Full Stack Application Development- SE ZG503

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Lecture No: 3 – Understanding the Basic Web application

Client Server Pattern

Context: shared resources and services accessed by distributed clients

Problem: By managing a set of shared resources and services, promote modifiability and reuse

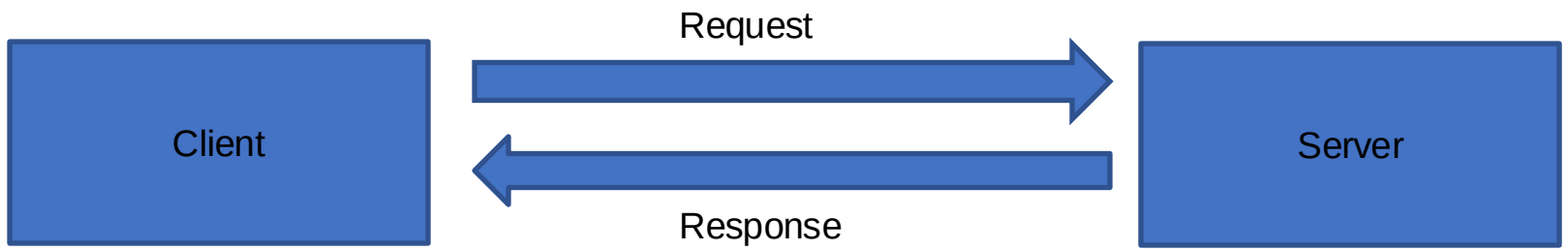
Solution: Clients interact by requesting services of servers, which provide a set of services. Some components may act as both clients and servers.

Client Server Architecture

Request – Response Model

Providers of a resource or service, Server

Service requester/Consumer - Client



Client Server Architecture

Benefits

- ✓ **Higher security**
- ✓ **Centralized data access**.
- ✓ **Ease of maintenance**.

The client-server architectural style has evolved into the more general 3-tier (or N-tier) architectural style for the web

Variants of Client Server Pattern:

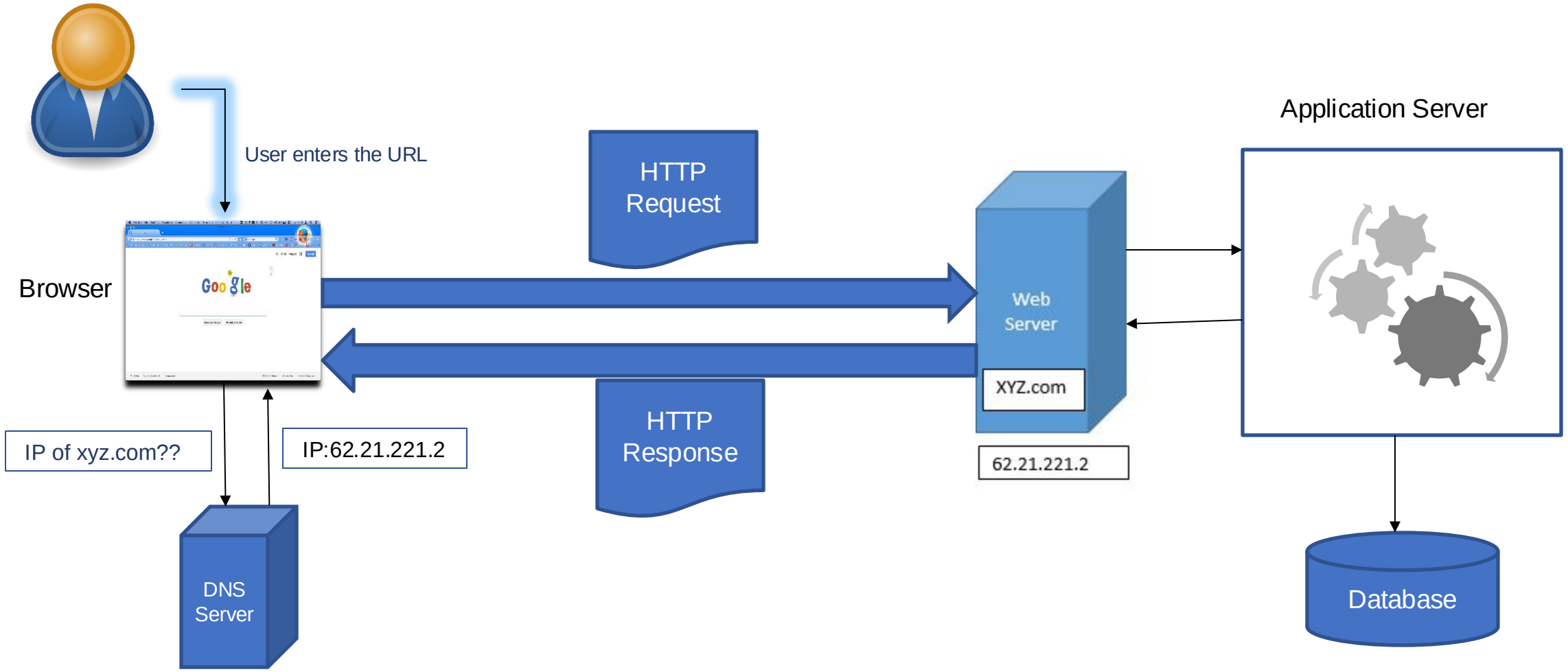
Peer-to-Peer (P2P) applications

Application servers

Variations

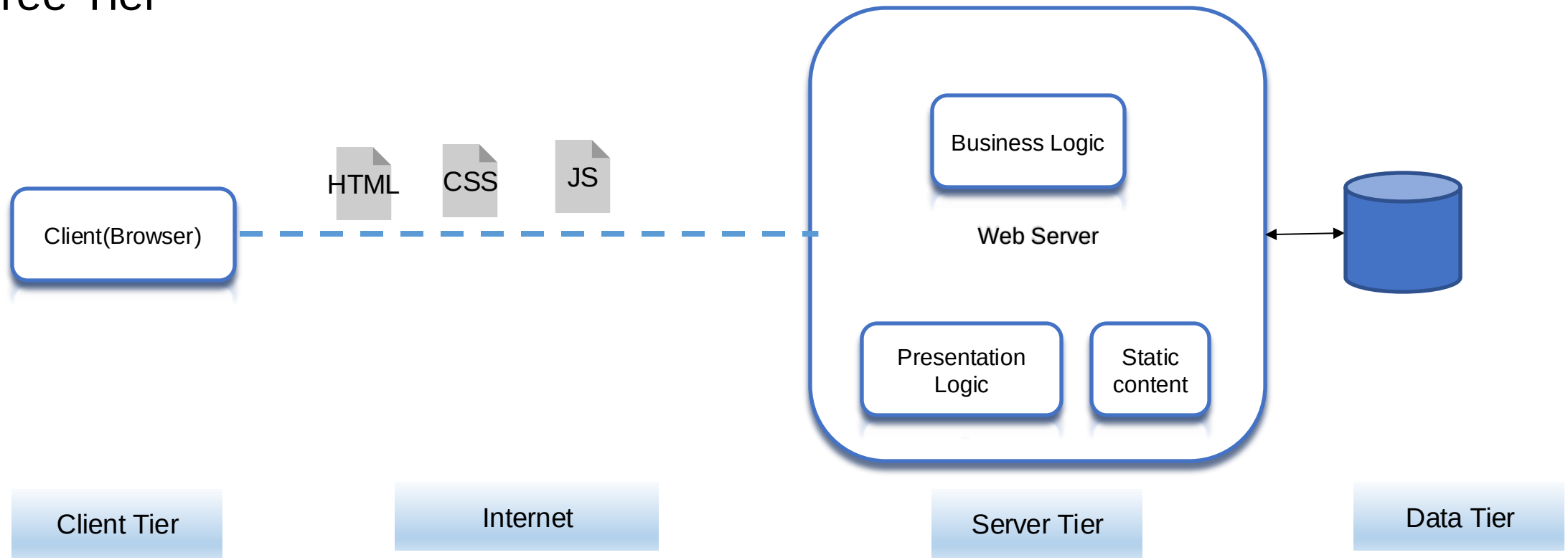
- ✓ Web browsers don’t block until the data request is served up - Asynchronous
- ✓ In some client-server patterns, servers can initiate certain actions on their clients.
- ✓ Service calls over a request/reply connector are bracketed by a “session”

Working of the Web

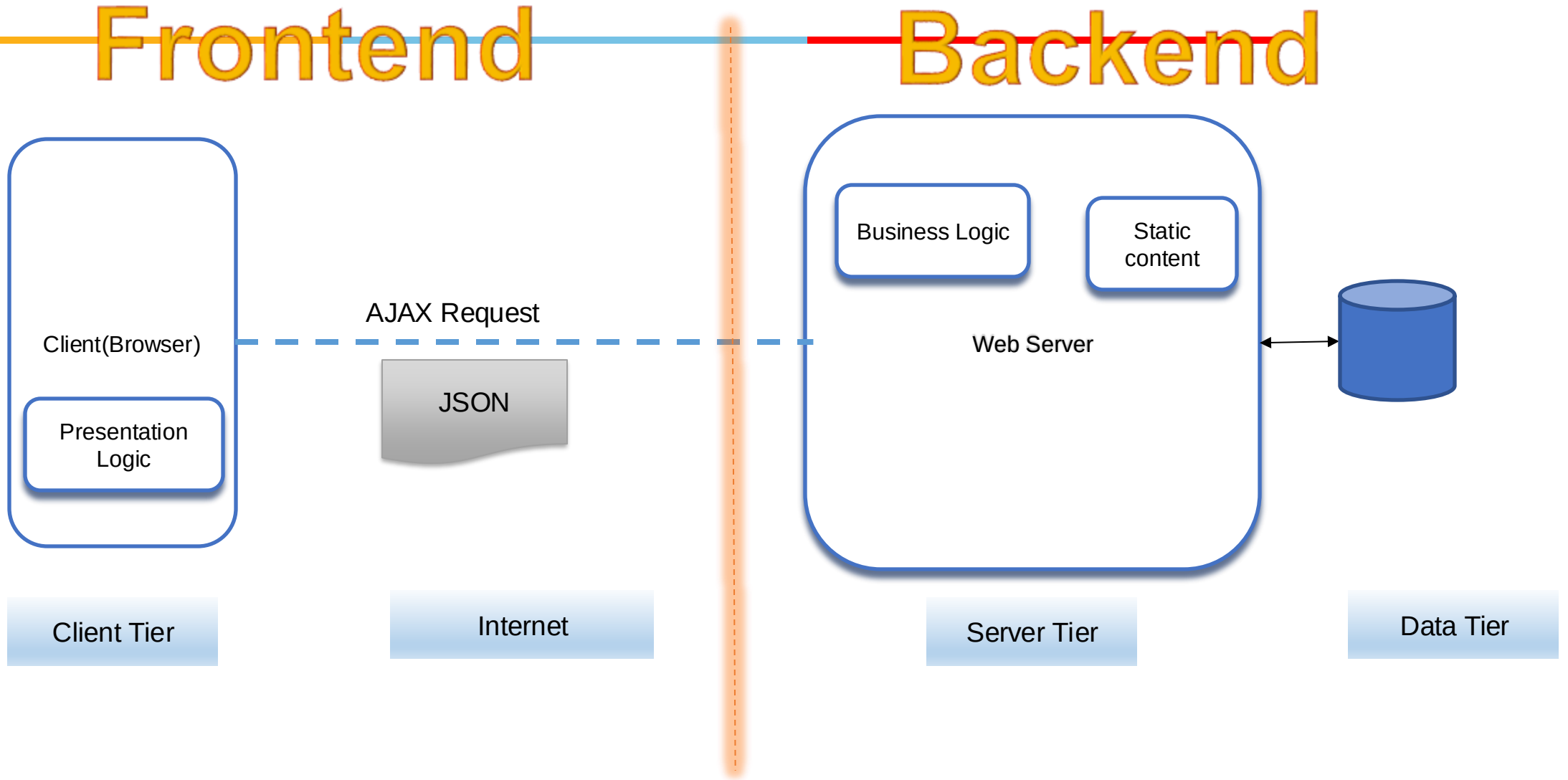


Traditional Web Application

Three Tier



Modern Web Application



AJAX

Asynchronous JavaScript and XML (Ajax) refer to a concept that is used to develop web applications in a better way.

Ajax defines a method of initiating client-to-server communication without page reloads.

It provides a way to enable partial page updates.

In an Ajax web application, the user is not interrupted in interactions with the web application.

Model of a Web application

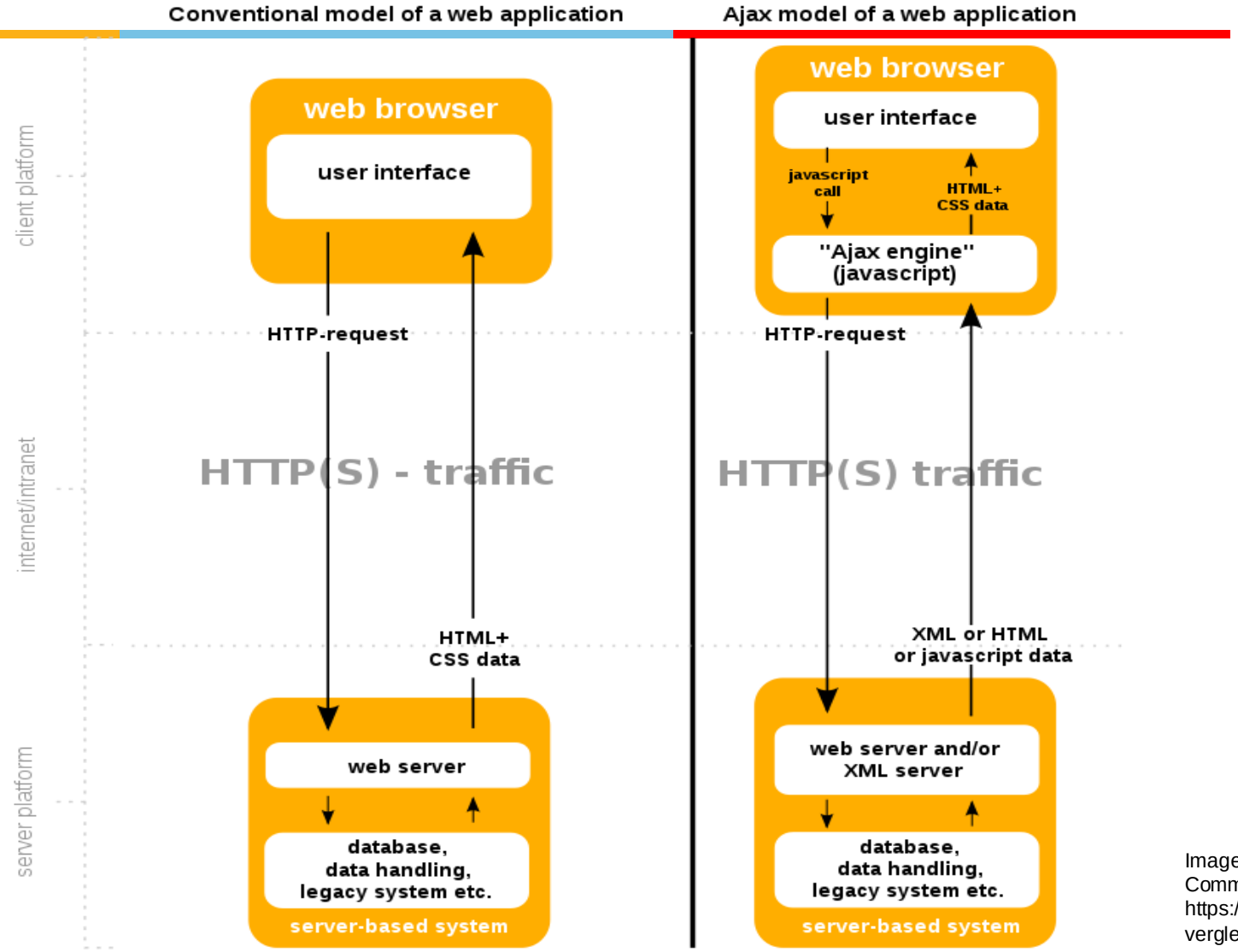


Image source: By DanielSHaischt, via Wikimedia Commons - https://commons.wikimedia.org/wiki/File%3AAjax-vergleich.svg, CC BY-SA 3.0,

Front-end Responsibilities

User Interface elements

Mark-up and web languages such as HTML, CSS, JavaScript and supporting libraries

Asynchronous request handling and AJAX

Single-page applications (with frameworks like React, AngularJS or Vue.js)

Web performance

Responsive web design

Cross-browser compatibility issues and workarounds

End-to-end testing with a headless browser

Build automation to transform and bundle JavaScript files, reduce image size

Search engine optimization

Accessibility concerns

Backend Responsibilities

Software Architecture

Application Business Logic

Application Data Access

Database management

Scripting languages like JavaScript, Node.js, PHP, Python, Ruby, Java etc.

Automated testing frameworks for the language being used

Scalability

High availability

Security concerns, authentication and authorization

Parts of an URL

http://abc.company.com:80/a/b/c.html?user=John&year=2020#p2

The scheme identifies the protocol used to fetch the content.

Host name name of a machine to connect to.

The server's port number allows multiple servers to run on the same machine.

The hierarchical portion is used by the server to find content.

The Query parameters provide additional parameters

Fragment : Have the browser scroll the page to a specific part of the webpage fragment

Different types of links

Full URL: News

Absolute URL: <a href="/stock/quote.html">

- same as http://www.xyz.com/stock/quote.html

Relative URL (intra-site links): <a href="b/March.html">

- same as http://www.xyz.com/news/2008/March.html

Define an anchor point (a position that can be referenced with # notation):

- <a id="sec3">

Go to a different place in the same page: <a href="#sec3">

URL Encoding

How are special characters sent in the URL?

- http://www.xyz.com/companyInfo?name=A&B CO
- Any character in a URL other than A-Z, a-z, 0-9, or any of -_.~ must be represented as %xx, where xx is the hexadecimal value of the character:
- http://www.xyz.com/companyInfo?name=A%26B%20CO

Escaping is a commonly used technique.

Domain Name System

The Domain Name System (DNS) is the phonebook of the Internet.

Humans access information online through domain names such as google.com or facebook.com.

The network of devices interacts through Internet Protocol (IP) addresses.

DNS translates domain names to IP addresses so browsers can load Internet resources.

Each device connected to the Internet has a unique IP address, which other machines use to find the device.

DNS servers eliminate the need for humans to memorize IP addresses

Domain Name System

The Domain Name System resolves the names of internet sites with their underlying IP addresses.

A DNS server is a computer server that contains a database of public IP addresses and their associated hostnames.

DNS is a distributed database implemented in a hierarchy of name servers.

It is an application layer protocol for message exchange between clients and servers.

Domain Name System

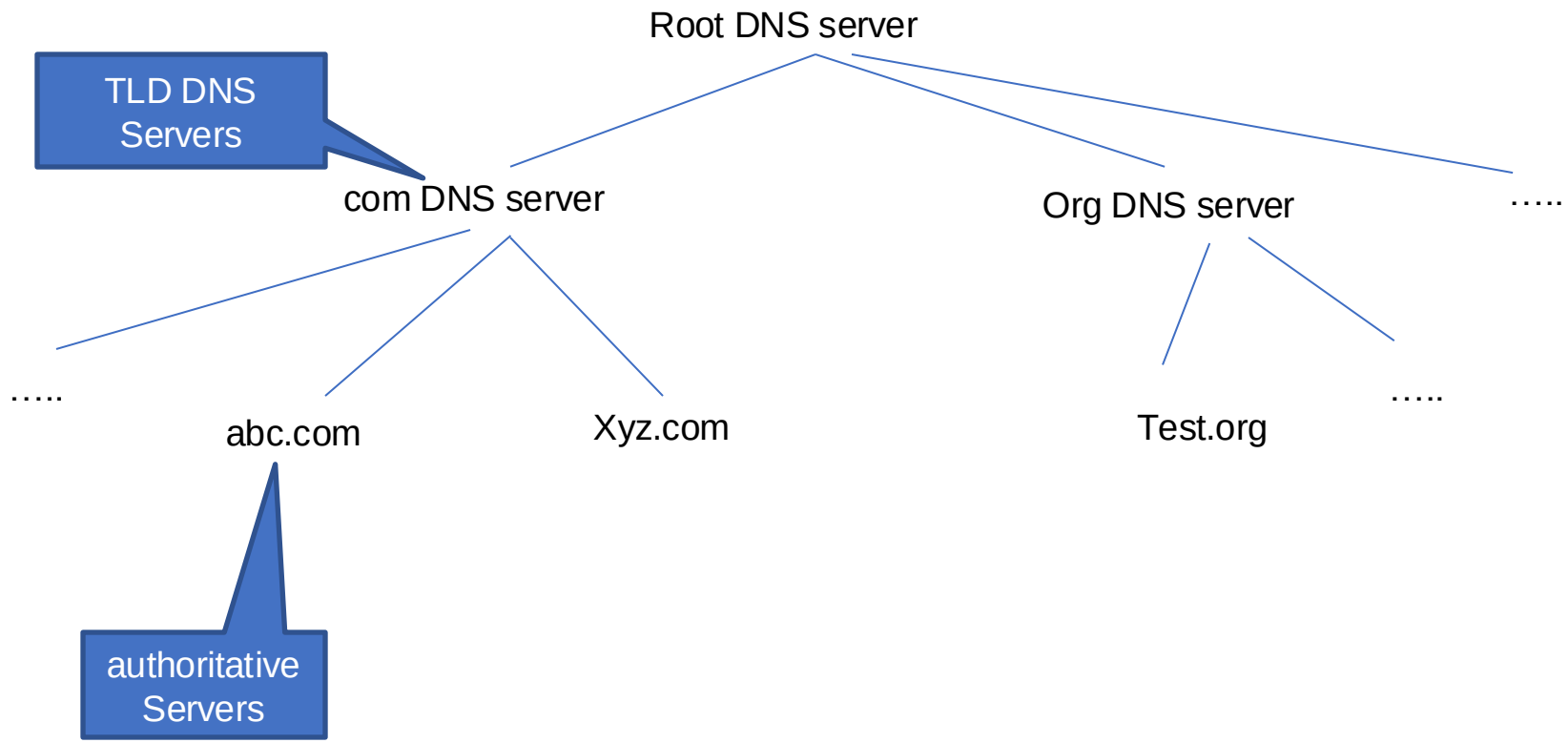
The **DNS recursor** is a server designed to receive queries from client machines through applications such as web browsers.

The **root server** is the first step in translating (resolving) human-readable host names into IP addresses.

TLD nameserver - The top level domain server (TLD)

The authoritative nameserver is the last stop in the nameserver query

Domain Name System Lookup



Content Delivery Network

A content delivery network (CDN) is a geographically distributed group of servers that caches content close to end users.

A CDN allows for the quick transfer of assets needed for loading Internet content, including HTML pages, JavaScript files, stylesheets, images, and videos.

Is a CDN the same as a web host?

CDN can’t replace the need for proper web hosting, It improve Web performance!!

CDN

A CDN improves website load times.

The globally distributed nature of a CDN reduces the distance between users and website resources.

A CDN caches content (such as images, videos, or webpages) in proxy servers that are located closer to end users than origin servers.

CDNs also reduce the amount of data transferred by reducing file sizes using minification and file compression tactics.

Load balancing distributes network traffic evenly across several servers, making it easier to scale rapid boosts in traffic.

Benefits of using a CDN

Improving website load times

Reducing bandwidth costs

Increasing content availability and redundancy

Improving website security

Web hosting

https://w3techs.com/technologies/history_overview/web_hosting

	2023 1 Aug	2023 1 Sep	2023 1 Oct	2023 1 Nov	2023 1 Dec	2024 1 Jan	2024 1 Feb	2024 1 Mar	2024 1 Apr	2024 1 May	2024 1 Jun	2024 1 Jul	2024 1 Aug	2024 16 Aug
Amazon	6.0%	6.0%	6.0%	6.0%	6.0%	5.9%	5.9%	5.8%	5.8%	5.7%	5.6%	5.6%	5.5%	5.5%
Shopify	4.0%	4.0%	4.0%	4.1%	4.1%	4.2%	4.3%	4.3%	4.3%	4.4%	4.4%	4.5%	4.5%	4.5%
Newfold Digital Group	4.1%	4.1%	4.1%	4.0%	3.9%	3.9%	3.8%	3.7%	3.7%	3.6%	3.6%	3.5%	3.5%	3.4%
OVH	3.3%	3.3%	3.3%	3.3%	3.3%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	3.1%	3.1%
Hostinger	1.6%	1.7%	1.8%	1.9%	2.0%	2.0%	2.1%	2.3%	2.6%	2.7%	2.8%	2.9%	3.0%	3.1%
Wix	2.5%	2.5%	2.5%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.7%	2.7%	2.8%	2.8%	2.9%
GoDaddy Group	3.3%	3.1%	3.0%	2.9%	2.9%	2.9%	2.8%	2.8%	2.8%	2.7%	2.7%	2.7%	2.7%	2.6%
Hetzner	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%
United Internet	2.1%	2.1%	2.1%	2.1%	2.1%	2.2%	2.2%	2.3%	2.3%	2.3%	2.4%	2.4%	2.4%	2.4%
Squarespace	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.2%
SiteGround	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%
team.blue	1.8%	1.8%	1.8%	1.8%	1.8%	1.9%	1.9%	1.9%	1.9%	1.9%	1.9%	1.9%	1.9%	1.9%

Client-Side Programming-Frontend / User Interface

Involves everything users see on their screens.

Major frontend technology stack components:

- HTML, CSS and JS

Hypertext Markup Language (HTML) and Cascading Style Sheets (CSS)

- HTML tells a browser how to display the content of web pages
- CSS styles that content
- Bootstrap is a helpful framework for managing HTML and CSS

JavaScript (JS)

- Makes web pages interactive
- Many JavaScript libraries (such as jQuery, React.js)
- frameworks (such as Angular, Vue, Backbone, and Ember)

Server-Side Programming-Backend

Major server-side technology stack components:

- Programming language, Framework, web server and databases

Server-side programming languages used to create the logic of applications

Frameworks offer lots of tools for simpler and faster development of applications

Options

- Ruby (Ruby on Rails)
- Python (Django, Flask, Pylons)
- PHP (Laravel)
- Java (Spring)
- Scala (Play)
- Javascript (Express Node.js)

Other Components

Storage

- Apps needs a place to store its data
- Two types of databases:

○relational and non-relational

- Most common databases for web development:

○MySQL (relational)
○PostgreSQL (relational)
○MongoDB (non-relational, document)

Other Components

Caching system

- Used to reduce the load on the database and to handle large amounts of traffic
- Memcached and Redis are the most widespread.

Web servers/Load balancers/Proxy servers

- Needs a server to handle requests from clients' computers
- Two major players: Apache, Nginx
- Cloud Based Servers (EC2, Serverless, ELB)

Example TechStack

MEAN / MERN / MEVN Stack

- MongoDB: A NoSQL database that stores data in a flexible, JSON-like format.
- Express.js: A minimal and flexible Node.js web application framework that provides robust features for web and mobile applications.
- Frontend Framework
  Vue.js: A JavaScript framework for building user interfaces.
  Angular: A TypeScript-based open-source front-end web application framework maintained by Google.
  React: A JavaScript library for building user interfaces, developed by Facebook.
- Node.js: A JavaScript runtime built on Chrome's V8 JavaScript engine. It allows developers to use JavaScript for server-side scripting.

Python Stack:

- Flask or Django: Flask is a lightweight Python web framework, and Django is a high-level Python web framework.
- SQLAlchemy: An SQL toolkit and Object-Relational Mapping (ORM) library.
- Django REST framework: If using Django for building APIs.
- Database: Various options, including SQLite, PostgreSQL, or MySQL.
- HTML/CSS/JavaScript or React/Angular for frontend

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Rendering Patterns

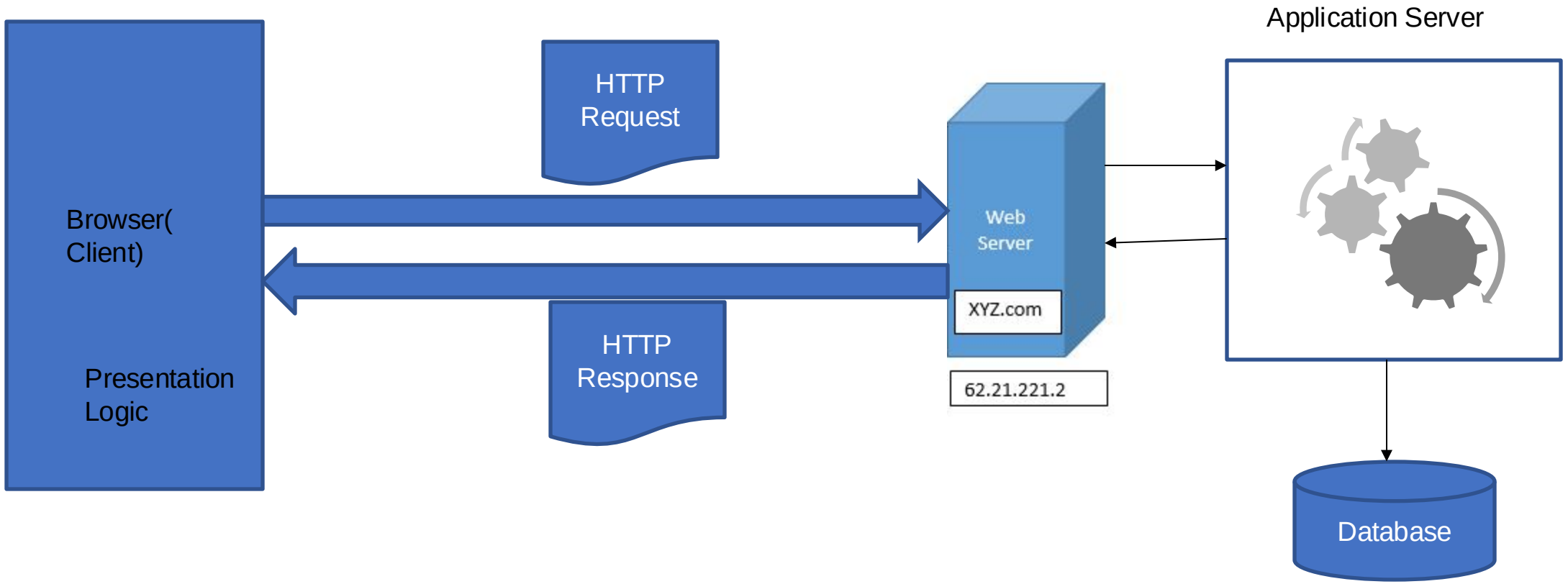
Client-side rendering (CSR)

Client-side rendering (CSR) is a technique for rendering web content on the client-side, i.e., in the user's browser.

With CSR, the client requests a minimal HTML file from the server containing the necessary JavaScript and CSS files.

When the client loads the JavaScript files, the JavaScript code is executed, which renders the content in the browser.

Client Side rendering



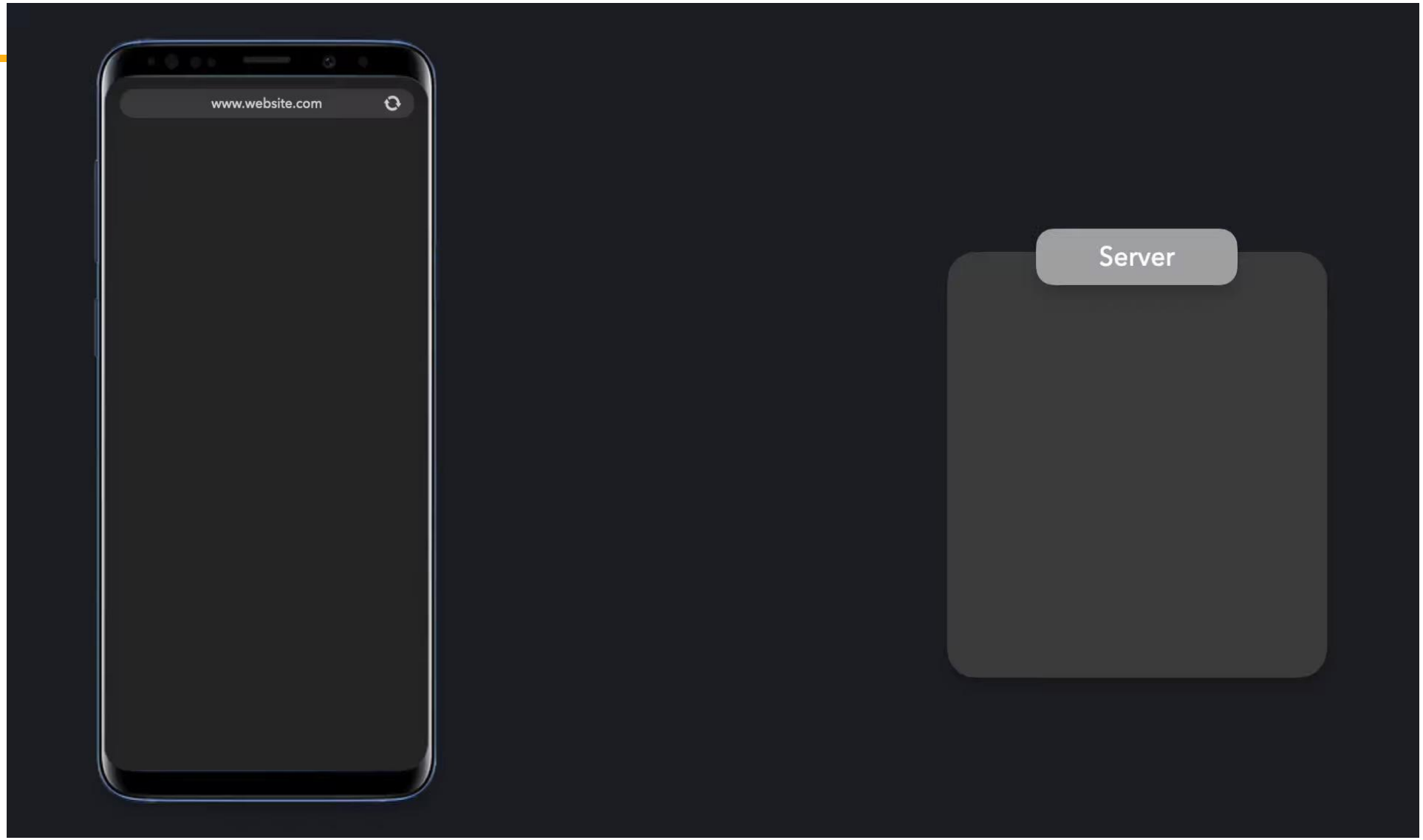
Server-Side Rendering

Server-side rendering (SSR) is a technique for rendering web content on the server-side, i.e., before the page is sent to the client.

Server-Side Rendering is also named Pre-Rendering because the fetching of external data and transformation of components, content, and data into HTML happens before the result is sent to the client.

There are several benefits of using server-side rendering:

- Better SEO
- Faster Initial Page Load
- Improved Accessibility
- Better Performance on Low-Powered Devices


www.website.com
Server

Static Site Generation

Static site generation (SSG) is a popular approach to website development that involves generating a website's content ahead of time and delivering it as static HTML files to end-users.

In SSG, the HTML is generated once, at build time.

The HTML is stored in a CDN or elsewhere and re-used for each request.

A static site generator combines the content and templates into a collection of static HTML files.

This process may also include optimizing images, minifying code, and generating metadata.

Static Site Generation

Benefits:

- Performance
- SEO
- Cost

Limitations:

- Not suitable for all types
- No Real-time data

Some popular static site generators include Jekyll, Hugo, and Gatsby.

Example- Case study- Ecommerce

Page Type	Rendering Method	Why?
Homepage	✅ SSG (Static Site Generation)	✅ Prebuild for fast load, ✅ SEO-friendly
Product Listing Page (Category Page)	✅ SSR (Server-Side Rendering)	✅ Always fresh data, ✅ SEO
Product Details Page	✅ SSG (with ISR for periodic updates)	✅ Prebuild for speed, ✅ SEO-friendly, ✅ Updates periodically
User Dashboard (Orders, Wishlist)	✅ CSR (Client-Side Rendering)	❌ Not SEO-relevant, ✅ Personal user data, ✅ Faster navigation
Cart & Checkout	✅ CSR (Client-Side Rendering)	❌ No SEO needed, ✅ User-specific, ✅ Immediate updates
Admin Dashboard	✅ CSR (Client-Side Rendering)	❌ No SEO needed, ✅ Better interactivity
Search Page	✅ SSR (Server-Side Rendering)	✅ Fresh, dynamic results, ✅ Good for SEO

Self Reading

https://www.patterns.dev/vanilla/rendering-patterns/

References

1. https://www.patterns.dev/vanilla/rendering-patterns/

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Thank you