COURSE GUIDE

CIT410
CYBER SECURITY

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First Printed 2022

ISBN: 978-058-557-5

Printed by: NOUN PRESS
January 2022

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INTRODUCTION

Both professionals and governments have increasingly utilized the term "Cyber Security" over the last several years. As with many modern slang expressions, there seems to be little understanding of what the phrase implies in actuality. Using the term casually won't cause any complications; using it for business purposes, though, or in agreements with other governments across the globe may. This may be done by using a range of cybersecurity-related methods and instruments such as policies, processes, safeguards, guidelines, and risk management strategies to protect a company and its users' assets.

The assets of an enterprise or individual user include connected computing devices, workers, infrastructure, apps, and services, as well as telecommunications systems and the totality of information sent or stored in the cyber environment. The goal of cybersecurity is to guarantee that the security properties of the business and the assets of its users are protected against relevant cyber threats.

COURSE AIM

The course's objective is to provide an overview of cyber security. CIT410 is designed to provide you with the information to comprehend the fundamental principles of cyber security and the cyberspace environment, both from an organizational and user perspective.

COURSE OBJECTIVES

To achieve the aims set out, the course has a set of objectives. Each unit has specific objectives, which are included at the beginning of the unit. Students may wish to refer to them during their studies to check on their progress. They should always look at the unit objectives after the completion of each unit. By doing so, they would know whether they had followed the instructions in the unit.
Below are the comprehensive objectives of the course as a whole. By meeting these objectives, students should have achieved the aims of the course as a whole. In addition to the aims earlier stated, this course aims to achieve some objectives. Thus, after going through the course, you should be able to:

- Understand the concept of cyber security
- Describe the benefit of cyber security
- Explain cyberspace, cyber law, and cyber security counter measures
- Define Cyber Security

- Classify Cyber crimes
- Understand the concept and types of cyber crime
- Understand who is a hacker
- Demonstrate cyber crime motivation
- Demonstrate the concept of firewalls and their importance
- Set up a simple VPN
- Manage access control
- Improve data privacy through hardware protection
- Protect yourselves from software and internet attacks
- Understand the concept of computer forensics and their characteristics
- Appreciate the advantages and disadvantages of computer forensics
- Understand the concept of Disk Forensics and their process
- Appreciate Network Forensics and under the procedure
- Explain Malware Forensics
- Understand the concepts of cyber law, Malware Forensics, Email Forensics, Memory Forensics, and Mobile Phone Forensics
- Explain ddigital **Forensic Examination Process**
- Justify cyber crimes as sanctioned in cyber laws
- Understands laws binds to cyberspace and appreciate their rights in data and privacy protection
- Learn from existing scenarios of cybercrimes in India
- Explain international laws and treaties
- Explain international cyber-attacks previously occurred
- Understand the use of ethical theories in ethical arguments.
- Articulate the ethical tradeoffs in a technical decision.
- Understand the role of professional codes of ethics.

WORKING THROUGH THIS COURSE

To complete this course, you are required to read each study unit, read the textbooks and read other materials which may be provided by the National Open University of Nigeria. Each unit contains self-assessment exercises and at certain point in the course you would be required to submit assignments for assessment purposes. At the end of the course there is a final examination. The course should take you about a total of 17 weeks to complete. Below you will find listed all the components of the course, what you have to do and how you should allocate your time to each unit in order to complete the course on time and successfully. This course entails that you spend a lot time reading. I would advise that you avail yourself the opportunity of comparing your knowledge with that of other learners.

STUDY UNITS

The study units in this course are as follows:

Module 1 **Cyber Security Fundamentals**
Unit 1 Cyber Security Fundamentals, Benefits, Cyber space and Cyber-Law
Unit 2 Cyber Crimes Classification and Types of Cyber Crimes
Unit 3 Scope of Cybercrimes

Module 2 **Cyber Threat Management**
Unit 1 Firewalls
Unit 2 Virtual Private Networks (VPN)
Unit 3 Security Control Management
Unit 4 Hardware and Software Prevention

Module 3 **Computer Forensics and Digital Investigation**
Unit 1 Computer Forensics
Unit 2 Network, Disk, Malware and Database Forensics
Unit 3 Email, Memory and Mobile Forensics
Unit 4 Malware Analysis

Module 4 **Introduction to Cyber Law and Ethics**
Unit 1 Concept of Cyber Law
Unit 2 The INDIA cyber-Acts
Unit 3 The International Laws
Unit 4 Cyber Ethics

Module One teaches the fundamentals of cyber security. It explains the cyber-crime world, who are cyber attackers, their motivations and benefits. The module further discusses the types of attacks carry out by attackers, the tools and techniques they use and how they explore their targets.

Module Two highlighted cyber threat prevention concepts. Most prevention techniques were discussed in this module. The importance of firewalls in traffic control, traffic diversion using VPN, access control management, protecting yourself from cyber-attack and hardware security implementation are all discussed in this module

In module Three, we have discussed many computer investigation measures known as forensic analysis. When cyber guru is been suspected of cyber frauds act, the only means of verifying the claim is to carry out forensic analysis on the suspect operating computer. Why forensic analysis, importance of forensic analysis and types of forensic analysis are all discussed in this module.

The last module tries to look at law enforcement binding cyber activities. Strength, limits and rules that guide what one can do on the cyber space are discussed in this module. We discussed why we need cyber law and some law Acts that reflect cyber rule and regulation. Finally cyber ethics for professional cyber space usage was also addressed.

Each unit consists of one or two weeks' work and include an introduction, objectives, reading materials, exercises, conclusion, summary, tutor-marked assignments (TMAs), references and other resources. The units direct you to work on exercises related to the required reading. In general, these exercises test you on the materials you have just covered or require you to apply it in some way and thereby assist you to evaluate your progress and to reinforce your comprehension of the material. Together with TMAs, these exercises will help you in achieving the stated learning objectives of the individual units and of the course as a whole.

PRESENTATION SCHEDULE

Your course materials have important dates for the early and timely completion and submission of your TMAs and attending tutorials. You should remember that you are required to submit all your assignments by the stipulated time and date. You should guide against falling behind in your work.

ASSESSMENT

There are three aspects to the assessment of the course. First is made up of self-assessment exercises. Second, consists of the tutor-marked assignments and third is the written examination/end of course examination.

You are advised to do the exercises. In tackling the assignments, you are expected to apply information, knowledge and techniques you have gathered during the course. The assignments must be submitted to your facilitator for formal assessment in accordance with the deadline stated in the presentation schedule and the assessment file. The work you submit to your tutor for assessment will count for 30% of your total course mark. At the end of the course, you will need to sit for a final or end of course examination of about three hours duration. This examination will count for 70% of your total course mark.

TUTOR-MARKED ASSIGNMENT (TMAS)

The TMA is a continuous assessment component of your course. It accounts for 30% of the total score. You will be given four TMAs to answer. Three of these must be answered before you are allowed to sit for

end of course examination. The TMAs would be given to you by your facilitator and should be returned after you have done the assignment. Assignment questions for the units in this course are contained in the assignment file. You will be able to complete your assignments from the information and material contained in your reading, references and study units. However, it is desirable in all degree level of education to demonstrate that you have read and researched more into your references, which will give a wider view point and may provide you with a deeper understanding of the subject.

Make sure that each assignment reaches your facilitator on or before the deadline given in the presentation schedule and assignment file. If for any reason you cannot complete your work on time, contact your facilitator before the assignment is due to discuss the possibility of an extension. Extension will not be granted after the due date unless in exceptional circumstances.

FINAL EXAMINATION AND GRADING

The end of course examination for Cyber Security 1 (CIT410) will be for three (2) hours and it has a value of 70% of the total course score. The examination will consist of questions, which will reflect the type of self-testing, practice exercise and tutor-marked assignment problems you have previously encountered. All areas of the course will be assessed.

Use the time between finishing the last unit and sitting for the examination to revise the whole course. You might find it useful to review your self-test, TMAs and comments on them before the examination. The end of course examination covers information from all parts of the course.

COURSE MARKING SCHEME

Assignment	**Marks**
Assignment 1 – 4	For assignment, best three marks of the four counts at 10% each, i.e., 30% of Course Marks.
End of Course Examination	70% 0f the overall Course Marks.
Total	100% of Course Material.

FACILITATORS/TUTORS AND TUTORIALS

There are 16 hours of tutorials provided in support of this course. You will be notified of the dates, time, and location of these tutorials as well

as the name and phone number of your facilitator, as soon as you are allocated to a tutorial group.

Your facilitator will mark and comment on your assignments, keep a close watch on your progress and any difficulties you might face and provide assistance to you during the course. You are expected to mail your Tutor-Marked Assignments to your facilitator before the schedule date (at least two working days are required). They will be marked by your tutor and returned to you as soon as possible.

Do not delay to contact your facilitator by telephone or e-mail if you need assistance.

The following might be circumstances in which you would find assistance necessary, hence you would have to contact your facilitator if:

- You do not understand any part of the study or assigned readings
- You have difficulty with self-tests
- You have question or problem with an assignment or with the grading of an assignment.

You should endeavour to attend the tutorials. This is the only chance to have face to face contact with your course facilitator and to ask questions which may be answered instantly. You can raise any problem encountered in the course of your study.

To have more benefits from course tutorials, you are advised to prepare a list of questions before attending them. You will learn a lot from participating actively in discussions.

SUMMARY

Cyber Security 1 is a course that intends to intimate the learner with basic facts on cyber space, crime, security, cyber regulations and professional ethics. Upon completing this course, you will be equipped with the knowledge of cyber security fundamentals, who are cyber attackers and what acts are classified as cybercrime, prevention means against cyber-attacks, cyber investigation and laws that regulate cyber activities.

I wish you success in the course and I hope you find it very interesting.

MAIN COURSE

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MODULE 1: CYBER SECURITY FUNDAMENTALS

UNIT 1: CYBER SECURITY FUNDAMENTALS, BENEFITS, CYBER SPACE AND CYBER-LAW

CONTENTS

Introduction of Module

As more human activities, financial, technical, and communication processes migrate into cyberspace, online vulnerability and cyber-attacks remain an issue that has continued to plague the online environment. Cyber security has always been an important aspect of computing systems, but its importance has increased greatly in recent years. The curriculum covers areas where cyber security is of major importance but have different security requirements and may be exposed to different threats and attacks. It also covers techniques and mechanisms used to secure computer systems and data to meet those requirements and protect them. The areas looked at include computer operating systems (and increasingly, distributed operating systems), distributed applications (such as electronic commerce over the Internet), embedded systems (ranging from smart cards to large industrial plants and telecommunications systems), and users. The techniques and mechanisms looked at include cryptography, authentication & authorization, and

access control. Furthermore, the curriculum integrates the legal, ethical, and professional perspectives, for instance, to address concerns about data security, privacy, and societal impact of computing systems

1.0 INTRODUCTION

The internet is the most widely used technology on the planet. It's now accessible to practically everyone, which is a big deal. Today's digital era is made possible by Internet of Things (IoT) technologies, which enable internet access to be available to objects other than smart devices. As more and more assets and data are traded via the internet, the prevalence of cyber fraud is increasing at an alarming rate. Because of this, it is necessary to teach people about cyber security, including how to defend oneself, who cyber criminals are, and what the law and ethical standards are in the field of cyber security.

2.0 INTENDED LEARNING OUTCOMES (ILOS)

By the end of this unit, you will be able to:

- Understand the concept of cyber security
- Describe the benefit of cyber security
- Explain cyber space, cyber law, and cyber security counter measures
- Define Cyber Security
- Classify Cyber crimes
- Understand the concept and types of cyber crime
- Understand who is a hacker

3.0 MAIN CONTENT

3.1 Cyber security

Cyber security is the technique of guarding against malicious assaults on computers, servers, mobile devices, electronic systems, networks, and data. Additionally, it is referred to as information technology security or electronic data security.

Cybersecurity is critical because governments, military groups, corporations, financial institutions, and healthcare organizations acquire, analyze, and store massive quantities of data on computers and other devices. A significant amount of such data may include sensitive information, such as intellectual property, financial data, personal information, or other forms of data for which unlawful access or disclosure might have severe implications. Organizations transport

sensitive data through networks and to other devices as part of their daily operations, and cyber security is the discipline devoted to safeguarding that data and the systems that handle or store it. As the number and complexity of cyber assaults increases, businesses and organizations, particularly those entrusted with protecting national security, health, or financial data, must take efforts to defend their critical business and people information.

3.2 Benefits of cybersecurity

The benefits of implementing and maintaining cybersecurity practices include:

- **Business protection**: The implementation of cyber security has helped business organizations protect their information, operations, and transactions against attacks and data breaches.
- **Protection for data and networks:** Network and data breaches through networking devices have been minimized as a result of fundamental knowledge and implementation of cyber security.
- **Prevention of unauthorized user access**: social engineering is one of the techniques used by hackers to gain access through a legit user device. Cyber security awareness has prepared admins and users to control who can access the organization's network and devices.
- **Improved recovery time after a breach**: It usually takes a long time for an organization to recover from a cyber disaster. Cyber security helps to have all recovery plans in place. This improves the time to recover from cyber-attacks and disasters.
- **Protection for end-users and endpoint devices**: Nowadays, network endpoints have advanced security techniques that shield untrusted traffic and attacks. End users have also improved security threats through proper security adherence, such as strong password policies and active and passive periods of devices.
- **Regulatory Compliance**: Organizations now have compliance regulations and policies in place that users must adhere to in order to maintain a health security state. These regulations have been placed and are being monitored to ensure they are being followed in accordance with
- **Business continuity**: The most important objective of an organization is to maintain a continuous process irrespective of an attack. There is always a backup plan that will make sure the organization is operating even if it couldn’t operate at an ideal state.

3.3 Cyber security domains

There is a lot of news about cybercrime right now because it's a big problem all over the world and it's been a big story. Putting people's safety at risk is a risk to big businesses, banks, and governments around the world. Today, organized crime syndicates are like start-up businesses. They hire highly-skilled developers who are always coming up with new ways to attack people online. When there's so much data out there that can be hacked, Cybersecurity has become a must. A strong cybersecurity strategy has layers of protection to defend against cyber crime, including cyber attacks that attempt to access, change, or destroy data; extort money from users or the organization; or aim to disrupt normal business operations. Countermeasures should address. The domains of cyber security that holds to core of protection are Security Management, Identity and Access Management, Security Engineering, Business Continuity, Compliance, Cryptography, Physical Security, Software Development Security, Security Operations

3.3.1 Critical infrastructure security

Physical and cyber systems and assets that are so crucial to a nation's or organization's physical and economic security, as well as the health and safety of the general public, are referred to as "critical infrastructure." Despite the fact that vital infrastructure varies from country to country, most countries have many of the same components. US Homeland Security has designated 16 essential infrastructure sectors that include energy, transportation and communications; financial services and agriculture; as well as food and agriculture.

The National Institute of Standards and Technology (NIST) has created a cybersecurity framework to help organizations in this area, The Framework emphasizes using business goals to guide cybersecurity activities and taking cybersecurity risks into account as part of an organization's risk management process. All three parts are called "Framework Profiles." They are called "Framework Core," "Framework Tiers," and "Framework Profiles." Cybersecurity activities, results, and sources of information are all part of the Framework Core, which is a set of things that happen in all sectors of the economy and critical infrastructure. Critical Infrastructure is an advance topic and which discussed deeply in advanced cyber security courses.

3.3.2 Network security

There are a lot of things that can happen to your network and your data if you don't have Network Security. This is a very broad term that covers everything from hardware and software to processes and rules and

configurations about how networks are used, how they can be accessed, and how they can be protected from all kinds of threats. It includes things like access control, virus and antivirus software, application security, network analytics, types of network security (endpoint, web, wireless), firewalls, VPN encryption, and many other things.

3.3.3 Application security

Increasingly, today's applications are accessible via several networks and linked to the cloud, which increases the risk of security breaches. More and more emphasis is being placed on securing networks and applications at the same time. One of the reasons for this is that hackers are increasingly targeting applications in their assaults. This kind of attack may be prevented if flaws in the applications are found via application security testing. At the application level, it refers to security measures designed to prevent data or code from being hacked and stolen from the application. Additionally, it includes methods and ways to secure applications once they have been deployed. This includes the security considerations that occur throughout application development and design.

Hardware, software, and methods that uncover or reduce security flaws may all be part of an application's security. It's a kind of hardware application security when a router blocks the Internet from seeing a computer's IP address. The software often includes security protections such as an application firewall that restricts what can and cannot be done.

3.3.4 Cloud security

Security measures for cloud computing, often known as cloud security, are meant to safeguard cloud-based infrastructure, applications, and data. User and device authentication, access control and privacy protection are all covered by these procedures. Distributed denial of Service (DDoS) attacks, viruses, hackers, and even unauthorized user access or usage may all be prevented by cloud security in a cloud environment. When we say cloud service, the data and applications we used are hosted by third parties which are fundamentally different from conventional IT, where most data were housed in a self-controlled network. The first step in creating a cloud security plan is to recognize your own security responsibilities.

3.4 Operational security

An operational security (OPSEC) approach ensures that sensitive information does not get into the hands of the wrong people. This approach encourages IT and security professionals to consider their systems and operations from the point of view of an intruder. Activities and procedures, including as behavior tracking, social media monitoring,

and security best practices, are part of this category. Organizations may safeguard their data processing via the use of OPSEC, which consists of five phases.

- Identify Sensitive Data
- Identify Possible Threats
- Analyze the Vulnerabilities
- What is the Threat Level
- Devise a Plan To Mitigate the Threats

3.5 End-user education and awareness

End-user education is teaching employees how to protect themselves and their company data from being lost or stolen. It also gives them the tools and skills they need to do this. End-user education and reviews are important to show employees how the organization, systems, and security flaws work.

Hackers are getting more and cleverer at finding ways to get into your company's private systems through employees. People who know about cyber threats are better able to spot the early signs of an attack and stay safe. One of the best ways to reduce cybersecurity risk and build a security-aware culture is to teach people about security. For instance, anyone can accidentally introduce a virus to an otherwise secure system by failing to follow good security practices. Teaching users to delete suspicious email attachments, not plug in unidentified USB drives, and various other important lessons is vital for the security of any organization. end-user education also helps in building security awareness across the organization to strengthen endpoint security. For example, users can be trained to delete suspicious email attachments, avoid using unknown USB devices, etc.

3.6.1 Disaster recovery / business continuity planning

This define how an organization responds to a cyber-security incident or any other event that causes loss of operations or data. Disaster recovery policies dictate how organization restores its operations and information to return to the same operating capacity as before the event. Business continuity is the plan the organization falls back on while trying to operate without certain resources

3.7 Storage security

Storage resources and the data stored on them, both on-site and in other data centers and the cloud, need to be protected from both accidental and intentional damage or destruction and from unauthorized users. It's important for businesses to pay attention to this area because most data

breaches are caused by a breach in data storage security. Data security is a type of security for the things you store. It is important to keep data safe in both storage and on the computer. Data security is mostly about keeping private information out of the hands of people who aren't supposed to see it. It also protects data from other types of attacks, like ransomware that stops people from getting their information or attacks that change data, making it unreliable.

Encryption and immutable and isolated data copies remain in the same pool so they can quickly be restored to support recovery, minimizing the impact of a cyber-attack.

3.8 Cyberspace

Cyberspace refers to the virtual computer world, and more specifically, an electronic medium that is used to facilitate online communication. Cyberspace typically involves a large computer network made up of many worldwide computer subnetworks that employ TCP/IP protocol to aid in communication and data exchange activities. Cyberspace's core feature is an interactive and virtual environment for a broad range of participants.

3.9 Cyber Laws

Cyber laws encompass all the legal issues related to the communicative, distributive and transactional aspects of network-related information devices and technologies. It is different from the Property Law or any other law. Unlike property law, it is not so distinct; it is broader since it covers several areas of laws and regulations. It encapsulates the statutory, legal and constitutional provisions related to computers and the internet. Cyber laws are related to individuals and institutions that

- Plays a crucial role in providing cyberspace access to people
- Generates software and/or hardware to allow people with entry into cyberspace, and
- Make use of their computer system to gain entry into cyberspace.

3.10 Cyber Laws and Cyber Security

Cyber laws are generated Cyber technologies from being misused. The essence is to prevent any person from violating the right of other persons in cyberspace. Any kind of violation of cyber rights is considered to be a cyberspace violation and are deemed punishable under cyber laws. It is important to note that since cyberspace does not belong to the physical world, the physical laws do not apply to cyberspace crime. A separate set of cyber laws are formulated by the government to provide cybersecurity to cyber users. Such cyber laws are needed to monitor and prevent any

immoral or illegal activities of humans. Some of the common cyberspace violation activities include hacking, theft, money laundering, terrorism, piracy, etc. Hackers can get hold of any internet account through the Domain Name Server (DNS), phishing, IP address, etc. to get entry into the computer system of any person and steal the data, or introduce computer bugs and render the system ineffective.

Discussion
Which of the security infrastructure is most critical and why?

4.0 SELF-ASSESSMENT EXERCISES

1. Define cyber security, what are the benefits of Cybersecurity?

Answer
Cybersecurity is the protection of internet-connected systems such as hardware, software and data from cyberthreats. The practice is used by individuals and enterprises to protect against unauthorized access to data centres and other computerized systems

Benefits of cybersecurity
The benefits of implementing and maintaining cybersecurity practices include

- Business protection against cyberattacks and data breaches.
- Protection for data and networks.
- Prevention of unauthorized user access.
- Improved recovery time after a breach.
- Protection for end users and endpoint devices.
- Regulatory Compliance
- Business continuity

5.0 CONCLUSION

Organizations are finding themselves under the pressure of being forced to react quickly to the dynamically increasing number of cybersecurity threats, Cyber security is also one of the most important aspects of the fast-paced growing digital world. The threats of it are hard to deny, so it is crucial to learn how to defend critical organization infrastructure

6.0 SUMMARY

In this unit, we were able to understand that cyber security is all about protecting our network and end-point devices from being attacked, controlling our activities and information shared over the internet. The knowledge of cyber security benefits us to prepare in advance for an attack. Critical Infrastructure is those assets that are precious to an

organization or nation. These assets need to be protected. NIST developed a framework that ensures proper protection of critical infrastructure. Different levels of security are network security, Application Security, Cloud security (if in usage), Storage and data security, and End users' education & awareness. Cyberspace is a virtual where everyone connects to communicate which is refers to “internet”. Cyber law and ethics provide us with policies that guide our behavior on the internet. Law and regulations enforce sanctions over internet misconduct.

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UNIT 2: CYBER CRIMES CLASSIFICATION AND TYPES

CONTENTS

1.0 INTRODUCTION

There are many issues with Cybercrime when private information is stolen or leaked, legally or not. Internationally, both government and non-government groups are involved in cybercrimes, such as espionage, financial theft, and other crimes that happen across borders. Cybercrime is a crime that has to do with a computer and a network. There is a chance that the computer was used in a crime, or that it was the target. Someone's security and finances could be at risk because of cybercrime.

Besides cyber crime, cyber attacks can also be linked to cyber warfare or cyberterrorism, like hacktivists. People who are criminally motivated want to make a lot of money by taking money, data, or causing problems at work. In the same way, people who are personally motivated, like disgruntled current or former employees, will try to get money, data, or a chance to mess with a company's system. However, they are mostly after revenge. Socio-political attackers want to get attention for their causes.

This makes them show the public what they did, which is called hacktivism.

2.0 INTENDED LEARNING OUTCOMES (ILOS)

By the end of this unit, you will be able to:

- Understand the concept of Cyber Crimes
- Define and Classify Cyber crimes from different perspectives.
- Understand similarities amongst different types of cyber crimes

3.0 MAIN CONTENT

3.1 Classification of Cyber Crimes

The cyber-criminal could be internal or external to the organization facing the cyber attack.

3.1.1 Insider Attacks

An attack to the network or the computer system by some person with authorized system access is known as insider attack. It is generally performed by dissatisfied or unhappy inside employees or contractors. The motive of the insider attack could be revenge or greed. It is comparatively easy for an insider to perform a cyber attack as he is well aware of the policies, processes, IT architecture and wellness of the security system. Moreover, the attacker have an access to the network. Therefore, it is comparatively easy for a insider attacker to steel sensitive information, crash the network, etc. In most of the cases the reason for insider attack is when a employee is fired or assigned new roles in an organization, and the role is not reflected in the IT policies. This opens a vulnerability window for the attacker. The insider attack could be prevented by planning and installing an Internal intrusion detection system (IDS) in the organization

3.1.2 External Attacks

When the attacker is either hired by an insider or an external entity to the organization, it is known as external attack. The organization which is a victim of cyber-attack not only faces financial loss but also the loss of reputation. Since the attacker is external to the organization, so these attackers usually scan and gathering information. An experiment network/security administrator keeps regular eye on the log generated by the firewalls as external attacks can be traced out by carefully analyzing these firewall logs. Also, Intrusion Detection Systems are installed to keep an eye on external attacks.

The cyber-attacks can also be classified as structured and unstructured based on the level of maturity of the attacker.

3.1.3 Unstructured attacks

These attacks are generally performed by armatures who don't have any predefined motives to perform the cyber-attack. Usually, these armatures try to test a tool readily available over the internet on the network of a random company. For example, a young attacker who tries to break into organization network through his/her computer with blocking his/her IP address or device location. This kind of attacker has the intrusion potentials but lack enough sophisticated tools to prevent their identities been exposed.

3.1.4 Structured Attack

These types of attacks are performed by highly skilled and experienced people and the motives of these attacks are clear in their mind. They have access to sophisticated tools and technologies to gain access to other networks without being noticed by their Intrusion Detection Systems (IDSs). Moreover, these attacker have the necessary expertise to develop or modify the existing tools to satisfy their purpose. These types of attacks are usually performed by professional criminals, by a country on other rival countries, politicians to damage the image of the rival person or the country, terrorists, rival companies, etc.

3.2 Types of Cyber Crimes

Cybercrime is any unauthorized activity involving a computer, device, or network. The three types are computer-assisted crimes, crimes where the computer itself is a target, and crimes where the computer is incidental to the crime rather than directly related to it. Cybercriminals usually try to profit off of their crimes using a variety of tactics, including:

3.2.1 Denial of Service (DOS)

These are used to make an online service unavailable and take the network down by overwhelming the site with traffic from a variety of sources. Large networks of infected devices known as Botnets are created by depositing malware on users' computers. The hacker then hacks into the system once the network is down. One of the world's greatest attack was the one made on Google in 2020. In 2020, Google Threat Analysis group announced attacks on several of their IP addresses, the attack on hundreds of Google IP addresses, launched by three Chinese ISPs, lasted six months

and peaked at a breath-taking 2.5Tbps. Google Security reliability engineer say" The attacker exploited many networks to fake 167 Mpps (millions of packets per second) to 180,000 vulnerable CLDAP, DNS, and SMTP servers, which subsequently sent us massive responses". This displays the might of a well-resourced attacker: This was four times the size of the Mirai botnet's previous year's record-breaking 623 Gbps assault.

3.2.2 Botnets

A botnet is a group of computers that have been infected with malware. The person who runs the botnet infrastructure is called a "bot herder." They use the computers that have been infected with malware to launch attacks that are meant to shut down a target's network, get their passwords, or do other things that require a lot of processing power. Each device in the botnet network is called a "bot." It's up to the person who runs a botnet to control it in one of two ways: through a centralized model with direct communication between the bot herder and each computer, or through a decentralized system with many links between all the botnet devices.

3.2.3 Identity Theft

Identity theft is the stealing of another person's personal or financial information in order to exploit that person's identity to conduct fraud, such as making unlawful transactions or purchases. Identity theft occurs in a variety of ways, leaving victims with harm to their credit, income, and reputation. Identity theft happens when someone takes your personal information, such as your NIN, bank account number, and credit card information. Identity theft may be perpetrated in a variety of ways. They can also open a phone/internet account in your name, use your name to plan a criminal activity and claim government benefits in your name. They may do this by finding out user’s passwords through hacking, retrieving personal information from social media, or sending phishing emails. Some identity thieves rummage through garbage cans in search of bank account and credit card statements. Accessing company databases to obtain lists of client information is a more high-tech way. Once identity thieves have obtained the information they want, they may destroy a person's credit rating as well as the standing of other personal information.

3.2.3 Cyberstalking

This kind of cybercrime involves online harassment where the user is subjected to a plethora of online messages and emails. Typically, cyberstalkers use social media, websites and search engines to intimidate

a user and instill fear. Usually, the cyberstalker knows their victim and makes the person feel afraid or concerned for their safety.

3.2.4 Social Engineering

Social engineering involves criminals making direct contact with you usually by phone or email. They want to gain your confidence and usually pose as a customer service agent so you'll give the necessary information needed. This is typically a password, the company you work for, or bank information. Cybercriminals will find out what they can about you on the internet and then attempt to add you as a friend on social accounts. Once they gain access to an account, they can sell your information or secure accounts in your name.

3.2.5 Potentially Unwanted Programs

Potentially Unwanted Programs (PUPs) are less threatening than other cybercrimes, but are a type of malware. They uninstall necessary software in your system including search engines and pre-downloaded apps. They can include spyware or adware, so it's a good idea to install an antivirus software to avoid the malicious download.

3.2.6 Phishing

This type of attack involves hackers sending malicious email attachments or URLs to users to gain access to their accounts or computer. Cybercriminals are becoming more established and many of these emails are not flagged as spam. Users are tricked into emails claiming they need to change their password or update their billing information, giving criminals access.

3.2.7 Prohibited/Illegal Content

This cybercrime involves criminals sharing and distributing inappropriate content that can be considered highly distressing and offensive. Offensive content can include, but is not limited to, sexual activity between adults, videos with intense violent and videos of criminal activity. Illegal content includes materials advocating terrorism-related acts and child exploitation material. This type of content exists both on the everyday internet and on the dark web, an anonymous network.

3.2.8 Online Scams

These are usually in the form of ads or spam emails that include promises of rewards or offers of unrealistic amounts of money. Online scams

include enticing offers that are “too good to be true” and when clicked on can cause malware to interfere and compromise information.

3.2.9 Exploit Kits

Exploit kits need a vulnerability (bug in the code of a software) in order to gain control of a user’s computer. They are readymade tools criminals can buy online and use against anyone with a computer. The exploit kits are upgraded regularly similar to normal software and are available on dark web hacking forums.

Discussion

Why is identity theft so critical in cyberspace?

4.0 SELF-ASSESSMENT EXERCISE

1. Define Cyber Security

Answer
Cyber Security is a process that’s designed to protect networks and devices from external threats. Businesses typically employ Cyber Security professionals to protect their confidential information, maintain employee productivity, and enhance customer confidence in products and services.

2. List and explain different classification of cyber crimes

Answer
i. Insider Attack - An attack to the network or the computer system by some person with authorized system access is known as insider attack
ii. External attack - When the attacker is either hired by an insider or an external entity to the organization, it is known as external attack
iii. Unstructured attacks - These attacks are generally performed by amateurs who don’t have any predefined motives to perform the cyber attack
iv. Structure attack - These types of attacks are performed by highly skilled and experienced people and the motives of these attacks are clear in their mind

5.0 CONCLUSION

Most attackers use proxies to hide their IP address and, therefore, their true physical location. In this way, attackers can conduct fraudulent financial transactions, launch attacks, or perform other actions with little

risk. While law enforcement can visit a physical location identified by an IP address, attackers that use one (or multiple) proxies across country boundaries are more difficult to locate

6.0 SUMMARY

Cybercrime is the breach of personal information or privacy by unauthorized user. Organizations and target individuals faces serious cyber threats. Insider attacker is one who directly operates in the target environment e.g a staff of an organization. External attacker is attacker that does not relate to the target organization. Might use different techniques to gain access. Structured and Unstructured attacker differs from their level of expertise in the domain. Structured attacker uses sophisticated tools to exploit weakness of an organization as well as able to prevent their selves from been expose or caught.

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Further Study Materials

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UNIT 3 SCOPE OF CYBERCRIMES

CONTENTS

1.0 INTRODUCTION

Cybercrime is already a big problem all over the world, and it's growing fast. The law enforcement world is scrambling to catch up; legislators are passing new laws to address this new way of committing crime, and police agencies are forming special computer crime units and pushing their officers to become more technically savvy. As the internet is growing, different cybercrimes emerge. We will be discussing the categories of cybercrime, the types of hackers and their motivation towards the act of cyber attacks

2.0 INTENDED LEARNING OUTCOMES (ILOS)

At the end of this unit, students will able to:

- Explain the concept of cyber crime
- Understand who is a hacker
- Demonstrate cyber crime motivation

3.0 MAIN CONTENT

3.1 Nature and Scope of Cyber crime

Cybercrime is a transnational crime by definition. These crimes are perpetrated when the perpetrator is not physically present at the scene of the crime. These offenses take place in the impenetrable realm of computer networks. To perpetrate such crimes, all that is required is a computer linked to the internet. The emergence of lightning speed internet has decreased the amount of time required to conduct cybercrime. As a borderless world, cyberspace has become a playground for perpetrators, where they commit crimes while remaining conspicuously absent from the scene of the crime. It is an open challenge to the law, which is supported by tangible facts and proofs. Cybercrime has grown to such proportions that it is no longer possible to categorize it formally. Each day, a new type of cybercrime is born, making any attempt to combat it nearly futile. Identification is a significant problem for cybercrime. When it comes to the identification aspect of cybercrime, one thing that is common is anonymous identity. It is quite simple to create a false identity and use it to commit crimes over the internet. Due to the fact that cybercrime is technology-driven, it evolves rapidly and ingeniously, making it difficult for cyber investigators to find solutions to cyber law crimes. Crimes committed over the internet are fundamentally different from those committed in the physical world. In cyberspace-related crimes, there are no physical footprints, tangible traces, or objects that can be used to track down cyber criminals. When it comes to investigation, cybercrime presents a bunch of challenges.

3.2 Categories of Cybercrimes

Cybercrime can be basically categorized into three parts:

- Cybercrimes against persons
- Cybercrimes against property
- Cybercrimes against government.

3.2.1 Cybercrimes against persons

Cybercrimes committed against persons include various crimes like transmission of child-pornography, harassment of any one with the use of a computer such as e-mail. The trafficking, distribution, posting, and dissemination of obscene material including pornography and indecent exposure, constitutes one of the most important Cybercrimes known today. The potential harm of such a crime to humanity can hardly be amplified.

3.2.2 Cybercrimes against property

The second category of Cyber-crimes is that of Cybercrimes against all forms of property. These crimes include computer vandalism (destruction of others' property), transmission of harmful programmes.

3.2.3 Cybercrimes against government

The third category of Cyber-crimes relate to Cybercrimes against Government. Cyber terrorism is one distinct kind of crime in this category. The growth of internet has shown that the medium of Cyberspace is being used by individuals and groups to threaten the international governments as also to terrorize the citizens of a country. This crime manifests itself into terrorism when an individual "cracks" into a government or military maintained website.

- **Malware -** Where vic - ims are hit with a worm or virus that renders their devices useless
- **Man in the Middle -** Where a hacker puts himself between a victim's machine and a router to sniff data packets
- **Phishing -** Where a hacker sends a seemingly legitimate-looking email asking users to disclose personal information

Other types of cyberattacks include cross-site scripting attacks, password attacks, eavesdropping attacks (which can also be physical), SQL-injection attacks, and birthday attacks based on algorithm functions.

3.3 Motivation to Cyber Criminals

The main motive behind the cybercrime is to disrupt regular business activity and critical infrastructure. Cybercriminals also commonly manipulate stolen data to benefit financially, cause financial loss, damage a reputation, achieve military objectives, and propagate religious or political beliefs. Some don't even need a motive and might hack for fun or simply to showcase their skills. So who are these cybercriminals? Here's a breakdown of the most common types:

3.3.1 Black-Hat Hackers

A black hat hacker is typically one that engages in cybercrime operations and uses hacking for financial gain, cyber espionage purposes or other malicious motives, like implanting malware into computer systems. Gray-Hat Hackers.

3.3.2 White-Hat Hackers

A white hat hacker, also called an ethical hacker, is the antithesis of a black hat hacker. White hat hackers are not cybercriminals, rather they are security specialists hired by organizations to conduct tasks such as penetration tests and vulnerability assessments on their systems to improve their security defenses. When working as pen testers, white hat hackers conduct tests and attacks on networks, websites and software in order to identify possible vulnerabilities. They also follow established rules, such as bug bounty policies. They will notify the affected organizations directly of any issues so that a patch can be released or other steps taken to fix the flaw.

3.3.3 Suicide Hackers

Suicide hackers are individuals who aim to bring down critical infrastructure for a "cause" and are not worried about facing jail terms or any other kind of punishment. They are similar to suicide bombers, who sacrifice their life for an attack and are thus not concerned with the consequences of their actions.

3.3.4 Script Kiddies

A derogatory term often used by amateur hackers who don't care much about the coding skills. These hackers usually download tools or use available hacking codes written by other developers and hackers. Their primary purpose is usually to impress their friends or gain attention. However, they don't care about learning. By using off-the-shelf codes and tools, these hackers may launch some attacks without bothering for the quality of the attack. commonest cyber attacks by script kiddies might include DoS and DDoS attacks.

3.3.5 Gray Hats Hackers

Gray hat hackers fall somewhere in between white hat and black hat hackers. While they'll not use their skills for personal gain, they can, however, have both good and bad intentions. as an example, a hacker who hacks into a corporation and finds some vulnerability may leak it over the web or inform the organization about it. It all depends upon the hacker. Nevertheless, as soon as hackers use their hacking skills for personal gain they become black hat hackers. there's a fine line between these two.

3.3.6 Blue Hats Hackers

These are another form of novice hackers very similar to script kiddies whose main agenda is to require revenge on anyone who makes them

angry. They need no desire for learning and should use simple cyber attacks like flooding your IP with overloaded packets which can result in DoS attacks. A script kiddie with a vengeful agenda are often considered a blue hat hacker.

3.3.7 Malicious Insider or Whistle blower

A malicious insider or a whistle blower could also be an employee with a grudge or a strategic employee compromised or hired by rivals to garner trade secrets of their opponents to remain on top of their game. These hackers may take privilege from their quick access to information and their role within the corporate to hack the system.

3.3.8 State/Nation Sponsored Hackers

State or Nation sponsored hackers are those that have been employed by their state or nation's government to snoop in and penetrate through full security to realize tip from other governments to stay at the highest online. They have an endless budget and extremely advanced tools at their disposal to target individuals, companies or rival nations.

3.3.9 Hacktivist Hackers

Hacktivist is when hackers break into government or corporate computer systems as an act of protest. Hacktivists use hacking to increase awareness of their social or political agendas, as well as themselves, in both the online and offline arenas. They are individuals who promote a political agenda by hacking, especially by defacing or disabling websites. Common hacktivist targets include government agencies, multinational corporations, or any other entity that they perceive as a threat. It remains a fact, however, that gaining unauthorized access is a crime, irrespective of their intentions.

Discussion

How can cybercrime be mitigated? Discuss

4.0 SELF-ASSESSMENT/EXERCISE

1. It has been expressed those cyber-attacks involving data breach are more dangerous than that of monetary. Why?
2. Why do we need a White hacker in cyber society?

5.0 CONCLUSION

While click fraud appears to be a problem with a scope limited to just advertisers and ad networks, fraudsters' use of infected computers to click ad links makes click fraud a problem for everyone with a computer. Being part of a click fraud botnet consumes a system's bandwidth and displays additional advertisements to the user, which is usually undesirable.

6.0 SUMMARY

Cybercrime occurs without present appearance of the perpetrators. Cyber crime can be categorized as for against person, property and government. There are different types of types depending on their motives for attacks. White attacker is well known as ethical hacker. Usually known and employ by the government and organization to carry out vulnerability test on an organization. Gray hacker can be dangerous but has no precise motive, mostly for fun and satisfaction. A black hacker is dangerous and need to be avoided.

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MODULE 2: CYBER THREAT MANAGEMENT

UNIT 1: FIREWALL

CONTENTS

1.0 INTRODUCTION

The term "firewall" used to refer to a wall that was meant to keep a fire from spreading from one building to another. Later, the word is used to describe structures that are similar, like the metal sheet that separates the engine compartment of a car or plane from the passenger compartment. Use: People started calling this technology in the late 1980s, when the Internet was still a lot less well-known than it is now. Network technology came out at that time.

A firewall forms a barrier through which the traffic going in each direction must pass. A firewall security policy dictates which traffic is authorized to pass in each direction. Firewall may be designed to operate as a filter at the level of IP packets, or may operate at a higher protocol layer.

Introduction of Module

Cyber threat management is the process of detecting, analyzing, assessing, and resolving the cyber security needs of an organization. Threats and vulnerabilities are two essential cyber security considerations for an organization's security. These two variables contribute to an organization's resilience against cyber threats. A vulnerability is a flaw in a computer system that may be exploited by hackers to obtain unauthorized access. A cyberattack that successfully exploits a vulnerability may execute malicious code, install malware, and even steal sensitive data. A threat is a harmful act that aims to corrupt data, steal data, or otherwise disrupt digital life. Computer viruses, data breaches,

Denial of Service (DoS) assaults, and other attack vectors are all examples of cyber dangers. Cyber threats can include the likelihood of a successful cyber-attack aimed at gaining unauthorized access to, damaging, disrupting, or stealing an information technology asset, computer network, intellectual property, or any other kind of sensitive data.

Cyber threat management not only assists organizations in preventing data breaches, but also equips them to cope with security issues that do arise. A cyber threat management system that is automated and informed by artificial intelligence may assist in countering today's sophisticated cybercriminal threats. It provides security teams with the visibility they need to be successful. This module will guide you through several techniques through which cyber threats could be managed.

This module will consist of four units as follows
Unit 1: Firewalls
Unit 2: Virtual Private Networks (VPN)
Unit 3: Security Control Management
Unit 4: Hardware and Software Prevention

2.0 Intended Learning Outcomes (ILOs)

At the end of this unit, students will able to:

- Understand the concept of firewall
- Appreciate Firewalls operations, strength and limitations.

3.0 Main Content

3.1 What is Firewall

A Firewall is a network security device that monitors and filters incoming and outgoing network traffic based on an organization’s security policies. At its most basic, a firewall is essentially the barrier that sits between a private internal network and the public Internet. Firewall’s main purpose is to allow non-threatening traffic in and to keep dangerous traffic out. Firewalls can be an effective means of protecting a local system or network of systems from network-based security threats while at the same time affording access to the outside world via wide area networks and the Internet.

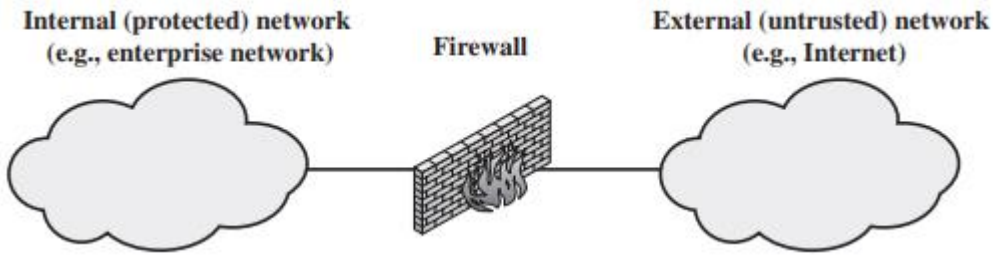

Figure 2.1: Firewall gateway

3.1.1 Characteristics of firewalls

1. All traffic from inside to outside, and vice versa, must pass through the firewall. This is achieved by physically blocking all access to the local network except via the firewall. Various configurations are possible, as explained later in this chapter.
2. Only authorized traffic, as defined by the local security policy, will be allowed to pass. Various types of firewalls are used, which implement various types of security policies, as explained later in this chapter.
3. The firewall itself is immune to penetration. This implies the use of a hardened system with a secured operating system. Trusted computer systems are suitable for hosting a firewall and often required in government applications.

3.1.3 Limitation of Firewall

1. The firewall cannot protect against attacks that bypass the firewall. Internal systems may have dial-out capability to connect to an ISP. An internal LAN may support a modem pool that provides dial-in capability for traveling employees and telecommuters.
2. The firewall may not protect fully against internal threats, such as a disgruntled employee or an employee who unwittingly cooperates with an external attacker.
3. An improperly secured wireless LAN may be accessed from outside the organization. An internal firewall that separates portions of an enterprise network cannot guard against wireless communications between local systems on different sides of the internal firewall.
4. A laptop, PDA, or portable storage device may be used and infected outside the corporate network, and then attached and used internally.

3.2 Types of Firewalls

A firewall may act as a packet filter. It can operate as a positive filter, allowing to pass only packets that meet specific criteria, or as a negative

filter, rejecting any packet that meets certain criteria. Depending on the type of firewall, it may examine one or more protocol headers in each packet, the payload of each packet, or the pattern generated by a sequence of packets. In this section, we look at the principal types of firewalls.

3.2.1 Packet Filtering

Firewall A packet filtering firewall applies a set of rules to each incoming and outgoing IP packet and then forwards or discards the packet. The firewall is typically configured to filter packets going in both directions (from and to the internal network). Filtering rules are based on information contained in a network packet:

- **Source IP address**: The IP address of the system that originated the IP packet (e.g., 192.178.1.1)
- **Destination IP address**: The IP address of the system the IP packet is trying to reach (e.g., 192.168.1.2)
- **Source and destination transport-level address**: The transport-level (e.g., TCP or UDP) port number, which defines applications such as SNMP or TELNET
- **IP protocol field**: Defines the transport protocol
- **Interface**: For a firewall with three or more ports, which interface of the firewall the packet came from or which interface of the firewall the packet is destined for

The packet filter is typically set up as a list of rules based on matches to fields in the IP or TCP header. If there is a match to one of the rules, that rule is invoked to determine whether to forward or discard the packet. If there is no match to any rule, then a default action is taken. Two default policies are possible:

- **Default = discard**: That which is not expressly permitted is prohibited.
- **Default = forward**: That which is not expressly prohibited is permitted.

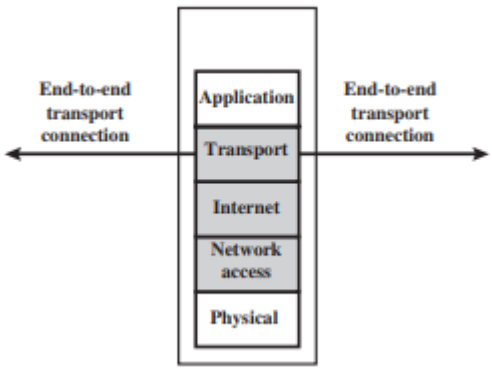

Figure 2.2: Packet filter mechanism

3.2.2 Stateful Inspection Firewalls

A traditional packet filter makes filtering decisions on an individual packet basis and does not take into consideration any higher layer context.

- A simple packet filtering firewall must permit inbound network traffic on all these high-numbered ports for TCP-based traffic to occur. This creates a vulnerability that can be exploited by unauthorized users.
- A stateful inspection packet firewall tightens up the rules for TCP traffic by creating a directory of outbound TCP connections. There is an entry for each currently established connection. The packet filter will now allow incoming traffic to high-numbered ports only for those packets that fit the profile of one of the entries in this directory.
- A stateful packet inspection firewall reviews the same packet information as a packet filtering firewall, but also records information about TCP connections. Some stateful firewalls also keep track of TCP sequence numbers to prevent attacks that depend on the sequence number, such as session hijacking. Some even inspect limited amounts of application data for some well-known protocols like FTP, IM and SIPS commands, in order to identify and track related connections.

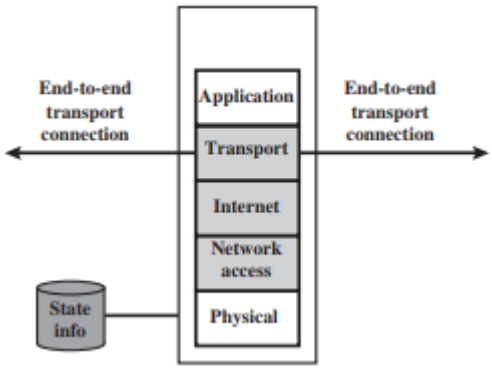

Figure 2.3: Stateful packet inspection

3.2.3 Application-Level Gateway

An application-level gateway, also called an application proxy, acts as a relay of application-level traffic. The user contacts the gateway using a TCP/IP application, such as Telnet or FTP, and the gateway asks the user for the name of the remote host to be accessed. When the user responds and provides a valid user ID and authentication information, the gateway contacts the application on the remote host and relays TCP segments containing the application data between the two endpoints. If the gateway does not implement the proxy code for a specific application, the service is not supported and cannot be forwarded across the firewall. Further, the

gateway can be configured to support only specific features of an application that the network administrator considers acceptable while denying all other features. Application-level gateways tend to be more secure than packet filters. Rather than trying to deal with the numerous possible combinations that are to be allowed and forbidden at the TCP and IP level, the application-level gateway need only scrutinize a few allowable applications. In addition, it is easy to log and audit all incoming traffic at the application level. A prime disadvantage of this type of gateway is the additional processing overhead on each connection. In effect, there are two spliced connections between the end users, with the gateway at the splice point, and the gateway must examine and forward all traffic in both directions.

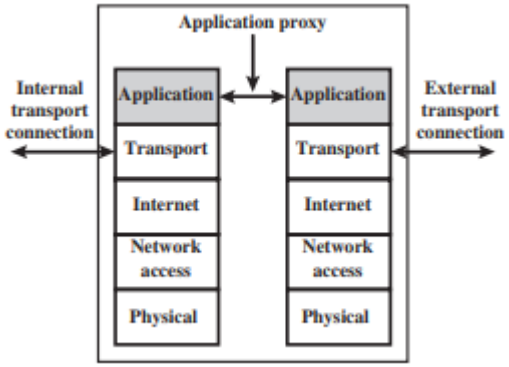

Figure 2.4: Application proxy firewall

3.2.4 Circuit-Level Gateway

A fourth type of firewall is the circuit-level gateway or circuit-level proxy. This can be a stand-alone system or it can be a specialized function performed by an application-level gateway for certain applications. As with an application gateway, a circuit-level gateway does not permit an end-to-end TCP connection; rather, the gateway sets up two TCP connections, one between itself and a TCP user on an inner host and one between itself and a TCP user on an outside host. Once the two connections are established, the gateway typically relays TCP segments from one connection to the other without examining the contents. The security function consists of determining which connections will be allowed.

A typical use of circuit-level gateways is a situation in which the system administrator trusts the internal users. The gateway can be configured to support application-level or proxy service on inbound connections and circuit-level functions for outbound connections. In this configuration, the gateway can incur the processing overhead of examining incoming application data for forbidden functions but does not incur that overhead on outgoing data.

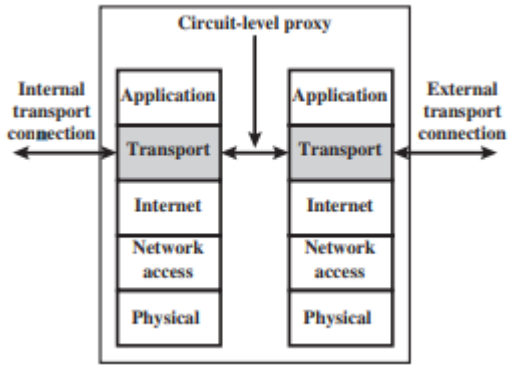

Figure 2.5: Circuit-level proxy

3.4 Cases/Example

An example of a personal firewall is the capability built in to the Mac OS X operating system. When the user enables the personal firewall in Mac OS X, all inbound connections are denied except for those the user explicitly permits. Figure 2.6 shows this simple interface. The list of inbound services that can be selectively reenabled, with their port numbers, includes the following:

- Personal file sharing (548, 427)
- Windows sharing (139)
- Personal Web sharing (80, 427)
- Remote login - SSH (22)
- FTP access (20-21, 1024-64535 from 20-21)
- Remote Apple events (3031)
- Printer sharing (631, 515)
- IChat Rendezvous (5297, 5298)
- ITunes Music Sharing (3869)
- CVS (2401)

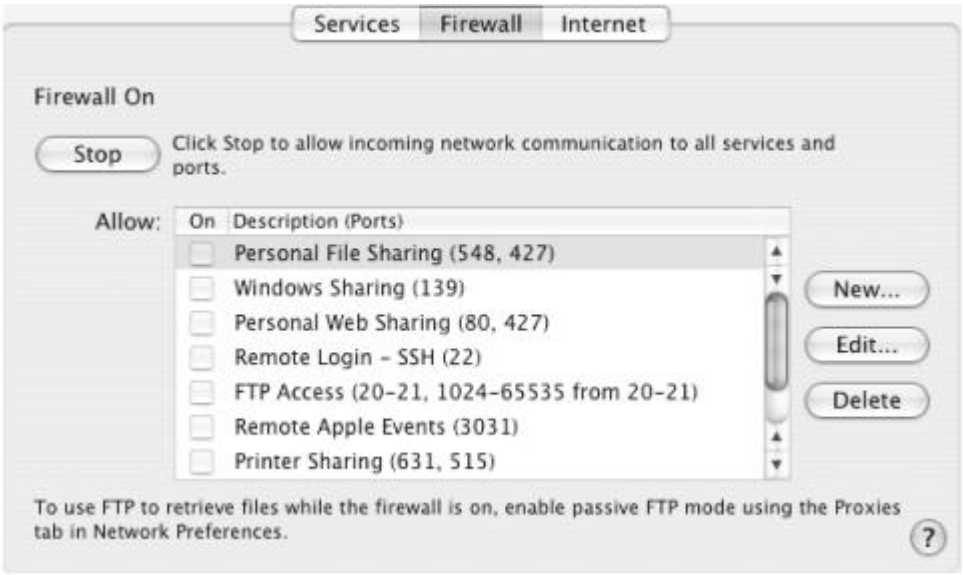

Figure 2.6: Example of Personal firewall interface on MAC

When FTP access is enabled, ports 20 and 21 on the local machine are opened for FTP; if others connect to this computer from ports 20 or 21, the ports 1024 through 64535 are open. For increased protection, advanced firewall features are available through easy-to-configure checkboxes. Stealth mode hides the Mac on the Internet by dropping unsolicited communication packets, making it appear as though no Mac is present. UDP packets can be blocked, restricting network traffic to TCP packets only for open ports. The firewall also supports logging, an important tool for checking on unwanted activity

Discussion

What is the difference in the operation of firewalls at Application security and internet security?

4.0 SELF-ASSESSMENT/EXERCISES

1. Briefly describe a Personal Firewall

Answer

A personal firewall controls the traffic between a personal computer or workstation on one side and the Internet or enterprise network on the other side. Personal firewall functionality can be used in the home environment and on corporate intranets. Typically, the personal firewall is a software module on the personal computer. In a home environment with multiple computers connected to the Internet, firewall functionality can also be housed in a router that connects all of the home computers to a DSL, cable modem, or other Internet interface.

2. What are the benefits of host-based firewall?

Answer
A host-based firewall is a software module used to secure an individual host. Such modules are available in many operating systems or can be provided as an add-on package. Like conventional stand-alone firewalls, host-resident firewalls filter and restrict the flow of packets. A common location for such firewalls is a server.

There are several benefits to the use of a server-based or workstation-based firewall:

- Filtering rules can be tailored to the host environment. Specific corporate security policies for servers can be implemented, with different filters for servers used for different application.
- Protection is provided independent of topology. Thus, both internal and external attacks must pass through the firewall.

- Used in conjunction with stand-alone firewalls, the host-based firewall provides an additional layer of protection.

A new type of server can be added to the network, with its own firewall, without the necessity of altering the network firewall configuration.

5.0 CONCLUSION

Businesses need to make sure that there are no gaps in their information security processes, and this is very important. There are both threats inside and outside of your business. You need to make sure you can see them all, both inside and outside your business. Using a firewall is one way to deal with threats. A firewalled system looks at network traffic according to a set of rules. It only welcomes connections that it has been set up to accept. You send data packets, which are units of communication that you send over digital networks, to be allowed or blocked based on rules that have been set up in the past.

6.0 SUMMARY

Firewall is a network device that filter and monitor traffic. It protects not just itself from penetration but also incoming and outgoing traffics. Internal attacks or attacks that does not pass through the firewall cannot be prevented by the firewall. Types of firewalls are Packet Filtering, Stateful Inspection Firewalls, Application-Level Gateway, and Circuit-Level Gateway.

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UNIT 2 VIRTUAL PRIVATE NETWORKS

CONTENTS

1.0 INTRODUCTION

VPNs date back to 1996, when Microsoft engineers developed the point-to-point tunneling protocol, sometimes known as peer-to-peer tunneling protocol or PPTN. This protocol was a way of encrypting data and building a tunnel through a LAN or WAN connection to create a secure network between users. The large number of terms used to categorize and describe the functionality of Virtual Private Networks has led to a great deal of confusion about what exactly VPNs are and what they can do. The unit covers VPN devices, protocols, technologies, as well as VPN categories and models.

2.0 INTENDED LEARNING OUTCOMES (ILOS)

At the end of this unit, students will able to:

- understand the basic concepts of VPNs
- Set up a simple VPN for small enterprises

3.0 MAIN CONTENT

3.1 What is Virtual Private Network?

VPN meaning that a private point-to-point connection between two machines or networks over a shared or public network such as the internet. A Virtual Private Network is a combination of software and hardware. VPN (Virtual Private Network) technology, can be used in organization to extend its safe encrypted connection over less secure internet to connect remote users, branch offices, and partner private, internal network. VPN turn the Internet into a simulated private WAN. It uses "virtual" connections routed through the internet from a business's private network to the remote site. A Virtual Private Network is a technology which creates a network, and that network is virtually private. The letter V in VPN stands for "virtual" means that it shares physical circuits with other traffic and it has no corresponding physical network. A VPN client uses TCP/IP protocol, that is called tunneling protocols, to make a virtual call to VPN server.

Employees in a branch office, for example, might access to the main office's internal network through a VPN. A remote worker working from home, on the other hand, may need to connect to their company's internet or restricted programs.

3.1.1 Uses of Virtual Private Networks

VPNs are fairly simple tools, but they can be used to do a wide network access activities:

- Access a business network while traveling
- Access your Home Network while travelling
- Hide your browsing activity from your Local Network and ISP
- Access Geo-Blocked Websites
- Bypass Internet Censorship

3.1.2 Advantages of VPNs

- Security: The VPN should protect data while it's travelling on the public network. If intruders attempt to capture data, they should be unable to read or use it.
- Cost Savings: Its operational cost is less as it transfers the support burden to the service providers.
- It reduces the long-distance telephone charges.
- It cut technical support.
- It eliminates the need for expensive private or leased lines.
- Its management is straightforward.

- Scalability: growth is the flexible, i.e., we can easily add new locations to the VPN.
- It is efficient with broadband technology.
- By using VPN, the equipment cost is also reduced

3.1.3 Disadvantages of VPNs

- For VPN network to establish, we require an in-depth understanding of the public network security issues.
- VPNs need to accommodate complicated protocols other than IP.
- There is a shortage of standardization. The product from different vendors may or may not work well together.
- The reliability and performance of an Internet-based private network depend on uncontrollable external factors, which is not under an organization's direct control.

3.2 Types of Virtual Private Network

VPN is of three kinds:

3.2.1 Remote access VPN (Virtual Private Network)

The VPN which allows individual users to establish secure connections with a remote computer network is known as remote-access VPN. There is a requirement of two components in a remote-access VPN which are as follows:

i. Network Access Server (NAS)
ii. Client software.

It enables the remote connectivity using any internet access technology. Here, the remote user launches the VPN client to create a VPN tunnel.

3.2.2 Intranet VPN (Virtual Private Network)

If a company has one or more remote locations and the company wants to join those locations into a single private network, then that company can create an intranet VPN so that they can connect LAN of one site to another one. Intranet VPN can link corporate headquarters, remote offices and branch offices over a shared infrastructure using dedicated connections. If we use intranet VPN, then it reduces the WAN bandwidth costs. The user can also connect new sites easily by using this network.

3.2.3 Extranet VPN (Virtual Private Network)

If a company has the close relationship with the other company (that company can be their customer, supplier, branch and another partner

company), then those companies can build an extranet VPN so that they can connect LAN of one company to the other. It allows all of the companies to work in a shared environment.

3.3 VPN Technologies and Protocols

There are three network protocols are used within VPN tunnels.

1. Internet Protocol Security (IPSec)

We can make use of this protocol for encryption. It is used as a protocol suite. It is used as a "protocol suite for securing Internet Protocol (IP) communications by authenticating and encrypting each packet of IP of a data stream." It requires expensive, time-consuming client installations, which is its most significant disadvantage.

2. Point-to-Point Tunneling Protocol (PPTP)

Generally, it is the most widely used VPN protocol among windows users. It was created by Microsoft in association with the other technology companies. The most significant disadvantage of PPTP is that it does not provide encryption. It relies on PPP (Point-to-Point Protocol). It is implemented for the security measures. It is also available for Linux and Mac users. As compared to other methods, PPTP is faster.

3. Layer 2 Tunneling Protocol (L2TP)

It is another tunneling protocol which supports VPN. L2TP is created by Microsoft and Cisco as a combination between PPTP and L2F (Layer 2 Forwarding). L2TP also does not provide encryption as like as PPTP. The main difference between both of them is that L2TP delivers data confidentiality and data integrity.

Secure Socket Layer (SSL): It is a VPN accessible via https over a web browser. Its most significant advantage is that it doesn't need any software installed because it uses the web browser as the client application. With the help of SSL VPN, the user's access can be restricted to specific claims instead of allowing access to the whole network.

3.4. Working of VPN

When you connect your computer (or another device, such as a smartphone or tablet) to a VPN, the computer acts as if it's on the same local network as the VPN. All your network traffic is sent over a secure connection to the VPN. Because your computer behaves as if it's on the network, this allows you to securely access local network resources even when you're on the other side of the world. You'll also be able to use the Internet as if you were present at the VPN's location, which has some benefits if you're using pubic Wi-Fi or want to access geo-blocked

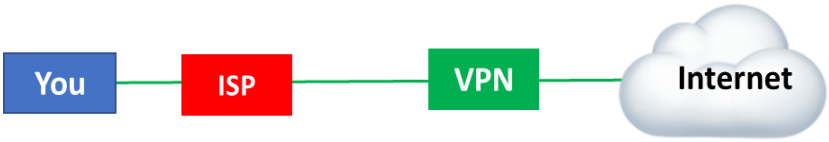
websites. When you browse the web while connected to a VPN, your computer contacts the website through the encrypted VPN connection. The VPN forwards the request for you and forwards the response from the website back through the secure connection.

If you're using a USA-based VPN to access Netflix, Netflix will see your connection as coming from within the USA.

3.5 How to Setup a VPN

There are following two ways to create a VPN connection:
By dialing an Internet service provider (ISP)

If you dial-in to an ISP, your ISP then makes another call to the private network's remote access server to establish the PPTP or L2TP tunnel After authentication, you can access the private network.



By connecting directly to the Internet
If you are already connected to an Internet, on a local area network, a cable modem, or a digital subscriber line (DSL), you can make a tunnel through the Internet and connects directly to the remote access server. After authentication, you can access the corporate network.

3.6 Cases/Example

Suppose there is a company which has two locations, one in Noida and other in Pune. For both places to communicate efficiently, the company has the choice to set up private lines between the two locations. Although private lines would restrict public access and extend the use of their bandwidth, it will cost the company a great deal of money since they would have to purchase the communication lines per mile. So, the more viable option is to implement a VPN. The company can hook their communication lines with a local ISP in both cities. Thus, the ISP would act as a middleman, connecting the two locations. This would create an affordable small area network for the company.

Discussion

How are Privacy, security and Encryption ensured using VPN

4.0 SELF-ASSESSMENT/EXERCISES

What are the equipment used for VPN implementation?
Answer

Equipment having the VPN function includes routers and firewalls. Basically, communication is made via VPN equipment. Information is encrypted by the transmission VPN equipment before transmission and decoded by the receiving VPN equipment after receipt of information. The key for encrypt the data is set in VPN equipment in advance. The VPN equipment at receiving side decodes encrypted data before sending it to the receiving computer.

What are the key Features of a Typical VPN solution?

When the remote offices connect each other to share vital resources and secret information, the VPN solution must ensure the privacy and integrity of the data as it traverses the Internet. Therefore, a VPN solution must provide at least all of the following:

a. **Keep data confidential** (**encryption**) - Data carried on the public network must be rendered unreadable to unauthorized clients on the network.

b. **Ensure the identities of two parties communicating** (**authentication**)

The solution must verify the user's identity and restrict VPN access to authorized users only. It must also provide audit and accounting records to show who accessed what information and when.

- Safeguard the identities of communicating parties (tunneling)
- Guard against packets being sent over and over (replay prevention)
- Ensure data is accurate and in its original form (non-repudiation)

c. **Address Management.** The solution must assign a client's address on the private net and ensure that private addresses are kept private.

d. **Key Management.** The solution must generate and refresh encryption keys for the client and the server.

e. Multiprotocol Support. The solution must handle common protocols used in the public network. These include IP, Internet Packet Exchange (IPX), and so on.

An Internet VPN solution based on the Point-to-Point Tunneling Protocol (PPTP) or Layer 2 Tunneling Protocol (L2TP) meets all of these basic requirements and takes advantage of the broad availability of the Internet. Other solutions, including the new IP Security Protocol (IPSec), meet only some of these requirements, but remain useful for specific situations.

5.0 CONCLUSION

Virtual private network extends a private network across public networks. VPN allows users working at home or office to connect in a secure fashion to a remote corporate server using the routing infrastructure provided by a public inter-network (such as the Internet). The nature of the intermediate inter-network is irrelevant to the user because it appears as if the data is being sent over a dedicated private link.

6.0 SUMMARY

A virtual private network (VPN) allows the provisioning of private network services for an organization or organizations over a public or shared infrastructure such as the Internet Service Provider (ISP) backbone network. The shared service provider backbone network is known as the VPN backbone and is used to transport traffic for multiple VPNs, as well as possibly non-VPN traffic.

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UNIT 3 SECURITY CONTROL MANAGEMENT

CONTENTS

1.0 INTRODUCTION

As long as you are carrying an access card or ID badge, it means that your office uses an access system Control, which is always aims at ensuring that users' privileges are used as expected. How does it really work? It's difficult since most people have never seen an access system. Most people believe it is just a card reader on the wall. Of course there is a little bit more to it in reality. It's not very difficult though, there are just a few parts behind the scenes that make the magic of easily unlocking a door every time.

This unit will give you a full and comprehensive understanding how access control systems, how it work, control list and AAA framework.

2.0 Intended Learning Outcomes (ILOs)

At the end of this unit, students will able to:

- Understand the concept of access control Management
- Manage access control

3.0 MAIN CONTENT

3.1 Access Control

In a computer context, access control is a security approach that restricts who or what may see or utilize resources. It is a basic security concept that reduces the risk to the company or organization. Physical and logical access control are the two forms of access control. Access to campuses, buildings, rooms, and physical IT assets is restricted via physical access control. Connections to computer networks, system files, and data are all restricted by logical access control. Organizations utilize electronic access control systems to monitor employee access to restricted company locations and private regions, such as data centers, using user credentials, access card readers, audits, and reporting. To prevent unwanted access or activities, some of these systems have access control panels that limit admittance to rooms and buildings, as well as alarms and lockdown capabilities.

By analyzing needed login credentials, such as passwords, personal identification numbers (PINs), biometric scans, security tokens, or other authentication elements, access control systems conduct identification, authentication, and authorisation of individuals and entities. Multifactor authentication (MFA), which needs two or more authentication factors, is often used to defend access control systems as part of a layered defense.

3.1.1 Why is access control important?

3.1.2 How access control works

3.2 Types of Access control

Access control can be split into two groups designed to improve physical security or cybersecurity:

- **Physical access control**: limits access to campuses, building and other physical assets, e.g., a proximity card to unlock a door.
- **Logical access control**: limits access to computers, networks, files and other sensitive data, e.g., a username and password.

Access control Models
The main models of access control are:

- **Attribute-based Access Control (ABAC):** In this model, access is granted or declined by evaluating a set of rules, policies, and relationships using the attributes of users, systems and environmental conditions.

- **Discretionary Access Control (DAC)**: In DAC, the owner of data determines who can access specific resources.
- **History-Based Access Control (HBAC)**: Access is granted or declined by evaluating the history of activities of the inquiring party that includes behavior, the time between requests and content of requests.
- **Identity-Based Access Control (IBAC)**: By using this model network administrators can more effectively manage activity and access based on individual requirements.
- **Mandatory Access Control (MAC)**: A control model in which access rights are regulated by a central authority based on multiple levels of security. Security Enhanced Linux is implemented using MAC on the Linux operating system.
- **Organization-Based Access control (OrBAC)**: This model allows the policy designer to define a security policy independently of the implementation.
- **Role-Based Access Control (RBAC)**: RBAC allows access based on the job title. RBAC eliminates discretion on a large scale when providing access to objects. For example, there should not be permissions for human resources specialist to create network accounts.
- **Rule-Based Access Control (RAC)**: RAC method is largely context based. Example of this would be only allowing students to use the labs during a certain time of day.

3.3 Access control Lists

Another way of simplifying access rights management is to store the access control matrix a column at a time, along with the resource to which the column refers. This is called an access control list, or ACL. ACLs have a number of advantages and disadvantages as a means of managing security state. These can be divided into general properties of ACLs and specific properties of particular implementations. ACLs are widely used in environments where users manage their own file security, such as the Unix systems common in universities and science labs. Where access control policy is set centrally, they are suited to environments where protection is data oriented; they are less suited where the user population is large and constantly changing, or where users want to be able to delegate their authority to run a particular program to another user for some set period of time. ACLs are simple to implement, but are not efficient as a means of doing security checking at runtime, as the typical operating system knows which user is running a particular program, rather than which files it has been authorized to access since it was invoked. The operating system must either check the ACL at each file access or keep track of the active access rights in some other way.

Finally, distributing the access rules into ACLs can make it tedious to find all the files to which a user has access. Revoking the access of an employee who has just been fired, for example, will usually have to be done by cancelling their password or other authentication mechanism. It may also be tedious to run systemwide checks, such as verifying that no files have been left world-writable. This could involve checking ACLs on millions of user files.

3.3.1 Access control Groups

Access control groups (ACGs) are groupings of access privileges for objects (catalogs, hierarchies, collaboration areas, and import jobs) that are treated at the same level in the Collaboration Server system. ACG is defined on a group of objects to which you can assign a level of access based on a role. For example, an ACG can be defined on one catalog, one hierarchy, and two collaboration areas. You can assign and edit privileges to this group of objects to users in Role A and view privileges to users in Role B.

3.3.2 Access control roles

Access control roles (ACRs) are set of privileges that are defined following organization defined policies. These roles assigned to different users based on their access rights according to their job role in the organization.

Some people use the words group and role interchangeably, and with many systems they are; but the more careful definition is that a group is a list of principals, while a role is a fixed set of access permissions that one or more principals may assume for a period of time using some defined procedure.

3.4 AAA Framework

AAA is a standard-based framework used to control who is permitted to use network resources (through **Authentication**), what they are authorized to do (through **Authorization**), and capture the actions performed while accessing the network (through **Accounting**).

The administrator can take access to a router or a device through a console but it is very inconvenient if he is sitting far from the place of that device. So, eventually, he has to take remote access to that device. But as remote access will be available by using an IP address, therefore, it is possible that an unauthorized user can take access using that same IP address therefore for security measures, we have to put authentication. Also, the packets exchanged between the device should

be encrypted so that any other person should not be able to capture that sensitive information. Therefore, a framework called **A**uthentication, **A**uthorization and **A**ccounting shorthand **AAA** is used to provide that extra level of security.

3.4.1 Authentication

The process by which it can be identified that the user, which wants to access the network resources, is valid or not by asking some credentials such as username and password.

As network administrators, we can control how a user is authenticated if someone wants to access the network.

3.4.2 Authorization

It provides capabilities to enforce policies on network resources after the user has gained access to the network resources through authentication. After the authentication is successful, authorization can be used to determine what resources is the user allowed to access and the operations that can be performed.

3.4.3 Accounting

It provides means of monitoring and capturing the events done by the user while accessing the network resources. It even monitors how long the user has access to the network. The administrator can create an accounting method list to specify what should be accounted for and to whom the accounting records should be sent.

3.5 Cases/Example

An administrator can take access to a router or a device through a console but it is very inconvenient if he is sitting far from the place of that device. So, eventually, he has to take remote access to that device. But as remote access will be available by using an IP address, therefore, it is possible that an unauthorized user can take access using that same IP address therefore for security measures, we have to put authentication. Also, the packets exchanged between the device should be encrypted so that any other person should not be able to capture that sensitive information.

Discussion

Discuss all possible policies attached to accessing resources in your school

4.0 SELF-ASSESSMENT/EXERCISES

1. Who is a system administrator?

Answer
The SysAdmin, or Systems Administrator, is the person responsible for configuring and managing a company's entire infrastructure, including all of the hardware, software, and operating systems that are necessary to support the running of the business.
The sysadmin is responsible for Configuring and managing company infrastructure, managing user access and permissions to all systems and data, perform daily security backups and restored, manage all monitoring and alerting throughout company applications and infrastructure; solve and troubleshoot problems.

2. What happens to organizations that does not have access control implementation?

Answer
Everyone in the organization, no matter what their title, would have access to all the company's information on all of their systems and applications. Employees would be able to make changes to secure data, such as the payroll and customer information. The scary part is that many organizations often have minimal access management structures in place or they believe they are managing their access rights correctly, when they may actually not be. Without proper access management, security risks are high, and it is easy lose track of who has access to what, easily leading to a security breach.

5.0 CONCLUSION

It is important also for an enterprise to develop the security system that secure the information system against external threats. Very important stage of data protection building in information system is the creation of high-level model, independent from the software, satisfying the needs of protection and security of a system. Security policies of information systems determine that it is necessary to define for each user a set of operations that it could be perform. Due to it the set of permissions should be defined for each system's user. It suffices to determine the permissions for execution of particular methods on each object accessible for that user. There exists the need to create the tool, designated mainly for security administrator who could manage one of the security aspects of information systems, namely the control of users' access to data stored in a system.

6.0 SUMMARY

One of the basic concepts of protection models is access control. The purpose of access control to data in information system is a limitation of actions or operations that the system's users can execute. The access control based on role concept represents interesting alternative in relation to traditional systems of DAC (Discretionary Access Control) type or MAC (Mandatory Access Control) type. RBAC (Role-Based Access Control) model based on a role concept defines the user's access to information basing on activities that the user can perform in a system. (Messaoud, n.d.)

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UNIT 4 HARDWARE AND SOFTWARE PROTECTION

CONTENTS

1.0 INTRODUCTION

Hardware security is vulnerability prevention provided by a physical device rather than software implemented on the computer system's hardware. Hardware solutions may offer a higher level of security than software alone and can also serve as an extra layer of protection for critical systems. Software protection refers to the safeguarding of data stored on hardware and accessed by a computer system in order to execute operations. The term "software protection" refers to the safeguarding of algorithms, computer codes, and graphical user interfaces. It employs many tools, each of which safeguards a different part of a program.
This unit will address measures on hardware and software based to prevent potential attack or damage of organization data.

2.0 INTENDED LEARNING OUTCOMES (ILOS)

At the end of this unit, students will able to:

- Improve their data privacy through hardware protection
- Protect their selves from software and internet attacks

3.0 MAIN CONTENT

3.1 Hardware Protection

Hardware security may refer to a device that performs system scans or monitors network traffic. Hardware firewalls and proxy servers are both common instances. To evaluate a hardware device's security, it's vital to examine vulnerabilities inherent in the device's production as well as other possible sources, such as running code and the device's data I/O through a network.

3.1.1 CPU Protection

CPU protection defends the CPU of the node on which it is installed against a DOS attack by restricting the amount of traffic flowing in from one of its ports and intended to be processed by its CPU using a combination of configurable restrictions.

3.1.2 Memory Protection

In memory protection, we are talking about situations where two or more processes are in memory and one process may access the other process memory and to protecting this situation we are using two registers as:

1. Bare register
2. Limit register

Base register store the starting address of program and limit register store the size of the process, so when a process wants to access the computer memory then it is checked that it can access or cannot access the memory.

3.1.3 I/O Protection

A user process could interrupt regular functioning of the system by issuing the unlawful I/O instructions, by accessing memory locations and addresses inside the operating system itself, or by refusing to yield CPU. We may use of numerous measures to guarantee that such interruptions should not take place in the system. To ensure I/O protection, some cases will never have occurred in the system as:

1. Termination I/O of other process
2. View I/O of other process
3. Giving priority to a particular process I/O If an application process wants to access any I/O device then it will be done through system call so that OS will monitor the task. Like In C language write () and read () is a system call to read and write on file.

There are two modes in instruction execute:

- **User mode** - The system performs a task on behalf of user application this instruction. In this mode, the user cannot directly access hardware and reference memory.
- **Kernel mode** - Whenever a direct access to hardware is required a system call is used by the application program. We know that when an application process wants to access any I/O device it should be done through system call so that the Operating system will monitor the task.

3.2 Software and OS protection

Operating system (OS) security is the process of ensuring OS integrity, confidentiality and availability. It refers to specified steps or measures used to protect the OS from threats, viruses, worms, malware or remote hacker intrusions. Security refers to providing a protection system to computer system resources such as CPU, memory, disk, software programs and most importantly data/information stored in the computer system. If a computer program is run by an unauthorized user, then he/she may cause severe damage to computer or data stored in it. A computer system must be protected against unauthorized access, malicious access to system memory, viruses, worms etc. OS security encompasses all preventive-control techniques, which safeguard any computer assets capable of being stolen, edited or deleted if OS security is compromised. OS security may be approached in many ways, including adherence to the following:

- Performing regular OS patch updates
- Installing updated antivirus engines and software
- Scrutinizing all incoming and outgoing network traffic through a firewall
- Creating secure accounts with required privileges only (i.e., user management)

3.2.1 Authentication

Authentication refers to identifying each user of the system and associating the executing programs with those users. It is the responsibility of the Operating System to create a protection system which ensures that a user who is running a particular program is authentic. Operating Systems generally identifies/authenticates users using following three ways –

- **Username / Password** − User need to enter a registered username and password with Operating system to login into the system.
- **User card/key** − User need to punch card in card slot, or enter key generated by key generator in option provided by operating system to login into the system.

- **User attribute** - fingerprint/ eye retina pattern/ signature − User need to pass his/her attribute via designated input device used by operating system to login into the system.

3.2.2 One Time Password (OTP)

One Time passwords - One-time passwords provide additional security along with normal authentication. In One-Time Password system, a unique password is required every time user tries to login into the system. OTP is implemented in various ways, but it cannot be used again once it is used.

- **Random numbers** − Users are provided cards having numbers printed along with corresponding alphabets. System asks for numbers corresponding to few alphabets randomly chosen.
- **Secret key** − User are provided a hardware device which can create a secret id mapped with user id. System asks for such secret id which is to be generated every time prior to login.
- **Network password** − Some commercial applications send one-time passwords to user on registered mobile/ email which is required to be entered prior to login.

3.2.3 Program Threat

Operating system's processes and kernel do the designated task as instructed. If a user program induces a malicious tasks, then it is known as Program Threats. One of the common examples of program threat is a program installed in a computer which can store and send user credentials via network to some hacker. e.g. Trojan Horse, trap door, logic bomb, virus, etc

3.2.4 System Threat

System threats refers to misuse of system services and network connections to put user in trouble. System threats can be used to launch program threats on a complete network called as program attack. System threats creates such an environment that operating system resources/ user files are misused. e.g. worm, port scanning, DoS, etc.

3.3 Cases/Examples

Software patching such as updating Operating system, obsolete applications are good practice of software prevention. To update your Windows 7, 8, 8.1, and 10 Operating System, the following steps are advice:

1. Open Windows Update by clicking the **Start** button in the lower-left corner. In the search box, type **Update**, and then, in the list of results, click either **Windows Update** or **Check for updates**
2. Click the **Check for updates** button and then wait while Windows looks for the latest updates for your computer
3. If you see a message telling you that important updates are available, or telling you to review important updates, click the message to view and select the important updates to download or install
4. In the list, click the important updates for more information. Select the checkboxes for any updates that you want to install, and then click **OK**
5. Click **Install updates**

Note: It is very important that you don't shut down your computer or let it run out of battery while the update is taking place. Doing so can cause the operating system to become corrupted, which can only be fixed by resetting the computer.

Discussion
Is it possible to implement One Time Password on system logon security?

5.0 CONCLUSION

Securing organization's valuable assets does not end at the network level. The hardware storing the assets and the software use the generate operational data also need to be protected. This is actually done at the end-user level following sets of policies and routine guidelines. This is because not all attacks come from network. Some of the attackers may use social engineering technique to study the target user hereby gaining access to the user hardware devices. Gaining access to the hardware, the software if not properly secured will therefore be easily intrude. It is therefore very important for organizations to train and monitor their staffs' activeness to end-user devices.

6.0 SUMMARY

Hardware protection is provided at different level of hardware units. I/O protection prevent issuing wrong I/O operation to avoid program crash or system response time. CPU protection and Memory protection are other hardware protection units. Software protection poised at improving the integrity, availability and confidentiality of software and operational information. Authorization, One Time Password are two major protection main of software. System and Program threat analysis are used to detect any potential loopholes in a software.

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MODULE 3: COMPUTER FORENSICS AND DIGITAL INVESTIGATION

UNIT 1 COMPUTER FORENSICS

CONTENTS

1.0 INTRODUCTION

Computer Forensics is a scientific method of investigation and analysis in order to gather evidence from the digital devices or computer networks and components which is suitable for presentation in a court of law or legal body. It involves performing a structured investigation while maintaining a documented chain of evidence to find out exactly what happened on a computer and who was responsible for it. Crimes committed within electronic or digital domains, particularly within cyberspace, have become extremely common these days. Criminals are using technology to a great extent in committing various digital offences and creating new challenges for law enforcement agents, attorneys, judges, military, and security professionals. Digital forensics has become an incredibly useful and invaluable tool in the detection of criminal activities, identifying and solving computer-based and computer-assisted crimes.

Introduction of Module
Digital devices such as cell phones, tablets, gaming consoles, laptop and desktop computers have become indispensable part of the modern society. With the proliferation of these devices in our everyday lives, there is the

tendency to use information derived from them for criminal activities. Crimes such as fraud, drug trafficking, homicide, hacking, forgery, and terrorism often involve computers. To fight computer crimes, digital forensics (DF) originated in law enforcement, computer security, and national defense. Law enforcement agencies, financial institutions, and investment firms are incorporating digital forensics into their infrastructure. Digital forensics is used to help investigate cybercrime or identify direct evidence of a computer-assisted crime. The concept of digital forensics is dated back to late 1990s and early 2000s when it was considered as computer forensics. The legal profession, law enforcement, policy makers, the business community, education, and government all have a vested interesting DF. Digital forensics is often used in both criminal law and private investigation. It has been traditionally associated with criminal law. It requires rigorous standards to stand up to cross examination in court

This module consists of the following four units:
Unit 1: Computer Forensics
Unit 2: Network, Disk, Malware and Database Forensics
Unit 3: Email, Memory and Mobile Forensics
Unit 4: Malware & Malware Analysis

2.0 INTENDED LEARNING OUTCOMES (ILOS)

By the end of this unit, you will be able to:

- Understand the concept of computer forensics
- Appreciate the characteristics of digital forensics and procedure
- Compare the advantages and disadvantages of computer forensics

3.0 MAIN CONTENT

3.1 Computer Forensics History

It is difficult to pinpoint when computer forensics history began. Most experts agree that the field of computer forensics began to evolve more than 30 years ago. The field began in the United States, in large part, when law enforcement and military investigators started seeing criminals get technical. Government personnel charged with protecting important, confidential, and certainly secret information conducted forensic examinations in response to potential security breaches to not only investigate the particular breach, but to learn how to prevent future potential breaches. Ultimately, the fields of information security, which focuses on protecting information and assets, and computer forensics, which focuses on the response to hi-tech offenses, started to intertwine.

Over the next decades, and up to today, the field has exploded. Law enforcement and the military continue to have a large presence in the information security and computer forensic field at the local, state, and federal level. Private organizations and corporations have followed suit – employing internal information security and computer forensic professionals or contracting such professionals or firms on an as-needed basis. Significantly, the private legal industry has more recently seen the need for computer forensic examinations in civil legal disputes, causing an explosion in the e-discovery field. The computer forensic field continues to grow on a daily basis. More and more large forensic firms, boutique firms, and private investigators are gaining knowledge and experience in the field. Software companies continue to produce newer and more robust forensic software programs. And law enforcement and the military continue to identify and train more and more of their personnel in the response to crimes involving technology.

3.2 Definition of Computer Forensics

Computer or Cyber Forensics refers to the analysis of information in the computer systems, with the objective of finding any digital evidence that can be used for legal proceedings, but also to discover the cause of an incident. Computer forensics is the process of extracting data and information from computer systems to function as digital evidence for civic purposes, or in most cases to prove and legally impeach cybercrime. The purpose of computer forensics is to provide forensic practices, legal processes, and ethical principles to assure reliable and detailed digital evidence that can be used for the courtroom needs. The objective of computer forensics is to guarantee a well-structured investigation and a follow-up of processes in order to resolve incidents and malfunctions in an organization.

3.2.1 Objectives of computer forensics

- It helps to recover, analyze, and preserve computer and related materials in such a manner that it helps the investigation agency to present them as evidence in a court of law.
- It helps to postulate the motive behind the crime and identity of the main culprit.
- Designing procedures at a suspected crime scene which helps you to ensure that the digital evidence obtained is not corrupted.
- Data acquisition and duplication: Recovering deleted files and deleted partitions from digital media to extract the evidence and validate them.
- Helps you to identify the evidence quickly, and also allows you to estimate the potential impact of the malicious activity on the victim

- Producing a computer forensic report which offers a complete report on the investigation process.
- Preserving the evidence by following the chain of custody.

3.2.2 Characteristics of Digital Forensics

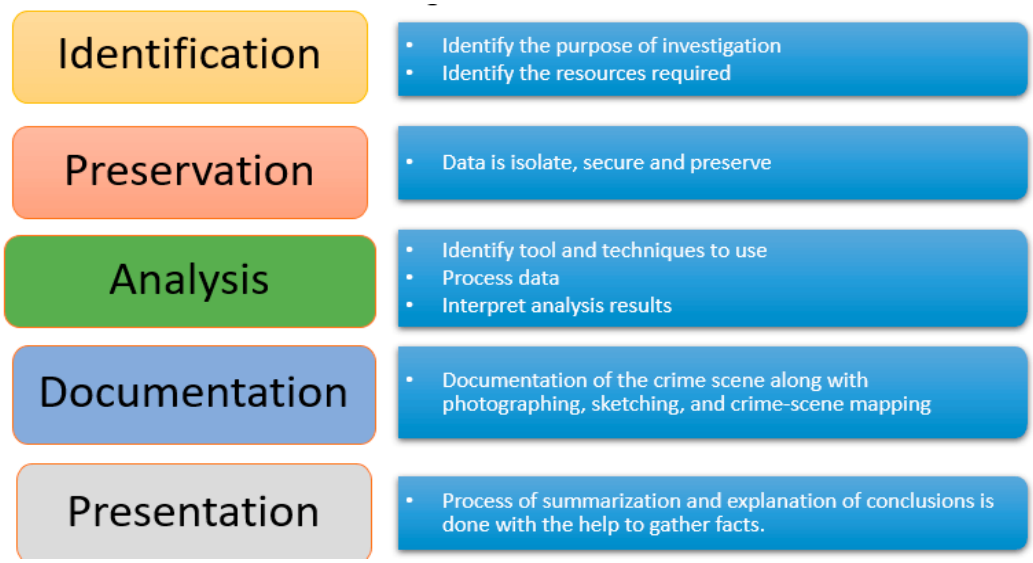
- Identification: Identifying what evidence is present, where it is stored, how it is stored (in which format). Electronic devices can be personal computers, Mobile phones, PDAs, etc.
- Preservation: Data is isolated, secured, and preserved. It includes prohibiting unauthorized personnel from using the digital device so that digital evidence, mistakenly or purposely, is not tampered with and making a copy of the original evidence.
- Analysis: Forensic lab personnel reconstruct fragment of data and draw conclusions based on evidence.
- Documentation: A record of all the visible data is created. It helps in recreating and reviewing the crime scene. All the findings from the investigations are documented.
- Presentation: All the documented findings are produced in a court of law for further investigations.

3.2.3 **Digital Forensics** Procedure

Digital forensics entails the following steps

- Identification
- Preservation
- Analysis
- Documentation
- Presentation

The procedure starts with identifying the devices used and collecting the preliminary evidence on the crime scene. Then the court warrant is obtained for the seizures of the evidences which leads to the seizure of the evidences. The evidences are then transported to the **forensics lab** for further investigations and the procedure of transportation of the evidence from the crime scene to labs are called chain of custody. The evidences are then copied for analysis and the original evidence is kept safe because analysis are always done on the copied evidence and not the original evidences. The analysis is then done on the copied evidence for suspicious activities and accordingly the findings are documented in a non-technical tone. The documented findings are then presented in the court of law for further investigations. The figure below illustrate the step by step procedures



3.2.4 Advantages of Computer Forensics

- To produce evidence in the court, which can lead to the punishment of the culprit.
- It helps the companies gather important information on their computer systems or networks potentially being compromised.
- Efficiently tracks down cyber criminals from anywhere in the world.
- Helps to protect the organization's money and valuable time.
- Allows to extract, process, and interpret the factual evidence, so it proves the cybercriminal action's in the court.

3.2.5 Disadvantages of Computer Forensics

- Before the digital evidence is accepted into court it must be proved that it is not tampered with.
- Producing and keeping the electronic records safe are expensive.
- Legal practitioners must have extensive computer knowledge.
- Need to produce authentic and convincing evidence.
- If the tool used for digital forensic is not according to specified standards, then in the court of law, the evidence can be disapproved by justice.
- Lack of technical knowledge by the investigating officer might not offer the desired result.

3.2.6 Limitation of Digital forensic investigation

Digital forensic investigation offers certain limitations listed below:

- Need to produce convincing evidences

One of the major setbacks of digital forensics investigation is that the examiner must have to comply with standards that are required for the evidence in the court of law, as the data can be easily tampered. On the other hand, computer forensic investigator must have complete knowledge of legal requirements, evidence handling and documentation procedures to present convincing evidences in the court of law.

- Lack of technical knowledge among the audience

Another limitation is that some individuals are not completely familiar with computer forensics; therefore, many people do not understand this field. Investigators have to be sure to communicate their findings with the courts in such a way to help everyone understand the results.

- Cost

Producing digital evidences and preserving them is very costly. Hence this process may not be chosen by many people who cannot afford the cost.

3.2.7 Applications of Digital Forensics

Digital forensics deals with gathering, analyzing and preserving the evidences that are contained in any digital device. The use of digital forensics depends on the application. it is used mainly in the following two applications

- **Criminal Law**

In criminal law, the evidence is collected to support or oppose a hypothesis in the court. Forensics procedures are very much similar to those used in criminal investigations but with different legal requirements and limitations.

- **Private Investigation**

Mainly corporate world uses digital forensics for private investigation. It is used when companies are suspicious that employees may be performing an illegal activity on their computers that is against company policy. Digital forensics provides one of the best routes for company or person to take when investigating someone for digital misconduct.

3.3 Digital forensics Application

In recent time, commercial organizations have used digital forensics in following a type of cases

- Intellectual Property theft
- Industrial espionage
- Employment disputes
- Fraud investigations
- Inappropriate use of the Internet and email in the workplace
- Forgeries related matters
- Bankruptcy investigations
- Issues concern with the regulatory compliance

4.0 SELF-ASSESSMENT EXERCISES

1. Define Computer Forensics and what are the Characteristics of Digital Forensics

Answer
Computer forensics is the process of extracting data and information from computer systems to function as digital evidence for civic purposes, or in most cases to prove and legally impeach cybercrime.

Characteristics of Digital Forensics

- Identification:
- Preservation
- Analysis
- Documentation
- Presentation

5.0 CONCLUSION

Digital forensics involves the process of identifying, collecting, acquiring, preserving, analysing, and presenting of digital evidence. Digital evidence must be authenticated to ensure its admissibility in a court of law. Ultimately, the forensic artefacts and forensic methods used (e.g., static or live acquisition) depend on the device, its operating system, and its security features.

6.0 SUMMARY

In this unit, we have been able to outline computer forensics history, characteristics of digital forensics, digital forensics **procedure,** advantages of computer forensics and disadvantages of computer forensics

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UNIT 2 NETWORK, DISK, MALWARE AND DATABASE FORENSICS

CONTENTS

1.0 INTRODUCTION

As we have seen from unit 1 above, digital forensics is the process of conducting an analysis on a suspected device before handing it over to law enforcement. Digital forensics is carried out on several media or devices such as Mobile phones, computers, servers or network. Types of forensics are categorized based on the device being investigated. These types are network forensics and disk forensics. This unit will focus more on these types and how they have been achieved.

2.0 Intended Learning Outcomes (ILOs)

By the end of this unit, you will be able to:

- Explain the concept of Disk Forensics
- Understand Network Forensics **procedure**
- Implement Network Forensics
- **Appreciate Network Forensics Examinations**
- Explain Malware Forensics

3.0 MAIN CONTENT

3.1 Types of Digital Forensics

3.1.1 Disk Forensics

Disk forensics deals with extracting raw data from primary or secondary storage of the device by searching active, modified, or deleted files. Disk forensics is also the science of extracting forensic information from digital storage media like Hard disk, USB devices, Firewire devices, CD, DVD, Flash drives, Floppy disks etc.. The process of Disk Forensics are:

i. Identify digital evidence
First step in Disk Forensics is identification of storage devices at the scene of crime like hard disks with IDE/SATA/SCSI interfaces, CD, DVD, Floppy disk, Mobiles, PDAs, flash cards, SIM, USB/ Fire wire disks, Magnetic Tapes, Zip drives, Jazz drives etc. These are some of the sources of digital evidence.

ii. Authenticate the evidence
Authentication of the evidence is carried out in Cyber Forensics laboratory. Hash values of both source and destination media will be compared to make sure that both the values are same, which ensures that the content of destination media is an exact copy of the source media.

iii. Seize & Acquire the evidence
Next step is seizing the storage media for digital evidence collection. This step is performed at the scene of crime. In this step, a hash value of the storage media to be seized is computed using appropriate cyber forensics tool. Hash value is a unique signature generated by a mathematical hashing algorithm based on the content of the storage media. After computing the hash value, the storage media is securely sealed and taken for further processing.

One of the cardinal rules of Cyber Forensics is “Never work on original evidence”. To ensure this rule, an exact copy of the original evidence is to be created for analysis and digital evidence collection. Acquisition is the process of creating this exact copy, where original storage media will be write protected and bit stream copying is made to ensure complete data is copied into the destination media. Acquisition of source media is usually done in a Cyber Forensics laboratory.

iv. Preserve the evidence
Electronic evidences might be altered or tampered without trace. Once the acquisition and authentication have been done, the original evidence should be placed in secure storage keeping away from highly magnetic

and radiation sources. One more copy of image should be taken and it needs to be stored into appropriate media or reliable mass storage. Optical media can be used as the mass storage. It is reliable, fast, longer life span and reusable.

v. Analyze the evidence

Verification of evidence before starting analysis is an important step in Cyber Forensics process. This is done in Cyber Forensics laboratory before commencing analysis. Hash value of the evidence is computed and compared it with the hash value taken at the time of acquisition. If both the values are same, there is no change in the content of the evidence. If both are different, there is some change in the content. The result of verification should be properly documented.

Analysis is the process of collecting digital evidence from the content of the storage media depending upon the nature of the case being examined. This involves searching for keywords, picture analysis, time line analysis, registry analysis, mailbox analysis, database analysis, cookies, temporary and Internet history files analysis, recovery of deleted items and analysis, data carving and analysis, format recovery and analysis, partition recovery and analysis, etc.

vi. Report the findings

Case analysis report should be prepared based on the nature of examination requested by a court or investigation agency. It should contain nature of the case, details of examination requested, details of material objects and hash values, result of evidence verification, details of analysis conducted, and digital evidence collected, observations of the examiner and conclusion. Presentation of the report should be in simple terms and precise way so that non-technical persons should be able to understand the content of the report.

vii. Documenting

Documentation is very important in every step of the Cyber Forensics process. Everything should be appropriately documented to make a case admissible in a court of law. Documentation should be started from the planning of case investigation and continue through searching in scene of crime, seizure of material objects, chain of custody, authentication and acquisition of evidence, verification and analysis of evidence, collection of digital evidence and reporting, preservation of material objects and up to the closing of a case.

3.1.2 Network Forensics

Network forensics, unsurprisingly, refers to the investigation and analysis of all traffic going across a network suspected of use in cyber crime, say the spread of data-stealing malware or the analysis of cyber attacks.

Network forensics is also a subset of digital forensics that deals with the collection and analysis of network traffic with the goal of better understanding and avoiding cybercrime. The importance of network forensics has grown in recent years, according to a report from the European Union Agency for Cybersecurity (ENISA), with the emergence and popularity of network-based services such as e-mails, Directory services, World Wide Web, and others. Using network forensics, the entire contents of e-mails, instant messages, web browsing operations, and file transfers can be recovered and rebuilt to reveal the original transaction. The payload inside the highest-layer packet may end up on disc, but the envelope that delivered it is only captured in network traffic. For the investigator, the network protocol data that surrounded each conversation is often highly valuable.

There are two methods of overarching network forensics, the first being the **"catch it as you can" method**, which involves capturing all network traffic for analysis, which can be a long process and requires a lot of storage. The second technique is the **"stop, look and listen" method,** which involves analysing each data packet flowing across the network and only capturing what is deemed as suspicious and worthy of extra analysis; this approach can require a lot of processing power but does not need as much storage space.

3.1.2.1 Methods of Network Forensics

There are two approaches to network forensics:

- The "catch it as you can" strategy captures all network traffic. It ensures that no crucial network events are missed. This procedure takes time and affects storage efficiency as storage capacity increases.
- "Stop, look, and listen" method: Administrators monitor each data packet that passes over the network, but they only record what is questionable and warrants further investigation. While this approach takes up little space, it may need a large amount of computing power.

All network traffic is captured using the "catch it as you can" technique. It ensures that no significant network events are overlooked. This is a time-consuming process that reduces storage efficiency as storage volume increases.

3.1.2.2 Examinations of Network Forensics

The steps involves in network forensics investigation are as follows:

- **Recognition**

Because this step is the path to the case's conclusion, the identification process has a significant effect on the subsequent steps. The process of identifying and assessing an incident based on network indicators is included in this step.

- **Safeguarding**

In the second step, the examiner would isolate the data for preservation and security purposes, preventing others from accessing the digital device and tampering with the digital evidence. Many software tools, such as Autopsy and Encase, are available for data preservation.

- **Accumulating**

The act of documenting the physical scene and duplicating digital evidence using standardized processes and procedures is known as accumulating.

- **Observation**

This procedure entails keeping track of all visible data. Many pieces of metadata from data may be discovered by the examiner, which may be useful in court.

- **Investigation**

The investigation agents can reconstruct data fragments after recognizing and safeguarding the evidence (data). The agent draws a conclusion based on the evidence after analyzing the data. SIEM (Security Information and Event Management) software keeps track of what happens in the IT environment. With security information management (SIM), which gathers, analyses, and reports on log data, SIEM tools analyze log and event data in real-time to provide threat monitoring, event correlation, and incident response.

- **Documentation**

Forensic is a legal term that means "to bring to the court". The procedure for summarizing and explaining conclusions has been completed. This should be written in layman's terms with abstracted terminologies, with all abstract terminologies referring to precise details.

- **Incident Response**

The information gathered to validate and assess the incident led to the detection of an intrusion.

3.1.2.3 Database Forensics

Database servers store sensitive information. Database forensics refers to the branch of digital forensic science specifically related to the study of databases and the data they keep. Database forensics look at who access the database and what actions are performed. Large data security breaches are a large problem, and criminal investigators search for related information. Modern criminal investigations often involve database forensics as investigators search for motive and method and try to identify suspects.

A forensic examination of a database may investigate the timestamps relating to the update time of a row in a relational table in order to verify the actions of a database user. Another database forensics case might examine all transactions within a database system or application over a specific period of time in order to identify any fraudulent transactions. Experts in database forensics need to be well-versed in almost all aspects of database development and use, as they have to preserve, authenticate, analyze and output data from large, custom-built databases that cannot just be copied and taken back to the office for further investigation.
Sometimes, a database may be perfectly healthy but suspicious activities and results may have raised questions from a customer that prompted a forensic investigation. The following scenarios would require the intervention of a database forensic specialis

- Failure of a database
- Deletion of information from database
- Inconsistencies in the data of a database
- Detection of suspicious behavior of users

A database forensics expert will normally use a read-only method or an identical forensic copy of the data when interfacing with a database to ensure that no data is compromised. They will run a series of diagnostic tools to help them to:

- Create a forensic copy of a database for analysis
- Reconstruct missing data and/or log files associated with the deletion
- Decipher data and ascertain possible causes of corruption
- Audit user activities and isolate suspicious and illegal behavior

3.1.2.4 Malware Forensics

It is a way of finding, analyzing & investigating various properties of malware to seek out the culprits and reason for the attack. The method also includes tasks like checking out the malicious code, determining its entry, method of propagation, impact on the system, ports it tries to use

etc. investigators conduct forensic investigation using different techniques and tools.

3.1.2.5 Types of Malware

The category of malware is predicated upon different parameters like how it affects the system, functionality or the intent of the program, spreading mechanism, and whether the program asks for user's permission or consent before performing certain operations. a number of the commonly encountered malwares are:

- Backdoor
- Botnet
- Downloader
- Launcher
- Rootkit
- HackTool
- Rogue application
- Scareware
- Worm or Virus
- Credential-stealing program, etc.

3.1.2.6 Symptoms of Infected Systems

- System could become unstable and respond slowly as malware might be utilizing system resources.
- Unknown new executables found on the system.
- Unexpected network traffic to the sites that you simply don't expect to attach with.
- Altered system settings like browser homepage without your consent.
- Random pop-ups are shown as advertisement.

Recent additions to the set are alerts shown by fake security applications which you never installed. Messages like "Your computer is infected" are displayed and it asks the user to register the program to get rid of the detected threat. Overall, your system will showcase unexpected & unpredictable behavior.

3.1.2.7 Different Ways Malware Can Get Into System:

- Instant messenger applications
- Internet relay chat
- Removable devices
- Links and attachments in emails

- Legitimate "shrink-wrapped" software packaged by disgruntled employee
- Browser and email software bugs
- NetBIOS (File sharing)
- Fake programs
- Untrusted sites & freeware software
- Downloading files, games screensavers from websites

4.0 SELF-ASSESSMENT EXERCISES

1. Explain the following
   i. Disk Forensics
   ii. Network Forensics
   iii. Methods of Network Forensic
   iv. Database Forensics
   v. Malware Forensics
2. Explain the symptoms of infected systems
3. Explain different ways malware can get into system

5.0 CONCLUSION

The forensic examination of electronic systems has undoubtedly been a huge success in the identification of cyber and computer-assisted crime. Organisations are placing an increasing importance on the need to be equipped with appropriate incident management capabilities to handle misuse of systems. Computer forensics is an invaluable tool in the process. The domain of computer forensics has grown considerably in the last decade. Driven by industry, focus was initially placed upon developing tools and techniques to assist in the practical application of the technology

6.0 SUMMARY

- Digital Forensics is the preservation, identification, extraction, and documentation of computer evidence which can be used in the court of law
- Process of Digital forensics includes 1) Identification, 2) Preservation, 3) Analysis, 4) Documentation and, 5) Presentation
- Different types of Digital Forensics are Disk Forensics, Network Forensics, Wireless Forensics, Database Forensics, Malware Forensics, Email Forensics, Memory Forensics, etc.

Digital forensic Science can be used for cases like 1) Intellectual Property theft, 2) Industrial espionage 3) Employment disputes, 4) Fraud investigations

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UNIT 3 EMAIL, MEMORY AND MOBILE FORENSICS

CONTENTS

1.0 INTRODUCTION

The Internet is a very easy way to reach any system. If confidential data is not properly protected, then it becomes opens to vulnerable access and misuse. Cyber-crime can cause varying degrees of damage by hackers. So, detailed forensic analysis is required to come to a conclusion about an incident and to prove or disprove someone's guilt. Some criminal activities like child pornography, hacking, and identity theft can be traced and the criminals can be punished if proper evidence is found against them. Email communication is also on target. Because it is one of the most popular and commonalty used means of online communication, for both prospects individuals and businesses, emails are normally used by organizations to exchange most simple information, such as meeting schedules, document distribution and some sensitive information. Mobile forensics is about getting evidence from mobile devices like phones and tablets, like the iPhone. Today, because so many people use mobile devices to send, receive, and search for data, it stands to reason that these devices have a lot of evidence that could be useful to investigators. A memory dump (also known as a core dump or system dump) is a snapshot of computer memory data captured at a certain point in time. A memory

dump may include useful forensic data on the status of the system before to an occurrence, such as a crash or security breach.

2.0 INTENDED LEARNING OUTCOMES (ILOS)

By the end of this unit, you will be able to:

- Understand the concept of Email Forensics and Memory Forensics
- Understand the concept of Mobile Phone Forensics
- Explain ddigital **Forensic Examination Process**

3.0 MAIN CONTENT

3.1 Email Forensics

Email forensics is the analysis of source and content of the email message, identification of sender and receiver, date and time of email and the analysis of all the entities involved. Email forensics also reforms to the forensics of client or server systems suspected in an email forgery. It starts with the study of email **header** as it contains a vast amount of information about the email message.

3.1.1 Email Header Analysis

This analysis consists of both the study of the content body and the email header containing the info about the given email. Email header analysis helps in identifying most of the email related crimes like spear phishing, spamming, email spoofing etc. Spoofing is a technique using which one can pretend to be someone else, and a normal user would think for a moment that it's his friend or some person he already knows. It's just that someone is sending emails from their friend's spoofed email address, and it is not that their account is hacked.

3.1.2 Challenges in Email Forensics

Email forensics play a very important role in investigation as most of the communication in present era relies on emails. However, an email forensic investigator may face the following challenges during the investigation

- **Fake Emails**

The biggest challenge in email forensics is the use of fake e-mails that are created by manipulating and scripting headers etc. In this category criminals also use temporary email which is a service that allows a

registered user to receive email at a temporary address that expires after a certain time period.

- **Spoofing**

Another challenge in email forensics is spoofing in which criminals used to present an email as someone else's. In this case the machine will receive both fake as well as original IP address.

- **Anonymous Re-emailing**

Here, the Email server strips identifying information from the email message before forwarding it further. This leads to another big challenge for email investigations.

3.1.3 Techniques Used in Email Forensic Investigation

Email forensics is the study of source and content of email as evidence to identify the actual sender and recipient of a message along with some other information such as date/time of transmission and intention of sender. It involves investigating metadata, port scanning as well as keyword searching.

Some of the common techniques which can be used for email forensic investigation are

- Header Analysis
- Server investigation
- Network Device Investigation
- Sender Mailer Fingerprints
- Software Embedded Identifiers

3.2 Memory Forensics

Deals with collecting data from system memory (system registers, cache, RAM) in raw form and then analysing it for further investigation. Memory forensics is a vital form of cyber investigation that allows an investigator to identify unauthorized and anomalous activity on a target computer or server. This is usually achieved by running special software that captures the current state of the system's memory as a snapshot file, also known as a memory dump. This file can then be taken offsite and searched by the investigator.

Memory Forensics is useful because of the way in which processes, files and programs are run in memory, and once a snapshot has been captured, many important facts can be ascertained by the investigator, such as:

- Processes running
- Executable files that are running
- Open ports, IP addresses and other networking information

- Users that are logged into the system, and from where
- Files that are open and by whom

3.3 Mobile Phone Forensics

Mobile Phone Forensics mainly deals with the examination and analysis of phones and smartphones and helps to retrieve contacts, call logs, incoming, and outgoing SMS, etc. and other data present in it. Mobile forensics is a subset of digital forensics, the retrieval of data from an electronic source. Specifically, mobile forensics deals with recovery evidence from mobile devices such as smartphones and tablets. Today, because individuals rely on mobile devices for so much of their sending, receiving and searching of data, it stands to reason that these devices hold a vast quantity of evidence that might be applicable to investigators. Mobile devices can provide all types of important data, ranging from call logs and text messages to web search history and location data that shows where the device owner might have been at a given time.

3.3.1 Mobile Device Forensic Examination Process

Digital evidence is fragile and volatile. Improper handling of a mobile phone can alter or destroy the evidence contained on the device. Further, if the mobile phone is not handled following digital forensics best practices, it can be impossible to determine what data was changed and if those changes were intentional or unintentional. To protect the evidence and prevent spoliation, mobile devices need to be analyzed by a trained examiner using mobile device forensic tools.

The initial handling of digital evidence can be divided into four phases: identification, collection, acquisition, and preservation.

3.3.1.1 Identification

The identification phase's purpose and scope are to identify the digital evidence relevant to the case. It is possible that this evidence will span multiple devices, systems, servers, and cloud accounts. With a mobile phone, the data is not isolated only to the device. The data contained in the device can be synced to cloud storage or another mobile device or backed up onto a computer.

Identification also requires comprehensive documentation. Documentation is critical throughout the entire investigative process, but especially in the beginning, as any mistakes can taint the evidence. The acquisition phase gives us a perfect snapshot in time (forensic copy) of how the data exists. Since identification is the first step and before acquisition, mistakes made here are carried out throughout the process.

3.3.1.2 Collection

The collection phase involves gathering physical devices, such as the smartphone and other mobile devices. Since digital evidence can span multiple devices, systems, and servers, collecting it can become more complicated than securing more traditional forensic evidence. There are vital functions that should be performed to protect the evidence.

- **Isolating Device Users**

The primary goal of the collection process, other than ensuring all relevant electronic items are collected, is to protect digital evidence from contamination. One way this is done is by isolating the devices from their respective users until a forensic acquisition of the mobile device can be performed. While in their custody, the user could delete, create, or change data before the forensic acquisition (the perfect snapshot in time of the mobile phone data) is performed. They could also factory reset or wipe the device, permanently destroying some data or potentially everything on the mobile phone.

- **Isolating Devices**

Along with isolating the mobile phone from the user, we also need to isolate the device itself. By design, mobile phones are intended for communication, and they are continually sending and receiving data even when they are on the bedside table charging overnight. If data transmission occurs, even with no person physically touching the phone, data can be lost, changed, or destroyed.

Isolation of the device itself is achieved by eliminating all forms of data transmission, including the cellular network, Bluetooth, wireless networks, and infrared connections. By isolating the phone from all networks, the mobile phone is prevented from receiving any new data that would cause other data to be deleted or overwritten.

3.3.1.3 Acquisition

The acquisition process is where a digital forensic examiner acquires, or forensically copies, the data from a mobile device using a variety of methods.

- **Logical Extraction**

A logical extraction of data from a mobile phone collects the files and folders contained on the device without any unallocated space. While what is commonly called "deleted space" is not recovered, deleted data on a mobile phone can be recovered using forensic tools and methods via a logical extraction. This data comes in the form of various database files, especially SQLite. Typically, data collected via a logical extraction

includes messaging, pictures, video, audio, contacts, application data, some location data, internet history, search history, social media, and more.

- **File System Extraction**

A file system extraction is an extension of a logical extraction. It collects much of the same data as a logical extraction along with additional file system data. During a file system extraction, the forensic tool accesses the internal memory of the mobile phone, which means that the forensic software can collect system files, logs, and database files from the device that a logical acquisition cannot.

Most applications store their data in database files on a mobile phone. Since a file system extraction recovers more of these database files, more deleted data like database files and data related to application usage on the device can be recovered.

- **Physical Extraction**

The physical extraction of a mobile phone captures the entirety of the device's data, including all files, user content, deleted data, and unallocated space. While this extraction method is the most extensive, it is also the least supported. Like the forensic imaging of a computer hard drive, a physical extraction creates a bit-by-bit copy of the mobile phone's entire contents.

With a bit-by-bit copy, the logical and file system data are recovered, as well as unallocated space. This extraction method allows for the recovery of deleted data that would otherwise be inaccessible to a forensic examiner, including location information, email, messages, videos, photos, audio, applications, and almost any other data contained on a mobile phone.

- **Cloud Data**

Mobile phone forensic companies have developed tools that allow for accessing and acquiring data in the cloud. Cellebrite, the leading mobile phone forensic tool provider, can collect cloud data from cloud backups and the actual cloud-based applications themselves. While a forensic image of a mobile phone is a potential gold mine of evidence, the ability to use the mobile phone information to find even more evidence in the cloud is a significant force multiplier.

3.3.1.4 Preservation

The mobile phone's integrity and the data on it need to be established to ensure that evidence is admissible in court.

- **Chain of Custody**

Evidence preservation aims to protect digital evidence from modification. This protection begins by ensuring that first responders, investigators, crime scene technicians, digital forensic experts, or anyone else who touches the device handles it properly. A chain of custody must be maintained throughout the entire life cycle of a case.

- **Mathematical Hashing Algorithm**

The forensic data collection process from the mobile device is better called a "forensics extraction," as data is extracted from the device instead of a perfect bit-for-bit copy of the evidence item. With the mobile phone powered on, the forensic software cannot access some areas of data. However, data that is inaccessible because the mobile device is powered on is usually of little to no value evidentiarily. Following the forensic copying comes the hashing process. A mathematical algorithm is run against the copied data, producing a unique hash value. This hash value can be thought of as a digital fingerprint, uniquely identifying the copied evidence exactly as it exists at that point in time.

3.3.1.5 Reporting

If requested by the client, a report will be prepared of the data contained on the mobile device. Sometimes, it makes the most sense for our examiners to export all of the data from a cell phone for counsel's review. We format this export in such a way that makes it as accessible as possible, with the ability to search and filter the data.

Sometimes, when timelines, data types, or types of particular forensic artifacts need to be explained in order to tell the story of what happened in a case, a more in-depth report is needed.

3.3.1.6 Expert Testimony

Expert testimony is the culmination of everything that goes into a mobile device forensic examination. Selecting the expert with the appropriate technical expertise and experience is vital. It is also important that the expert is able to explain technical concepts, forensic procedures, and digital artifacts in plain language, as the use of jargon and acronyms can be detrimental to the triers of fact. Ultimately, if an expert has an airtight analysis but cannot communicate it effectively to a judge and jury, their words are meaningless. When selecting an expert, choose the one you can have a conversation with. If that expert cannot explain technical details to you in an accessible way, they likely don't understand what they are talking about themselves.

4.0 SELF-ASSESSMENT EXERCISES

1. Explain email forensics

Email forensics is the analysis of source and content of the email message, identification of sender and receiver, date and time of email and the analysis of all the entities involved. Email forensics also reforms to the forensics of client or server systems suspected in an email forgery.

2. What is the purpose of email header analysis

Email header analysis helps in identifying most of the email related crimes like spear phishing, spamming, email spoofing etc. Spoofing is a technique using which one can pretend to be someone else, and a normal user would think for a moment that it's his friend or some person he already knows

3. List the common techniques used in email forensic investigation

- Header Analysis
- Server investigation
- Network Device Investigation
- Sender Mailer Fingerprints
- Software Embedded Identifiers

5.0 CONCLUSION

Carrying forensics on Email, Mobile and Memory is necessary with almost users' activities take place in these on them. Mobile phone is arguable the most used device by individuals making several communications and transactions. Mobile device carries memory that store all data generated through communication and browser web cache. The email is one of the most important platforms through which communication exchange takes place. Carrying out forensics on these areas of technology will definitely give a lead upon investigation.

6.0 SUMMARY

Forensic study of emails, both sent and received, is known as "email forensics," and it is used to look for signs of criminal activity. A number of elements are scrutinized, including the email's header, body, sender/receiver, and the time and date. There are few forensic practices as critical as mobile forensics. There is no prior study of apps or services installed on the device for this inquiry, which covers the complete device. Dig into the stored data on a device through memory forensics. Forensics on only one suspect is certain to provide a lead if the individual is found guilty of the crime.

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UNIT 4 MALWARE & MALWARE ANALYSIS

CONTENTS

1.0 INTRODUCTION

Malware is any piece of software which is intended to cause harm to your system or network. This is different from normal programs in a way that they most of them have the ability to spread itself in the network, remain undetectable, cause changes/damage to the infected system or network, persistence. They have the ability to bring down the machine's performance to knees and can cause a destruction of the network. Consider the case when the computer becomes infected and is no longer usable, the data inside becomes unavailable – these are some of the malware damage scenarios. Malware attacks can be traced back to the time, even before the internet became widespread.

Malware analysis is the process of determining the purpose and functionality of a piece of malware. This process will reveal what type of harmful program has infected your network, the damage it's capable of causing, and most importantly how to remove it. Malware analysis used to be performed manually by experts in a time-consuming and cumbersome process. Today, there are a number of open-source malware analysis tools that can perform this process automatically.

2.0 Intended Learning Outcomes (ILOs)

By the end of this unit, you will be able to:

- understand the term "Malware Analysis"
- Familiar with Types of Malwares and Malware Analysis

3.0 MAIN CONTENT

3.1 Types of Malwares

Malware can take many forms and comes in many variations. I don't want to end up here with a lengthy post, so I'm going to keep the following list short. I have listed here the most common malware types that you should know about.

- **Virus**: Viruses are pieces of malware that require human intervention to propagate to other machines. Think of this intervention as a user installing a malicious program from a website or a phishing email. Virus is the first category of malware to appear on the horizon of computer security. It is self-replicating in nature and is referred to as a parasitic infector. It does not have a separate existence; instead, it inserts its code into existing files on the system. It could be an executable program or script of different programming languages like VBScript, JavaScript, Perl, etc.
- **Worm**: Unlike Viruses, Worms do not need the help of humans to move to other machines. They can spread easily and can infect a high number of machines in a short amount of time. Worms are also self-replicating; however, they are standalone malware strains. They do not modify other files to spread; instead, they make copies of themselves over network shares or on other systems. Worms are further classified based upon the spreading mechanism used such as email, P2P, IRC, etc.
- **Trojan**: These appear to be normal programs that have a legitimate function, like a game or a utility program. But underneath the innocent-looking user interface, a Trojan performs malicious tasks without the user being aware. A Trojan always disguised as useful software and tempts a user to install it and it is also bundled with hidden malicious functionality. It is non-replicating in nature, i.e. it does not spread in a similar manner as viruses or worms.
- **Spyware**: Spyware is software that gathers personal or confidential information from user systems without their knowledge. It includes monitoring the systems to collect information such as browsing habits, recently visited sites, passwords, credit card information, and other confidential information. Once spyware is installed, it does not show any visible notifications to indicate that it is monitoring user activities. It instantly sends this information to the configured remote server.
- **Keylogger**: This is a special type of spyware. It is specialized in recording the keystrokes made by the user. Keyloggers are a particularly insidious type of spyware that can record and steal consecutive keystrokes (and much more) that the user enters on a device. The term keylogger, or "keystroke logger," is self-

explanatory: Software that logs what you type on your keyboard. However, keyloggers can also enable cybercriminals to eavesdrop on you, watch you on your system camera, or listen over your smartphone's microphone

- **Ransomware**: Ransomware is a form of malware that encrypts a victim's files. The attacker then demands a ransom from the victim to restore access to the data upon payment. Users are shown instructions for how to pay a fee to get the decryption key. The costs can range from a few hundred dollars to thousands, payable to cybercriminals in Bitcoin.

3.2 Types of Malware Analysis

3.2.1 Static analysis

Static analysis examines a malware file without actually running the program. This is the safest way to analyze malware, as executing the code could infect your system. In its most basic form, static analysis gleans information from malware without even viewing the code. Metadata such as file name, type, and size can yield clues about the nature of the malware. MD5 checksums or hashes can be compared with a database to determine if the malware has been previously recognized. And scanning with antivirus software can reveal what malware you're dealing with.
Advanced static analysis—also known as code analysis—dissects the binary file to study each component, still without executing it. One method is to reverse engineer the code using a disassembler. Machine code is translated into assembly code, which is readable and understandable. By looking at the assembly instructions, an analyst can tell what the program is meant to do. A file's headers, functions, and strings can provide important details. Unfortunately, modern hackers are adept at evading this technique. By embedding certain syntax errors into their code, they can misdirect disassemblers and ensure the malicious code still runs. Because static malware analysis can be more easily foiled, dynamic malware analysis is also necessary, here are some examples of valuable information that we can extract using static analysis.

- File Headers

Depending on the target operating system, malware files can be one of two types : **Portable Executable(PE)** or **Executable and Linkable Format (ELF)**. The latter is used in Linux, whereas the former is the standard format used by Windows executable files.

Since Windows is more targeted by malware than Linux, you will encounter PE-based malware files more often than their ELF-based counterparts.

It would therefore be more rewarding to learn about PE format first and to understand how you could retrieve useful information by examining certain sections of the file.

For example, by examining the **PE header**, you can obtain information about which functions from other libraries does the malware call, or at what memory address does the program execution starts.

- Hash

A **Hash** is a unique string of a fixed length that can be generated based on an input. No matter the size of this input, the hash value will always be of a fixed length.

A hash is used to check for the integrity of files. If the content of the file changes, then its hash value will also change.
Now, by calculating the hash value of a file, we can verify if it's a known malware by searching for this hash and see if it exists on a malware database such as Virustotal.

- Strings

Strings is a tool that you can use to extract the ASCII text from a program file. It does this by searching for any series of consecutive ASCII characters.

Very often, you will find interesting stuff using this tool, such as a hidden code or a domain name address.

- Code Analysis

Programs are executed in a special series of operations called **opcodes** (operation codes). These are special binary instructions that are generally represented in hexadecimal. They can be interpreted by computers and are far less understandable by us humans.
Disassembly is the process of extracting Assembly code from these opcodes. Although Assembly isn't an easy language either, it is much more approachable compared to opcodes.
By performing disassembly, a malware analyst can peek into the instructions of the malware to understand what it does, where the malicious portions of the program are, and what hidden information they can retrieve.

Another way to reverse engineer malware is to go one step further and use a **Decompiler** instead of a Disassembler. While the latter outputs the assembly code, the former presents a much better alternative by providing the source code in a high-level language that is friendlier and easier to understand for humans.

3.2.2 Dynamic analysis

Dynamic analysis also called malware behavior analysis runs the malware program to examine its behavior. Of course, running a piece of malware always carries some risk, so dynamic analysis must be performed in a safe environment. A "sandbox" environment is a virtual system that is isolated from the rest of the network and can run malware without risk to production systems. After the analysis is done, the sandbox can be rolled back to its original state without permanent damage.

When a piece of malware is run, technical indicators appear and provide a detection signature that dynamic analysis can identify. Dynamic analysis software monitors the sandbox system to see how the malware modifies it. Modifications may include new registry keys, IP addresses, domain names, and file path locations. Dynamic analysis will also reveal whether the malware is communicating with a hacker's external server. Debugging is another useful dynamic analysis technique. As the malware is running, a debugger can zero in on each step of the program's behavior while the instructions are being processed.

As with static analysis, cybercriminals have developed techniques to foil dynamic analysis. Malware may refuse to run if it detects a virtual environment or debugger. The program may delay the execution of its harmful payload or require certain user input. To reach the best understanding of a particular malware threat, a combination of static and dynamic analysis is most effective. This method is obviously less safe than static analysis because basically, you would willingly be infecting your machine. It is a good practice to perform it on a sandbox environment, such as a virtual machine, or even better, a completely separate physical machine isolated from any network.

- **Debugging**

A **debugger** is a powerful tool that any malware analyst should know how to use. It allows you to follow the flow of the program as it executes and provides useful features that give you better control over the execution of a program.

For example, you can set breakpoints on certain instructions where you want the execution to pause. You can also examine the contents of registers and specific memory addresses, and even better, you can modify their values while the program is running.

4.0 SELF-ASSESSMENT EXERCISES

i. Define Malware Analysis

Malware analysis is the process of determining the purpose and functionality of a piece of malware. This process will reveal what type of harmful program has infected your network, the damage it's capable of causing, and most importantly how to remove it.

ii. List and explain Types of Malwares

- **Virus**: Viruses are pieces of malware that require human intervention to propagate to other machines.
- **Worm**: Unlike Viruses, Worms do not need the help of humans to move to other machines. They can spread easily and can infect a high number of machines in a short amount of time.
- **Trojan**: These appear to be normal programs that have a legitimate function, like a game or a utility program. But underneath the innocent looking user interface, a Trojan performs malicious tasks without the user being aware.
- **Spyware**: Spyware is software that gathers personal or confidential information from user systems without their knowledge.
- **Keylogger**: This is a special type of spyware. It is specialized in recording the keystrokes made by the user.
- **Ransomware**: Ransomware is a form of malware that encrypts a victim's files. The attacker then demands a ransom from the victim to restore access to the data upon payment.

iii. Explain Static and Dynamic Analysis

Dynamic analysis also called malware behavior analysis runs the malware program to examine its behavior, while Static analysis examines a malware file without actually running the program.

5.0 CONCLUSION

Malwares are very destructive programs that can be devastating to companies and individual. The best defense against malware is a combination of vigilant and sensible behavior on the Internet, proper computer usage, and anti-malware software. By erring on the side of caution when surfing the web, not opening strange links or emails from unknown senders, and regularly updating and running an anti-malware program, you'll be relatively safe from the manifold dangers of the Internet.

6.0 SUMMARY

In this unit, we have been able to outline malware analysis, types of malwares and malware analysis. Malware is a form of software attack that tend to harm the target device. Types of malware are keylogger, virus, spyware, worm, Trojan, Ransonware etc. Malware analysis is the investigation of malware. Determining the kind of harmful programs affecting a network or device.

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MODULE 4 INTRODUCTION TO CYBER LAW AND ETHICS

UNIT 1 CONCEPT OF CYBER LAWS

CONTENTS

1.0 INTRODUCTION

Technology has engendered new types of lawsuits or modified old ones. As, for example, the next generation of offences arose within the field of computer crimes (e.g., identity thefts), technology impacted on traditional rights such as copyright (1709) and privacy (1890), turning them into a matter of access, control, and protection over information in digital environments. This unit we explain the concepts of cyber law, the need of cyber law in the IT world and why is important to actually address cyber crime issues.

Module 4 Introduction

As soon as cyberspace and e-commerce were created in the mid-1990s, cybercrime flourished on a parallel track. Today, cybercrime has been doubling every single year in the number of incidents, as well as monetary losses. It is impossible to truly quantify cybercrime because most victims only see further losses in publicizing their inability to defend themselves from this modern day menace. The interesting note is that, of the cybercriminals who have been caught, the vast majority have pleaded guilty. The word ethics comes from the ancient Greek word ‘eché, which means character. Every human society practices ethics in some way because every society attaches a value on a continuum of good to bad, right to wrong, to an individual’s actions according to where that

individual's actions fall within the domain of that society's rules and canons. In this module, Cyber crime Acts will be addressed to provide legal backings to human data and privacy.

Unit 1: Concept of Cyber Law
Unit 2: Cyber Crimes Acts, 2015
Unit 3: The International Laws
Unit 4: Cyber Ethics

2.0 INTENDED LEARNING OUTCOMES (ILOS)

At the end of this unit, student will able to:

- Justify cyber crimes as sanctioned in cyber laws
- Demonstrate the understanding of the concept of cyber law

3.0 MAIN CONTENT

3.1 What is Cyber Law

Cyber Law or IT Law is referred to as the Law of the Internet. The Cyber law definition says it is a legal system designed to deal with the Internet, computing, Cyberspace, and related legal issues. The apt introduction to Cyber Law is: It is 'paper laws' in the 'paperless world'.

Cyber law encompasses aspects of intellectual property, contract, jurisdiction, data protection laws, privacy, and freedom of expression. It directs the digital circulation of software, information, online security, and e-commerce. The area of Cyber Law provides legal recognition to e-documents. It also creates a structure for e-commerce transactions and e-filling. Hence, to simply understand the Cyber law's meaning, it is a legal infrastructure to deal with Cybercrimes. An increase in the usage of E-commerce has made it pivotal that there are proper regulatory practices set up to ensure no malpractices take place.

The laws implemented for cybersecurity largely vary from country to country and their respective jurisdiction. The punishments for the same also vary from fine to imprisonment based on the crime committed. It is very important for citizens to know the cyber laws of their respective countries to make sure they are well aware of all information regarding cybersecurity. The first cyber law to ever exist was the Computer Fraud and Abuse Act in 1986 that prohibited Unauthorized access to computers and illegal usage of digital information.

3.1.1 Categories of Cyber Law

Individual - Cybercrimes against individuals involve crimes like online harassment, distribution and trafficking of child pornography, manipulation of personal information, use of obscene data, and identity theft for personal benefit.

Property - Usage, and transmission of harmful programs, theft of information and data from financial institutions, trespassing cyberspace, computer vandalism, and unauthorized possession of information digitally are some of the crimes under the property.

Government - The crimes that come under this are cyber terrorism, manipulation, threats, and misuse of power against the Government and citizens. Groups or Individuals terrorizing Government websites is when this form of cyber terrorism occurs.

3.1.2 Components of Cyber Law

Safeguarding data and privacy – Both private and professional information and data must be secured thoroughly. Personal and financial information always attracts cybercriminals. Misuse of this information by any other person is illegal and that is where these laws come into play. The basic steps to safeguard your data and privacy is elaborated below:

- Two-factor authentication for financial platforms and any other forums that provide this function.
- Initiate Virus protection software.
- Use only verified payment methods on reputed websites.
- Avoid giving out personal information

Cybercrimes - These crimes are any illegal activities that occur on a networked technological device. These crimes include online and network attacks, extortion, harassment, money laundering, hacking, and many more.

Intellectual property - Intellectual property is basically an individual or group's work, designs, symbols, inventions, or anything owned by them which are intangible and are usually patented or copyrighted. Now cyber theft would mean the stealing or illegal use of the same intangible items.

Electronic and digital signatures - Nowadays most individuals and companies use electronic signatures to verify electronic records. This has become reliable and regular. The wrong usage by another of this signature is illegal and hence a cybercrime.

3.1.3 Importance of Cyber Law

Cyber laws are important to punish criminals who commit serious crimes related to the computer such as hacking, online harassment, data theft, disrupting the online workflow of any enterprise, attacking another individual or website.

- Cyber laws decide different forms of punishment depending on the type of law you broke, who you offended, where you violated the law, and where you live.
- It is important to bring criminal behind the bars, as most cybercrimes do not enter the category of common crime and it may lead to denial of justice.
- These crimes may endanger the confidentiality and financial security of a nation therefore these problems should be addressed lawfully

3.2 Types of Cyber Laws

The law has rules dictating behavior while using computers and the internet. It also prevents unscrupulous activities online. Some major types of Cyber Law are:

- **Copyright:** These days' copyright violations come under Cyber law. It protects the rights of companies and individuals to get profit from their creative work. In earlier days, online copyright violation was easier. But due to the introduction of Cyber law, it has become difficult to violate copyright. Which is very good!

- **Defamation:** Generally, people use the internet to speak out their minds. But in the case of fake public statements on the internet that are bound to hamper someone's business and reputation, that is when defamation law comes into the picture. Defamation Laws are a kind of civil law.

- **Fraud:** What is Cybercrime law? The major motive of this law is to protect people from online fraud. Consumers these days depend on Cyber Law to prevent online fraud. IT law prevents credit card theft, identity theft, and other money-related crimes that are bound to happen online. People who commit online fraud, face state criminal charges. They may also witness a civil action by the victim.

- **Harassment and Stalking:** Some statements made by people can violate criminal law that refuses stalking and harassment online. When somebody posts threatening statements repeatedly about somebody else, this violates both criminal and civil laws. Cyber lawyers fight and defend people when online stalking occurs.

- **Freedom of Speech:** The internet is used as a medium of free speech. But there are laws to avoid free speech that may cause immorality online. Cyber lawyers should advise their clients about the amount of free speech allowed online. Sometimes the Cyber lawyers fight cases for their clients where they debate whether their client's actions are within the permissible limit of free speech.

- **Trade Secrets:** Businesses depend on Cyber laws to preserve their trade secrets. For example, some organizations might steal online algorithms or features designed by another firm. In this case, Cyber laws empower the victim organization to take legal action to protect its secrets.

- **Contracts and Employment Laws:** You might have agreed upon many terms and conditions while opening a website or downloading some software. This is where the Cyber law is used. These Terms and Conditions are designed for online privacy concerns.

3.3 Why do we need Cyber Laws

As of early 2021, the number of people that use the internet is over 4.66 Billion. With that number increasing by 7% annually. This also means every day can account for almost 8,75,000 new users. Given this swift increase in the use of Cyberspace, implementation and the usage of strict cyber rules helps establish a safe and secure environment for the users. Living in a rapidly progressing world, the one thing to keep pace with it is the Internet. Although it initially started off as an information tool, today it helps with communication and commerce. Being highly sophisticated and developing every single day, the usage of cyberspaces has become common, hence the increase in cybercrimes is inevitable. Cyber laws provide sanctions to those that break the cyber rules making the cyber space a safe place to certain extent to operate.

Discussion
What is biggest crime ever committed in the cyber space?

4.0 SELF-ASSESSMENT/EXERCISES

Explain the different sources of law.
Answer

a) **Legislation**: - It is the formal enactment of law by the legislature created or authorized by the constitution. It stands in contrasted with judge made law. Legislation consists of written laws, as contrasted with judge made law or common law. It also stans in contrasted to customary law.

b) **Common Law**: - It comprises the body of principle, which derive their authority solely from the decisions of courts. It is a body of law that develops and derives through judicial decisions different from legislative enactments. Its principals do not derive their validity from formal law making by anybody, but from their enunciation through decisions of courts.

c) **Custom**: - Custom‟ denotes a usage or practice of the people (including a particular social group or a group residing in a particular locality) which by common adoption and acquiescence and by long and unvarying habit, has become compulsory and has acquired the force of law with respect to the place or subject matter to which it relates.

5.0 CONCLUSION

Cyberlaw does concern you. As the nature of Internet is changing and this new medium is being seen as the ultimate medium ever evolved in human history, every activity of yours in Cyberspace can and will have a Cyber legal perspective. From the time you register your Domain Name, to the time you set up your web site, to the time you promote your website, to the time when you send and receive emails, to the time you conduct electronic commerce transactions on the said site, at every point of time, there are various Cyberlaw issues involved.

6.0 SUMMARY

Cyber law describes the legal issues related to use of communications technology, particularly "cyberspace", i.e. the Internet. It is less a distinct field of law in the way that property or contract are as it is an intersection of many legal fields. Cyber law is an attempt to integrate the challenges presented by human activity on the Internet with legacy system of laws applicable to the physical world.

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UNIT 2 THE CYBERCRIME ACT, 2015

CONTENTS

1.0 INTRODUCTION

The cyberspace is anticipated to become even more complex in the upcoming years, with the increase in networks and devices connected to it. Nigeria as a nation has encountered several cybercrime the likes of yahoo boys which forced the government to impose cyber law that regulates the code and conducts of the people of Nigeria and international on the cyberspace. The Act establishes a comprehensive, effective, and unified legal, regulatory, and institutional framework for the prevention, detection, prosecution, and punishment of cybercrime in Nigeria. Additionally, this legislation safeguards essential national information infrastructure, promotes cybersecurity, and safeguards computer systems and networks, electronic communications, data and computer programs, intellectual property, and privacy rights. The Act is segmented into 8 parts
Part I: Objectives and Application
Part II: Protection of Critical National Information Infrastructure
Part III: Offences and Penalties
Part IV: Duties of Service Providers
Part V: Administration and Enforcement
Part VI: Search, Arrest and Prosecution
Part VII: Jurisdiction and International Co-operation

2.0 INTENDED LEARNING OUTCOMES (ILOS)

At the end of this unit, the student will able to

- Understands laws binding Cyberspace
- Know their rights in data and privacy protection

- Learn from existing scenarios of cybercrimes in Nigeria

3.0 MAIN CONTENT

3.1 Objectives and Application

In 2015, the National Assembly of the Federal Republic of Nigeria passed an ACT to address cybercrime prevention, detection, response, investigation, and punishment.

1. It is the objectives of this legislation to

a) Provide a comprehensive legal and regulatory framework for the prevention, identification, prosecution and incarceration of cybercrimes in Nigeria.
b) Ensure the protection of critical national information infrastructure.
c) Safeguard and enhance computer systems and networks by promoting cyber security.
d) Information technology (IT), data and software, intellectual property (IP), and personal data protection (PDP).

2. Application: The provisions of this Act shall apply throughout the Federal Republic of Nigeria

3.2 Protection of Critical National Information Infrastructure

3. Designation of certain computer systems or networks as critical national information infrastructure.

1. On the recommendation of the National Security Adviser, the President may, by Order published in the Federal Gazette, designate certain computer systems, networks, and information infrastructure critical to Nigeria's national security or the economic and social well-being of its citizens as Critical National Information Infrastructure.
2. The Presidential Order issued under subsection (1) of this section may establish minimum standards, guidelines, regulations, or procedures for –
   (a) The protection or preservation of critical information infrastructure;
   (b) The general management of critical information infrastructure;
   (c) Access to, transfer and control of data in any critical information infrastructure; Designation of certain computer

systems or networks as essential national information infrastructure.

(d) Infrastructure or procedural rules and requirements for ensuring the integrity and authenticity of data or information contained in any designated critical national information infrastructure;

(e) Storage or archiving of data or information designated as critical national information infrastructure; and

(f) recovery plans in the event of disaster, breach, or loss of the critical national information infrastructure or any part of it.

4. Audit and Inspection of critical national information infrastructure

The Presidential Order issued under Section 3 of this Act may, from time to time, demand the audit and inspection of any Critical National Information Infrastructure to assess conformity with the terms of this Act.

3.3 Offences and Penalties

5. Offences against critical national information infrastructure

a) Any person who commits any offence punishable under this Act against any
critical national information infrastructure, designated pursuant to section 3 of
this Act, is liable on conviction to imprisonment for a term of not less than fifteen
years without an option of fine.

b) Where the offence committed under subsection (1) of this section results in grievous bodily injury, the offender shall be liable on conviction to imprisonment for a minimum term of 15 years without option of fine.

Where the offence committed under subsection (1) of this section results in death, the offender shall be liable on conviction to death sentence without out option of fine.

6. Unlawful access to a computer

a) Any person, who without authorization or in excess of authorization, intentionally accesses in whole or in part, a computer system or network, commits an offence and liable on conviction to imprisonment for a term of not less than two years or to a fine of not less than N5,000,000 or to both fine and imprisonment.

b) Where the offence provided in subsection (1) of this section is committed with the intent of obtaining computer data, securing access to any program, commercial or industrial secrets or

confidential information, the punishment shall be imprisonment for a term of not less than three years or a fine of not less than N7,000,000.00 or to both fine and imprisonment.

c) Any person who, with the intent to commit an offence under this section, uses any device to avoid detection or otherwise prevent identification with the act or omission, commits an offence and liable on conviction to imprisonment for a term of not less than three years or to a fine of not less than N7,000,000.00 or to both fine and imprisonment.

This sections under offences and Penalties goes all the way to section 23. See reference below

3.4 Administration and Enforcement

1. Co-ordination and enforcement

i. The Office of the National Security Adviser shall serve as the coordinating body for all security and law enforcement agencies established by this Act and must;
   a) Assist all appropriate security, intelligence, law enforcement, and military services in Nigeria in preventing and combating cybercrime.
   b) Guarantee the effective development and execution of Nigeria's comprehensive cybersecurity policy.
   c) Develop capability for the efficient fulfillment of all applicable security, intelligence, law enforcement, and military tasks under this Act or any other cybercrime legislation in Nigeria.
   d) Conduct any other actions or things essential for the proper execution of the appropriate security and enforcement agencies' tasks under this Act.

ii. The Attorney – General of the Federation (in this Act referred to as "Minister") shall be the coMinister for the effective implementation and administration of this Act; and shall strengthen and enhance the existing legal framework to ensure.
   1. Compliance with international standards and the African Union Conventions on Cybersecurity by Nigeria's cybercrime and cybersecurity laws and policies.
   2. Preserve the international cooperation necessary to prevent and fight cybercrime and advance cybersecurity.
   3. Ensuring the successful prosecution of cybercrime and cybersecurity-related offenses.

iii. All law enforcement, security, and intelligence agencies shall develop the institutional capacity necessary to carry out the provisions of this Act effectively and, in collaboration with the National Security Adviser, shall initiate, develop, or organize training programs for officers charged with the responsibility of prohibiting, preventing, detecting, investigating, and prosecuting cybercrime on a national or international level.

2. Establishment of the Cybercrime Advisory Council

a) A Cybercrime Advisory Council (referred to in this Act as "the Council") is created. The Council shall be comprised of a representative from each of the Ministries and Agencies named in the Schedule to this Act.

b) A representative appointed according to subsection (1) of this section must be a Public Service official with at least the Directorate Cadre or its equivalent.

c) The Council should foster a culture of sharing expertise, experience, intelligence, and information among its members on a regular basis and shall make recommendations on problems relevant to the prevention and combatting of cybercrime and the advancement of cybersecurity in Nigeria.

d) A member of the Council must vacate office if:

1. he vacates the position for which he was elected; or
2. the President determines that the person's continued service as a member of the Council is not in the public interest.

1. The National Security Adviser shall preside over Council meetings.
2. The Council must assemble at least four times a year and whenever the National Security Adviser so requests.

3. Functions and powers of the Council

i. The Council must –

a) develop and offer broad policy recommendations for the execution of this Act's provisions; and

b) provide advise on ways to prevent and fight computer-related offenses, cybercrime, threats to national cyberspace, and other cyber security-related concerns.

ii. The Council shall have the authority to regulate its own proceedings and to adopt standing rules governing the holding of meetings, the giving of notices, the keeping of minutes of its proceedings, and such other issues as the Council may decide from time to time.

3.5 Search, Arrest and Prosecution

4. Power to conduct search and arrest

1. A fully authorized law enforcement official may apply ex parte to the court for the issue of a warrant for the purpose of conducting an investigation into cybercrime or computer-related crime.
2. A court may issue a warrant empowering an officer of the law to-
   a) Enter the stated or described premises or conveyance in the warrant;
   b) Conduct a search of the premises or conveyance, as well as any person discovered within; and
   c) Seize and hold any computer or electronic device, as well as any pertinent data stored on it.
3. The court must not issue a warrant according to paragraph (2) of this section unless and until the court determines that -
   a) The warrant is sought to avert the conduct of an offense punishable under this Act or to avert interference with an investigation according to this Act; or
   b) To conduct investigations into cybercrime, cybersecurity breaches, or other computer-related offenses; or
   c) There are reasonable reasons to believe that the person or property on the premises or conveyance may be important to the investigation of cybercrime or computer-related offenses; and
   d) The individual specified in the warrant is prepared to commit a violation of this Act.

5. Powers to conduct investigation or search without warrant

1. Where there is a verifiable threat of cybercrime or computer-related offenses, or where there is an urgent need to prevent the commission of an offence under this Act, and an application to the court or to a Judge in Chambers for a warrant would cause undue delay that would jeopardize the maintenance of public safety or order, an authorized law enforcement officer may, without prejudice to the provisions of section 27 of this Act or any other provision of law, without obtaining a warrant.
   a) enter and search any premises or location if he has reasonable grounds to believe that, inside such premises, location, or conveyance –
      i) An offense is being committed or is likely to be committed under this Act; or
      ii) there is evidence that an offence under this Act has been committed; or

iii) there is an immediate necessity to prevent an offence under this Act from being committed.

b) search any person or conveyance discovered on any premises or place that such authorized officers are authorized to enter and search pursuant to paragraph (a) of this subsection;

c) stop, board, and search any conveyance where the authorised officer has reasonable grounds to suspect the commission or likelihood of the commission of an offence under this Act;

d) seize, remove, and detain anything that is, or contains, or appears to him to be, or to contain, an offence under this Act;

e) use or cause to be used a computer or any device to search for data contained in or accessible to any computer system or computer network;

f) use any technology to decode or decrypt any coded or encrypted data contained in a computer into readable text or comprehensible format;

g) require any person in charge of or otherwise involved with the operation of any computer or electronic device in connection with an offence under this Act to produce such computer or electronic device.

h) arrest, search, and detain any individual who the officer has a reasonable suspicion of having committed or is about to commit a violation of this Act.

2. Where a seizure is effected in the course of search or investigation under this Act, a copy of the list of all the items, documents and other materials seized shall be made, duly endorsed and handed to the-
   a) Person on whom the search is made; or
   b) The owner of the seized property, location, or conveyance.
3. Notwithstanding subsection (1) of this section, a woman may be searched only by another woman.
4. Nothing in this section will be regarded as impairing any person's legitimate right to self-defense or property.
5. A fully authorized law enforcement officer who uses reasonable force in accordance with this Act is not responsible in any criminal or civil action for causing injury or death to any person or damage to or loss of any property via the use of reasonable force.

3.5 Cases/Examples

Cybercrime Scenarios

(i) Frios vs State of Kerala

Facts: In this case it was declared that the FRIENDS application software as protected system. The author of the application challenged the notification and the constitutional validity of software under Section 70.

The court upheld the validity of both. It included tampering with source code. Computer source code the electronic form, it can be printed on paper.

Held : The court held that tampering with Source code are punishable with three years jail and or two lakh rupees fine of rupees two lakh rupees for altering, concealing and destroying the source code.

(ii). R vs. Whiteley

In this case the accused gained unauthorized access to the Joint Academic Network (JANET) and deleted, added files and changed the passwords to deny access to the authorized users. Investigations had revealed that Kumar was logging on to the BSNL broadband Int ernet connection as if he was the authorized genuine user and 'made alteration in the computer database pertaining to broadband Internet user accounts' of the subscribers. The CBI had registered a cybercrime case against Kumar and carried out investigations on the basis of a complaint by the Press Informat ion Bureau, Chennai, which detected the unauthorised use of broadband Internet. The complaint also stated that the subscribers had incurred a loss of Rs 38,248 due to Kumar's wrongful act. He used to 'hack' sites from Bangalore, Chennai and other cities too, they said. Verdict: The Additional Chief Metropolitan Magistrate, Egmore, Chennai, sentenced N G Arun Kumar, the techie from Bangalore to undergo a rigorous imprisonment for one year with a fine of Rs 5,000 under section 420 IPC (cheating) and Section 66 of IT Act (Computer related Offense).

Discussion
Discuss any two cybercrimes in your country.

4.0 SELF-ASSESSMENT/EXERCISES

Discuss the classification of crimes under the Cybercrime Act.
Answer

i) Accessing or securing access to computer system or network.
ii) Downloading, coping or extracting any data or information.
iii) Introducing any computer, virus or contaminant in the computer.
iv) Disrupting the working of the computer.
v) Disrupting the access of the computer of an authorized user.
vi) Providing assistance to ensure unauthorized access to the computer.
vii) Tampering with computer source documents.
viii) Hacking of computer system.
ix) Caring on activities that are not in compliance with the provisions of the Act.

5.0 CONCLUSION

Cybercrime is a new kind of crime that's on the rise, thanks to the widespread use of the internet. Although Nigeria is not immune to cybercrime, lawmakers passed a measure to help curtail and combat the problem. Yahoo Boys, a slang term for Nigeria's notorious online scammers, are well-known around the world. When scammers are found, they face harsh penalties under this law.

6.0 SUMMARY

The National Assembly of the Federal Republic of Nigeria has proposed the Cybercrime Act 2015. These examples highlight how there are many crimes being committed, some of which have been caught, while others go unnoticed. The ACT is divided into eight sections, each with its own sequential section number. It's divided into 42 parts. The unit did not highlighted all the section in this ACT. See the reference to access all the sections.

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UNIT 3 THE INTERNATIONAL LAWS

CONTENTS

1.0 INTRODUCTION

Cybercrime is "international". Various organizations and governments have already made joint efforts in establishing global standards of legislation and law enforcement both on a regional and on an international scale. NIST designed a compliance framework that manage cyber risks. Implementing such framework ensures that a set of policies and procedures are in place to strengthen security. European and United Nations also provide governing regulations that guides the behavior of every individuals within the enforced region.

2.0 INTENDED LEARNING OUTCOMES (ILOS)

At the end of this unit, student will able to:

- have a better understanding of international laws and treaties
- Explain international cyber-attacks previously occurred

3.0 MAIN CONTENT

3.1 NIST Compliance

The Cybersecurity Framework (NCFS), authorized by the National Institute of Standards and Technology (NIST), offers a harmonized approach to cybersecurity as the most reliable global certifying body. NIST Cybersecurity Framework encompasses all required guidelines, standards, and best practices to manage the cyber-related risks responsibly. This framework is prioritized on flexibility and cost-

effectiveness. It promotes the resilience and protection of critical infrastructure by:

- Allowing better interpretation, management, and reduction of cybersecurity risks – to mitigate data loss, data misuse, and the subsequent restoration costs.
- Determining the most important activities and critical operations - to focus on securing them.
- Demonstrates the trust-worthiness of organizations who secure critical assets.
- Helps to prioritize investments to maximize the cybersecurity ROI Addresses regulatory and contractual obligations.

Supports the wider information security program By combining the NIST CSF framework with ISO/IEC 27001 - cybersecurity risk management becomes simplified. It also makes communication easier throughout the organization and across the supply chains via a common cybersecurity directive laid by NIST. Final Thoughts, as human dependence on technology intensifies, cyber laws in India and across the globe need constant up-gradation and refinements. The pandemic has also pushed much of the workforce into a remote working module increasing the need for app security. Lawmakers have to go the extra mile to stay ahead of the impostors, in order to block them at their advent. Cybercrimes can be controlled but it needs collaborative efforts of the lawmakers, the Internet or Network providers, the intercessors like banks and shopping sites, and, most importantly, the users. Only the prudent efforts of these stakeholders, ensuring their confinement to the law of the cyberland - can bring about online safety and resilience.

3.2 European Treaty on Cybercrime

In Europe, in 2004 the Council of Europe accepted a draft of a Treaty on Cybercrime, which was offered to countries worldwide. While many countries became signatories to the treaty, only a few have actually promulgated national laws compatible to the treaty. It is of interest that the treaty in Article 47 states: “Denunciation: Any Party may, at any time, denounce this Convention by means of a notification addressed to the Secretary General of the Council of Europe.” And Article 27 states: “Mutual assistance requests under this article shall be executed in accordance with the procedures specified by the requesting Party, except where incompatible with the law of the requested Party. The requested Party may refuse assistance”. Later in 2006, a controversial addendum was appended to the treaty that attracted a reduced number of signatory countries. The addendum was referring to fear of xenophobic concern surfacing on the Internet. All in all, the initiative of the Council of Europe

opened the way for national legislation on cybercrime in many countries and was used as a motivation for a similar treaty at the United Nations.

3.3 United Nations

The United Nations (UN) in 2010 received a proposal recommending a Cyberspace Treaty for the UN members. After extensive debate, the proposal was rejected because it contained unacceptable articles. Most of the controversy was created by the following articles:

- Article 2 of the proposal indicated supremacy of such treaty over national laws, stating that "Serious crimes against peace and security in cyberspace should be established as crimes under international law through a Cyberspace Treaty on the United Nations level, whether or not they were punishable under national law". This passage was considered ambiguous and offensive to national sovereignty.
- **Article 3.8.3**, referring to the European Union treaty counterpart, stated that "Data… of Internet traffic and transaction data, usually of telecommunications, emails, and websites visited [be retained] The purpose for data retention is traffic data analysis and mass surveillance of data…." The proposal implied that data be retained "for a period of between six months and two years." This article found the opposition of many local and international civil liberties organizations that found the wording offensive, especially the "mass surveillance of data," and clear violation of the fundamental civil rights, the cornerstone of which is privacy in personal communications.
- **Article 4** was the most controversial. In effect, the article is asking member-nations to accept the International Criminal

3.4 Impediments to Cyber Law Enforcement

International treaties can be drafted and signed and hopefully followed by the promulgation of national laws that effectively address cybercrime. This is only part one in the endless fight against cybercrime. Part two is the actual removal of the cybercriminals from society. Presently, in this there are several areas that need definition or improvement, with some listed below:

- National bureaucracy. In most countries the court systems are overloaded, and cases are scheduled to be heard one or two years after the accusation has been formalized and deposited. Until then the accused, if guilty, may be free to commit more cybercrime.
- Cyber-skilled judges. Most often, crimes committed in cyberspace involve network intrusions and security violations that are part of highly sophisticated fraud schemes. Judges without special and

continuous training may not understand why the accused is guilty or innocent of the charges.

- Authentication of evidence. If the header of an email has the email address of the accused, that in itself is not necessarily proof of guilt or innocence.
- Loss of evidence. With a long gap between the commitment of the alleged crime and the court hearing of the case, electronic evidence may be lost or altered.
- Access to evidence. Evidence may be in servers in a foreign country, and special data extradition procedures may be required.
- Comprehensive legislation. With cybercrime schemes ahead of law enforcement by several months, added delays are introduced into the process.
- Cybercrime investigators. With the Internet explosion and the parallel explosion in cybercrime, there is no country in the world that has sufficient cyber police personnel to pursue each and every case of alleged cybercrime.

3.5 Cases/Example

Three people held guilty in on line credit card scam. Customer's credit card details w ere misused through online means for booking air-tickets. These culprits were caught by the city Cyber Crime Investigation Cell in Pune. It was found that details misused were belonging to 100 people. Mr. Parvesh Chauhan, ICICI Prudential Life Insurance officer had complained on behalf of one of his customers. In this regard Mr. Sanjeet Mahavir Singh Lukkad, Dharmendra Bhika Kale and Ahmead Sikandar Shaikh were arrested. Lukkad being employed at a private institution, Kale was his friend. Sheikh was employed in one of the branches of State Bank of India. According to the informaion provided by the authorities, one of the customers received a SMS based alert for purchasing of the ticket even when the credit card was being held by him. Customer was alert and came to know something was fishy; he enquired and came to know about the misuse. He contacted the Bank in this regard. Police observed involvement of many Bank's in this reference. The tickets were book through online means. Police requested for the log details and got the information of the Private Institution. Investigation revealed that the details were obtained from State Bank of India. Sheikh was working in the credit card department; due to this he had access to credit card details of some customers. He gave that information to Kale. Kale in return passed t his inf ormat ion t o his f riend Lukkad. Using t he information obtained from Kale, Lukkad booked tickets. He used to sell these tickets to customers and get money for the same. He had given few tickets to various other institutions. Cyber Cell was involved in eight days of investigation and finally caught the culprits. In this regard various Banks

have been contacted; also four airline industries were contacted and alerted.

Discussion
What section of the Information Technology Act (ITA) sanction internet fraudsters? Explain the consequence according to the Act.

5.0 CONCLUSION

Lawmakers and law enforcement agencies, around the world, advocate the need for cyber laws that are written in the cyber language. That is, laws that explicitly define cyber offenses and fully support the acceptance of cyber evidence. International bodies, responding to this call, have convened and produced treaties and conventions that, unfortunately, have fallen short of receiving total acceptance by the member countries. A country's participation in an international agreement becomes effective only if domestic laws are drafted and approved that legislate the intent of the signed international agreement.

6.0 SUMMARY

Cyber security framework is authorized by the NIST. The framework is offered to harmonized cyber security risks. Europe accepted a cybercrime treaty in 2004 which was offered to countries worldwide. United Nation received a treaty in 2010 on cyberspace for UN members. After extensive debate, the proposal was rejected because it contained unacceptable articles. International treaties can be drafted and signed and hopefully followed by the promulgation of national laws that effectively address cybercrime.

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UNIT 4 CYBER ETHICS

CONTENTS

1.0 INTRODUCTION

Ethics is the study of right and wrong in human conduct. It is also referred to as a theoretical examination of morality or "theory of morals." Other philosophers have defined ethics in a variety of ways. Robert C. Solomon, in Morality and the Good Life, defines ethics as a set of "theories of value, virtue, or of right (valuable) action." O.J. Johnson, on the other hand, defines ethics as a set of theories "that provide general rules or principles to be used in making moral decisions and, unlike ordinary intuitions, provides a justification for those rules." The word ethics comes from the ancient Greek word eché, which means character. Every human society practices ethics in some way because every society attaches a value on a continuum of good to bad, right to wrong, to an individual's actions according to where that individual's actions fall within the domain of that society's rules and canons.

2.0 INTENDED LEARNING OUTCOMES (ILOS)

At the end of this unit, students will be able to:

- Understand the use of ethical theories in ethical arguments.
- Articulate the ethical tradeoffs in a technical decision.
- Appreciate the role of professional codes of ethics.

3.0 MAIN CONTENT

3.1 Ethical Theories

Since the dawn of humanity, human actions have been judged good or bad, right or wrong based on theories or systems of justice developed, tested, revised, and debated by philosophers and elders in each society. Such theories are commonly known as ethical theories. An ethical theory determines if an action or set of actions is morally right or wrong. Codes of ethics have been drawn up based on these ethical theories. The processes of reasoning, explanation, and justification used in ethics are based on these theories. Ethical theories fall into two categories: those based on one choosing his or her action based on the expected maximum value or values as a consequence of the action and those based on one choosing his or her action based on one's obligation or requirements of duty. The Greeks called the first category of theories telos, meaning purpose or aim. We now call these teleological or consequentialist theories. The Greeks called the second category of theories deon, meaning binding or necessary. Today, we call them deontological theories.

3.1.1 Consequentialist Theories

We think of the right action as that which produces good consequences. If an act produces good consequences, then it is the right thing to do. Those who subscribe to this position are called consequentialists. Consequentialist theories judge human actions as good or bad, right or wrong, based on the best attainable results of such actions—a desirable result denotes a good action, and vice versa. According to Richard T. Hull, consequentialist theories "have three parts: a theory of value, a principle of utility, and a decision procedure." Within these are further theories.

For example, in the theory of value there are several other theories held by consequentialists including:

- Hedonism, which equates good with pleasure, bad or evil with pain.
- Eudamonism, which equates good with happiness, bad or evil with unhappiness.
- Agathism, which views good as an indefinable, intrinsic feature of various situations and states. Evil is seen as either an indefinable, intrinsic feature of other situations and states, or simply as the absence of good.
- Agapeism, which equates good with live, bad with hate.
- Values pluralism, which holds that there are many kinds of good, including pleasure and happiness, but also knowledge, friendship,

love, and so forth. These may or may not be viewed as differing in importance or priority.

There are three commonly discussed types of consequentialist theory:

i. Egoism puts an individual's interests and happiness above everything else. With egoism, any action is good as long as it maximizes an individual's overall happiness. There are two kinds of egoism: ethical egoism, which states how people ought to behave as they pursue their own interests, and psychological egoism, which describes how people actually behave.

ii. Utilitarianism, unlike egoism, puts a group's interest and happiness above those of an individual, for the good of many. Thus, an action is good if it benefits the maximum number of people. Among the forms of utilitarianism are the following:
   - Act utilitarianism tells one to consider seriously the consequences of all actions before choosing that with the best overall advantage, happiness in this case, for the maximum number of people.
   - Rule utilitarianism tells one to obey those rules that bring the maximum happiness to the greatest number of people. Rule utilitarianism maintains that a behavioral code or rule is good if the consequences of adopting that rule are favorable to the greatest number of people.

iii. Altruism states that an action is right if the consequences of that action are favorable to all except the actor

3.1.2 Deontological Theories

The theory of deontological reason does not concern itself with the consequences of the action but rather with the will of the action. An action is good or bad depending on the will inherent in it. According to deontological theory, an act is considered good if the individual committing it had a good reason to do so. This theory has a duty attached to it. For example, we know that killing is bad, but if an armed intruder enters your house and you kill him, your action is good, according to deontologists. You did it because you had a duty to protect your family and property. Deontologists fall into two categories: act deontologists and rule deontologists.

- Act deontologists consider every judgment of moral obligation to be based on its own merit. We decide separately in each particular situation what is the right thing to do.
- Rule deontologists consider that one's duty in any situation is to act within rules.

All other contemporary ethical theories, as Richard T. Hull contends, are hybrids of utilitarianist and deontologist theories. The process of ethical reasoning takes several steps, which we refer to as layers of reasoning, before one can justify to someone else the goodness or badness, rightness or wrongness of one's action. For example, if someone wants to convince you to own a concealed gun, he or she needs to explain to you why it is good to have a concealed gun. In such an exercise, the person may start by explaining to you that we are living in difficult times and that no one is safe. You may then ask why no one is safe, to which the person might reply that there are many bad people out there in possession of high-powered guns waiting to fire them for various and very often unbelievable reasons. So owning a gun will level the playing field. Then you may ask why owning a gun levels the playing field, to which the answer would be that if the bad guys suspect that you own a gun just like theirs, they will think twice before attacking you. You may further ask why this is so; the answer may be that if they attack you, they themselves can get killed in the action. Therefore, because of this fear, you are not likely to be attacked. Hence, owning a gun may save your life and enable you to continue pursuing the ultimate concept of the good life: happiness.

On the other hand, to convince somebody not to own a concealed gun also needs a plausible explanation and several layers of reasoning to demonstrate why owning a gun is bad. Why is it a bad thing, you would ask, and the answer would be because bad guys will always get guns. And if they do, the possibility of everyone having a concealed gun may make those bad guys trigger- happy to get you fast before you get them. It also evokes an image of the Wild West filled with gun- toting people daring everyone in order to get a kick out of what may be a boring life. You would then ask why is this situation dangerous if no one fires? The reply might be because it creates a situation in which innocent people may get hurt, denying them happiness and the good life. The explanation and reasoning process can go on and on for several more layers before one is convinced that owning a gun is good or bad. The act of owning a gun is a human act that can be judged as either good or bad, right or wrong depending on the moral and ethical principles used.

3.2 Codes of Ethics

The main domains in which ethics is defined are governed by a particular and definitive regiment of guidelines and rules of thumb called codes of ethics. These rules, guidelines, canons, advisories, or whatever you want to call them, are usually followed by members of the respective domains. For example, your family has an ethical set of rules that every member of the family must observe. Your school has a set of conduct rules that all students, staff and faculty must observe. And, your college has a set of

rules that govern the use of college computers. So depending on the domain, ethical codes can take any of the following forms:

- principles, which may act as guidelines, references, or bases for some document;
- public policies, which may include aspects of acceptable behavior, norms, and practices of a society or group;
- codes of conduct, which may include ethical principles; and
- legal instruments, which enforce good conduct through courts.

Although the use of ethical codes is still limited to professions and high visibility institutions and businesses, there is a growing movement toward widespread use. The wording, content, and target of codes can differ greatly. Some codes are written purposely for the public, others target employees, and yet others are for professionals only. This unit is referred to the codes of the Association of Computing Machinery (ACM) and the Institute of Electric and Electronics Engineers' Computer Society (IEEE Computer), both professional organizations. Codes for the ACM can be found at and those for IEEE Computer at www.ieee.org.

Objectives of Codes of Ethics

Different domains and groups of people formulate different codes of ethics, but they all have the following objectives:

- **Disciplinary**: By instilling discipline, the group or profession ensures professionalism and integrity of its members.
- **Advisory**: Codes are usually a good source of tips for members, offering advice and guidance in areas where moral issues are fuzzy.
- **Educational**: Ethical codes are good educational tools for members of the domain, especially new members who have to learn the dos and don'ts of the profession. The codes are also a good resource for existing members needing to refresh and polish their possibly waning morals.
- **Inspirational**: Besides being disciplinary, advisory, and educational, codes should also carry subliminal messages to those using them to inspire them to be good.
- **Publicity**: One way for professions to create a good clientele is to show that they have a strong code of ethics and, therefore, their members are committed to basic values and are responsible.

Discussion
Why is ethics relevant in the cyberspace?

4.0 SELF-ASSESSMENT/EXERCISES

1. What are the ten commandments for computer ethics?

Answer

(i) Thou shalt not use a computer to harm other people.
(ii) Thou shalt not interfere with other people's computer work.
(iii) Thou shalt not snoop around in other people's files.
(iv) Thou shalt not use a computer to steal.
(v) Thou shalt not use a computer to bear false witness.
(vi) Thou shalt not use of copy software for which you have not paid.
(vii) Thou shalt not use other people's computer resources without authorization.
(viii) Thou shalt not appropriate other people's intellectual output.
(ix) Thou shalt think about the social consequences of the program u write.
(x) Thou shalt use a computer in ways to show consideration and respect.

2. Explain the three levels of computer ethics.

Answer

- **First level**: - It is the basic level where computer ethics tries to sensitize people to the fact that computer technology has social and ethical consequences. Newspaper, TV news program, and magazines have highlighted the topic of computer ethics by reporting on events relating to computer viruses, software ownership law suits, computer aided bank robbery, computer malfunction etc.
- **Second level**:- It consists of someone who takes interest in computer ethics cases, collects examples, clarifies them, looks for similarities and differences reads related works, attends relevant events to make preliminary assessments and after comparing them.
- **Third level**: - It referred to as „theoretical" computer ethics applies scholarly theories to computer ethics cases and concepts in order to deepen the understanding of issues. All three level of analysis are important to the goal of advancing and defending human values.

5.0 CONCLUSION

The role of ethics is to help societies distinguish between right and wrong and to give each society a basis for justifying the judgment of human actions. Ethics is, therefore, a field of inquiry whose subject is human actions, collectively called human conduct, that are taken consciously, willfully, and for which one can be held responsible. According to Fr.

Austin Fagothey, such acts must have knowledge, which signifies the presence of a motive, be voluntary, and have freedom to signify the presence of free choice to act or not to act.

6.0 SUMMARY

The purpose of ethics is to interpret human conduct, acknowledging and distinguishing between right and wrong. The interpretation is based on a system which uses a mixture of induction and deduction. In most cases, these arguments are based on historical schools of thought called ethical theories. There are many different kinds of ethical theories, and within each theory there may be different versions of that theory. Let us discuss these next.

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