Music & the Internet
MUMT301

Gabriel Vigliensoni
Schulich School of Music
McGill University

Plan

- Review of the last class and assignment
- Internet technologies
- Introduction to CSS
- In-class exercise
- Assignment #3

Review last class

- History of Internet
- History of the WWW and HTML
- History of web browsers
- Set up server accounts
- Code editor and FTP software
- Introduction to HTML
  - basic tags and elements
  - basic webpage template
  - Assignment 2

Assignment 2

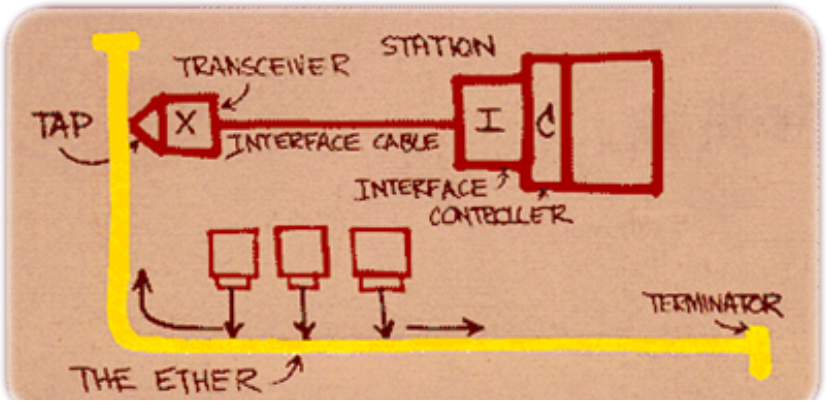
- music.mcgill.ca/~backer
- music.mcgill.ca/~davis
- music.mcgill.ca/~hecht
- music.mcgill.ca/~hiebert
- music.mcgill.ca/smith
- music.mcgill.ca/szeto
- http://132.206.14.130/akdag
- What did we learn?

Internet technologies and protocols

- Ethernet
- TCP/IP
- OSI Model
- IP Addresses
- DNS
- Ports
- DHCP
- FTP
- SSH
- HTTP

Ethernet

- Computer networking technology
- Specifies a protocol and frame format for data communication
- Invented by Bob Metcalf. First documented in internal XEROX PARC memo (1973)



Metcalf's original sketch of Ethernet

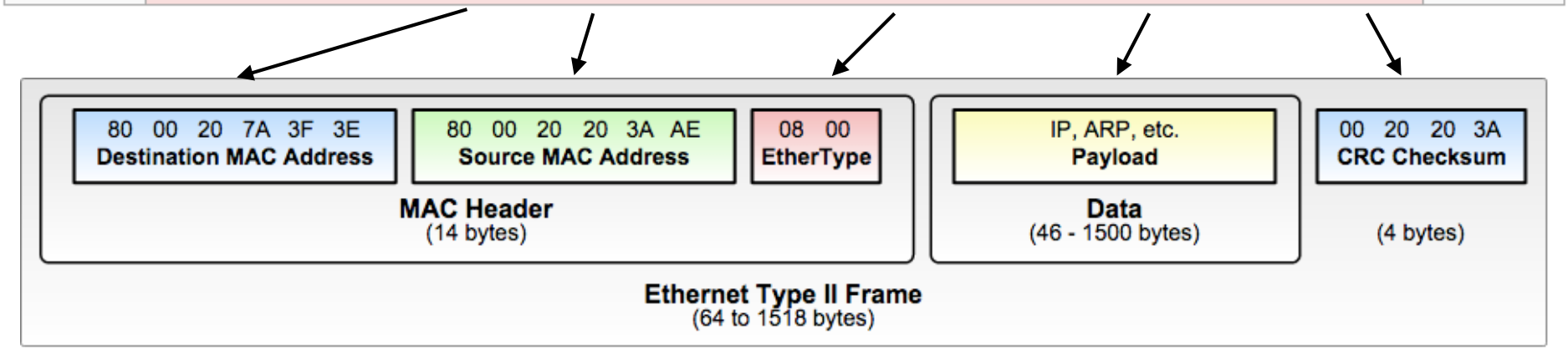
Ethernet

- Stream of data is divided into shorter pieces called frames.
  - Each frame contains source and destination addresses
  - Damaged data can be detected and re-transmitted by means of error-checking data (CRC)
- Each hardware is given a 6 octets (48 bit) MAC address
- Originally based on inexpensive and ubiquitous coaxial cable and twisted pair wiring
- Standardized in IEEE 802.3 (1983) with a data rate of 10Mbps (10BASE-T)
- In 1995 was standardized to 100Mbps ("Fast Ethernet")
- Contemporary alternative to wired Ethernet is IEEE 802.11, also known as WiFi

Ethernet packet and frame

802.3 Ethernet packet and frame structure

Layer	Preamble	Start of frame delimiter	MAC destination	MAC source	802.1Q tag (optional)	Ethertype (Ethernet II) or length (IEEE 802.3)	Payload	Frame check sequence (32-bit CRC)	Interpacket gap
	7 octets	1 octet	6 octets	6 octets	(4 octets)	2 octets	46(42)[b]–1500 octets	4 octets	12 octets
Layer 2 Ethernet frame			← 64–1518(1522) octets →						
Layer 1 Ethernet packet	← 72–1526(1530) octets →								



Taken from http://en.wikipedia.org/wiki/Ethernet_frame

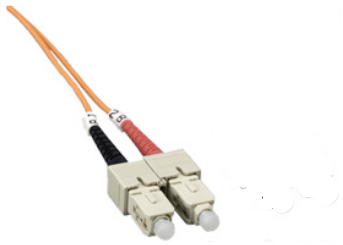
Ethernet standards

Name	Connector	Speed	Distance
10BASE-2	AUI	10 Mbps	500m
10BASE-5	BNC	10 Mbps	200m
10BASE-T	RJ-45	10 Mbps	100m
100BASE-TX	RJ-45	100 Mbps	100m
100BASE-FX	ST, SC, LC	100 Mbps	2000m
1000BASE-T	RJ-45	1 Gbps	100m
1000BASE-X	ST, SC, LC	1 Gbps	2000m
10GBASE-X	ST, SC, LC	10 Gbps	2000m

Thin and thick coaxial

Twisted pairs

Multimode fiber

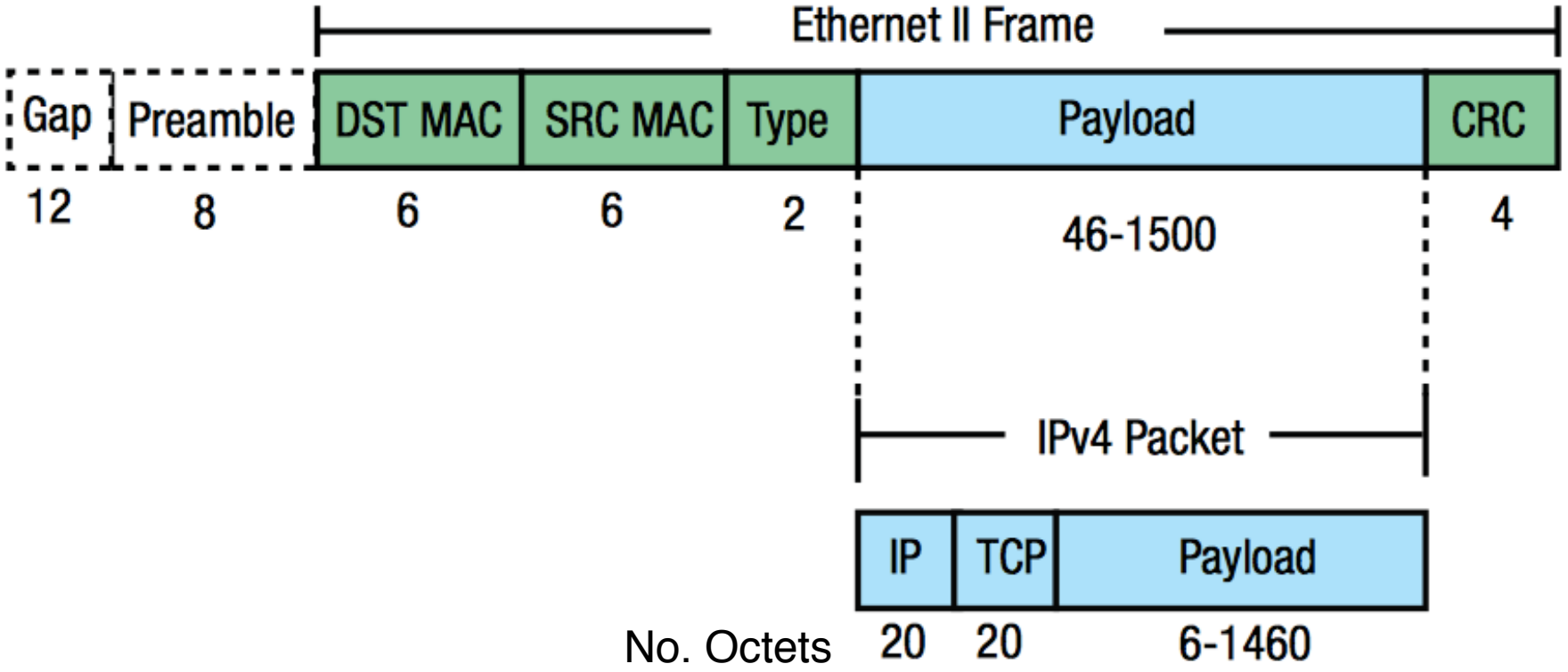


Internet Protocol Suite (TCP/IP)

- The Internet Protocol Suite (TCP/IP) works on top of Ethernet frame
  - provides end-to-end connectivity
  - specifyies how data is packetized, addressed, transmitted, routed and received at the destination.
- Web browsers use these protocols when they connect to servers on the WWW
- HTTP, HTTPS, SMTP, POP3, IMAP, SSH, FTP, SFTP are protocols encapsulated within TCP/IP

Complete Ethernet Packet

Taken from openmicrolab.com



IP Headers

IPv4 (20 bytes)

IPv4 Header Format

Offsets	Octet	0								1								2								3							
Octet	Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	0	Version				IHL				DSCP						ECN		Total Length															
4	32	Identification																Flags			Fragment Offset											
8	64	Time To Live								Protocol								Header Checksum															
12	96	Source IP Address																															
16	128	Destination IP Address																															
20	160	Options (if IHL > 5)																															

Taken from wikipedia.com

IPv6 (36 bytes)

Fixed header format

Offsets	Octet	0								1								2								3							
Octet	Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	0	*Version*				*Traffic Class*												*Flow Label*															
4	32	*Payload Length*																*Next Header*								*Hop Limit*							
8	64	*Source Address*																															
12	96																																
16	128																																
20	160																																
24	192	*Destination Address*																															
28	224																																
32	256																																
36	288																																

Taken from wikipedia.com

TCP Header (20 bytes)

TCP Header

Offsets Octet		0								1								2								3							
Octet	Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	0	Source port																Destination port															
4	32	Sequence number																															
8	64	Acknowledgment number (if ACK set)																															
12	96	Data offset				Reserved 0 0 0				NS	CWR	ECE	URG	ACK	PSH	RST	SYN	FIN	Window Size														
16	128	Checksum																Urgent pointer (if URG set)															
20 ...	160 ...	Options (if *data offset* > 5. Padded at the end with "0" bytes if necessary.) ...																															

Taken from wikipedia.com

UDP Header

Offsets Octet		0								1								2								3							
Octet	Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	0	Source port																Destination port															
4	32	Length																Checksum															

Taken from wikipedia.com

MAC and IP Addresses

- IPv4 (32 bits = 4 bytes)
  - 4,294,967,296 possible IP addresses
    - one billion already used
- IPv6 (128 bits)
  - $3.4*10^{38}$ (340 trillion trillion trillion)
    - Bacterial cells on earth: $5*10^{30}$
- MAC (Media Access Control)
  - MAC-48: 2^{48} = 281,474,976,710,656 addresses (281 x 10^{12}, trillions)
    - All fish in the ocean: $3.5*10^{12}$

OSI Model

- The Open System Interconnection model conceptualizes all functions in a communication system
- OSI model is an ISO standard for worldwide communications that defines a framework for implementing protocols in seven layers
- Transmitting bits from one device to another is not enough to establish comprehensible communications
- All information must be organised in a hierarchical manner to convey a message
- It defines what a transmitting device must do to pack up a message for transmission and what the receiving device must do to unpack the transmission to recreate the original message
- Ethernet-based communication protocols do obey the OSI model

OSI Model

Taken from http://www.escotal.com/osilayer.html

OSI (Open Source Interconnection) 7 Layer Model

Layer	Application/Example		Central Device/ Protocols			DOD4 Model
Application (7) Serves as the window for users and application processes to access the network services.	**End User layer** Program that opens what was sent or creates what is to be sent Resource sharing • Remote file access • Remote printer access • Directory services • Network management		**User Applications** SMTP		**GATEWAY** Can be used on all layers	Process
Presentation (6) Formats the data to be presented to the Application layer. It can be viewed as the "Translator" for the network.	**Syntax layer** encrypt & decrypt (if needed) Character code translation • Data conversion • Data compression • Data encryption • **Character Set Translation**		JPEG/ASCII EBDIC/TIFF/GIF PICT			
Session (5) Allows session establishment between processes running on different stations.	**Synch & send to ports** (logical ports) Session establishment, maintenance and termination • Session support - perform security, name recognition, logging, etc.		**Logical Ports** RPC/SQL/NFS NetBIOS names			
Transport (4) Ensures that messages are delivered error-free, in sequence, and with no losses or duplications.	**TCP** Host to Host, Flow Control Message segmentation • Message acknowledgement • Message traffic control • Session multiplexing	PACKET FILTERING	TCP/SPX/UDP			Host to Host
Network (3) Controls the operations of the subnet, deciding which physical path the data takes.	**Packets** ("letter", contains IP address) Routing • Subnet traffic control • Frame fragmentation • Logical-physical address mapping • Subnet usage accounting		**Routers** IP/IPX/ICMP			Internet
Data Link (2) Provides error-free transfer of data frames from one node to another over the Physical layer.	**Frames** ("envelopes", contains MAC address) [NIC card — Switch — NIC card] (end to end) Establishes & terminates the logical link between nodes • Frame traffic control • Frame sequencing • Frame acknowledgment • Frame delimiting • Frame error checking • Media access control		**Switch Bridge WAP** PPP/SLIP	Land Based Layers		Network
Physical (1) Concerned with the transmission and reception of the unstructured raw bit stream over the physical medium.	**Physical structure** Cables, hubs, etc. Data Encoding • Physical medium attachment • Transmission technique - Baseband or Broadband • Physical medium transmission Bits & Volts		**Hub**			

OSI Model

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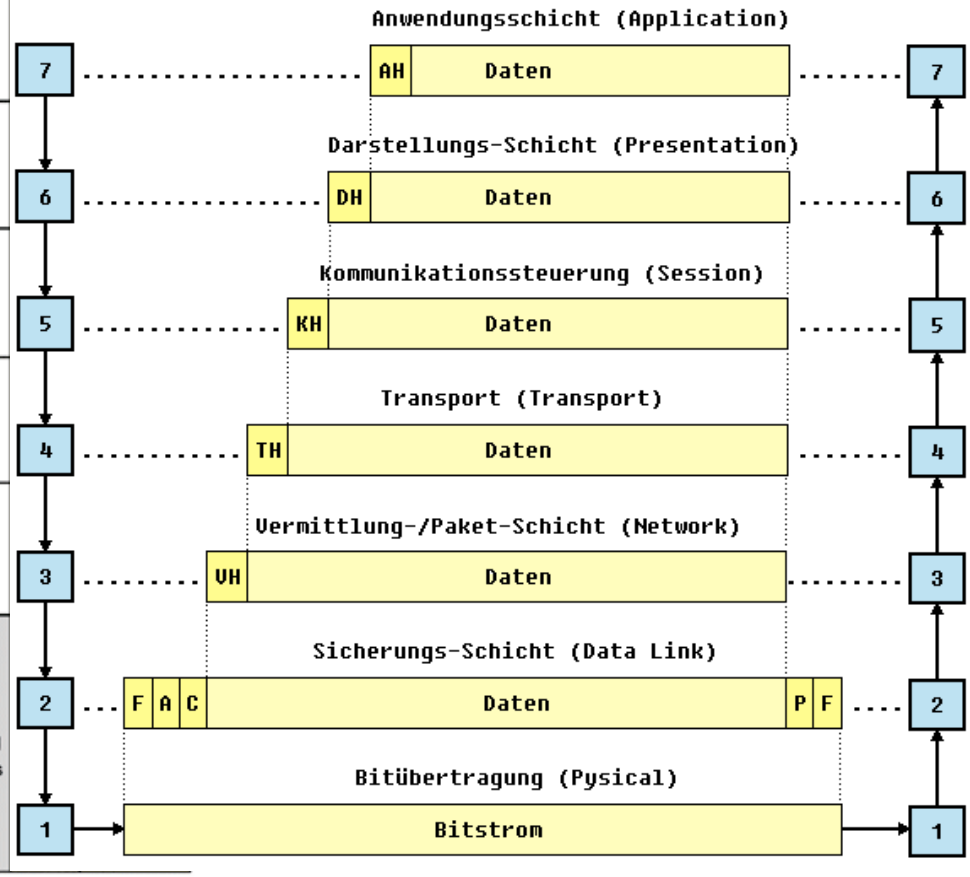
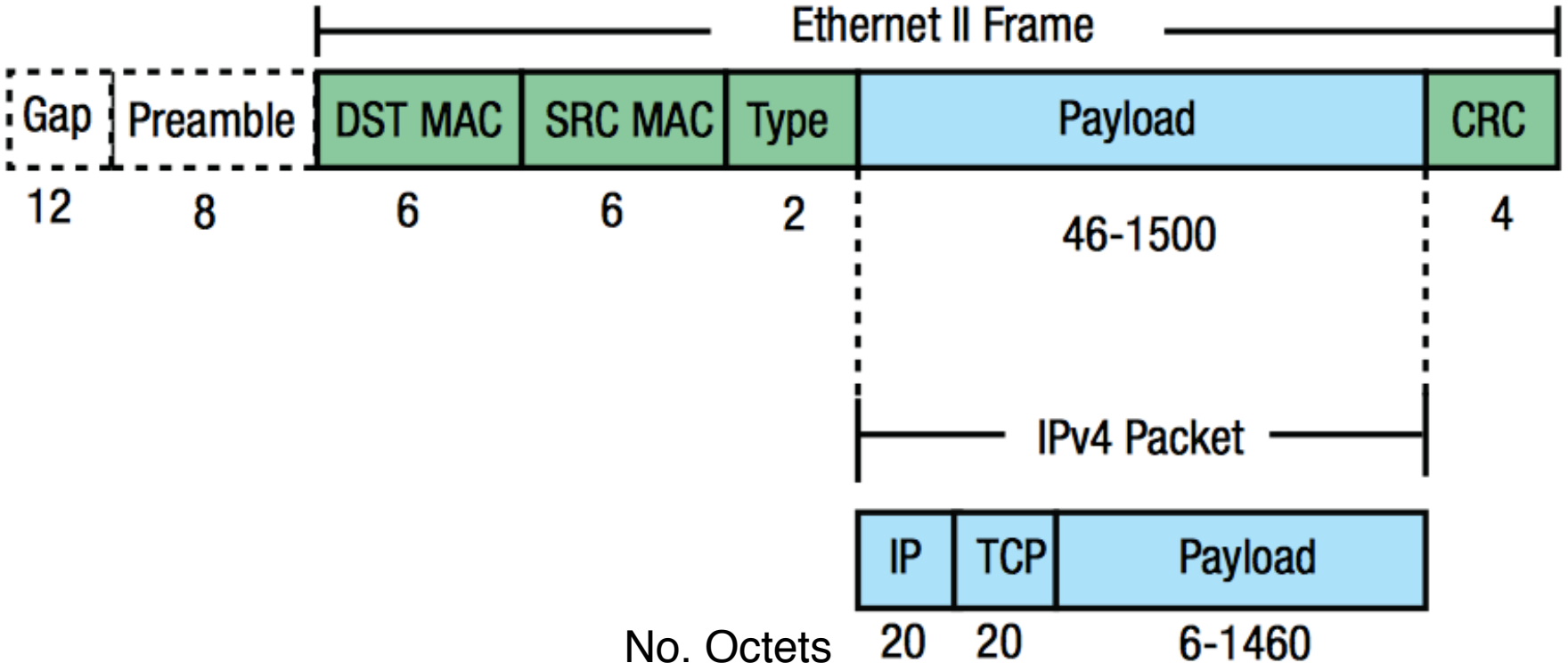


Complete Ethernet Packet

Taken from openmicrolab.com



Domain Name System (DNS)

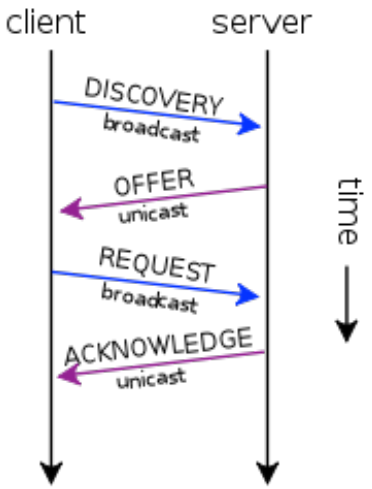
- Domain name servers translate domain names to IP addresses (they are aliases for IP addresses)
- Defined by P. Mockapetris (1982) in RFC882
  - Defined syntax of domain name
    - Righmost label conveys the top-level domains, e.g., .edu, .org, or .com
    - Restriction on the length of domain names to 63 characters, excluding the top-level domain
    - Subdivision of domain names can go up until 127 levels
    - Maximum total length of 255 characters
  - Domain names are also limited to a subset of ASCII characters, preventing many languages from representing their names and words correctly
- Obsoleted in RFC1034, RFC1035 (1987)
  - It is based on thirteen "root servers" worldwide, all but three were located in the US. Nowadays they are spread across multiple countries

Ports

- Virtual pathways on which Internet data travels
- If we think of IP addresses as telephone numbers, ports are telephone number extensions
- The port number added to the IP address completes the address for a communication session
- All data sent to an IP address is sent on specific ports
- Ports identify unique applications or processes running on a computer and enable them to share a single physical connection in the Internet
- 16 bits are dedicated for port numbers: 65535 different ports
- Syntax: `(IP Address):(Port Number)`
- Typical system ports: 21 (FTP), 22 (SSH), 25 (SMTP), 53(DNS), 80 (HTTP), 194 (IRC), 443(HTTPS)
- Registered ports: 5050 (Yahoo! Messenger), 9293 (Sony Playstation remote play), 19294 Google Talk, ... partial list here What's in 8888?

DHCP

- How does the Internet find me when I move around with my laptop/tablet/phone?
  - By using a Dynamic Host Configuration Protocol
- Protocol standardized in 1993 by which computers on a network requesting IP addresses and network parameters are assigned from DHCP servers



FTP
(File Transfer Protocol)

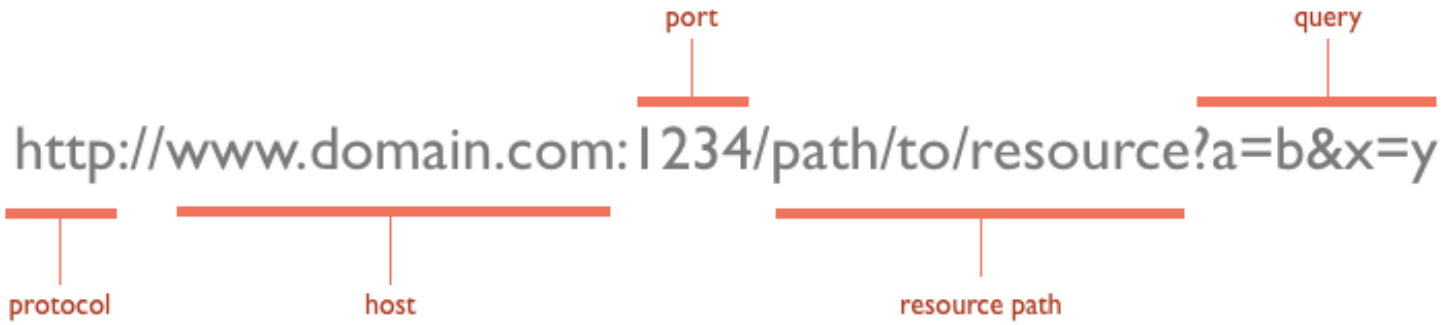
- Protocol that computers on a TCP/IP network use to transfer files to and from each other
  - Can be used with a client application or from command line
  - Usually works on port 21
  - Data is transmitted on plain text
- SFTP (Secure File Transfer Protocol) is similar to FTP but performs over an encrypted SSH transport
  - Used to access 132.206.14.130
  - Usually works on port 22
  - Data is encrypted

SSH (Secure Shell)

- Network protocol that runs over TCP/IP
- Allows to make a remote login over TCP/IP network via port 22
- Provides access to the shell of a computer
- A shell is an interface to an operating system, e.g.:
  - Finder (GUI)
  - Bash (CLI)

HTTP
(Hypertext transfer protocol)

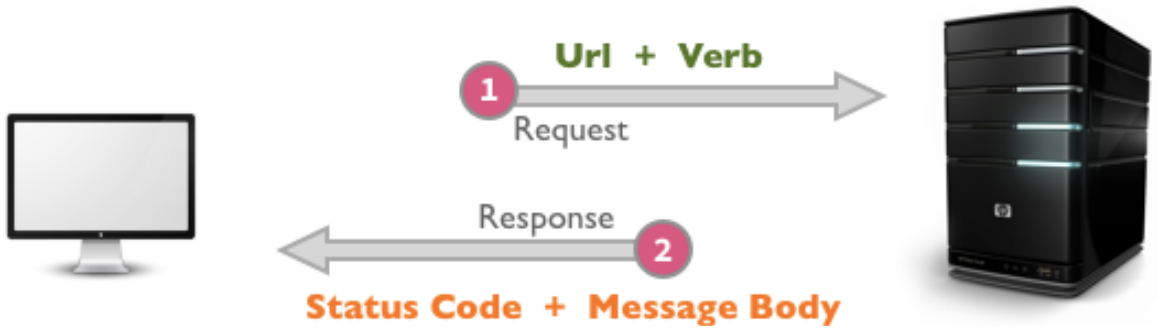
- Hypertext concept introduced by Ted Nelson (1965)
- Hypertext is structured text that uses logical links (hyperlinks) between nodes containing text
- HTTP is the protocol to exchange or transfer hypertext
- First Hypertext Transfer Protocol documented in 1991 by Tim Berners-Lee and his group@CERN
- HTTP works over TCP/IP and default port 80
- At the heart of web communications using HTTP is the request message
- These request messages are sent using URLs (Uniform Resource Locators)
- URLs have the following components:



Taken from http://code.tutsplus.com/

HTTP

- “The first version of the protocol had only one method, namely GET, which would request a page from a server. The response from the server was always an HTML page.” (T. Berners-Lee)



Taken from http://code.tutsplus.com/

- However, these days there are some other HTTP “verbs” that allow us to perform other actions on resources:
  - GET: fetch an existing resource
  - POST: create a new resource
  - PUT: update an existing resource
  - DELETE: delete an existing resource

BREAK

HTML/CSS

"HTML was intended to define the content of a document, CSS defines how HTML elements are to be displayed." - http://www.w3schools.com/css/css_intro.asp

A HTML document has two big parts:
head, and body.

HEAD - Internal (hidden) information, metadata

- Title http://www.w3schools.com/tags/tag_title.asp
- Base href - setting up your base reference link
- Link to favicon - http://www.favicon.cc/
- Meta tags (keywords, description, copyright, publisher-email, author)
- Styles/link stylesheet
- Javascript

BODY - Perceived (rendered) information

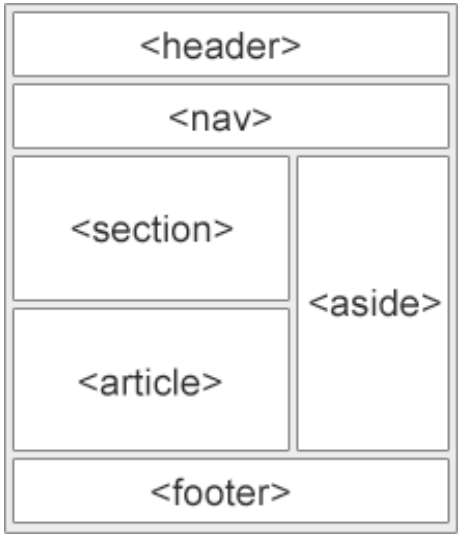
- Content
- Footer

HTML5 SEMANTIC ELEMENTS

A semantic element **clearly describes its meaning** to both the browser and the developer

Examples of non-semantic elements: `<div>` and `<span>`
These elements tell nothing about their content

Examples of semantic elements: `<form>`, `<table>`, and `<img>`
These elements clearly define their content



CSS

Cascading Style Sheets

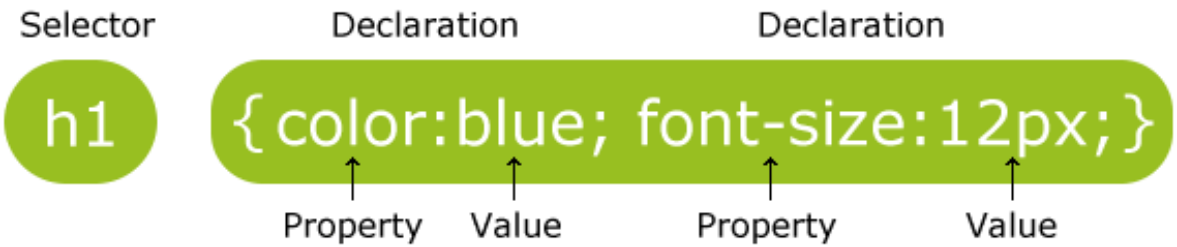
CSS defines how the HTML elements will be displayed!

CSS is designed primarily to enable the separation of document content from document presentation

http://www.w3schools.com/css/demo_default.htm

CSS SYNTAX

A CSS rule has two main parts: a selector, and one or more declarations



Example:

```
p {
font-family: arial, helvetica, sans-serif;
font-size: 12px;
color: black;
line-height: auto;
}
```

SOME SELECTORS

1. *

```
* {
 margin: 0;
 padding: 0;
}
```

2. #X

```
#container {
   width: 960px;
   margin: auto;
}
```

3. .X

```
.error {
  color: red;
}
```

4. X Y

```
li a {
  text-decoration:
none;
}
```

http://code.tutsplus.com/tutorials/the-30-css-selectors-you-must-memorize–net-16048

Three Ways to Insert CSS

- External style sheet
- Internal style sheet
- Inline style

External style sheet

```
<head>
<link rel="stylesheet" type="text/css" href="mystyle.css">
</head>
```

Internal style sheet

```
<head>
<style>
body {
    background-color: blue;
}
h1 {
    color: red;
    margin-left: 40px;
}
</style>
</head>
```

Inline styles

```
<h1 style="color:blue;margin-left:30px;">This is a heading.</h1>
```

CSS Styles

Position
Borders
Backgrounds
Gradients
Text Effects
Fonts
2D Transforms
3D Transforms
Transitions
Animations
Multiple Columns
User Interface

grids
grids
grids

In-class demo

- https://mumt301.github.io/2016/code/18plus.html

Today's class

- Internet technologies
- Introduction to CSS
- In-class demo
- Assignment #3