

Systems Analysis and Design



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Application Architecture

Chapter 8

Key Definitions



☑ Architecture design

- Plans for how the system will be distributed across computers and what the hardware and software will be used for each computer


☑ Hardware and software specification

- Describes the hardware/software components in detail to aid those responsible for purchasing those products.

ELEMENTS OF AN ARCHITECTURE DESIGN



Architectural Components (Functions) of Software



- ☑ Data storage
- ☑ Data access logic
 - Processing required to access stored data
- ☑ Application logic
 - Processing logic of the application
- ☑ Presentation logic
 - Information display and user command processing

Architectural Design Purpose



- ☑ Determine what parts of the application software will be assigned to what hardware.
- ☑ Hardware options:
 - Clients
 - Input/output devices employed by users
 - PCs, laptops, handheld devices, cell phones
 - Servers
 - Larger computers storing software
 - Accessible by many users

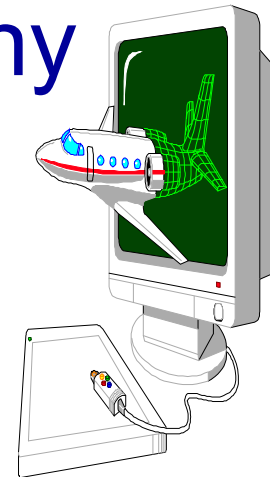
Server-Based Architectures



- ☑ Mainframe
- ☑ Minicomputer
- ☑ Microcomputer (personal computer)

Client-Based Architectures

- ☑ Terminals
- ☑ Microcomputer (personal computer)
- ☑ Special purpose terminals(ATMs, kiosks, Palm Pilots, and many others)

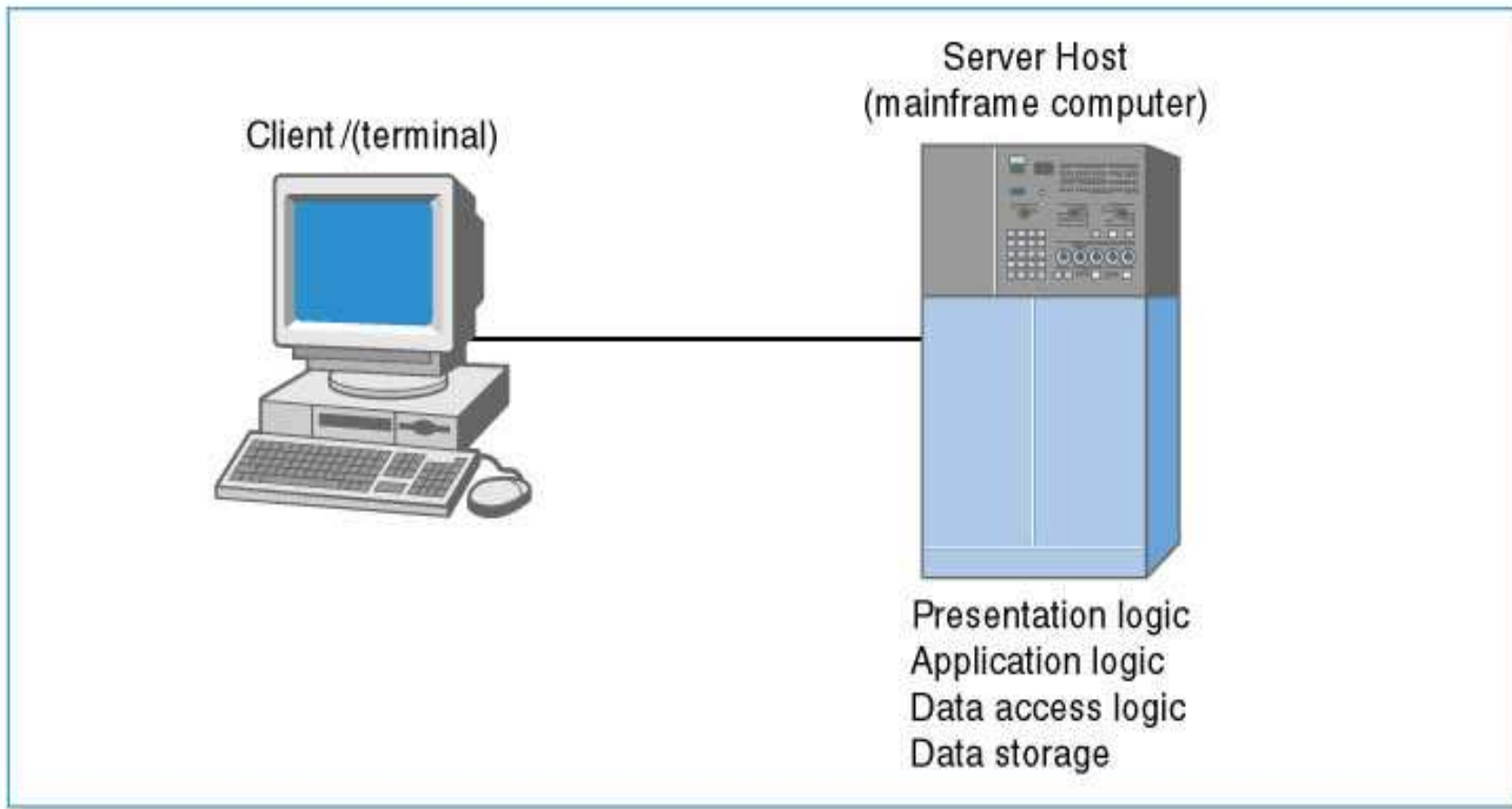


Client-Server Architectures

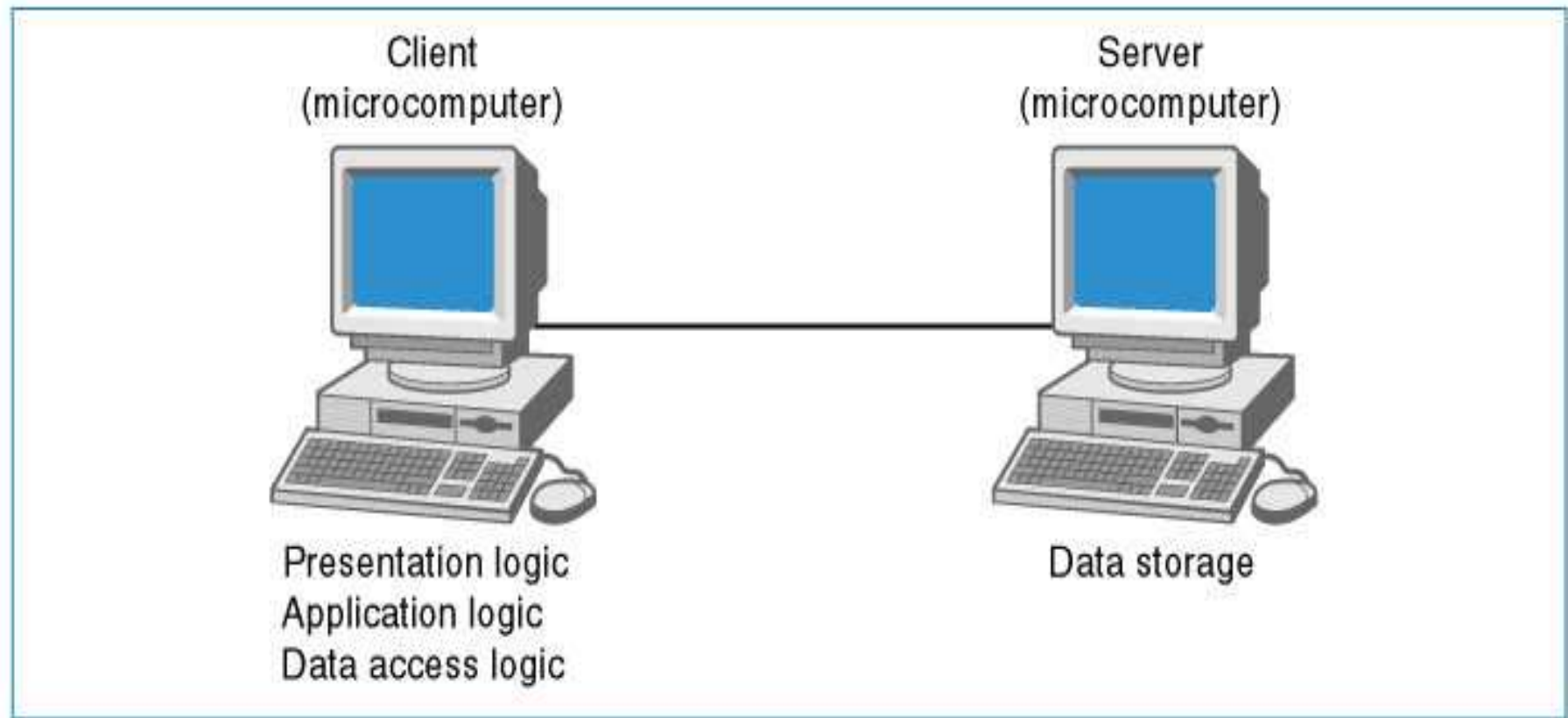


- ☑ Server-based Architecture
- ☑ Client-based Architecture
- ☑ Client-server based Architecture

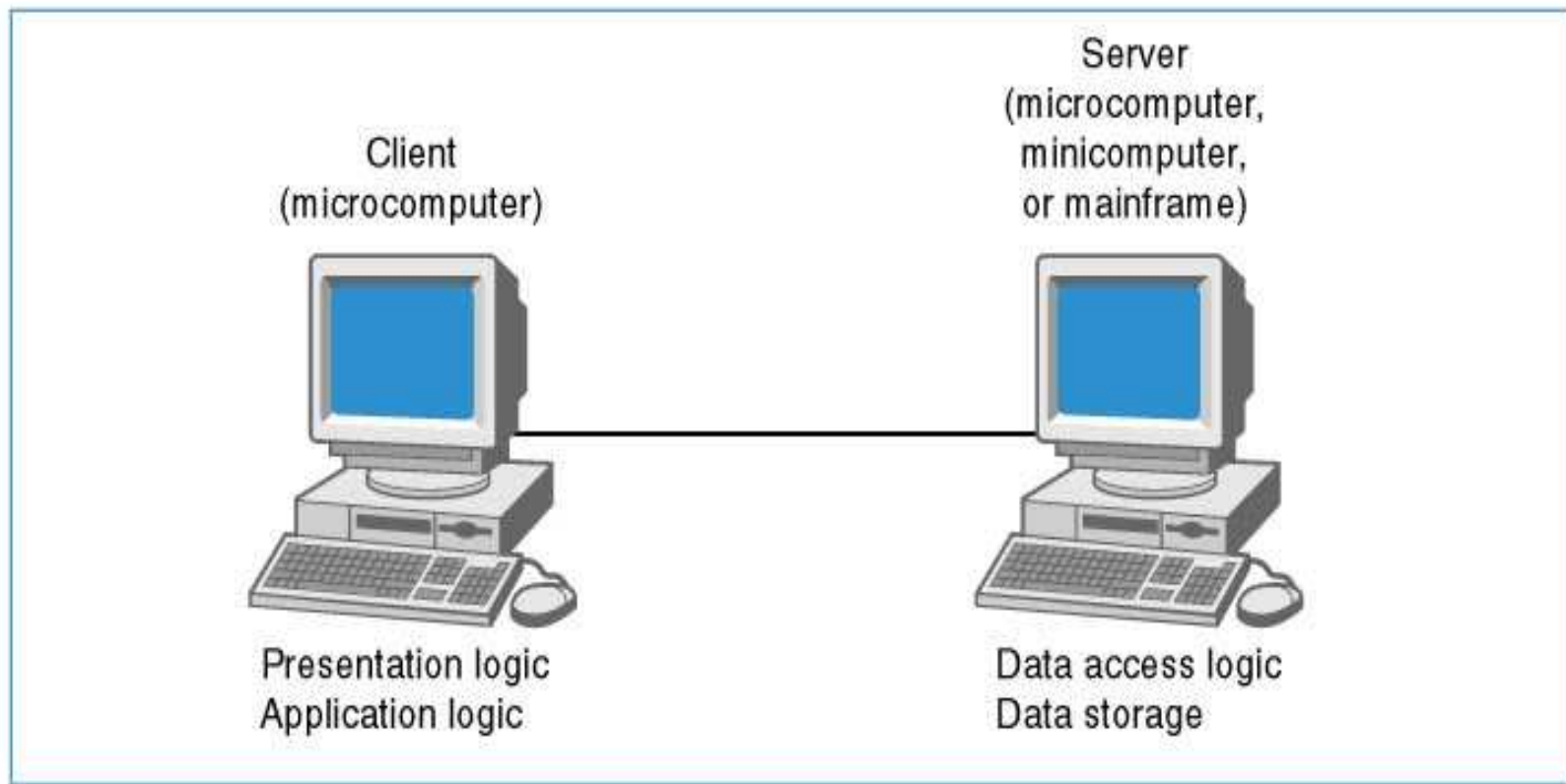
Server-Based Architecture



Client-Based Architecture



Client-Server Architecture (Two-Tiered)



Client-Server Attributes



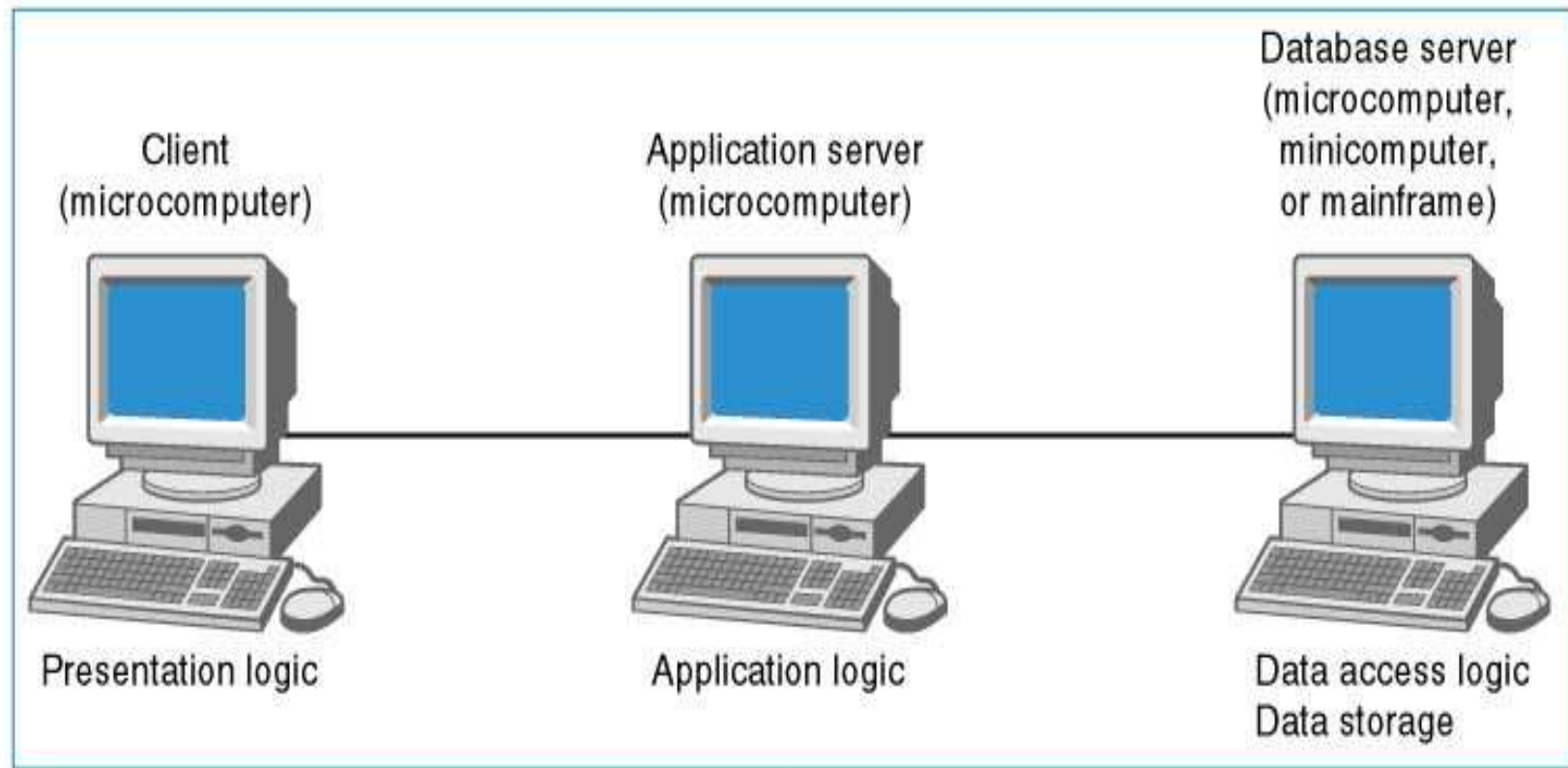
☑ Benefits

- Scalable
- Works with multiple vendors/products through **middleware**
- Improved modularity of web-based systems
- No central point of failure

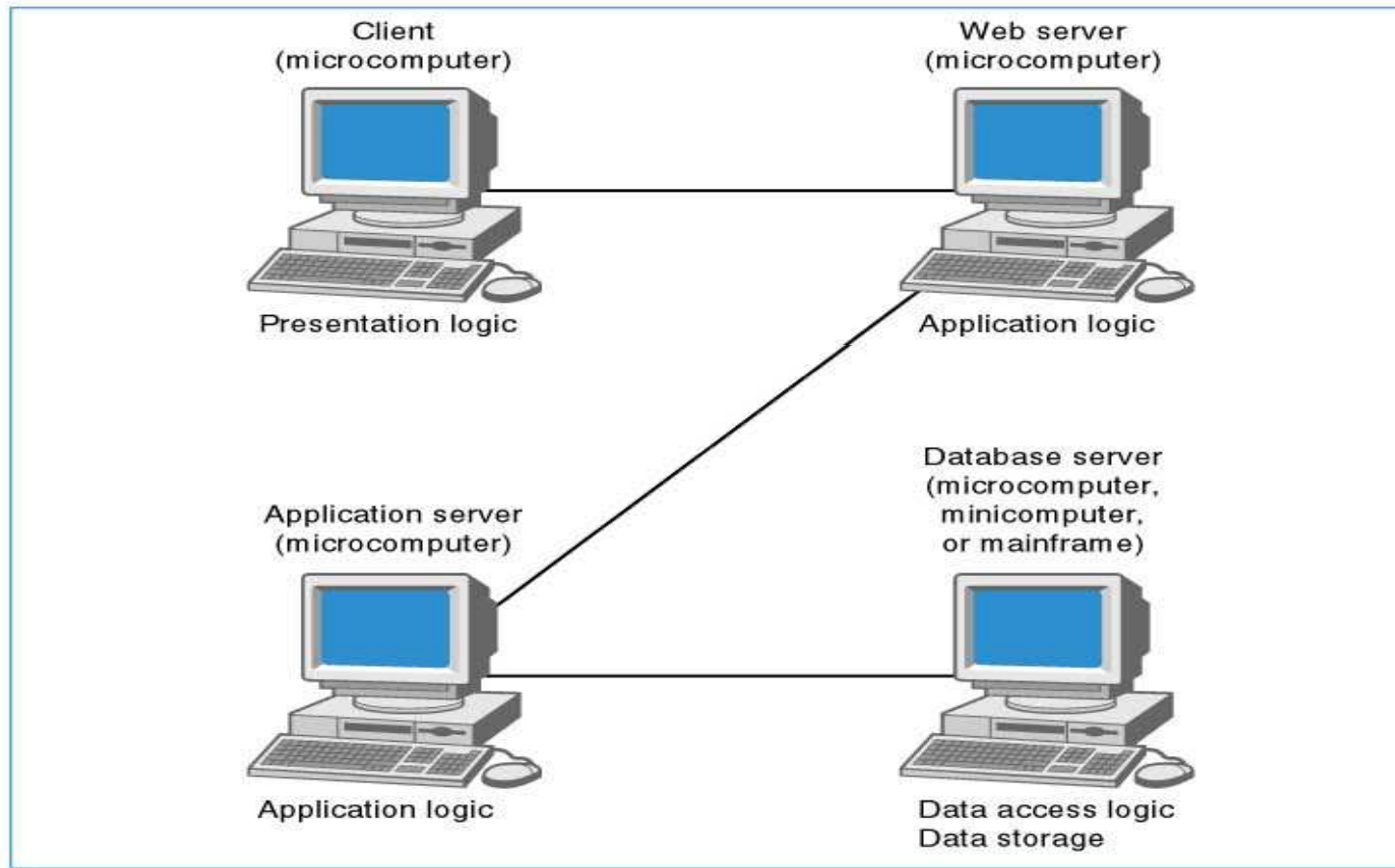
☑ Limitations

- Complexity
- New programming languages and techniques (adds stress for personnel)
- More complex to update

Three-Tiered Client-Server Architecture



Four-Tiered Client-Server Architecture



N-Tiered versus 2-Tiered Client-Server Architectures



Benefits

- Separates processing to better balance load on different servers
- More scalable

Limitations

- Greater load on the network
- More difficult to program and test

Your Turn



- ☑ Consider the course registration system at your university:
- ☑ What computing architecture does it use?
- ☑ What computing architecture would you use if you were replacing it today?

CREATING AN ARCHITECTURE DESIGN



Selecting an Architecture Design



- ❑ Lower costs often used to justify choice of client-server
- ❑ Recommended selection process:
 - Expand nonfunctional requirement details
 - Base architecture selection on the detailed nonfunctional requirements

Operational Requirements

Type of Requirement

Definition

Examples

Technical Environment Requirements	Special hardware, software, and network requirements imposed by business requirements	<ul style="list-style-type: none"> • The system will work over the Web environment with Internet Explorer. • All office locations will have an always-on network connection to enable real-time database updates. • A version of the system will be provided for customers connecting over the Internet via a small screen PDA.
System Integration Requirements	The extent to which the system will operate with other systems	<ul style="list-style-type: none"> • The system must be able to import and export Excel spreadsheets. • The system will read and write to the main inventory database in the inventory system.
Portability Requirements	The extent to which the system will need to operate in other environments	<ul style="list-style-type: none"> • The system must be able to work with different operating systems (i.e., Linux; Windows XP) • The system may need to operate with handheld devices such as a Palm.
Maintainability Requirements	Expected business changes to which the system should be able to adapt	<ul style="list-style-type: none"> • The system will be able to support more than one manufacturing plant with 6 months advance notice. • New versions of the system will be released every six months.

Performance Requirements

Type of Requirement	Definition	Examples
Speed Requirements	The time within which the system must perform its functions	<ul style="list-style-type: none">• Response time must be less than 7 seconds for any transaction over the network• The inventory database must be updated in real time.• Orders will be transmitted to the factory floor every 30 minutes.
Capacity Requirements	The total and peak number of users and the volume of data expected	<ul style="list-style-type: none">• There will be a maximum of 200 simultaneous users at peak use times.• A typical transaction will require the transmission of 10K of data.• The system will store data on approximately 5,000 customers for a total of about 2 MB of data.
Availability and Reliability Requirements	The extent to which the system will be available to the users and the permissible failure rate due to errors.	<ul style="list-style-type: none">• The system should be available 24 x 7, with the exception of scheduled maintenance.• Scheduled maintenance shall not exceed one 6-hour period each month.• The system will have 99% uptime performance.

Security Requirements

Type of Requirement	Definition	Examples
System Value Estimates	Estimated business value of the system and its data	<ul style="list-style-type: none"> The system is not mission critical but a system outage is estimated to cost \$50,000 per hour in lost revenue. A complete loss of all system data is estimated to cost \$20 million.
Access Control Requirements	Limitations on who can access what data	<ul style="list-style-type: none"> Only department managers will be able to change inventory items within their own department. Telephone operators will be able to read and create items in the customer file, but cannot change or delete items.
Encryption and Authentication Requirements	Defines what data will be encrypted where and whether authentication will be needed for user access	<ul style="list-style-type: none"> Data will be encrypted from the user's computer to the Web site to provide secure ordering. Users logging in from outside the office will be required to authenticate.
Virus Control	Requirements to control the spread of viruses	<ul style="list-style-type: none"> All uploaded files will be checked for viruses before

Cultural/Political Requirements

Type of Requirement

Definition

Examples

Multilingual Requirements	The language in which the system will need to operate	<ul style="list-style-type: none"> • The system will operate in English, French, and Spanish.
Customization Requirements	Specification of what aspects of the system can be changed by local users	<ul style="list-style-type: none"> • Country managers will be able to define new fields in the product database to capture country-specific information. • Country managers will be able to change the format of the telephone number field in the customer database.
Making Unstated Norms Explicit	Explicitly stating assumptions that differ from country to country	<ul style="list-style-type: none"> • All date fields will be explicitly identified as using the month-day-year format. • All weight fields will be explicitly identified as being stated in kilograms.
Legal Requirements	The laws and regulations that impose requirements on the system	<ul style="list-style-type: none"> • Personal information about customers cannot be transferred out of European Union countries into the United States. • It is against U.S. federal law to divulge information on who rented what videotape, so access to a customer's rental history is permitted only to regional managers.

Designing the Architecture




- ☑ Technical environment requirements, driven by business requirements, often define the application architecture
- ☑ If not, other nonfunctional requirements become important

Nonfunctional Requirements and their Implications for Architecture Design



Requirements	Server-Based	Client-Based	Thin Client-Server	Thick Client-Server
Operational Requirements				
System Integration Requirements	✓		✓	✓
Portability Requirements			✓	
Maintainability Requirements	✓		✓	
Performance Requirements				
Speed Requirements			✓	✓
Capacity Requirements			✓	✓
Availability/Reliability Requirements	✓		✓	✓
Security Requirements				
High System Value	✓		✓	
Access Control Requirements	✓			
Encryption/Authentication Requirements			✓	✓
Virus Control Requirements	✓			
Cultural/Political Requirements				
Multilingual Requirements			✓	
Customization Requirements			✓	
Making Unstated Norms Explicit			✓	
Legal Requirements	✓		✓	✓

HARDWARE AND SOFTWARE SPECIFICATION



Hardware and Software Specification




- ☑ Used if new hardware or software must be purchased
- ☑ Communicates project needs
- ☑ Actual acquisition of hardware and software usually left to a purchasing department -- especially in larger firms

Hardware and Software Specification



- ❑ Determine software needs
 - OS, special purpose
 - Training, warranty, maintenance, licensing needs
- ❑ Determine hardware needs
 - Server(s), clients, peripherals, backup devices, storage components
 - Minimum configuration needs

Sample Hardware and Software Specification



	Standard Client	Standard Web Server	Standard Application Server	Standard Database Server
Operating System	<ul style="list-style-type: none"> • Windows • Mozilla 	<ul style="list-style-type: none"> • Linux 	<ul style="list-style-type: none"> • Linux 	<ul style="list-style-type: none"> • Linux
Special Software	<ul style="list-style-type: none"> • Real Audio • Adobe Acrobat Reader 	<ul style="list-style-type: none"> • Apache 	<ul style="list-style-type: none"> • Java 	<ul style="list-style-type: none"> • Oracle
Hardware	<ul style="list-style-type: none"> • 40-gig disk drive • Pentium • 17-inch Monitor 	<ul style="list-style-type: none"> • 80-gig disk drive • Pentium 	<ul style="list-style-type: none"> • 80-gig disk drive • Pentium 	<ul style="list-style-type: none"> • 200-gig disk drive • RAID • Quad Pentium
Network	<ul style="list-style-type: none"> • Always-on Broadband preferred • Dial-up at 56Kbps possible with some performance loss 	<ul style="list-style-type: none"> • Dual 100 Mbps Ethernet 	<ul style="list-style-type: none"> • Dual 100 Mbps Ethernet 	<ul style="list-style-type: none"> • Dual 100 Mbps Ethernet

Factors in Hardware and Software Selection




1. **Functions and Features** What specific functions and features are needed (e.g., size of monitor, software features)
2. **Performance** How fast the hardware and software operates (e.g., processor, number of database writes per second)
3. **Legacy Databases and Systems** How well the hardware and software interacts with legacy systems (e.g., can it write to this database)
4. **Hardware and OS Strategy** What are the future migration plans (e.g., the goal is to have all of one vendor's equipment)
5. **Cost of Ownership** What are the costs beyond purchase (e.g., incremental license costs, annual maintenance, training costs, salary costs)
6. **Political Preferences** People are creatures of habit and are resistant to change, so changes should be minimized
7. **Vendor Performance** Some vendors have reputations or future prospects that are different from those of a specific hardware or software system they currently sell

Summary



- ☑ The three fundamental computing architectures are server-based, client-based, and client-server based.
- ☑ Select architecture design based on detailed nonfunctional requirements
- ☑ Hardware and software specification documents acquisition needs

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