Introduction to Internet Software Development

Abdulla Ebrahim Subah

University of Bahrain

September 7, 2024

Logistics

- Course website: https://itcs333.github.io
- We will use it for:
  - Slides
  - Notes
  - Course Outline
  - etc.
- I will not upload material to teams / blackboard
- Teams will be used for announcements / questions
- Blackboard will be used for assignments and grades

Overview

- A brief history of the Internet and the Web
- What happens when you enter a URL into a browser?

Early Days

- **1960s**: The birth of the Internet
  - ARPANET: The first packet-switching network
  - Funded by the U.S. Department of Defense
  - Aimed to create a network that could survive partial outages
- **1970s**: Development of TCP/IP
  - Transmission Control Protocol (TCP) and Internet Protocol (IP)
  - Foundation of modern networking

Figure 1: World First Router. By Steve Jurvetson. (Source)

The Birth of the Web

- **1989**: Tim Berners-Lee invents the World Wide Web
  - Proposed a system for sharing information using hypertext
  - Introduced three key technologies:
    1. **HTML**: Hypertext Markup Language (Document structure)
    2. **URI**: Uniform Resource Identifier (Addressing)
    3. **HTTP**: Hypertext Transfer Protocol (Communication)

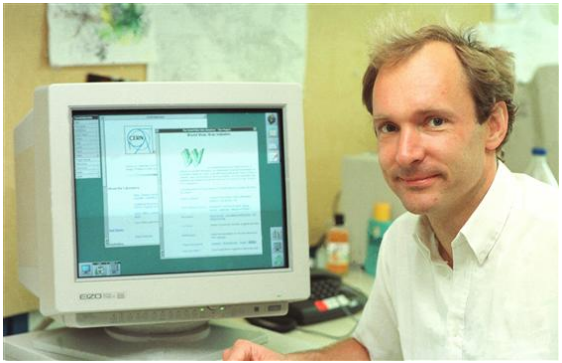


Figure 2: Tim Berners-Lee, World Wide Web inventor. (Source)

The First Website

- **1991**: The first website goes live at CERN
  - Link to the first website
  - line-mode browser

The Web's Evolution

- **1990s**: The Web goes mainstream
  - Birth of **Mosaic**, the first popular web browser
  - Rise of companies like **Netscape** and **Yahoo!**
- **2000s**: Web 2.0 and interactivity
  - User-generated content (e.g., blogs, social media)
  - **AJAX**: Asynchronous JavaScript and XML
- **2010s - Today**: The mobile and responsive web
  - Growth of mobile browsing
  - Responsive design and Single Page Applications (SPAs)

What Happens When You Enter a URL?

Let's break it down step by step...

Step 1: You Enter a URL

- You type a URL like `https://www.uob.edu.bh` into the browser's address bar
- What does a URL consist of?
  - **Protocol**: `https://`
  - **Domain name**: `www.example.com`
  - **Port** (optional): :80
  - **Path** (optional): `/about`, `/products`
  - etc.

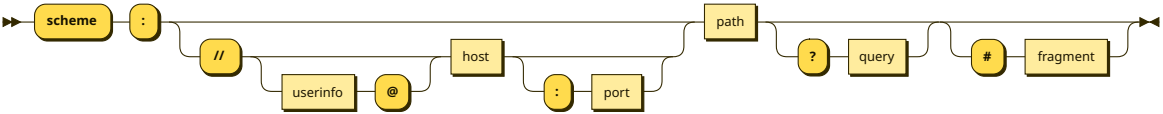
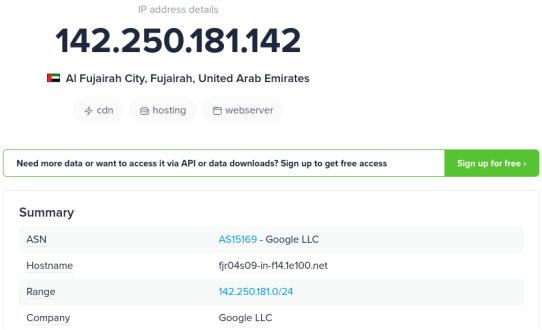


Figure 3: URL Syntax. By Alhadis (Source)

Step 2: DNS Lookup

- The browser needs to convert the domain name to an IP address
- It queries the **DNS (Domain Name System)** to find the IP address
  - Example: `www.google.com` → `142.250.181.142`
- If the browser has the IP cached, it skips this step



Step 3: Browser Initiates a TCP Connection

- The browser establishes a **TCP connection** with the server
  - Uses the IP address from the DNS lookup
  - Connects on port **80** for HTTP or **443** for HTTPS

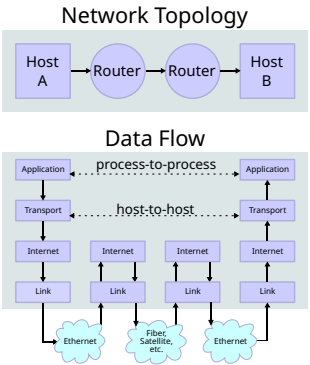


Figure 4: Data Flow in a Network. By Kbrose. (Source)

Step 4: Sending an HTTP Request

- The browser sends an **HTTP request** (or **HTTPS** if secure)
  - Example: `GET /index.html HTTP/1.1`
  - Includes headers like `Host: www.example.com`
- If using HTTPS, the request is encrypted via **TLS (Transport Layer Security)**

Step 5: Server Processes the Request

- The server receives the request and processes it
  - Checks the requested resource (e.g., `index.html`)
  - Executes any server-side logic (e.g., PHP, Node.js)
- The server generates an **HTTP response** and sends it back

Step 6: Browser Receives the Response

- The browser receives the **HTTP response**
  - Common response codes:
    - `200 OK`: Success
    - `404 Not Found`: Resource not found
    - `500 Internal Server Error`: Server issue
    - `418 I'm a teapot`: HTCPCP
- The response contains:
  - **HTML**, **CSS**, **JavaScript**, images, etc.

Step 7: Rendering the Page

- The browser parses the **HTML** and builds the **DOM (Document Object Model)**
  - Downloads and applies **CSS** for layout and styling
  - Executes **JavaScript** for interactivity
- The final output is displayed to the user

Step 8: Additional Requests

- The browser may initiate additional requests for resources:
  - Images, CSS files, JavaScript files, etc.
- These are fetched using separate HTTP requests
- Browser optimizations:
  - **Caching**: Reusing resources from previous requests
  - **Lazy loading**: Loading resources only when needed https://cds.cern.ch/images/CERN-GE-9407011-31

  ## Recap: What Happens When You Enter a URL? ::: columns :::: column

1. URL is parsed
2. DNS lookup to get IP
3. TCP connection established
4. HTTP request sent

Thank You!

- Questions?
- Next lecture: **Introduction to HTML**