

Internet and Information Technology

Lecture 7

ITC202

Network and Internet Security

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Chapter 7: Network and Internet Security

Networking Applications

Mobile Communication

Global Positioning System (GPS)

Network Characteristics

Wired vs. Wireless Networks

Network Topologies

Network Size and Coverage Area

Networking Media

The Internet

How Does the Internet Work

What is the World Wide Web?

Types of Internet Connections

Computer Sabotage

Virus

Worm

Botnets

Denial of Service Attack

Ransomware

Social Engineering

Insider Attacks

Learning Objectives

- Define a network and its purpose.
- Understand the various characteristics of a network, such as topology, architecture, and size.
- Name specific types of wired and wireless networking media
- Describe device and connection options for connecting to the Internet, as well as some considerations to keep in mind when selecting an ISP.

Learning Objectives

- Explain why computer users should be concerned about network and Internet security.
- Provide several examples of computer sabotage.
- List steps individuals can take to safeguard their personal safety when using the Internet.

What is a network?

- **Computer network:** Collection of computers and other hardware devices connected together so that network users can share hardware, software, and data, as well as communicate with each other electronically.
- Computer networks range from small private networks to the Internet.
- Uses for computer networks
 - ❖ Sharing an Internet connection among several users.
 - ❖ Sharing application software, files, printers, and other resources.

Case study 1

🏢 A small local company that provides accounting and financial consulting services to small and medium-sized businesses. It has approximately twenty employees, divided between the accounting department, customer service department, and administration.

- **Problems Before Networking**

- ❖ Manual file exchange between departments, leading to delays in reporting.
- ❖ Lack of a central database for customers and transactions.
- ❖ Difficulty working remotely, especially in emergencies or while traveling.
- ❖ Loss of some files due to local storage on employee devices.
- ❖ Data duplication and lack of coordination between departments

Case study 1

- Technical solution: **building a simple intranet**
- The management made a small investment decision to establish an intranet that includes:

1. Central server

- ❖ To store all accounting files and reports.
- ❖ Folders are organized by department and permissions.

2. Local area network (LAN)

- ❖ Connects all employee devices within the office.
- ❖ Allows file, printer, and software sharing.

3. VPN system

- ❖ Allows accountants to access remotely.
- ❖ Maintains data security during external connections.

4. Automatic backup system

- ❖ Files are copied daily to an external device.
- ❖ Reduces the risk of data loss

Case study 1

- Decisions affected by the network

Administrative field	Network impact
Financial Planning	Central data availability helps management accurately analyze revenues and expenses.
Coordination between departments	Instant File sharing, improving collaboration between accountants and customer service.
Time Management	Reporting time was reduced by 40%, allowing more time for analysis and decision-making.
Internal Control	Managers are now able to review files in real-time, improving quality control.
Operational Resilience	Enabling remote work helps businesses continue operating during emergency situations such as pandemics or travel.

How does mobile phone work



How does mobile phone work

How Mobile Communication Works

- **Voice Conversion:** Your voice is converted into a digital signal (0s and 1s) using a microphone
- **Signal Transmission:** The signal is transmitted as electromagnetic waves via the phone's antenna.
- **Range Limitation:** Electromagnetic waves can't travel far due to obstacles and Earth's curvature.

How does mobile phone work

📶 Cellular Technology

- **Cell Towers:** Geographic areas are divided into hexagonal cells, each with its own tower.
- **Fiber Optics:** Towers are connected via underground or undersea optical fiber cables.
- **Signal Routing:** Towers convert signals to light pulses, process them, and route them to the destination tower.

Case Study 2: Coca-Cola's Use of SMS-Based Mobile Network for Supply Chain Optimization

- In many rural and low-infrastructure regions, **Coca-Cola** faced significant operational challenges in managing its distribution network. These included:
 - ❖ Limited access to internet connectivity and digital infrastructure.
 - ❖ Difficulty in tracking real-time sales and inventory levels at local retail points.
 - ❖ Delays in replenishing stock due to lack of timely data from distributors.
- These challenges hindered Coca-Cola's ability to maintain product availability and respond efficiently to market demand.
- Instead of deploying complex digital systems or internet-dependent applications, Coca-Cola implemented a **simple, low-cost solution** using **SMS** over the **cellular network**. This approach allowed local distributors to report sales and inventory data using basic mobile phones without requiring internet access.



Case Study 2: Coca-Cola's Use of SMS-Based Mobile Network for Supply Chain Optimization

How the System Works



1. Local Distributor Interaction

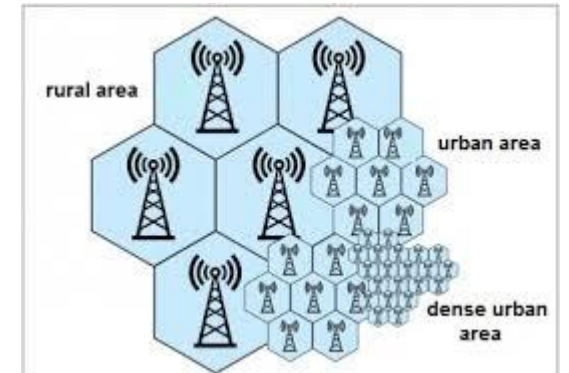
- ❖ Each distributor or shop owner uses a basic mobile phone with a SIM card.
- ❖ After selling Coca-Cola products, they send a structured SMS containing:
 - ❑ Product code (e.g., COKE500)
 - ❑ Quantity sold (e.g., 20)
 - ❑ Location identifier (e.g., KAMPALA)
- Example SMS: COKE500 20 KAMPALA

Case Study 2: Coca-Cola's Use of SMS-Based Mobile Network for Supply Chain Optimization

How the System Works

2. Data Transmission via Cellular Network

- The SMS is transmitted over the mobile network to Coca-Cola's central data system.
- The system parses the message and updates:
 - ❖ Sales records
 - ❖ Inventory status
 - ❖ Replenishment schedules



3. Automated Response and Action

- ❖ The distributor receives a confirmation SMS (e.g., "Order received. Delivery scheduled within 48 hours.").
- ❖ Coca-Cola's logistics team is notified to dispatch new stock based on real-time demand.

Case Study 2: Coca-Cola's Use of SMS-Based Mobile Network for Supply Chain Optimization

Benefits of the SMS-Based System

Managerial Dimension	Impact
Inventory Management	Real-time visibility into product movement without internet
Distribution Efficiency	Faster and more accurate restocking based on actual sales
Operational Control	Enhanced monitoring of distributor performance
Cost Optimization	No need for smartphones, apps, or internet infrastructure
Scalability	Easily replicable in other low-connectivity regions

Case Study 2: Coca-Cola's Use of SMS-Based Mobile Network for Supply Chain Optimization

Strategic and Educational Insights



◆ Frugal Innovation

- This case exemplifies how **simple technologies** can solve complex operational problems when tailored to the local context. Coca-Cola's use of SMS is a form of **frugal innovation**, prioritizing functionality over sophistication.

◆ Context-Aware Management

- Rather than imposing global digital solutions, Coca-Cola adapted its strategy to fit the **technological realities** of its target markets. This reflects a deep understanding of **environmental constraints** and **local user behavior**.

◆ Digital Transformation Without Internet



- The case challenges the assumption that digital transformation requires internet access. It shows that **mobile networks alone** can support effective data exchange and operational coordination.

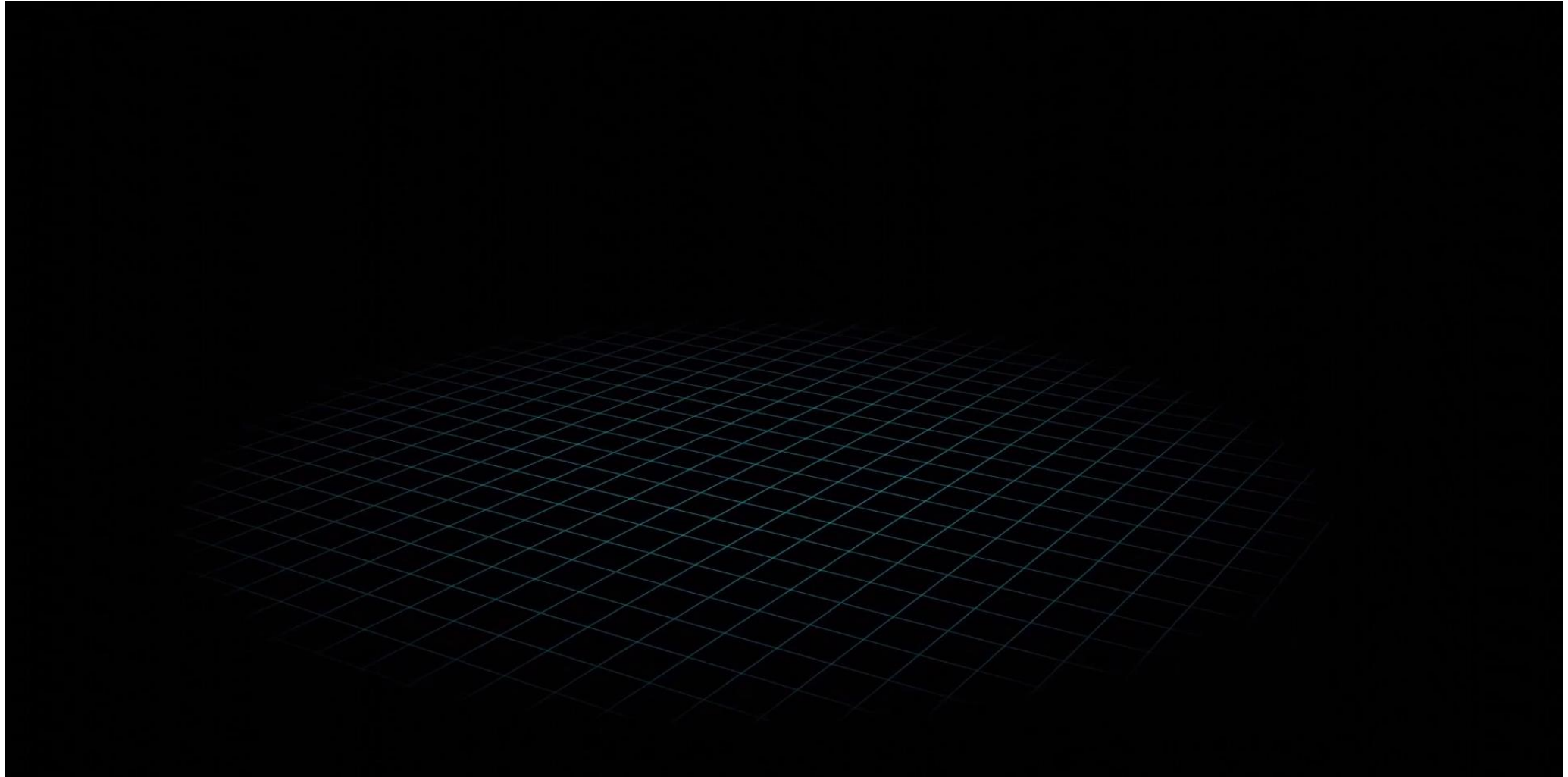
Case Study 2: Coca-Cola's Use of SMS-Based Mobile Network for Supply Chain Optimization

Conclusion

- Coca-Cola's SMS-based system demonstrates that managerial **innovation** is not always about adopting the **latest technology**, but about choosing the right technology for the right context. It highlights the importance of **adaptability**, **cost-efficiency**, and user-centric design in global operations.



How-GPS-Works



How-GPS-Works

- **GPS is based on trilateration:** It calculates the device's location using distances from multiple satellites.
- **Minimum of four satellites are needed for accurate 3D positioning**
- **Distance is calculated using signal travel time:** GPS receivers measure how long it takes for signals to reach them from satellites.
- **Applications of GPS include**
 - Navigation (cars, planes, ships), location tracking (phones, vehicles) ,Emergency services, rescue operations, agriculture, surveying, and scientific research.



Case Study 3: Uber – Using GPS to Revolutionize Dynamic Pricing and Resource Allocation

Introduction

- **Uber**, originally a simple ride-hailing service, transformed its business model by leveraging **GPS technology** not just for navigation, but as a **strategic tool** to drive pricing, resource distribution, and customer experience.

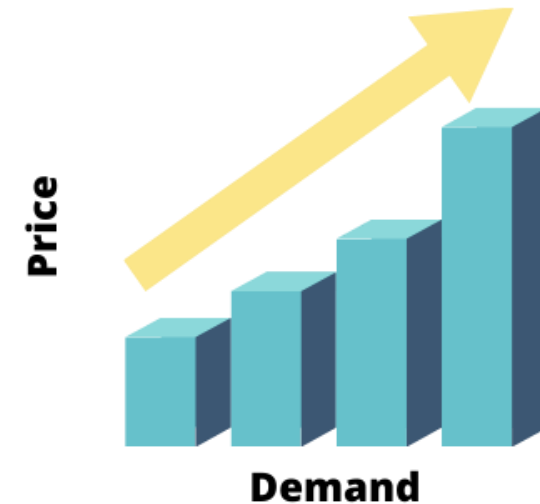


Case Study 3: Uber – Using GPS to Revolutionize Dynamic Pricing and Resource Allocation

The Innovation: GPS as a Pricing Engine, Not Just a Location Tool

1. Dynamic Pricing Based on Real-Time GPS Data

- Uber uses GPS to monitor:
 - ❖ Rider demand in specific areas.
 - ❖ Driver availability nearby.
 - ❖ Traffic conditions and event-based surges.
- When demand exceeds supply in a certain location, **prices automatically increase** (known as surge pricing), encouraging more drivers to move to that area.



This transforms GPS from a passive tracking tool into a **real-time economic signal**.

Case Study 3: Uber – Using GPS to Revolutionize Dynamic Pricing and Resource Allocation

The Innovation: GPS as a Pricing Engine, Not Just a Location Tool

2. Smart Driver Deployment

- GPS data helps Uber identify “hot zones” with high demand.
- Drivers receive notifications to move toward these areas, optimizing supply.



This reduces wait times for riders and idle time for drivers, improving efficiency on both ends.

3. Behavioral and Market Analytics

- Uber analyzes GPS movement patterns to:
 - ❖ Understand commuting trends.
 - ❖ Identify underserved areas.
 - ❖ Predict future demand.

These insights inform **strategic expansion, marketing campaigns, and urban partnerships.**



Case Study 3: Uber – Using GPS to Revolutionize Dynamic Pricing and Resource Allocation

GPS dynamic pricing benefits

Business Area	GPS-Driven Innovation
Pricing Strategy	Real-time, location-based dynamic pricing
Resource Allocation	Efficient driver distribution based on live demand
Customer Experience	Reduced wait times and more accurate ETAs
Market Intelligence	Data-driven decisions on service expansion

Case Study 3: Uber – Using GPS to Revolutionize Dynamic Pricing and Resource Allocation

Key Takeaways for Business Students

- **Technology can redefine business models** – GPS enabled Uber to move from fixed pricing to a dynamic, data-driven model.
- **Real-time data creates real-time value** – GPS data is not just for tracking, but for **decision-making**.
- **Cross-functional innovation** – GPS impacts operations, marketing, pricing, and customer service.
- **Behavioral economics in action** – Surge pricing influences both driver and rider behavior.

Conclusion

- Uber's use of GPS is a prime example of **strategic innovation**: turning a common technology into a competitive advantage. It shows how companies can **reimagine the role of data** to create smarter, more adaptive business systems—an essential mindset for future managers and entrepreneurs.

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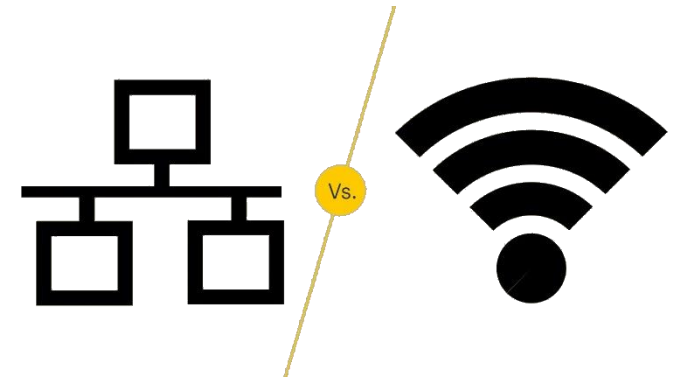
Social Engineering

Insider Attacks

Network Characteristics

Wired vs. Wireless Networks

- **Wired network:** the computers and other devices on the network are physically connected (via cabling) to the network.
- **Wireless network connection:** wireless signals are used to send data through the air between devices, instead of using physical cables.
- Wired networks tend to be **faster** and more **secure** than wireless networks, but wireless networks have the advantage of allowing **easy connections** in locations where physical wiring is impractical or inconvenient.

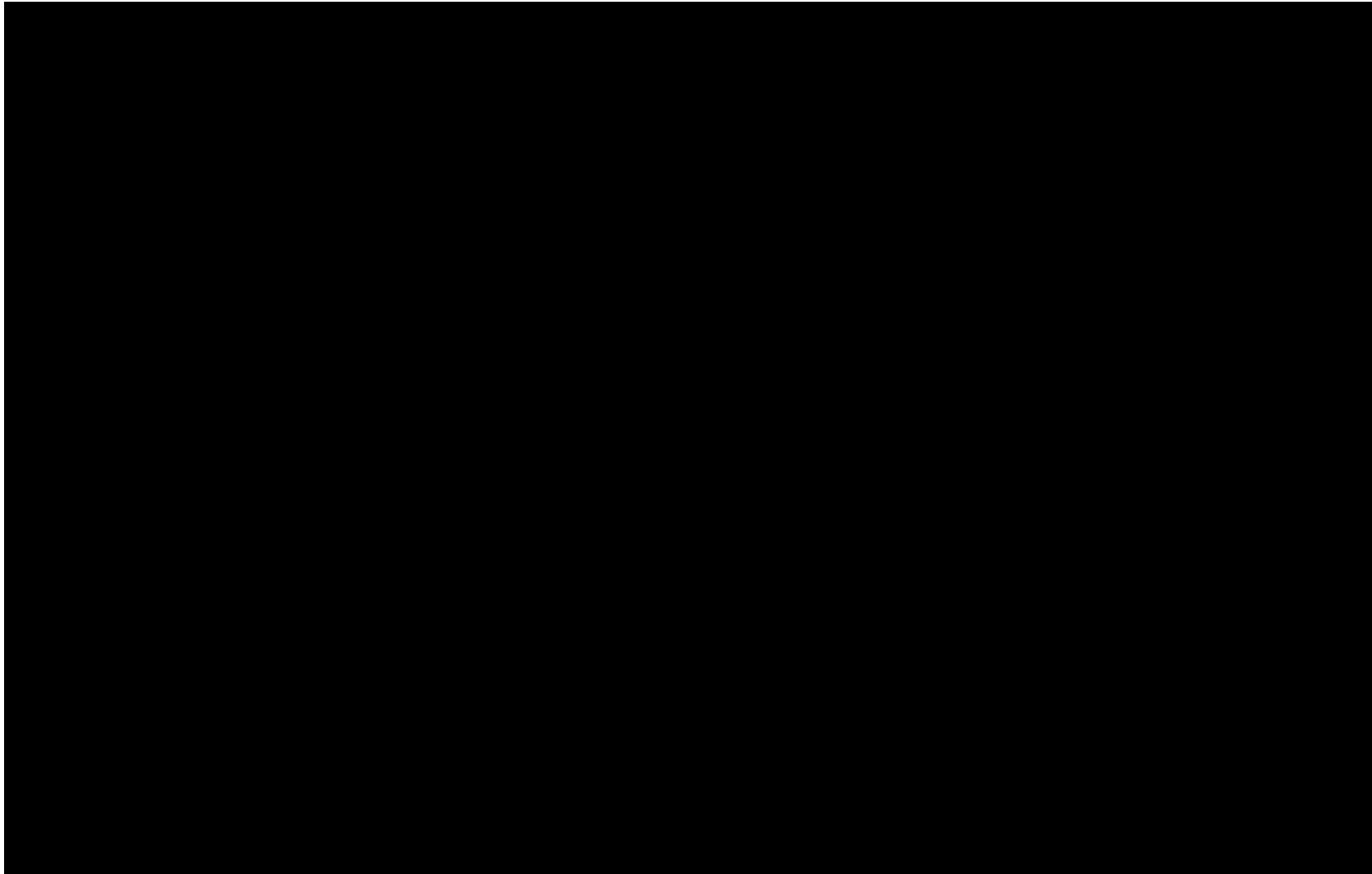


Network Characteristics

Network Topologies

- **Star network:** All the networked devices connect to a central device through which all network transmissions are sent. If the central device fails, then the network cannot function.
- **Bus network:** uses a central cable to which all network devices connect. All data is transmitted down the bus line from one device to another so, if the bus line fails, then the network cannot function
- **Mesh network:** each device on the network is connected to every other device on the network so that data can take any of several possible paths from source to destination.
- Consequently, if one device on a mesh network fails, the network can still function.

Network Characteristics



Network Characteristics

Network Size and Coverage Area

- **Personal Area Networks (PANs)**
 - Connect an individual's personal devices (Personal computer, mobile phone, digital camera)
 - Devices must be physically located close together
- **Local Area Networks (LANs)**
 - Connect devices located in a small geographic area
- **Metropolitan Area Networks (MANs)**
 - Cover a metropolitan area such as a city or county
- **Wide Area Networks (WANs)**
 - Cover a large geographic area
 - Two or more LANs connected together

Network Characteristics

PAN PERSONAL AREA NETWORK



Network Characteristics



Virtual private networks (VPNs)

- A virtual private network (VPN) is a private, secure path across a public network (usually the internet) that is set up to allow authorized users private, secure access to the company network.
- For instance, a vpn can allow a traveling employee to connect securely to the company network via the internet.
- Special encryption technology is used to protect the data so it cannot be understood if it is intercepted during transit
- Essentially, vpns allow an organization to provide secure, remote access to the company network without the cost of physically extending the private network.

Network Characteristics

So WHAT

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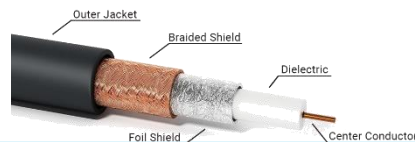
Insider Attacks

Networking Media

- **Twisted-Pair Cable:** made up of pairs of thin strands of insulated wire twisted together to reduce interference and improve performance. the least expensive type of networking cable.



- **Coaxial cable:** consists of a relatively thick center wire surrounded by insulation and then covered with a shield of braided wire to block electromagnetic signals from entering the cable. More expensive than twisted-pair cabling, it is much less susceptible to interference and can carry more data more quickly.



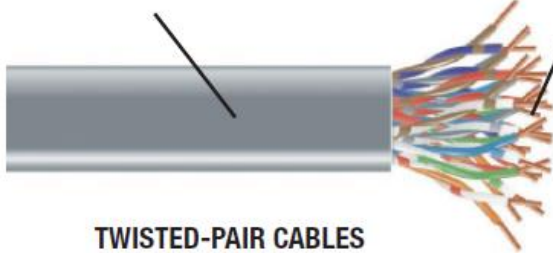
Networking Media

- **Fiber-Optic Cable** the fastest wired transmission media. It contains multiple clear glass or plastic fiber strands, each about the thickness of a human hair.
- Fiber-optic cable transfers data represented by light pulses at speeds of billions of bits per second.
- Each strand can only send data in one direction so two strands are needed for full-duplex data transmissions.
- Disadvantage of fiber-optic cabling is the initial expense of both the cable and the installation.



Networking Media

The entire cable is covered by a plastic covering.



Pairs of copper wires are insulated with a plastic coating and twisted together; most cables contain at least two pairs.

TWISTED-PAIR CABLES



The entire cable is covered by a plastic covering.



Outer conductor is made out of woven or braided metal.

White insulating material surrounds the copper wire.

The innermost part of the cable is a single copper wire.

COAXIAL CABLES



The entire cable is surrounded by strengthening material and covered by a plastic covering.



The core of each fiber is a single glass or plastic tube, which is surrounded by a reflective cladding.

A protective plastic coating protects each fiber; a cable contains multiple fibers.

FIBER-OPTIC CABLES



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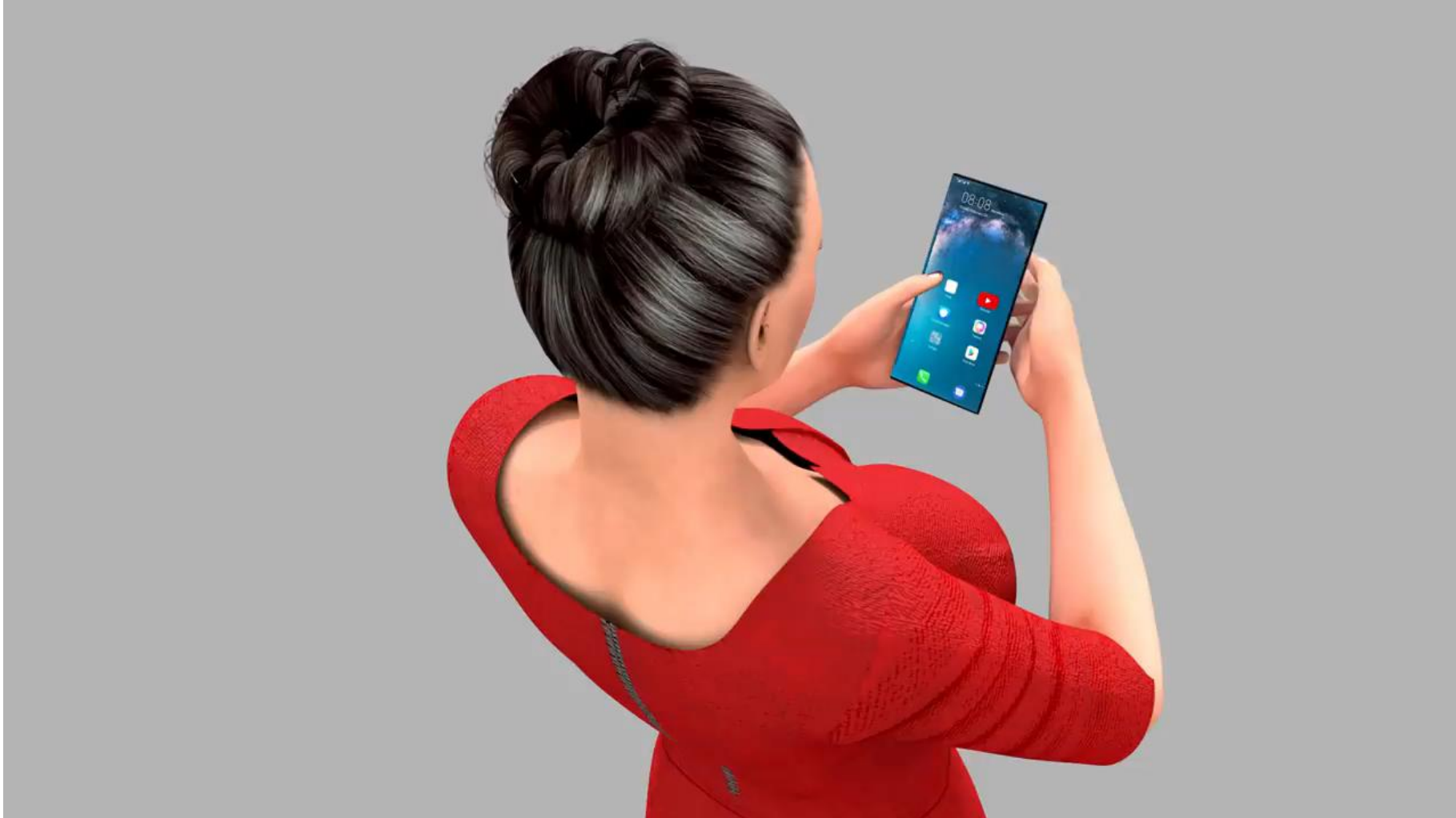
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How does the **INTERNET** work



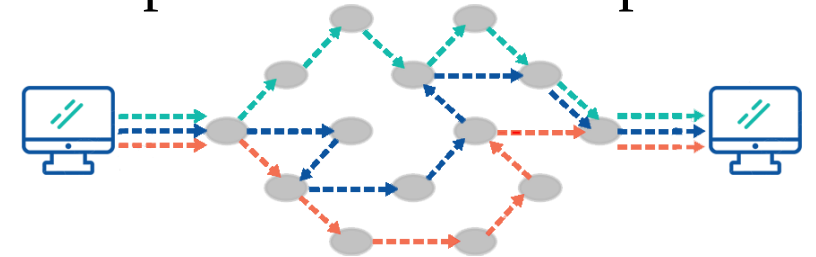
Internet

- **Data Centers Store Content:** Videos and websites are stored in servers inside data centers, often far from the user.
- **Optical Fiber Cables Are the Backbone:** Data travels as light pulses through underground and undersea fiber optic cables, not satellites (due to high latency).
- **IP Address System:** Every device has a unique IP address, like a home address, used to route data correctly.
- **Domain Names & DNS**
 - Domain names (e.g., youtube.com) are easier to remember than IP addresses.
 - DNS servers act like phone books, translating domain names into IP addresses.

Internet

- **Data Transmission via Packets**

- Data is split into small packets, each with a sequence number and source/destination IPs.
- Packets may take different routes and are reassembled upon arrival. Lost packets are resent.



- **ICANN Manages Internet Infrastructure**

- Responsible for IP address allocation and domain name registration globally.



Case Study 4: Airbnb: Revolutionizing Hospitality Through the Internet

💡 The Innovative Idea

- Airbnb didn't build hotels or own real estate. Instead, it created an **online platform** that allowed:
 - ❖ **Homeowners** to rent out spare rooms or entire homes,
 - ❖ And **travelers** to find affordable, unique places to stay.



🚀 How the Internet Enabled Their Success

- ❖ **Peer-to-Peer Model:** Airbnb used the internet to connect people directly, cutting out traditional hotel chains.
- ❖ **Trust System:** Through reviews, ratings, and secure payments, they built a trusted global community.
- ❖ **Smart Algorithms:** They used AI to recommend listings, optimize pricing, and detect fraud.
- ❖ **Global Reach:** With just a website and app, they scaled to over 220 countries and regions.

Case Study 4: Airbnb: Revolutionizing Hospitality Through the Internet

Impact

- Airbnb became one of the world's largest hospitality companies **without owning a single property**.
- It transformed how people travel, offering more personal and local experiences.
- Its valuation soared into the tens of billions of dollars.

What is the World Wide Web?

What is the World Wide Web?

World Wide Web

- **The Web $\neq$ The Internet:**
- The Internet is the infrastructure that connects computers.
- The Web is a service that runs on the Internet, used to access websites and content.
- **Web Servers & Hosting**
- Websites are stored on web servers, which are computers connected to the Internet.
- Web hosts rent space on these servers to individuals or organizations.



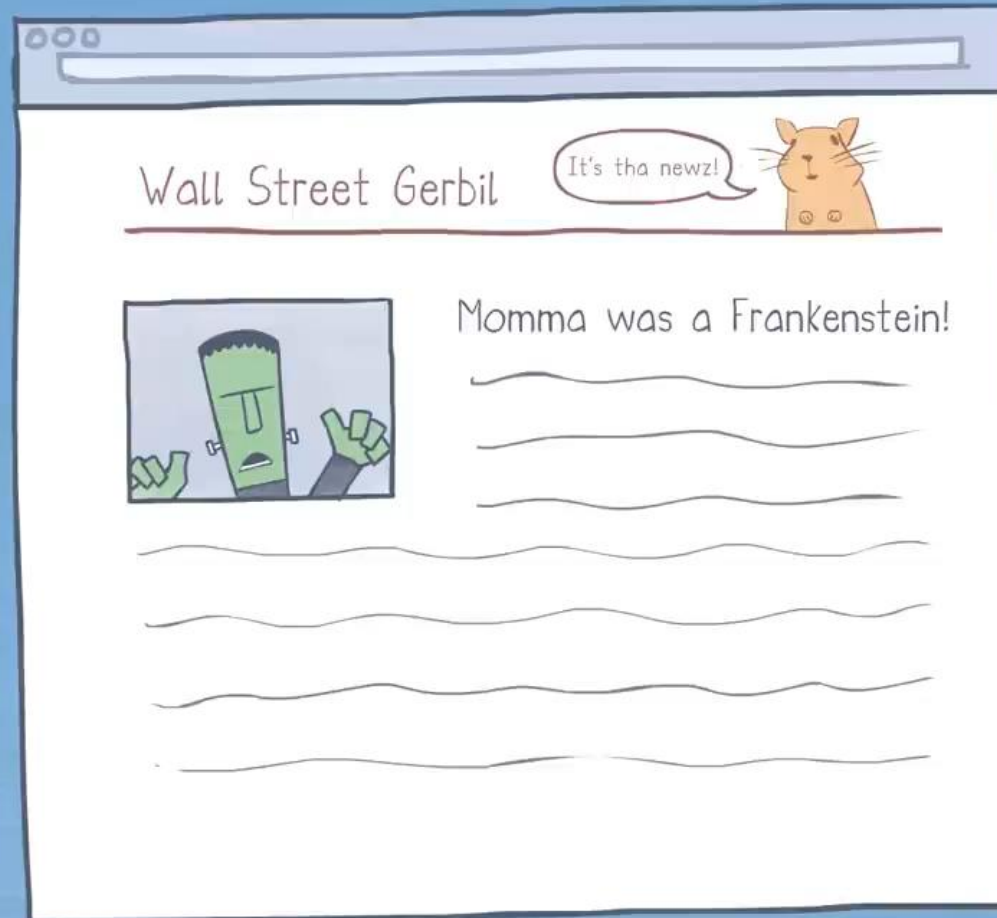
World Wide Web

- **Domain Names & Addresses**
- Websites use domain names (e.g., example.com) to make access easier.
- These names are linked to IP addresses via the DNS system, like a phone book for the Web.
- **The Web Is Decentralized**
 - No one owns the Web; anyone can create a website and contribute.
 - Access requires services like ISPs, hosting providers, and domain registrars.

Types of Internet Connections

Connection Type	Typical Speed Range	Notes
Dial-Up	Up to 56 kbps	Very slow, outdated
DSL	1 Mbps – 100 Mbps	Uses phone lines, faster than dial-up
Cable Internet	10 Mbps – 1 Gbps	Shared bandwidth, common in cities
Fiber Optic	100 Mbps – 10 Gbps+	Fastest and most reliable
Satellite Internet	12 Mbps – 100 Mbps	High latency, used in remote areas
Mobile Data (3G)	0.1 Mbps – 2 Mbps	Basic browsing, outdated
Mobile Data (4G)	5 Mbps – 100 Mbps	Common for smartphones
Mobile Data (5G)	100 Mbps – 10 Gbps	Very fast, low latency
Wi-Fi	Depends on source connection	Wireless access via router

What the Internet is Doing to Our Brains



What the Internet is Doing to Our Brains

- The internet encourages constant distraction and shallow thinking.
- Our brains evolved to seek new info, but now this leads to overload.
- Frequent interruptions harm deep learning and memory consolidation.
- Quick searches without reflection weaken critical thinking.
- Focused attention is essential for building real knowledge.
- To protect our minds, we need daily time offline and focused work.

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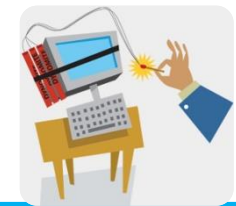
Ransomware

Social Engineering

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Computer Sabotage

- **Computer sabotage** can take several forms, including launching a computer virus or a denial of service (DoS) attack, altering the content of a Web site, or changing data or programs located on a computer.
- Computer sabotage is illegal, and acts of sabotage are estimated to cost individuals and organizations billions of dollars per year, primarily for labor costs related to correcting the problems caused by the sabotage, lost productivity, and lost sales.



Computer Sabotage

Computer Viruses and Other Types of Malware

Malware: is any type of malicious software. Malware programs are intentionally written to perform destructive acts, such as damaging programs, deleting files, erasing an entire hard drive, or slowing down the performance of a computer.

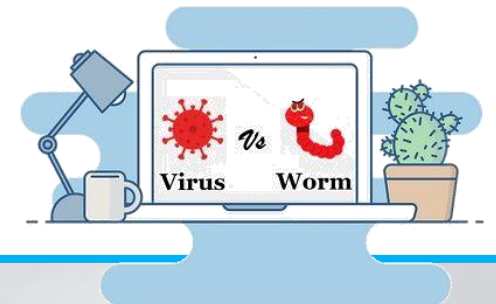
This damage can take place immediately after a computer is infected or it can begin when a particular condition is met.

A malware program that activates when it detects a certain condition, such as when a particular keystroke is pressed or an employee's name is deleted from an employee file, is called a **logic bomb**.



Computer Sabotage

- A **virus** is a computer program that **when executed** can replicate itself and spread to other files.
- Computer viruses deliver a payload such as the display of a message or image, or it may be highly destructive, reformatting the computer's hard drive.
- **Worm** is self-replicate and spread rapidly across networks without human intervention. consuming network bandwidth, potentially overloading systems, and causing damage by deleting files, stealing data, or installing other malware.
- Virus requires a host program or file and user **action** to spread, while a worm is a standalone program that can **self-replicate** and spread independently across networks without user interaction.

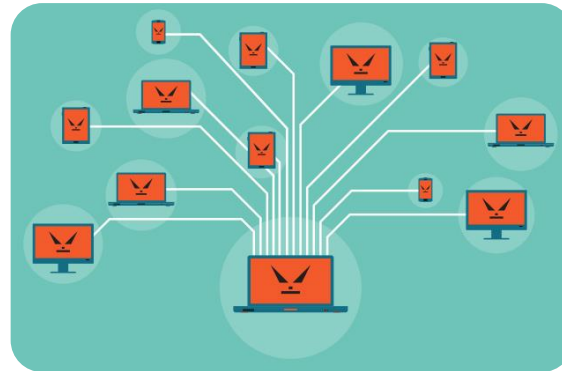


What is a Botnet?

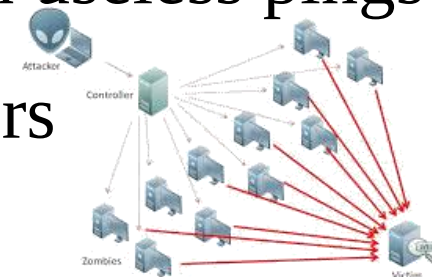


Computer Sabotage

- **Botnets:** A computer that is controlled by a hacker controls a group of bots to use for computer sabotage, such as to spread malware and to launch denial of service (dos) attacks

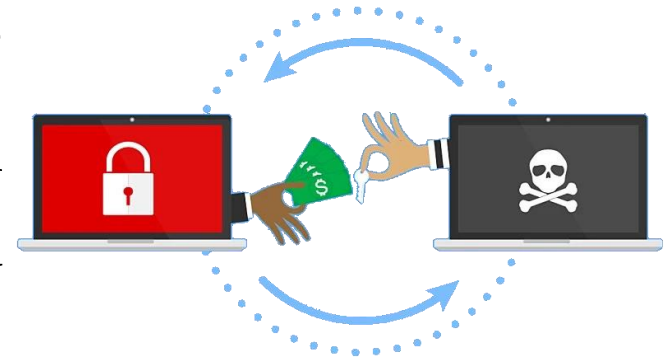


- In a **Denial of Service (DoS) attack**, hackers flood a website with useless pings or page requests that inundate and overwhelm the site's web servers



Computer Sabotage

- **Ransomware** is a type of malware that blocks or limits access to a computer or network by encrypting files and then demanding a ransom payment, typically in a cryptocurrency such as Bitcoin, in exchange for the decryption key.
- **Social engineering** relies on human curiosity, greed, gullibility, and fear in order to trick people into taking an action that enables a hacker to gain access to a computer system



Computer Sabotage

Insider attacks



- The Largest financial threats to business institutions come not from robberies but from embezzlement by insiders.
- Bank employees steal far more money than do bank robbers.
- Some of the largest disruptions to service, destruction to sites, and diversions of customer financial data and personal information have come from insiders—once-trusted employees.

Online safety for grown ups



Summary

What is a network?

- **Communications** refers to data being sent from one device to another over a distance such as over long-distance phone lines, via privately owned cables, or by satellite.
- A **computer network** is a collection of computers and other hardware devices that are connected together to share hardware, software, and data, as well as to facilitate electronic communications.

Summary

Networking APPLICATIONS

- There are a variety of other important business and personal applications that utilize networks.
- For making phone calls while on the go cellular (cell) and satellite phones are used
- There are a variety of global positioning system (GPS) and monitoring system applications used by individuals and businesses

Summary

Network characteristics

- Networks can be either wired or wireless
- Networks can be classified in terms of their **topology** or physical arrangement (such as a **star** network, **bus** network, or **mesh** network).
- Networks can also be classified by size. Personal area networks (**PANs**) connect the devices immediately around an individual; local area networks (**LANs**) connect geographically close devices, such as within a single building; metropolitan area networks (**MANs**) provide Internet access to cities; and wide area networks (**WANs**) span relatively wide geographical areas.
- Virtual private networks (**VPNs**) are used to transfer private information over a public communications system.

Summary

Networking Media & Communication Technologies

- **Twisted-Pair Cable:** Thin insulated wires twisted together to reduce interference.
- **Coaxial Cable:** Thick central wire with insulation and braided shielding.
- **Fiber-Optic Cable:** Uses glass/plastic strands to transmit data as light pulses.
- Fastest wired medium; supports billions of bits per second.
- Requires two strands for full-duplex; high installation cost.

Summary

Cellular Technology

- Areas divided into hexagonal cells with towers.
- Towers connected via fiber-optic cables.
- Signals are routed and converted to light pulses.

GPS Technology

- Uses **trilateration** from at least 4 satellites.
- Measures signal travel time to calculate location.

Summary

How the Internet Works

- **Data Centers** store content like videos and websites.
- **Fiber-optic cables** transmit data as light pulses.
- **IP addresses** route data; **DNS** translates domain names.
- **Routers** convert signals for devices and mobile networks.
- Data sent in **packets**, reassembled at destination.
- **ICANN** oversees global IP and domain management.

Summary

World Wide Web (WWW)

- The Web is a service running on the Internet.
- Websites are hosted on servers and accessed via domain names.
- The Web is **decentralized** and open to all.

Summary

Computer sabotage

- **Computer sabotage** includes **malware** (computer viruses, computer worms, and **Trojan horses** designed to cause harm to computer systems), **denial of service (DoS) attacks** (designed to shut down a Web server), and data and program alteration.
- Computer sabotage is often performed via the Internet, increasingly by the **bots** in a **botnet**.

Summary

Protecting against computer sabotage

- Protection against computer sabotage includes using appropriate access control systems to keep unauthorized individuals from accessing computers and networks, as well as using **security software**. In particular, **antivirus software** protects against computer viruses and other types of malware. It is important to keep your security software up to date.

Reference

15th Edition

Understanding Computers

Today and Tomorrow

Comprehensive



Deborah Morley