



Faculty of Engineering & Applied Science

SOFE4790U – Distributed Systems

Homework: Web Server Software

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Webserver Summary

Each program on the internet will communicate with IP protocol (32-bit number), while the TCP/IP is used to communicate with two different systems. When two computers communicate with each other at each endpoint are called sockets. At each socket, the computer will have an IP address and a port number where the IP address is the source, and the port identifies the specific application. A DNS (Domain Name Service) translates the IP address into a name service to allow for easy access.

Can you compile a list of software requirements of a web-server as described in the article?

Functional Requirements

- The server must have an IP
- Must have a socket for communication
- Must support TCP/IP
- Each socket must have a port number associated with it.
- Parse each request and what's associated with the request
- Fetch the data
- Format the data in HTML format
- Transmit the data
- [CGI Protocol](#)
- [Data Fetch](#)
- [Listing Directories](#)
- [Format Data](#)

At what layers of the OSI models does this system operate? What is the role of HTTP, DNS, HTML in the described system?

Layer	Operation	Protocol
Application Layer	The Applications such as DNS will run here.	HTTP
Presentation Layer	If the web server is sending or receiving files.	HTTP

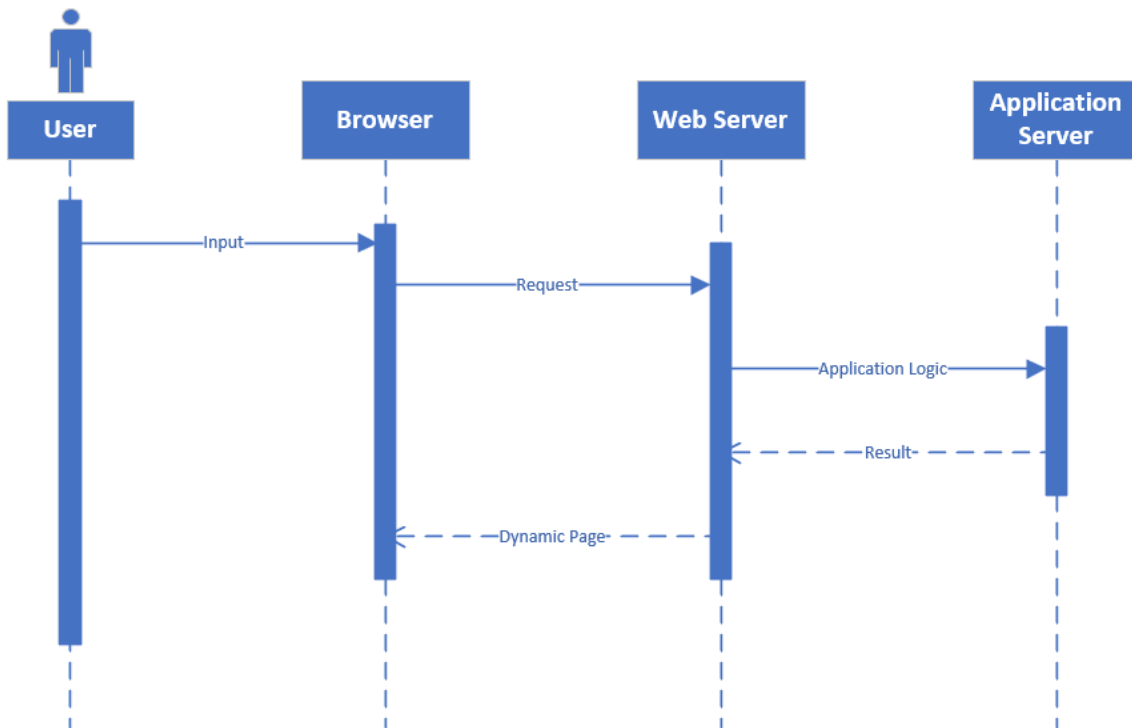
Session Layer	The socket will use IP and port number to establish a connection with the application.	HTTP
Transport Layer	It is used to communicate with other systems through an end-to-end connection.	TCP/IP
Network Layer	The webserver must be connected to the outside world through a router to communicate with other client requests.	IP
Data Link Layer	For a web server to communicate to clients over the internet, it must have a NIC card and a MAC address.	Ethernet
Physical Layer	Each web server must be connected through an Ethernet cable.	Ethernet

Protocol	Role
HTTP	HTTP (Hyper Text Transfer Protocol) is used to communicate between the client and server while allowing them to exchange data. The role of the HTTP protocol in the simple web server application is it uses this protocol while allowing the client to make requests to the server and the server responds back with the required data.
DNS	The DNS is used to map IP addresses to a name such as google.ca, which helps user to remember the name rather than the 4-byte IP address.
HTML	HTML (HyperText Markup Language) is a standard language to display a document on a web browser.

Take CNN.Com for example, their webserver updates the information displayed on each client? How can a web server do this? Draw UML sequence diagrams? What functions/ components need to be added to the described system?

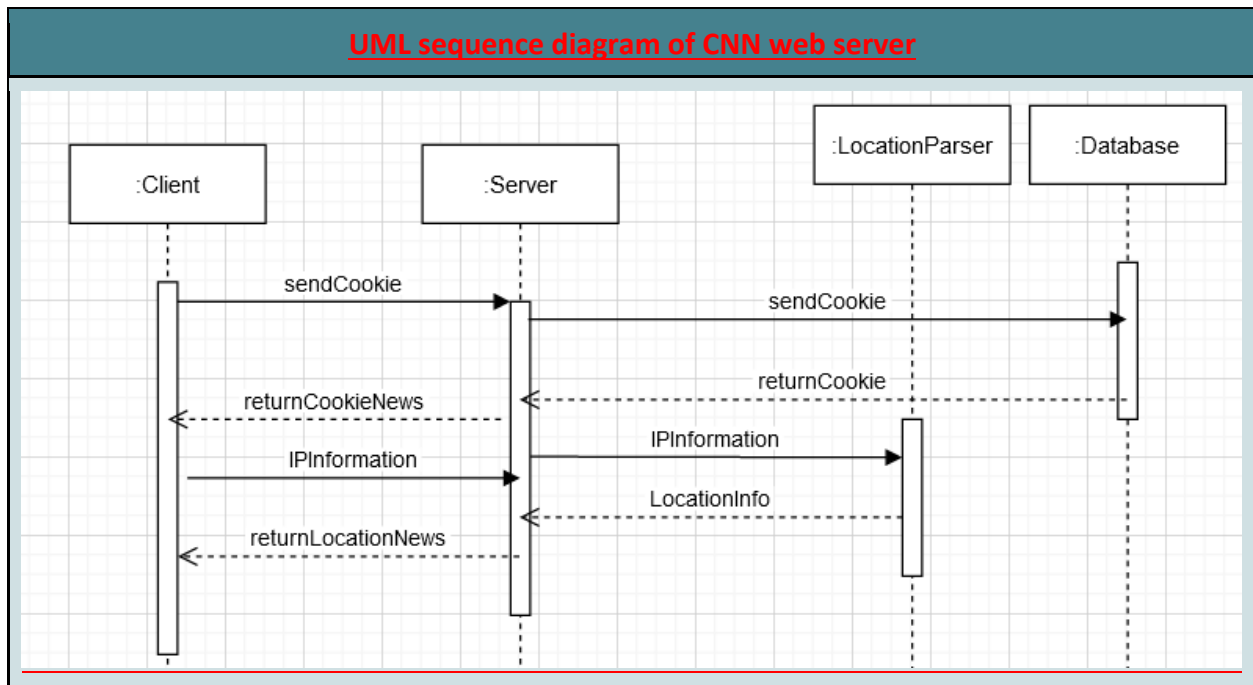
CNN uses an application server as a middleware to update the information on the client side. The web server allows communication between the client while the application server implements business logic and produces dynamic content for multiple users. The data provided is based on the region or location of the request through the IP address, then displays the image or content. The application server component must be added to the simple web server, and a UML sequence diagram is provided below.

Sequence Diagram



//Don't know which one is right! VAGUE QUESTION

Using cnn.com as an example, their web server updates the information that is displayed on each client's browser by possibly getting their general location by their IP address, and displaying news that is more applicable to that location. Another their web server can display more personalized information by using cookies, and displaying news that is similar to what searches have been made, or previous visits to the cnn site.



The functions/components added are the location parser and the database. Where the database holds the cookie information of the clients, where it is used to validate the clients accessing the site with previous sessions. The web server will present the client with a page that reflects their previous session information. The location parser is used to get the general location of the client as to have a location based web page presented to the client upon access.

How are transparencies provisioned within the described image sharing system?

The following transparency is provisioned within the image-sharing web server,

- Access Transparency: The data of many images stored on multiple servers are hidden from the client.
- Location Transparency: The data returned to the user, such as an image or a document, will be displayed, but no information regarding the physical location of the file will be accessed by the user.
- Migration Transparency: The image being moved or transferred onto a new physical server, or the directory of the image being updated within the server is changed. The user should not be impacted when they are accessing the website.

What is synchronous messaging" or request reply messaging? what is the role of a web server in this type of messaging? How is that different from Asynchronous Messaging Primer?

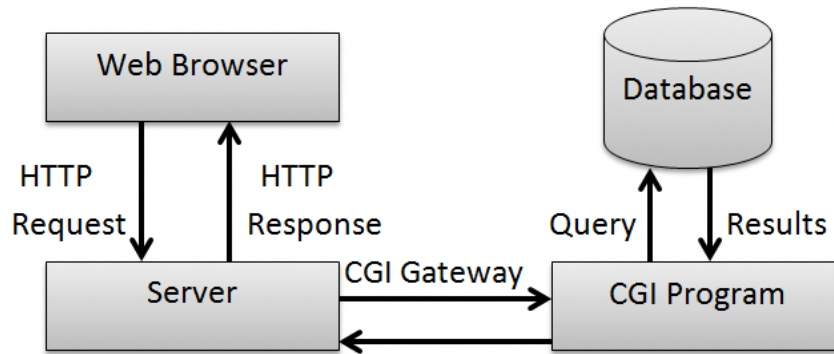
Synchronous messaging is best described as two-way communication among two systems where one system sends a message, and the other is waiting for the message. The web server and the client use transmission control protocol (TCP) and TCP handshake to communicate. When the client visits a website (CNN.com), it will send a request to the server, and the client will wait. Once the connection is established, the server will send an acknowledgment to the client. The client will request the information, and the database will retrieve the data (CNN webpage with the images). Afterwards, it will transmit the message to the client with an acknowledgment. An example of synchronous messaging is when a user purchases an item during online shopping. At the same time, the application waits to check if there is enough inventory before proceeding to check out. Asynchronous messaging is one-way communication between two systems where the sender sending the data or information does not need acknowledgment from the receiver. An example of asynchronous messaging is an application sending NBA score updates throughout the day.

Synchronous messaging/request reply messaging will block the execution of code in the browser, which inherently pauses the user experience until a response is received. This is done when the client requests to visit a page on a web server, where the client requests the page, the client will then wait for the request to be served. The server will respond to the request with the requested page. The client then gets the page it requested and the user experience is resumed. Asynchronous messaging is different as there is an intermediate messaging broker which provides functionality of moving messages from the producer to the consumer. The broker can assist in async messaging processing when there are operations being executed that take longer to complete, so if a command is sent, the producer will not have to wait for the consumer to complete with the inclusion of the broker.

What is the role of a web server in Queue-Based Load Leveling Pattern:

A queue-based load-leveiling pattern allows for a message queue which stores many tasks from different users. The queue behaves as a buffer for the tasks to be stored and waits until the service is ready to execute that task. The webserver runs the queue-based load level pattern on the server and continuously keeps the tasks in the queue until the service is ready to process the next task. This allows the webserver to accept many incoming requests and level the load for each service.

What can you do with CGI ? what are the pros and cons? How can we enhance CGI? Read about three-tier architecture and multi-tier architectures ... How did this functionality evolved from CGI?



The common gateway interface (CGI) allows static HTML pages to run external programs such as scripts to generate dynamic web pages. It acts as a middleware between the web server and databases. A three-tier architecture consists of a presentation layer, a business layer, and a data layer. The presentation layer is where the user interface is displayed, which shows the application's functions that the client can understand. The business layer is where the calculations or processing are done. Lastly, the data layer is used to store or retrieve data from a database which is used in the logic layer for processing and forwarded to the presentation layer. The common gateway interface is between the database and the server, as shown in the image above. This architecture runs various programs for the user or some logic to display on the webpage, which helped evolve into an n-tier architecture where the CGI is evolved to a business (application) layer. In the business layer, it performs various processes and rather than just producing dynamic web pages, it also decides what is accepted by the application and what functionality to perform. The pros and cons of CGI is displayed below.

Pros	Cons
Allows the program to be written with any language	Overheads from loading page into memory.
Provides an interactive dynamic webpage for the user	Consumes a lot of processing time
CGI runs on the servers which are secure	Hackers can view the host system through CGI allowing them to access confidential files.

A web server is just one piece of the "enterprise architecture" what are other pieces? How can such architecture handle very large amounts of data? Where would you fit a Database? How can the operating system support such a webserver?

An enterprise architecture contains many pieces besides a web server. A few components integrated into an enterprise architecture are an application server, storage, OS, load balancer, database, and gateway. In the current era, cloud computing is the center of most enterprises.

Much data is stored in a data center where all the databases reside. It is extremely difficult to process all the data on one machine, where cloud computing is integral to managing big data. It helps deal with “big data” and processing through resources being pooled together in the cloud, and the cloud also provides you with a database built in the cloud (DBaaS) that can be managed on a virtual OS. A web server is usually installed on the server OS, which allows the user to install or deploy business layer applications and web applications.