CLOUD COMPUTING

Foundations of Web development

Chapter Objectives

- Describe servers, server-based processing, clients, and client-based processing
- Explain client/server architecture, including tiers, cost-benefit issues, and performance considerations
- Describe the impact of the Internet on system architecture

Chapter Objectives

- Explain the difference between online and batch processing
- Define network topology, and provide examples of hierarchical, star, bus, and ring network models
- Explain network protocols and licensing issues

Introduction

- An effective system combines elements into an architecture, or design, that is flexible, cost-effective, technically sound, and able to support the information needs of the business
- System architecture translates the logical design of an information system into a physical structure that includes hardware, software, network support, and processing methods

Planning the Architecture

- **Servers**
  - Server
  - Clients
  - The terms mainframe architecture and centralized system typically describe a multiuser environment where the server is significantly more powerful than the clients

Planning the Architecture

- **Servers**
  - Background
    - In addition to centralized data processing, early systems performed all data input and output at a central location, often called a data processing center
    - Users had no input or output capability, except for printed reports that were distributed by a corporate IT department

Planning the Architecture

- **Servers**
  - Server-based processing
    - In a centralized design, the remote user's keystrokes are transmitted to the mainframe, which responds by sending screen output back
    - Server-based processing typically uses character-based terminals which is a disadvantage
    - An Internet-based retail operation might use centralized data management
    - As server technology evolved, terminal technology also has changed dramatically

Planning the Architecture

- **Clients**
  - As PC technology exploded in the mid-1980s, microcomputers quickly appeared on corporate desktops
  - Users found that they could run their own word processing, spreadsheet, and database applications
  - Most companies linked the stand-alone computers into networks

Planning the Architecture

- **Clients**
  - Stand-Alone Computing
    - Stand-alone computing was inefficient and expensive
    - Maintaining data on individual workstations raised major concerns about data security, integrity, and consistency
    - It was impossible to protect and back up valuable business data, and companies were exposed to enormous risks
    - This led to data inconsistency and unreliability

Planning the Architecture

- **Clients**
  - Local and wide area networks
    - Resolved the problems of stand-alone computing by joining clients into a local area network (LAN)
    - A wide area network (WAN) spans long distances and can connect LANs that are continents apart
    - The network is transparent
    - Compared to mainframe architecture, distributed systems increase concerns about data security and integrity

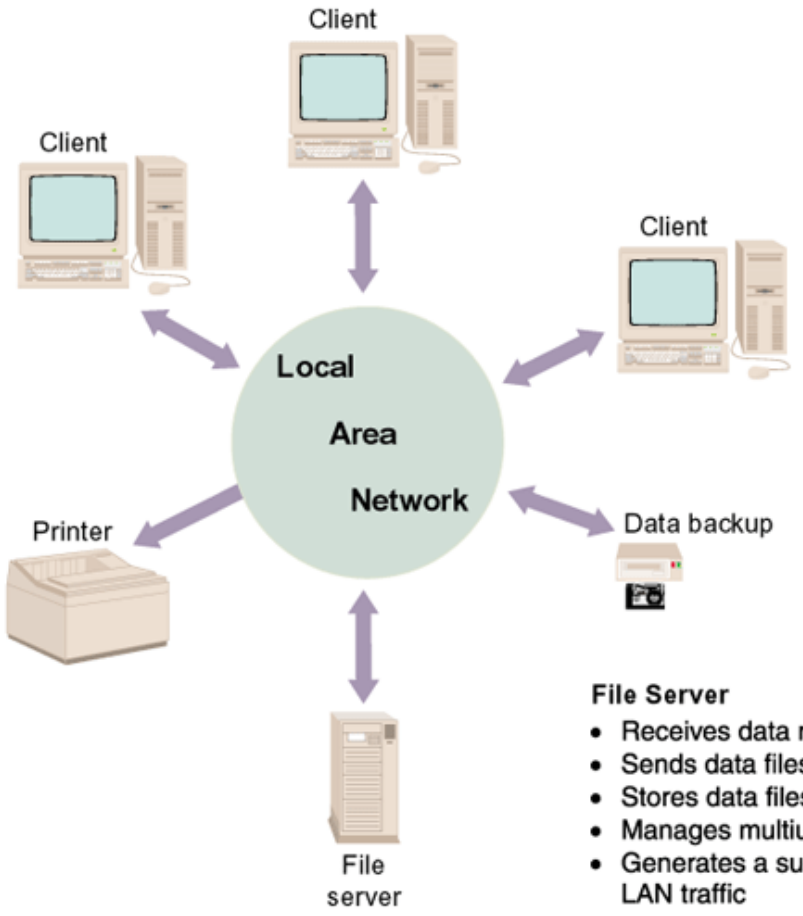
Planning the Architecture

- **Clients**
  - Client-based processing
    - In a typical LAN, clients share data stored on a local server
    - In a file server design, also called a file sharing architecture, an individual LAN client has a copy of the application program installed locally, while the data is stored on a central file server
    - A file server design requires significant network resources

Planning the Architecture

Client

- Handles user interface
- Sends data request to server
- Receives data files from server
- Runs application program locally to process data
- Sends data file back to server



File Server

- Receives data requests from client
- Sends data files to client
- Stores data files
- Manages multiuser access
- Generates a substantial amount of LAN traffic

Client/Server Architecture

- **Overview**
  - Client/server architecture
  - The client submits a request for information from the server, which carries out the operation and responds to the client
  - Many early client/server systems did not produce expected savings
  - Many companies had an installed base of mainframe data, called legacy data, which was difficult to access and transport to a client/server environment

Client/Server Architecture

- **Overview**

Characteristics of Client/Server Versus Mainframe Systems		
Characteristics	**Client/Server**	**Mainframe**
Basic architecture	Very flexible	Very rigid
Application development	Flexible Fast Object-oriented	Highly structured Slow Traditional
User environment	PC-based GUI Empowers the user Improves productivity	Uses terminals Text interface Constrains the user Limited options
Security and control features	Decentralized Difficult to control	Centralized Easier to control
Processing options	Can be shared and configured in any form desired	Cannot be modified
Data storage options	Can be distributed to place data closer to users	All data is stored centrally
Hardware/software integration	Very flexible Multivendor model	Very rigid Single proprietary vendor

Client/Server Architecture

- **Types of Clients: Fat and Thin**
  - Fat client - thick client
  - Thin client
  - Most IT experts agree that thin client designs provide better performance, because program code resides on the server, near the data
  - In contrast, a fat client handles more of the processing and must access and update the data more often

Client/Server Architecture

- **Types of Clients: Fat and Thin**

Characteristic	Fat Client	Thin Client
Network traffic	Higher, because the fat client must communicate more often with the server to access data and update processing results	Lower, because most interaction between code and data takes place at the server
Performance	Slower, because more network traffic is required	Faster, because less network traffic is required
Initial cost	Higher, because more powerful hardware is required	Lower, because workstation hardware requirements are not as stringent
Maintenance cost	Higher, because more program code resides on the client	Lower, because most program code resides on the central server
Ease of development	Easier, because systems resemble traditional file-server designs where all processing was performed at the client	More difficult, because developers must optimize the division of processing logic

Client/Server Architecture

- **Client/Server Tiers**
  - Two-tier design
  - Three-tier design
  - Think of the middle layer as an application server, because it provides the application logic, or business logic
  - Three-tier designs also are called n-tier designs
  - The middle layer is more efficient and cost-effective in large-scale systems

Client/Server Architecture

- **Middleware**
  - Enables the tiers to communicate and pass data back and forth
  - Provides a transparent interface that enables system designers to integrate dissimilar software and hardware
  - Can integrate legacy systems and Web-based applications

Client/Server Architecture

- **Cost-Benefit Issues**
  - Client/server systems enable the firm to scale the system in a rapidly changing environment
  - Client/server computing also allows companies to transfer applications from expensive mainframes to less expensive client platforms
  - Client/server systems reduce network load and improve response times

Client/Server Architecture

- **Client/Server Performance Issues**
  - Client/server architecture does involve performance issues that relate to the separation of server-based data and networked clients
  - In contrast to the centralized system, a client/server design separates applications and data
  - Client/server systems must be designed so the client contacts the server only when necessary

Client/Server Architecture

- **Client/Server Performance Issues**
  - Distributed database management system (DDBMS)
  - Data stored closer to users can reduce network traffic
  - The system is scalable, so new data sites can be added without reworking the system design
  - The system is less likely to experience catastrophic failure

Impact of the Internet

- **E-Commerce Strategies**
  - In-house development
    - If you decide to proceed with an in-house solution, you must have an overall plan to help achieve your goals
    - An in-house solution usually requires a greater initial investment, but provides more flexibility for a company that must adapt quickly in a dynamic e-commerce environment

Impact of the Internet

- **E-Commerce Strategies**
  - Packaged solutions and e-commerce service providers
    - Many vendors offer turnkey systems for companies
    - Another alternative is to use an application service provider (ASP)
    - Must consider whether the advantage of lower initial cost outweighs the disadvantage of reduced flexibility later on
  - Corporate portals
    - A portal is an entrance to a multifunction Web site
    - A corporate portal can provide access for customers, employees, suppliers, and the public

Impact of the Internet

- **Industry Experience and Trends**
  - A systems analyst confronts a bewildering array of products and strategies when constructing Internet- or intranet-based systems
  - A good starting point might be to consider the experience of other companies in the same industry
  - This type of research can provide valuable information about a vendor's products and services

Processing Methods

- **Online Processing**
  - Online processing systems have four typical characteristics:
    1. The system processes transactions completely when and where they occur
    2. Users interact directly with the information system
    3. Users can access data randomly
    4. The information system must be available whenever necessary to support business functions

Processing Methods

- **Batch Processing**
  - In a batch processing system, data is collected and processed in groups, or batches
  - The IT operations group can run batch programs on a predetermined schedule without user involvement; and batch programs require significantly fewer network resources than online systems

Processing Methods

- **Combined Online and Batch Processing**
  - Point-of-sale (POS)
  - Online processing offers an inherent advantage because data is entered and validated as it occurs
  - Online processing is more expensive
  - Backup and recovery for online processing is more difficult
  - In many situations, batch processing is cost-effective, less vulnerable to system disruption, and less intrusive

Network Models

- **A network allows the sharing of hardware, software, and data resources in order to reduce expenses and provide more capability to users**
- **The OSI Reference Model**
  - Before you study network topology, you should have a basic understanding of the OSI (open system interconnection) model

Network Models

- **The OSI Reference Model**
  - The OSI model consists of seven layers.
    - Application layer: provides network services requested by local workstation
    - Presentation layer: assures that data is uniformly structured and formatted for network transmission
    - Session layer: defines control structures that manage the communications link between computers
    - Transport layer: provides reliable data flow and error recovery

Network Models

- **The OSI Reference Model**
  - The OSI model consists of seven layers.
    - Network layer: defines network addresses and determines how data is routed over the network
    - Data link layer: defines specific methods of transmitting data over the physical layer, such as defining the start and end of a data block
    - Physical layer: contains physical components that carry data, such as cabling and connecters

Network Models

- **Network Modeling Tools**
  - As you translate the OSI logical model into a physical model of the networked system, you can use software tools, such as Microsoft Visio, which is a multipurpose drawing tool, to represent the physical structure and network components

Network Models

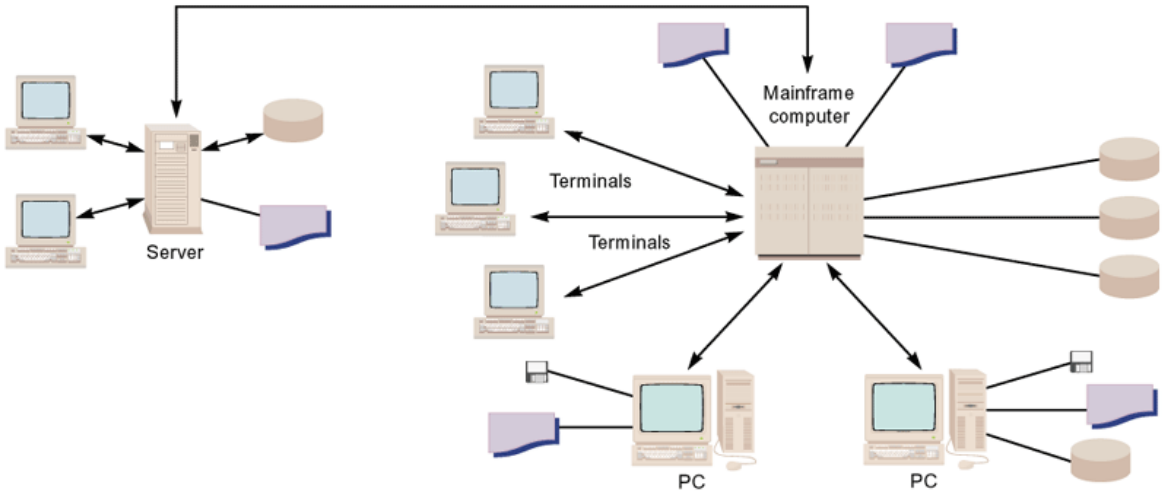
- **Network Topology**
  - The way a network is configured is called the network topology
  - LAN and WAN networks typically are arranged in four patterns: hierarchical, star, bus, and ring

Network Models

- **Network Topology**
  - Hierarchical network
    - One disadvantage of a hierarchical network is that if a business adds additional processing levels, the network becomes more complex and expensive to operate and maintain
    - One advantage is that it mirrors the actual operational flow in the organization

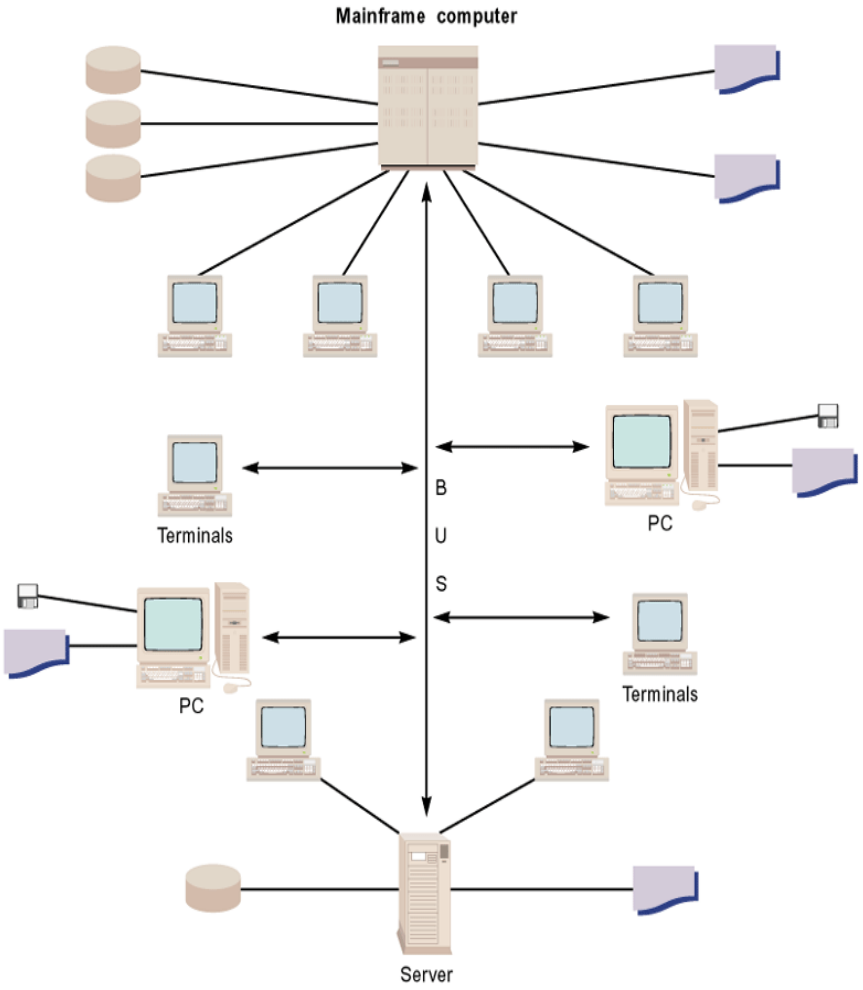
Network Models

- **Network Topology**
  - –Star network
    - At the center of the star, which is called the hub, the central computer manages the network
    - While a star network provides efficiency and close control, a major disadvantage of this design is that the entire network depends on the central computer



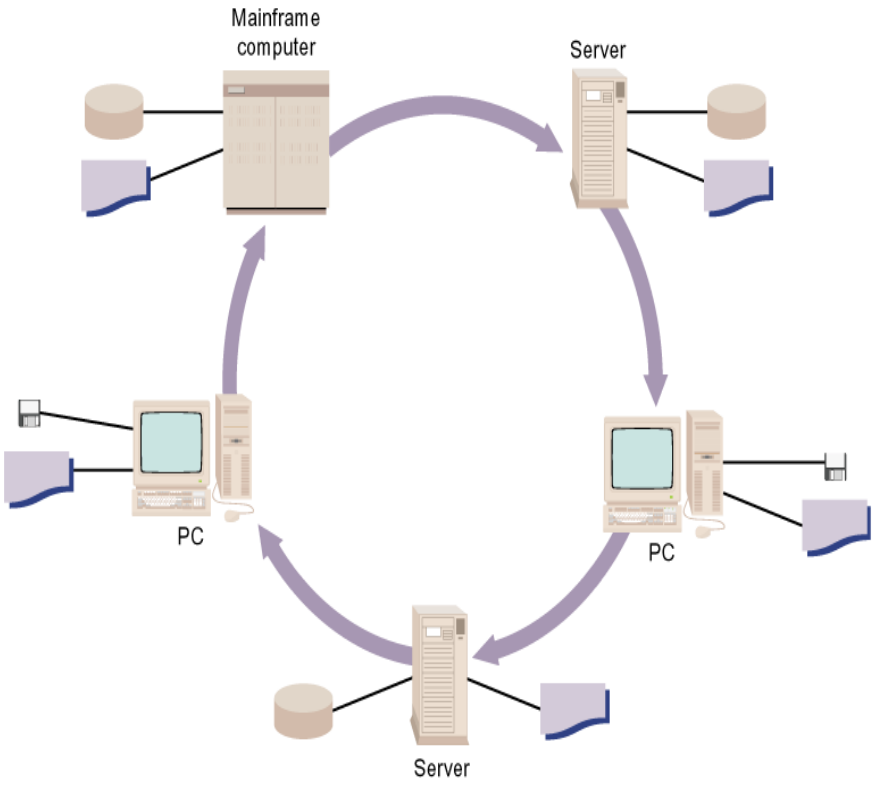
Network Models

- **Network Topology**
  - –Bus network
    - Advantage – devices can be attached or detached from the network at any point without disturbing the rest of the network
    - Disadvantage – performance can decline as users and devices are added, because all message traffic must flow along the central bus



Network Models

- **Network Topology**
  - –Ring network
    - Used when processing is performed at local sites rather than at a central location
    - Data flows only in one direction
    - Disadvantage – if a network device fails, devices downstream cannot communicate with the network



Network Models

- **Network Protocols**
  - The network must use a protocol
  - A popular network protocol is Transmission Control Protocol/Internet Protocol (TCP/IP)
  - A familiar example of a TCP/IP protocol is the file transfer protocol (FTP)

Network Models

- **Licensing Issues**
  - Various types of individual and site licenses are available from software vendors
  - Some vendors limit the number of users or the number of computers that can access the program simultaneously
  - Carefully investigate the capabilities of network software to ensure that it can handle the anticipated system traffic

System Management and Support

- **Performance Management**
  - Performance management tools are designed to collect information about system resources and activity levels
  - Firms such as NetScout Systems offer comprehensive performance management packages
  - The NetScout Web site mentions studies that show network delays cost the industry more revenue than actual stoppages

System Management and Support

- **System Security**
  - First, provisions must be made to assign and monitor user IDs, passwords, and access levels
  - Second, the system security tools must handle virus protection and detect any unauthorized access
  - Many security management software products are available

System Management and Support

- **Fault Management, Backup, and Disaster Recovery**
  - The best strategy is to prevent problems before they can affect they system
  - You must provide additional means, however, to deal with system faults and interruptions
  - Fault management
    - Fault management includes monitoring the system for signs of trouble, logging all system failures, diagnosing the problem, and applying corrective action

System Management and Support

- **Fault Management, Backup, and Disaster Recovery**
  - Backup and disaster recovery
    - Backup
    - Recovery
    - Disaster recovery plan
    - Backup and recovery planning depends on the type of system involved
    - With online systems, you must either perform backups when the system is inactive, or continuously back up the data

System Management and Support

- **Fault Management, Backup, and Disaster Recovery**
  - Backup and disaster recovery
    - Another common strategy is to use a RAID (redundant array of independent disks) system
    - RAID systems are called fault-tolerant
    - Experienced IT professionals often note that the three most important system security tools are backup, backup, and more backup

System Management and Support

- **Fault Management, Backup, and Disaster Recovery**
  - Backup and disaster recovery
    - Log file or journal file
    - Business insurance can help offset expenditures
    - File retention laws and regulations apply to company data
    - If a government rule specifies that a record of all payments to the company must be kept for three years, then your design must retain the data for that period

Systems Design Completion

- **System Design Specification**
  - System design specification
  - Technical design specification
  - Detailed design specification
  - The system design specification is the baseline against which the operational system will be measured
  - The system design specification varies in length

Systems Design Completion

- **System Design Specification**
  - A typical system design specification uses a structure similar to the following:
    - Executive summary
    - System components
    - System environment
    - Implementation requirements
    - Time and cost estimates
    - Appendices

Systems Design Completion

- **User Approval**
  - Users must review and approve the interface design, report and menu designs, data entry screens, source documents, and other areas of the system that affect them
  - Other IT department members also need to review the system design specification
  - When the system design specification is complete, you distribute the document to a target group of users, IT department personnel, and company management

Systems Design Completion

- **Presentations**
  - The presentations give you an opportunity to explain the system, answer questions, consider comments, and secure final approval
  - The first presentation is to the systems analysts, programmers, and technical support staff members
  - Your next presentation is to department managers and users from departments affected by the system

Systems Design Completion

- **Presentations**
  - The final presentation is for company management
  - Key objective: to obtain management's approval and support for the next development step
  - Management might reach one of three decisions: proceed with systems development, perform additional work on the systems design phase, or terminate the project

Chapter Summary

- Networks allow the sharing of hardware, software, and data resources in order to reduce expenses and provide more capability to users
- The way a network is configured is called the network topology
- The system design specification presents the complete systems design for an information system