# Information and Computer Security

IE 5602 ICT for Industrial Engineering

# The Threat Landscape

- Number of cybercrimes are increasing
- Organizations are putting in place a range of countermeasures to combat cybercrime
- Computer security incidents surged in the following industries:
  - Public sector organizations
  - Entertainment, media, and communications
  - Technology and telecommunications companies
  - Pharmaceuticals and life sciences
  - Power and utilities organizations

# Why Computer Incidents Are So Prevalent

- Increasing Complexity Increases Vulnerability
  - Cloud computing, networks, computers, mobile devices, virtualization, OS applications, Web sites, switches, routers, and gateways are interconnected and driven by millions of lines of code
- Expanding and Changing Systems Introduce New Risks
  - It is difficult for IT organizations to keep up with the pace of technological change, successfully perform an ongoing assessment of new security risks, and implement approaches for dealing with them

# Why Computer Incidents Are So Prevalent

- Increased Prevalence of Bring Your Own Device Policies
  - Bring your own device (BYOD): a business policy that permits (encourages) employees to use their own mobile devices to access company computing resources and applications
  - BYOD makes it difficult for IT organizations to adequately safeguard additional portable devices with various OSs and applications
- Growing Reliance on Commercial Software with Known Vulnerabilities
  - An exploit is an attack on an information system that takes advantage of a particular system vulnerability
    - -Often this attack is due to poor system design or implementation
  - Users should download and install patches for known fixes to software vulnerabilities
    - -Any delay in doing so exposes the user to a potential security breach

# Why Computer Incidents Are So Prevalent

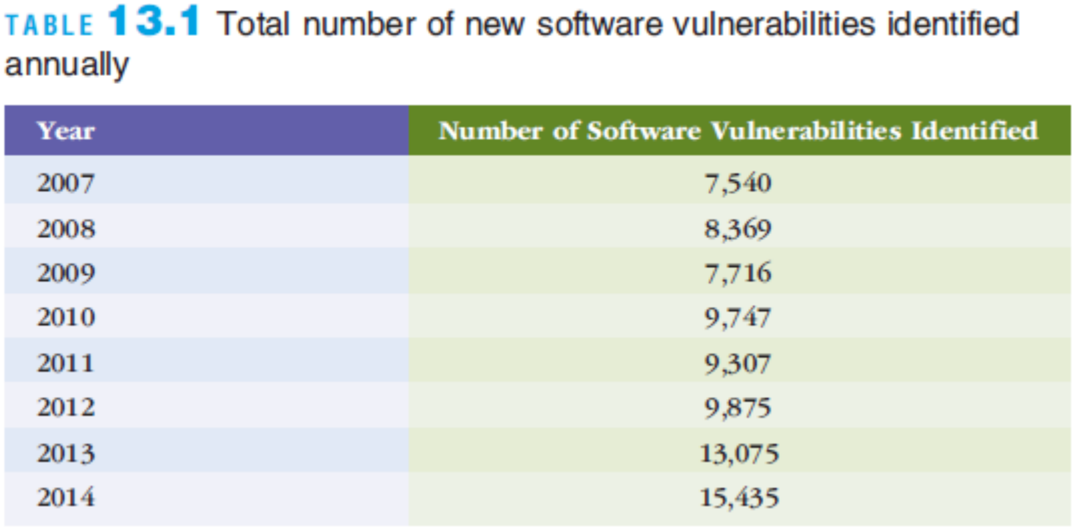


TABLE 13.1 Total number of new software vulnerabilities identified annually

| Year | Number of Software Vulnerabilities Identified |
|---|---|
| 2007 | 7,540 |
| 2008 | 8,369 |
| 2009 | 7,716 |
| 2010 | 9,747 |
| 2011 | 9,307 |
| 2012 | 9,875 |
| 2013 | 13,075 |
| 2014 | 15,435 |

Source: https://www.imperva.com/blog/the-state-of-vulnerabilities-in-2019/

# Why Computer Incidents Are So Prevalent

- Increasing Sophistication of Those Who Would Do Harm
  - Today's computer menace is organized and may be part of an organized group that has an agenda and targets specific organizations and Web sites

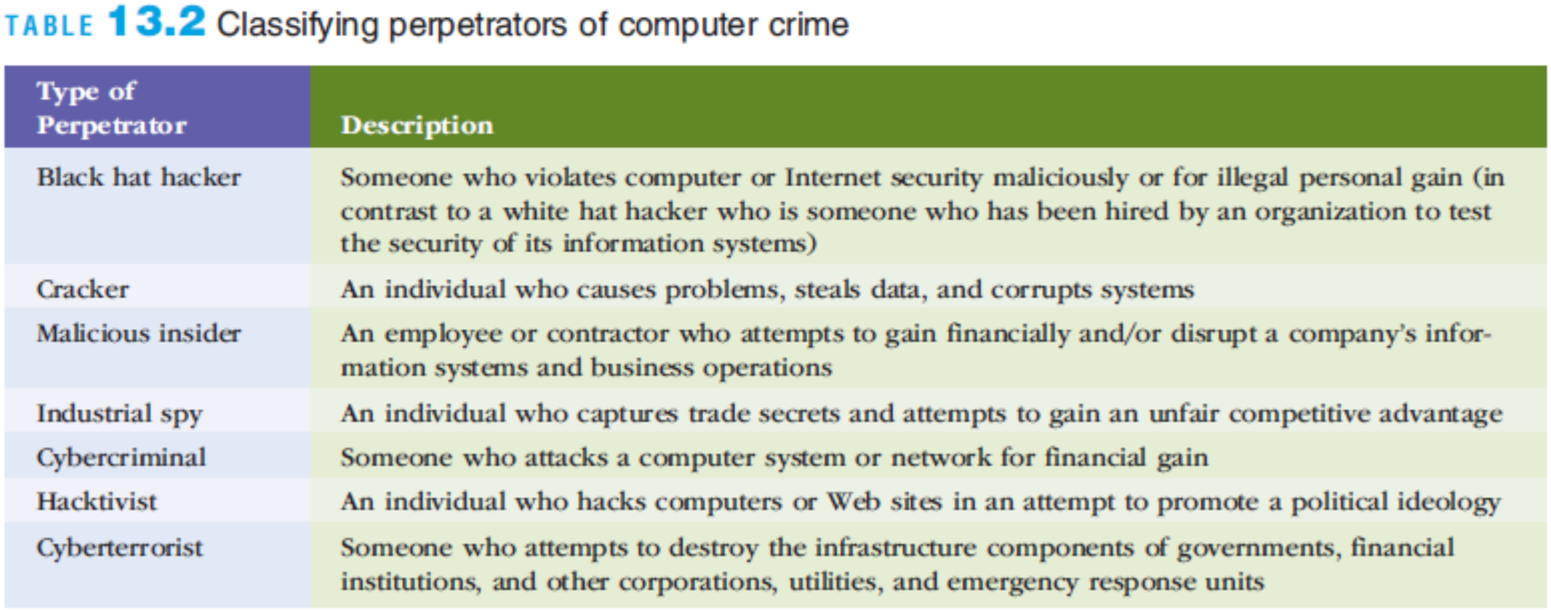


TABLE 13.2 Classifying perpetrators of computer crime

| Type of Perpetrator | Description |
|---|---|
| Black hat hacker | Someone who violates computer or Internet security maliciously or for illegal personal gain (in contrast to a white hat hacker who is someone who has been hired by an organization to test the security of its information systems) |
| Cracker | An individual who causes problems, steals data, and corrupts systems |
| Malicious insider | An employee or contractor who attempts to gain financially and/or disrupt a company's information systems and business operations |
| Industrial spy | An individual who captures trade secrets and attempts to gain an unfair competitive advantage |
| Cybercriminal | Someone who attacks a computer system or network for financial gain |
| Hacktivist | An individual who hacks computers or Web sites in an attempt to promote a political ideology |
| Cyberterrorist | Someone who attempts to destroy the infrastructure components of governments, financial institutions, and other corporations, utilities, and emergency response units |

# Types of Exploits

- Common attacks include:
  - Ransomware
  - Viruses
  - Worms
  - Trojan horses
  - Blended threat
  - Spam
  - Distributed denial-of-service attacks
  - Rootkits
  - Advanced persistent threat
  - Phishing, spear-phishing, smishing and vishing
  - Identity theft
  - Cyberespionage and cyberterrorism

# Types of Exploits

- Ransomware
  - Malware that stops you from using your computer or accessing your data until you meet certain demands such as paying a ransom or sending photos to the attacker
- Viruses
  - A piece of programming code (usually disguised as something else) that causes a computer to behave in an unexpected and undesirable manner
  - Spread to other machines when a computer user shares an infected file or sends an email with a virus-infected attachment
- Worms
  - A harmful program that resides in the active memory of the computer and duplicates itself
  - Can propagate without human intervention

# Types of Exploits

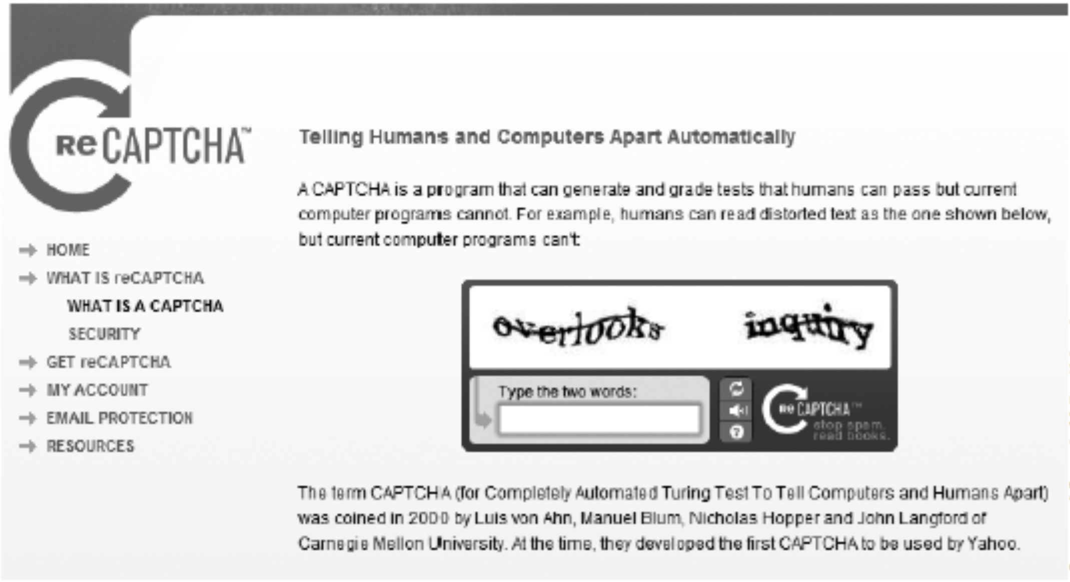
- Trojan Horses [https://en.wikipedia.org/wiki/Trojan_Horse#:~:text=The%20Trojan%20Horse%20is%20a,of%20men%20inside%2C%20including%20Odysseus.]
  - A seemingly harmless program in which malicious code is hidden
  - A victim on the receiving end is usually tricked into opening it because it appears to be useful software from a legitimate source
    - The program's harmful payload might be designed to enable the attacker to destroy hard drives, corrupt files, control the computer remotely, launch attacks against other computers, steal passwords or spy on users
  - Often creates a "backdoor" on a computer that enables an attacker to gain future access
  - Logic bomb
    - A type of Trojan horse that executes when it is triggered by a specific event

# Types of Exploits

- Spam
  - The use of email systems to send unsolicited email to large numbers of people
  - Also an inexpensive method of marketing used by many legitimate organizations
  - Controlling the Assault of Non-Solicited Pornography and Marketing (CAN-SPAM) Act states that it is legal to spam, provided the messages meet a few basic requirements
    - Spammers cannot disguise their identity by using a false return address
    - The email must include a label specifying that it is an ad or a solicitation
    - The email must include a way for recipients to opt out of future mass mailings

# Types of Exploits

- Spam (cont'd)
  - CAPTCHA (Completely Automated Public Turing Test to Tell Computers and Humans Apart) software generates and grades tests that humans can pass and all but the most sophisticated computer programs cannot



**Telling Humans and Computers Apart Automatically**

A CAPTCHA is a program that can generate and grade tests that humans can pass but current computer programs cannot. For example, humans can read distorted text as the one shown below, but current computer programs can't:

The term CAPTCHA (for Completely Automated Turing Test To Tell Computers and Humans Apart) was coined in 2000 by Luis von Ahn, Manuel Blum, Nicholas Hopper and John Langford of Carnegie Mellon University. At the time, they developed the first CAPTCHA to be used by Yahoo.

Courtesy of Carnegie Mellon University

FIGURE 13.1

**Example of CAPTCHA**

CAPTCHA is used to distinguish humans from automated bots.

# Types of Exploits

- Distributed Denial-of-Service (DDOS) Attacks
  - An attack in which a malicious hacker takes over computers via the Internet and causes them to flood a target site with demands for data and other small tasks
  - Keeps target so busy responding to requests that legitimate users cannot get in
  - Botnet
    - A large group of computers, controlled from one or more remote locations by hackers, without the consent of their owners
    - Sometimes called zombies
    - Frequently used to distribute spam and malicious code

# Types of Exploits

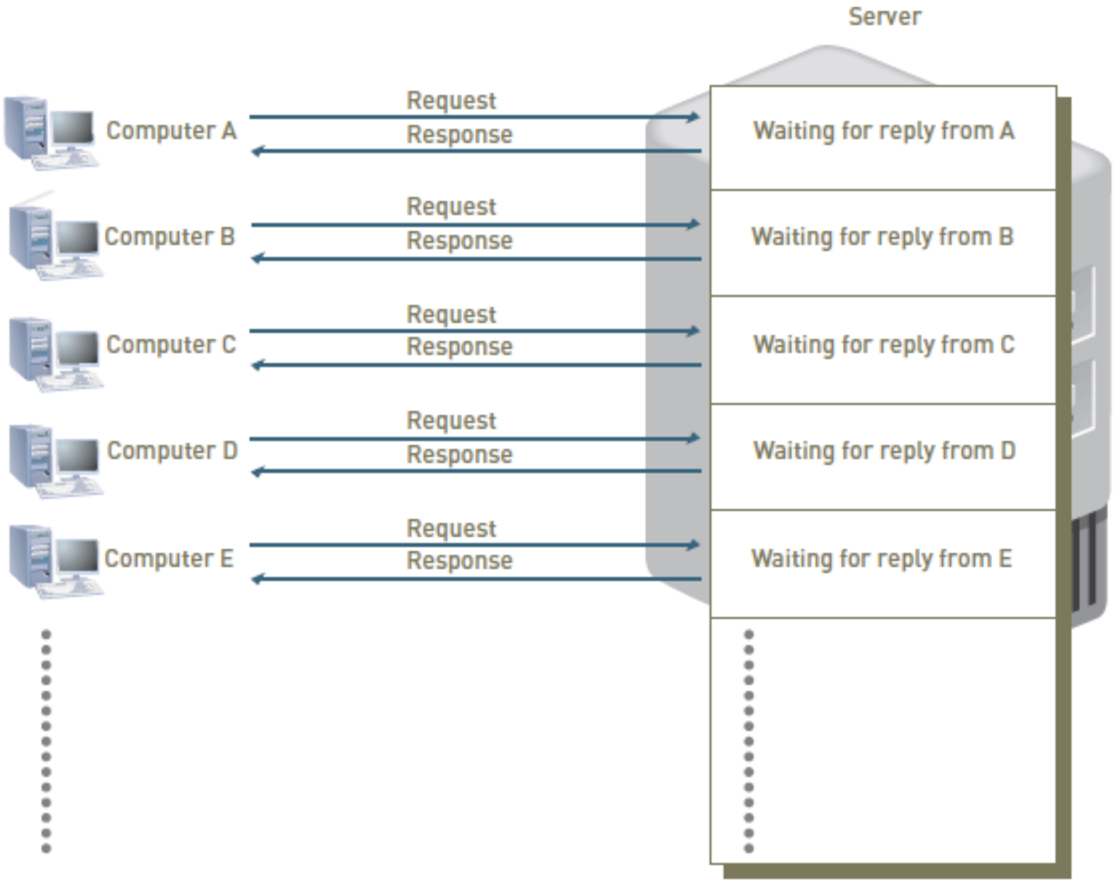


FIGURE 13.2

**Distributed denial-of-service attack**

A DDoS attack floods a target site with demands for data and other small tasks.

# Types of Exploits

- Rootkit
  - A set of programs that enables its user to gain administrator-level access to a computer without the end user's consent or knowledge
  - Attackers can use the rootkit to execute files, access logs, monitor user activity, and change the computer's configuration
  - Symptoms of rootkit infections:
    - Computer locks up or fails to respond to input from the keyboard
    - Screen saver changes without any action on the part of the user
    - Taskbar disappears
    - Network activities function extremely slow

# Types of Exploits

- Advanced Persistent Threat
  - APT is a network attack in which an intruder gains access to a network and stays undetected with the intention of stealing data over a long period of time
  - An APT attack advances through the following five phases:

    -Reconnaissance

    -Incursion

    -Discovery

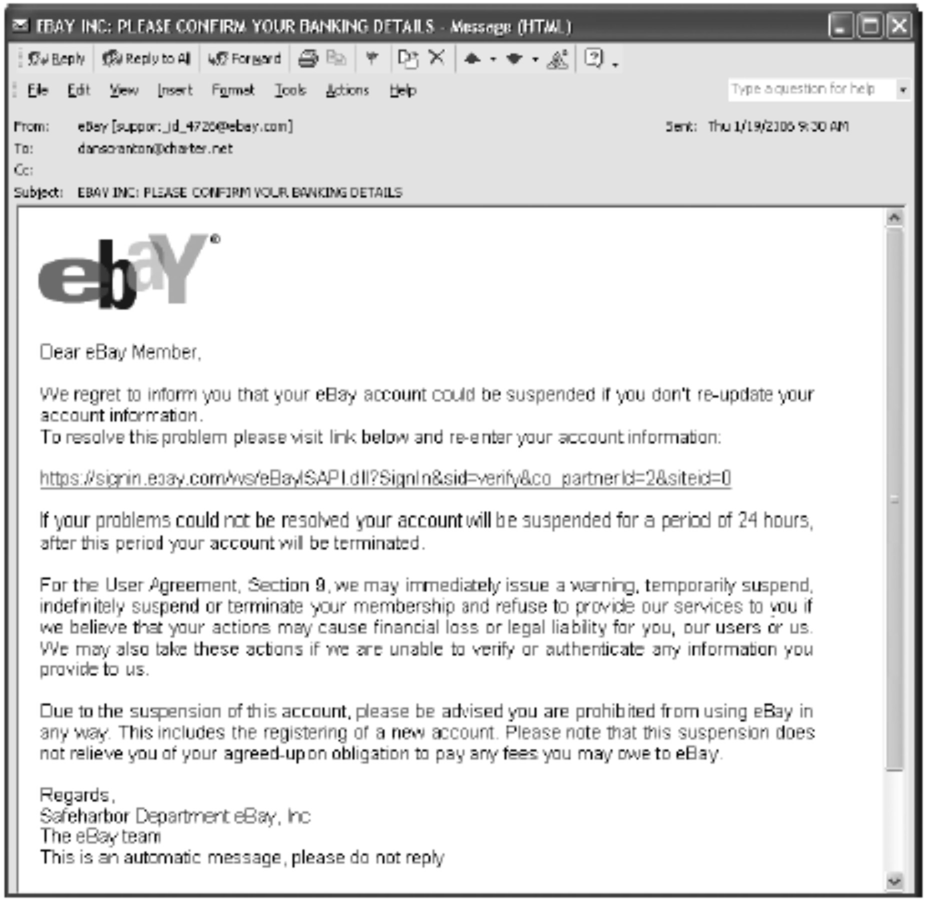
    -Capture

    -Export
  - Detecting anomalies in outbound data is the best way for administrators to discover that the network has been the target of an APT attack

# Types of Exploits

- Phishing
  - The act of fraudulently using email to try to get the recipient to reveal personal data
  - Con artists send legitimate-looking emails urging recipients to take action to avoid a negative consequence or to receive a reward
  - Spear-phishing is a variation of phishing where fraudulent emails are sent to a certain organization's employees
    - Much more precise and narrow
    - Designed to look like they came from high-level executives within organization

# Types of Exploits



From: eBay [support_id_4720@ebay.com]  Sent: Thu 1/19/2006 9:30 AM
To: danscranton@charter.net
Cc:
Subject: EBAY INC: PLEASE CONFIRM YOUR BANKING DETAILS

Dear eBay Member,

We regret to inform you that your eBay account could be suspended if you don't re-update your account information.
To resolve this problem please visit link below and re-enter your account information:

https://signin.ebay.com/ws/eBayISAPI.dll?SignIn&sid=verify&co_partnerId=2&siteid=0

If your problems could not be resolved your account will be suspended for a period of 24 hours, after this period your account will be terminated.

For the User Agreement, Section 9, we may immediately issue a warning, temporarily suspend, indefinitely suspend or terminate your membership and refuse to provide our services to you if we believe that your actions may cause financial loss or legal liability for you, our users or us. We may also take these actions if we are unable to verify or authenticate any information you provide to us.

Due to the suspension of this account, please be advised you are prohibited from using eBay in any way. This includes the registering of a new account. Please note that this suspension does not relieve you of your agreed-upon obligation to pay any fees you may owe to eBay.

Regards,
Safeharbor Department eBay, Inc
The eBay team
This is an automatic message, please do not reply

**FIGURE 13.3**

**Example of phishing email**

Phishing attacks attempt to get the recipient to reveal personal data.

# Types of Exploits

- Smishing and Vishing
  - Smishing is a variation of phishing that involves the use of texting
  - Vishing is similar to smishing except the victims receive a voice mail message telling them to call a phone number or access a Web site
- Identity Theft
  - The theft of personal information and then used without their permission
  - Data breach is the unintended release of sensitive data or the access of sensitive data by unauthorized individuals

    -Often results in identity theft
  - Most e-commerce Web sites use some form of encryption technology to protect information as it comes from the consumer

# Types of Exploits

- Cyberespionage
  - Involves the development of malware that secretly steals data in the computer systems of organizations, such as government agencies, military contractors, political organizations, and manufacturing firms
  - Mostly targeted toward high-value data such as the following:
    - Sales, marketing, and new product development plans, schedules, and budgets
    - Details about product designs and innovative processes
    - Employee personal information
    - Customer and client data
    - Sensitive information about partners and partner agreements

# Federal Laws for Prosecuting Computer Attacks

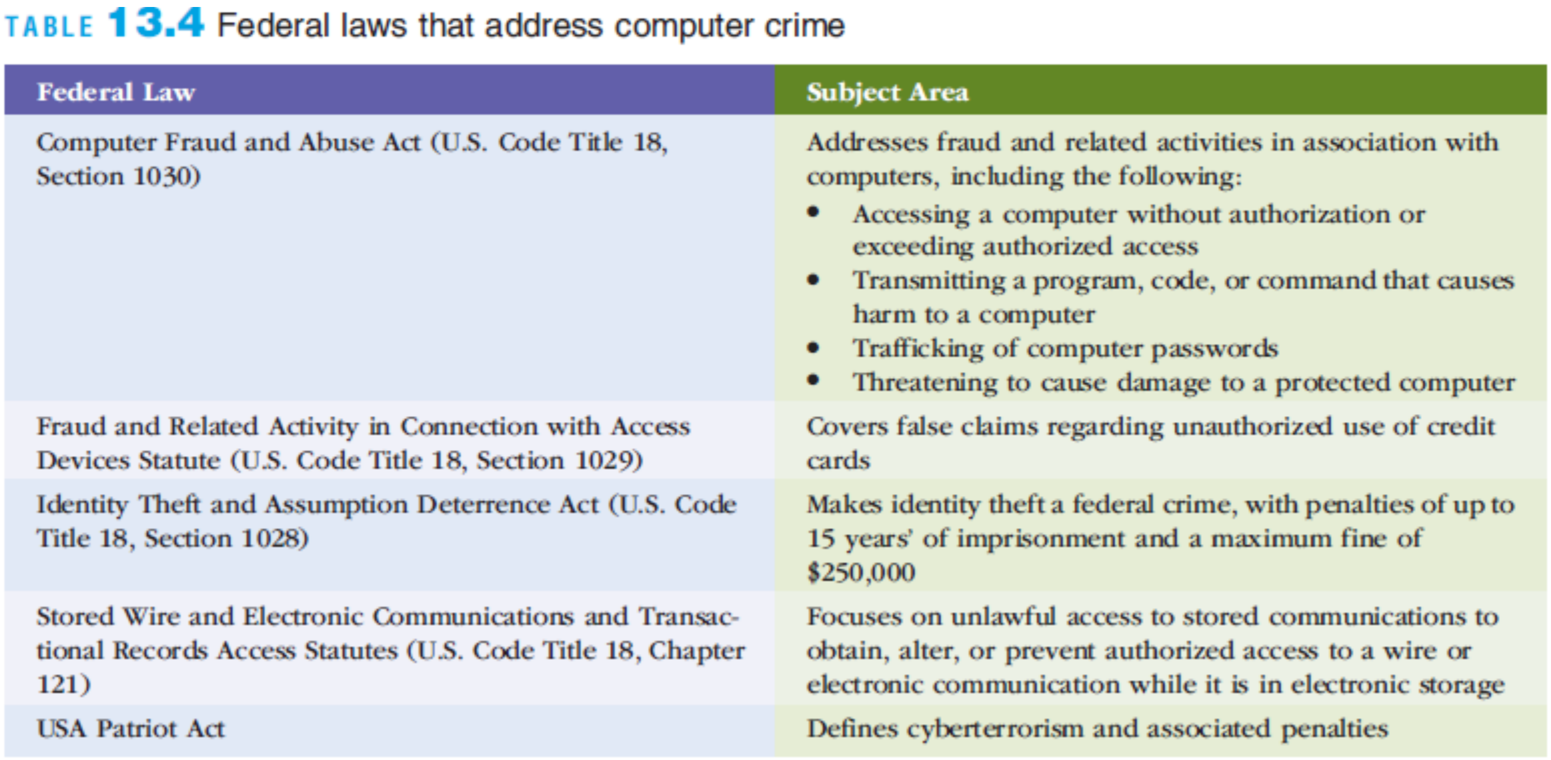


TABLE 13.4 Federal laws that address computer crime

| Federal Law | Subject Area |
|---|---|
| Computer Fraud and Abuse Act (U.S. Code Title 18, Section 1030) | Addresses fraud and related activities in association with computers, including the following:<br>• Accessing a computer without authorization or exceeding authorized access<br>• Transmitting a program, code, or command that causes harm to a computer<br>• Trafficking of computer passwords<br>• Threatening to cause damage to a protected computer |
| Fraud and Related Activity in Connection with Access Devices Statute (U.S. Code Title 18, Section 1029) | Covers false claims regarding unauthorized use of credit cards |
| Identity Theft and Assumption Deterrence Act (U.S. Code Title 18, Section 1028) | Makes identity theft a federal crime, with penalties of up to 15 years' of imprisonment and a maximum fine of $250,000 |
| Stored Wire and Electronic Communications and Transactional Records Access Statutes (U.S. Code Title 18, Chapter 121) | Focuses on unlawful access to stored communications to obtain, alter, or prevent authorized access to a wire or electronic communication while it is in electronic storage |
| USA Patriot Act | Defines cyberterrorism and associated penalties |

# พ.ร.บ. การรักษาความมั่นคงปลอดภัยไซเบอร์ พ.ศ. 2562

- มีการกำหนดโครงสร้างและแนวทางการกำกับดูแลด้านความมั่นคงปลอดภัยไซเบอร์
- มีการกำหนดนโยบาย แผนงาน และกรอบการดำเนินงานด้านความมั่นคงปลอดภัยไซเบอร์
- จัดทำแผนการตรวจสอบและประเมินความเสี่ยงด้านการรักษาความมั่นคงปลอดภัยไซเบอร์
- มีการทดสอบด้านความมั่นคงปลอดภัย ค้นหาช่องโหว่ และทดสอบเจาะระบบ CII ที่สำคัญ
- จัดทำแผนการรับมือภัยคุกคามไซเบอร์ รวมไปถึงแนวทางปฏิบัติ และการเฝ้าระวังทั้งในภาวะปกติและภาวะฉุกเฉิน

# พ.ร.บ. การรักษาความมั่นคงปลอดภัยไซเบอร์ พ.ศ. 2562

- มีกลไกหรือขั้นตอนสำหรับเฝ้าระวังและรับมือกับภัยคุกคามไซเบอร์ทั้งระดับไม่ร้ายแรง ระดับร้ายแรง และระดับวิกฤต
- มีการตรวจสอบด้านความมั่นคงปลอดภัยไซเบอร์ โดยผู้ตรวจสอบภายในหรือผู้ตรวจอิสระภายนอก
- มีการประสานงานกับ ThaiCERT, TB-CERT, หน่วยงานควบคุมและกำกับดูแลที่เกี่ยวข้อง
- มีการพัฒนาบุคลากรและผู้เชี่ยวชาญด้านการรักษาความมั่นคงปลอดภัยไซเบอร์ทั้งภาครัฐและเอกชน
- สร้างความตระหนักด้านการรักษาความมั่นคงปลอดภัยไซเบอร์ให้แก่ผู้บริหารและผู้ปฏิบัติงาน

https://techsauce.co/news/cybersecurity-act-and-data-privacy-act-2019-announcement

# Implementing Secure, Private, Reliable Computing

- A strong security program begins by
  - Assessing threats to the organization's computers and network
  - Identifying actions that address the most serious vulnerabilities
  - Educating users about the risks involved and the actions they must take to prevent a security incident
- If an intrusion occurs, there must be a clear reaction plan that addresses:
  - Notification
  - Evidence protection
  - Activity log maintenance
  - Containment
  - Eradication
  - Recovery

# Risk Assessment

- Risk assessment
  - The process of assessing security-related risks to an organization's computer and networks form both internal and external threats
- Steps in a general risk assessment process are:
  - Identify the set of assets about which the organization is most concerned
  - Identify the loss events or the risks or threats that could occur
  - Assess the frequency of events or the likelihood of each potential threat
  - Determine the impact of each threat occurring
  - Determine how each threat can be mitigated so it is less likely to occur
  - Assess the feasibility of implementing the mitigation options
  - Perform a cost-benefit analysis to ensure that your efforts will be cost effective
  - Make the decision on whether or not to implement a particular countermeasure

# Establishing a Security Policy

- Security policy
  - Defines an organization's security requirements along with the controls and sanctions needed to meet those requirements
  - Outlines what needs to be done but not how to do it
- Automated system rules should mirror an organization's written policies
- Some companies have begun to include special security requirements for mobile devices as part of their security policies

# Educating Employees and Contract Workers

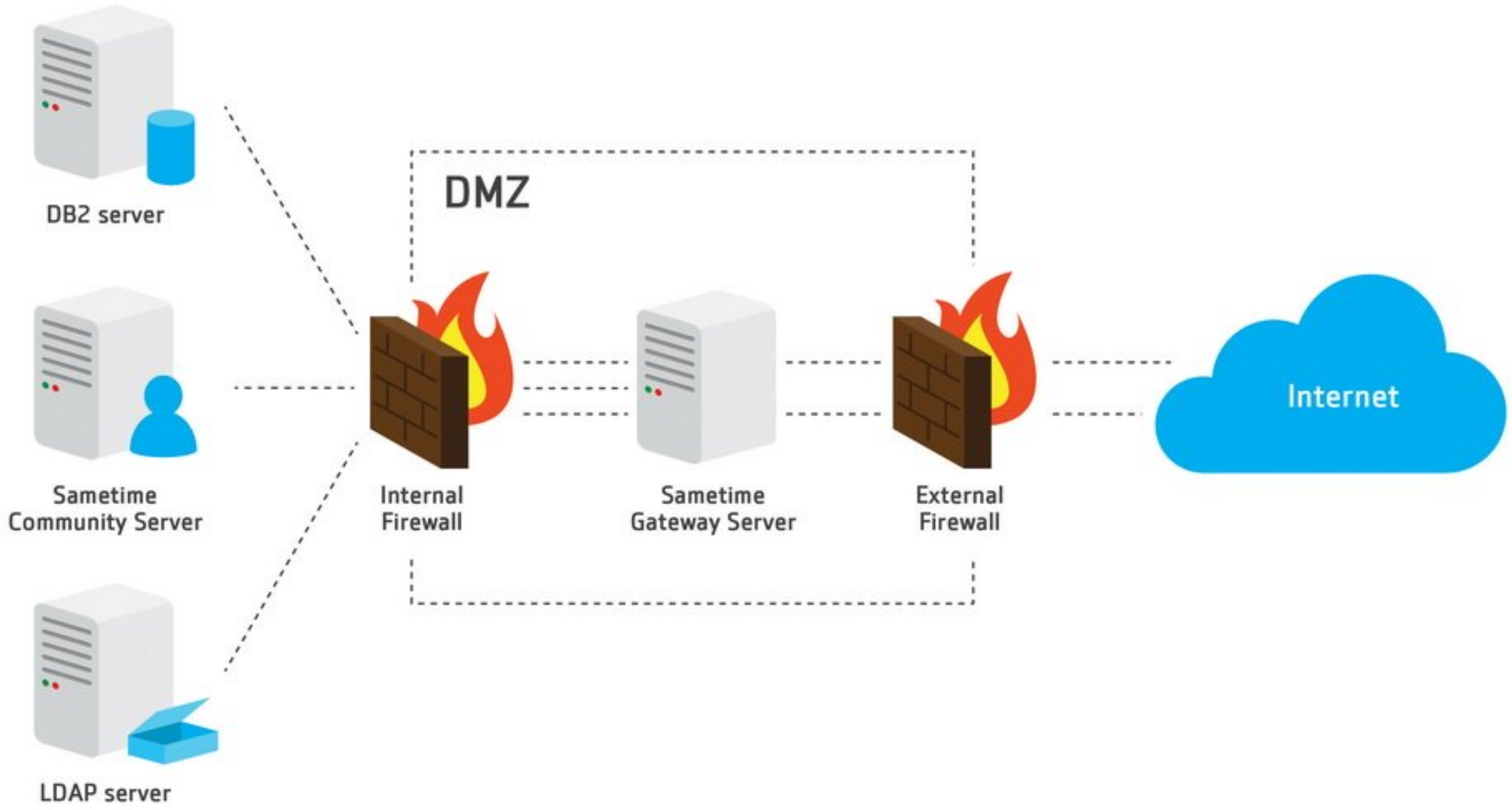
- Users can protect an organization’s information systems by:
  - Guarding their passwords to protect against unauthorized access to their accounts
  - Prohibiting others from using their passwords
  - Applying strict access controls (file and directory permissions) to protect data from disclosure or destruction
  - Reporting all unusual activity to the organization’s IT security group
  - Taking care to ensure that portable computing and data storage devices are protected (hundreds of thousands of laptops are lost or stolen per year)

# Prevention

- Organizations should implement a layered security solution to make computer break-ins so difficult that an attacker gives up
  - If an attacker breaks through one layer, another layer must then be overcome
- Layers of protective measures are explain in more detail in the following sections

# Implementing a Corporate Firewall

- Firewall
  - A system of software, hardware, or a combination of both that stands guard between an organization's internal network and the Internet and limits network access based on the organization's access policy
- Next-generation firewall (NGFW)
  - A hardware- or software-based network security system that is able to detect and block sophisticated attacks by filtering network traffic dependent on the packet contents
  - Goes deeper to inspect the payload of packets and match sequences of bytes for harmful activities


DB2 server
DMZ
Sametime Community Server
Internal Firewall
Sametime Gateway Server
External Firewall
Internet
LDAP server

# Installing Antivirus Software on Personal Computers

- Antivirus software
  - Scans for specific sequence of bytes, known as a virus signature, that indicates the presence of a specific virus
- If virus is found
  - Antivirus software informs the user and may clean, delete, or quarantine any files, directories, or disks affected by the malicious code
- It is crucial that antivirus software be continually updated with the latest virus signatures

# Implementing Safeguards against Attacks by Malicious Insiders

- User accounts that remain active after employees leave a company are a potential security risk
  - IS staff must promptly delete computer accounts, login IDs, and passwords of departing employees
- Another safeguard
  - Create roles and user accounts so that users have the authority to perform their responsibilities and nothing more

# Addressing the Most Critical Internet Security Threats

- Computer attackers
  - Know that many organizations are slow to fix problems
  - Scan the Internet for vulnerable systems
- US-CERT regularly updates a summary of the most frequent, high-impact vulnerabilities being reported
  - https://us-cert.cisa.gov/ncas/current-activity
  - ThaiCERT www.thaicert.or.th
- Actions required to address these issues include installing a known patch to the software
  - And keeping applications and OSs up-to-date

# Conducting Periodic IT Security Audits

- Security audit
  - Evaluates whether an organization has well-considered security policy in place and if it is being followed
- The audit should
  - Review who has access to particular systems and data and what level of authority each user has
  - Test system safeguards to ensure that they are operating as intended
- Some organizations also perform a penetration test (Pentest)
  - Individuals try to break through the measures and identify vulnerabilities

# Detection

- Intrusion detection system (IDS)
  - Software and/or hardware that monitors system and network resources and activities
  - Notifies network security personnel when it detects network traffic that attempts to circumvent the security measures of a networked computer environment
- Knowledge-based IDS
  - Contain information about specific attacks and system vulnerabilities
- Behavior-based IDS
  - Models normal behavior of a system and its user from reference information collected by various means

# Detection

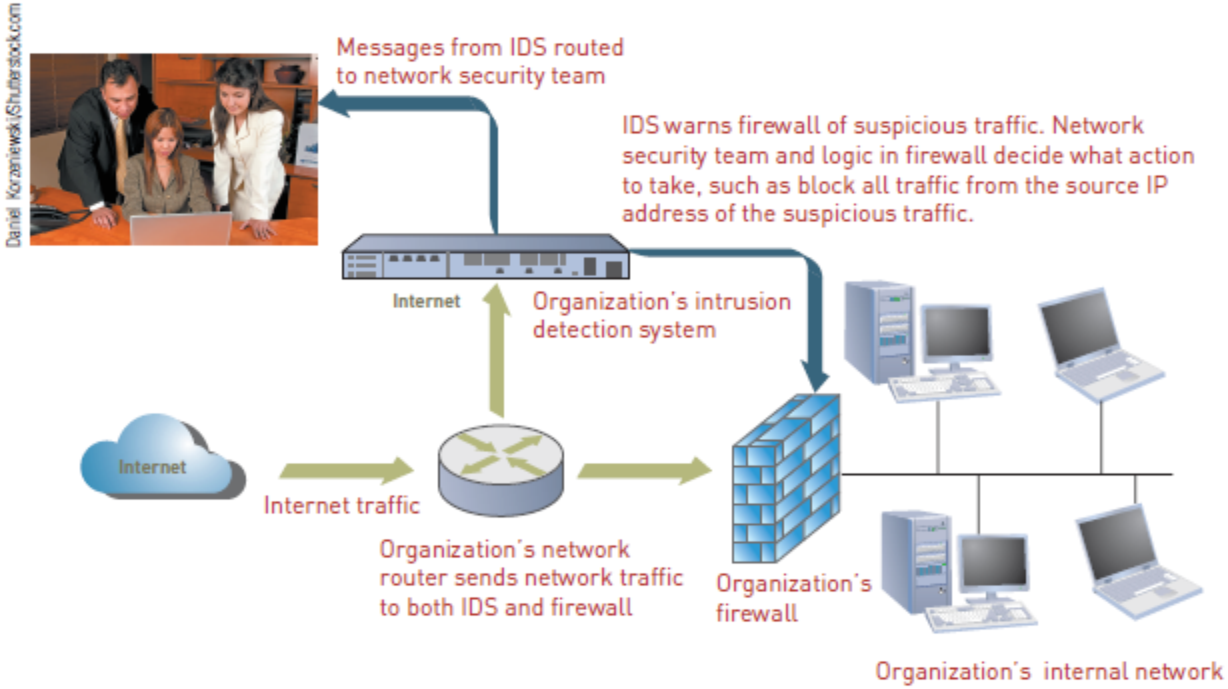

Daniel Korzeniewski/Shutterstock.com
Messages from IDS routed to network security team
IDS warns firewall of suspicious traffic. Network security team and logic in firewall decide what action to take, such as block all traffic from the source IP address of the suspicious traffic.
Internet
Organization's intrusion detection system
Internet
Internet traffic
Organization's network router sends network traffic to both IDS and firewall
Organization's firewall
Organization's internal network

FIGURE 13.5

**Intrusion detection system**

An IDS notifies network security personnel when it detects network traffic that attempts to circumvent the security measures of a networked computer environment.

# Response

- A response plan should be developed well in advance of any incident
    - Should be approved by the organization's legal department and senior management
- A well-developed response plan helps keep an incident under technical and emotional control
- In a security incident, the primary goal must be to:
    - Regain control and limit damage, not to attempt to monitor or catch an intruder

# Incident Notification

- Key element of a response plan is to
  - Define who to notify and who not to notify in the event of a security incident
- Questions to cover:
  - Within the company, who needs to be notified, and what information does each person need to have?
  - Under what conditions should the company contact major customers and suppliers?
  - How does the company inform them of a disruption in business without unnecessarily alarming them?
  - When should local authorities be contacted?
- A critical ethical question:
  - What to tell customers and others whose personal data may have been compromised?

# Protection of Evidence and Activity Logs

- Organizations should document all details of a security incident as it works to resolve the incident
- Documentation captures valuable evidence for a future prosecution
  - And provides data to help during the incident eradication and follow-up phases
- Organizations should establish a set of document-handling procedures using the legal department as a resource

# Incident Containment

- The incident response plan should clearly define the process for deciding if an attack is dangerous enough to warrant shutting down or disconnecting critical systems from the network
- Elements of an effective response plan:
  - How decisions for shutting down systems is made
  - How fast those decisions are made
  - Who makes them

# Eradication

- Before eradication, the IT security group must:
  - Collect and log all possible criminal evidence from the system
  - Verify that all necessary backups are current, complete, and free of any malware
  - Create a forensic disk image of each compromised system
  - After eradication, a new backup must be created
- A log should be kept of all actions taken
- All backups should be created with enough  frequency to enable a full and quick restoration of data
  - If an attack destroys the original

# Incident Follow-Up

- Follow-up should include:
  - Determining how the organization’s security was compromised
  - A review to determine exactly what happened and to evaluate how the organization responded
  - A detailed chronology of all events
  - An estimate of the monetary damage
  - A decision on how much effort should be put into capturing the perpetrator
  - A decision on whether it has an ethical or a legal duty to inform customers or clients of a cyber attack

# Computer Forensics

- Computer Forensics
  - A discipline that combines elements of law and computer science to identify, collect, examine, and preserve data from computer systems, networks, and storage devices in a manner that preserves the integrity of the data gathered
- Computer forensics investigators work as a team to investigate an incident and conduct the forensic analysis
- Proper handling of computer forensics investigation is the key to fighting computer crime successfully in a court of law
- Numerous certifications exist:
  - CCE (Certified Computer Examiner), CISSP (Certified Information Systems Security Professional), CSFA (CyberSecurity Forensic Analyst), and GCFA (Global Information Assurance Certification Certified Forensic Analyst)

# Computer Forensics

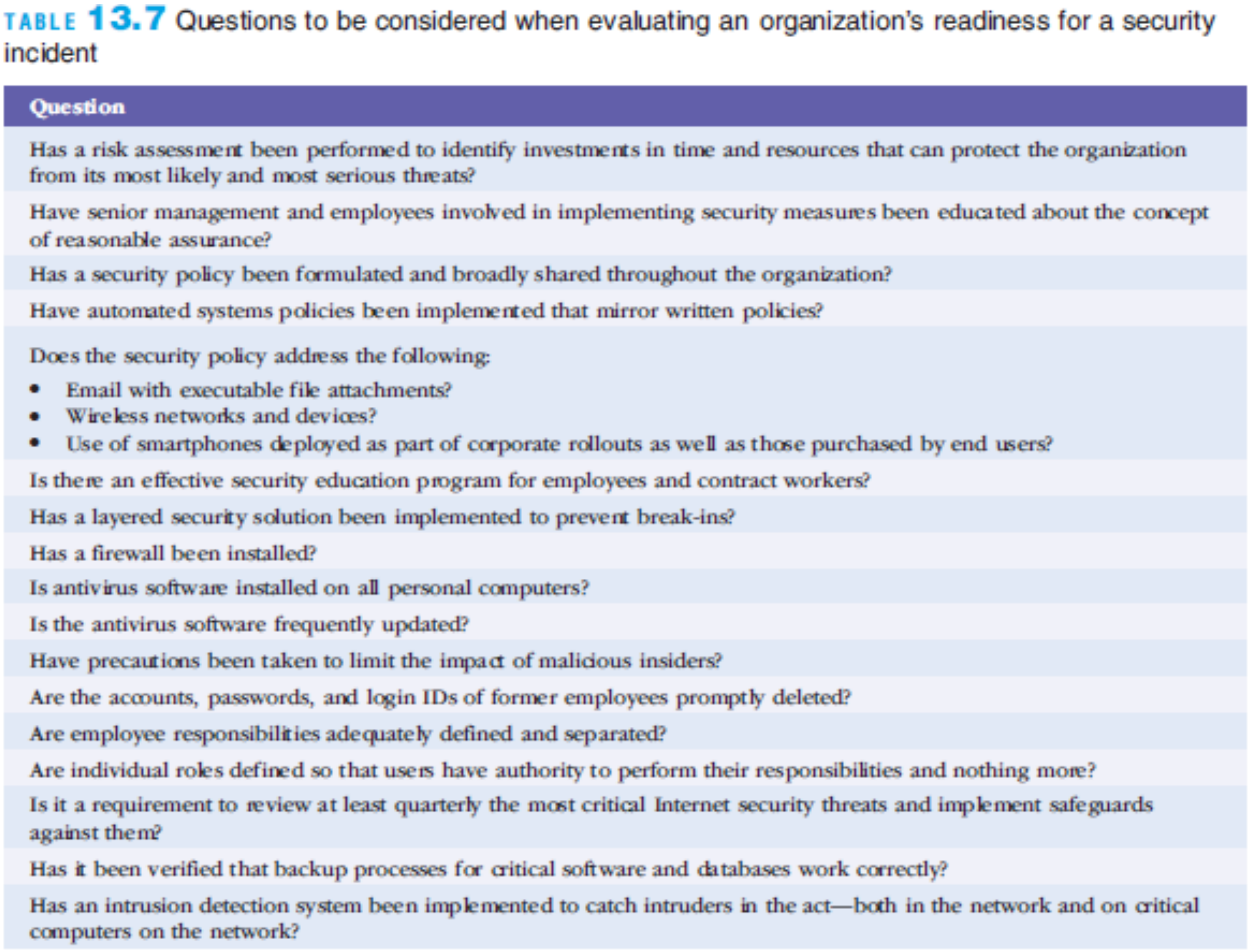


TABLE 13.7 Questions to be considered when evaluating an organization's readiness for a security incident

| Question |
|---|
| Has a risk assessment been performed to identify investments in time and resources that can protect the organization from its most likely and most serious threats? |
| Have senior management and employees involved in implementing security measures been educated about the concept of reasonable assurance? |
| Has a security policy been formulated and broadly shared throughout the organization? |
| Have automated systems policies been implemented that mirror written policies? |
| Does the security policy address the following:<br>• Email with executable file attachments?<br>• Wireless networks and devices?<br>• Use of smartphones deployed as part of corporate rollouts as well as those purchased by end users? |
| Is there an effective security education program for employees and contract workers? |
| Has a layered security solution been implemented to prevent break-ins? |
| Has a firewall been installed? |
| Is antivirus software installed on all personal computers? |
| Is the antivirus software frequently updated? |
| Have precautions been taken to limit the impact of malicious insiders? |
| Are the accounts, passwords, and login IDs of former employees promptly deleted? |
| Are employee responsibilities adequately defined and separated? |
| Are individual roles defined so that users have authority to perform their responsibilities and nothing more? |
| Is it a requirement to review at least quarterly the most critical Internet security threats and implement safeguards against them? |
| Has it been verified that backup processes for critical software and databases work correctly? |
| Has an intrusion detection system been implemented to catch intruders in the act—both in the network and on critical computers on the network? |

# Computer Forensics

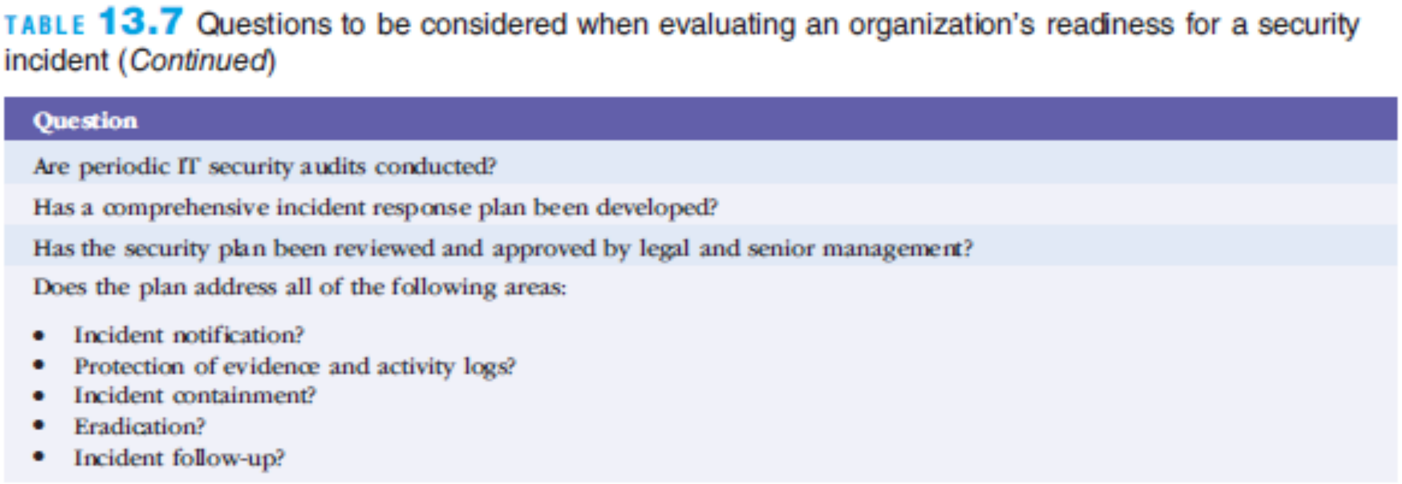


TABLE 13.7 Questions to be considered when evaluating an organization's readiness for a security incident (*Continued*)

| Question |
|---|
| Are periodic IT security audits conducted? |
| Has a comprehensive incident response plan been developed? |
| Has the security plan been reviewed and approved by legal and senior management? |
| Does the plan address all of the following areas:<br>• Incident notification?<br>• Protection of evidence and activity logs?<br>• Incident containment?<br>• Eradication?<br>• Incident follow-up? |

# Summary

- Computer crime is a serious and rapidly growing area of concern requiring management attention
- Organizations must take strong measures to ensure secure, private, and reliable computing experiences for their employees, customers, and business partners