Introduction to
Web Development

Topic 1: Web Dev and How the Web Works

The Internet Ecosystem

The Internet Ecosystem

History

And Definitions

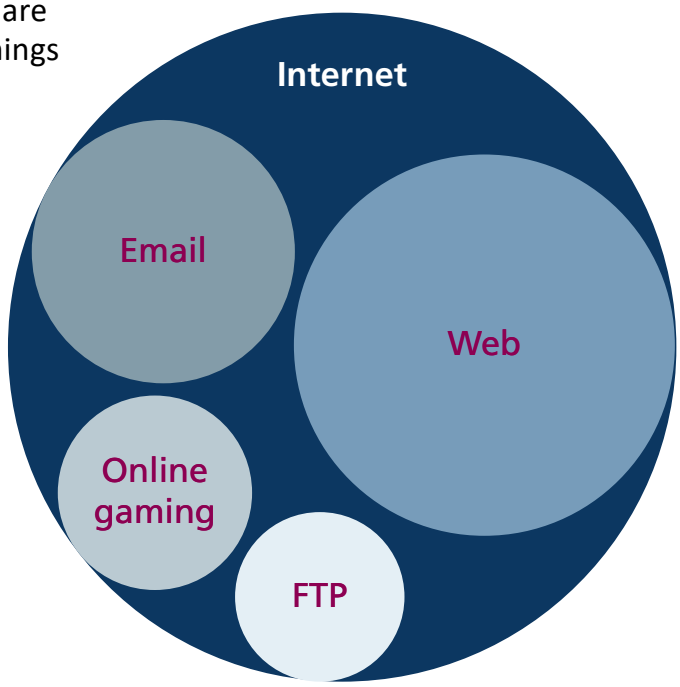
Definitions and History

A Short History of the Internet

- Telephone Network
- Packet Networks
  - ARPANET (1969)
  - X.25 (1974)
  - USENET (1979)
  - TCP/IP (1983) ← INTERNET

Definitions and History

The Internet and WWW are different (but related) things



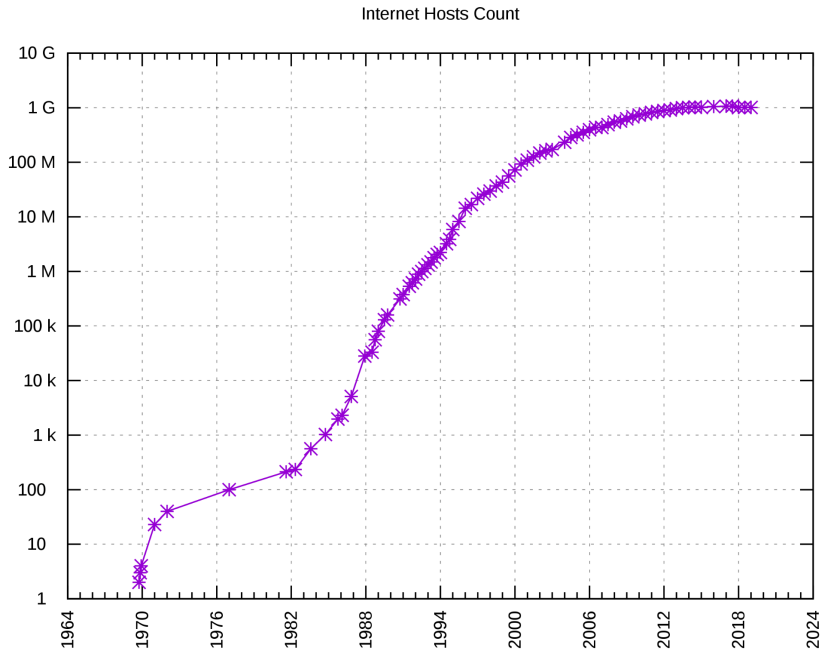
Definitions and History

The Birth of the Web (1990)

1. URLS
2. HTTP
3. SERVERS
4. BROWSERS
5. HTML

Definitions and History

The Growth of the Internet



Source: wikipedia.com

Definitions and History

Web Applications in Comparison to Desktop Applications

Advantages:

Definitions and History

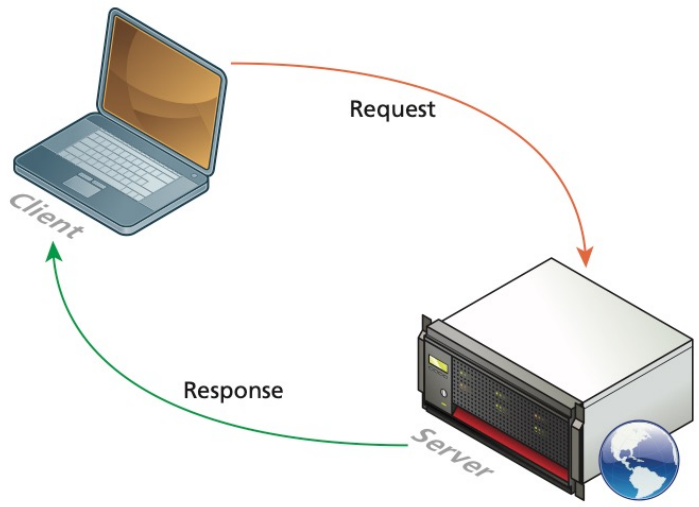
Web Applications in Comparison to Desktop Applications

Disadvantages:

The Client-Server Model

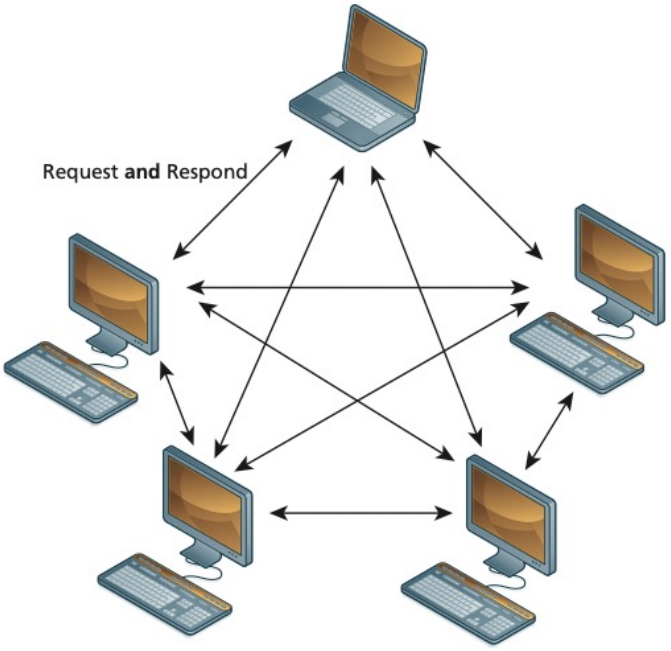
The Client-Server Model

The Request-Response Loop



The Client-Server Model

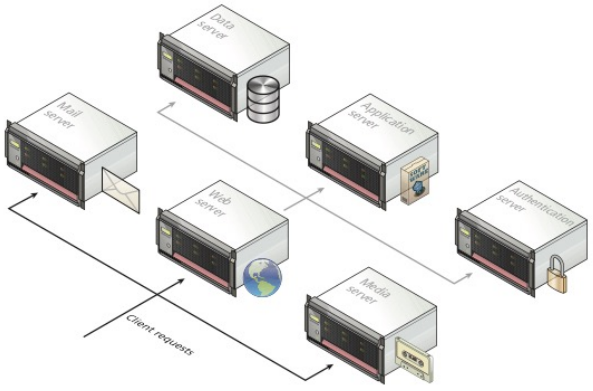
The Peer-to-Peer Alternative



The Client-Server Model

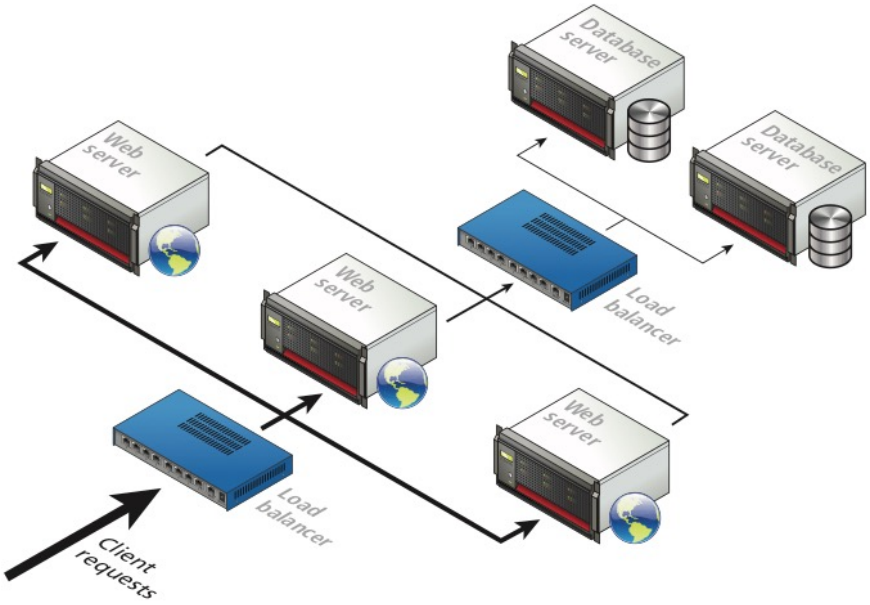
Server Types

- Web Servers
- Application Servers
- Database Servers
- Mail Servers
- Media Servers
- Authentication Servers
- …



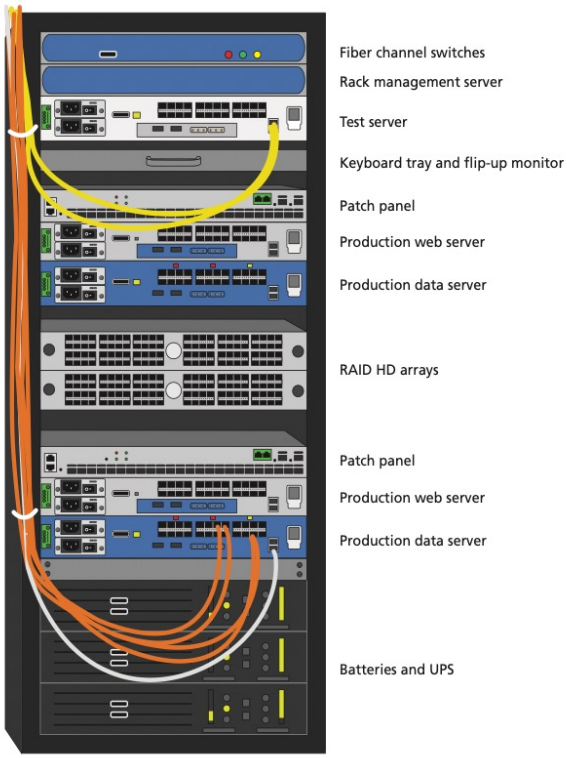
The Client-Server Model

Real-World Server Installations – Server Farm



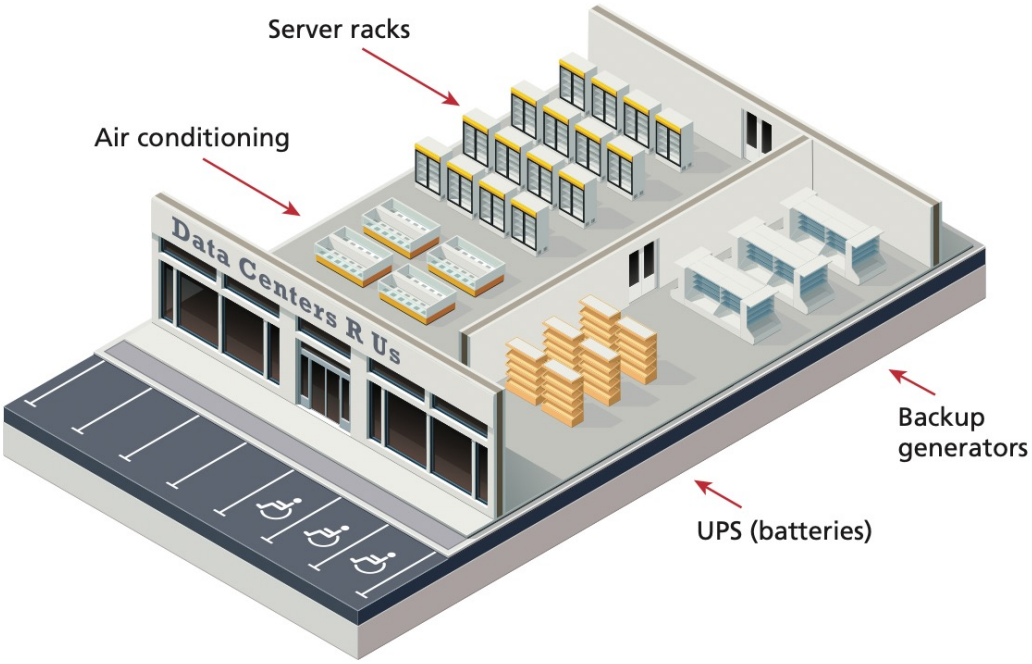
The Client-Server Model

Real-World Server Installations – Server Rack



The Client-Server Model

Real-World Server Installations – Data Center



The Client-Server Model

Real-World Server Installations – Data Center

Case: Google's Data Centers

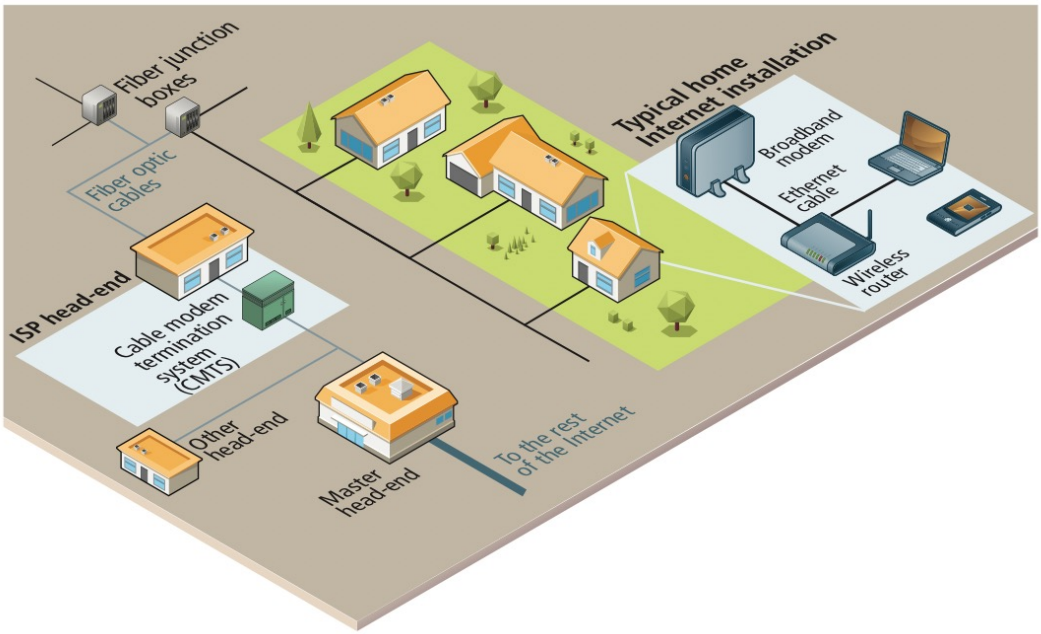
- As of 2021, fourteen data center locations in the U.S., one in South America, six in Europe and two in Asia.
  - also has many caching sites in colocation facilities, locations unknown.

- Physically anywhere from 200,000 square feet to 1,000,000 square feet
- As of 2021, these data centers contained over 3.2 million servers

Where is the Internet?

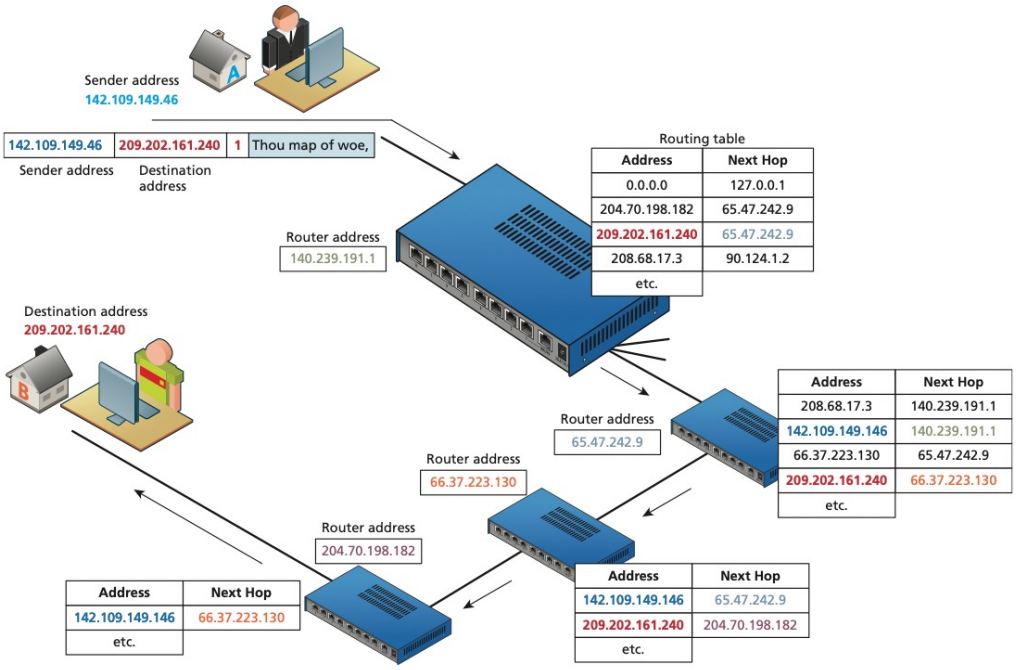
Where Is the Internet?

From the Computer to the Local Provider



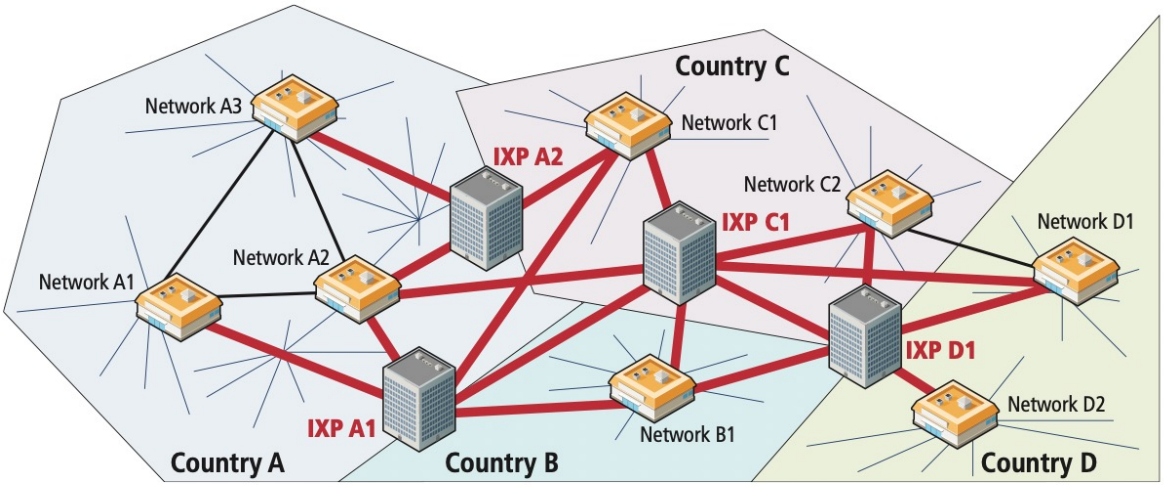
Where Is the Internet?

(Simplified) Routing Tables



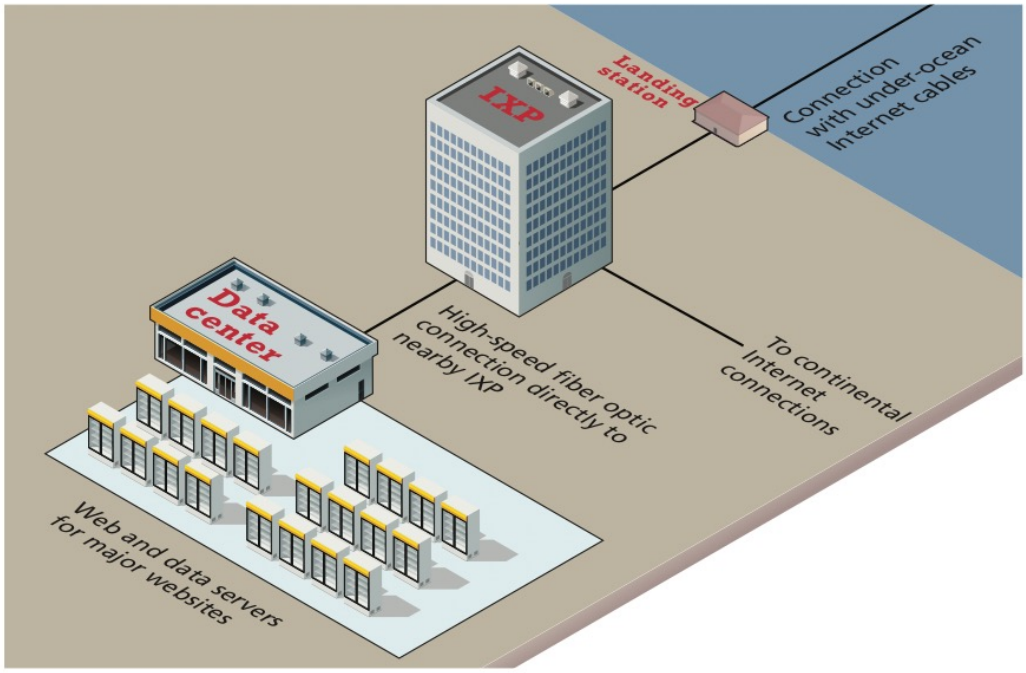
Where Is the Internet?

From the Local Provider to the Ocean's Edge



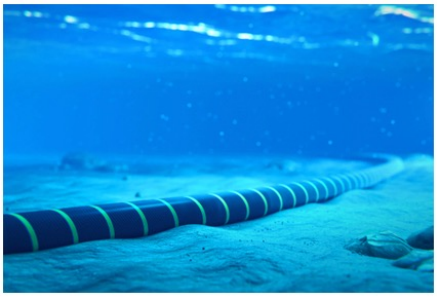
Where Is the Internet?

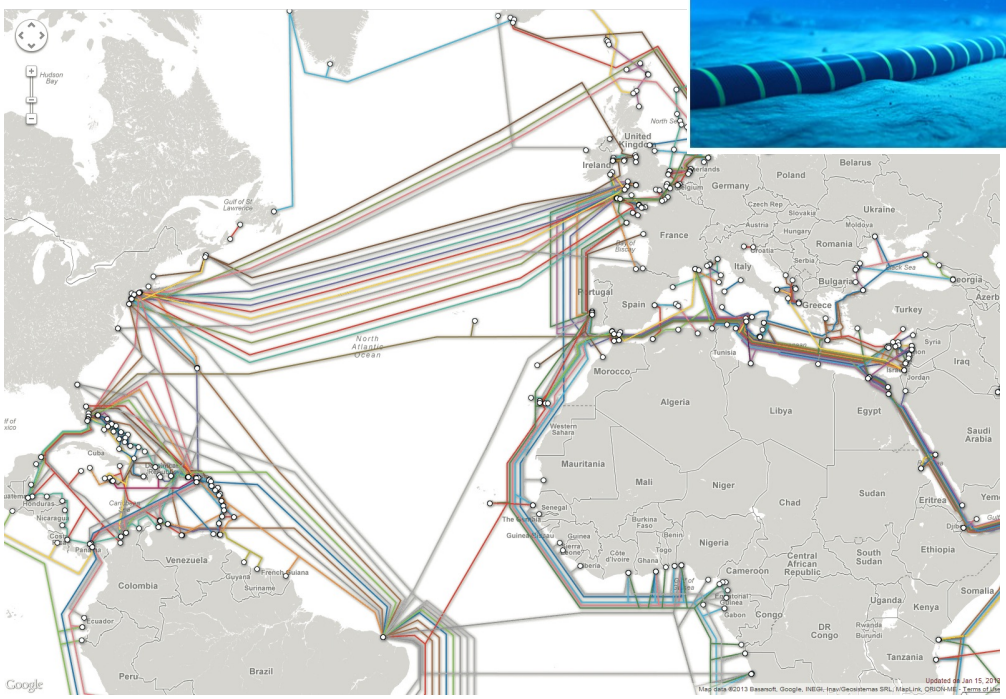
From the Local Provider to the Ocean's Edge –IXP and Data Centers



Where Is the Internet?

Across the Oceans

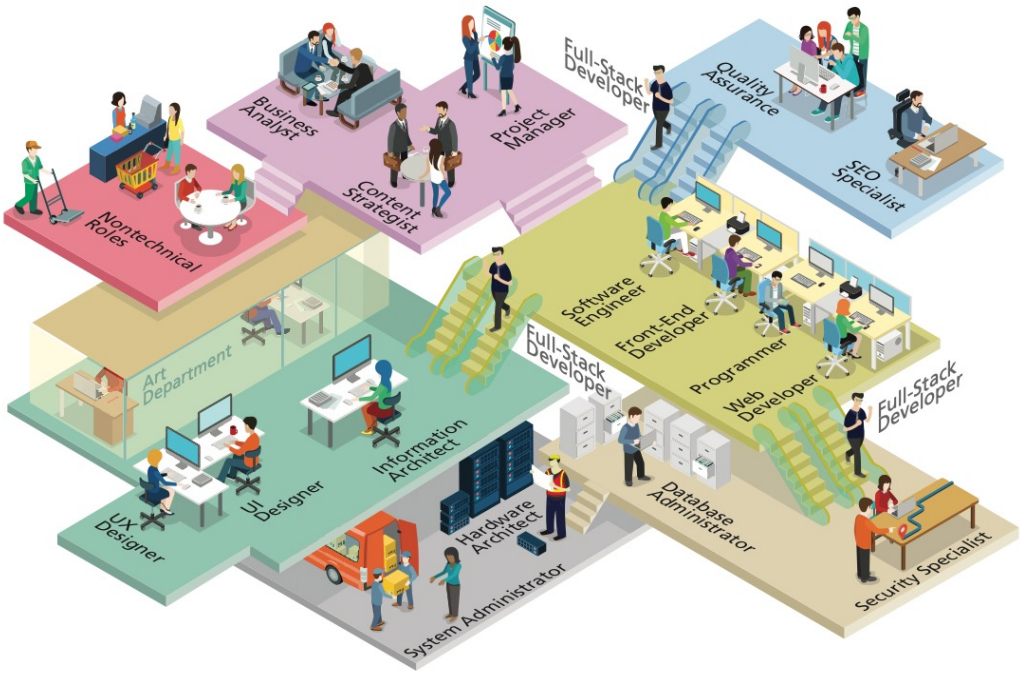




Web Development

Web Development Overview

Roles and Skills



Web Development Overview

Roles and Skills

- Hardware Architect/Network Architect/Systems Engineer
- System Administrator
- Database Administrator/Data Architect
- Security Specialist/Consultant/Expert
- Developer/Programmer
- Front-End Developer/UX Developer

Web Development Overview

Roles and Skills (II)

- Software Engineer
- UX Designer/UI Designer/Information Architect
- Tester/Quality Assurance
- SEO Specialist
- Content Strategists/Marketing Technologist
- Project Manager/Product Manager
- Business Analyst

Working in Web Development

Types of Web Development Companies

Internet Protocols

Internet Protocols

A Layered Architecture

TCP/IP.

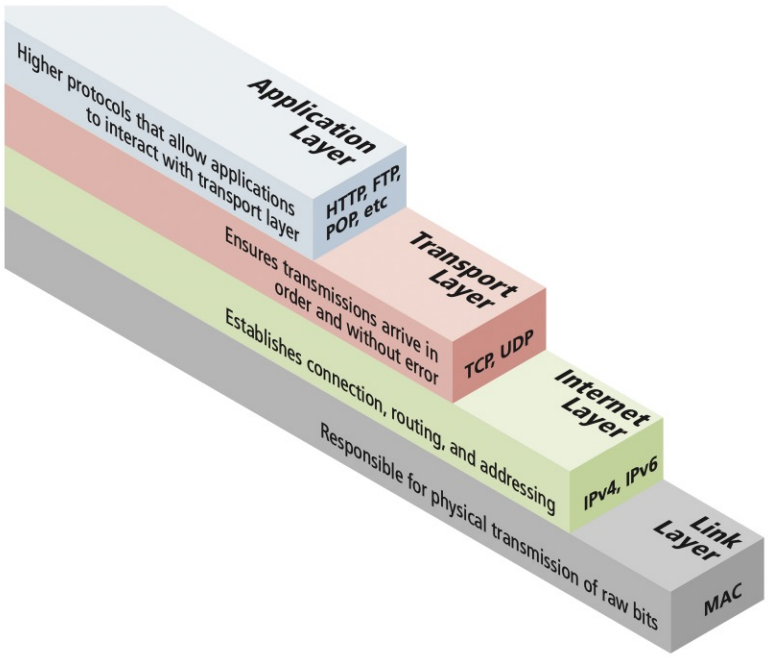
These protocols have been implemented in every operating system, and make fast web development possible.

Networking is it's own entire discipline.

Web developer needs general awareness of what the suite of Internet protocols does

Internet Protocols

A Layered Architecture



Internet Protocols

Link Layer

- Responsible for
  - physical transmission of data across media (both wired and wireless) and
  - Establishing logical links.

  It handles issues like packet creation, transmission, reception, error detection, collisions, line sharing, and more.

  Much more to learn in Networking courses outside of web development.

Internet Protocols

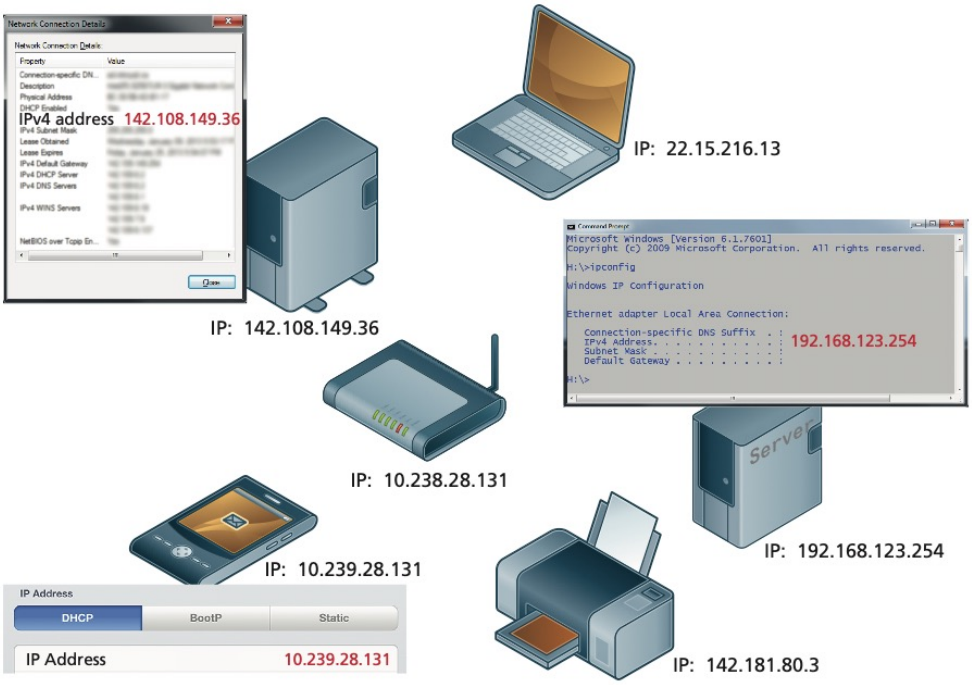
Internet Layer

The Internet layer provides “best effort” communication.

Makes use of IP addresses

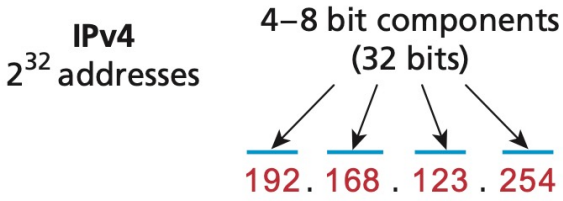
Internet Protocols

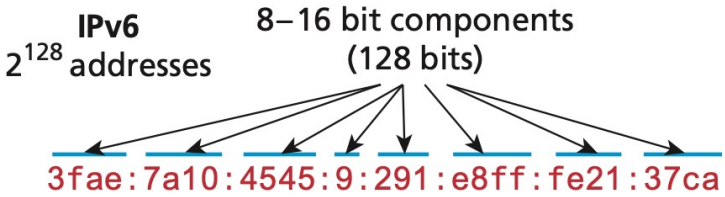
Internet Layer (IP)



Internet Protocols

IP addresses

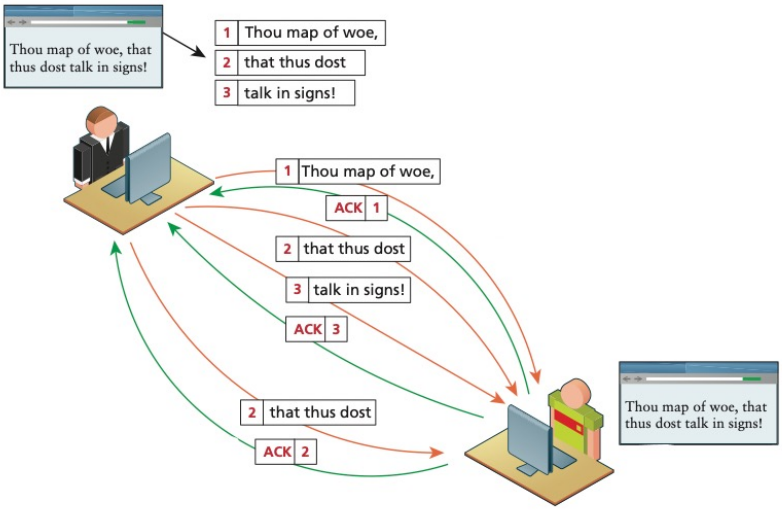




Internet Protocols

Transport Layer (TCP)

- Ensures transmissions arrive in order and without error



Internet Protocols

Application Layer

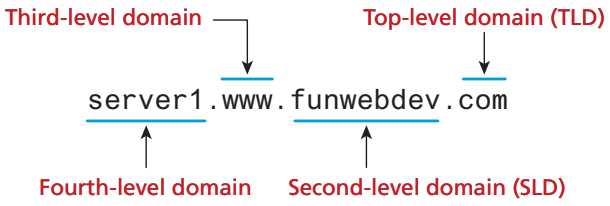
There are **many** application layer protocols. Web developers should be aware of :

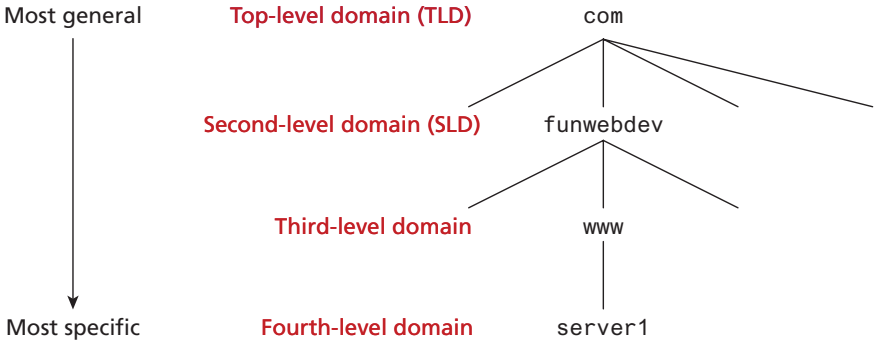
- **HTTP.**
- **SSH.**
- **FTP**.
- **POP/IMAP/SMTP**.
- **DNS**.

Domain Name System

Domain Name System

Name Levels





Domain Name System

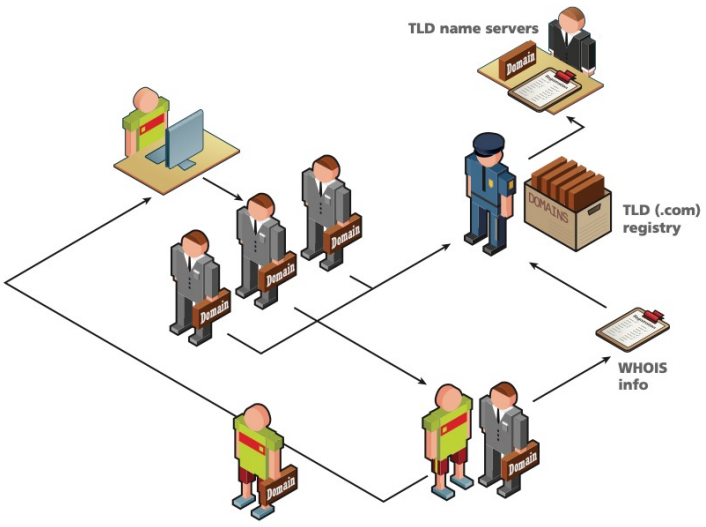
Types of Top Level Domains

- Generic top-level domain (gTLD)
  - Unrestricted. TLDs include .com, .net, .org, and .info.
  - Sponsored. TLDs including .gov, .mil, .edu, and others.
  - New TLDs.

- Country code top-level domain (ccTLD)
  - TLDs include .us , .ca , .uk , and .au.
  - Internationalized Domain Names

Domain Name System

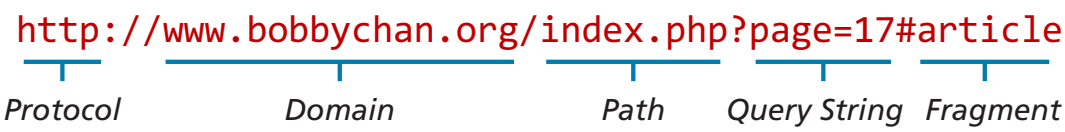
Name Registration



Uniform Resource Locators

Uniform Resource Locators

Overview



Uniform Resource Locators

Protocol

Recall that we listed several application layer protocols on the TCP/IP stack. FTP, SSH, HTTP, POP, IMAP, DNS, …

Requesting

- **ftp**://example.com/abc.txt → sends out an FTP request on port 21, while
- **http**://example.com/abc.txt → transmits an HTTP request on port 80.

Uniform Resource Locators

Domain

- The domain identifies the server from which we are requesting resources.
- Since the DNS system is case insensitive, this part of the URL is case insensitive.
- Alternatively, an IP address can be used for the domain

Uniform Resource Locators

Port

- The optional port attribute allows us to specify connections to ports other than the defaults

- Add a colon after the domain, then specify an integer port number.

Uniform Resource Locators

Path

Familiar concept to anyone who has ever used a computer file system.

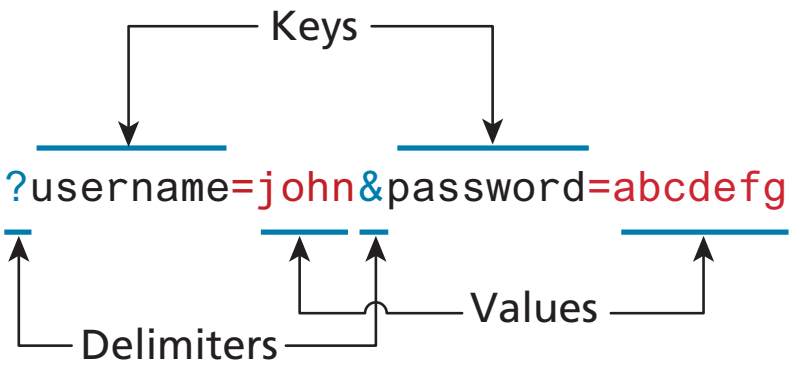
The root of a web server corresponds to a folder somewhere on that server.

- On many Linux servers that path is /var/www/html/
- On Windows IIS machines it is often /inetpub/wwwroot/

The path is optional. However, when requesting a folder or the top-level page, the web server will decide which file to send you.

Uniform Resource Locators

Query String



Uniform Resource Locators

Fragment

A way of requesting a portion of a page.

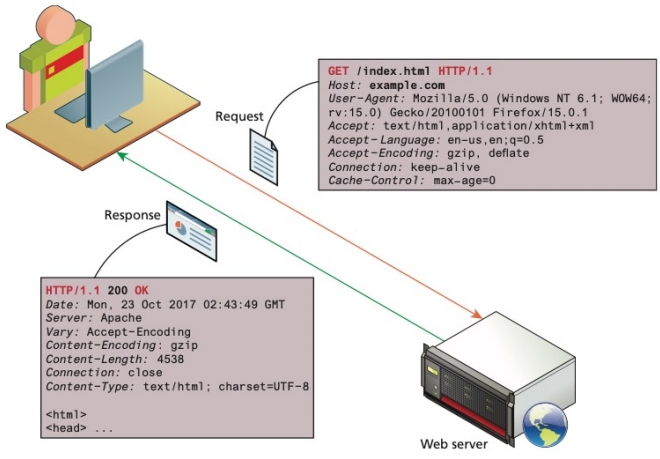
- Browsers will see the fragment in the URL, seek out the tag anchor in the HTML, and scroll the website to it.

Hypertext Transfer Protocol

Hypertext Transfer Protocol

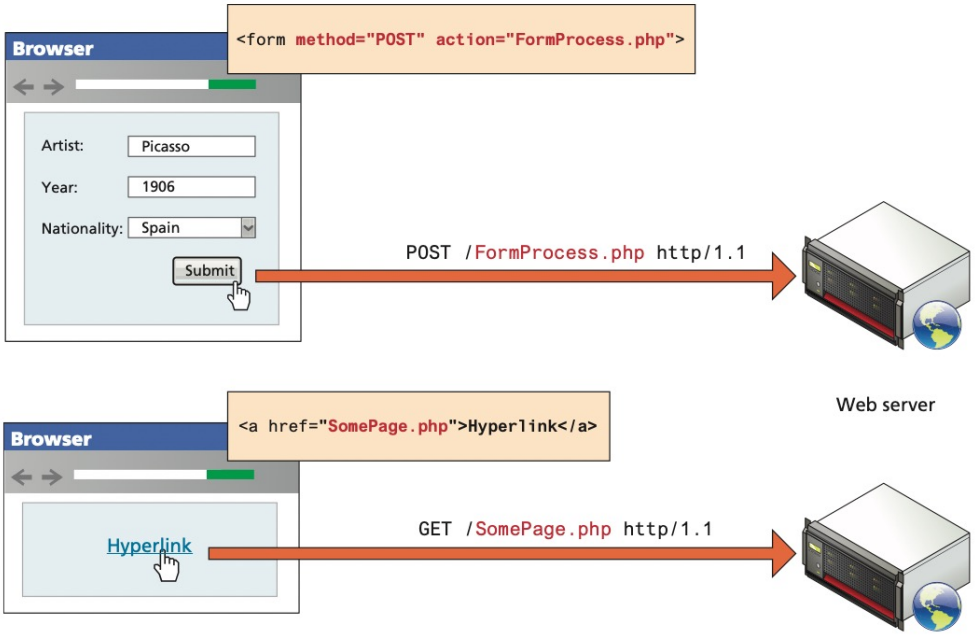
Headers

- **Request headers** include data about the client machine.
- **Response headers** have information about the server answering the request and the data being sent



Hypertext Transfer Protocol

Request Methods



Hypertext Transfer Protocol

Response Codes

- 2## codes are for successful responses,
- 3## are for redirection-related responses,
- 4## codes are **client** errors,
- 5## codes are **server** errors.

Hypertext Transfer Protocol

(Some) Response Codes

200: OK

301: Moved Permanently

304: Not Modified

307: Temporary redirect

400: Bad Request

401: Unauthorized

404: Not found

414: Request URI too long

500: Internal server error