

# Music & the Internet

## MUMT301

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# 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
- Introduction to HTML
  - basic tags and elements
  - basic webpage template
- Code editor, Git, and Github
- In-class assignment

# Assignment 2

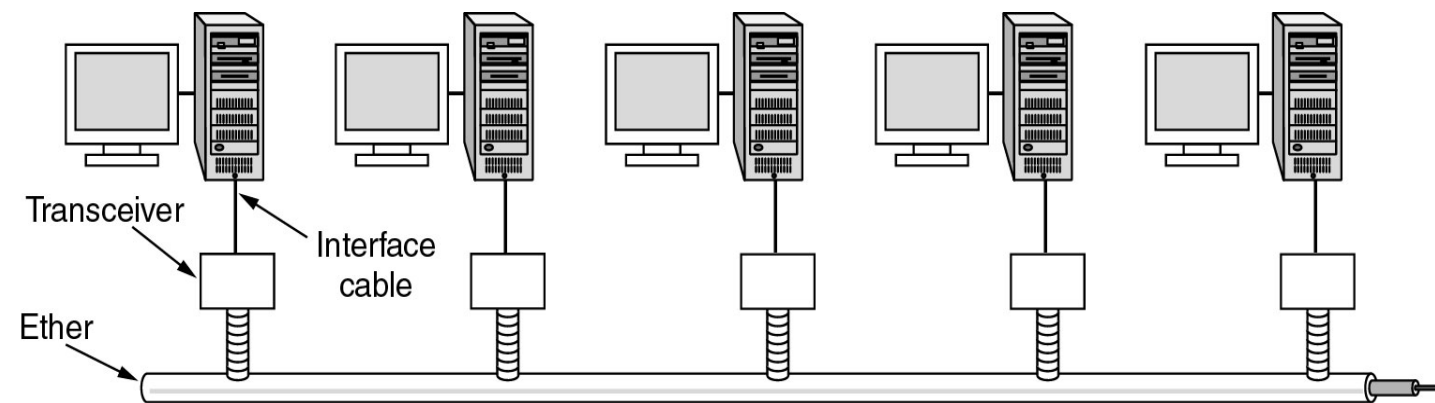
- <https://mumt301.github.io>

# 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 Metcalfe. First documented in internal XEROX PARC memo (1973)



Architecture of the original Ethernet (1976).

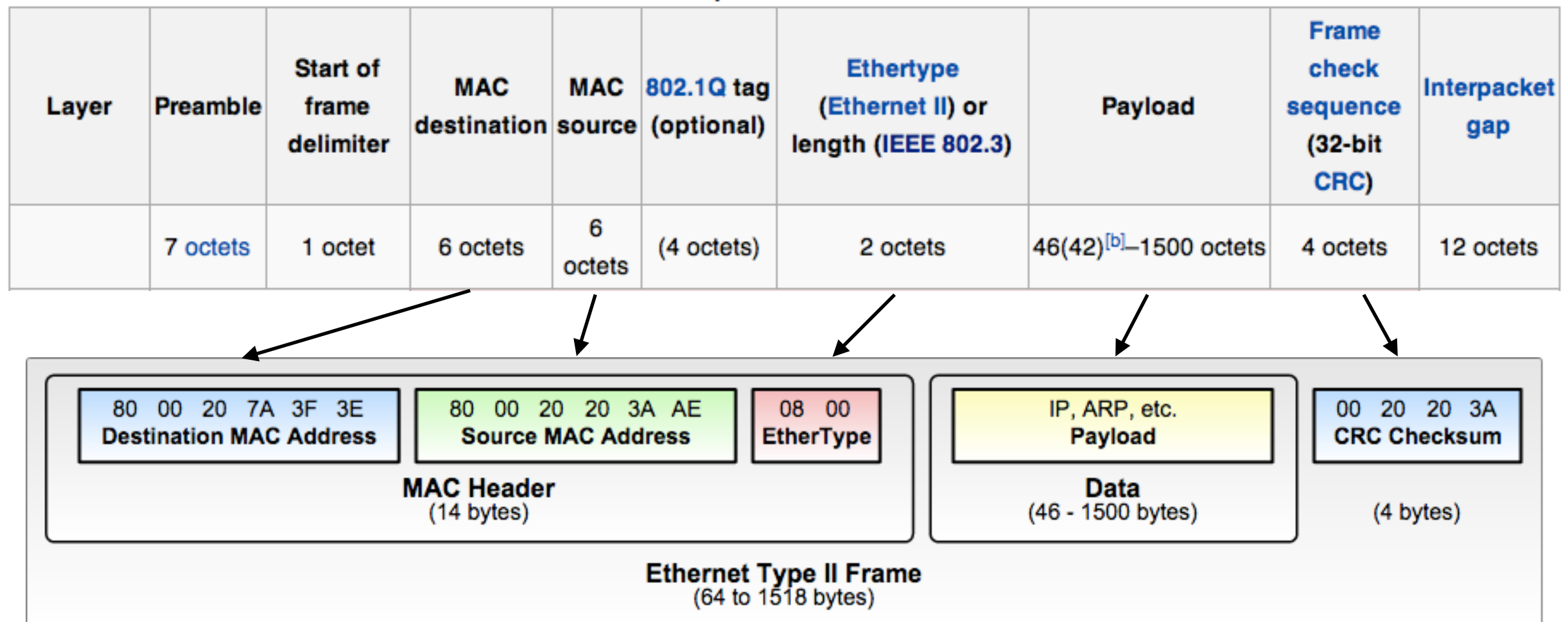
- Thick coaxial “multidrop” cable up to 2.5km long (with repeaters every 500 meters)
- Connect up to 256 computers
- 2.94Mbps line speed

# Ethernet

- Stream of **data is divided** into shorter pieces called frames.
  - Each frame contains **source and destination** addresses
  - **Damaged data** can be detected by means of error-checking data (CRC) and is **re-transmitted**
  - Each networking equipment is given a **unique identifier** comprised of 6 octets (48 bit), known as **Media Access Control (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) and in memo RFC 894 (1984)
- 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



Taken from [http://en.wikipedia.org/wiki/Ethernet\\_frame](http://en.wikipedia.org/wiki/Ethernet_frame)



# Ethernet standards

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



Thin and thick coaxial



Twisted pairs



Multimode fiber

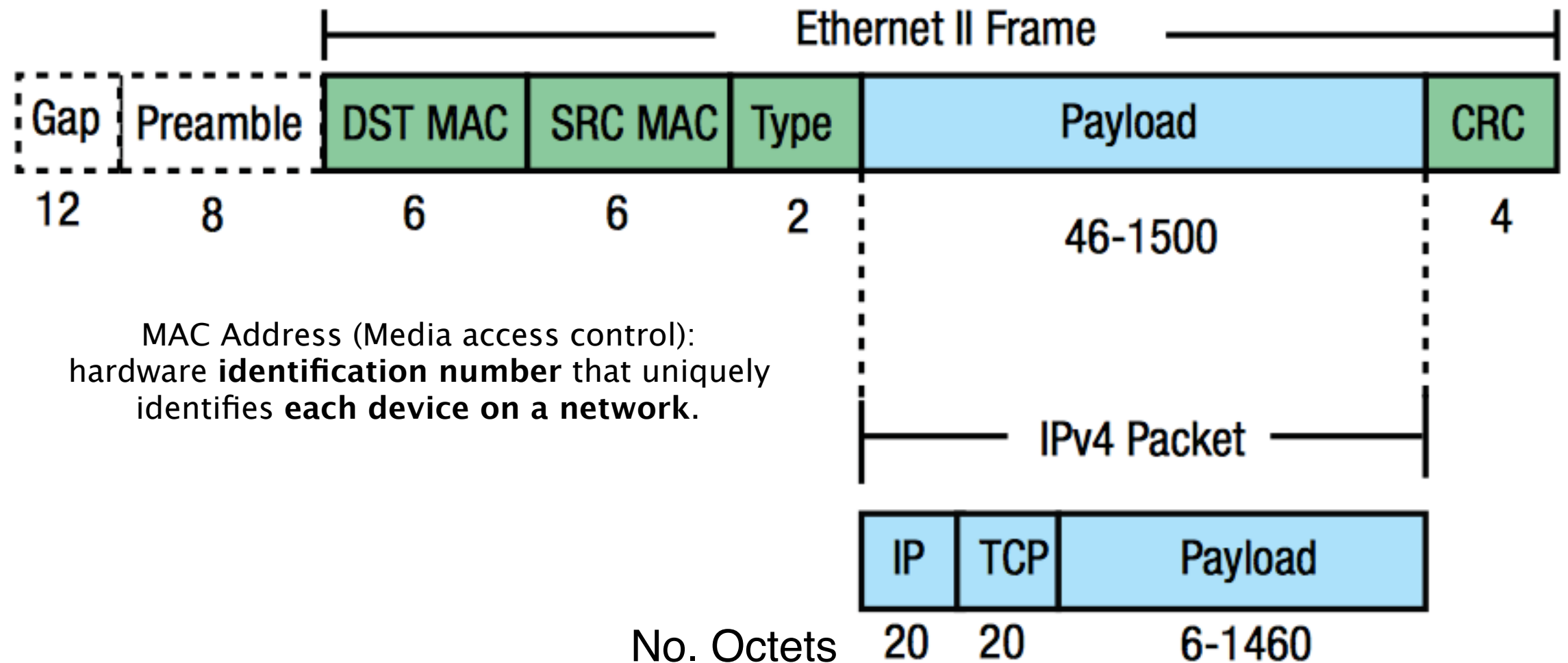


# Internet Protocol Suite (TCP/IP)

- The Internet Protocol Suite (Transmission Control Protocol and Internet Protocol) **works on top of Ethernet frame**
  - provides **end-to-end connectivity**
  - **specifies** how data is packetized, addressed, transmitted, routed, and received at the destination
- Web **browsers use this protocol** 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](http://openmicrolab.com)



# IP Headers

IP has the task of **delivering packets** from the source host to the destination host solely **based on the IP addresses** in the packet 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																															4 octets = 4 8-bit byte = 32 bits	
16	128	Destination IP Address																																
20	160	Options (if IHL > 5)																																

4 octets = 4 8-bit byte = 32 bits -> 4.2 billion IP addresses

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  16 octets = 16 8-bit byte = 128 bit																															
12	96																																
16	128																																
20	160																																
24	192	Destination Address																															
28	224																																
32	256																																
36	288																																

16 octets = 16 8-bit byte = 128 bit -> 340 undecillion IP addresses

Taken from wikipedia.com

# TCP Headers

TCP provides an **error-checked delivery of a stream of octets** between programs running on computers connected to a LAN

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			N S		C W R	E C R	U R C	A C S	P S S	R S Y	S I N	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](https://en.wikipedia.org/wiki/TCP_header)

User Datagram Protocol (UDP) is by applications that do not require the reliability of a TCP connection and delivery validation (“handshaking”)

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](https://en.wikipedia.org/wiki/UDP_header)

# MAC and IP Addresses

- IPv4 (32 bits = 4 bytes)
  - 4,294,967,296 possible IP addresses
    - More than one billion already used (!)
- IPv6 (128 bits)
  - $3.4 \times 10^{38}$  (340 trillion trillion trillion, or 3.4 undecillion)
    - Bacterial cells on earth:  $5 \times 10^{30}$
- MAC addresses:
  - MAC-48:  $2^{48} = 281,474,976,710,656$  addresses ( $2.8 \times 10^{14}$ , trillions)
    - All fish in the ocean:  $3.5 \times 10^{12}$

# OSI Model

- **OSI model** defines a **framework for implementing protocols**
- **Transmitting bits from one device to another** is not enough to establish comprehensible communications
- All **information must be organized in a hierarchical manner** to convey a message
- OSI model defines
  - what a transmitting device must do to **pack up a message for transmission**
  - what the receiving device must do to **unpack the transmission to recreate the original message**
- **Ethernet-based communication protocols follow the OSI model**



# OSI Model

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

OSI (Open Source Interconnection) 7 Layer Model

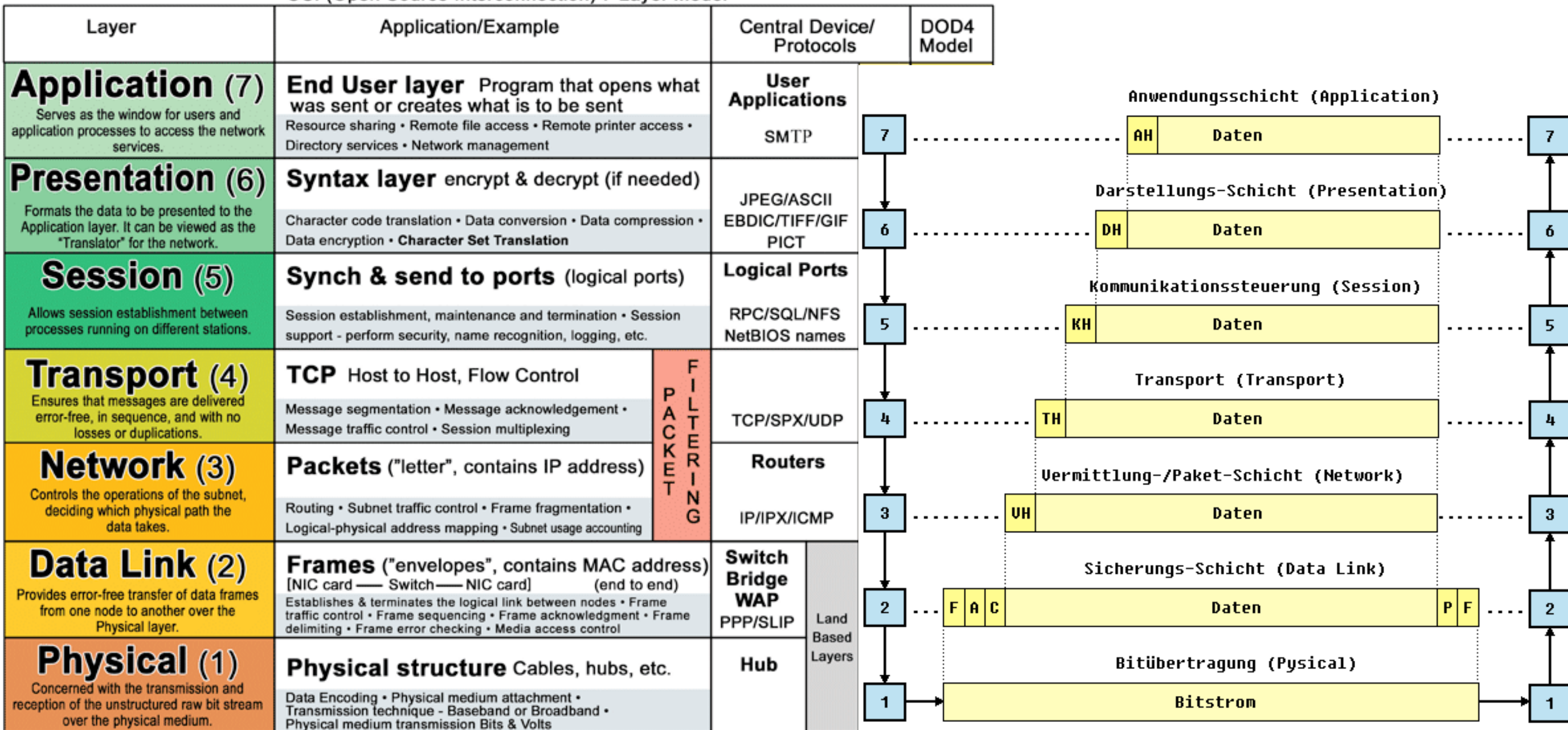
Layer	Application/Example	Central Device/ Protocols		DOD4 Model
<b>Application (7)</b> Serves as the window for users and application processes to access the network services.	<b>End User layer</b> Program that opens what was sent or creates what is to be sent Resource sharing • Remote file access •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



# OSI Model

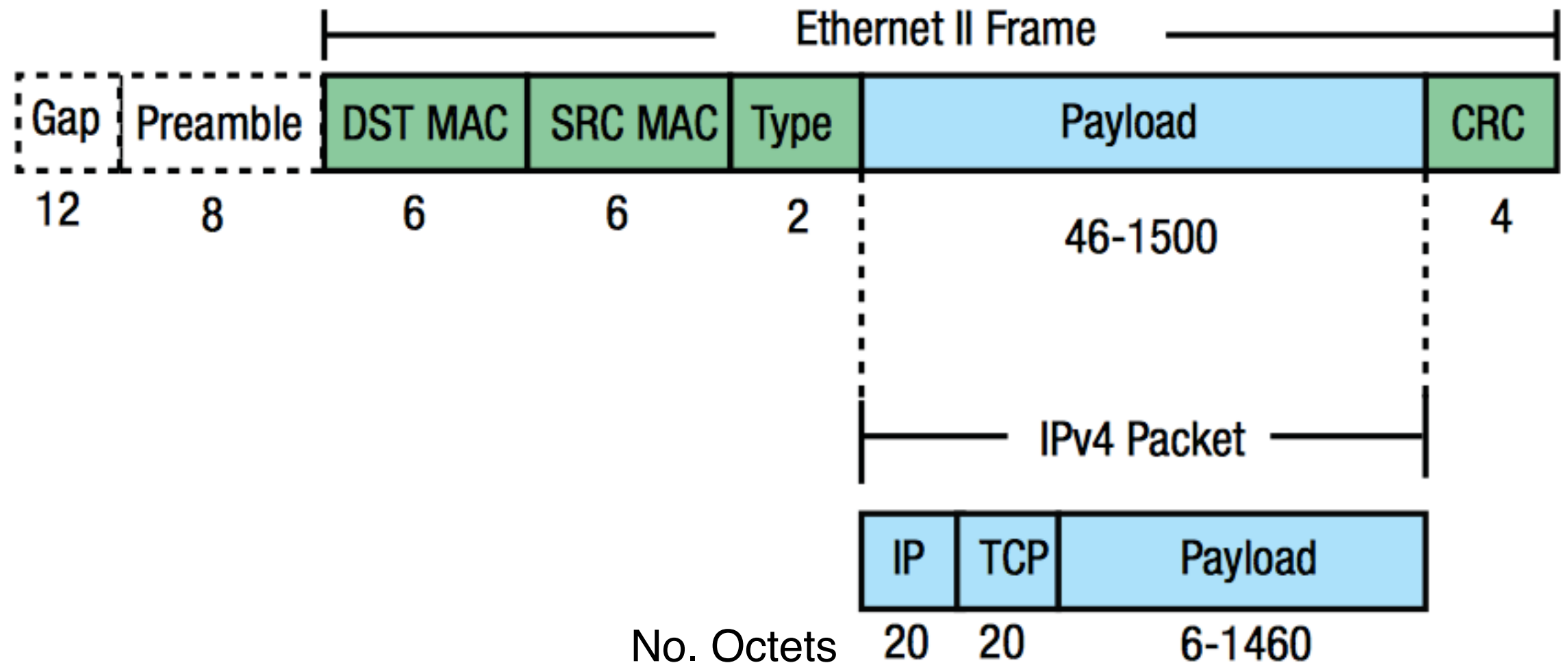
Taken from <http://www.escotal.com/osilayer.html>

OSI (Open Source Interconnection) 7 Layer Model



# Complete Ethernet Packet

Taken from [openmicrolab.com](http://openmicrolab.com)



# Domain Name System (DNS)

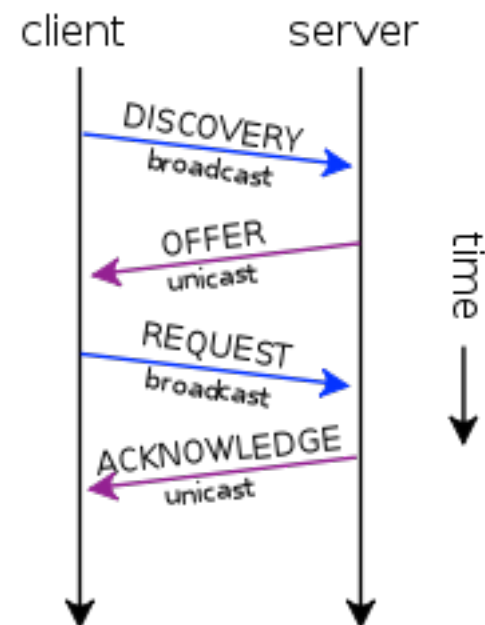
- DNS **translate domain names to IP addresses** (domain names are aliases for IP addresses)
- Defined by P. Mockapetris (1982) in RFC882
  - **Defined syntax of domain names**
    - Rightmost label conveys the **top-level domains**, e.g., .edu, .org, or .com
    - Restriction on the length of **domain 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 (but recent efforts to enable domain names in local languages)
- Domain name system expanded 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
- **Metaphor:** 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
- **Ports identify unique applications or processes** running on a computer and enable them to share a single physical connection in the Internet
- **All data sent to an IP address is sent on specific ports**
- Syntax: (IP Address) : (Port Number)
- **16 bits** are dedicated for port numbers in TCP and UDP (65536 different ports)
  - 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](#)

# DHCP

- How does the Internet find me when I move around with my laptop/tablet/phone? Or when I plug my computer to an Ethernet jack?
  - By using the **Dynamic Host Configuration Protocol**
- Protocol standardized in 1993 that uses IP
- DHCP dynamically **distributes network configuration parameters** to computers on a network, without the need of a network administrator



# 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
  - We used it to access the server 132.206.14.130
  - Usually works on port 22
  - Data is encrypted

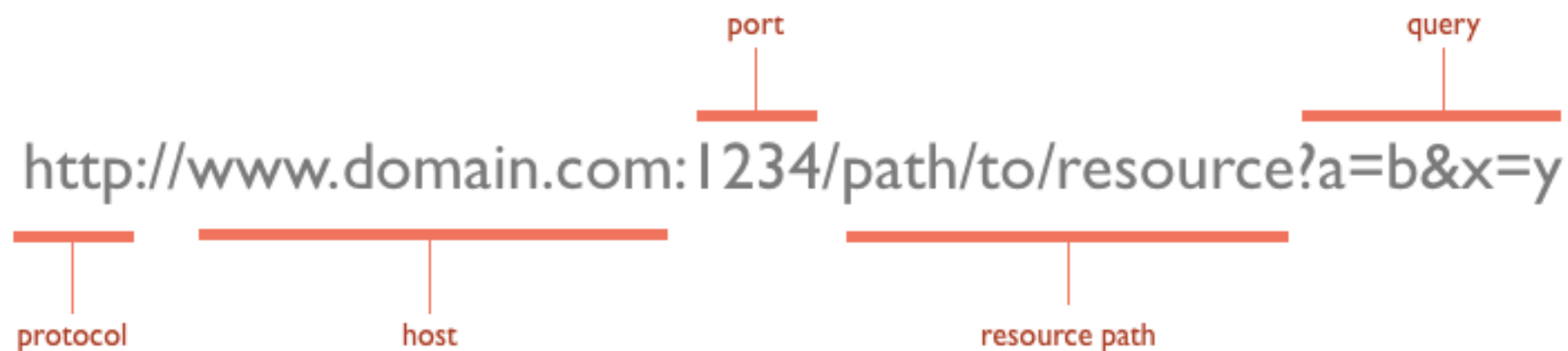
# SSH (Secure Shell)

- 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, for example:
  - 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
- At the heart of web communications using HTTP is the **request message**
- These request messages **are sent using Uniform Resource Locators**, known as URLs
- URLs have the following **components**:

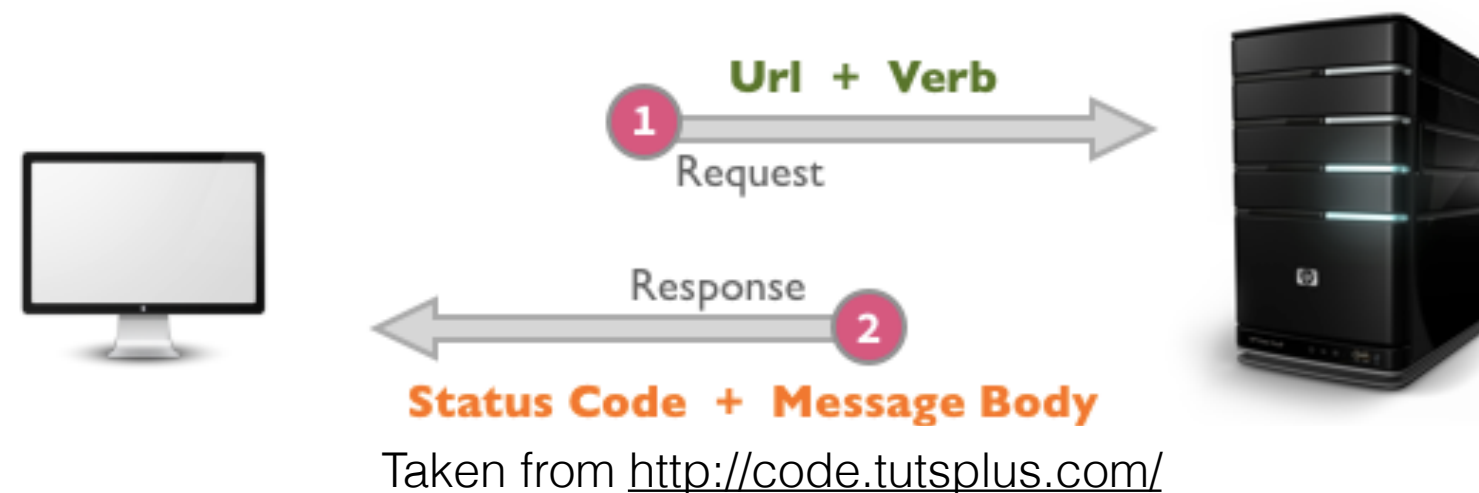


Taken from <http://code.tutsplus.com/>



# 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)



- 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](http://www.w3schools.com/css/css_intro.asp)**



**An HTML document has two main parts:  
head and body.**

## HEAD - Internal (hidden) information, metadata

- Title [http://www.w3schools.com/tags/tag\\_title.asp](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

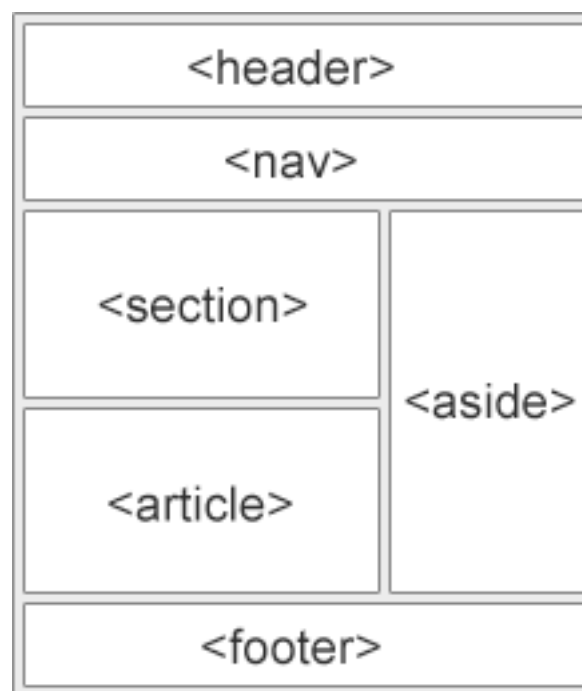
# HTML5 SEMANTIC ELEMENTS

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

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

Non-semantic elements **tell nothing about their content**

Examples of non-semantic elements: `<div>` and `<span>`



# CSS

## Cascading Style Sheets

**CSS defines how the HTML elements will be displayed!**

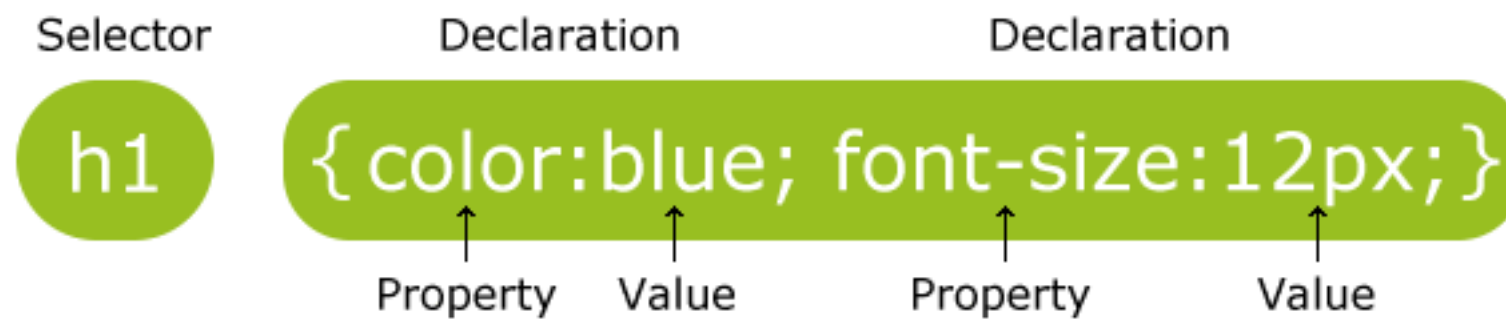
**CSS is designed primarily to enable the separation of document content from document presentation**

**[http://www.w3schools.com/css/demo\\_default.htm](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;  
}
```

3. .X

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

2. #X

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

4. X Y

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

## Three Ways to Insert CSS

- Inline style
- Internal style sheet
- External style sheet

# Inline styles

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

# Internal style sheet

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

# External style sheet

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

# CSS Styles

Position

Borders

Backgrounds

Gradients

Text Effects

Fonts

2D Transforms

3D Transforms

Transitions

Animations

Multiple Columns

User Interface

grids

# In-class demo

- Style the page for a band that I like
- <https://mumt301.github.io/code/18plus.html>



# Today's class

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