



LESSON PREVIEW

Computer Networks and the Internet

A computer network is a group of two or more computers or devices that are connected together and can share information and resources. It wasn't that long ago that businesses could only share an expensive resource, such as a printer, by physically connecting all the computers in an office to that printer. This is called a local area network (LAN). Once the ability to connect remotely was added, businesses could share resources with computers at different locations. This is known as a wide area network (WAN). When networks are connected with other networks, this is called an internet. Today, the Internet connects everything!

But the Internet is simply an internet, albeit the largest network of networks in the world. This module is all about networks—what they are, what they can do, and how organizations use the Internet to increase communication in every aspect of business life.

After completing this section, you will be able to:

- Describe various types of networks, including PANs, LANs, WANs, internets, and the Internet.
- Describe how the Internet and IP addresses work.
- Define the World Wide Web, Web 2.0, and Web 3.0.
- Describe GIS and how it is used in business.
- Describe how cellular phone communication works.
- Describe the Internet of Things (IoT).
- Discuss Cloud computing and its effect on the business landscape.
- Describe content delivery networks and other web services.
- Describe how blockchain works.
- Define cryptocurrency.
- Define the use of collaboration software in today's business landscape.



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Types of Networks

A **network** is a group of two or more devices or computers connected together for the exchange of information and for the sharing of resources. Types of networks include:

- **PAN (personal area network):** connects devices around an individual device
- **LAN (local area network):** connects devices at a single site
- **WAN (wide area network):** connects devices at two or more geographic locations
- **internets:** connect LANs, WANs, and other networks together
- **the Internet:** the world's largest internet (note uppercase "I")



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How the Internet Works

The Internet uses a vast complex of hardware connected by large fiber-optic bundles called the **Internet backbone**, along with specific software known as the suite of **Internet protocols**.

Data on the Internet are stored on **servers**. Data are transferred from one network to another through hardware called **routers**. Information sent over the Internet is transferred in small groupings called **packets**. A router sends each packet to the correct receiving router via the fastest route possible at the moment it has been transmitted.



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IP Addresses and TCP/IP

An **Internet Protocol (IP)** address is a number that is assigned to all connection devices. It identifies the device and allows the device to communicate with other devices.

An IP address can be **static**, which means it is assigned permanently. These are usually used for email servers, businesses, or other reasons. IP addresses can also be **dynamic**, which means a new address is assigned as soon as a connection is made.

IP addresses are either in **IPv4** format (four-decimal notation) or **IPv6** notation (many more letters and numbers, such as 2001:0db8:85a3:0000:0000:8a2e:0370:7334). The **Domain Name System (DNS)** translates these characters into words that are easier to remember, such as google.com.

TCP/IP stands for **Transmission Control Protocol/Internet Protocol**. TCP refers to how software applications communicate across networks and how data packets are assembled when sent and reassembled when received. IP refers to how to address and route data packets to ensure they reach their correct destination.



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Using the Internet for Communication and Services

Resource	Support Functions
World Wide Web	Displaying, formatting, and retrieving data
Instant Messaging and Chat	Conversations that are Internet based
File Transfer Protocol (FTP)	File transfer between computers
Email	File sharing and messaging
Electronic Funds Transfer (EFT)	Digitized bank transactions



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The World Wide Web

The **World Wide Web**, referred to as **WWW** or the **web**, is an interconnected system of web pages. The web just one of many applications supported by the Internet. Standards and protocols for the web are developed by the World Wide Web Consortium (W3C). Components of the web include:

- **Hypertext Transfer Protocol (HTTP)**, which governs the transfer of data between a client and server computer
- **Uniform Resource Locator (URL)**, which is the address of a resource on the web
- **Hypertext Markup Language (HTML)**, which is a commonly used format for publishing web documents and content
- **Hyperlinks**, which are words, phrases, or images that the user can click on to move to a new web document or a new web page



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Web 2.0 and Web 3.0

Web 2.0 is the second-generation Internet, based on interactivity and dynamic content. It allows people to collaborate and share information online. Key features of Web 2.0 include interactivity, folksonomy, user participation, and Software as a Service (SaaS).

Web 3.0 is the next evolution on the web. It will include many features and tools allowing individuals to make better use of the billions of web pages on the Internet, the wide array of smartphone applications, and to make the best use of the Internet of Things (IoT). Web 3.0 will support widespread use of Cloud computing and SaaS in business environments as well as ubiquitous computing (being everywhere at the same time), 3D graphics, and artificial intelligence (AI).



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Geographic Information Systems

Geographic Information Systems (GIS) are focused on the capture, analysis, use, and management of spatial location information by integrating data to create visualizations using maps and 3D scenes. The retail sector uses GIS to determine regional demand preferences. Organizations can use GIS combined with data analytics to determine customer needs and wants.



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Cellular Phone Communication

A cell phone is basically a two-way radio consisting of a radio transmitter and receiver. Cell phone communication requires the following:

- **Base transceiver station (BTS):** transmits cell phone signals to the system's mobile switching station
- **Mobile switching station:** connects one person's call with the mobile switching station of the person being called
- **Analog-digital converter:** allows a smartphone to receive an analog sound wave and convert it to a digital signal necessary to be processed by a computer
- **Digital signal processor (DSP):** a small computer in a smartphone that reduces unwanted noise, moderates speech volume, and buffers signals



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The Internet of Things

The **Internet of Things (IoT)** combines connected devices with automated systems that gather data, analyze the data, and convert the data into usable information. It includes objects connected to the Internet that talk to each other, such as sensors, wearable technology, and smartphones.



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5G Connectivity

5G networks are the next generation of mobile connectivity. 5G will provide faster connection and data transfer speeds, greater capacity to connect over a single network, and lower latency. **Latency** is the amount of time between a device being requested to perform a task and when it completes the task.

5G Connectivity and the IoT

The enhancements allowed by 5G connectivity will increase IoT capabilities for business and home users. Some of the enhancements to the IoT include connected cities, improved and streamlined transportation, and enabled devices.



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Cloud Computing

A computer model where processing, storage, software, applications, and a variety of services are provided over a network, mainly accessed via the Internet, is known as **Cloud computing**. Cloud computing removes the need to have data, files, and software stored directly on a device.

The U.S. National Institute of Standards and Technology (NIST) identifies five essential characteristics of Cloud computing:

- **On-demand self-service:** Human intervention is not required for a consumer to use the services such as server time and network storage.
- **Broad network access:** Services are available over the network and accessed through standard devices such as mobile phones, tablets, laptops, and workstations.
- **Resource pooling:** Resources are pooled to serve multiple consumers that can be assigned and reassigned according to consumer demand.
- **Rapid elasticity:** Capabilities can be elastically provisioned and released to meet demand.
- **Measured service:** Cloud systems control and optimize resource use.



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Cloud Computing in the Business Landscape

Large and small businesses find they can decrease their reliance on internal IT infrastructure and reduce cost by utilizing Cloud-based technologies.



Why Organizations Prefer the Cloud

Benefits of Cloud Computing	
Flexibility	Allows for the access of data, files, and programs via any web-enabled device
Cost Savings	Reduces the expenditures on IT infrastructure and hard disk space
Collaboration	Allows organizations to communicate and share data and information efficiently and facilitate collaboration
Disaster Recovery	Makes data backup and recovery easier



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Limitations of the Cloud

Disadvantages of Cloud Computing	
Downtime	Is subject to planned and unplanned downtime
Security	Involves a certain level of risk when storing data and files using Cloud services
Limited Control	Offers the customer little control over Cloud service processes and procedures
Vendor Agreements (vendor lock-in)	Makes switching between Cloud services difficult due to differences between platforms



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Cloud Deployment Models

According to NIST, the four Cloud computing deployment models are:

- **Private Cloud:** Infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units).
- **Community Cloud:** Infrastructure is designed for exclusive use by a specific community of consumers from organizations that have shared concerns. Access may be restricted to community members.
- **Public Cloud:** Infrastructure is provisioned for open use by the general public, and these are often used for file sharing and email.
- **Hybrid Cloud:** Infrastructure is a composition of two or more distinct Cloud infrastructures.



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Services Provided by Cloud Service Vendors

There are a number of Cloud service vendors that provide a variety of Cloud services.

Cloud Service Provider	Services Offered
Amazon Web Services (AWS)	Offers many Cloud-based products, including computing, storage, databases, analytics, networking, mobile, developer and management tools, IoT, security, and enterprise applications
Google Cloud	Offers a suite of modular Cloud computing services, including data storage, data analytics, computing, and machine learning as well as serverless computing, IaaS, and PaaS
Kamatera Performance Cloud	Offers Cloud servers, Cloud block storage, private Cloud network, Cloud firewall, and fully managed Cloud
Salesforce	Offers Cloud solutions for customer relationship management (CRM), including all applications required by businesses such as CRM, enterprise resources planning (ERP), customer service, sales, mobile applications, and marketing



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Content Delivery Networks

A **content delivery network (CDN)** consists of geographically distributed network server groups that work together to deliver web pages and other content to users. A CDN stores cached versions of content in multiple geographic locations. These are also called **points of presence (PoPs)**. A **cache** is a storage location where active data are placed to make it easier to access.



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Web Services

Web services are a set of software technologies that are able to exchange information with each other using standardized web communication protocols and languages. They can be used to create apps that link systems of different organizations and to build open standard-based web applications.



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Software as a Service

Software as a Service (SaaS) is hosted on a vendor's Cloud. It allows users to access a software application using a web browser and Internet connection instead of having to download software directly to a device. One example is Microsoft 365.

Platform as a Service

Platform as a Service (PaaS) is a model where providers offer hardware and software tools needed for application and software development via the Internet. Vendors provide services such as mobile software development kits (SDKs), point-and-click app building, multilanguage program development, and built-in social and mobile capabilities.



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Infrastructure as a Service

Infrastructure as a Service (IaaS) is an instant computing infrastructure composed of processing, data storage, and other resources provided by a vendor. It allows organizations to avoid acquiring and managing their own physical servers and datacenter architecture and is scalable so companies pay only for what they use.

Serverless Computing

Serverless computing occurs when a Cloud service provider offers backend services (infrastructure and infrastructure management) on an as-used basis so developers can build applications without worrying about infrastructure management. While physical servers are still used by the Cloud service provider, these are called serverless because this infrastructure is not owned, controlled, or maintained by the organization.



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Cloud Services Security

Cloud services security includes policies, procedures, controls, and hardware that work together to ensure that Cloud-based systems are secure. Before signing a service level agreement, one should ask:

- What type of disaster plans are in place?
- Is the service in compliance with local, state, and federal security standards and regulations?
- Does the service go through external security audits?
- Does the service have any specific security certifications?
- How are data from different corporations kept separate?
- What encryption mechanisms are in place?

Virtual Private Networks

A **virtual private network (VPN)** creates a secure connection between two computers, allowing for encrypted communications, using the Internet as the pathway for data transmission and communication. VPNs can be used by organizations whose employees need to access the company network remotely.



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Blockchain

Blockchain stores transaction data in blocks that are linked together to form a chain. Each block in the blockchain contains a **hash**, batches of recent time-stamped transactions, and the hash from the previous block. Security in the blockchain is maintained because the previous hash links the blocks together.

Blockchain Uses in the Business Environment

Blockchain Uses in Business	
Business Contracts	Secure information contained in contracts makes it almost impossible to change any information in the contract.
Monetary Transactions	Blockchain is ideal for monetary transactions because of its encryption and it eliminates the need for banks to handle monetary transactions.
Audits	It can make audits more efficient and accurate.
Supply Chain Management	Blockchain provides a way to trace goods in a cost-effective manner. It allows shippers and customers to verify where items and goods are along the supply chain.
Quality Assurance	Blockchain can be used to trace mistakes and errors to the point of origin, making it easier for organizations to investigate mistakes and mitigate damage.



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The Process of Blockchain

A blockchain consists of multiple blocks that are linked together. For a new block to be added to the blockchain, four criteria must be met:

1. A transaction must take place (e.g., a person decides to make a purchase).
2. The transaction must be verified. After making the purchase, the transaction must be verified. In the blockchain, a network of computers confirms the details of the purchase, including transaction date and time, the amount, and the buyer and seller.
3. The transaction is stored in a block. The block includes digital signatures of the buyer and seller and the amount of the purchase.
4. A hash is added. The hash is a unique identifying code. The block also receives the hash of the most recent block (i.e., the one that was created before this one).



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Cryptocurrencies

Cryptocurrencies are digital currencies that only exist on computers without any intermediary such as a bank or other financial institution. Transactions or exchanges of cryptocurrency are recorded on a blockchain, also called a **digital public ledger**. New cryptocurrency is created by a process called **mining**. Computer users who are running software and hardware aimed at confirming transactions to the digital ledger are considered **miners**.



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How Cryptocurrency Is Created

1. Decide on a **consensus mechanism**. These are protocols that ensure all devices on the blockchain are synchronized and in agreement about which transactions are legitimate.
2. Select a **blockchain platform**. Leading blockchain platforms include Ethereum, IBM Blockchain, and Microsoft Azure Blockchain.
3. Design the **nodes**. Nodes are designed according to the functionality of the blockchain such as the blockchain host, hardware needed, and so on.
4. Decide on internal **architecture**. Deciding on the parameters of the blockchain is a critical element of cryptocurrency design.
5. Create **API integration**. The API (Application Programming Interface) lists different operations developers can use as well as descriptions of the executable elements of the operation.
6. Create **interface** design. The design of a user-friendly interface is where the architecture is tested and the front-end and back-end programming are checked, along with market testing with potential users.
7. Bring into **compliance**. The cryptocurrency must be in compliance with any laws that govern cryptocurrency. There is emerging legislation in the United States that governs virtual currencies. Legislation is being considered by the Internal Revenue Service (IRS), Securities and Exchange Commission (SEC), and other legal entities.



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Popular Cryptocurrencies

The first cryptocurrency was created in 2008. Today, there are many, but these are a few of the most popular:

- **Bitcoin (BTC):** Created in 2008, it is the most widely traded and respected cryptocurrency. Bitcoin is accepted by Starbucks, Whole Foods, Nordstrom, and other businesses.
- **Ethereum (ETH):** Created in 2015, it is the second most valuable cryptocurrency after Bitcoin.
- **Bitcoin Cash (BCH):** BCH is a forked cryptocurrency from Bitcoin. A fork is when a cryptocurrency is split into two different cryptocurrencies. The parent (original) retains the original features while the child (the new currency) is technologically enhanced.



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Collaboration Software

Collaboration software allows for the creation of a dedicated workspace where users can add data and workflows. The dedicated workspace is viewable and editable, based on assigned privileges, by users regardless of their physical location.

The Use of Collaboration Software in the Business Environment

Collaboration Software Benefits	
Better Communication	People from across the organization can share content in real time.
Project Management Capabilities	The four functions of project management include planning, organizing, leading, and controlling. Collaboration software allows project leaders to create a plan and to schedule and share this with all members of the team.
Improved Engagement	Collaboration software helps create engagement by allowing remote and organization-based employees the ability to exchange and interact.
Streamlined Workflow	Collaboration software creates streamlined workflows because scheduling is easy to add and update.



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Popular Collaboration Software Programs

Collaboration Software Programs	
Smartsheet	Smartsheet focuses on the collaborative aspects of project management. It allows users to create web forms, create sheets (similar to spreadsheets), get alerts, and have discussions.
Slack	Slack is a collaboration hub that aims to replace email and make communication seamless. It is composed of channels where teams and members of the organization can communicate and allows for thousands of apps to be connected to each workspace.
Trello	Trello is a collaboration tool that organizes projects into boards, creating a visual representation of what's being worked on, who's doing the work, and where something is in a process. It is fully scalable to mobile.



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