are locked from the outside, but have crash bars on the inside that allow easy exit. Double-entry doors are typically used only for emergency exits. Alarms sound when double-entry doors are opened.
	
	Regular doors are susceptible to social engineering attacks such as *piggybacking*, or *tailgating*, where an unauthorized person follows an

	authorized person through a door. Mantraps and turnstiles that permit only a single person to enter and require individual authentication are effective deterrents to piggybacking.

Door locks	Door locks allow access only to people with the proper key. Lock types are explained in the following list.
	• *Pick-resistant locks* with restricted key duplication are the most secure key lock. It is important to note that all traditional key locks are vulnerable to lock picking (shimming).
	• *Keypad locks* require knowledge of a code and reduce the threat of lost keys and cards. Keypads should be cleaned frequently to remove indications of buttons used.
	• Electronic systems often use *key cards* (or ID badges) instead of keys to allow access.
	  ○ *Dumb cards* contain limited information.
	  ○ *Smart cards* have the ability to encrypt access information. Smart cards can be contact or contactless. Contactless smart cards use the 13.56 MHz frequency to communicate with *proximity readers*.
	  ○ *Proximity cards*, also known as radio frequency identification (RFID) cards, are a subset of smart cards that use the 125 kHz frequency to communicate with proximity readers. Proximity cards differ from smart cards because they are designed to communicate only the card's identity. A smart card can communicate much more information.
	• *Biometric locks* increase security by using fingerprints or iris scans. They reduce the threat of lost keys or cards.

Physical access logs	Physical access logs are implemented by a facility's guards and require everyone gaining access to the facility to sign in up on entry.
Physical access controls	Physical access controls can be implemented inside the facility in the following ways. • Physical controls may include key fobs, swipe cards, or badges. • Physical controls may include biometric factors such as fingerprint scanners, retinal scanners, iris scanners, voice recognition, and facial recognition.

	- The *false acceptance rate* (FAR) refers to the likelihood that an unauthorized user will incorrectly be given access. - The *false recognition rate* (FRR) refers to the likelihood that an authorized user will incorrectly be rejected and denied access. - Both the FAR and FRR are influenced by the biometric scanners threshold settings. The *crossover error rate* (CER) is the rate at which the FAR becomes equal to the FRR after adjusting the threshold. The lower the CER, the better the biometric system. - To control access to sensitive areas within the facility, require a card swipe or reader. - Some systems can track personnel movement within a facility and proactively lock or unlock doors based on each person's access token device. - An *anti-passback system* prevents a card holder from passing a card back to someone else. - Physical controls are often implemented along with sensors and alarms to detect unauthorized access. *Photoelectric* sensors detect motion and are better suited to detect a perimeter breach than interior motion detection. - Wave pattern, heat sensing, and ultrasonic sensors are all better suited for interior motion detection than perimeter breach detection.
Employee and visitor safety	As you implement physical security, be sure to keep the safety of employees and visitors in mind. Consider the importance of the following actions: - Implement adequate lighting in parking lots and around employee entrances. - Implement emergency lighting that runs on protected power and automatically switches on when the main power goes off. - Implement fail-open locking systems that allow employees to exit your facility quickly in the event of an emergency. - Devise escape plans that utilize the best escape routes for each area in your organization. Post these escape plans in prominent locations. - Conduct emergency drills to verify that the physical safety and security measures you have implemented function correctly.

Protected distribution system	A *protected distribution system* (PDS) encases network cabling within a *carrier*. This enables data to be securely transferred directly between two high-security areas through an area of lower security. Three types of PDS are most frequently implemented: • In a *hardened carrier PDS*, network cabling is run within metal conduit. All conduit connections are permanently welded or glued to prevent external access. To identify signs of tampering, regular visual inspections of the carrier should be conducted. • In an *alarmed carrier PDS*, an electronic alarm system replaces the welds and/or glue used to secure a hardened carrier. The electronic alarm system can detect attempts to compromise the carrier and access the protected cable within it. • In a *continuously viewed carrier PDS*, security guards continuously monitor the carrier to detect any intrusion attempt by attackers.

Security Sequence

Physical security should deploy in the following sequence. If a step in the sequence fails, the next step should implement itself automatically.

1. Deter initial access attempts.
2. Deny direct physical access.
3. Detect the intrusion.
4. Delay the violator to allow for response.

Layered Defense

When designing physical security, implement a *layered defense* system. A layered defense system is one in which controls are implemented at each layer to ensure that defeating one level of security does not allow an attacker subsequent access. Using multiple types of security controls within the same layer further enhances security. Tips for implementing a multi-layered defense system include the following:

- Protect entry points with a card access system (or some other type of control) as well as a security camera.
- Use a reception area to prevent the public, visitors, or contractors from entering secure areas of the building without an escort.
- Use the card access or other system to block access to elevators and stairwells. This will prevent someone who successfully tailgates from gaining further access.

- Use a different access system such as key locks, keypad locks, or biometric controls to secure offices or other sensitive areas.
- Implement security within offices and data centers using locking storage areas and computer passwords.

3.2.4 Physical Security Attack Facts

Planning, preparation, and prevention for physical security threats must be taken into consideration to protect an organization's data and systems. The National Institute of Standards and Technology (NIST) has a special publication, NIST SP 800-53, that details security controls and assessment procedures to protect the integrity of information systems.

This lesson covers the following topics:

- Environmental threats
- Threats to assets and property
- Facility breaches
- Physical attacks

Environmental Threats

The following table describes some of the environmental threats an organization may encounter.

Threat	Description
Flood	Flooding can occur for a variety of reasons, including heavy rains, overflowing rivers, broken dams, urban drainage basins, storm surges, broken pipes, and lack of vegetation.
Fire	Fires are a common environmental threat. There are many controls available that, if properly implemented, help reduce fire damage and diminish their threat to physical security.
Hurricane and tornado	Hurricanes and tornadoes are intense weather events that can be extremely destructive. They often disrupt services, such as electricity and communications networks, and prevent facility access.

Tsunami	Tsunamis are caused by underwater earthquakes, volcanic eruptions, or other events that results in the displacement of large volumes of water. Tsunami waves can be tens of feet high and cause an immense amount of destruction.
Earthquake	Earthquakes result from the seismic shift of tectonic plates moving along fault lines. Shaking ground, ruptured ground, and landslides can destroy buildings, cause dams to collapse, and ignite ruptured gas lines.
Other natural disasters	Other natural disasters include wind storms, electrical storms, blizzards, and other types of extreme weather.

Threats to Assets and Property

Threats to assets and property can be posed by those external to the organization as well as insiders. The table below describes some of these threats.

Threat	Description
Theft	Theft of an organization's assets can be very detrimental. For example if an employee's laptop is stolen, it's not only inconvenient for the employee but also any plans, projects, and other sensitive data that might be on that laptop could be leaked or used against the organization. The more important the position of the employee within the organization, the more serious the theft is.
Vandalism	Vandalism is damaging, defacing, or destroying someone else's property. Vandalism can be done by resentful employees or ex-employees; someone with a political agenda or vendetta against the organization; or for other reasons.
Destruction	Destruction is similar to vandalism, but it aims to completely destroy the organization's assets. This kind of malicious act could result in significant loss for the organization.

Facility Breaches

The following table describes a few techniques an attacker can use to gain access to a facility.

Technique	Description

Bump keys	A bump key is cut to the number nine position, which is the lowest possible cut. When the bump key goes inside the lock, the hacker puts a little bit of pressure on the back of the key by either bumping or tapping it. Doing this makes the pins jump inside of the cylinder, creating a temporary shear line that allows enough time for the intruder to quickly turn the lock.
Lock picking	Lock picking involves manipulating the lock's components to open it without a key. An attacker only needs a tension wrench and a pick. A tension wrench is a small, L-shaped tool available in several thicknesses and sizes. A pick is a small, angled, and pointed tool.
Scrubbing	One of the most common ways to pick a lock is called scrubbing. This method involves holding the lock with the tension wrench while quickly scraping the pins with the pick. Some of the pins are placed in a mechanical bind and become stuck in the unlocked position. With practice, an attacker can do this very easily. When all the pins stick, the lock is disengaged.
Lock shim	Another technique uses lock shims. This tool is, basically, a thin, stiff piece of metal that can be inserted into the latch of the padlock.
Badge cloning	Many employee ID badges use an RFID chip to access their office and other parts of their organization's building. However, this kind of chip can be easily copied to another card. To do this, all an attacker needs is a high-frequency antenna to capture a card's frequency, a card read/write device, a legitimate card, and a blank card. The attacker gets close enough to the legitimate card to read it. Once the card information is read, the attacker can easily clone it.

Physical Attacks

The table below describes some physical attacks:

Attack	Description
Cold boot attack	In the cold boot attack, the attacker enters the facility and extracts data remanence from RAM that might still be available before the system is completely powered off.

BIOS access attack	BIOS attacks have been around for a long time but should not be overlooked. This attack usually involves changing the boot order on a PC so that the hacker can gain access to the computer by bypassing the installed operating system.

3.3.2 Countermeasures and Prevention Facts

Implementing and teaching strong security policies and procedures is a critical component of security management. The most effective countermeasure for social engineering is employee awareness training. Teach employees at all levels how to recognize social engineering schemes and how to respond to them appropriately.

This lesson covers the following topics:

- Hiring and termination process
- Help desk
- Employee identification
- Physical prevention
- User awareness
- Paper shredding
- Backups

Hiring and Termination Process

One of the most important policies any company should have in place is a hiring and termination process for employees. The following table describes both processes.

Process	Description
Hiring	The HR department should perform the following tasks: • Check the background and contact the references of every candidate who applies for a job with the company. • Verify the candidate's educational records. • Have all employees sign a nondisclosure agreement (NDA). • Have all employees sign acceptable use policies (AUPs).
Termination	When an employee leaves the company, the HR department should be responsible for:

	• Ensuring that an exit interview is conducted. • Reviewing the NDA with the employee during the exit interview. • Verifying that all the equipment belonging to the company and used by the employee during employment is returned. The equipment could include keys, ID cards, cell phones, credit cards, laptops, and software. • Verify that the employee's network access is suspended.

Help Desk

The two most basic procedures to be followed by the help desk are caller ID and employee callback. These two procedures ensure a safer employee verification. A second form of employee authentication also strengthens security. For example, the help desk could request a cognitive password before sharing an account password or other sensitive information.

If the company is highly concerned about security, it could implement a policy that prohibits passwords and other sensitive information to be given over the phone under any circumstances. Every employee should be taught to forward any call requesting a password or the name of an employee to the help desk. In most cases, a caller attempting to gather information through social engineering will mostly likely hang up when directed to the help desk.

Employee Identification

Implement policies and procedures that require employee identification. ID badges are a great and easy way to identify who is authorized to be in a given area. Employees should be trained to:

- Wear their badge at all times.
- Respond appropriately if they encounter a person without a badge.
- Prevent piggybacking and tailgating.
- Never share their ID badge with anyone.

Physical Prevention

Bollards are an easy physical barrier that deters aggressive intruders. Bollards can be small straight concrete pillars, flat barricades, ball-shaped pieces of concrete, large flowerpots, or even cement picnic tables, as long as they prevent attackers from forcing themselves in by driving through an exterior wall or door.

User Awareness

The table below describes different areas in which employees should be trained.

Area	Description

Phishing	Many browsers have phishing detection software. Require employees to enable the phishing detection feature and restrict employees from using browsers without that feature. Train employees to:
	• Check the link destination within emails to verify that it points to the correct URL.
	• Never click on links in emails.
	• Use the different types of HTTPS appropriately:
	  ○ Sites secured with a regular certificate will display a lock in the address bar of most browsers. This means that the connection is encrypted using HTTPS. However, it doesn't necessarily mean the identity of the person running the site is verified.
	  ○ Sites that display either a green lock or green bar in the address bar indicate that the site is secure and the identity of the site has been verified.

Guests	Ensure that any guest who visits the facility is escorted. This will help prevent attackers from trying to gather information from within the facility. Also, implement a policy that prohibits guests from connecting to the organization's wired or wireless network.
Passwords	Password protection is a vital part of securing a network. Teach users to: • Never write down or share passwords under any circumstances. It's not uncommon for users to write down their passwords. Sometimes, they write their passwords on a sticky note and attach it to the monitor, hide their password under the keyboard, or put the password inside a desk drawer. Strong passwords can be very difficult to remember, which tempts the user to write the password down to remember it. This practice should be prohibited. • Never store passwords in cell phones. Phones are easily lost or stolen, potentially exposing the passwords. • Never give out passwords to anyone. Many social engineering attacks attempt to leverage sympathy, bullying, or coercion to get the user to reveal a password. Train users not to give their passwords to anyone, even if that person claims to be the CEO or a help desk administrator.

	• Never email passwords. Most email systems are relatively secure as they transmit email messages, but not all of them are. If an email system uses clear text, such as POP3, IMAP, or SMTP, without also using encrypting protocols, incoming and outgoing messages are transmitted in clear text. An attacker running a sniffer could capture email messages and read the contents. • Never use personally associated passwords. For convenience, users tend to set passwords that contain personally associated information, such as their name, birthday, spouse's name, child's name, pet's name, anniversary date, and hometown. This is an unsecure practice. A simple social media search can reveal a great deal of personal information about a user, making it possible to guess a password. In fact, many attackers prefer this approach to a technological password attack because it is easier and faster and has a very high success rate.

Paper Shredding

Procure shredders that discourage or make it impossible to reassembled shredded documents. It's important to teach employees to safely shred all sensitive information before disposal. This is one of the best ways to prevent information from being leaked through a physical copy. There are two basic types of shredders, strip-cut and crosscut. The table below describes each type in more detail.

Type	Description
Strip-cut	Strip-cut shredders cut paper into long, thin strips. They usually handle a larger volume of paper than the crosscut shredders, and they're also lower maintenance. They usually shred paper into 1/8 to 1/2 inch thick strips. The downside of this type shredder is that dumpster divers can put the strips back together and reassemble documents.
Crosscut	Crosscut shredders are more secure because they cut the paper both vertically and horizontally, turning the paper into confetti. This makes it a lot more difficult for dumpster divers to reassemble the document.

Backups

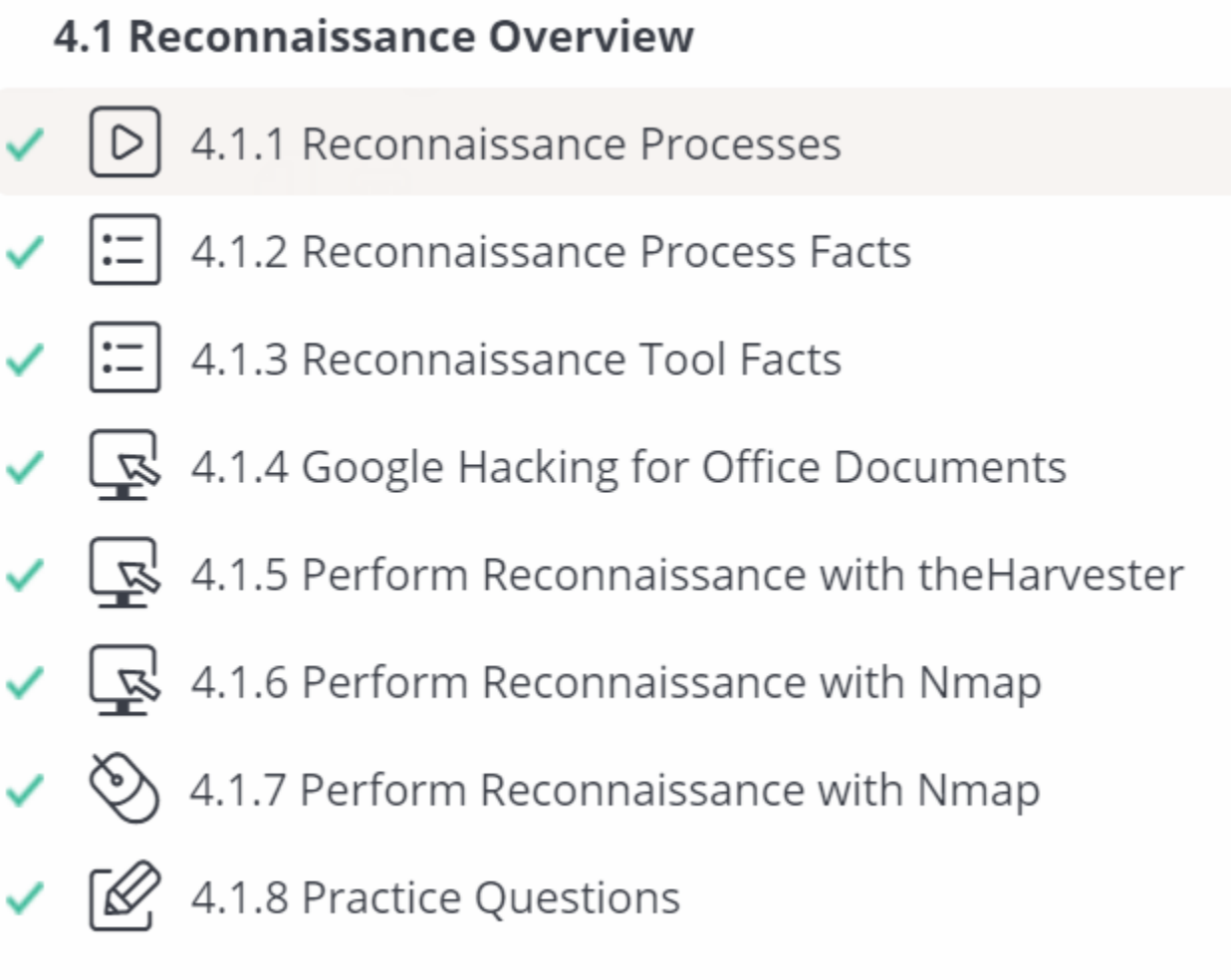
Most organizations back up data once a day, usually at night. A backup can be full, incremental, or differential. The table below describes each type of backup.

Backup Type	Description
Full backup	A full backup is exactly what it sounds like; it backs up everything. All data on the system is backed up each time the backup runs. It's the most complete backup you can choose. Most organizations run full backups at least weekly.
Incremental backup	An incremental backup backs up every file that's changed since the last full or incremental backup. This goes a lot faster than a full backup, allowing you to back up files daily. Incremental backups have one drawback: restoring data from incremental backups takes a long time. The first thing you must do is restore the first full backup. Then you have to restore every incremental backup in the order they were created. This could take hours.
Differential backup	A differential backup backs every file that's changed since the last full backup. This has advantages and disadvantages. The advantage is that when a system crashes, data can be restored quickly. Only the last full backup and the last differential backup are restored. The disadvantage is that, by the end of the work week, the differential backup may contain a week's worth of data instead of a day's worth.

Lab 3.3.3 Implement Physical Security Countermeasures

4. Reconnaissance

4.1 Reconnaissance Overview



4.1.2 Reconnaissance Process Facts

Reconnaissance is a systematic attempt to locate, gather, identify, and record information about a target.

This lesson covers the following topics:

- Information types
- Information gathering techniques
- Permission and documentation

Information Types

During the reconnaissance phase, you gather information about a company. In addition to technical information, you'll want to gather details about employees, vendors, business processes, and physical security.

Information	Description
Employees	Contact names, phone numbers, email addresses, fax numbers, addresses for any individuals associated with the target company
Physical security	Geographical information, entry control systems, employee routines, and vendor traffic
Vendors	Names, contact information, and account numbers
Operations	Intellectual property, critical business functions, and management hierarchy
Information systems	Operating systems, applications, security policies, and network mapping

Information Gathering Techniques

During the reconnaissance phase, you gather information by reading a company's website, getting to know their employees, or dumpster diving.

Method	Description
Websites	You can research company websites, social media, discussion groups, financial reports, and news articles. If you follow the breadcrumbs, you can find some pretty interesting things about an organization online.
Social engineering	Social engineering is an attempt to get to know the employees or the vendors of the company. After-work social gatherings can provide important tidbits of information about an employee and about a company, especially its weaknesses.
Dumpster diving	Despite our highly technical society, dumpster diving is still an option to consider. Let's be honest; it's not the most glamorous method. But, in some

	instances, it may be very effective for finding employee names, account numbers, client names, and vendor information.
Social networking	After you've located employee names, you can extend your search to LinkedIn, Facebook, Instagram, Twitter or People Search to learn even more information about a company, a vendor, or an employee.

Permission and Documentation

The difference between an ethical hacker and a criminal hacker is that the ethical hacker always obtains permission. Before beginning work of any kind, an ethical hacker needs to obtain written documentation granting permission from the customer. They should verify that the agreement specifies the scope of the assessment and any guidelines or limitations that may be in place.

As with any technical project, you will need to thoroughly document your findings. Recording information while it's fresh in your mind reduces the potential for errors or missing details.

4.1.3 Reconnaissance Tools Facts

4.1.3 Reconnaissance Tool Facts

There are several reconnaissance tools that you can use to gather information.

This lesson covers the following topics:

- Internet research tools
- Google hacking
- Network Footprinting tools

Internet Research Tools

The following table identifies several internet research tools:

Tool	Description
Google Earth	*Google Earth* is a satellite imagery tool that provides current and historical images of most locations. Images can date back over several decades.

Google Maps	*Google Maps* is a web mapping service that provides a street view of houses, businesses, roadways, and topologies.
Webcams	*Webcams* are online streaming digital cameras that can provide video of places, people, and activity in an area.
Echosec	*Echosec* is a tool that can be used to pull information from social media postings that were made using location services. You can select a location on a map and view all posts that have occurred at that location. These results can be filtered by user, date, or keyword.
Maltego	*Maltego* is an open-source forensics tool that can be used to pull information from social media postings and find relationships between companies, people, email addresses, and other information.
Wayback Machine	The *Wayback Machine* is a nonprofit catalog of old site snapshots. It may contain information that your target thought they had removed from the internet.

Google Hacking

Despite its name, Google Hacking is legal because all of the results are pulled from public websites. By adding a few operators, you can use the Google search engine to provide filtered information about a specific topic as shown below:

Operator/Syntax	Description
info:*website*	Provides all information about a website.
link:*website*	Lists web pages that contain links to websites.
related:*website*	Displays websites similar to the one listed.
index of /*keyword*	Displays websites where directory browsing has been enabled.
intitle:*keyword*	Shows results in pages that contain the keyword in the title.

allinurl:*keywords*	Shows results in pages that contain all of the listed keywords.

Network Footprinting Tools

Although similar to reconnaissance, footprinting refers more specifically to information that is accidentally shared publicly or that is outdated and has not been properly disposed of. Website and email footprinting can provide details on information flow, operating systems, filenames, and network connections.

Depending on the level of security within an organization, it is possible to create a network map without stepping foot into the building. Just as a mailman can find a mailbox using a mailing address, a hacker can find hosts and other objects on a network using DNS network addressing. An IP address can direct you to a network access point such as an email server or a web server.

The following table lists several network footprinting tools.

Tool	Description
Whois	*Whois* is a utility used to gain information about a target network. It can gather information about ownership, IP addresses, domain name, location, server type, and the date the site was created. The syntax is **Whois *domain_name***.
Nslookup	*Nslookup* is a utility used to query DNS servers to obtain information about the host network, including DNS records and host names.
ARIN	*ARIN* is a website that will provide you with information about a network's name, range, origination dates, and server details.

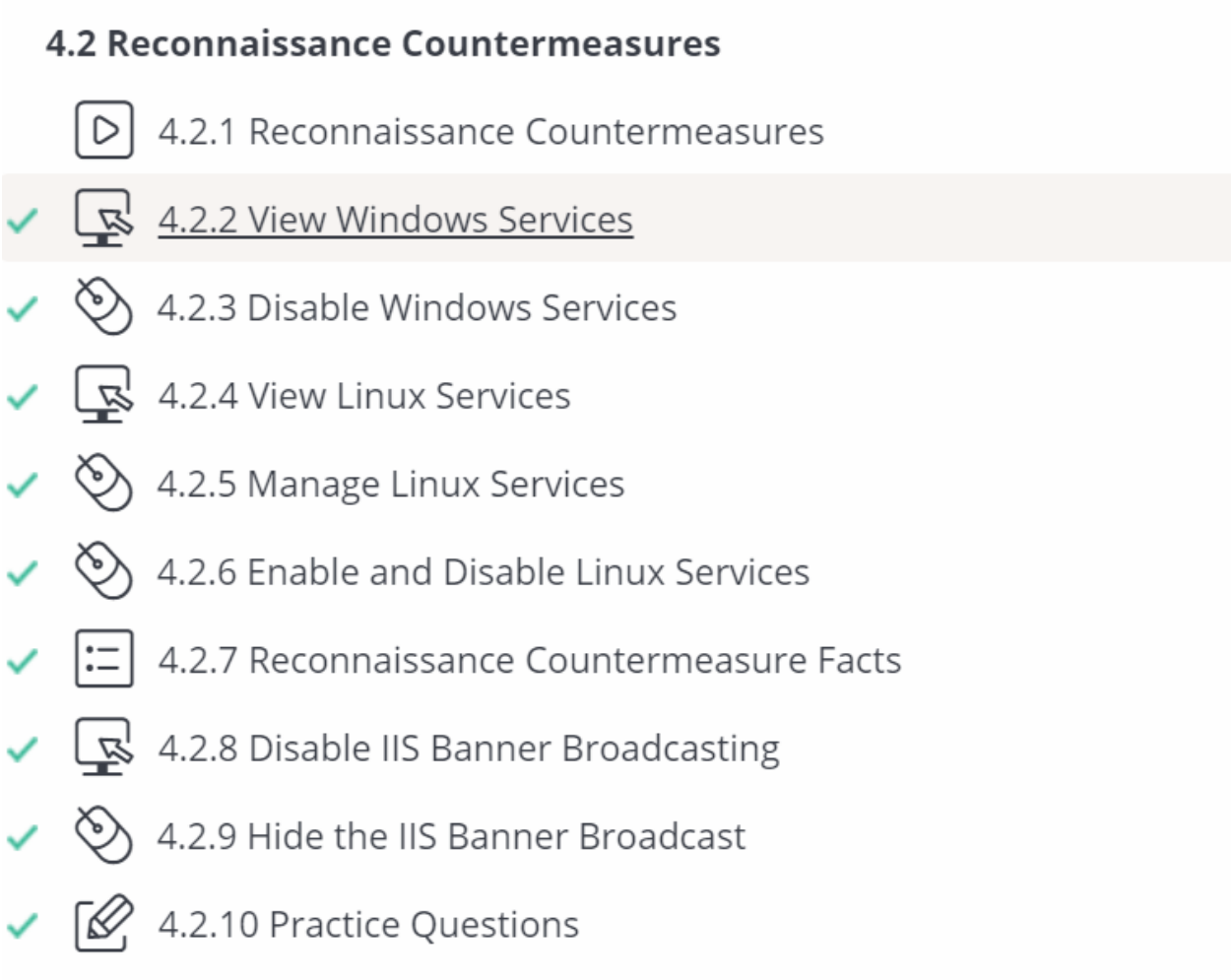
#Lab 4.1.7 Perform Reconnaissance Nmap

In this lab, your task is to perform reconnaissance on www.corpnet.xyz and to find potentially vulnerable ports on the servers in the CorpNet networks as follows:

- On Consult-Lap, use the Whois.org site to determine the domain name servers used by www.corpnet.xyz.
- On Consult-Lap, use **nslookup** to determine the primary web server address.
- On Consult-Lap2, use Zenmap to perform an nmap search for open ports for the 198.28.1.0/24 network.
- Answer the questions.

Complete this lab as follows:

1. Find the name servers used by www.corpnet.xyz as follows:
    a. From the taskbar, open Chrome.
    b. In the URL field, type **whois.org** and press **Enter**.
    c. In the Search for a domain name filed, enter **www.corpnet.xyz**.
    d. Select **Search**.
    e. In the top right, select **Answer Questions**.
    f. Answer question 1.
2. Find the IP address used by www.corpnet.xyz as follows:
    a. Right-click **Start** and select **Windows PowerShell (Admin)**.
    b. At the prompt, type **nslookup www.corpnet.xyz ns1.nethost.net** and press **Enter**.
    c. Answer question 2.
    d. Minimize the question dialog.
3. Use Zenmap to run an nmap command to scan for open ports as follows:
    a. From the navigation tabs, select **Buildings**.
    b. Under Red Cell, select **Consult-Lap2**.
    c. From the Favorites bar, open Zenmap.
    d. Maximize Zenmap for easier viewing.
    e. In the Command field type **nmap -p- 198.28.1.0/24**.
    f. Select **Scan** to scan for open ports on all servers located on this network.
    g. In the top right, select **Answer Questions**.
    h. Answer question 3.
    i. Select **Score Lab**.



#Lab 4.2.3 Disable Windows Services

In this lab, your task is to run a scan on the network with Zenmap to ensure that there are no traces of any remote software running on the network. Run the scan as follows:

- Scan the network for services running on port **3389**, match the IP address to the computer name in the table, then **disable** and **stop** the **Remote Desktop Services** service on that computer.
- Scan the network for services running on port **5938**, match the IP address to the computer name in the table, then **disable** and **stop** the **TeamViewer** service on that computer.

IP Address	Computer Name
192.168.0.30	Exec

192.168.0.31	ITAdmin
192.168.0.32	Gst-Lap
192.168.0.33	Office1
192.168.0.34	Office2
192.168.0.45	Support
192.168.0.46	IT-Laptop

Complete this lab as follows:

1. From the Favorites bar, open Zenmap.
2. In the Command field, type **nmap -p 3389 192.168.0.0/24**.
3. Select **Scan** to scan the subnet for a given service.
4. Using the table in the scenario, identify the *computer* with the open port using the IP address.
5. From the top navigation tabs, select **Floor 1 Overview**.
6. Select the identified *computer* to enter its OS view.
7. In the search field on the taskbar, type **Services**.
8. Under Best match, select **Services**.
9. Maximize the window for easier viewing.
10. Double-click the *service* that needs to be stopped to open the Properties dialogue.
11. From the Startup type drop-down list, select **Disabled**.
12. Under Service status, select **Stop**.
13. Select **OK**.
14. From the top navigation tabs, select **Floor 1 Overview**.
15. Under IT Administration, select **IT-Laptop**.
16. In Zenmap's Command Field, enter **nmap -p 5938 192.168.0.0/24**.
17. Repeat steps 3–13.

#Lab 4.2.5 Manage Linux Services

In this lab, your task is to:

- Use the **systemctl** command to start bluetooth.service.
- Use the **systemctl** command to stop bluetooth.service.
- Use the **systemctl** command to restart bluetooth.service.

Complete this lab as follows:

1. At the prompt, type **systemctl start bluetooth.service** and press **Enter** to start bluetooth.service.
2. Type **systemctl stop bluetooth.service** and press **Enter** to stop bluetooth.service.
3. Type **systemctl restart bluetooth.service** and press **Enter** to restart bluetooth.service.

#Lab 4.2.6 Enable and Disable Linux Services

In this lab, your task is to:

- Use the **systemctl** command to enable anaconda.service.
- Use the **systemctl** command to disable vmtoolsd.service.
- After each command, check the service status with the **systemctl is-enabled** command.

Complete this lab as follows:

1. At the prompt, type **systemctl enable anaconda.service** and press **Enter** to enable anaconda.service.
2. Type **systemctl is-enabled anaconda.service** and press **Enter** to check the service status.
3. Type **systemctl disable vmtoolsd.service** and press **Enter** to disable vmtoolsd.service.
4. Type **systemctl is-enabled vmtoolsd.service** and press **Enter** to check the service status.

4.2.7 Reconnaissance Countermeasures Facts

This lesson covers the following topics:

- Information sharing policies
- DNS countermeasures

Information Sharing Policies

Policy	Description
Internet	Review company websites to see what type of information is being shared about sensitive information. Opt out of archiving sites.
Company social media	Provide guidelines regarding the types of posts that are made to the company's social media site.
Employee social media	Implement policies that restrict the sharing of sensitive company information on an employee's personal social media page. This could include product

	information, customer or vendor information, employee information, or even pictures of the organization.
Printed materials	Limit the sharing of critical information in press releases, annual reports, product catalogs, or marketing materials.

DNS Countermeasures

DNS is one of the most popular internet services targeted during the reconnaissance phase. It goes without saying that we should harden our servers. Failure to do so could result in far bigger problems than just providing too much information to the outside world.

Even the strongest security features are only as good as their implementation, so you'll want to be sure to learn as much as you can about your web server software and verify that you're optimizing your resources to their full potential. After you've set everything up, your work is far from over. Hackers are always working to find new ways to access your system, and you'll want to work just as hard to keep your DNS servers up to date. This means installing patches against known vulnerabilities, cleaning up out-of-date zones, files, users, and groups, and, of course, running your own vulnerability tests.

You may also want to consider a split DNS. With the increase in the number of remote access and cloud-based applications, this solution is becoming more common. Using this method, clients accessing the DNS server from the internet receive public IP addresses, and clients inside the company's network receive internal IP addresses. Clients with the internal IP addresses can be granted access to more secure content than the clients with the external IP addresses.

#Lab 4.2.9 Hide the IIS Banner Broadcast

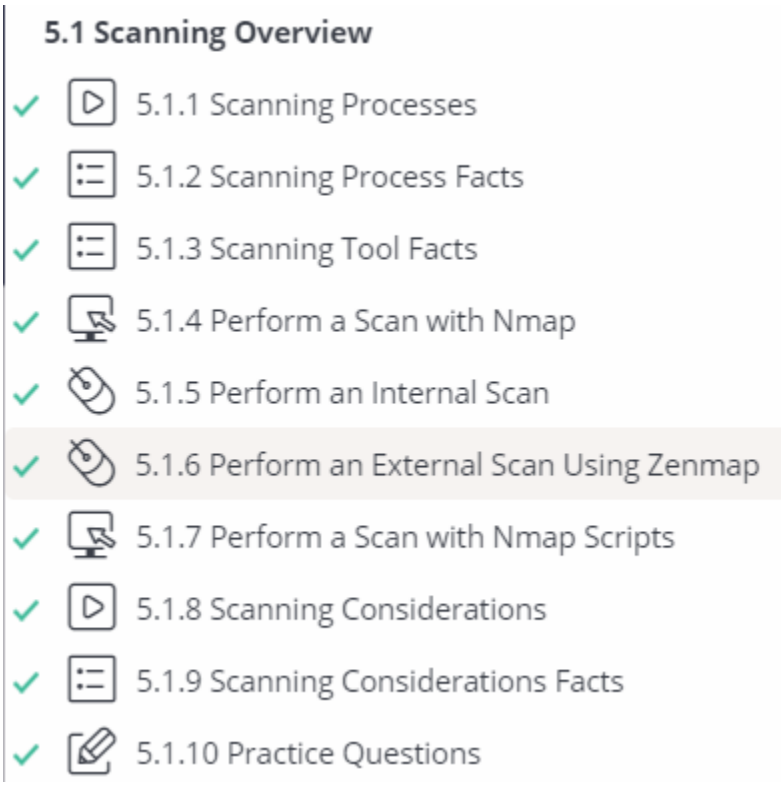
In this lab, your task is to configure the IIS web server to stop broadcasting banners by removing HTTP response headers from the CorpNet.xyz website.

Complete this lab as follows:

1. In Server Manager, select **Tools** > **Internet Information Services (IIS) Manager**.
2. In the left pane, expand **CorpWeb(CorpNet.xyz\Administrator) Home**.
3. Expand **Sites**.
4. Select **CorpNet.xyz**.
5. Double-click **HTTP Response Headers**.
6. Select a ***response header***.
7. Under Actions, select **Remove**.
8. Click **Yes** to confirm.
9. Repeat steps 6–8 for each response header.

5. Scanning

5.1 Scanning Overview



5.1.2 Scanning Process Facts

Scanning is the process of actively connecting to a system to get a response and gather information. Through scanning, you can determine live hosts, open ports, operating systems in use, running services or processes, implemented patches, and firewalls.

This lesson covers the following topics:

- Network scans
- TCP scans
- Port scans
- Operating system fingerprinting

Network Scans

Scan Type	Description

Wardialing	Using a modem, the scan dials a large block of phone numbers and attempts to locate other systems connected to a modem. If the modem gets a response, it can establish a connection. Modems are still often used for fax machines and multi-purpose copiers and as a backup for high-speed internet.
ping	ping works by sending an ICMP message from one system to another. Based on the ICMP reply, you know whether the system is live and how quickly the packets travel from one host to another.
ping sweep	A ping sweep scans a range of IPs to look for live systems. ping sweeps help to build a network inventory. However, they can also alert the security system, potentially resulting in an alarm being triggered or the attempt being blocked.

TCP Flags

TCP is a connection-oriented protocol that uses a three-way handshake to establish a connection with a system port. When examining a TCP packet, you'll notice the flag indicators. Two of these indicators are SYN and ACK. SYN starts a connection between two systems. ACK acknowledges that a packet has been received. There are other flag options as well. Any of these indicators can be turned on or off using a packet crafter.

The three-way handshake occurs when you're trying to use TCP to connect to a port. As indicated by the name, the handshake has three steps:

1. Computer 1 sends a SYN packet to Computer 2.
2. Computer 2 receives the packet and sends a SYN/ACK packet to Computer 1.
3. Computer 1 receives the SYN/ACK packet and replies with an ACK packet, and the connection is complete.

The following table describes TCP flags.

Flag	Description
SYN	Starts a connection between hosts.
ACK	Acknowledges the receipt of a packet.
FIN	Indicates that no additional information will be sent.

RST	Resets a connection.
URG	Flags a packet as urgent.
PSH	Directs the sending system to send buffered data.

Port Scans

After you've found a live system, you'll need to find a way in. To do this, you'll perform a port scan.

Scan	Description	Command
Full open scan	The full open scan completes a full three-way handshake on all ports. Open ports respond with a SYN/ACK, and closed ports respond with an RST flag, ending the attempt. The down side of this type of scan and the reason that it's not frequently used is that somebody now knows you were there.	**nmap –sT *IP address***
Half-open scan	A half-open scan, also known as a stealth scan, sends an SYN packet to a port. The three-way handshake does not occur because the originating system does not reply with the final ACK. At this point, you have discovered an open port. Because an ACK packet was not sent, a connection was not made, and there is no security log.	**nmap –sS *IP address***
Xmas tree scan	An Xmas tree scan gets its name because all of the flags are turned on, and the packet is lit up like a Christmas tree. The recipient has no idea what to do with this packet, so either the packet is ignored or dropped. If you get an RST packet, you know the port is closed. If you don't get a response, the port may be open.	**nmap –sX –v *IP address***
FIN scan	The packet is sent with the FIN flag set. This allows the packet to pass through firewalls and onto the intended target without attracting much attention. If a port is open, there will be no response. If the port is closed, an RST response is returned.	**nmap –sF *IP address***

NULL scan	The packet is sent with no flags set. If the port is open, there is no response. If the ports are closed, an RST response is returned.	**nmap –sN *IP address***
Idle scan	The hacker finds a target machine, but wants to avoid getting caught, so, he finds another system to take the blame. The blamed system is called a zombie machine because it's disposable and creates a good distraction. The scan directs all requests through the zombie machine. If that zombie machine is flagged, the hacker simply creates another zombie machine and continues to scan.	

Operating System Fingerprinting

You may be able to figure out which operating system a target is running by reviewing packet information. Fingerprinting relies on small differences in packets created by various operating systems. You can find differences by examining the TTL values, TCP window size, DHCP requests, ICMP requests, HTTP packets, and open port patterns.

5.1.3 Scanning Tools Facts

This lesson covers the following topics:

- Scanning tools
- Network mapping tools

Scanning Tools

The following tools can be used during the scanning phase of your investigation.

Tool	Description
CurrPorts	CurrPorts lists all open UDP and TCP/IP ports on your computer. It also provides information about the process that opened the port, the user who created the process, and what time the port was created.
ping	ping uses Internet Control Message Protocol (ICMP) messaging to determine whether a remote system is live.

hping3	hping3 sends packets across a network and can also create custom packets that can analyze the host. In addition to the normal ICMP pings, hping3 supports TCP and UDP, has a traceroute mode, and can send and receive files. This tool was primarily designed for the Linux operating system, but does have cross-platform capabilities.
Colasoft	Colasoft is a packet crafting software that can modify flags and adjust other packet content.
Angry IP Scanner	Angry IP Scanner is a network scanner. It scans local and remote networks and returns an IP range via a command-line interface.
SolarWinds Port Scanner	SolarWinds Port Scanner is a command line tool that provides a list of open, closed, or filtered ports.
IP-Tools	IP-Tools has 20 scanning utilities, including SNMP Scanner, UDP Scanner, Trace, Finger, Telnet, IP-Monitor, and Trap Watcher. The program supports multitasking so that you can use all utilities at once. IP-Tools is designed to work on a Windows system.

Network Mapping Tools

The following tools can be used for mapping network resources. Many are marketed as a system inventory tool for use inside of an organization, but, as with most tools, can serve multiple purposes depending on the user's intentions.

Tool	Description
NetAuditor	NetAuditor reports, manages, and diagrams network configurations.
SolarWinds Network Topology Manager	SolarWinds Network Topology Manager provides automated network discovery and mapping.
Scany	Scany is a scanner application for iOS devices. It scans networks, websites, and ports to find open network devices. It can obtain domain and network names and includes basic networking utilities such as ping, traceroute, and Whois.

Lab# 5.1.5 Perform an Internal Scan

In this lab, your task is to perform a port scan using nmap in Terminal.

Complete this lab as follows:

1. From the Favorites bar, open Terminal.
2. At the prompt, type **nmap -p- 192.168.0.45**.
3. Press **Enter**.

Lab# 5.1.6 Perform an External Scan Using Zenmap

In this lab, your task is to:

- Perform a Zenmap scan using the following information:
    - Network address: **73.44.216.0**
    - Subnet mask: **Class C**
- Answer the questions.

Complete the following:

1. From the Favorites bar, open Zenmap.
2. At the prompt, type **nmap 73.44.216.0/24**.
3. Select **Scan**.
4. Find the network vulnerabilities in the output.

5.1.9 Scanning Considerations Facts

This lesson covers the following topics:

- Scanning considerations
- Evasion
- Vulnerability scans
- Preventing banner grabbing

Scanning Considerations

You want to be strategic when you select which scanning tools and methods to use. Carefully consider the strengths and weaknesses of each scan type. Selecting the wrong method not only takes up valuable time, but it also increases the chances that you will get caught.

Consider the time of day that you'll be doing your scans. Do you want to scan when there's a lot of network traffic in hopes that you'll blend in with the crowd? Or do you want to attempt to access the system in the middle of the night, or on the weekends when no one's

around? There isn't necessarily a right or wrong answer to these questions, and your decisions could vary from one company to another depending on their operations.

Evasion

Even the stealthiest of ethical hackers are going to come across a few obstacles. After all, firewalls and security measures are typically in place to keep people like you out of the network. So, what can you do when you find that your scanning attempts are being blocked? A few options include scanning with ACK, fragmenting packets, spoofing IP addresses, and using a proxy.

Method	Description
Scan with ACK	This scan will help you determine whether the firewall is stateful or stateless and whether the ports are open. In an ACK scan, only the ACK flag is set. If a port is unfiltered, both open and closed ports return an RST packet. If a port is filtered, it either returns an error message or no response at all.
Fragment packets	Fragmenting is probably one of the most used methods to avoid detection. You're still sending packets; you're just breaking them apart so intrusion detection systems don't know what they are. If you're not bombarding the system, the packet segments float by without concern.
Spoof IP addresses	Many scanning tools have the functionality to recraft the packet so that the source address reflects a different IP address. The scan is sent to the recipient, the feedback is returned to the fake IP address, and there is no record of your IP address sending the requests.
Use a proxy	A proxy serves as a less vulnerable access point to a network. Typically, proxies are placed in networks to keep external users from accessing the internal network. Hackers like proxies because they filter incoming and outgoing traffic, provide you with anonymity, and shield you from possible detection.

Vulnerability Scans

All organizations should perform regular vulnerability scans. Various tools have been designed to scan ports, banners, coding, and other high-target areas within a network for vulnerabilities. Like virus scanners and malware detectors, though, a vulnerability scan is only as good as its data. If a vulnerability is not included in the current database of issues that are being scanned for, an "all clear" result could be misleading. In addition to keeping your scanning tools up to date, you will want to use a variety of tools to be sure you're covering as much ground as possible. Also, keep in mind that if these tools are available to

the companies you're working for, they are also available for hackers. Remind your clients that even if they aren't running these scans on a regular basis, someone else may be.

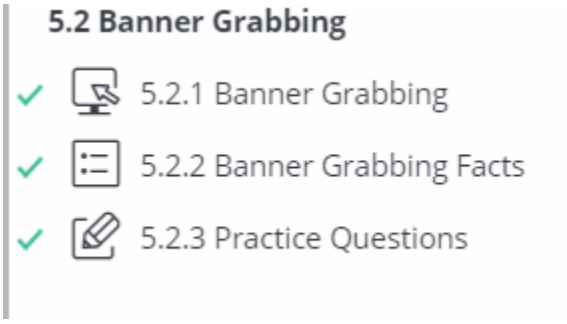
The following are a few of the vulnerability scanning tools available:

Tool	Description
Nessus	Nessus is often considered the industry standard for vulnerability scanning. The software helps to identify software flaws, malware, missing or outdated patches, and configuration errors across a network.
OpenVAS	OpenVAS provides authentication testing, protocol testing, and performance tuning for large-scale networks.
Beyond Trust	Beyond Trust provides a network security scanner that helps to identify vulnerabilities and prioritize solutions. This software is available as a standalone application or part of their larger vulnerability management solution.
InsightVM	Saint provides enterprise level vulnerability management tools.

Preventing Banner Grabbing

A few banner grabbing prevention options are available. One option is to disable the banners, or at least portions of the banner. Several utilities help to change or even remove the banner contents. Second, they'll want to hide file extensions. File extensions tell everyone what software is being used to create a web page. Hiding the file extension gives one less bit of information to an intruder. A third option to banner grabbing prevention is to enable custom error pages. This way, you have full control over what scanners can and cannot see when they trigger an error message.

5.2 Banner Grabbing



5.2.2 Banner Grabbing Facts

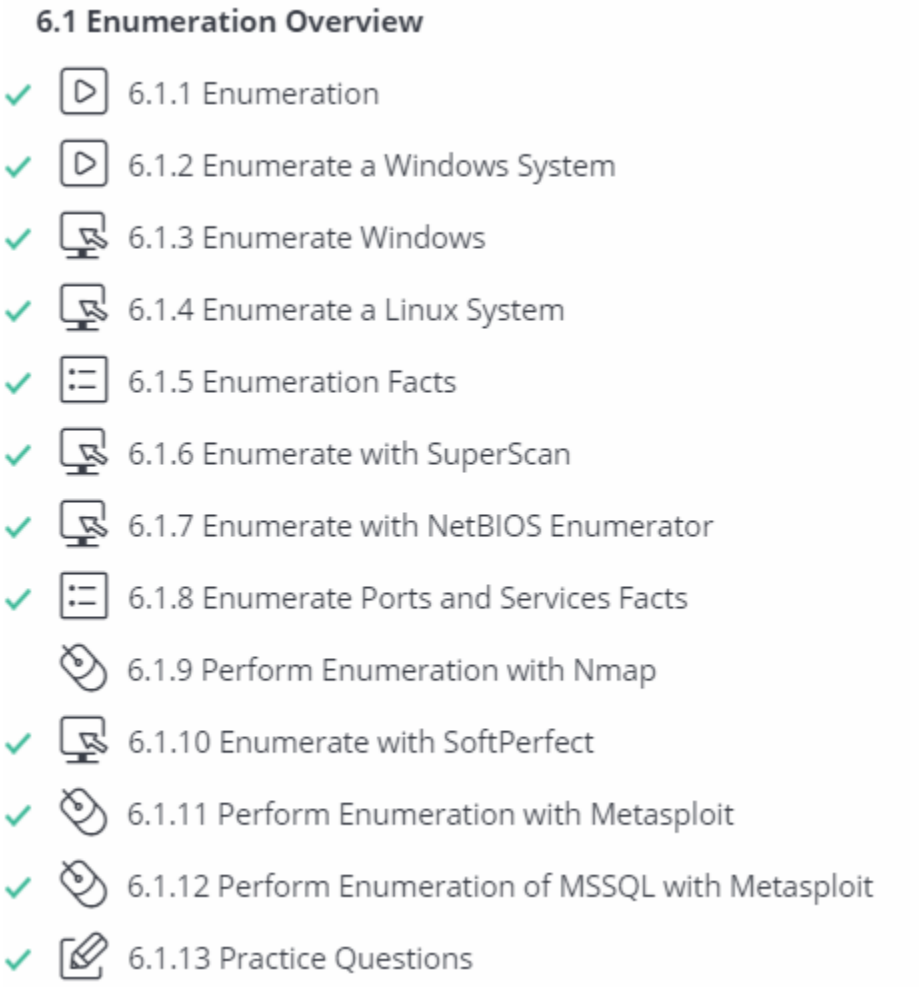
5.2.2 Banner Grabbing Facts

Banner grabbing is another common method for obtaining information about a system. You can grab a banner by connecting to a host, sending a request to a port, or analyzing network traffic. The targeted system returns a snippet of information, including information about its operating system and the services that are running on it. Banner grabbing tools include the following:

Tool	Description
Telnet	*Telnet* is many hackers' tool of choice for banner grabbing. It operates on port 23. If you type **telnet *ip_address*** at a command prompt, you'll send TCP packets to the destination port 23. However, by tacking a port number on to the end of the same command, you can check for other openings. If the port you specify is open, you'll receive a banner response for that port. These banners can include some interesting information about the target system, including software type, software version, services, patches, and the last modification date.
Netcraft	*Netcraft* is an online tool that is used to obtain server and web server information.
P0f	*P0F* is a Linux tool that analyzes network traffic and returns information on operating systems. Because it is passively viewing traffic, it is a stealthy method for gathering information.
nmap	nmap is another tool for banner grabbing. nmap connects to an open TCP port and returns anything sent in a five second period. The command syntax is **nmap –sV –script=banner *ip_address***. The -sV option probes open ports to determine service/version info.

6. Enumeration

6.1 Enumeration Overview



6.1.5 Enumeration Facts

The word enumerate means to list items one by one. During the enumeration phase of ethical hacking, you will extract and record as much information as you can about a network or system.

This lesson covers the following topics:

- Enumeration processes
- Windows enumeration
- Linux enumeration
- Enumeration tools

Enumeration Processes

Now that you have been able to establish active connections, you can gather information about usernames, group names, machine names, routing tables, network shares, applications, and more. Unlike the more passive phases of reconnaissance and scanning, we are moving into a more active approach to information gathering. The odds of getting caught are even higher now. You'll want every action to be strategic and precise.

It's also important to note that although you're still only gathering information, you're at the point where your actions could be considered illegal. Make sure your permission documentation is in order.

Process	Description
Extract email IDs	An email address contains two parts, the username, and the domain name.
Use default passwords	All devices have default passwords. These passwords are often left in place, providing an easy access point for an attacker.
Attack directory services	A directory service is a database of information that is used for network administration. Some directories are vulnerable to input verification deficiencies. Because of this, they are susceptible to brute force attacks. These attacks are usually automated. The program tries different combinations of usernames and passwords until it finds something that works.
Exploit SNMP	The Simple Network Management Protocol (SNMP) is used to manage devices such as routers, hubs, and switches. SNMP works with an SNMP agent and an SNMP management station. The agent is found on the device that is being managed, and the SNMP management station serves as the communication point for the agent. SNMP has two configuration passwords by default, one for public access, and one for private access. The public community string includes the configuration of the device or system. The private read/write community string provides read and write access to the device configuration. If the passwords were not changed from the default, a hacker will have access to these strings and therefore have access to usernames, information about network devices, routing tables, network traffic, and file shares.
Exploit SMTP	Simple Mail Transfer Protocol (SMTP) is the protocol used by most email servers and clients to send email messages. Scanning tools and commands

	can be used to verify the existence of specific email addresses. They can even provide a list of all users on a distribution list.
Perform DNS zone transfers	DNS zone transfer is the process of transferring a copy of the DNS zone file from the primary DNS server to a secondary DNS server. Zone transfers are designed to provide updated network and access information to DNS servers. This type of structural data could be valuable to a hacker. It could be used to provide a mapping of the network. To perform a DNS zone transfer, the hacker, pretending to be a client, sends a zone transfer request to the DNS server. The DNS server then sends a portion of its database as a zone to the hacker. This zone may contain a lot of information about the DNS zone network.
Retrieve system policies	Large networks, especially enterprise environments, frequently have policy settings in place to determine how security matters are handled. If you're able to gain access to these settings, you will know more about your target. The technique will vary depending on the operating system that you are targeting.
Enumerate IPsec	IPsec uses ESP (Encapsulation Security Payload), AH (Authentication Header), and IKE (Internet Key Exchange) to secure communication between virtual private network (VPN) endpoints. Using enumeration tools, hackers can pull sensitive information such as the encryption and hashing algorithm, authentication type, and key distribution algorithm.
Enumerate VoIP	VoIP uses SIP (Session Initiation Protocol) to enable voice and video calls over an IP network. SIP service generally uses UDP/TCP ports 2000, 2001, 5060, 5061.
Enumerate RPC	Remote Procedure Call (RPC) allows client and server to communicate in distributed client/server programs. Enumerating RPC endpoints enable hackers to identify any vulnerable services on these service ports. You can use the following nmap scan commands to identify RPC services running on the network: • **nmap -sR IP/network** • **map -T4 –A IP/network**

Windows Enumeration

In Windows, a user account is an object that contains information about a user, the user access level, groups the user is a member of, and user access privileges. The default Windows installation includes two primary user accounts, the administrator and the guest.

There are also a few other built-in accounts that are designed to run background processes as needed. These include local service, network service, and system.

User	Description
Guest	The guest account has been part of Windows for quite some time. By design, this account has remained pretty much the same and is meant to be used only in very limited circumstances. Although included in the Windows installation, it is not enabled by default.
Administrator	The administrator account has gone through quite a few changes as the operating system has evolved. In earlier versions of Windows, the administrator account was enabled by default. However, in more recent releases, Windows Vista and beyond, the administrator account has been disabled by default. This change was made primarily for security purposes. The administrator account was often used as a normal user account and, as a result, the everyday user had unlimited access to permissions that the user didn't necessarily know what to do with. If malware or other applications were running in the background, those programs also had access to those unlimited permissions. As you can imagine, that doesn't end well. Current versions of Windows require user accounts to be created. Although you can enable administrator privileges to the account, additional permission needs to be granted when elevated administrator privileges are needed. This way, the user cannot unintentionally allow an unwanted application or process to run in the background.
Local service	This account provides high-level access to the local machine, but only limited access to the network.
Network service	This account provides normal access to the network, but provides only limited access to the local machine.
System	This account provides almost unlimited access to the local machine.

Windows provides an efficient way of managing user control access. Users can be assigned to groups and permissions can be assigned to these groups. You can create your own groups based on departments, locations, or other methods. Microsoft also includes a few preconfigured user groups. These groups can be used as-is or modified to suit your needs.

Group	Description

Anonymous logon	This group provides anonymous access to resources, typically on a web server or web application.
Batch	This group is used to run scheduled batch tasks.
Creator group	A Windows 2000-specific group, the Creator group is used to grant permissions to users who are members of the same group as the creator of a directory or file.
Creator owner	The file or directory creator is a member of this group. By default, all releases after Windows 2000 use this group to grant permissions to the creator of the file or directory.
Everyone	All users are members of this group. It is used to provide wide-range access to resources.
Network	All users that access a system through a network are members of this group. It provides all remote users access to a specific resource.

Although we typically think of the username as being the unique identifier, behind the scenes, Windows relies on a security identifier (SID). When a user object is created, Windows assigns it an SID. And, unlike a username, that ID cannot be used again. Why is this necessary? Consider how many times a username could undergo a change. If permissions were tied to a specific name, a new account would have to be created every time. However, since Windows is looking at the SID, you simply adjust the username and maintain the same SID.

SID identifiers can help you know more about the account. For example, if you find an account ending in 500, then you've found the built-in administrator account. If you find an account ending in 501, you've found the built-in guest account. The Windows Security Accounts Manager (SAM) is a part of the system registry and stores all usernames and passwords. The passwords are not saved in plain text, of course, but are encrypted in LM and NTLM hash formats. For larger networks, Microsoft's Active Directory manages this data.

Linux Enumeration

A user account is needed to access a Linux system. When a user account is created, the values are stored in the etc/passwd file. This file is accessible with a text editor.

Value	Description
Username	A username and user ID (UID) are used to identify users. When a username is created, it is given a UID. This number is selected from a range of numbers, typically above 500.
Password	Each account has a password that is encrypted and saved on the computer or on the network.
Groups	Groups are used to manage permissions and rights. Group identification numbers (GIDs) are stored in the /etc/passwd file. All users are assigned to the default primary group and can be assigned to additional groups that are called secondary groups. Secondary groups are listed in the /etc/group file.

Enumeration Tools

The following table lists enumeration tools.

Tool	Description
finger	The Linux finger command provides information about a user. Use **finger –s *username*** to obtain the specified user's login name, real name, terminal name and write status, idle time, login time, office location, and office phone number. You can use **finger –s** to obtain the same information about all users on a system. Use **finger –l user@host** to obtain information about all users on a remote system.
NULL session	Null sessions are created when no credentials are used to connect to a Windows system. They are designed to allow clients access to limited types of information across a network. These sessions can be exploited to find information about users, groups, machines, shares, and host SIDs. A hacker can enter **net use //hostname/ipc$ *hostname*\ipc$ "" /user:""** to connect to a system. A hacker can use the command **net view *hostname*** to display shares available on a system. The command **net use s: *hostname**shared folder name*** allows a hacker to connect to and view one of these shares.
PsTools	*PsTools* is a suite of very powerful tools that allow you to manage local and remote Windows systems. The package includes tools that can change account passwords, suspend processes, measure network performance, dump event log records, kill processes, or view and control services.

SuperScan	SuperScan can be used to enumerate information from a Windows host. Information can be gathered on the following: NetBIOS name table, services, NULL session, trusted domains, MAC addresses, logon sessions, workstation type, account policies, users, and groups.

6.1.8 Enumerate Ports and Services Facts

Enumeration requires the ethical hacker to understand protocols, ports, and services. Although these items are a prerequisite for this course, we're going to identify the ones that are used for enumeration. The following table lists common ports:

Port	Description
TCP 21 FTP	Port 21 is used for the File Transfer Protocol (FTP). FTP is used by all operating systems to transfer files between client and server machines.
TCP 23 Telnet	Port 23 is used for the Telnet protocol/software. Telnet is used to connect to and run services on remote systems. Because of security concerns, Telnet is not used as frequently as it once was.
TCP 25 SMTP	Port 25 is used for the Simple Mail Transfer Protocol (SMTP). SMTP is used to send emails between client and server and between server and server.
TCP 53 DNS	Port 53 is used for DNS zone transfers. DNS zone transfer is the process of transferring a copy of the DNS zone file from the primary DNS server to a secondary DNS server. Zone transfers are designed to provide updated network and access information to the DNS servers.
UDP 53 DNS	Port 53 is used for UDP queries about IP-to-name and name-to-IP mappings.
TCP 80 HTTP	Port 80 is used for Hypertext Transport Protocol. HTTP is used by all web browsers and most web applications.
TCP 135 RPC	Port 135 is used by the Remote Procedure Call service in Windows for client-server communications.

TCP 137 NetBIOS	Port 137 is used by the NetBIOS Name Server (NBNS.) NBNS is used to associate names and IP addresses of systems and services.
TCP 139 NetBIOS	Port 139 is used by the NetBIOS Session Service (SMB over NetBIOS.) SMB over NetBIOS allows you to manage connection between NetBIOS clients and applications.
TCP 445 SMB over TCP	Port 445 is used by SMB over TCP. SMB over TCP also known as Direct Host is a service used to improve network access. This service is available in Windows 2000 and newer.
UDP 161 and 162 SNMP	Ports 161 and 162 are used by the Simple Network Management Protocol (SNMP.) SNMP is a standard method of managing devices and software from most manufacturers.
TCP/UDP 389 LDAP	Port 389 is used by the Lightweight Directory Access Protocol (LDAP.) LDAP is an internet protocol for accessing distributed directory service. If this port is open, it indicates that Active Directory or Exchange may be in use.
TCP/UDP 3268 Global Catalog Service	Port 3268 is used by the Global Catalog Service. The Global Catalog Service is used by Windows 2000 and later systems to locate information in Active Directory.

Lab# 6.1.9 Perform Enumeration with Nmap

In this lab, your task is to complete the following:

- Use Zenmap to determine the operating system of the hosts on your network.
- On ITAdmin, use **net view** to check for shared folders on CorpFiles12 and CorpFiles16.
- Map the H: drive to the Confidential folder on CorpFiles16.
- View the files in the Employee Records folder.
- Answer the questions.

Complete this lab as follows:

1. Scan for operating systems on the network as follows:
    a. From the Favorites bar, open Zenmap.
    b. In the Command field, type **nmap -O 192.168.0.0/24**.
    c. Select **Scan** to scan the local subnet.
    d. In the nmap scan, find the identified ***operating systems***.
    e. In the top right, select **Answer Questions**.

f. Answer question 1.

The nmap -O command may have a hard time recognizing the Windows OS, but can easily detect Linux.

2. View the shared folders on CorpFiles12 and CorpFiles16 as follows:
    a. From top navigation tabs, select **IT Administration**.
    b. On the ITAdmin monitor, select **Click to view Windows 10**.
    c. Right-click **Start** and select **Windows PowerShell (Admin)**.
    d. At the prompt, type **net view corpfiles12** and press **Enter**.
    e. Type **net view corpfiles16** and press **Enter**.
3. Map the H: drive to the Confidential folder on CorpFiles16 as follows:
    a. Type **net use \\corpfiles16\confidential h:** and press **Enter**.
    b. Type **h:** and press **Enter** to change to the H: drive.
4. View the files in the Employee Records folder as follows:
    a. Type **dir** and press **Enter** to view the folders available on the drive.
    b. Type **cd Employee Records** and press **Enter**.
    c. Type **dir** and press **Enter** to view the employee records.
    d. Answer question 2.
    e. Select **Score Lab**.

Lab# 6.1.11 Perform Enumeration with Metasploit

In this lab, your task is to

- Use the post/windows/gather/enum_patches exploit in Metasploit to enumerate the Windows patches that are missing or vulnerable.
- Answer the question.

Complete this lab as follows:

1. From the Favorites bar, open Metasploit Framework.
2. At the prompt, type **use post/windows/gather/enum_patches** and press **Enter** to use the enumerate patches exploit.
3. Type **show options** and press **Enter** to show the exploit options.
   Notice that the session option is absent.
4. Type **set session 1** and press **Enter** to specify the session.
5. Type **show options** and press **Enter**.
   Notice that the session option has been set.
6. Type **run** and press **Enter** to begin the exploit.
7. In the top right, select **Answer Questions**.
8. Answer the question.
9. Select **Score Lab**.

Lab# 6.1.12 Perform Enumeration of MSSQL with Metasploit

In this lab, your task is to use the auxiliary/scanner/mssql/mssql_ping exploit in Metasploit to determine which TCP port Microsoft SQL is using.

Complete this lab as follows:

1. From the Favorites bar, open Metasploit Framework.
2. At the prompt, type **use auxiliary/scanner/mssql/mssql_ping** and press **Enter** to use the MSSQL Ping Utility exploit.
3. Type **show options** and press **Enter** to show the exploit options.
   Notice that the RHOSTS setting is absent.
4. Type **set RHOSTS 198.28.1.3** and press **Enter** to specify the remote host.
5. Type **show options** and press **Enter** to show the exploit options.
   Notice that RHOSTS has been set.
6. Type **exploit** and press **Enter** to begin the exploit.

6.2 Enumeration Countermeasures

6.2.2 Enumeration Countermeasures Facts

We have seen the extent of the information that can be gathered through enumeration. Now, let's examine a few countermeasures.

This lesson covers the following topics:

- SNMP countermeasures
- DNS countermeasures
- SMTP countermeasures
- LDAP countermeasures

SNMP Countermeasures

There are several countermeasures for attacks on Simple Network Management Protocol (SNMP) processes:

Method	Description
Monitor SNMP ports	Block or monitor activity on ports 161 and 162 and any other ports that you have configured for SNMP traffic.
Remove SNMP agent	Remove the SNMP agent or turn off the SNMP service completely.
Update SNMP	Verify that you are always running the most recent version of SNMP.
Change default passwords	Change default passwords on all devices and services.

Run SNScan	Use SNScan, a utility that detects network SNMP devices that are vulnerable to attack.

DNS Countermeasures

Use the following countermeasures to mitigate attacks that target your Domain Name System (DNS) vulnerabilities:

Method	Description
DNS zone restriction	DNS zone restriction ensures that a server provides copies of zone files to only specific servers.
Digital signatures	Modern systems include digital signatures that help with DNS zone restriction.
Split DNS	Splitting the DNS into internal and external groups provides an added layer of security.

SMTP Countermeasures

The most basic way to counteract Simple Mail Transfer Protocol (SMTP) exploitation is to simply ignore messages to unknown recipients instead of sending back error messages. Additionally, you'll want to configure your server to block open SMTP relaying.

LDAP Countermeasures

Hardening against Lightweight Directory Access Protocol (LDAP) enumeration can be tricky. Although blocking LDAP port 389 is an option, you can't always block ports, or you'll risk impacting your network. Blocking LDAP ports could prevent your clients from querying necessary services. The best way to secure LDAP is to review and implement the security settings and services available with your server software.

Lab# 6.2.4 Prevent Zone Transfer

In this lab, your task is to disable zone transfers for the CorpNet.local zone.

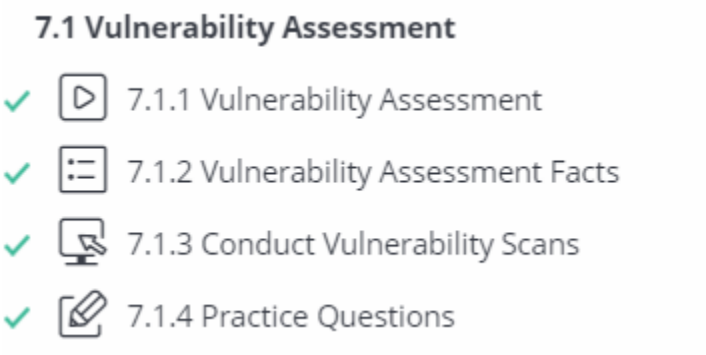
Complete this lab as follows:

1. From Server Manager, select **Tools** > **DNS**.
2. In the left pane, expand **CORPDC3**.
3. Expand **Forward Lookup Zones**.
4. Right-click **CorpNet.local** and select **Properties**.
5. Select the **Zone Transfers** tab.

6. Deselect **Allow zone transfers**.
7. Click **OK**.

7. Analyze Vulnerabilities

7.1 Vulnerability Assessment



7.1.2 Vulnerability Assessment Facts

A vulnerability assessment is the process of identifying weaknesses in an organization infrastructure, including the operating system, web applications, and web server. An assessment is also used to plan additional security measures to protect the organization from attack. Every business that uses a computer to run their business is at risk of having sensitive information stolen or misused. Having an ethical hacker conduct an assessment sheds light on vulnerability to malicious attack. In a world where so much private information is stored and transferred digitally, it is essential to be proactive in determining and addressing system weaknesses.

Data obtained from a vulnerability assessment reveals security weaknesses. It will open ports and running services, configuration errors, system flaws, and weaknesses in applications and services. It is important to target multiple areas of operation in order to have a comprehensive assessment. Once the data is obtained, a plan can be made to correct, patch, or harden systems to protect data.

This lesson covers the following topics:

- Vulnerability scanning types
- Scan limitations
- Assessment types
- Vulnerability research

Vulnerability Scanning Types

There are two types of vulnerability scans. Each type of scan has advantages. Both types can be used together to provide a more comprehensive assessment.

Vulnerability Scanning	Description
Active scanning	An active scan transmits to the nodes within a network to determine exposed ports and can independently repair security flaws. It can also simulate an attack to test for vulnerabilities and can repair weak points in the system.
Passive scanning	A passive scan tries to find vulnerabilities without directly interacting with the target network. The scan identifies vulnerabilities via information exposed by systems in their normal communications. You can set a scanner to scan constantly or at specific times.

Scan Limitations

It's important to understand that scanners are not foolproof. The following table identifies two significant limitations.

Scan Limitation	Description
Point in time	A scan can only obtain data for the time period when it runs. For example, some weaknesses may be exposed only when systems are operating at peak capacity, at certain times of day, or even at certain times of the year.
New vulnerabilities	Scans can only identify known vulnerabilities. This give an attacker that uses a new attack an advantage, as scans are written only for vulnerabilities that have been previously exploited.

Assessment Types

There is not one assessment testing tool that will cover every area to be tested. It is important to understand the goals and objectives of the organization; to gather information about the systems, network, and applications; and then to determine the best tools to make a comprehensive plan to correct security problems that you identify. Testing only one area of a system will not be sufficient to expose all vulnerabilities that exist.

Assessment Types	Description
Active assessment	In an active assessment, specifically created packets are sent to target nodes to determine the OS of the domain, the hosts, the services, and the vulnerabilities in the network. nmap is a useful tool for this assessment.
Passive assessment	Using sniffer traces from a remote system, you can determine the operating system of the remote host as well as a list of the current network work. Wireshark is a common tool for this type of information gathering and analysis.
External assessment	This type of assessment looks for ways to access the network infrastructure through open firewall ports, routers, web servers, web pages, and public DNS servers. It is external because it is working from the outside using public networks through the internet. This type of assessment may include: • Determining if maps exist for network and external service devices • Checking for vulnerabilities in web applications • Examining the rule set for external network router configurations and firewalls • Detecting open ports on the external network and services • Identifying DNS zones
Internal assessment	The ethical hacker can also be inside the network, testing the internal networks and systems. This type of assessment can include: • Inspecting physical security • Checking open ports on network devices and router configurations • Scanning for Trojans, spyware, viruses, and malware • Evaluating remote management processes • Determining flaws and patches on the internal network systems, devices, and servers
Host-based assessment	This assessment focuses on all types of user risks, including malicious users and untrained users as well as vendors and administrators. Host-

	based assessment can also test the vulnerability of databases, firewalls, files, and web servers, as well as flag configuration errors.
Application	Application-level scans allow the ethical hacker to scrutinize completed applications when the source code is unknown. Every application should be examined for input controls and data processing.
Wireless network assessment	A hacker can access sensitive information even from outside a building by sniffing network packets that are transmitted wirelessly through radio waves. Generally, a hacker will obtain the SSID (the name assigned to the wireless network) through sniffing and use it to hack the wireless network without ever entering the building. These assessments analyze the network for patching errors, authentication and encryption problems, and unnecessary services.

Vulnerability Research

Vulnerability research is the process of discovering vulnerabilities and design flaws that will open an operating system and its applications to attack or misuse. Time is on the attacker's side. It is crucial for an ethical hacker to put in the effort and time to research an organization from the outside in and to scan and gather information at every level.

Areas to Research	Description
Misconfigurations	The primary cause of misconfiguration is human error. Web servers, application platforms, databases, and networks are all at risk of unauthorized access. Areas to check include outdated software, unnecessary services, external systems that are incorrectly authenticated, security settings that have been disabled, and debug enabled on a running application.
Default settings	It is important to check default settings, especially for default SSIDs and admin passwords. If a company never changes the default admin passwords or the default SSID to combinations unique to the company, it is very simple for an attacker to gain access to the network.
Buffer overflows	A buffer is a temporary data storage area with limited space. Overflows occur when more data is attempted to be stored than the program was written for. Error checking should identify this problem. When overflow occurs, it can allow hackers to cause data to flow to

	other memory areas and to access database files or alter system files. System crashing or instability can also occur.
Unpatched servers	Hackers gain access to data in a system through misconfigured or unpatched servers. Since servers are integral part of an organization's infrastructure, this vulnerability creates a central route for access to sensitive data and operations. Fixing bugs, patching, and simply updating software can block an attack.
Design flaws	Every operating system or device has bugs or defects in its design. Hackers take advantage of design flaws such as broken authentication and access control, cross-site scripting, insufficient logging and monitoring, and incorrect encryption.
Operating system flaws	Flaws in the OS can leave a system susceptible to malicious applications such as viruses, Trojan horses, and worms through scripts, undesirable software, or code. Firewalls, minimal software application usage, and regular system patches create protection from this form of attack.
Application flaws	Flaws in the validation and authorization of users present the greatest threat to security in transactional applications. This type of assessment evaluates deployment and communication between the server and client. It is imperative to develop tight security through user authorization and validation. Both open-source and commercial tools are recommended for this assessment.
Open services	Ports and services must be checked regularly to prevent unsecure, open, or unnecessary ports, which can lead to attacks on connected nodes or devices, loss of private information, or even denial of service.
Default usernames and passwords	Passwords should always be immediately changed after installation or setup. Passwords should always be kept secret.

7.2 Vulnerability Management Life Cycle

7.2.2 Vulnerability Management Life Cycle

Every business has sensitive information that, if accessed by hackers, could be used in ways that could put the company and its employees at risk. Even a non-malicious user, such as an untrained employee, could cause problems if proper security isn't in place. Unless a business physically unplugs its computers and never uses a network at all, the company can be a target. Therefore, vulnerability management should be implemented in every organization to identify, evaluate, and control risks and vulnerabilities.

This lesson covers the topic of the vulnerability management lifecycle.

Vulnerability Management Lifecycle

The following table identifies the vulnerability management lifecycle an ethical hacker uses to protect an organization.

Phase	Description
Baseline creation	The lifecycle starts by defining the effectiveness of the current security policies and procedures. You should establish any risks that may be associated with the enforcement of current security procedures and what may have been overlooked. Try to see what the organization looks like from an outsider's perspective, as well as from an insider's point of view. No organization is immune to security gaps. Work with management to set goals with start dates and end dates. Determine which systems to begin with, set up testing standards, get approval in writing, and keep management informed as you go. For your own protection, it is important to make sure that everything you do is aboveboard. Fully disclose to management what you are doing, how you will do it, and the timing for each phase of the project. This protects you

	and reassures the organization's management of your integrity and professionalism. It is also crucial to know the goals of the organization so that you are able to address specific concerns. This will also help you to know where to begin and what is expected of you.
Vulnerability assessment	The vulnerability phase refers to identifying vulnerabilities in the organization's infrastructure, including the operating system, web applications, and web server. This is the phase where penetration testing begins. It is important to decide the best times to test. You don't want to risk having systems shut down during peak business hours or other sensitive times. You must also choose the best security assessment tools for the systems you choose to test. Be sure that you understand what each option of every tool can do before you use it. This helps you avoid damaging the systems. Everything you do as an ethical hacker depends on your ability to perform effective penetration testing. You must conduct the correct tests with the correct tools to be able to accurately assess the security vulnerabilities. All remaining phases depend on the effectiveness of this vulnerability assessment phase.
Risk assessment	In this phase, you organize the results of your vulnerability testing according to risk level and then categorize by levels of sensitivity and access. You will need to create and present reports that clearly identify the problem areas, then produce a plan of action to address weaknesses, protect the information, and harden the systems. At this phase, it is critical to communicate with management about your findings and your recommendations for locking down the systems and patching problems. You will be protected and valued as you communicate and receive written approval for implementing the suggested remediation.
Remediation	Remediation refers to the steps that are taken regarding vulnerabilities, such as evaluating vulnerabilities, locating risks, and designing responses for the vulnerabilities. In this phase, you implement the controls and protections from your plan of action. Begin with the highest-impact and highest-likelihood security problems, then work through the lower-impact and lower-likelihood issues. It makes the most sense to protect the organization from its most vulnerable areas first and then work to the less likely and less impactful areas. It may be impossible to identify and fix every single vulnerability that

	exists in an organization. That is why it is essential to start with the most urgent issues based on what makes the most business sense, what management expects from you, and compliance with regulations.
Verification	The verification phase helps the security analyst verify whether all the previous phases have been effectively executed. In this phase, you retest the systems for verification. Even though you may be certain that you have corrected vulnerability issues and are confident in your work, it benefits you to prove your work to management and have verifiable evidence to show that your patching and hardening implementations have been effective. You will increase the value of your services when you can show the validity of your work.
Monitoring	After you have verified your work, move on to the post-assessment phase, which is also known as the recommendation phase. At this point, recommend ongoing monitoring and routine penetration testing to be proactive in protecting the organization and its customers or clients. It may be tempting for an organization to feel secure after going through the process of penetration testing, implementing changes, and hardening the system. However, it's important for you to help management understand that hackers have time on their side and there will always be ongoing and new threats to security. Therefore, it is critical that the organization has monitoring tools in place and regularly schedules vulnerability maintenance testing.

7.2.4 Vulnerability Solution Facts

Vulnerability assessment is part of the scanning phase.

This lesson covers the following topics:

- Assessment solutions
- Assessment types
- Vulnerability scanning penetration steps

Assessment Solutions

There are two approaches to solving the vulnerability problems you find.

Solution	Description

Product-based	This solution involves an organization purchasing a product and administering it from inside the network. The product functions inside the firewall. This would make it inaccessible from outside penetration. An organization could implement this type of solution hoping that it solves vulnerability issues.
Service-based	A service-based solution entails hiring a professional, such as yourself, to provide a solution. This approach would involve using the vulnerability management life cycle. The professional would conduct the testing and solutions from outside the network. The risk of this approach is that an assessment based entirely from outside the network leaves potential for a hacker to gain access to the system.

An organization might be tempted not to hire a professional, but to install and run the product-based solutions themselves. However, it is likely the organization would not have the same level of protection that an ethical hacker would provide thorough analysis, assessment, remediation, verification, and continuous monitoring.

Assessment Types

There are two types of assessments.

Assessments	Description
Tree-based	With a tree-based assessment, you have a preset plan for testing and scanning based on some previous knowledge of the system. You then choose specific modes of testing for each operating system and machine.
Inference-based	In an inference-based approach, you test and discover information as you go. You then adjust your scans according to the information you discover.

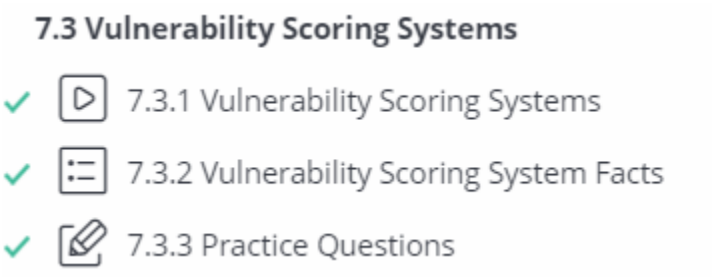
The tree-based assessment relies on the professional implementing a plan based on information that may or may not be accurate and complete for the system being tested. An inference-based approach relies on a current evaluation of the system to determine the next step, testing only relevant areas of concern.

Vulnerability Scanning Penetration Steps

As you conduct vulnerability scanning, it is important to understand that there are three basic steps in penetration testing.

Steps	Description
1	Locate the live nodes in the network. You can do this using a variety of techniques, but you must know where each live host is.
2	Itemize each open port and service in the network.
3	Test each open port for known vulnerabilities.

7.3 Vulnerability Scoring System



7.4 Vulnerability Assessment Tools

ExamTopics Review Questions

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The end!