NETWORK

Communication, Internet, Web

NETWORK

A digital computer network, sometimes abbreviated as network in this context, is a group of interconnected devices that communicate with each other.

COMMUNICATION FUNCTIONS

- Resource sharing and collaboration

- Remote access and telecommuting

- Data exchange and transfer

- Internet and web-based services

- User-friendly interfaces and human-computer interaction

Communication Elements

1. Medium
2. Address
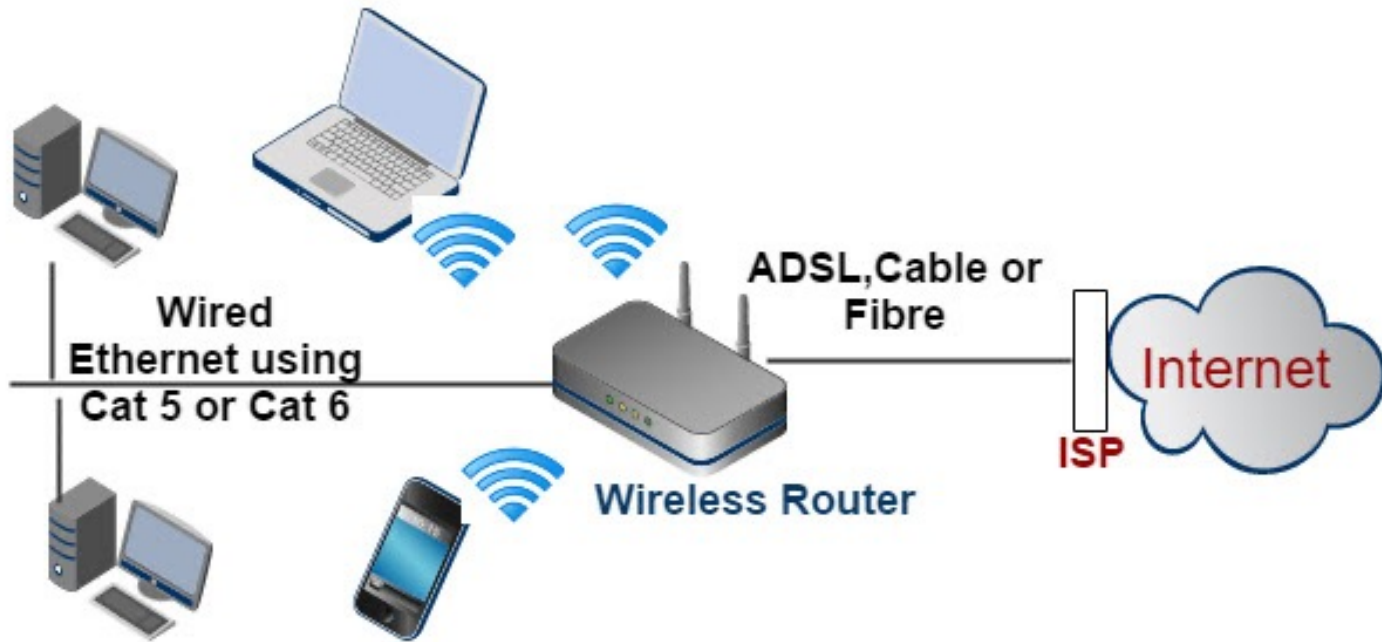3. Protocol
4. Language

NETWORK BY DISTANCE

Near Field Communication (NFC): 10cm

Bluetooth Networks: 10m

Local Area Networks (LAN): 10km, IEEE 802.3, 802.11

Wide Area Networks (WAN): 1000km, Internet

Satellite Networks: space neetwork

Network Diagram-Typical Simple Home Network

HOME NETWORK

CONNECT TO INTERNET

- ADSL (Asymmetric Digital Subscriber Line)

- Broadband Network (Cable or DSL)

- Fiber Optic Network

- Satellite Internet

- Mobile Broadband (4G/5G)

INTERNET: THE GLOBAL COMPUTER NETWORK

It is a network of networks, comprising millions of interconnected computers, servers, and devices that span the globe.

This early network, called ARPANET, was designed to be robust and fault-tolerant, with multiple paths for data to travel in case of a failure.
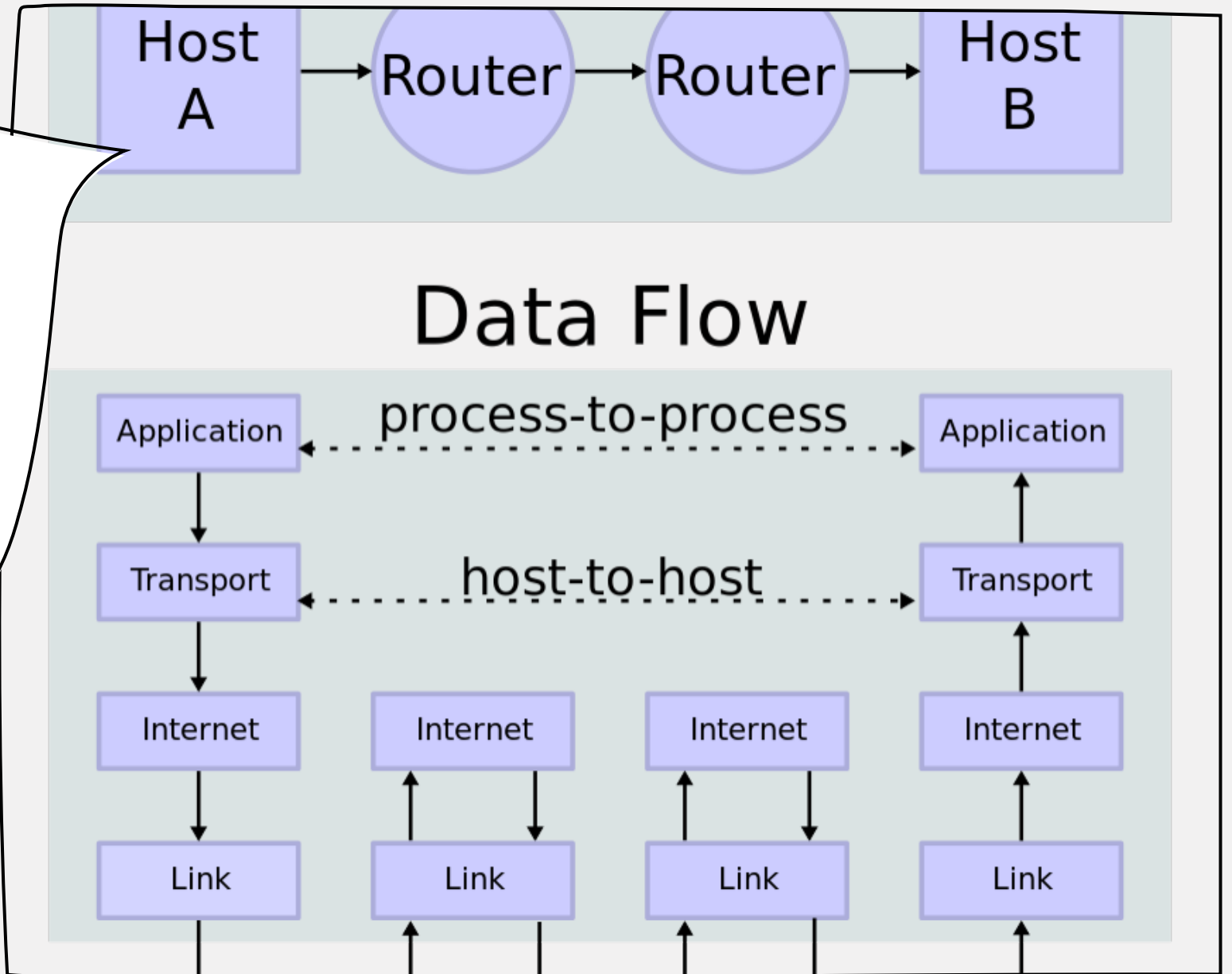
Vint Cerf internet https://youtu.be/Dxcc6ycZ73M

INTERNET: PROS AND CONS

- Pros: people from all over the world to connect with each other
- Cons: censorship and surveillance

History of internet: https://youtu.be/9hIQjrMHTv4

WHY LAYERS

- Modularity and Scalability: The layered architecture of the Internet promotes modularity, with each layer responsible for a specific set of functions.

- Abstraction and Simplification: The layered model abstracts the complexities of the underlying network infrastructure, allowing users and applications to interact with the network at a higher level of abstraction.

- Flexibility and Interoperability: The layered architecture of the Internet promotes flexibility and interoperability by providing well-defined interfaces between adjacent layers.

- Fault Isolation and Troubleshooting: The layered architecture of the Internet facilitates fault isolation and troubleshooting by compartmentalizing network functionality into distinct layers.

INTERNET PHYSICAL MEDIUM

The physical medium refers to the infrastructure that enables data transmission.

In the case of the Internet, this infrastructure consists of various Local Area Networks (LANs) and Wide Area Networks (WANs).

- ADSL (Asymmetric Digital Subscriber Line)

- Broadband Network (Cable or DSL)

- Fiber Optic Network

- Satellite Internet

- Mobile Broadband (4G/5G)

INTERNET ADDRESS

- IPv4, the original version of IP, was developed in the 1980s and was designed to support a small number of devices.

- Its 32-bit addressing scheme allowed for approximately 4.3 billion unique addresses, which seemed sufficient at the time.

- The 32-bit address is divided into four parts, each representing a byte in decimal.
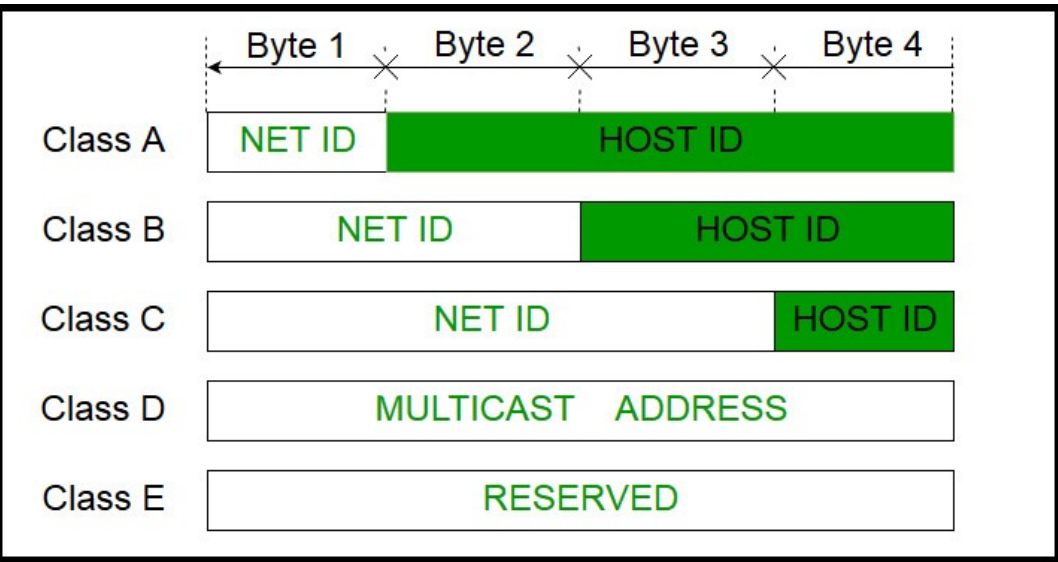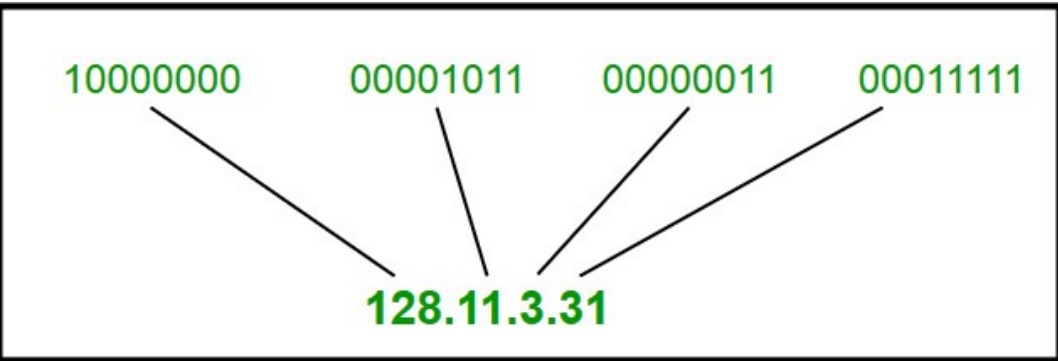
ADDRESS PATTERNS

- An IPv4 address consists of two parts: a network part and a host part.

- Addresses are classified into five categories: Class A, Class B, Class C, Class D, and Class E.

CLASS	LEADING BITS	NET ID BITS	HOST ID BITS	NO. OF NETWORKS	ADDRESSES PER NETWORK	START ADDRESS	END ADDRESS
CLASS A	0	8	24	2^7 (128)	2^{24} (16,777,216)	0.0.0.0	127.255.255.255
CLASS B	10	16	16	2^{14} (16,384)	2^{16} (65,536)	128.0.0.0	191.255.255.255
CLASS C	110	24	8	2^{21} (2,097,152)	2^8 (256)	192.0.0.0	223.255.255.255
CLASS D	1110	NOT DEFINED	NOT DEFINED	NOT DEFINED	NOT DEFINED	224.0.0.0	239.255.255.255
CLASS E	1111	NOT DEFINED	NOT DEFINED	NOT DEFINED	NOT DEFINED	240.0.0.0	255.255.255.255

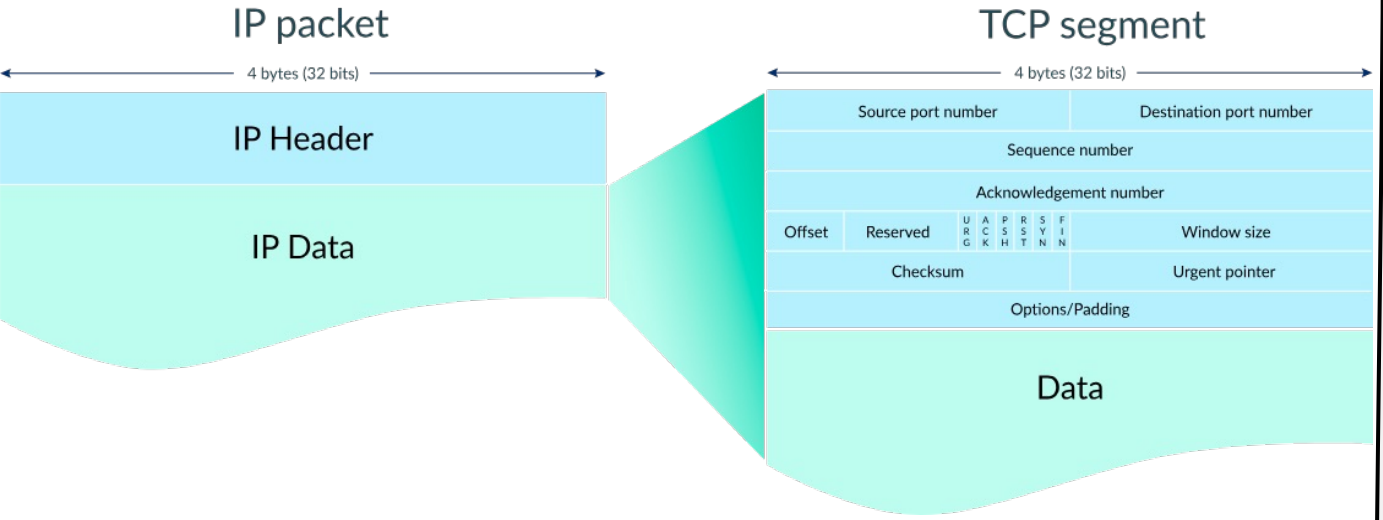# INTERNET PROTOCOLS: IP

The original message is Green, Blue, Red.
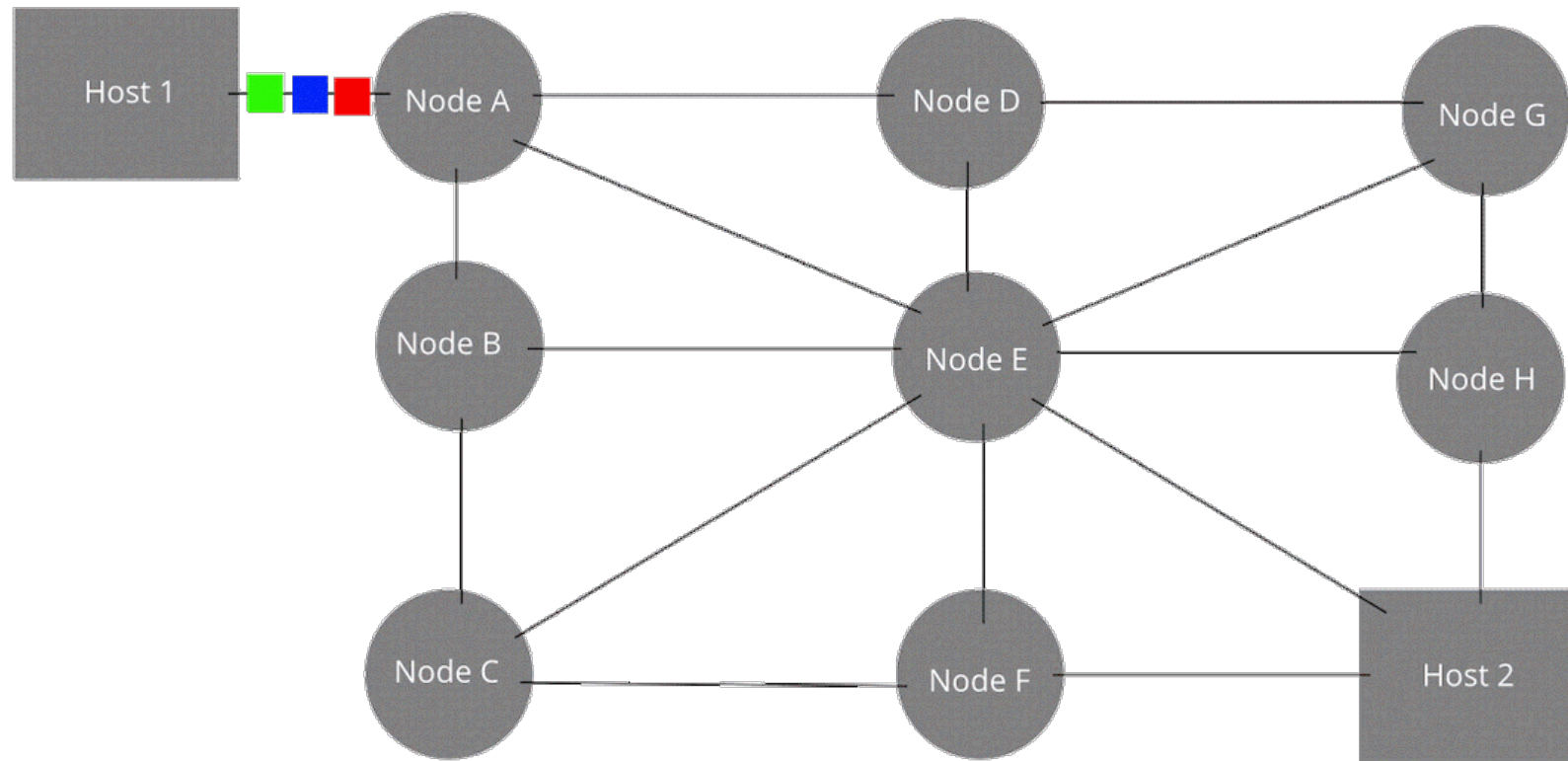
PACKET SWITCHING NETWORK

Packet Switching Video: https://youtu.be/pWLSS9fFhiM

TRANSPORT PROTOCOLS

- *Transmission Control Protocol (TCP*) ensures reliable communication over the internet by providing error-checking and correction mechanisms. It establishes a connection between devices before transmitting data and guarantees that data is delivered in the correct order. TCP's functions include connection establishment, error-checking, and correction, ensuring that data is delivered reliably and in the correct order. This protocol is essential for applications that require guaranteed delivery, such as file transfers and email.

- *User Datagram Protocol ((UDP)* is a connectionless protocol that prioritizes speed over reliability. It does not establish a connection before transmitting data and does not guarantee that data will be delivered. UDP's functions include transmitting data without establishing a connection and not guaranteeing delivery or order of data packets. This protocol is suitable for applications that require fast transmission, such as video streaming or online gaming, as it reduces overhead and improves performance.

IP packet

4 bytes (32 bits)

IP Header

IP Data

TCP segment

4 bytes (32 bits)

Source port number	Destination port number

Sequence number

Acknowledgement number

Offset	Reserved	U R G	A C K	P S H	R S T	S Y N	F I N	Window size

Checksum	Urgent pointer

Options/Padding

Data

Source: https://www.khanacademy.org/computing/computers-and-internet/xcae6f4a7ff015e7d:the-internet/xcae6f4a7ff015e7d:transporting-packets/a/transmission-control-protocol--tcp

INTERNET LANGUAGE: DEFINED STANDARDS

Internet Protocol (IP) packet

Transmission Control Protocol (TCP) segment

User Datagram Protocol (UDP) datagram

DNS

- The Domain Name System (DNS) is a vital component of the internet, enabling users to access websites and online services using easy-to-remember domain names instead of complex IP addresses.

- DNS is a hierarchical naming system used to organize and identify resources on the Internet in a structured manner.

- Domain names are organized into levels, with each level representing a different part of the hierarchy. The most common levels include the top-level domain (TLD), second-level domain (SLD), and subdomain.
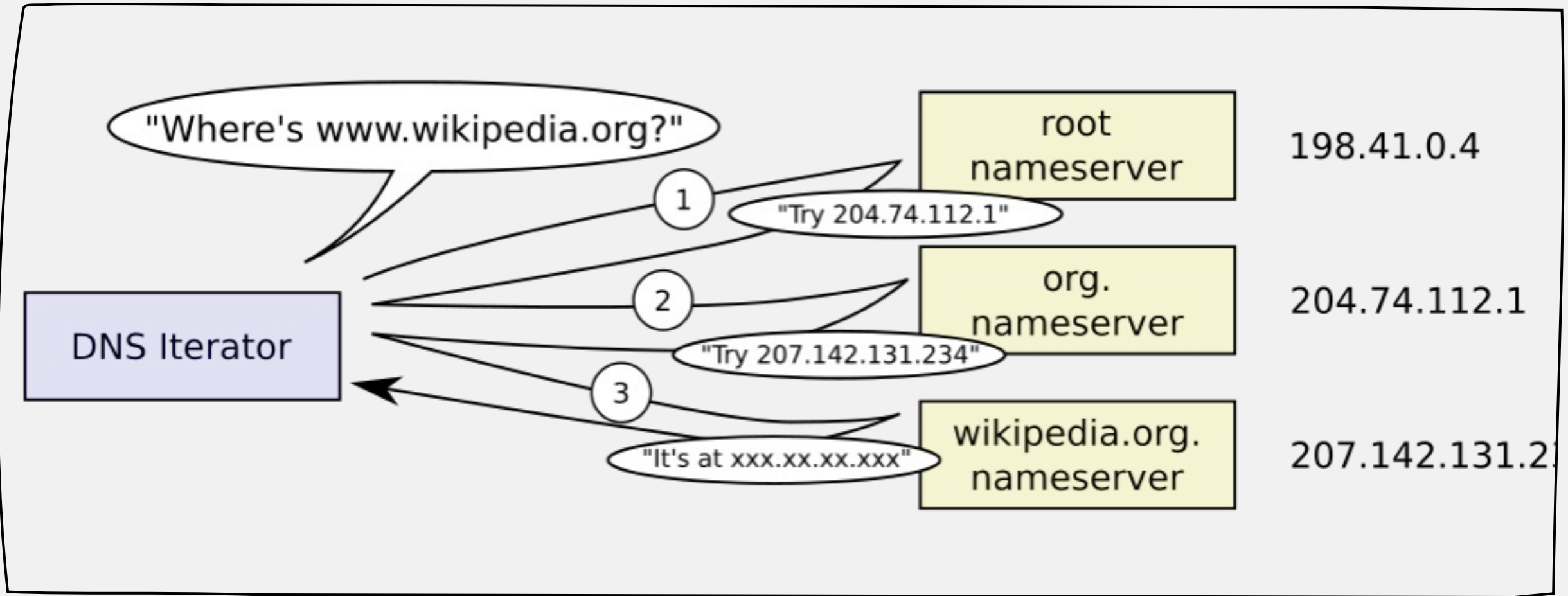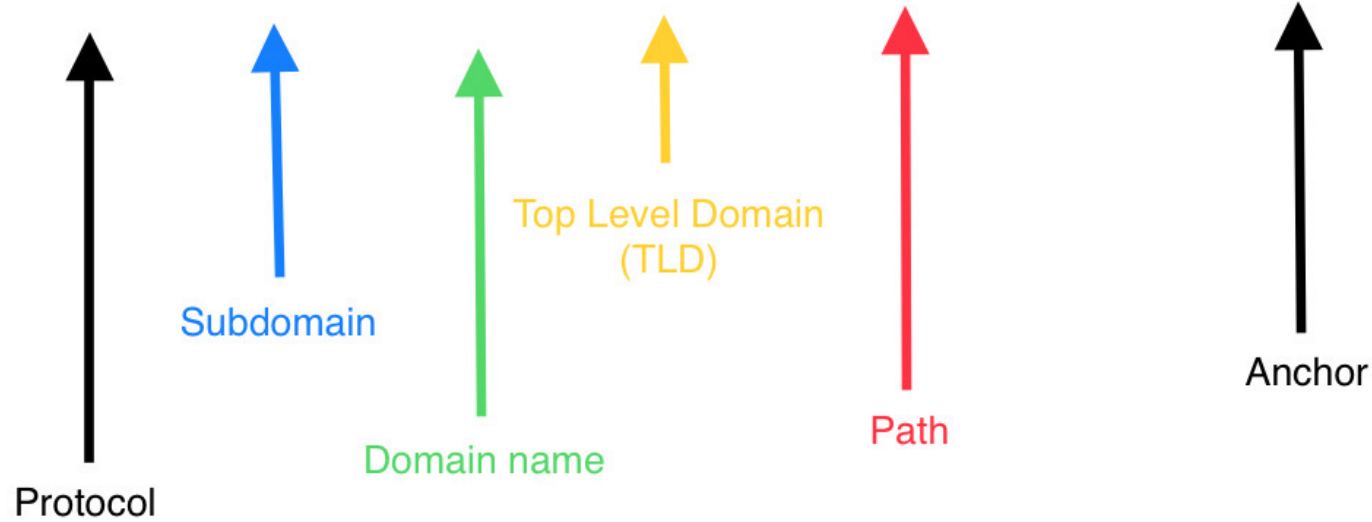
DNS
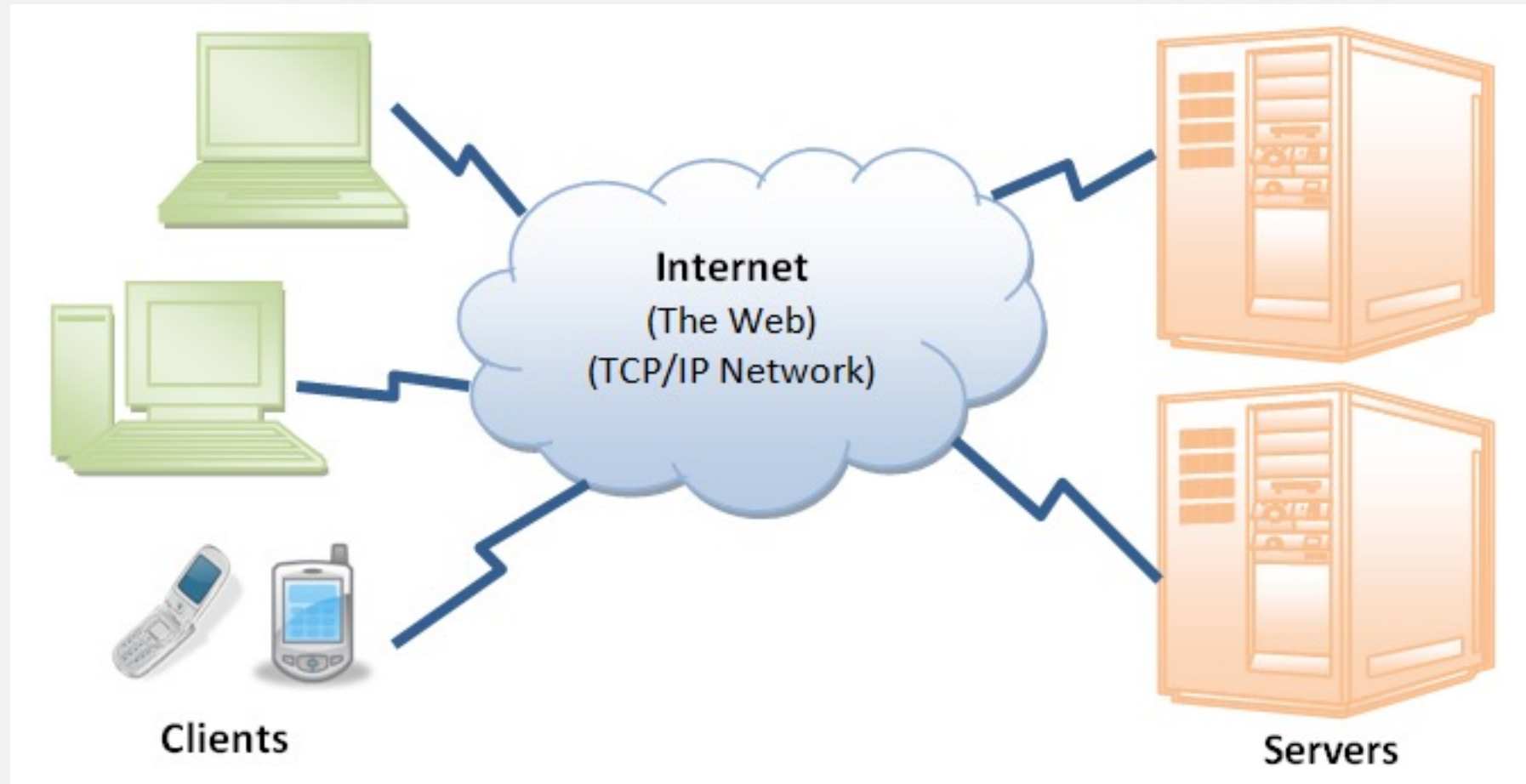
WWW COMPONENTS

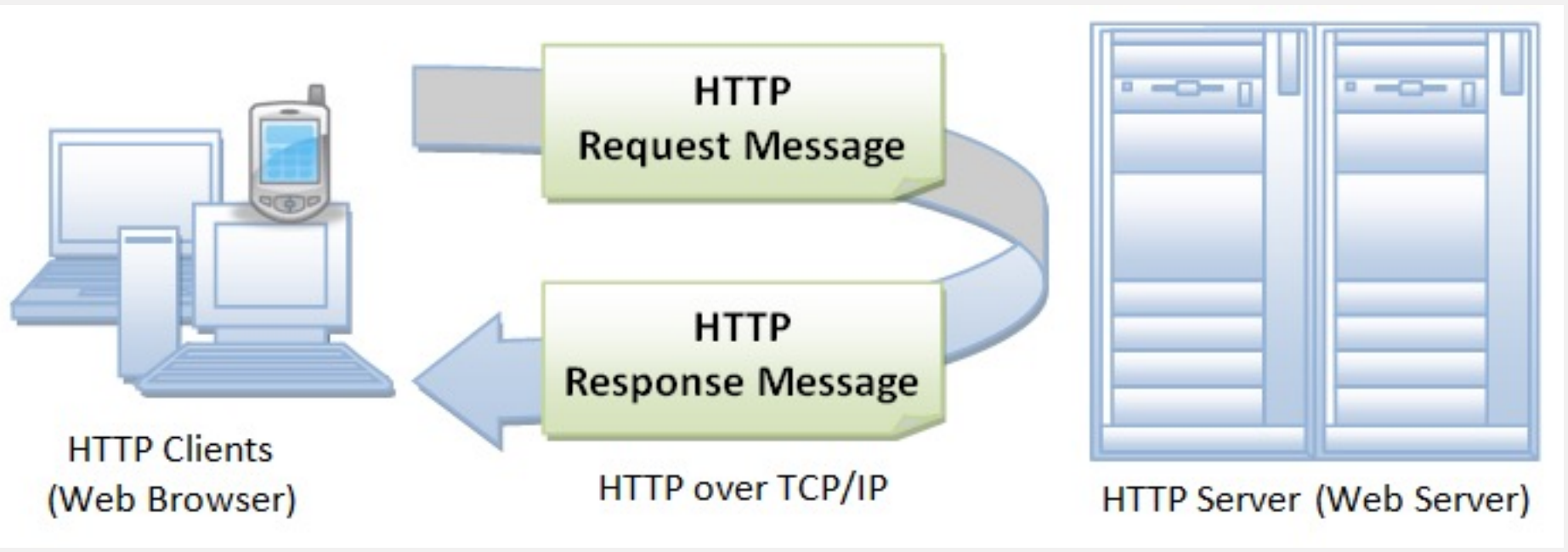Physical Medium: Internet

Address: URL

Protocols: HTTP, HTTP/S

Language: HTML + CSS + JavaScript

https://en.wikipedia.org/wiki/Internet#Terminology

Top Level Domain
(TLD)

Subdomain

Anchor

Path

Domain name

Protocol

URL

Internet
(The Web)
(TCP/IP Network)

Clients

Servers

HTTP
Request Message

HTTP
Response Message

HTTP Clients
(Web Browser)

HTTP over TCP/IP

HTTP Server (Web Server)

(1) User issues URL from a browser
http://host:port/path/file

(2) Browser sends a request message

```
GET URL HTTP/1.1
Host: host:port
.................
.................
```

(3) Server maps the URL to a file or program under the document directory.

(4) Server returns a response message

```
HTTP/1.1 200 OK
.................
.................
.................
```

(5) Browser formats the response and displays

Client (Browser)

HTTP (Over TCP/IP)

Server (@ host:port)

HTTPS: HYPERTEXT TRANSFER PROTOCOL SECURE

- Encryption: HTTPS encrypts the data exchanged between the website and its users, making it difficult for hackers to intercept and read the data.

- Authentication: HTTPS verifies the identity of the website, ensuring that users are communicating with the intended website and not an imposter.

- Trust: HTTPS establishes a secure connection, giving users confidence that their data is protected.

- SEO: Google gives a slight ranking boost to websites that use HTTPS, making it a crucial factor in search engine optimization.
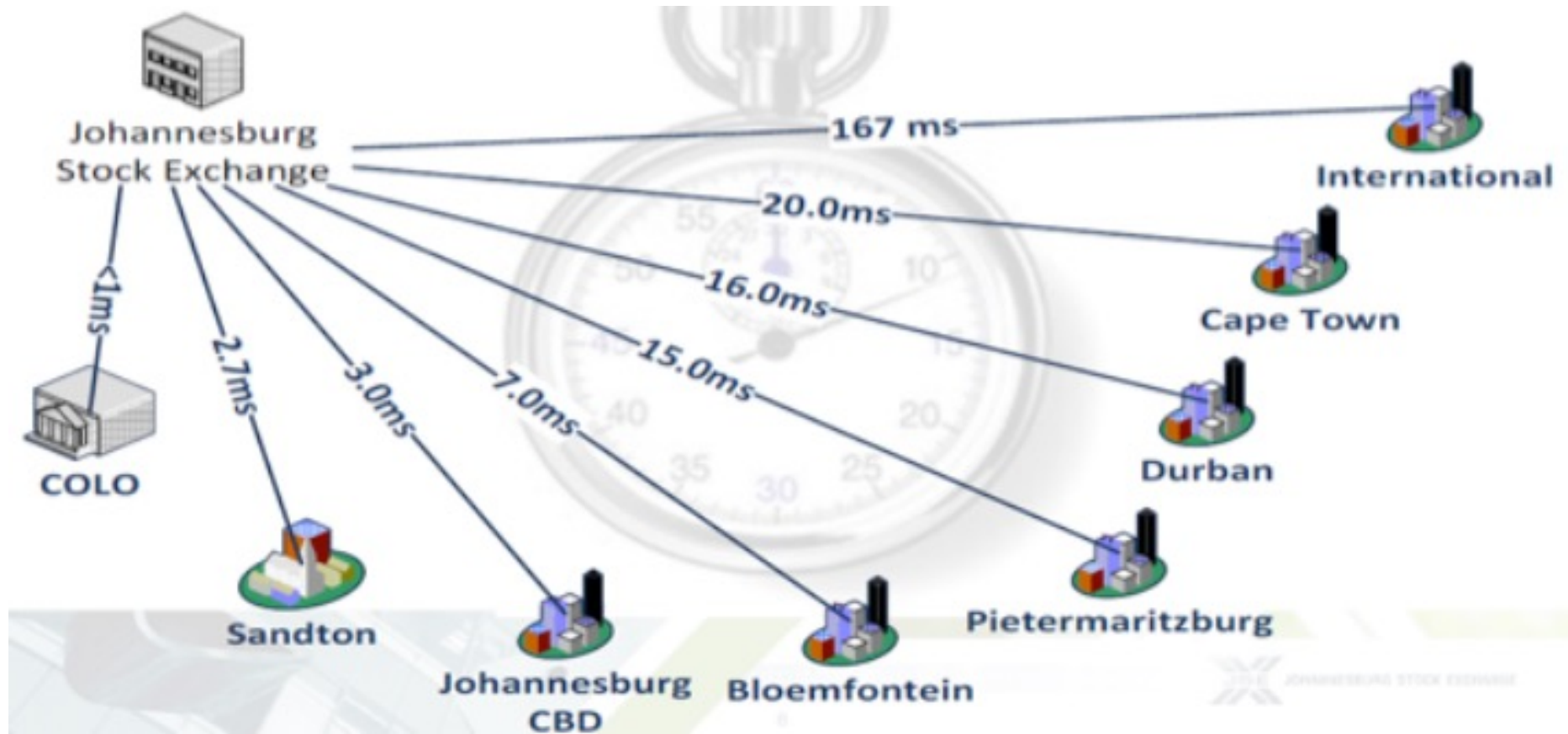
HIGH FREQUENCY TRADING (HFT) AND COLOCATION