

Chapter 8: Client/Server Technology and Web Services

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INTRODUCTION

- Introducing web services into the client/server model, it become browser/server models.
- These models are Server-Centric, which make applications easy to load and install, but reduces rich user interaction.
- Individual installation and maintenance across platforms made web services seem like a good solution.
- Client processing power atrophied as execution of programs took place on central servers and output or responses were transmitted back to the browser through standard IP (Internet Protocols)

Web Services History

- The World Wide Web was developed by Tim Berners-Lee.
- In 1990, he wrote the program for the World Wide Web. This program created the first web browser and HTML editor. It was the first program to use both FTP and HTTP.
- By 1994, computers could transfer data between each other through a cable linking ports across various operating systems.
- The first web server, also written by Berners-Lee, ran on NeXTSTEP, the

Web Server Technology

- The web server is the program that delivers the files that make up web pages. Every web site or computer that creates a web site requires

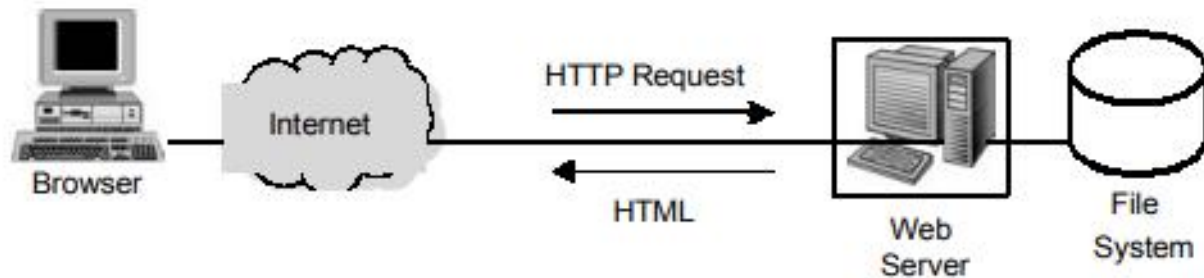


Fig. 8.1(a): Web Technology Yesterday

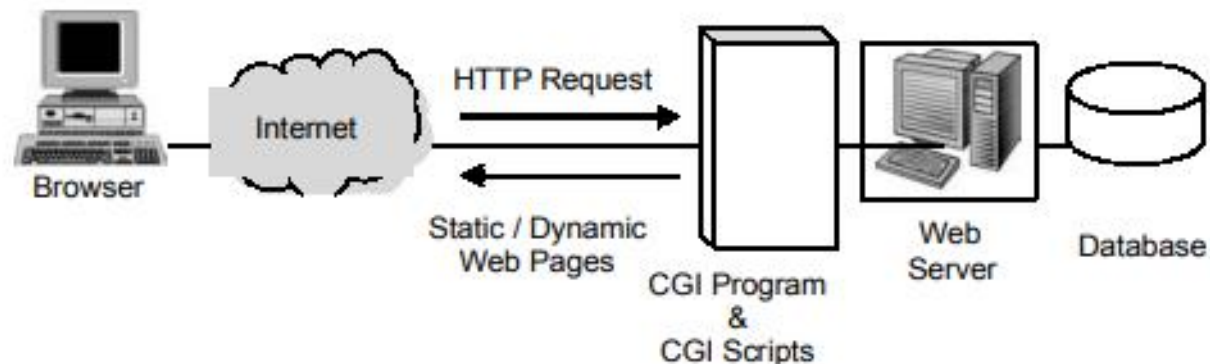


Fig. 8.1(b): Web Technology Today

Web Server Technology

- Web servers translate URL path components in local file systems. The URL path is dependent on the server's root directory.
- The root directory is the top directory of a file system that usually exists hierarchically as an inverted tree. URL paths are similar to UNIX like operating systems.

Web Server Technology

- The typical client request reads, for example, “http://www.example.com/path/file.html”.
- This client web browser translates this request through an HTTP request and by connecting to “www.example.com”, in this case.
- The web server will then add the requested path to its root directory path. The result is located in the server’s local file system or hierarchy of directories.
- The server reads the file and responds to the browser’s request. The response contains the requested documents, in this case, web sites and the constituent pages.

Web Browser (Web Client)

- A browser is a software that acts as an interface between the user and the inner workings of the internet, specifically the World Wide Web. Browsers are also referred to as web clients, or Universal Clients, because in the Client/Server model, the browser functions as the client program.
- The WWW incorporates hypertext, photographs, sound, video, etc. that can be fully experienced through a graphical browser. Browser often includes “helper application” which are actually software programs that are needed to display images, hear sounds or run animation sequences.

Accessing Database on the Web Page

- Step 1: The user types in a URL or fills out a form or submits a search on a Web page and clicks the Submit button.
- Step 2: The browser sends the user's query from the browser to the Web server, which passes it on to a CGI script.
- Step 3: The CGI script loads a library that lets it talk to an SQL database server, and it uses that library to send SQL commands to the database server.
- Step 4: The database server executes the SQL commands and sends the request information to the CGI script.
- Step 5: The CGI script generates an HTML

Web Server

- A computer that runs a computer program that is responsible for accepting HTTP requests from clients, which are known as web browsers, and serving them HTTP responses along with optional data contents, which usually are web pages such as HTML documents and linked objects (images, etc.).
- Usually web servers have also the capability of logging some detailed information, about client requests and server responses, to log files; this allows the webmaster to collect statistics by running log analyzers on

Web Server Communication

- According to its inventor, Tim Berner-Lee, the World Wide Web is “the universe of network accessible information, an embodiment of human knowledge.”

Web Server Communication

- The communication initiates from a user request through a web browser. The request is delivered to a web server in 'HTTP' format.
- The server then processes the request, which can be anything from a general search to a specific task, and returns the results in the same format.
- The results are written in HTML, which is the language web pages are written in that supports high-speed travel between web pages.

ROLE OF JAVA FOR CLIENT/SERVER ON WEB

- The web hosting systems that run at host sites and provide access to processes and data requested by the client. In this case, these hosting systems are the server.
- Java is a programming language that has been developed specifically for the distributed environment of the Internet.
- OOP identifies objects (sets of data) and defines their relationship to each other. These objects are then generalized into a class. Methods or sequences of logic are applied to classes of objects.

ROLE OF JAVA FOR CLIENT/SERVER ON WEB

- Java is one of the most well-suited languages for working on the World Wide Web and the client server model is the primary models for working on distributed networks, of which the World Wide Web is just one.
- OOP is characterized by three properties also present in Java programming: inheritance, encapsulation, and polymorphism.

Socket-based Client Server Systems in Java

- Sockets are the endpoints of two-way communication between programs running in a network. They are software objects that connect applications to network protocols, so they become intelligible.
- Port numbers identify specific processes that are to be forwarded over a network, like the Internet, in the form of messages to the server.

Socket-based Client Server Systems in Java

- The client initiates the socket, which contains a host name and port number, by requesting connections.
- The server socket class in Java allows for servers to monitor requests for connections. As the socket communicates over the network, Java's server socket class assigns a one port number to each client in the server and creates a socket object or instance.

Java's RMI System

- The other method for using Java to build client server systems is RMI.
- RMI stands for Remote Method Invocation.
- RMI allows for client objects in JVMs to request services through a network from another computer (host or server). Client objects included with the request may call upon methods in the remote computer that change the results. Methods are programmed procedures attributed to a class that are contained in each of its objects (or instances).

Java's RMI System

- In Java, stub programs are also referred to as 'proxy'.
- Remote reference layers manage reference variables for remote objects, using the transport layer's TCP connection to the server.
- Reference variables contain class data and therefore include methods. The transport layer protects and maintains end to end communication through a network.

WEB SERVICES AND CLIENT/SEVER/BROWSER—SERVER TECHNOLOGY

- Applications using web services demonstrate the integration of components coming from multiple sources. This makes version management important.
- These distributed application components use universal formats provided by such programming languages as XML (Extensible Markup Language) and WSDL (Web Standard Description Language).

WEB SERVICES AND CLIENT/SEVER/BROWSER—SERVER TECHNOLOGY

- XML is the W3C standardized language that allows information and services to be written in a structurally and semantically intelligible way that both humans and machine on different platforms can understand.
- Distributed application components also use universal protocols like HTTP (Hypertext Transfer Protocol) and SOAP (Simple Object Access Protocol).

WEB SERVICES AND CLIENT/SEVER/BROWSER—SERVER TECHNOLOGY

- HTTP is the standard protocol for transmitting HTML files or documents. SOAP is a message-based protocol formatted in XML and using HTTP.
- It is a way for a program running in one operating system to communicate with a program running in another.

WEB SERVICES AND CLIENT/SEVER/BROWSER—SERVER TECHNOLOGY

- For example, traditional browser-server models were Server-Centric. They could handle user demands but did not take advantage of client-side processing that could predict user behavior.
- To predict the behavior from a diverse customer base requires headroom. Headroom is also known as the attenuation crosstalk ratio. It ensures the network connections are strong and that signals on the receiving end of a communication are strong enough to overcome any interference. This provides a consistent and customized user experience regardless of unpredictable behaviour in the network.

CLIENT/SERVER TECHNOLOGY AND WEB APPLICATIONS

- Desktop applications run on a single computer, while web applications run on the Internet. Since the invention of the Web, developers have been trying to design web applications that demonstrate the speed and interactivity of applications running on the client machine of a LAN (Local Area Network).
- Web applications dynamically generate web documents. These are HTML/XHTML (Hypertext Markup Language/Extensible Hypertext Markup Language) documents transmitted over the Internet through HTTP (Hypertext Transfer Protocol). These documents or pages make up the web site.

1st Generation Web Applications

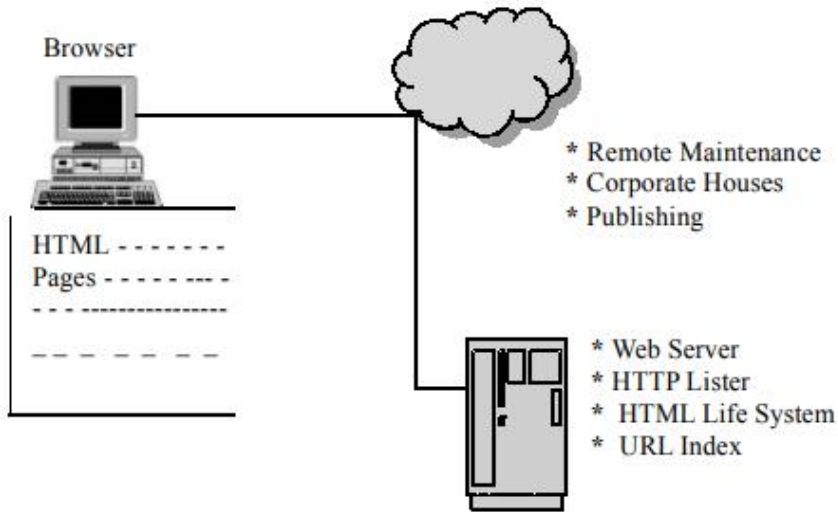


Fig. 8.3: Architecture of 1st Generation Web Application

- A primary limitation of first generation applications is that there is no database management system, connected to the web server and the software does not keep the track of who is requesting information or of the last request from that user.
- It is a stateless connection. The addition of DBMS capabilities to the HTML processes on the server will allow HTML servers to have memory.

2nd Generation Web Applications

- 2nd generation Web applications have live DBMS connections on the server.
- Several things will define this newer generation that are given as below:
 - Support for active clients via downloadable applets (software components),
 - Live DBMS links that enable the server to know who you are from page to page, and visit to visit, and
 - True interactivity between the client and server (indicated by the two-headed arrow).

BALANCED COMPUTING AND THE SERVER'S CHANGING ROLE

- In balanced computing, processing is shared between clients, servers, and any other devices connected via a network.
- In balancing, the processing required by each new use is often shifted back to the user's system, thereby taking fuller advantage of client-side processing power.
- This allows for improved scalability, since the processing load is increased insignificantly by the addition of users.

BALANCED COMPUTING AND THE SERVER'S CHANGING ROLE

- Load balancing can also be achieved by building Service-Oriented Applications (SOAs) where components run on different nodes in multiple locations duplicate services on multiple nodes.
- Balanced computing not only distributes the processing load, but changes the role of the server as well. Instead of computing so heavily, the server primarily directs traffic.
- Given rich clients and decent Internet connectivity, users directly contact databases instead of requiring server intervention.

BALANCED COMPUTING AND THE SERVER'S CHANGING ROLE

- Scripting languages, like JavaScript or VBScript, were embedded into HTML to improve user interfaces (among other things).
- Developing technologies like improved web-page scripting languages and AJAX (Asynchronous JavaScript and XML), made web browsers function more like rich client applications.

User Experience and Development

- Developers can focus on user experience by examining devices and customizing features. For example, different user interfaces can be customized for different departments that require different resources to perform their function.
- Well-defined user roles and profiles that are stored on user machines make more efficient use of server computation. It allows the server to pull customized responses based on the identity/role of the user.

User Experience and Development

- Data integration on user platforms offers new opportunities to build applications that draw data from a variety of sources and can add different contexts.
- The decentralization of distributed browser-server models also improves security and protects privacy.
- Distributed computing models address the future of IT architecture and application. Organization must aim to create independent and flexible applications that can respond quickly to a variety of contexts. Connections must be agile.

Chapter 9: Future of the Client/Server Computing

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TECHNOLOGY OF THE NEXT GENERATION

- While it's safe to say that processors will be faster and disk space cheaper, it's much more difficult to predict the way we'll use and develop software.
- Developers don't create the trends, they follow them.
- Users wanted to run business applications with their new GUI desktop applications.
- The predictions can be broken up into a few categories: **networking, development tools, processors and servers**, paradigms, and enabling technologies

1. Networking

- Client/Server developers must become networking gurus as well.
- The performance of the network dictates the performance of the Client/Server system.
- In addition to upgrading the speed and reliability of enterprise network technology, we are looking for ways to upgrade the speed of WAN technology.

2. Development Tools

- Client/Server development tools are finally delivering on promises made initially, but there is a lot of room for improvement.
- Some of the areas where tools can be made to perform better include:
 - Use of true compilers.
 - Native links to the distributed objects and TP monitors.
 - Better component development capabilities.
 - Use of standards.
 - Consistent language support.
 - True application-partitioning capabilities.
 - Consistent approach to the intranet.

3. Processors and Servers

- We can expect processing power to increase; without any slowdown in that area.
- When Windows 95 and Windows NT merge, clients will have a powerful operating system that can make the most of this new hardware.
- Servers will become more component-based.
- Advanced multiprocessing operating systems (such as Windows NT and Unix) will provide better load balancing and fault-tolerant capabilities, including, for instance, the ability to better work through memory, disk, and processor failures

4. ENABLING TECHNOLOGY

- Enabling technologies are the combinations of hardware and software that can be used to assist in creating a particular kind of application system.
- These technologies include
 - TP monitors
 - databases
 - middleware
 - Expert systems
 - Point-of-Services (POS)
 - imaging
 - intranet
 - and extranet.

Expert Systems

- Expert system is a branch of artificial intelligence that makes extensive use of specialized knowledge to solve problem at the level of human expert.
- The term expert system is often applied today to any system that uses expert system technology that includes special expert system languages, programs and hardware design to aid in the development and execution of expert systems.

Expert Systems

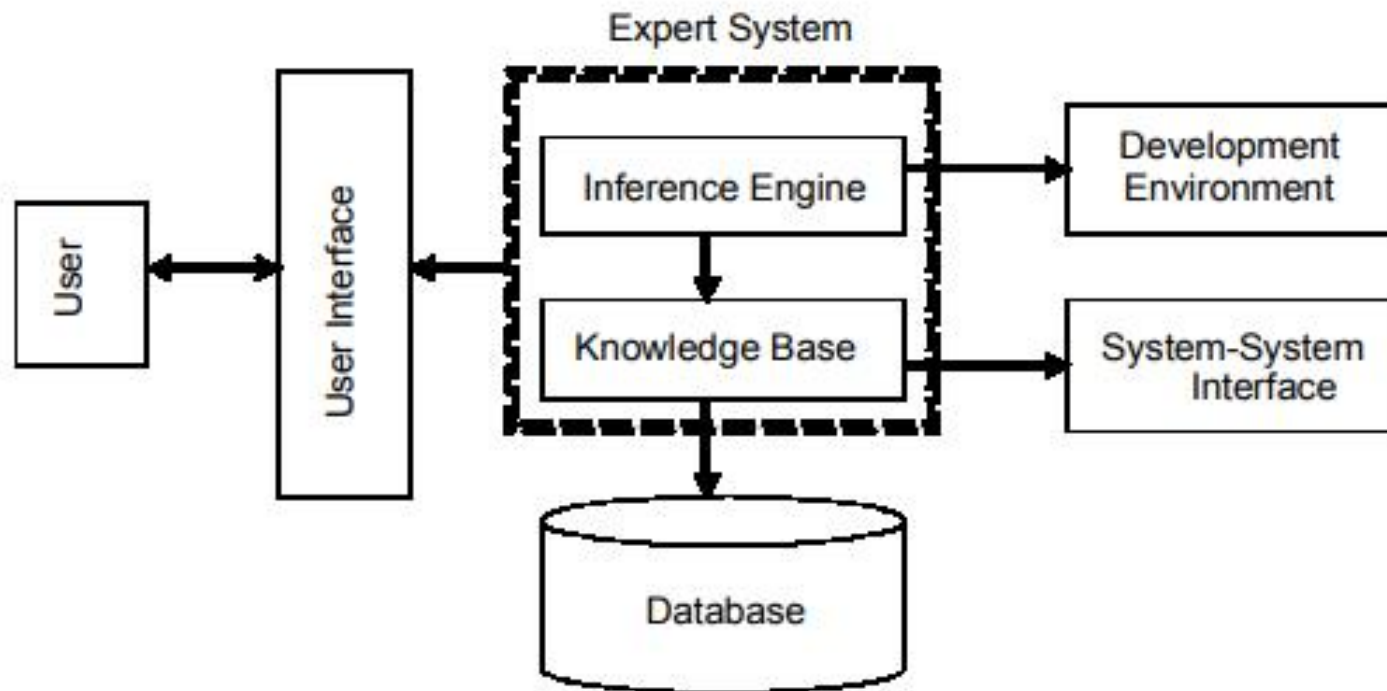


Fig.9.1: Basic Concept of Expert System

Expert Systems

- Applications of expert system are widely accepted and well-suited for the Client/Server models.
- The user interface provides some rule based advantages related with the processing power and some of the benefits at the workstations.
- The inference engine, a CPU-intensive process that takes advantage of low-cost processing and RAM available with Client/Server technology, enforces the rules.
- Most applications will be implemented using existing databases on host-based

Imaging

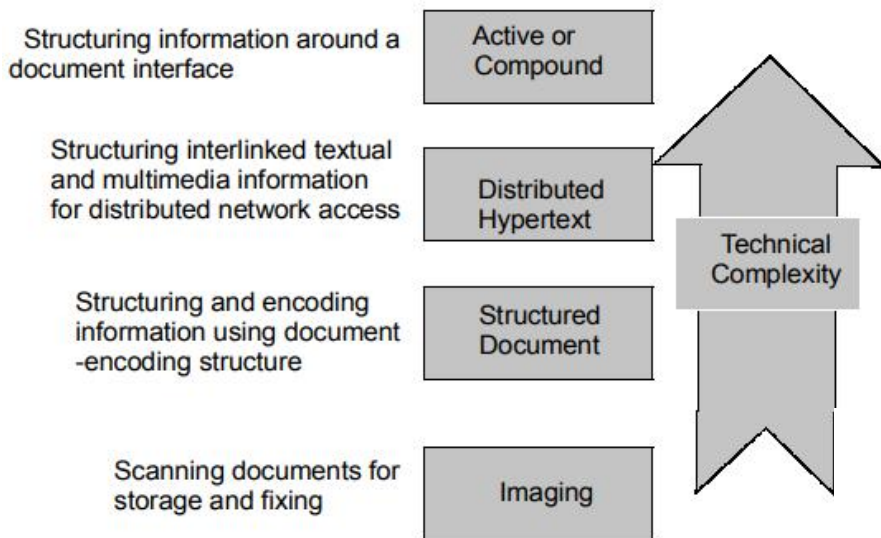


Fig. 9.2: Types of Digital Documents

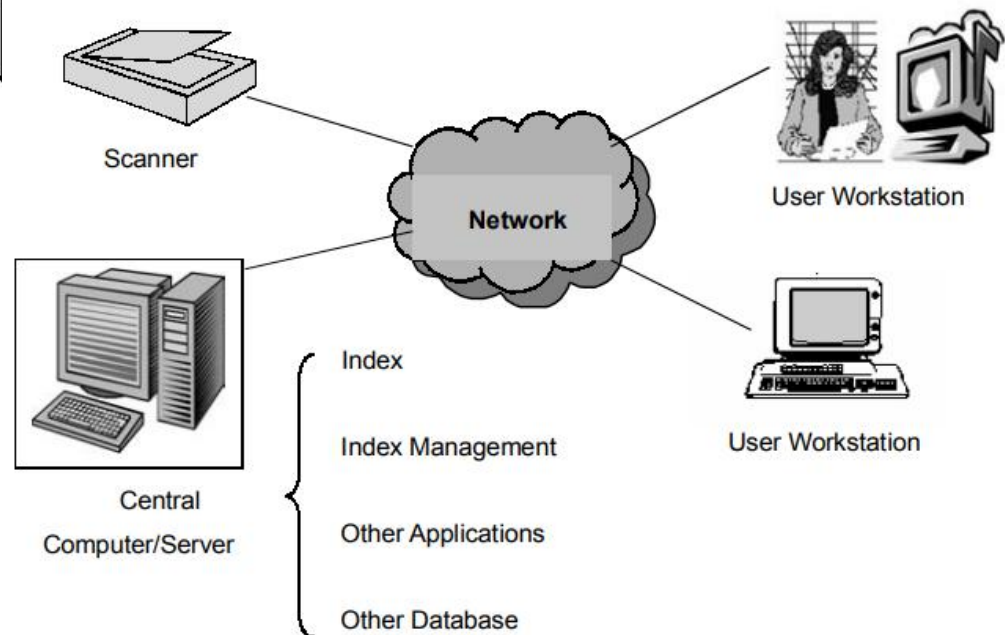


Fig. 9.3: Imaging System

Imaging

- Imaging is the method of getting digital documents from physical ones.
- An imaging system passes a paper document through a scanner that renders it digital and then stores the digital data as a bit mapped image of the document.
- The keyword for each document that helps in indexing and retrieval are entered during scanning.
- The index usually is stored in a relational database on a high-speed magnetic disk.
- These image documents can be accessed by any workstation, which accesses the

CLIENT/SERVER COMPUTING AND THE INTRANET

- Intranet is a term used to refer to the implementation of Internet technologies within a corporate organization, rather than for external connection to the global Internet.
- Supports a range of distributed computing architecture (few central server or many distributed servers).
- Rapid prototyping and deployment of new services.
- Structure to support integration of “legacy” information sources.

CLIENT/SERVER COMPUTING AND THE INTRANET

- Support a range of media types (Audio, video, interactive applications).
- Inexpensive to start, requires little investment either in new software or infrastructure.
- Virtually no training required on the part of users and little training required to developers, because the user services and user interfaces are

Is the Intranet Killing Client/Server?

- The intranet can employ existing Client/Server applications as true intranet applications, and integrate applications in the Web browser that would not normally work and play well together.
- The intranet also puts fat client developers on a diet.
- Maintenance and application deployment become much easier, and developers don't have to deal with the integration hassles of traditional Client/Server (such as loading assorted middleware and protocol stacks).

Is the Intranet Killing Client/Server?

- In many respects, the evolution of traditional Client/Server technology (middleware, databases, and front-end development tools) remained static while the technology vendors moved their products to the Web.

Extranet

- Extranet is the similar concept to the intranet, using TCP/IP protocols and applications, especially the Web.
- It provides the access to corporate resources by outside clients.
- An extranet provides a simpler Web access and more extensive access to corporate resources, enforcing some security policies becomes a necessity.
- Virtual private network.

FUTURE PERSPECTIVES

- Client/Server developers and application architects have a bright future.
- Clearly, the growth of Client/Server is steady, and as time goes on, the vast majority of applications we build for businesses will employ Client/Server technology.
- From time to time, we need to consider the following:
 - Re-evaluate our business objectives.
 - Re-evaluate the current technology infrastructure.
 - Determine the differences (what's missing?).

TRANSFORMATIONAL SYSTEM

- 1) Electronic mail.
- 2) Client/server and user security.
- 3) Object oriented technology: CORBA.
- 4) Electronic data interchange.