Lecture 2

Database System Concepts and Architecture

Centralized and Client-Server DBMS Architectures

- Centralized DBMS:
  - Combines everything into single system including- DBMS software, hardware, application programs, and user interface processing software.
  - User can still connect through a remote terminal – however, all processing is done at centralized site.

Centralized and Client-Server DBMS Architectures

- Older architectures used mainframe computers to provide the main processing for all system functions, including user application programs and user interface programs, as well as all the DBMS functionality.
- The reason was that in older systems, most users accessed the DBMS via computer terminals that did not have processing power and only provided display capabilities.
- All processing was performed remotely on the computer system housing the DBMS, and only display information and controls were sent from the computer to the display terminals, which were connected to the central computer via various types of communications networks.

Centralized and Client-Server DBMS Architectures

- As prices of hardware declined, most users replaced their terminals with PCs and workstations, and more recently with mobile devices.
- At first, database systems used these computers similarly to how they had used display terminals, so that the DBMS itself was still a **centralized** DBMS in which all the DBMS functionality, application program execution, and user interface processing were carried out on one machine.
- Figure 2.4 illustrates the physical components in a centralized architecture.
- DBMS systems started to exploit the available processing power at the user side, which led to client/server DBMS architectures.
- (Workstations are computers that are specifically configured to meet the most demanding technical computing requirements. To be considered a workstation, systems must include key capabilities related to performance, reliability, data integrity, scalability, and expandability.)

A Physical Centralized Architecture

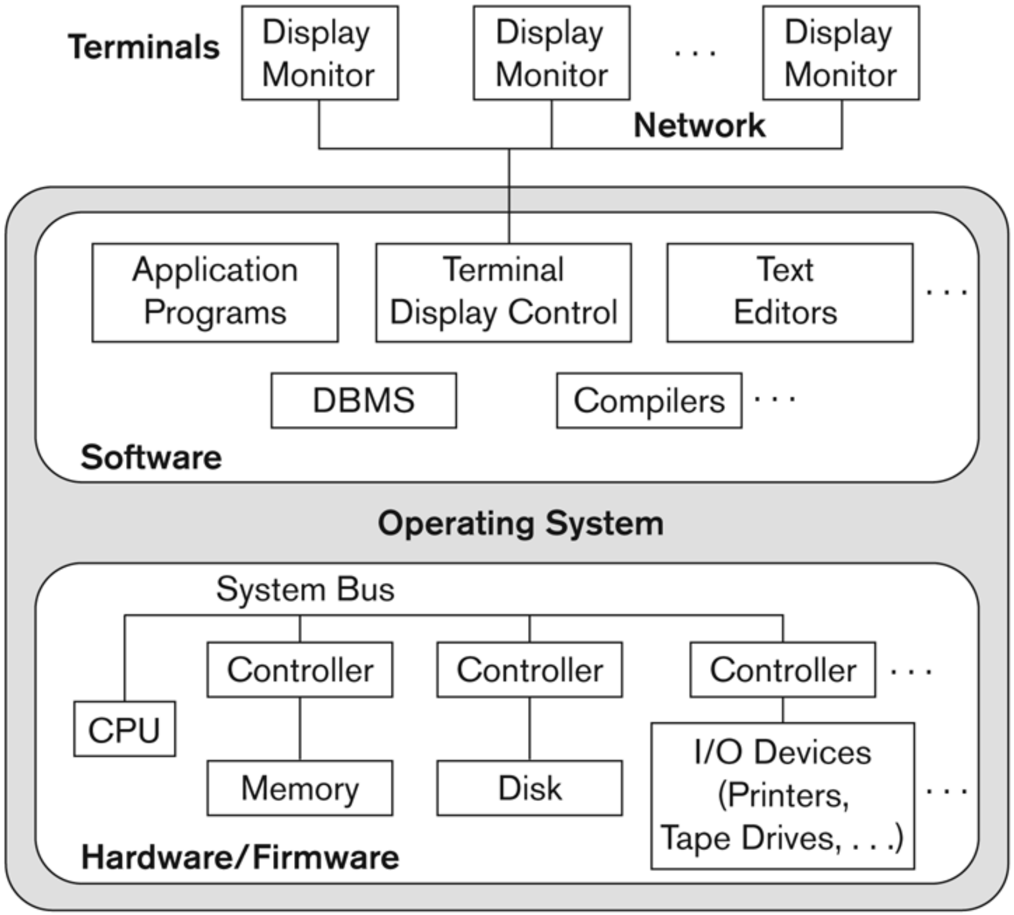


Figure 2.4
A physical centralized architecture.

Basic Client/Server Architectures

- The **client/server architecture** was developed to deal with computing environments in which a large number of PCs, workstations, file servers, printers, database servers, Web servers, e-mail servers, and other software and equipment are connected via a network.
- The idea is to define **specialized servers** with specific functionalities. For example, it is possible to connect a number of PCs or small workstations as clients to a **file server** that maintains the files of the client machines.
- Another machine can be designated as a **printer server** by being connected to various printers; all print requests by the clients are forwarded to this machine. **Web servers** or **e-mail servers** also fall into the specialized server category.
- The resources provided by specialized servers can be accessed by many client machines. The **client machines** provide the user with the appropriate interfaces to utilize these servers, as well as with local processing power to run local applications.

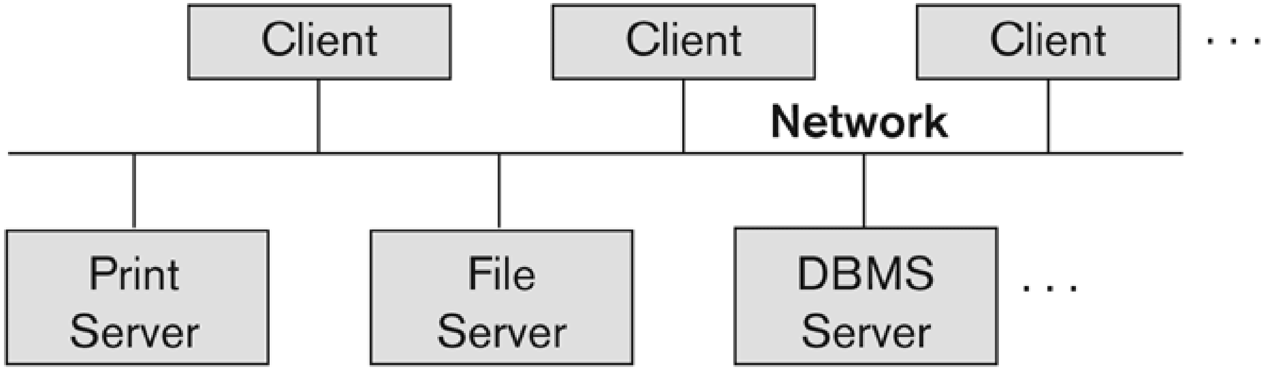
Basic 2-tier Client-Server Architectures

- Specialized Servers with Specialized functions
  - Print server
  - File server
  - DBMS server
  - Web server
  - Email server
- Clients can access the specialized servers as needed

- The concept of client/server architecture assumes an underlying framework that consists of many PCs/workstations and mobile devices as well as a smaller number of server machines, connected via wireless networks or Local Area Networks (LANs) and other types of computer networks.
- A **client** in this framework is typically a user machine that provides user interface capabilities and local processing. When a client requires access to additional functionality—such as database access—that does not exist at the client, it connects to a server that provides the needed functionality.
- A **server** is a system containing both hardware and software that can provide services to the client machines, such as file access, printing, archiving, or database access. In general, some machines install only client software, others only server software, and still others may include both client and server software, as illustrated in Figure 2.6.
- It is more common that client and server software usually run on separate machines.
- Two main types of basic DBMS architectures were created on this underlying client/server framework: **two-tier** and **three-tier**.

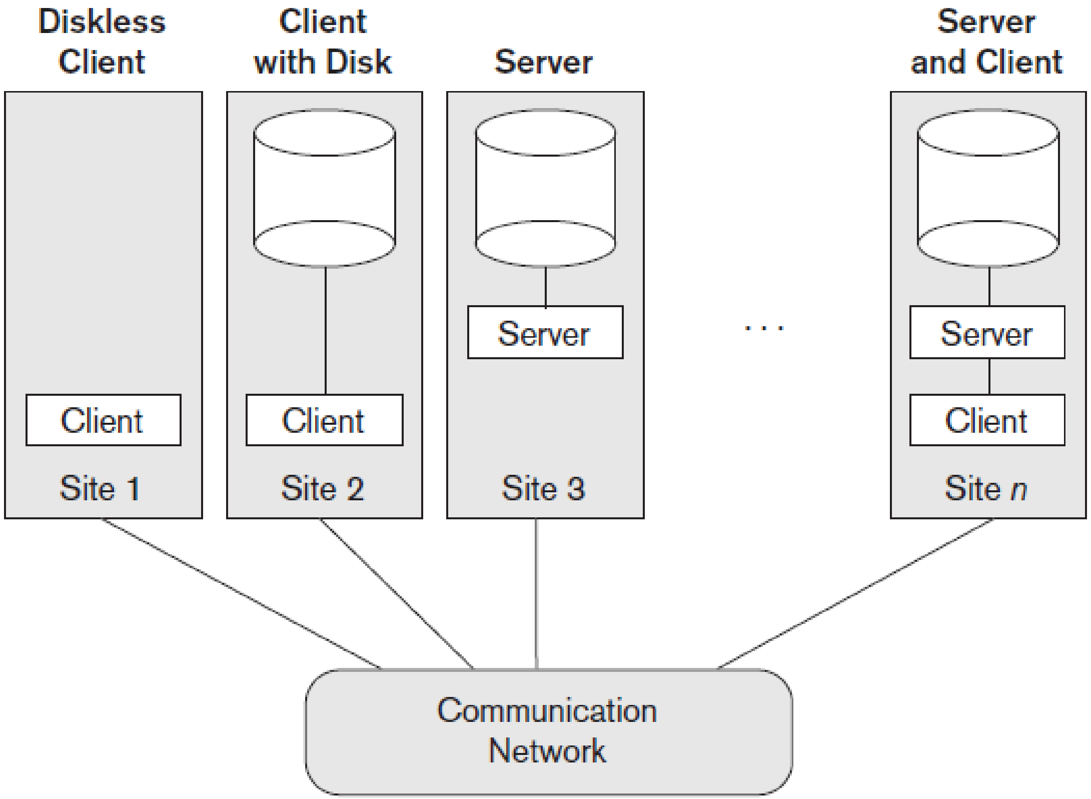
Logical two-tier client server architecture

Figure 2.5
Logical two-tier client/server architecture.



Physical two-tier client server architecture

Figure 2.6
Physical two-tier client/server architecture.



Clients

- Provide appropriate interfaces through a client software module to access and utilize the various server resources.
- Clients may be diskless machines or PCs or Workstations with disks with only the client software installed.
- Connected to the servers via some form of a network.
  - (LAN: local area network, wireless network, etc.)

DBMS Server

- Provides database query and transaction services to the clients
- Relational DBMS servers are often called SQL servers, query servers, or transaction servers
- Applications running on clients utilize an Application Program Interface (**API**) to access server databases via standard interface such as:
  - ODBC: Open Database Connectivity standard
  - JDBC: for Java programming access
- Client and server must install appropriate client module and server module software for ODBC or JDBC

Two Tier Client-Server Architecture

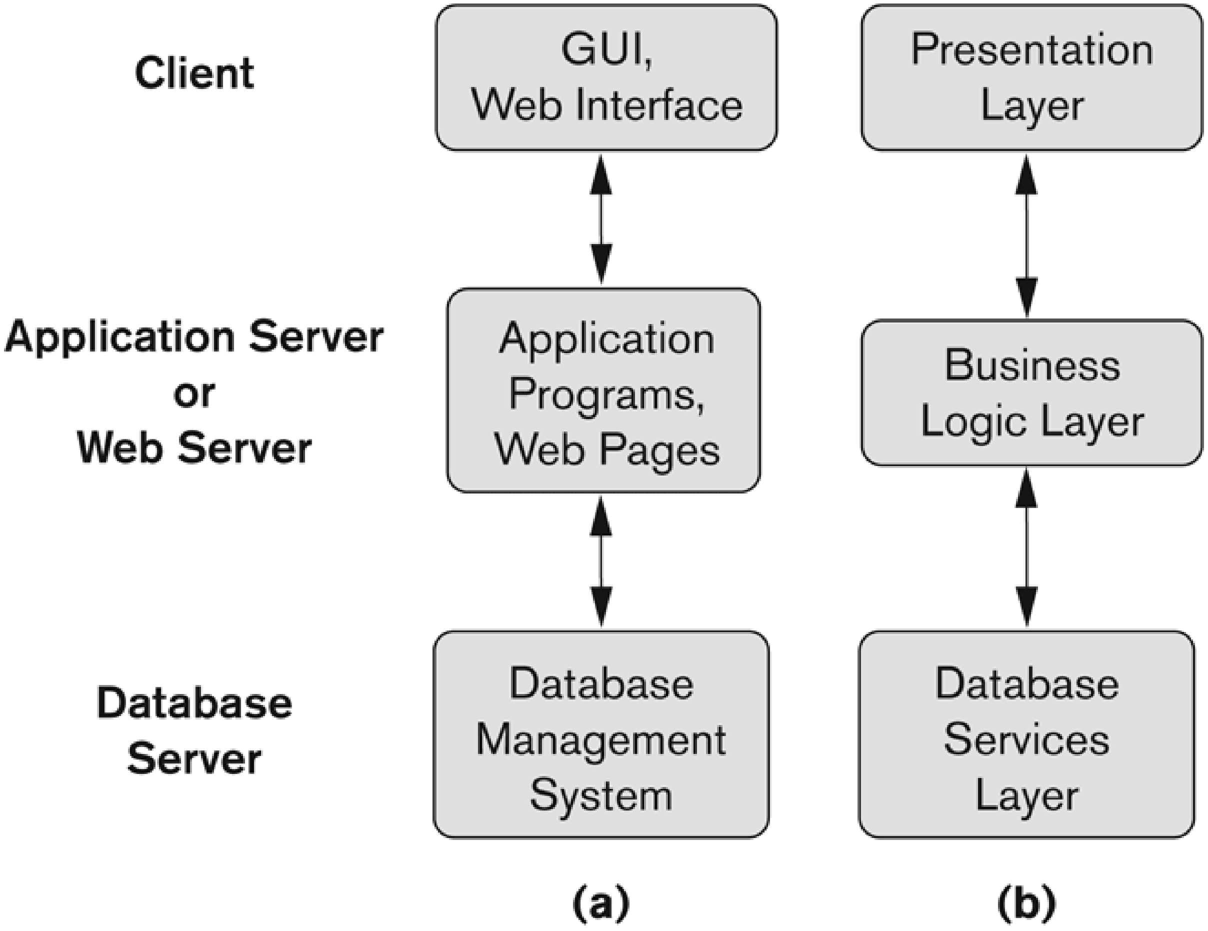
- A client program may connect to several DBMSs, sometimes called the data sources.
- In general, data sources can be files or other non-DBMS software that manages data.
- Other variations of clients are possible: e.g., in some object DBMSs, more functionality is transferred to clients including data dictionary functions, optimization and recovery across multiple servers, etc.

Three Tier Client-Server Architecture

- Common for Web applications
- Intermediate Layer called Application Server or Web Server:
  - Stores the web connectivity software and the business logic part of the application used to access the corresponding data from the database server
  - Acts like a conduit for sending partially processed data between the database server and the client.
- Three-tier Architecture Can Enhance Security:
  - Database server only accessible via middle tier
  - Clients cannot directly access database server

Three-tier client-server architecture

Figure 2.7
Logical three-tier client/server architecture, with a couple of commonly used nomenclatures.



Three-tier client-server architecture

- This server plays an intermediary role by running application programs and storing business rules (procedures or constraints) that are used to access data from the database server.
- It can also improve database security by checking a client's credentials before forwarding a request to the database server. Clients contain user interfaces and Web browsers.
- The intermediate server accepts requests from the client, processes the request and sends database queries and commands to the database server, and then acts as a conduit for passing (partially) processed data from the database server to the clients, where it may be processed further and filtered to be presented to the users.
- Thus, the *user interface, application rules,* and *data access* act as the three tiers.