Web Development

Technical Summer School 2018, IIT Bombay – Varun Patil

Part 1 – Introduction to the Web and HTML

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Full Stack DevOps

JS/TS, Angular, .NET, Python, Ruby, C++, OpenGL, Java …

Prerequisites

- Basic Hardware
- Desktop OS – Windows, GNU/Linux or macOS
- Python 3
- Web Browser - Mozilla Firefox or Google Chrome
- Code Editor – Notepad++, VS Code, Sublime etc.
- Basics of Programming – CS101

What is the Web?

- What we see in a Web Browser!
- HTML – not really
- A set of documents connected to each other.
- A system of **Internet servers** that support specially formatted documents, supporting links to other documents as well as graphics, audio and video files.
- Are *Web* and *Internet* synonymous? – No!

What is the Internet?

- Wi-Fi 😎
- A lot of connected devices – a network – which talk to each other
- A global computer network providing a variety of information and communication facilities, consisting of interconnected networks using **standardized communication protocols**

Courtesy – Google

Basics & Assumptions

- All information is **binary** - 01100010 01101001 01101110 01100001 01110010 01111001
- Binary data can be transmitted over a medium – think **wires** and **Morse code**
- There are no errors in transmission – for now!
- Two computers can communicate with each other and exchange information – with a physical connection

The Seven Layers of OSI*

1. Physical Layer
2. Link Layer
3. **Network Layer**
4. **Transport Layer**
5. Session Layer
6. Presentation Layer
7. **Application Layer**

* Open Systems Interconnection model

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The Network Layer

- **A → B** – A and B can talk – we already have this
- **A → B … C**
- **A → B … B → C**
- **A → B … B → C … A → C**
- What if D comes up? - ${}^{4}C_{2} = 6$
- Eventually … ${}^{50}C_{2} = 1225$ … ${}^{300}C_{2} = 44850$

Relaying Information

- **A → B → C → D**
- Or maybe **A ← B → C, D**
- Routers – devices designed for this – **B**
- Switches – Layer 2

Internet **P**rotocol

- What is a protocol – standardized communication
- Headers and body of packets
- Protocol used by the network layer
- Each device has a unique **IP Address** – like your postal address
- 32-bits – xxx.xxx.xxx.xxx (in IPv4)
- Best effort

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The Transport Layer

- Multiple applications on one machine
- Different applications – different people to communicate with at once
- Errors in transmission
- Congestion control
- Order of receiving - multiple paths of communication

Transmission **C**ontrol **P**rotocol

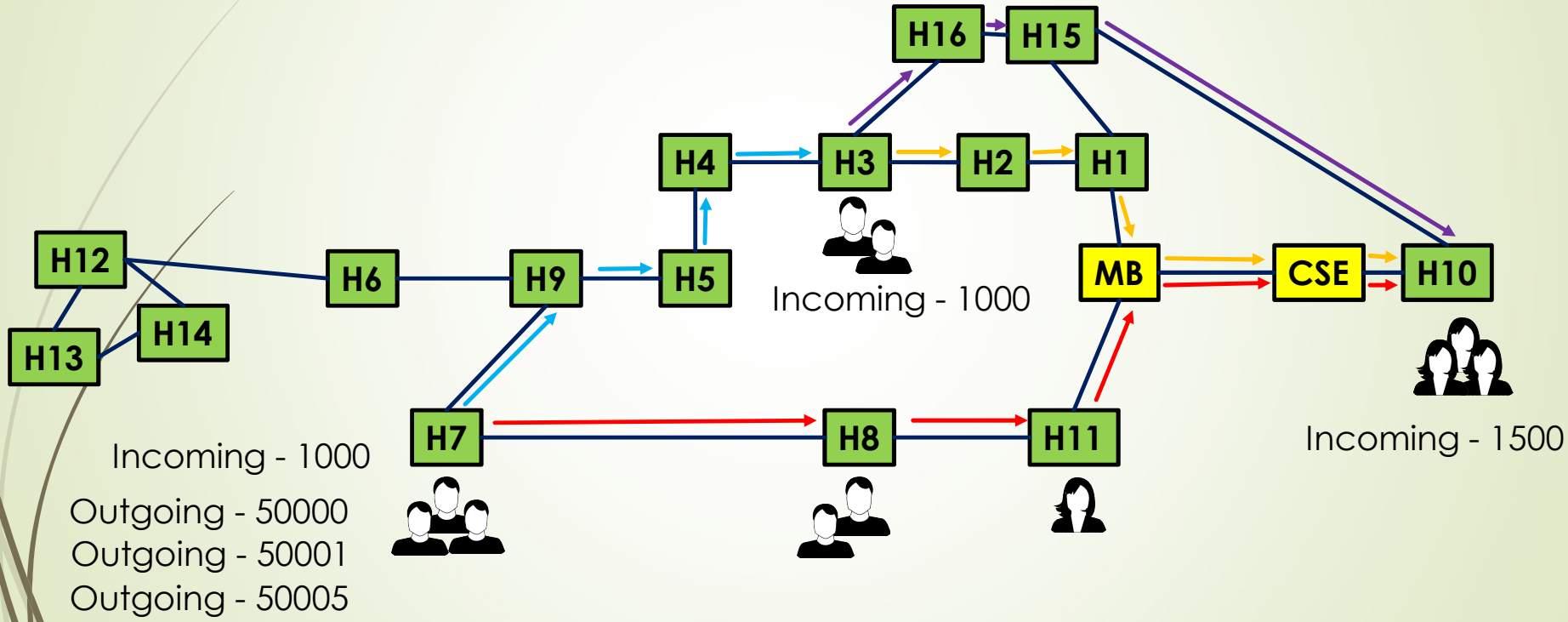
- Built into Operating Systems – with standards
- Performs error detection/correction
- Ensures correct ordering of data
- Allows multiple applications to communicate with **Ports**

Port

- 16-bit number – 0 to 65535
- Outgoing and incoming ports
- Can receive multiple connections on one port
- 4-tuple – identifying a unique connection
  - IP Address of A
  - Port of A
  - IP Address of B
  - Port of B

An Analogy

A Map?!


H16
H15
H4
H3
H2
H1
H12
H6
H9
H5
MB
CSE
H10
H14
H13
Incoming - 1000
H7
H8
H11
Incoming - 1500
Incoming - 1000
Outgoing - 50000
Outgoing - 50001
Outgoing - 50005

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The Application Layer

- Multiple protocols like HTTP, FTP etc.
- **HTTP** – Hypertext Transfer Protocol
  - Can transfer any type of content
  - Primarily for text – Hypertext i.e. with Hyperlinks
  - Protocol takes care of only transferring data
  - Understood by **Web Browsers**
  - Not the same as HTML – HTML is usually transferred over HTTP

Hyper**T**ext **T**ransfer **P**rotocol

- Headers
  - What is being transferred - **URL**
  - Size of content
  - Type of file – MIME* type
  - Extra information related to server
  - Extra information related to content
- Body
  - Actual contents of the file – the message

*Multipurpose Internet Mail Extensions

Uniform **R**esource **L**ocator

- Reference to a **web** resource that specifies its location on a computer network
- Usually used with HTTP
- Send as part of HTTP header when requesting a resource

Uniform **R**esource **L**ocator

- scheme://authority/path?query#fragment

  authority = userinfo@host:port
- scheme – usually **http**, can be ftp etc.
- path – path of resource we want - **known**
- port is usually (and defaults to) **80**
- query – for passing extra information

Uniform **R**esource **L**ocator

- http://www.iitb.ac.in/newacadhome/timetable.jsp
  - http:// → using Hypertext Transfer Protocol
  - www.iitb.ac.in → authority
    - port not specified → 80
    - "resolves" (see DNS) to an IP like 10.102.1.111
  - newacadhome/timetable.jsp → path
  - No query or fragment specified

- Server sends a response with the requested page

Web Browser

- Takes in a URL and makes an HTTP request for you
- Receives the content and understands it
- Displays it to the user
- Allows the user to interact with the received content
- Makes more requests

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Interactive

Hyper**T**ext **M**arkup **L**anguage

- A markup language is a system for **annotating** a document in a way that is **syntactically distinguishable** from the text
- Hypertext Markup Language is the **standard** markup language for creating web pages and web applications
- HTML elements are the building blocks of HTML pages
- Represented by **tags**

Courtesy – W3Schools

HTML Tags

- HTML tags label pieces of content such as "heading", "paragraph", "table", and so on
- Browsers do not display the HTML tags, but use them to render the content of the page
- For example
  - `<b>` - Make the text bold
  - `<p>` - Begin a new paragraph
- Closed as `</tag>` e.g. `<b>This is bold</b>`
- Just syntax

Courtesy – W3Schools

Basic HTML Skeleton

```
<!DOCTYPE html>
<html>

<head>
<title>Page Title</title>
</head>

<body>

<h1>My First Heading</h1>
<p>My first paragraph.</p>

</body>

</html>
```

<a> and <img>

```
<a href="http://www.iitb.ac.in/newacadhome/timetable.jsp">
    IITB Timetable
</a>

<img src="image.jpg" alt="My Image" width="104" height="142">
```

- Things to note:
  - href and src are **attributes**, the expressions in quotes are **values**
  - One tag can have one or more attributes (or none)
  - Attributes control content in the tag
  - img has no end tag
  - **image.jpg** indicates same path as the open page

Tag nesting

```
<ul>
    <li>Coffee</li>
    <li>Tea</li>
    <li>Milk</li>
</ul>
```

- Coffee
- Tea
- Milk

`<ul>` - Unordered List
`<li>` - List Item
`<ol>` - Ordered List

List of common tags (Non-exhaustive)

- <html> - HTML document
- <body> - Main body
- <h1> - Biggest heading, <h2>, <h3> are progressively smaller
- <b> - Bold text
- <a> - Hyperlink
- <img> - Image - no end tag
- <button> - Button!
- - Division
- <p> - Paragraph
-
 - Line Break - no end tag
- <pre> - Preformatted text

Thank You!