

The Internet and The Web

**Client Side
Web Application Development**
George Corser, PhD

Once Upon a Time...

People wanted **access to documents**...

...**remotely from anywhere** (so they invented network communications)

...**without depending on a specific network** (so they invented the Internet)

...**with hyperlinks to other documents** (so they invented the Web)



Agenda

The Internet

- Dumb terminals
- Client server model
- What is the Internet?
- What is a network?
- What is a protocol?
- What are routers?
- What is traceroute?
- What is the End-to-end Principle?
- What is a packet?
- What about my home network?

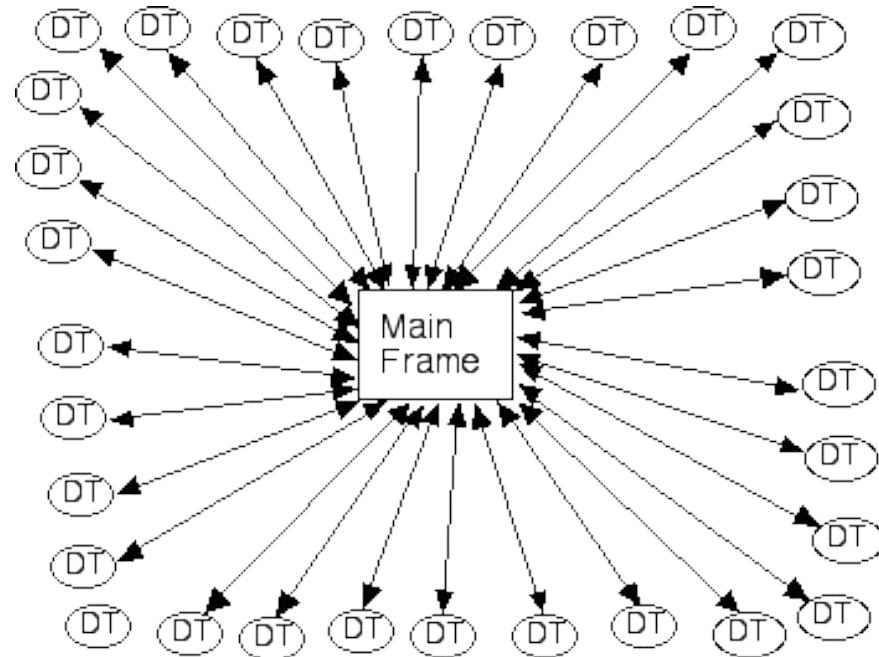
The Web

- What is the Web?
- What is a browser?
- What is a website?
- The Web is a subset of the Internet
- What is HTTP?
- What is the DOM?

Quiz Questions

The Internet

Dumb Terminals



If the central CPU goes down,
everything goes down

Client Server Model

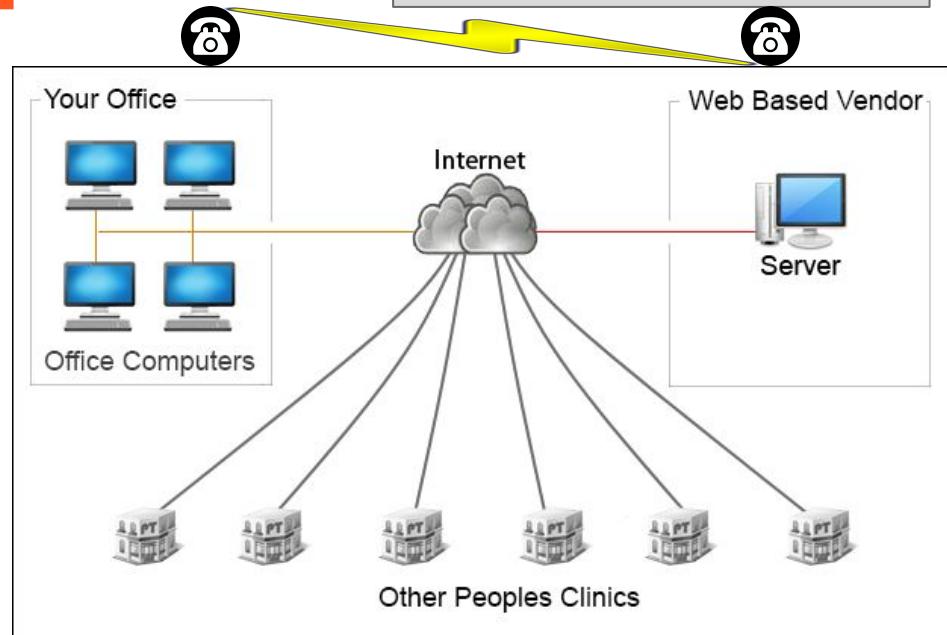
In client server model, clients are not “dumb”

Servers are usually modern computers, but not always, because servers can host “legacy” systems, enabling web access through a terminal emulator

It is even possible to use a terminal via telephone dial-up communications (gasp!)

The bottleneck today is network, not CPU

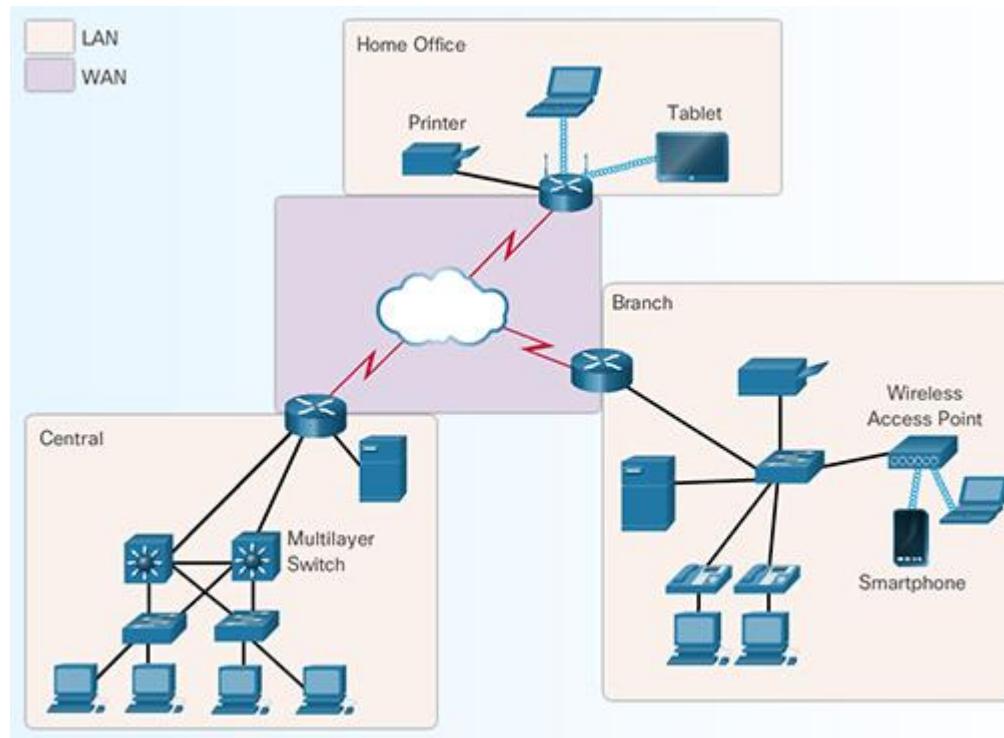
If the central CPU goes down,
local PC's stay up



<http://a2cmedical.com/web-vs-internet.html>

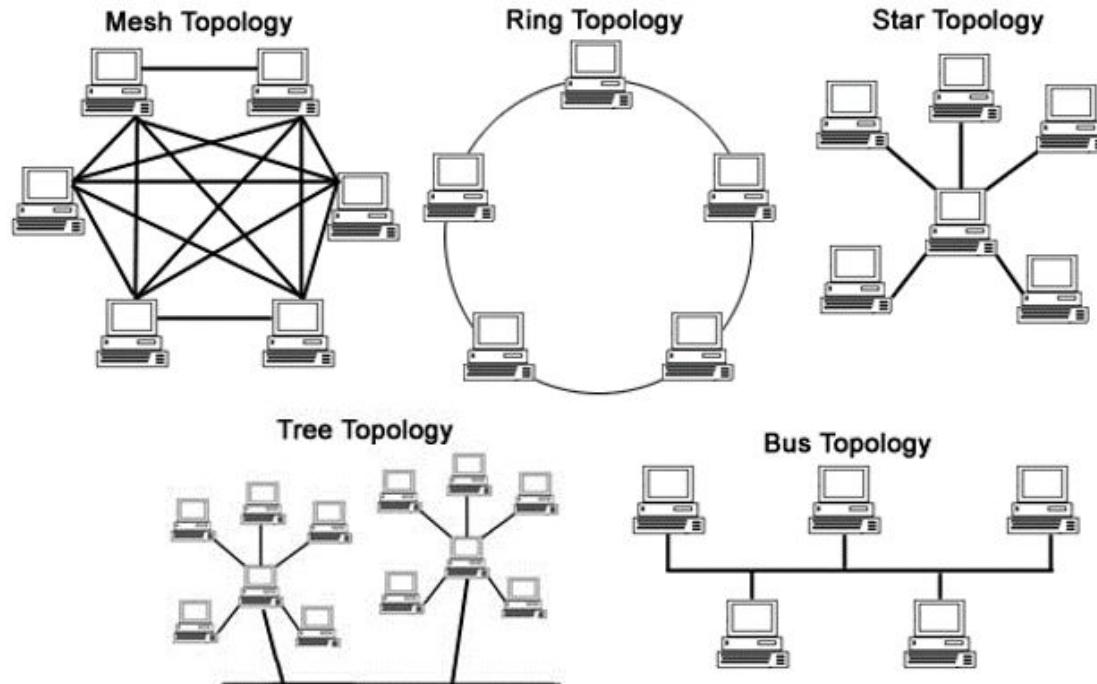
What is the Internet?

- “The” Internet is a **network of networks** that uses a common **protocol** for relaying packets



What is a Network?

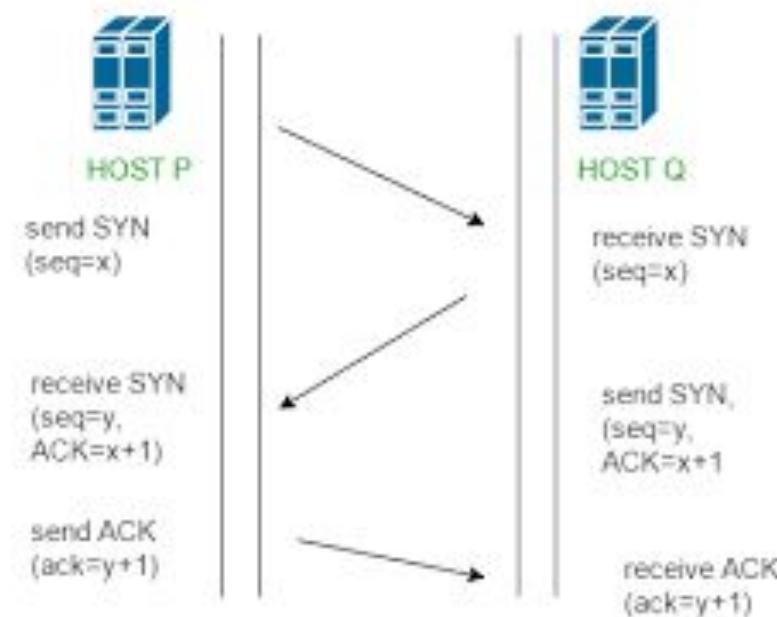
A **network** is a set of computers that can communicate, i.e. can transfer data between one another



What is a Protocol?

A communication **protocol** is a system of rules that allow two or more entities of a communications system to transmit information via any kind of variation of a physical quantity. The protocol defines the rules, syntax, semantics and synchronization of communication and possible error recovery methods. Protocols may be implemented by hardware, software, or a combination of both.

The Internet uses IP, or “Internet Protocol”



Protocol: Examples

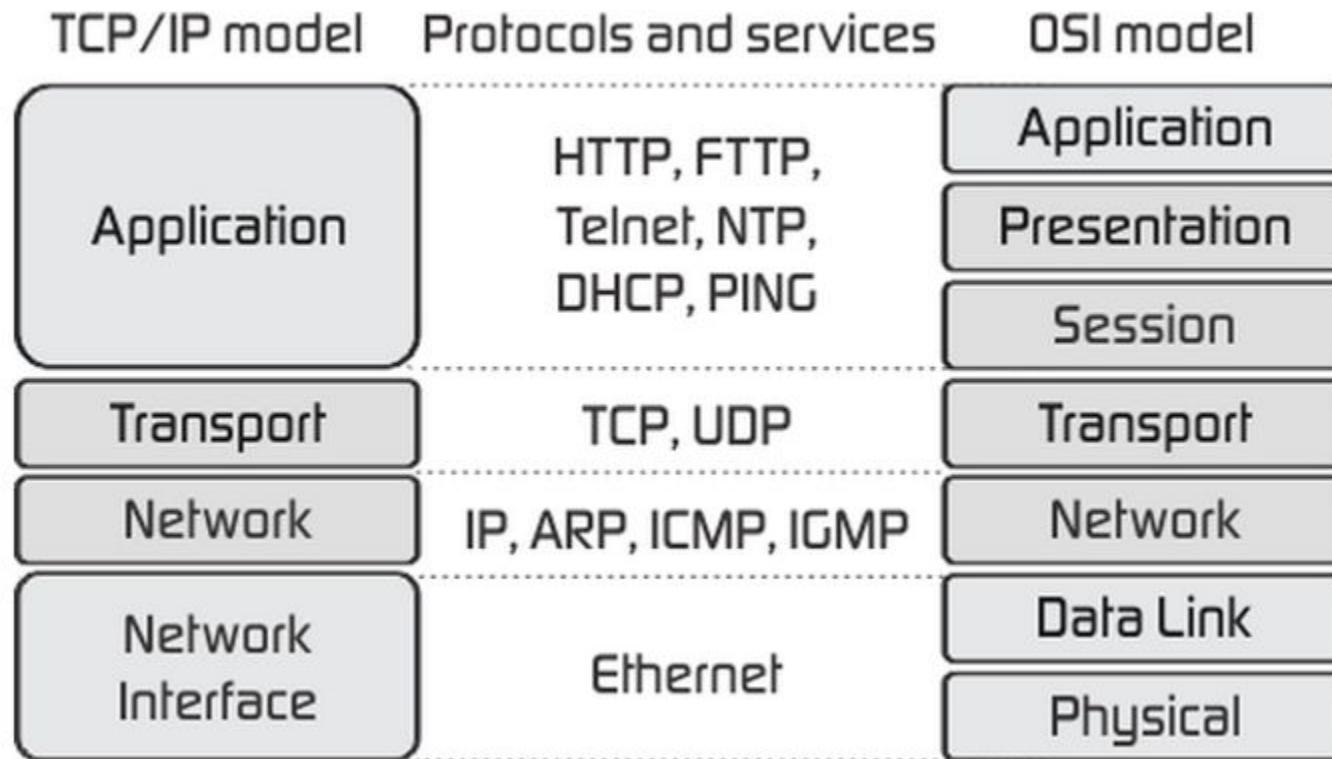
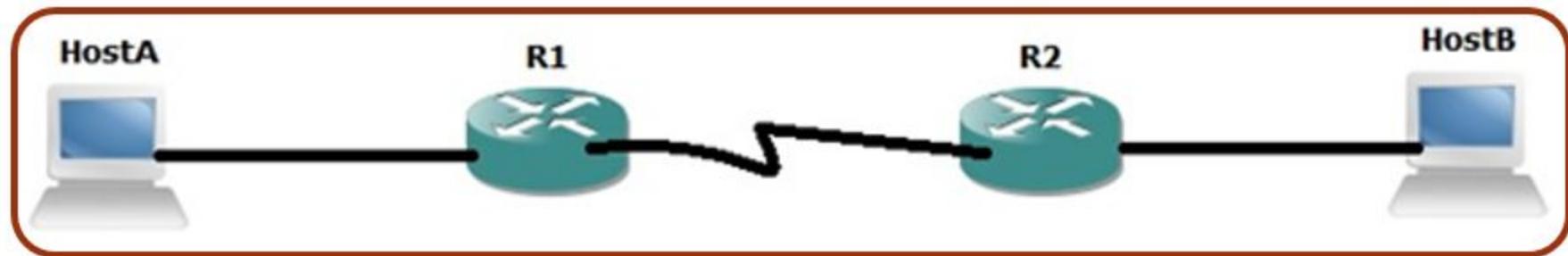


Image source: <https://medium.com/@sheffmachine/http-2-16ca9ef1215b>

What are Routers?

Routers are devices that relay data **packets**.
Internetworking is accomplished using routers.



What is traceroute?

You can use <https://whatismyipaddress.com/traceroute-tool> to find the relay route/path from one host to another

Hop	Time	Host	IP	Location
3	1.483	gateway.whatismyipaddress.com	66.171.248.161	Newport Beach, California, United States
4	0.536	66-171-255-233.alchemy.net	66.171.255.233	Trabuco Canyon, California, United States
5	1.925	66.186.30.201	66.186.30.201	Tarzana, California, United States
6	1.859	las-b24-link.telia.net	213.248.97.24	
7	32.834	dls-b22-link.telia.net	62.115.118.246	
8	43.364	kanc-b1-link.telia.net	62.115.125.158	
9	55.609	chi-b21-link.telia.net	213.155.130.176	
10	62.013	cco-ic-301244-chi-b21.c.telia.net	62.115.14.42	
17	66.722	71-89-159-170.static.aldl.mi.charter.com	71.89.159.170	United States
20	68.048	lan3-49.svsu.edu	155.138.3.49	Bay City, Michigan, United States
21	N/A	155.138.10.4	155.138.10.4	Bay City, Michigan, United States

Me!

What is the End-to-end Principle?

- [Internet Protocol](#) (IP) is a connectionless [datagram](#) service with no delivery guarantees.
- On the internet IP is used for nearly all communications.
- End-to-end acknowledgment and retransmission is the responsibility of the connection-oriented [Transmission Control Protocol](#) (TCP) which sits on top of IP.
- The functional split between IP and TCP exemplifies proper application of the end-to-end principle to transport protocol design.
- Source: [Wikipedia](#)

What is a Packet?

A **packet** is a unit of data, sometimes called a **datagram**, segment or frame. Examples:

- HTTP datagram
- TCP segment
- IP packet
- Ethernet frame
- Physical bits

FIGURE 1.29 PDU and layer addressing

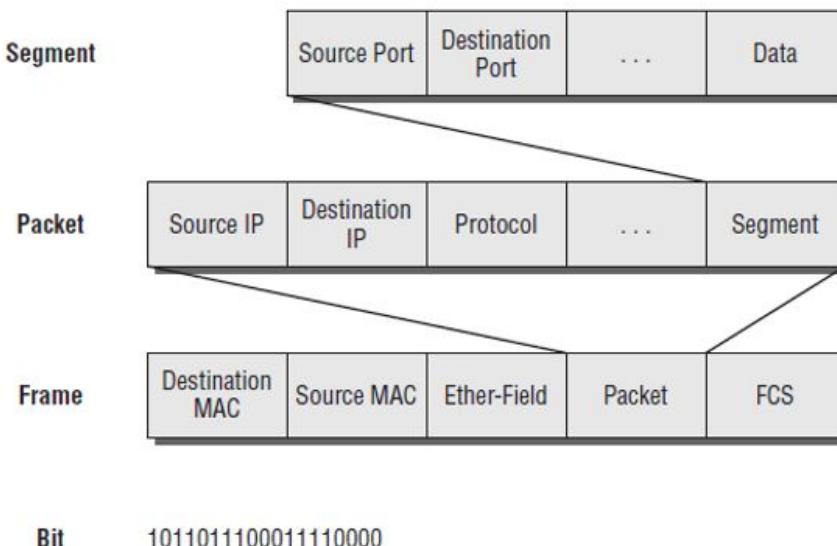
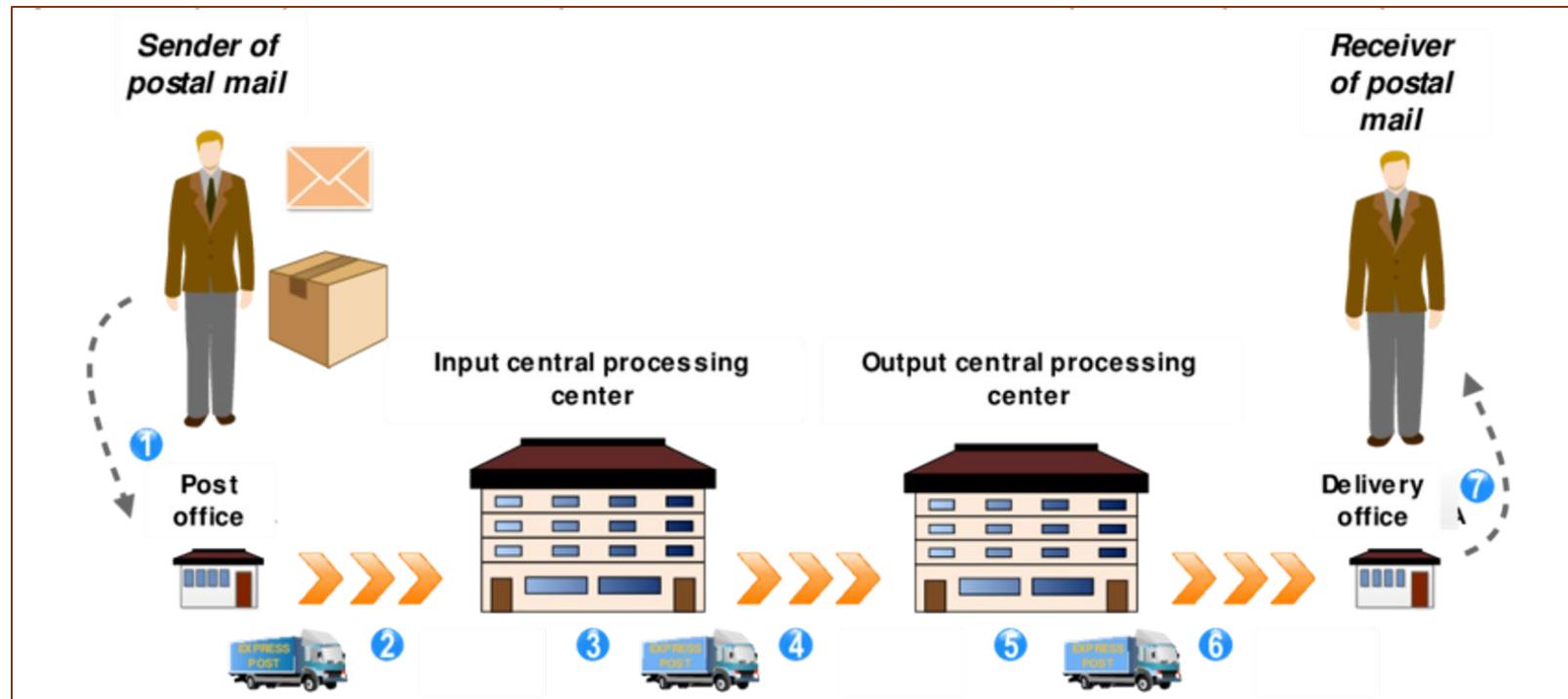


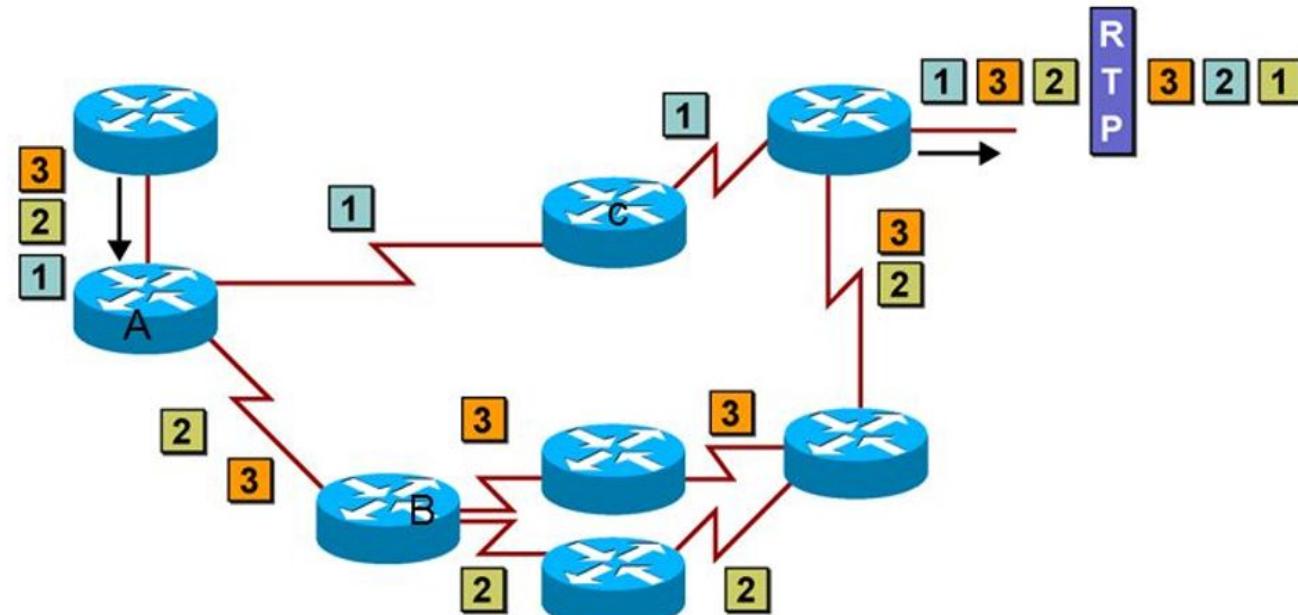
Image source: CCNA Study Guide (Sixth Edition)

packets: analogous to postal mail



Packet contents: ignored by routers

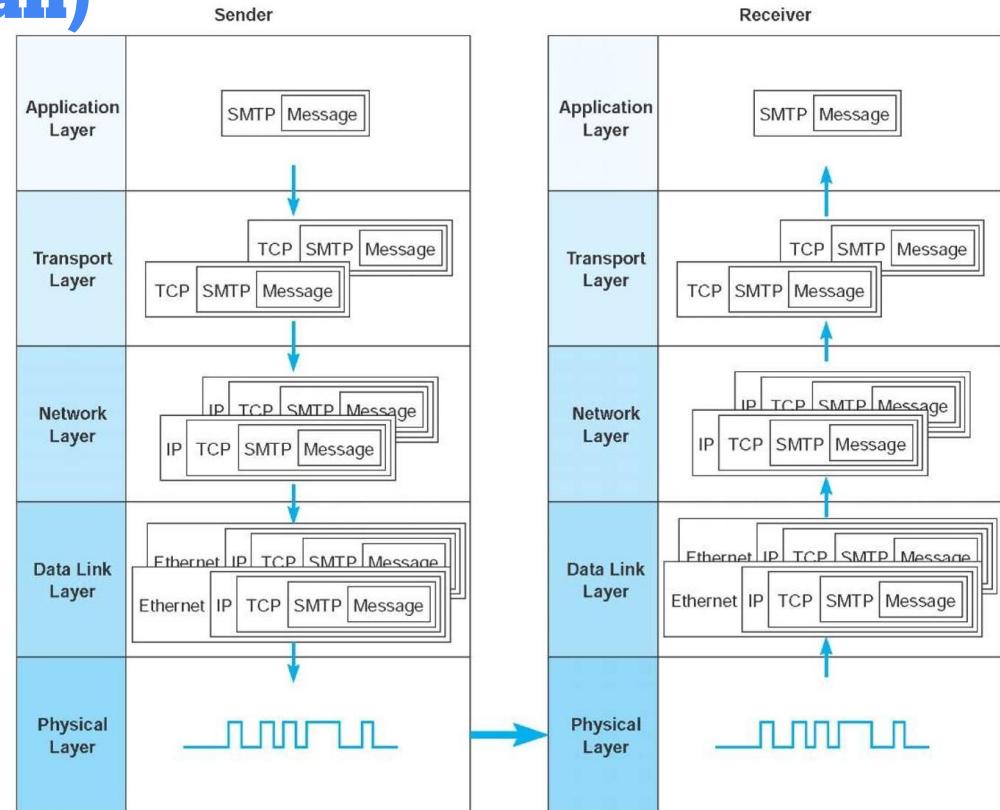
Packets arrive out of order. It's up to the receiving computer to reassemble.



Packets: example (email)

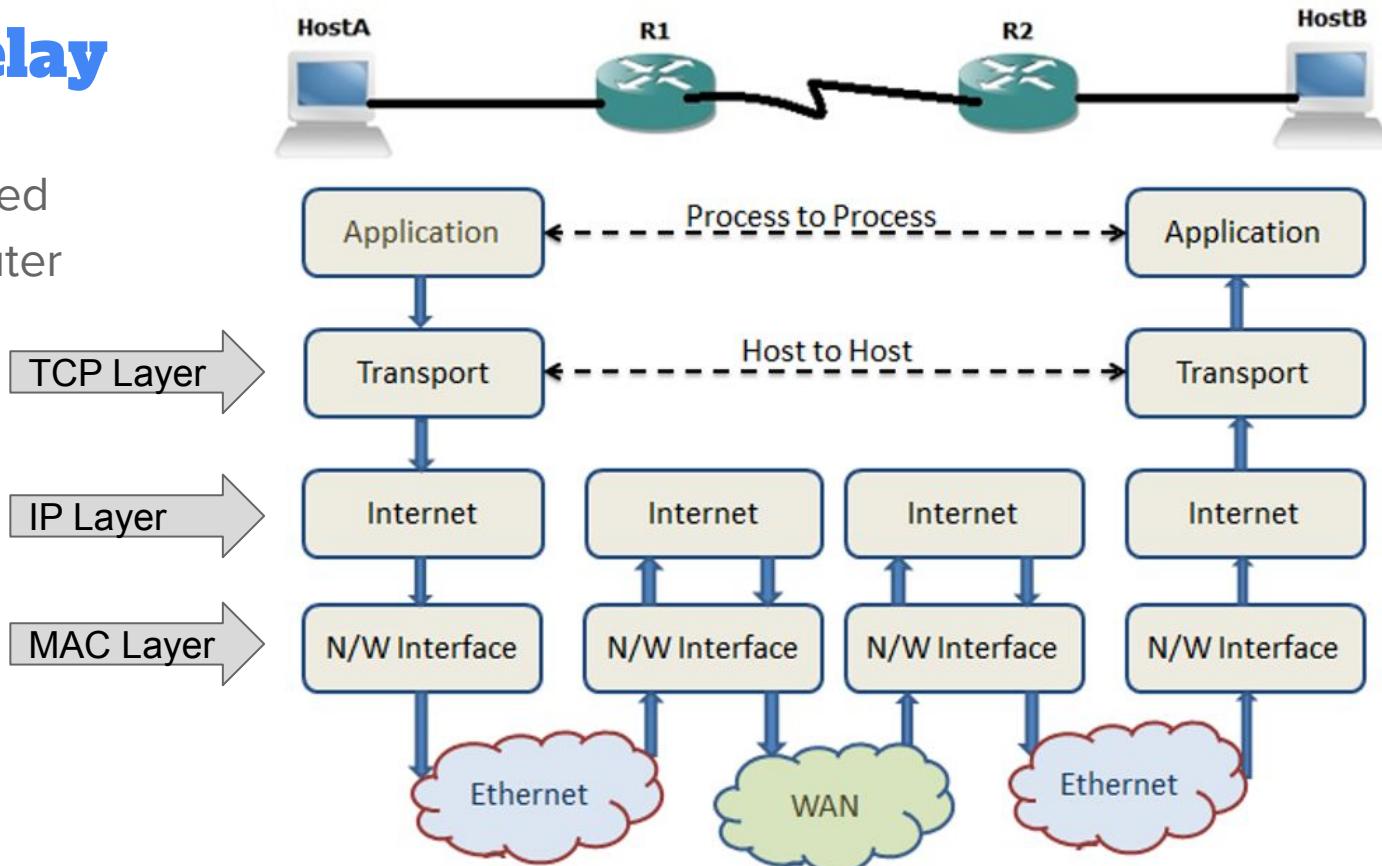
Email flows through the Internet the way postal mail flows through the postal network. (Kind of.)

This diagram illustrates the concept of encapsulation.



Packets: relay

Packets get relayed from router to router



What about my home network?

Ever more home devices connect to the Internet

You probably have a router!

Image source:

<https://setupideas.info/wp-content/uploads/2018/08/computer-desktop-diagram-computer-desktop-diagram-network-diagram-wireless-network-wireless-router-network-diagram.jpg>



The Web

What is the Web?

“The World Wide Web (WWW), commonly known as the Web, is an information system where **documents** and other web resources are identified by Uniform Resource Locators (URLs, such as <https://www.example.com/>), which may be **interlinked by hypertext**, and are accessible over the Internet.”

“The resources of the WWW may be accessed by users by a software application called a **web browser**. ”

Source: Wikipedia

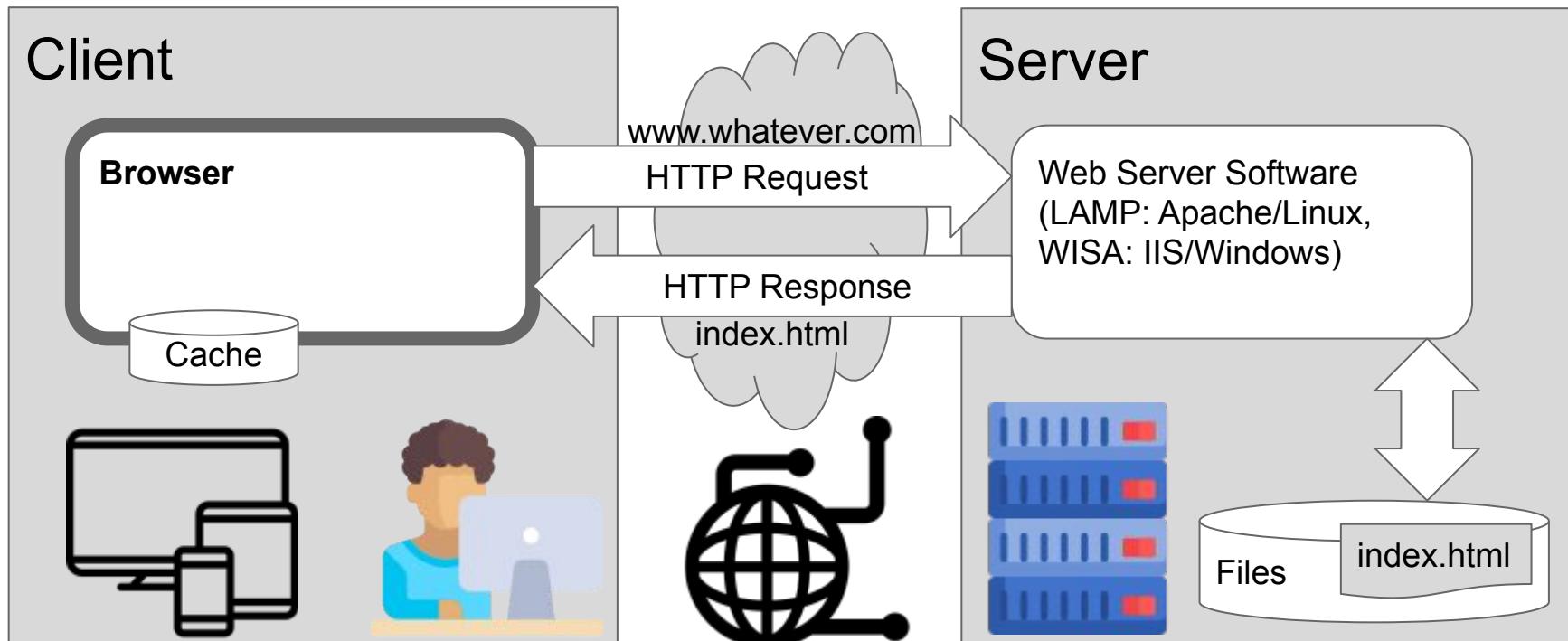
What is a Browser?

“A web browser (commonly referred to as a browser) is a **software application** for accessing information on the World Wide Web. Each individual web page, image, and video is identified by a distinct Uniform Resource Locator (URL), enabling browsers to retrieve these resources from a web server and display them on the user's device.”

“A web browser is not the same thing as a **search engine**, though the two are often confused.”

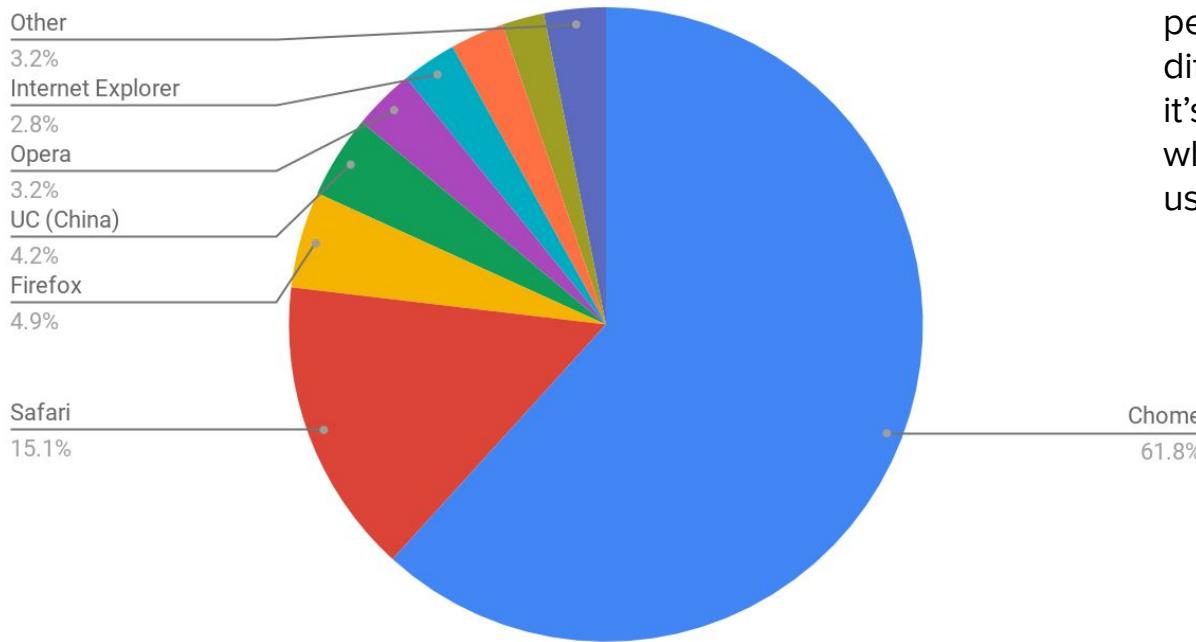
Source: Wikipedia

Browser in Client Server Model



Most popular browsers, 2019

Usage share of web browsers (2019)



Web applications may perform differently on different browsers, so it's important to know which browser(s) your users will be using.

What is a Website?

a collection of files

Web Application

The screenshot shows a web application titled "Welcome, Jan Schneider". The left sidebar contains links for Horde, Organizing, Address Book, New Contact, My Address Book, Search, Calendar, Taxes, New Event, Day, Work Week, Week, Month, Year, Notes, Tasks, Administration, Options, Global Options, and Address Book. The main content area has several sections:

- August, 2006**: A calendar showing events for the month. Notable entries include "Taxes" on August 1st, "Staff meeting" on August 12th, and "Mom's birthday" on August 26th.
- Tasks**: A list of tasks categorized by type (Consulting, Personal, Unfiled, Consulting) and priority (High, Medium, Low). Examples include "GIS: extra script", "Proposal phpworks", and "Install Horde".
- Notes**: A list of notes categorized by type (Consulting, Personal, Unfiled, Consulting, Privat). Examples include "Angebot tip-all de Redesign" and "Gebühren".
- Weather Forecast**: Displays current weather in Boston, MA, with a 2-day forecast for Tuesday and Wednesday.
- Current Time**: Shows the current time as Tuesday, August 08, 2006 22:44.
- Sunrise/Sunset**: Displays sunrise and sunset times for Boston, Logan International Airport, MA.

Web apps are “dynamic” (not the same info every time clicked) and user-specific (often allowing users to enter data, like a “regular” application)

Website

The screenshot shows a website homepage with a green gradient background. At the top, there is a navigation bar with links for Logo, Home, About, Products, Services, and a search bar. The main content area features a large banner with the text "Efficiently Unleash" and "Dramatically maintain clicks-and-mortar solutions without functional solutions." Below the banner is a "Unleash Now" button. The page also includes a section titled "Superior Collaboration Visualize Quality" with a sub-section about proactively envisioning multimedia based expertise and cross-media growth strategies.

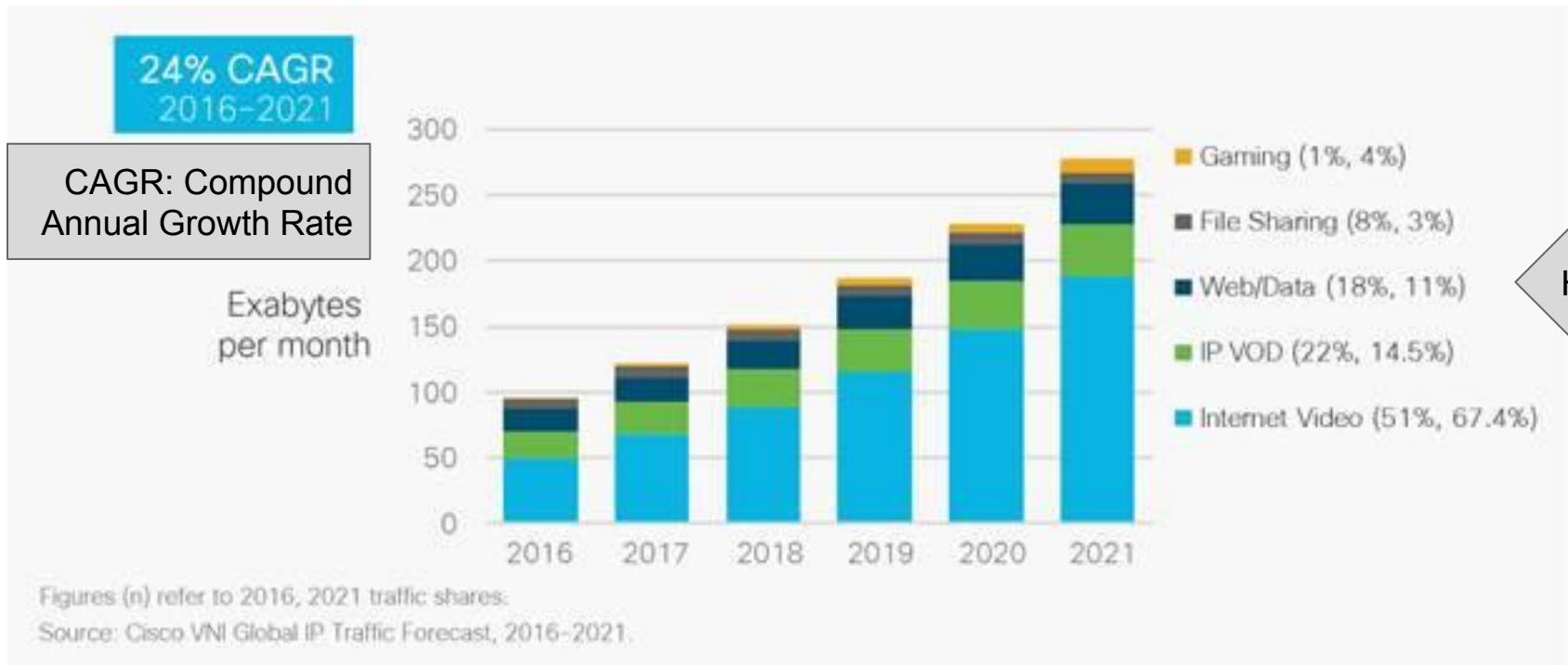
Web sites are “static” and/or display the same data for no matter which user clicks

Most popular websites*, 2019

* mostly web applications

- | | | |
|--------------------|---------------------------|-------------------------|
| 1. google.com | 17. xhamster.com | 33. imdb.com |
| 2. youtube.com | 18. netflix.com | 34. duckduckgo.com |
| 3. facebook.com | 19. ampproject.org | 35. accuweather.com |
| 4. amazon.com | 20. chase.com | 36. imgur.com |
| 5. yahoo.com | 21. walmart.com | 37. wellsfargo.com |
| 6. pornhub.com | 22. pinterest.com | 38. xfinity.com |
| 7. xnxx.com | 23. linkedin.com | 39. yelp.com |
| 8. xvideos.com | 24. office.com | 40. intuit.com |
| 9. ebay.com | 25. zillow.com | 41. fandom.com |
| 10. twitter.com | 26. paypal.com | 42. bankofamerica.com |
| 11. wikipedia.org | 27. espn.com | 43. youporn.com |
| 12. instagram.com | 28. chaturbate.com | 44. dailymail.co.uk |
| 13. reddit.com | 29. foxnews.com | 45. drudgereport.com |
| 14. craigslist.org | 30. msn.com | 46. microsoftonline.com |
| 15. bing.com | 31. cnn.com | 47. twitch.tv |
| 16. live.com | 32. indeed.com | 48. news.google.com |

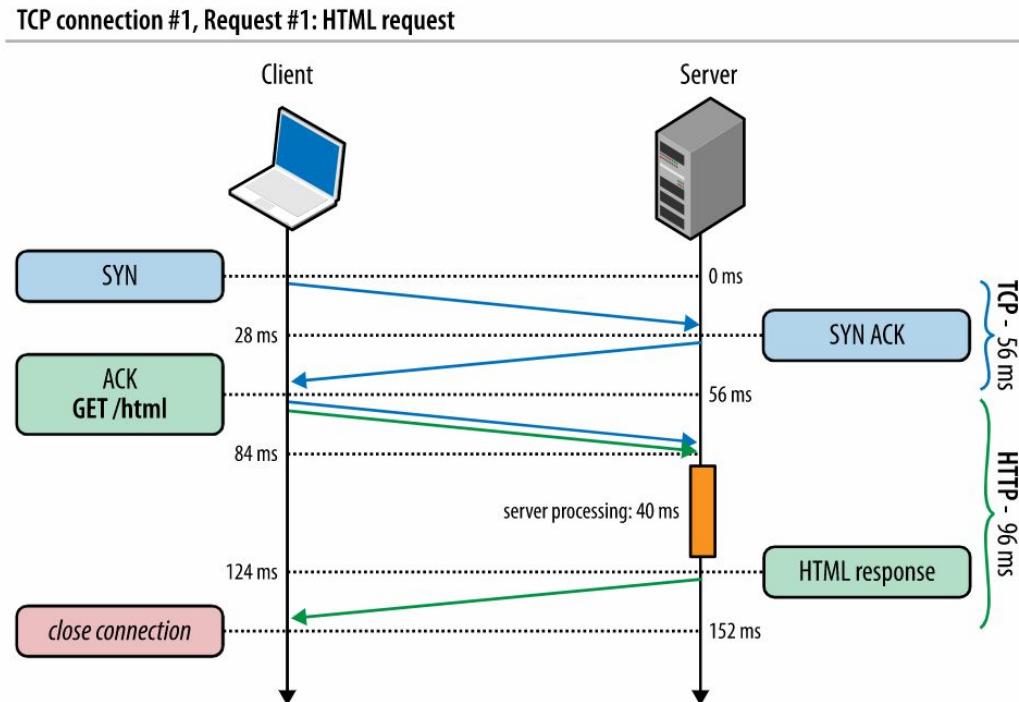
The Web is a subset of the Internet



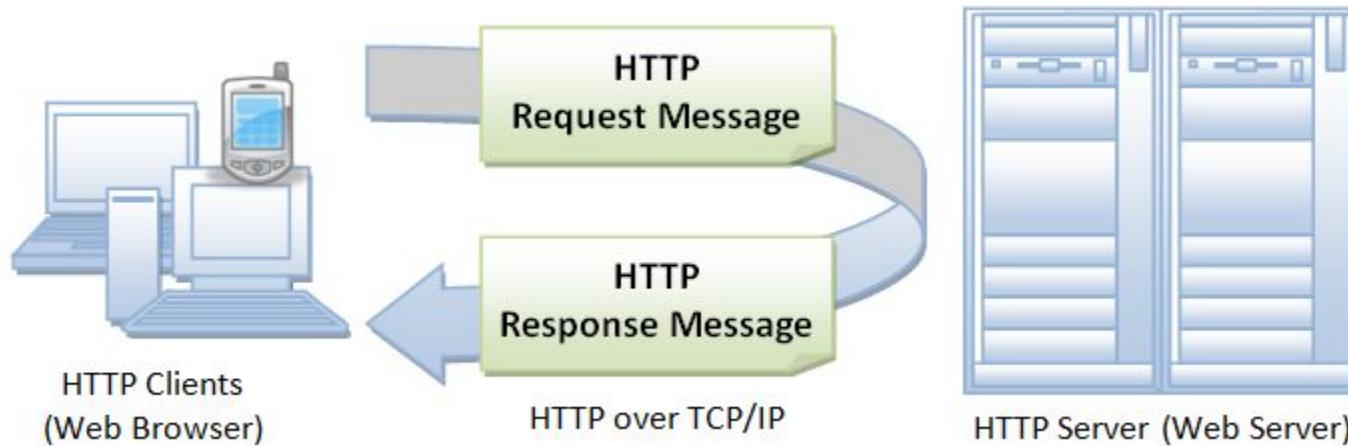
What is HTTP?

Hypertext Transfer Protocol

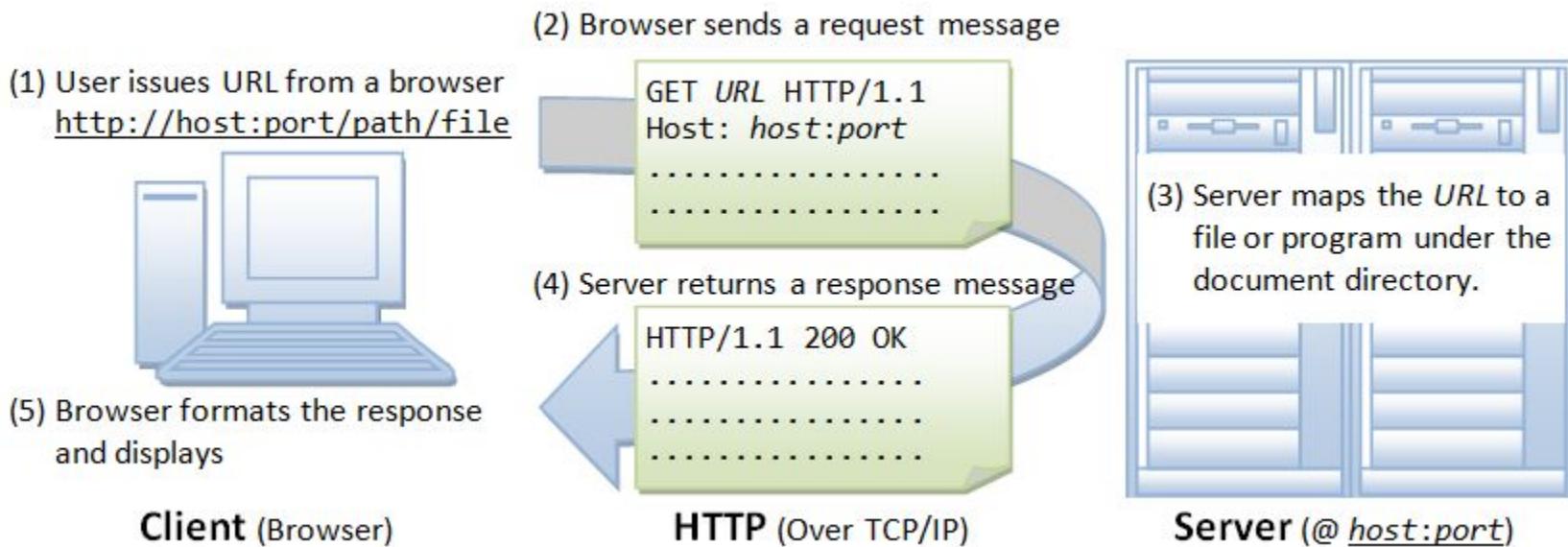
HTTP specifies how computers perform web requests and responses.



HTTP Request-Response (Simple)

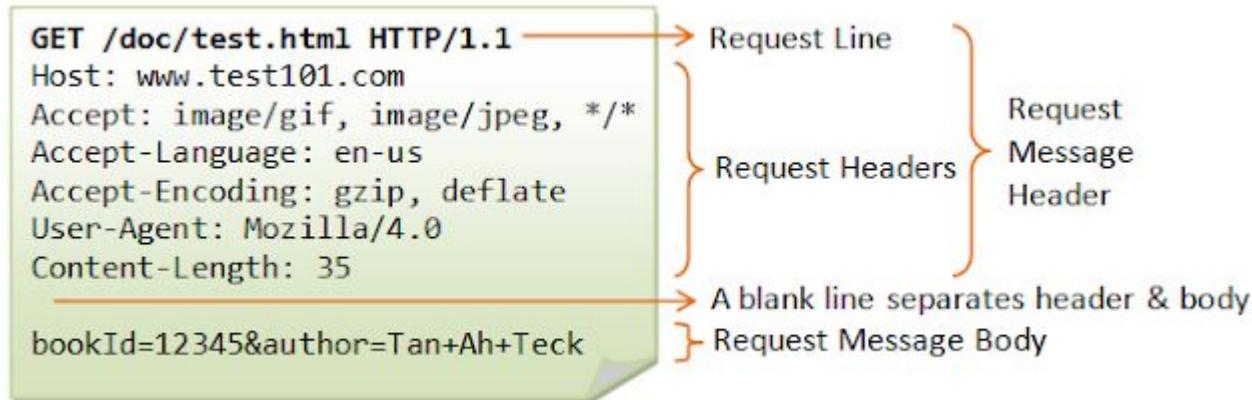


HTTP Request-Response (Detail)



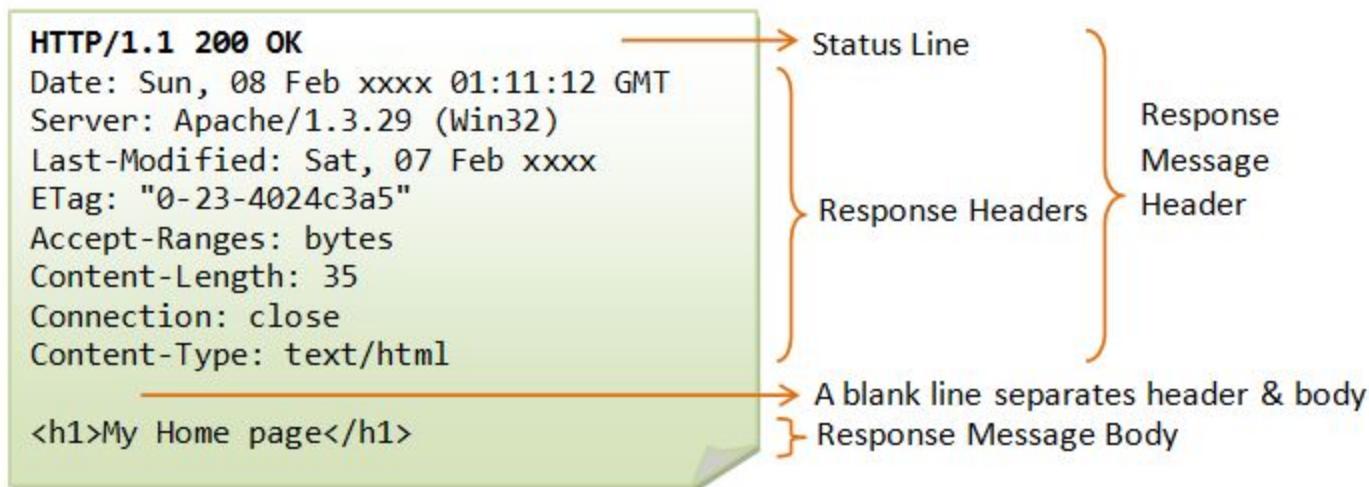
HTTP Request

- The first part of the HTTP Request message is the Request Line or Start Line that consists of the http method (GET in our case), the URI path /doc/test.html , and the version of the HTTP protocol of the client.



HTTP Response

- The first part of the Response message is the Status/Response Line that consists of the http version and the status code.



HTTP Headers in Chrome DevTools

The screenshot shows the Chrome DevTools Network tab. A request for `photo.jpg` is selected in the list. The Headers tab is active, displaying the following details:

- Request URL:** `https://lh3.googleusercontent.com/-HUKV91BSFWU/AAAAAAIAAAA/AAAAAAAAAAAA/APUIFaMwLqpqPenCvAZKaXD8-AuYb1lsyg/s64-c-m/photo.jpg`
- Request Method:** `GET`
- Status Code:** `200 (from ServiceWorker)`
- Remote Address:** `172.217.8.4:443`
- Referrer Policy:** `strict-origin`

Below the Headers section, the Response Headers are listed:

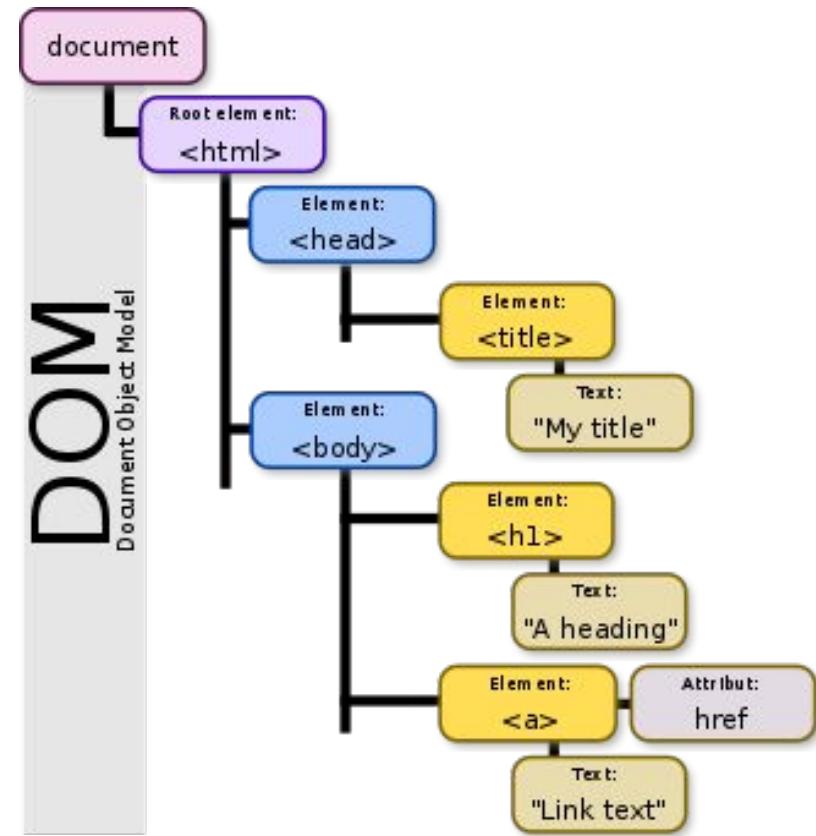
- `access-control-allow-credentials: true`
- `access-control-allow-origin: *`
- `access-control-expose-headers: Content-Length`

In Chrome

- Right-click
- click: inspect
- click: **Network**

What is the DOM?

“The web browser works as follows. First, the rendering engine parses CSS and HTML files. While parsing the HTML file, the rendering engine also produces **DOM tree** data construct where every node refers to an HTML tag, a property or a section of a text. CSS decides the visual style of the webpage based on the style rules, each of which selects single/multiple HTML tags for applying the properties.”



DOM in Chrome DevTools

The screenshot shows the Google homepage with a doodle for "National Doodle Day". The page includes links for "Gmail", "Images", and a user profile. The DevTools sidebar on the left lists "In Chrome" with three bullet points: "Right-click", "click: inspect", and "click: Elements". The main content area displays the Google logo and search bar. The DevTools interface on the right shows the "Elements" tab selected, displaying the DOM tree for the page. The tree starts with the root `<!doctype html>` and includes elements like the head, body, and various divs for the logo and search functionality. The "Styles" tab is active in the bottom navigation, showing CSS rules for the logo and doodle elements. A detailed element inspector on the right side highlights the "logo-default" element, showing its bounding box dimensions of 980 x 226.667 pixels. The page header indicates a responsive view with dimensions 714 x 443 at 100% scale and no throttling.

Responsive ▾ 714 x 443 100% ▾ No throttling ▾

Gmail Images

In Chrome

- Right-click
- click: inspect
- click: Elements

Google Images

Customize

Margin -
border -
padding -
980 x 226.667

35

Quiz Questions

Quiz Questions

1. What is the Internet?
2. What is the Web?
3. Which of the following statements is TRUE?
4. Essay: Do you support net neutrality?

Quiz Question #01

What is the Internet?

- a. A network of networks
 - b. An information system of documents interlinked by hypertext
 - c. A protocol
 - d. The DOM
 - e. A search engine
 - f. Connections between routers
 - g. A browser
 - h. A website
 - i. The Web
- a. **A network of networks**

Quiz Question #02

What is the Web?

- a. A network of networks
- b. An information system of documents interlinked by hypertext
- c. A protocol
- d. The DOM
- e. A search engine
- f. Connections between routers
- g. A browser
- h. A website
- i. The Internet

Quiz Question #03

Which of the following statements is TRUE?

- a. Routers ensure packets are transmitted in sequence order
 - b. Chrome DevTools can display HTTP headers, but not the DOM tree
 - c. Chrome DevTools can display the DOM tree, but not HTTP headers
 - d. The HTTP Request-Response loop represents a model for communication between a user and a browser
 - e. Chrome may be the most popular browser, but Firefox is the best
 - f. The Internet is a superset of the Web
- f. The Internet is a superset of the Web

Quiz Question #04 - Essay / Discussion

“**Network neutrality**, or simply **net neutrality**, is the principle that Internet service providers (ISPs) must treat all Internetcommunications equally, and not discriminate or charge differently based on user, content, website, platform, application, type of equipment, or method of communication.”

“With net neutrality, ISPs may not intentionally block, slow down, or charge money for specific online content. Without net neutrality, ISPs may prioritize certain types of traffic, meter others, or potentially block traffic from specific services, while charging consumers for various tiers of service.”

Source: https://en.wikipedia.org/wiki/Net_neutrality

Quiz Question #04 - Essay / Discussion (continued)

What are the pros
and cons of **net
neutrality**?

Why is the issue
controversial?

If implemented,
who gains, and
who loses?



The End