Internet and HTTP

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Technical Trainers

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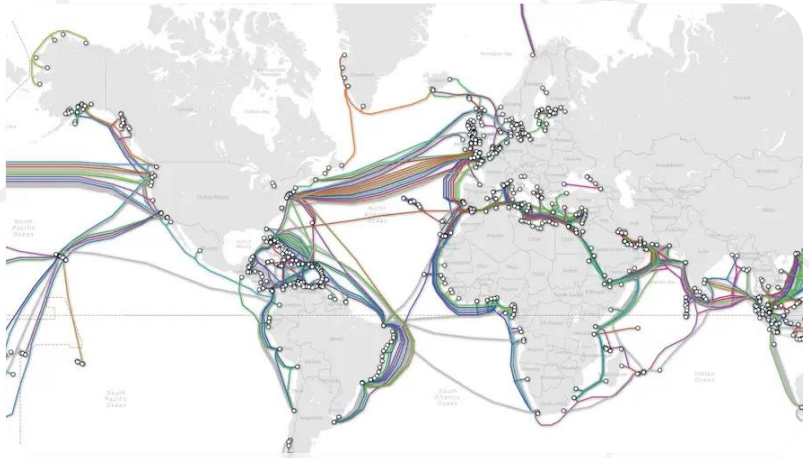
Introduction

An Introduction to the Internet

What is the Internet?

- **Vast network** that connects billions of devices together all over the globe
- Through **fiber optics**, **copper**, **satellites** or **cell phone network**
- We get indirectly **connected** though **ISP**s (**I**nternet **S**ervice **P**roviders)



Networks and Internet

- **Network** is a group of **two or more devices** that can communicate
- **The internet** is made of hundreds of thousands of **networks**
- These different systems **connect to each other**, **communicate with each other** and **work together** because of standards for how data is sent

Web Server Work Model

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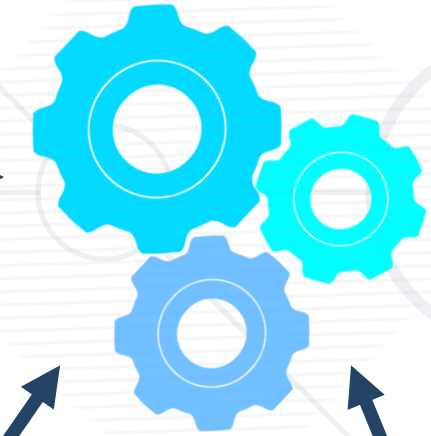
Web Client

Web Server

Technology

Request

Response



Web Resources

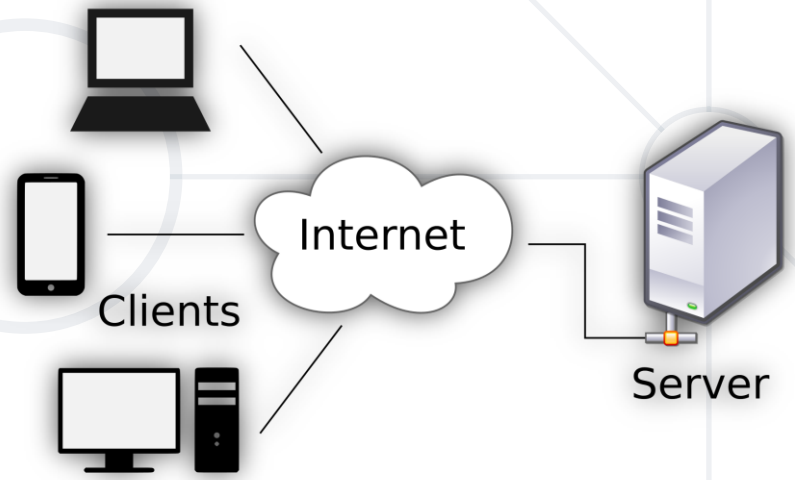
HTML, PDF, JPG…

Database

Important Definitions

Servers and Clients

- **Servers** are the machines that provide services to other machines
- **Clients** are the machines that are used to connect to those services

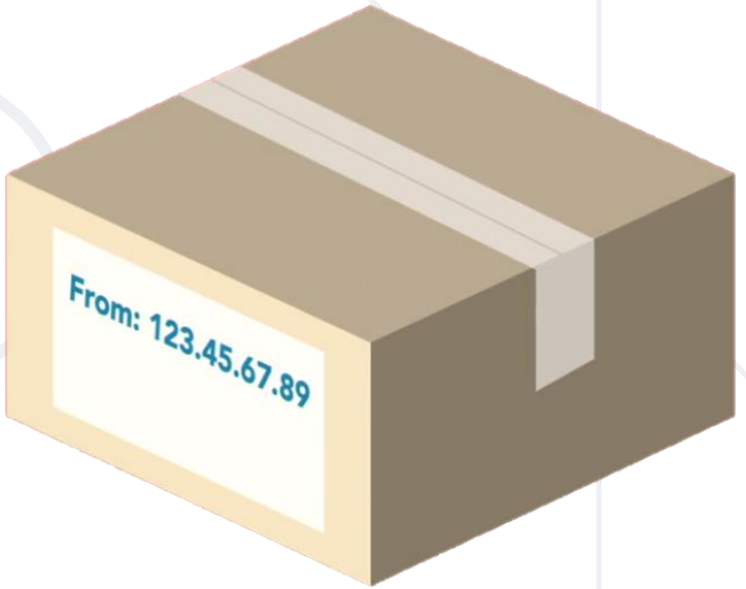


Network Protocol

- Set of **rules** and **standards**, that allow communication between network devices
- Include **mechanisms** for devices to **identify** and make **connections** with each other
- Example for standard network protocols:
  - TCP, UDP, IP, ARP
  - HTTP, FTP, TFTP, SMPT, SSH

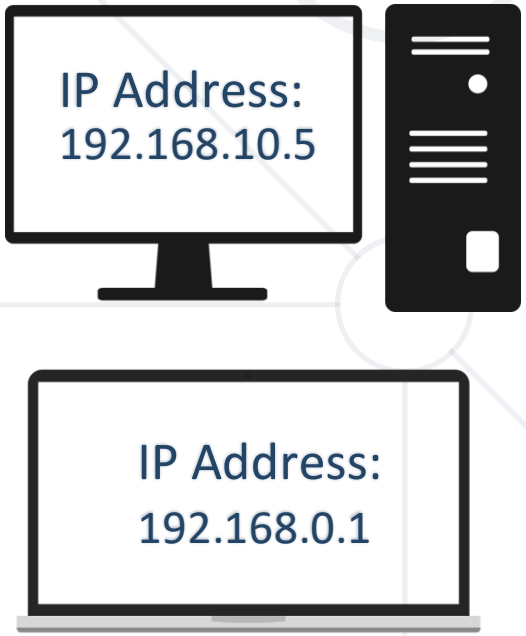
Packets

- Every message, file or stream of information **sent over computer networks** is broken down into small chunks called **packets**
- Each packet contains **important information** inside of it called a **header**:
  - Contents
  - Origin
  - Destination



Internet Protocol (IP)

- All the devices on the Internet have **IP Addresses**
- Each IP address is **unique** to each computer or a device at the edge of the network



IP Address

- An **IP Address** has many parts, organized in a hierarchy

Subnetworks

192.168.14.120

Device address

- This version of IP Addressing is called **IPv4**
  - Provides more than 4 billion **32 bits** unique addresses

IP address classes

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Class	Address range	Supports
Class A	1.0.0.1 to 126.255.255.254	Supports 16 million hosts on each of 127 networks.
Class B	128.1.0.1 to 191.255.255.254	Supports 65,000 hosts on each of 16,000 networks.
Class C	192.0.1.1 to 223.255.254.254	Supports 254 hosts on each of 2 million networks.
Class D	224.0.0.0 to 239.255.255.255	Reserved for multicast groups.
Class E	240.0.0.0 to 254.255.255.254	Reserved for future use, or research and development purposes.

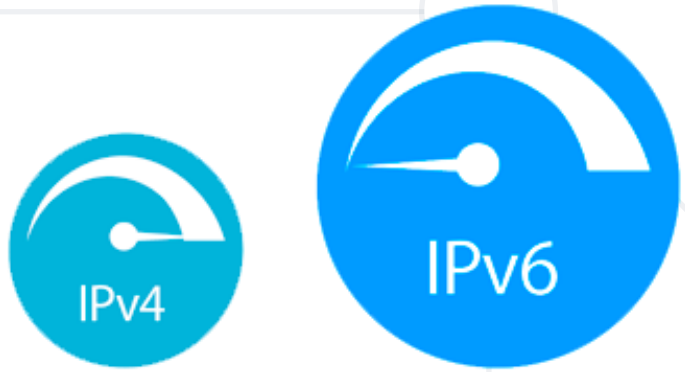
Classless Inter-Domain Routing

- CIDR is an **IP addressing scheme** that improves the allocation of IP addresses
- Replaces the old system based on classes A, B, and C
- Helps greatly **extend the life of IPv4**

CIDR	IP address range	Class
10.0. 0.0/8	10.0. 0.0 – 10.255. 255.255	A
172.16. 0.0/12	172.16. 0.0 – 172.31. 255.255	B
192.168. 0.0/16	192.168. 0.0 – 192.168. 255.255	C

IPv6

- **IPv6** uses **128 bits**
- Example of a full IPV6 address:
  - **3FFE:F200:0234:AB00:0123:4567:8901:ABCD**
  - The **leading zeros** can usually be left out
- Provides about 340 undecillion **unique** addresses



Domain Name Server

- The **domain name** is a human way to access IP addresses for devices and websites around the world
- When a domain name is entered in the browser, a request is made the **DNS**

IP Address	Domains
216.58.214.46	Google.com
217.174.159.195	Softuni.bg

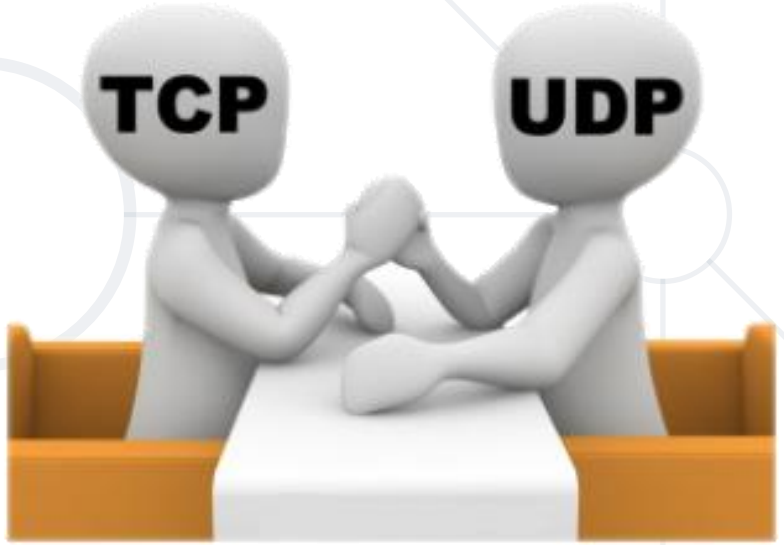
Transmission Control Protocol (TCP)

- Designed to **send packets** across the internet and **ensure the successful delivery** of data and messages over networks
- Uses a process, where it looks at **all the packets** in a message and **checks them**
- **TCP verifies** that all the packets are:
  - In the right order
  - Free of any issues

- After that it **certifies the data**, and the packets are **merged** to recreate the **original** file that was on the sender's device

TCP vs UDP

- **TCP** places **reliability** in a higher priority than speed
- For instances where reliability isn't as important, but **speed** is, there is another protocol called **UDP** (**User Datagram Protocol**)
- UDP doesn't do excessive reliability checks, but it can send information at a faster rate

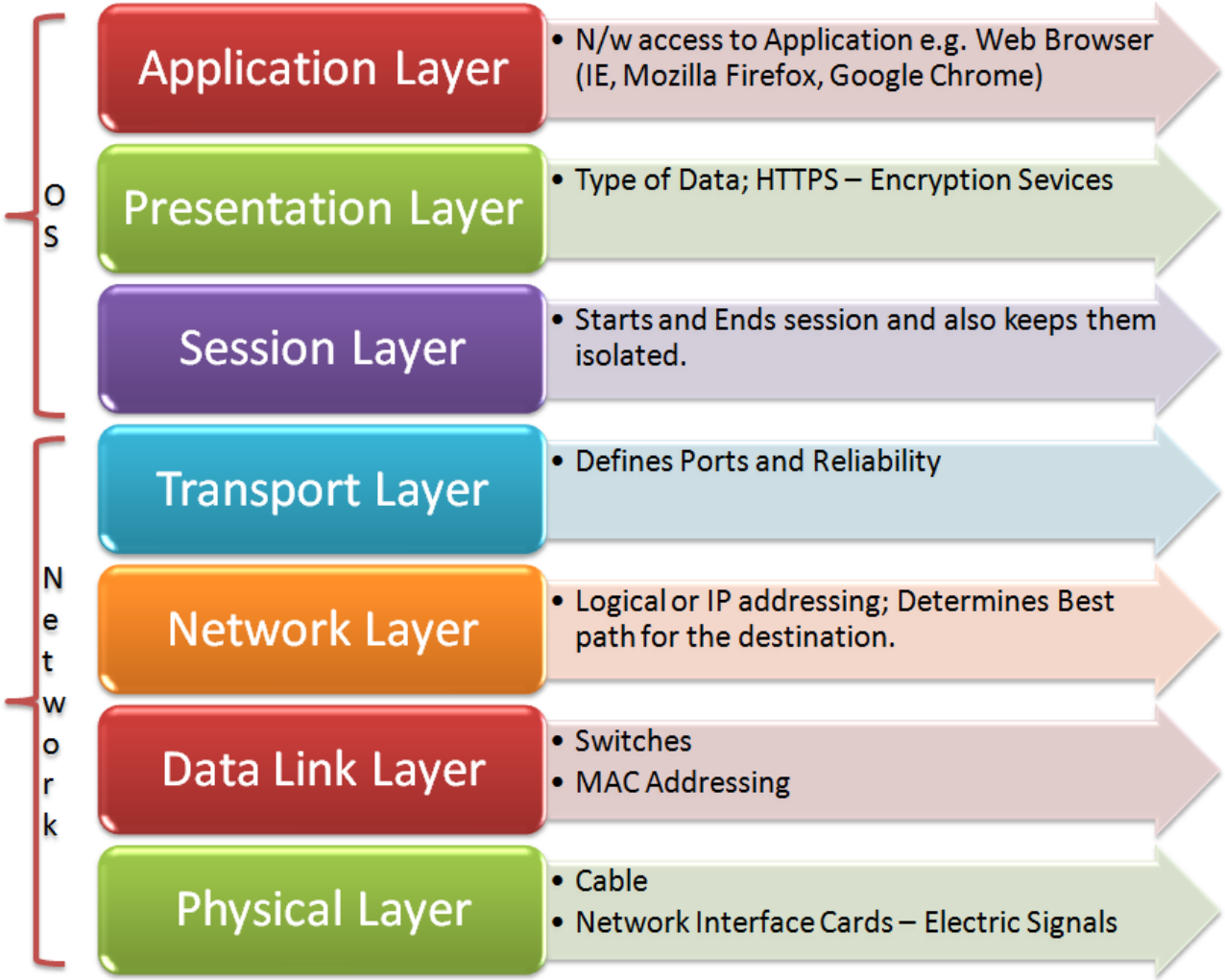


Open System Interconnect Model

- OSI Model consists of **7 layers**
  - Each layer serves the layer above it and in return, it is served by the layer below it
- Understanding each layer of the model helps us with:
  - **Troubleshooting**
  - **Communicating** better with technical and non-technical individuals about any system

OSI Layers

- OSI Model consists of 7 layers:



Example Protocols

HTTP, DNS, FTP, SMTP

TLS, SSL, compression

NetBIOS, PPTP, Sockets

TCP, UDP

IP, IPsec

ATM, Ethernet, MAC, LLC

USB, Bluetooth, 802.11a/b/g/n

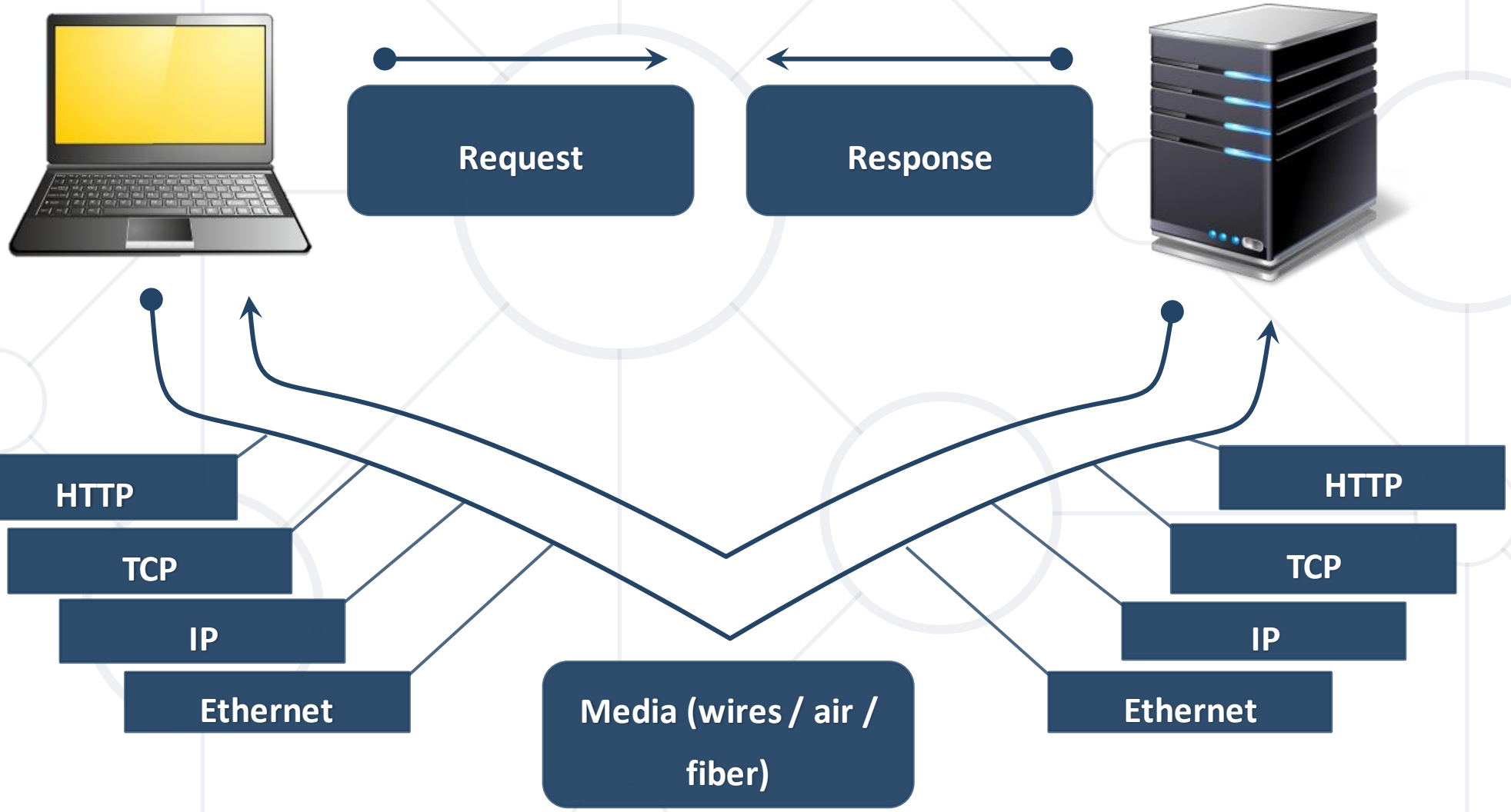
Basic Hardware Components

- **Cables** - transfer data from one device to another
- **Routers** - transfer data packets between different computer networks (operates on level 3 of OSI)
- **Repeaters**, **Hubs** and **Switches** - connect network devices together so that they can function as a single segment
- **Network Interface Card** (**NIC**) - computer component that connects the device to the network

HTTP Basics

Web Communication Explained

Hyper Text Transfer Protocol



HTTP Request Methods

Method	Description
POST	Create / store a resource
GET	Read / retrieve a resource
PUT	Update / modify a resource
DELETE	Delete / remove a resource

The four basic functions of persistence storage.

Other HTTP Methods
CONNECT
HEAD
OPTIONS
TRACE

HTTP Conversation: Example

- HTTP **request**:

```
GET /courses/javascript HTTP/1.1
Host: www.softuni.bg
User-Agent: Mozilla/5.0
<CRLF>
```

The empty line denotes the end of the request headers

- HTTP **response**:

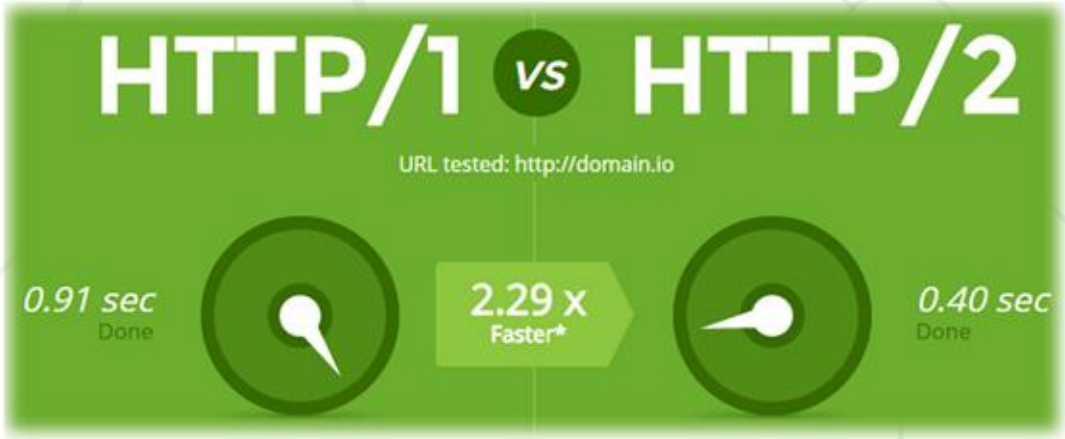
```
HTTP/1.1 200 OK
Date: Mon, 5 Jul 2010 13:09:03 GMT
Server: Microsoft-HTTPAPI/2.0
Last-Modified: Mon, 12 Jul 2014 15:33:23 GMT
Content-Length: 54
<CRLF>
<html><title>Hello</title>
Welcome to our site</html>
```

The empty line denotes the end of the response headers

What's HTTP/2.0

- Major revision of the **HTTP** network protocol used by the **World Wide Web**
  - Supported by most of the popular web browsers
- Fast and optimized, meets modern web usage requirements
- Completely Backwards-Compatible

- Almost **50%** of all the websites support **HTTP/2** (W3Techs statistics)



URL

Uniform Resource Locator

Uniform Resource Locator (URL)

- A **URL** is a reference to a web resource that specifies its location on a network and a mechanism for retrieving it
- A URL is a specific type of URI (**Uniform Resource Identifier**)

URL Encoding

- URLs are encoded according RFC 1738:
  - Safe URL characters: `[0-9a-zA-Z]`, `$`, `-`, `_`, `.`, `+`, `*`, `'`, `(`, `)`, `,`, `!`
- All other characters are escaped by:

```
%[character hex code]
```

  - Space is encoded as "`+`" or "`%20`"

```
Наков-爱-SoftUni
```

  - URL-encoded string:

```
%D0%9D%D0%B0%D0%BA%D0%BE%D0%B2-%E7%88%B1-SoftUni
```

Char	URL Encoding
space	%20
щ	%D1%89
"	%22
#	%23
$	%24
%	%25
&	%26

Tools for Developers

Dev Tools

Tools for Developers – Browser Dev Tools

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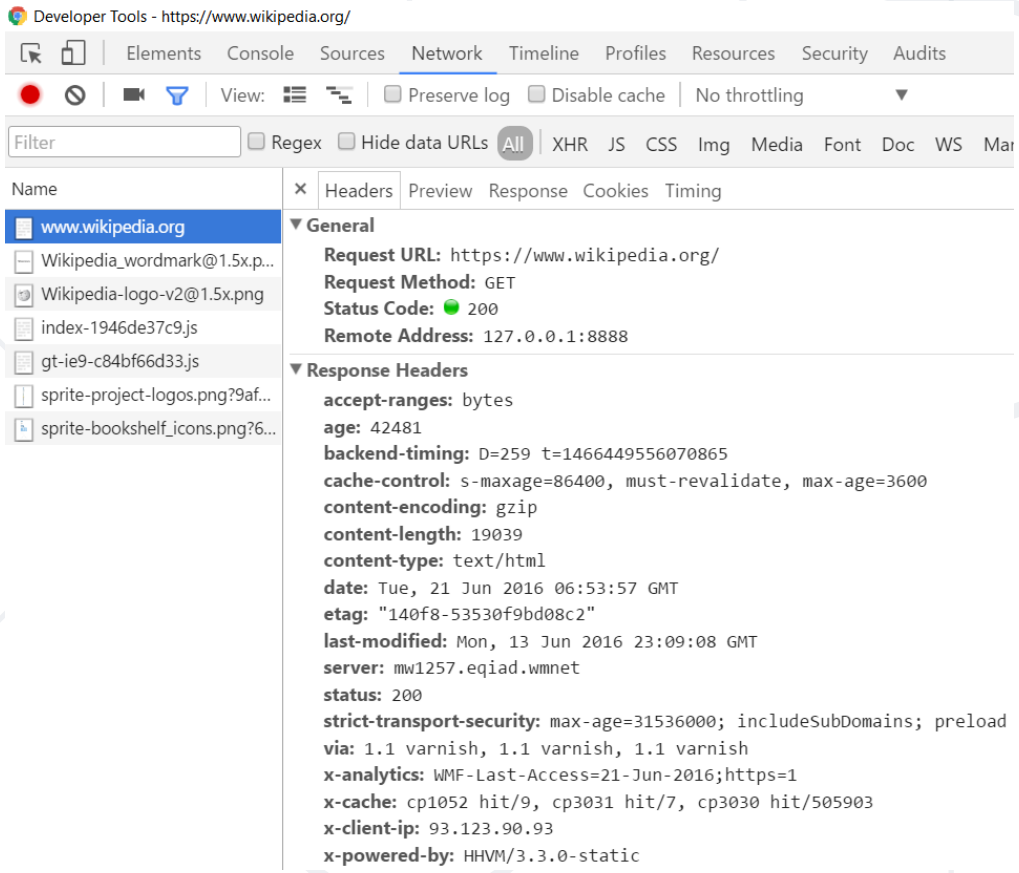
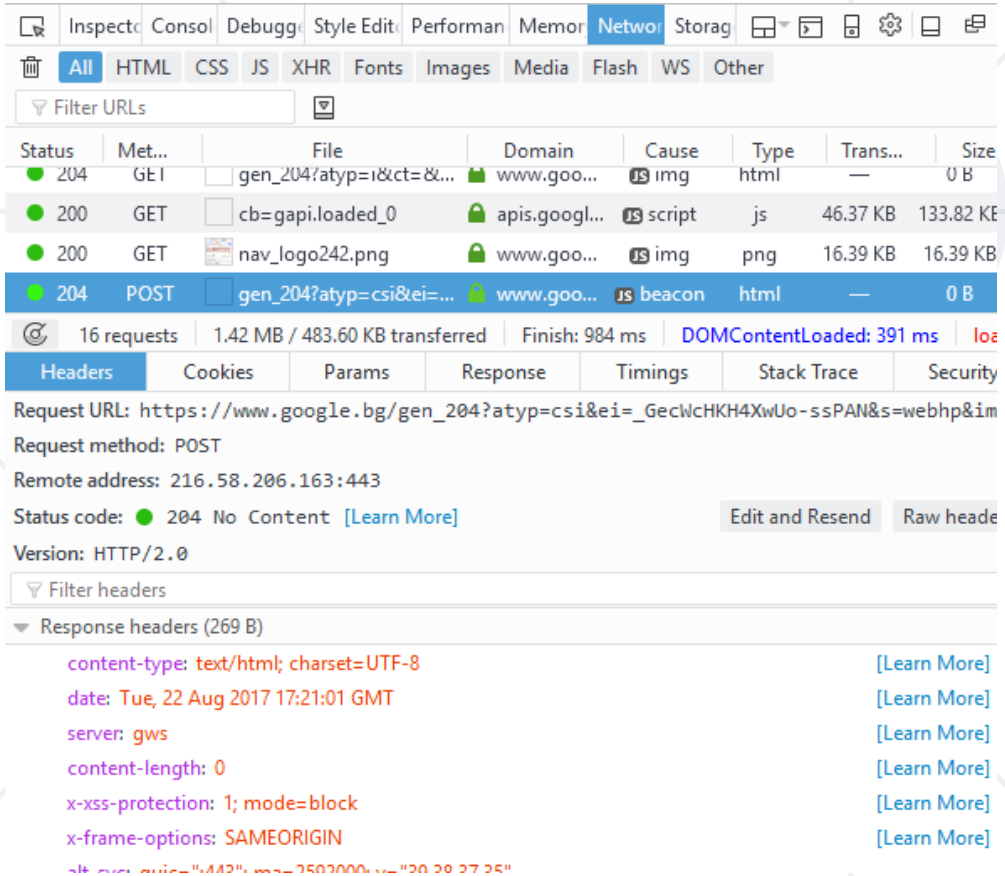


Chrome Developer Tools



Mozilla Developer Tools

Tools for Developers – Browser Add-ons

Postman - Chrome

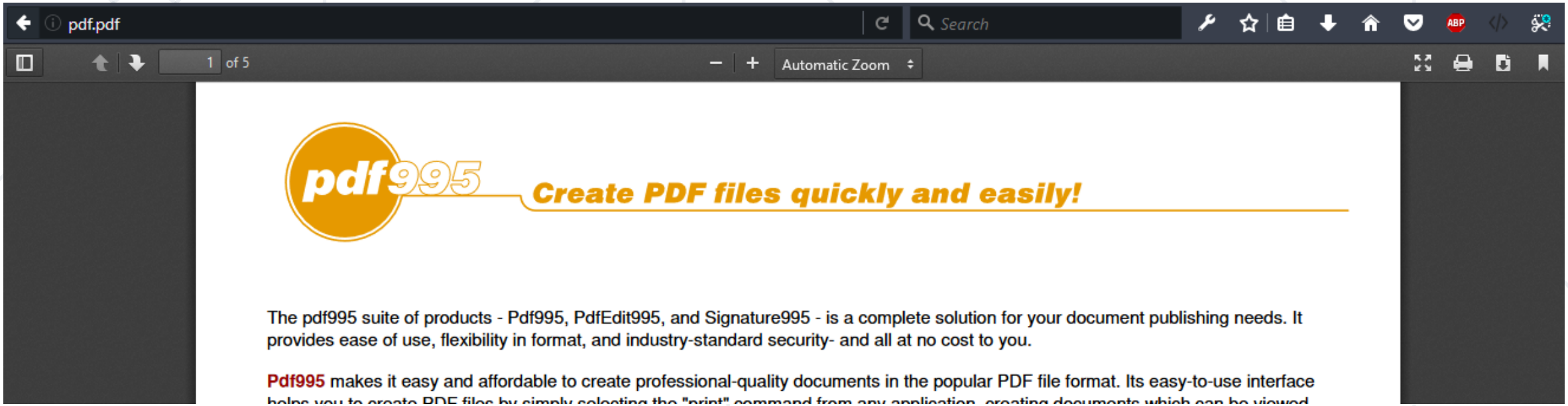
Rested - Firefox

Multi-Purpose Internet Mail Extensions

MIME and Media Types

What is MIME?

- MIME == Multi-Purpose Internet Mail Extensions
  - Internet standard for encoding resources
  - Originally developed for email attachments
  - Used in many Internet protocols like HTTP and SMTP



Common MIME Media Types

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MIME Type / Subtype	Description
application/json	JSON data
image/png	PNG image
image/gif	GIF image
text/html	HTML
text/plain	Text
text/xml	XML
video/mp4	MP4 video
application/pdf	PDF document

HTTP Request / HTTP Respond

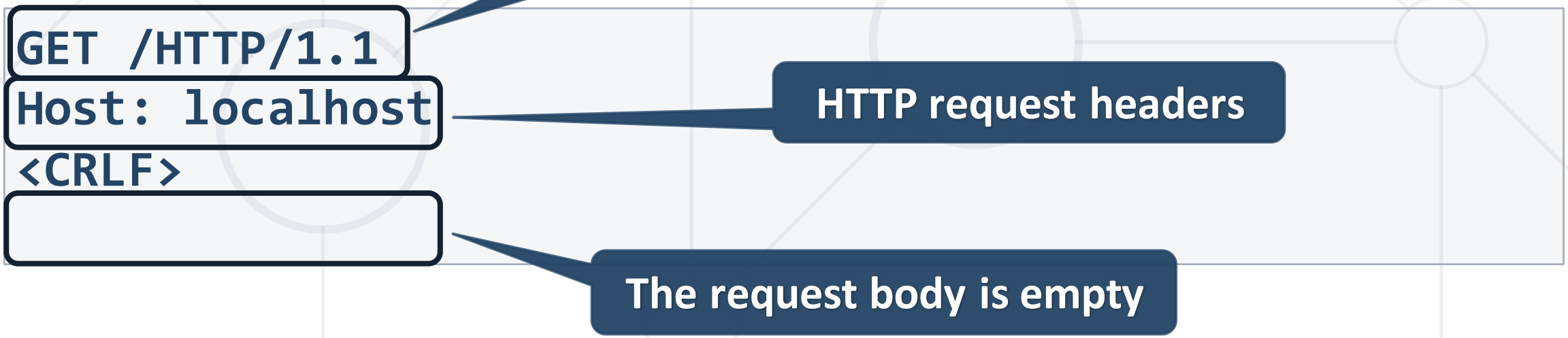
HTTP Request Message

- Request message sent by a client consists of:
  - HTTP **request line**
    - Request **method** (GET / POST / PUT / DELETE / …)
    - Resource **URI** (URL)
    - Protocol **version**
  - HTTP **request headers**
    - Additional parameters
  - HTTP **request body** – optional data e.g., posted form fields

```
<method> <resource> HTTP/<version>
<headers>
(empty line)
<body>
```

GET Request Method – Example

```
<form method="get">
    Name: <input type="text" name="name" />
    Age: <input type="text" name="age" />
    <input type="submit" />
</form>
```



POST Request Method – Example

- The **POST** method transfers data in the HTTP body
- **POST** can send text and binary data e.g., upload files

```
POST /login HTTP/1.1
Host: localhost
Content-Length: 59
<CRLF>
username=mente&password=top*secret!
<CRLF>
```

HTTP request line

HTTP request headers

The request body holds the submitted form data

HTTP Response Message

- The **response message** sent by the HTTP server consists of:
  - HTTP response **status line**
    - Protocol version
    - Status code
    - Status text
  - Response **headers**
    - Provide meta data about the returned resource
  - Response **body**
    - The content of the HTTP response (data)

```
HTTP/<version> <status code> <status text>
<headers>
<CRLF>
<response body - the requested resource>
```

HTTP Response Codes

- HTTP response code classes
  - **1xx**: informational (e.g., "**100 Continue**")
  - **2xx**: successful (e.g., "**200 OK**", "**201 Created**")
  - **3xx**: redirection (e.g., "**304 Not Modified**", "**301 Moved Permanently**", "**302 Found**")
  - **4xx**: client error (e.g., "**400 Bad Request**", "**404 Not Found**", "**401 Unauthorized**", "**409 Conflict**")
  - **5xx**: server error (e.g., "**500 Internal Server Error**", "**503 Service Unavailable**")

HTTP Response – Example

- Example of **HTTP response** from the Web server:

```
HTTP/1.1 200 OK
Date: Fri, 17 Jul 2010 16:09:18 GMT+2
Server: Apache/2.2.14 (Linux)
Accept-Ranges: bytes
Content-Length: 84
Content-Type: text/html
<CRLF>
<html>
  <head><title>Test</title></head>
  <body>Test HTML page.</body>
</html>
```

HTTP response **status line**

HTTP response **headers**

HTTP response **body**

HTTP Response – Example

- Example of **HTTP response** with **error** result:

```
HTTP/1.1 404 Not Found
Date: Fri, 17 Nov 2014 16:09:18 GMT+2
Server: Apache/2.2.14 (Linux)
Connection: close
Content-Type: text/html
<CRLF>
<HTML><HEAD><TITLE>404 Not Found</TITLE></HEAD>
<BODY>
<H1>Not Found</H1>
The requested URL /img/logo.gif was not found on this server.<P>
<HR><ADDRESS>Apache/2.2.14 Server at Port 80</ADDRESS>
</BODY></HTML>
```

HTTP response status line

HTTP response headers

The HTTP response body

Browser Redirection

- HTTP **GET requesting** a moved URL:

```
GET / HTTP/1.1
Host: http://softuni.org
User-Agent: Gecko/20100115 Firefox/3.6
<CRLF>
```

- The following HTTP response (**301 Moved Permanently**) tells the browser to request another URL:

```
HTTP/1.1 301 Moved Permanently
Location: http://softuni.bg
...
```

Summary

- Internet, Definitions of Internet
- Sending and Receiving Information
- What is HTTP
- What is URL
- Browser Tools for Developers
- What is MIME

Questions?

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SoftUni Foundation

SoftUni Kids

SoftUni Diamond Partners

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Educational Partners

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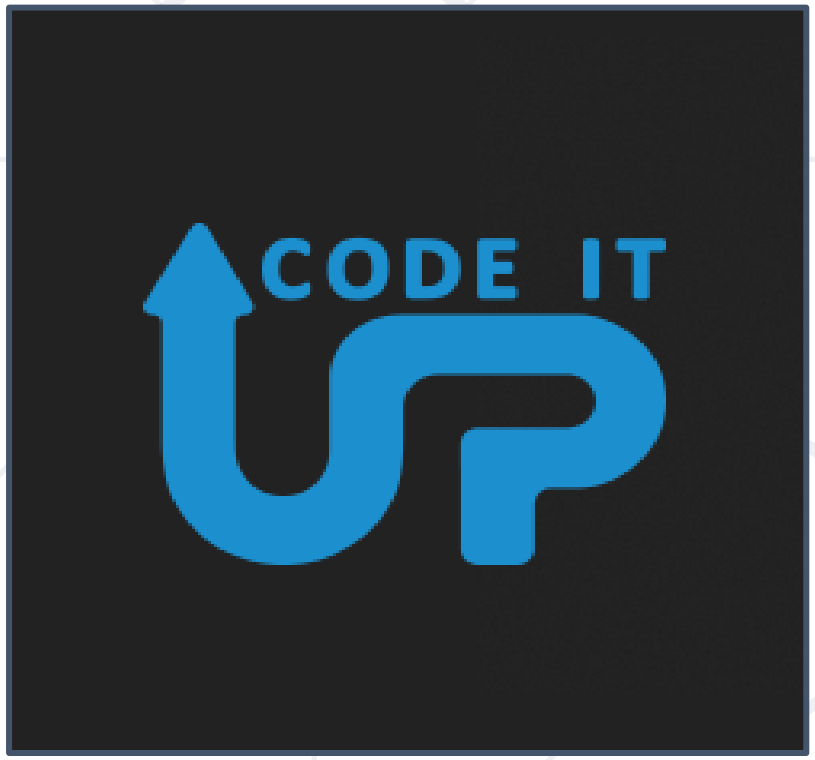

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