# WEB DESIGN & DEVELOPMENT

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# DOMAIN NAME SERVER (DNS)

## What is domain name server?

The Domain Name Server (DNS) may be thought of as the phonebook for the Internet, a worldwide network of devices of various shapes and sizes. The Domain Name Server's job is to convert human-readable and understandable domain addresses into machine-readable domain addresses.

Similar to how a phonebook is used to refer to a person's phone number. The DNS translates a human-readable web address to an IP address, similar to how the phonebook maps a phone number to a person.

In a phonebook, if you needed to find Jane's phone number, you'd go to the J section and browse through the names until you found Jane, then look at the phone number.

When you put google.com into a browser's address bar and click enter, an instant request is made to the DNS, which searches its enormous databases for the domain of google.com. Once discovered, the IP address of google.com is obtained, and a request (HTTP GET) is sent to that IP address.

The Domain Name Server was created because it was difficult for humans to recall an IP address made up of digits, and it also became inefficient because certain online services/applications/sites have several IP addresses, each of which is unique to a nation. The Internet as we know it would not be worldwide if it weren't for DNS.

## Types of domain name servers

There are four Domain Name Servers involved in the entire process of loading a web page into a browser, and they are:

1. **The Domain Name Server Recursive (DNS Recursive)** might be compared to a librarian who is requested to locate a certain book in a library. The DNSRS is a server that receives web addresses from any system connected to the internet via a web browser application. The DNSRS is typically, but not always, held accountable for making extra queries to satisfy the user's requested domain address. Error management is generally included in this.

2. **The RNS (Root Name Server)** is the first step in converting human-readable web addresses to IP addresses. The Root Name Server takes up the majority of the time in the procedure.

3. **The Top-Level Domain Name Server** is an optional stage in the process; think of it as a shelf in a bookcase reserved for rare books. If the site address has not previously been resolved in the Root Name Server, the TLD Name Server is generally the next step after that. This can also happen before the RNS is completed. Top level domains with the extensions.com and.org are common examples.

4. **Authoritative Name Server** is the final domain name server in the process, and it's usually the most difficult. Consider it a dictionary containing the definitions and permission information for a web address. If and only if the Authoritative Name Server has access to a certain requested web address resolution, it will return the requested web address's IP address to the Recursive Server that made the ANS request in the first place.

## Domain name server management & organization

As you may have gathered, the Domain Name Server is critical not just for the purpose and functionality it gives to the internet, but also because it is the Internet's core; without it, most humans will regard the internet to be a hostile service. As a result, despite the fact that the internet is free, the assignment of free space within the cyber world of the internet is controlled by the government.

The maintenance of the DNS is primarily the responsibility of the following organizations:

- The Internet Corporation for Assigned Names and Numbers (ICANN) is a non-profit organization that assigns names and numbers (ICANN)
- The Internet Assigned Numbers Authority (IANA) is a government agency that oversees the (IANA)
- Top-Level-Domain (TLD) Operators (Could be any company that holds legal rights to a TLD)
- Registers that have been approved (Like Namecheap or GoDaddy)

The root zone is the top level of the DNS hierarchy. The IANA, with the cooperation and assistance of ICANN, manages the DNS root zone. This is done by administering and analyzing the data contained in each root name server's root zone file. ICANN also manages the "root zone database," which is often what you'd find if you conducted a simple WHOIS on a website.

The DNSSEC section of ICANN controls the Key Signing Key (KSK), which provides the security that Domain Name Servers require. The Internet Corporation for Assigned Names and Numbers (ICANN) develops several regulations for the administration of domain names.

The DNSSEC section of ICANN is responsible for managing the Key Signing Key (KSK), which provides the security that Domain Name Servers require. Through the guidance of two big technical groups, ICANN develops various rules for the management of the root zone. The RSSAC (Root Server System Advisory Committee) and the SAC (Security and Stability Advisory Committee) are two committees that advise on root server systems (SSAC).

ICANN also oversees the Top Level Domains (such as.com,.org, and.gov), which are given special treatment, and rewards any and all registrars that purchase and maintain the internet's free space. There are hundreds of such registrars (such as Namecheap and GoDaddy) that are known as 3rd party registrars and are open to anybody in the world. The Generic Names Supporting Organization (GNSO) and Country Code Names Supporting Organization (CCNSO) are two significant ICANN segments that apply and maintain worldwide conventions for Top Level Domains (CCNSO).

# COMMUNICATION PROTOCOLS

Communication protocols are a collection of principles that allow web apps that need to communicate with one another to function within the cyber space. This section of the handbook will go through five widely utilized and widely used communication protocols that are used by virtually every significant platform on the planet, namely:

- **Simple Mail Transfer Protocol (SMTP):** SMTP is a protocol widely used in many industrial organizations. This protocol performs the function of sending, authorizing, managing, organizing and establishing a connection so that an electronic mail can be sent from one person to another. SMTP is widely used in every design and functionality related to mail servers, most websites nowadays have newsletters, these newsletter services are done using SMTP

- **Transmission Control Protocol / Internet Protocol (TCP / IP):** The TCP / IP protocol is a large set, it is also called IP set. TCP/IP brings what is known as a session to a web application, in terms of design and purpose within a web service, sessions enable a web service to store, manage and manipulate data specific to each instance a user of a particular website or web application.

- **Voice over Internet Protocol (VoIP)** As you can see on many social media platforms, games and various other communication platforms, just as the name of this protocol suggests that it is a protocol that allows the transfer of audio as data packets over the internet from one user to another. In terms of design and purpose, VoIP is widely used in the industry for conferencing, security applications, and even simple server-side audio playback. VoIP is one of the protocols that is starting to get a lot of attention.

- **Hypertext Transfer Protocol (HTTP):** The oldest and most basic communication protocol on the Internet, this protocol allows the transfer of data in the form of text on the Internet. In terms of design and purpose, this protocol does just about everything from assisting in rendering static and dynamic text content to sustaining repetitive transfers of text data from one place to another.

- **User Datagram Protocol (UDP)** The UDP protocol is similar in design and purpose to the TCP/IP protocols, but without the sessions. There is no additional overhead to create sessions between internet users when it comes to UDP, it is generally used in situations where performance is a critical component and security is not an issue, for example when streaming videos.

# WEB SERVER OPERATING SYSTEM, HARDWARE AND SOFTWARE

A web server is a device that allows you to host your web application or website in such a way that anybody in the world may access it. There are several operating systems, software, and hardware to discuss, but the majority of them are not used in industry.

There are two major areas in both industrial and commercial online hosting and publishing when it comes to pioneers in operating systems, also known as server system software:

**Microsoft Windows Server:** In businesses with less technical experience, this is the most widely utilized web hosting and publishing operating system. Of course, there is a drawback to this added simplicity of usage. Microsoft Windows web servers are notorious for consuming a lot of resources. The majority of viruses, malware, and malicious software are designed to attack web servers running Microsoft Windows Servers. However, there is extremely capable software that can assist in resolving similar issues, but these programs are also quite resource intensive. The Microsoft Windows Server operating system is used by the majority of startups and organizations without a strong technical experience.

**Linux:** Linux is usually utilized by businesses that have been around for a while and have a strong technological background. For more effective resource usage and other considerations such as security, more businesses move to linux-based web servers. Linux-based web servers, on the other hand, often lack a graphical user interface and must be controlled via the command line.

The following table lists the various hardware and software components involved with web servers:

*Table 1: Different between software and hardware in web server*

| Software | Hardware |
| --- | --- |
| **Nginx:** This is a multi-functional piece of software that can act as a reverse proxy, load balancer, HTTP cache and a mail proxy. It promises to accelerate security, responsiveness and overall efficiency of a web server. | **Server towers:** These are large and highly efficient computer systems that are specially built for hosting and publishing web applications or web sites. They consume large amounts of electricity, often they have more |

**NodeJS:** A server runtime that allows web developers to write web server logic and functionality with Javascript. It is a C/C++ program that binds Javascript to allow to create server instances.

**Apache HTTP Server:** A quite legacy level web server software that allows for hosting web applications. It can act as a simple File server, mail server or a complex server that has multiple other functions.

**Mongoose:** This is a cross-platform embedded web server and networking librabry that promises to provide functions like TCP, HTTP client servers, Web Socket client and server and MQTT client/broker services. It allows literally any device out in the world that have basic processing rules and technology to act as a web server. It is an application that is quite fundamental in the industrial web hosting and publishing sphere.

**WampServer:** This is a software stack that was created by Microsoft Windows for the Microsoft Windows server operating systems, which consists of the Apache web server, Open SSL, MySQL and PHP. This is counted as an obsolete and legacy stack and is no longer widely used in the industry anymore.

than 1 CPU, GPU or RAM cards. They go beyond just normal performance ranges, they have high amounts of resources and usually have backup power sources as a fallback procedure.

**Load balancers:** Load balancers are devices that sits between the clients and the servers. The purpose of a load balancer is to distribute traffic in a particular preconfigured pattern among large clusters of web servers, which leads to higher performance and other benefits. This reduces the resource consumption of each component of a cluster of web servers.

**Hardware Firewalls:** Hardware firewalls interpret and police internet traffic that clients send to web servers. According to a preconfigured set of inbound and outbound rules, a firewall will allow or deny web traffic from particular clients to or from a web server.

**Proxy Servers**: These devices also sit between clients and web servers, but proxy servers usually act as the intermediate or the mediator between the two ends. For particular clients, a proxy server may decide to send a different set of responses unlike another set of particular clients.

# IMPACT OF COMMON WEB DEVELOPMENT TECHNOLOGIES AND TOOLS

There are several web development technologies and tools available; their primary aim is to make the process of developing a bespoke online application or website easier.

These technologies are utilized in industry for the following reasons:

- Performance
- Security
- Efficiency
- Ease of implementation
- Validity
- Higher Exposure

Using technologies or tools like these ensures the security of the web application or web site since it allows a company to utilize something that has been tested and recognized as a solution for their web development needs and requirements by many other comparable companies.

Because these technologies have stood the test of time and have been improved in various ways by a large number of other more experienced web developers, performance and efficiency are almost always guaranteed.

When you use web technologies and tools, it becomes easier to implement your web application or website because there are multiple levels of abstraction over complex and usually logic-demanding concepts that are difficult to implement.

Using such technologies and tools increases an organization's visibility and legitimacy since other organizations that have been known to thrive using the same technology realize that the tools you employ are more than a fluke.

# SEARCH ENGINE OPTIMIZATION (SEO)

It makes no difference how wonderful your web application is if it does not have a high Search Engine rating. A search engine is a piece of software that allows users to search through vast databases of websites to locate the ones they want.

Good SEO is critical to the website's effect since it determines whether or not users of your organization are aware of and rely on your website. Otherwise, if your SEO is bad, your users will be ignorant, and your website will not receive a lot of traffic. This will be a waste of resources, money, and effort invested on creating a website in the first place.

MOZ - ([www.moz.com](www.moz.com)) is a company that does Search Engine Optimization professionally, the following procedures are what Moz does for all their customers, these have been proven to work per the reviews at their official homepage. Search Engine Optimization according to Moz focuses on the following points:

**Tracking Accessibility:** Tracking is the process of an application moving through text-based informational text within a website. Moz recommends that crawl accessibility is an important part for search engines to see your website and then rank your content.

**Attractive content:** According to Moz, audio, video or text-based content should be attractive and relevant to the user.

**Keyword Optimization:** It is a must to have very specific keywords that help search engines understand the relevance of your website content.

**Quality User Experience (UX):** Fast loading speeds of images and the website in general, have compressed images that don't sacrifice quality, are responsive to look good on multiple devices.

**Curious Content:** All your content should be shareable, according to Moz, so that people will take the content from your website and quote it elsewhere, which will lead other people to your website.

**Attractive web address and title:** This is the most important and effective method for improving SEO optimization according to Moz, a web address like "JanesFood" is better than a web address like "DeliciousFoods" like a name like "JanesFood". is unique and aims to give you a high position in the search engine.

# FRONT-END (OR) BACK-END WEB TECHNOLOGIES AND FRAMEWORK TOOLS

How do web technologies cater to the OSI model?

A web technology can take the form of a framework or a tool developed by a large community of developers to facilitate and improve the web development process. In web development in particular, there are two different sections that deal with:

- **Front-end** The visible view displayed in your browser is called the interface of a website or web application. The frontend design and development is completely focused on logical and functional implementations of various concepts that ensure a good user experience (UX). The interface is also known as the user interface (UI). The interface is what acts as the presentation layer, compression algorithms like JPEG, GIF, PNG are used to display image data, although SVG is much more popular these days. The presentation layer is what the user interacts with directly in the OSI model and the interface is what establishes the functionality of the presentation layer in the OSI model.

- **Back-end**: the invisible part of a website or web application. It manages the screen, controls it, and manipulates the data displayed on the user interface. In general, computational logic that consumes large amounts of resources that would otherwise freeze the user interface, is done in the backend. Backend web development is much more difficult than frontend development in most scenarios, as it involves the cumulative focus on many concepts, including frontend maintenance. The backend is what the application layer focuses on, the manipulation of the application layer produces different behaviors and responses. When you interact with the presentation layer, the components of the application layer, which is the backend, are manipulated.

# CUSTOM BUILT VS WEB CREATION TOOL-BUILT WEBSITES

Websites can be created in multiple ways, due to the evolution of different technologies and tools, many different solutions have been produced to facilitate the development procedure.

However, there are currently 2 ways to create websites:

- **Use a website builder tool -** doing this will save you from writing code or designing anything. Everything from website design to website hosting is done by the web builder tool, its sole purpose is to fill in content and drag and drop components onto your website. While this is very easy to do, it is extremely inflexible. UI / UX flexibility is very low, you cannot flexibly create a website to suit your needs. Components that you drag and drop can only be used as is, and you can't toggle their layout or behavior unless they explicitly provide you with an interface to do so.

- **Custom built -** Everything from the design to the hosting of your web application is up to you. This actually consumes more resources and time, but it ensures security and many other important features of a good website, such as mobile first design, use of design patterns, privacy, data flows, implementation of standards. ISO and efficient UI / UX design.

Some examples of website creation tools are:

- Wix
- Weebly
- Web
- Wordpress drag and drop tool
- Bootstrap creation tool

All of these authoring tools have big problems when it comes to good UI / UX design, also the reputation you will have as an organization if you use any of these authoring tools to create your website will be significantly lower than the perspective that most of Developers and Industry Experts who have tools to create websites are quite scarce.

So only use website builder tools if flexible UI / UX design isn't your concern, but ease of implementation is. For the most part, web authoring tools are used by individuals and not by organizations, mostly they are used to create blogs, image portfolios and journals.

# Justification, recommendation and explanation of various front and backend design and development technologies for custom built websites

The design section of each category includes tools used for designing the frontend or the backend, while the development section will include frameworks and runtimes that are used for backend development.

Front-end

*Table 2: front-end design and development*

| Design | Development |
|---|---|
| **Adobe Xd –** A industrially accepted design, wireframing and prototyping application produced by Adobe. It is slowly getting very high exposure and popularity in the industry. It is very effective and has a lot of components that already come with it. The already existing functionality of Adobe Xd can be extended using community plugins as such the power you have with Adobe Xd is endless.<br><br>**Microsoft Publisher –** Quite the obsolete and legacy type of application that is used to design websites. It has a very simple interface like most of the Microsoft applications but the functionality and the purpose it has only stretches so much. It is not as industrially popular as it was back in the 2007s. | **JQuery –** A very famous and almost obsolete frontend development framework that is focused on DOM manipulation, and doing it safely while ensuring that you do not sacrifice performance. JQuery has survived the test of time and is quite often used in the industry due to its extreme simplicity and performant interfaces. It uses Javascript concepts like function currying and composition and ES6 symbols. Usually for support for various technologies that are not supported in Internet Explorer, JQuery is used to write efficient polyfills.<br><br>**ReactJS –** An extremely popular and the frontend development giant in the development world, produced and used by Facebook, it has multiple features like one-way data flow/binding, stateful and functional components, hooks and lifecyle methods. |

**Sketch** – A MacOS only digital design tool, which is very famous among frontend designers, as sketch provides various UI frameworks and widgets that allow designing responsive and appealing frontends in very short periods of time.

**Adobe Illustrator** – Although not majorly used for UI/UX design, illustrator is quite often used by beginner frontend designers for design phase of the frontend alone. It does not provide any features like wireframing or prototyping by default, as such it is not industrially used for frontend design.

**Adobe Photoshop** – Like Adobe Illustrator, it is also just used to make mockups of frontend UI/UX designs, it too, does not provide any features like wireframing or prototyping. However though, as graphic designers use Adobe Photoshop intensively, Adobe Photoshop sees large industrial exposure for frontend design.

ReactJS is described as the V in the MVC design pattern.

**AngularJS** – A frontend framework that has a much more higher resource consumption and composition than ReactJS produced by Google specifically for Single Page Applications (SPAs). It has a multiple features like server-side rendering, stateful components. AngularJS is also described as the V in the MVC design pattern.

**VueJS** – Another frontend framework that was produced to combine the features of AngularJS and ReactJS but in a smaller minified size so that your bundle size is as less as possible. It is seeing a lot of industrial exposure and is widely used in China as the developer/founder of VueJS is Chinese.

**Supercharged CSS** – SCSS is a CSS preprocessor. SCSS allows for multiple things that are usually not possible with pure CSS like mixins, blends, conditional statements, loops etc.

## Back-end

*Table 3: back-end design and development*

| Design | Development |
|---|---|
| There are not a many ways that you can "design" a backend, however there are two very effective methods which are:<br><br>**Visualization through rough sketches -** by doing so you will try to visually describe every component of the backend, how data flows, how each component of the backend interacts with each other and how the backend architecture must be implemented.<br><br>**UML Diagrams –** Using multiple UML diagrams like flowcharts, data flow diagrams, entity relationship diagrams etc. you can describe and express the architecture and the logistics within the backend of an application. There are many industrially accepted UML diagrams that have been proven to focus and efficiently demonstrate the backend design of a web application. | **PHP –** One of the oldest languages to exist that have been used for backend development. It isn't used as intensively anymore as the way of programming is no longer synchronous. PHP has proven to be a rabbit hole of a lot of problems, and it is extremely challenging to create an efficient architecture using PHP. It is however an extremely simple language to develop the backend as such the industrial exposure it has seen reduces by each month.<br><br>**ExpressJS –** It is a backend web application framework developed for NodeJS based solutions. It is widely used by developers for creation of RESTFul APIs and it is extremely efficient and performant. It is widely used by both experts and beginners in the industry. It has been ranked as one of the most used technologies for backend development by the Developer Economics Survey 2018.<br><br>**Flask –** A python based web application framework for Python based solutions. It is very simple to get started with. Although it's features are limited, it is very efficient in what it does. Most startups and developers that are just starting web developers reap benefits |

| | from PyFlask, however there is usual a transition from Flask to something more capable like Django. |
| --- | --- |
| | **Django –** A python based web application framework for Python based solutions. This isn't as user-friendly and more difficult to get started with when it comes to backend development. However it has a lot of features for heavy industrial complications and features and has been a framework that has survived the test of time.<br><br>**Spring –** A Java based web application framework for Java based solutions. It has a lot features and mainly focuses on the Object Oriented Programming paradigm as Java revolves around this programming paradigm. |

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