SERVER-SIDE WEB TECHNOLOGIES

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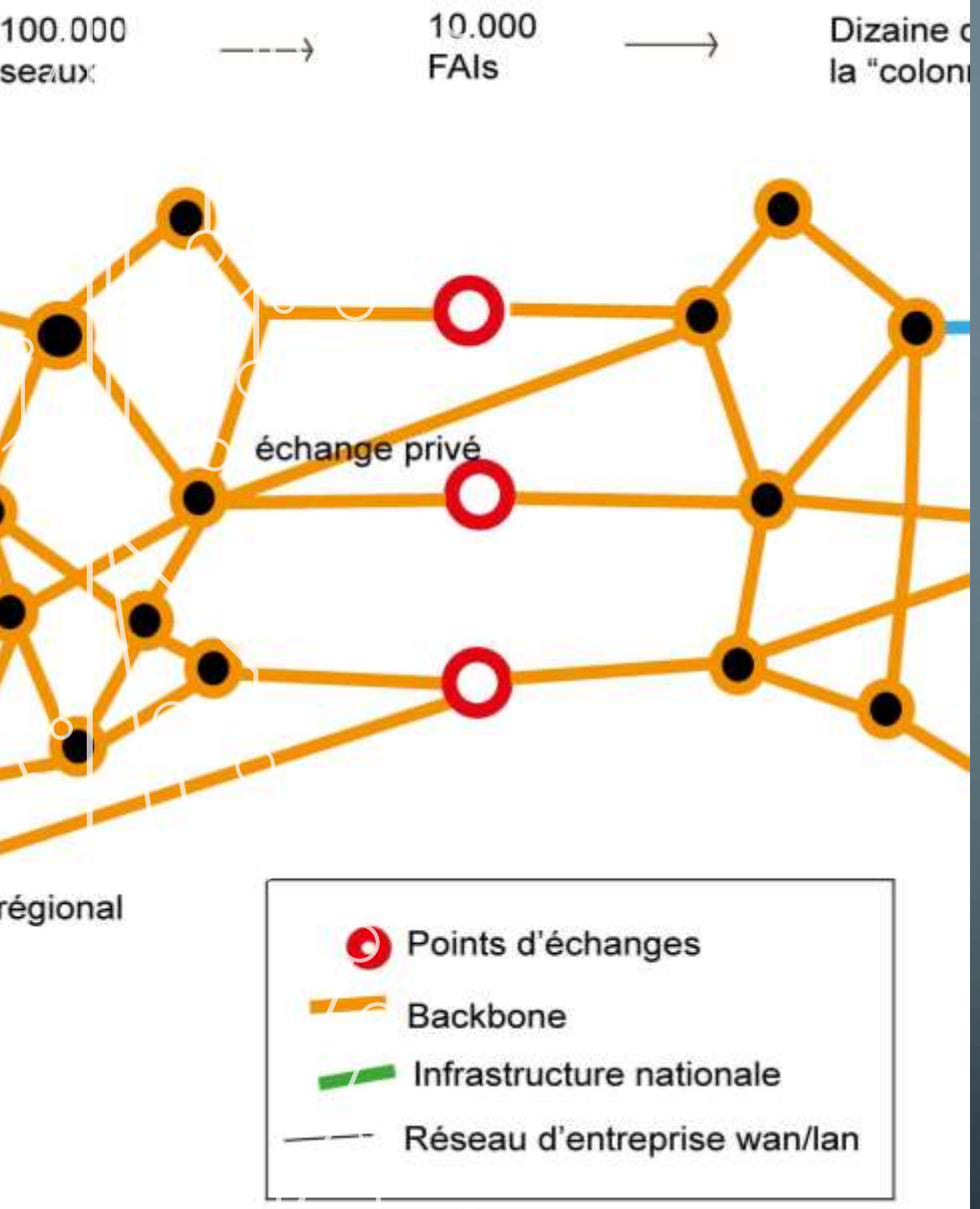
AGENDA

- Internet
- World Wide Web
- Client Server Architecture
- URL
- Example of web Application
- Web Programming



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INTERNET

- Collection of networks
  - Thousands of interconnected networks around the world
  - Which are based on different technologies.
  - Comprises servers, routers, and fiber optics cables.
- Connected via the public backbone and
- Communicating across networks using TCP/IP network protocols to facilitate data transmission and exchange.

EVOLUTION OF INTERNET AND WORLD WIDE WEB

- Arpanet
  - Established in late 1960's by US Department of Defense.
  - To facilitate research among research Institutions
- Birth of the World Wide Web
  - Invented by Tim Berners Lee in 1989
  - Revolutionized information sharing.
  - Leading to the creation of websites and hyperlinks.
- Global Connectivity
  - Connected billions of people worldwide
  - Exponential growth – Revolutionizing communication, commerce and information sharing worldwide.

EVOLUTION OF TODAY'S INTERNET

Pre-Internet

- Human to human
- Fixed line telephones
- Postal Services

Internet of Content

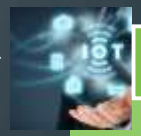
- Computers
- Networks
- Internet
- World Wide Web
- Browsers
- Search Engines
- Contents or Information

Internet of Services

- Web 2.0
- E-Commerce
- Smart Phones and Applications

Internet of People

- Social Media
- Skype
- Facebook
- YouTube



Internet of Things

- Machine to Machine
- Identification
- Tracking
- Monitoring
- Metering
- Automation
- Smart Devices
- Blockchain

WORLD WIDE WEB

The Web is an application (website) running on the Internet.

It is a collection of interconnected documents (web pages) and services maintained on the Internet

The web pages are stored in web servers and made accessible to client computers through the internet.

Computers reading the Web pages are called Web clients.

Web clients use a program called a Web browser to view the web pages.

The web browser can interact with several different kinds of servers

Web pages can be accessed either by:

Typing the URL (Uniform Resource Locator) of the page into a web browser

Following a hyperlink to that page or resource.

IMPACT OF THE WORLD WIDE WEB

Revolutionized information access.	• Changed the way information is accessed, shared and consumed
Facilitated E-commerce.	• Enabled the growth of online businesses and digital transactions.
Transformed Social Networking	• Changed the dynamics of how people connect and interact online.
Enabled online education	• Provided opportunities for remote learning and skills development.

CHALLENGES OF THE WORLD WIDE WEB

Cybersecurity threats

- Includes hacking, data breaches, and malware, necessitating proactive security measures.

Privacy concerns

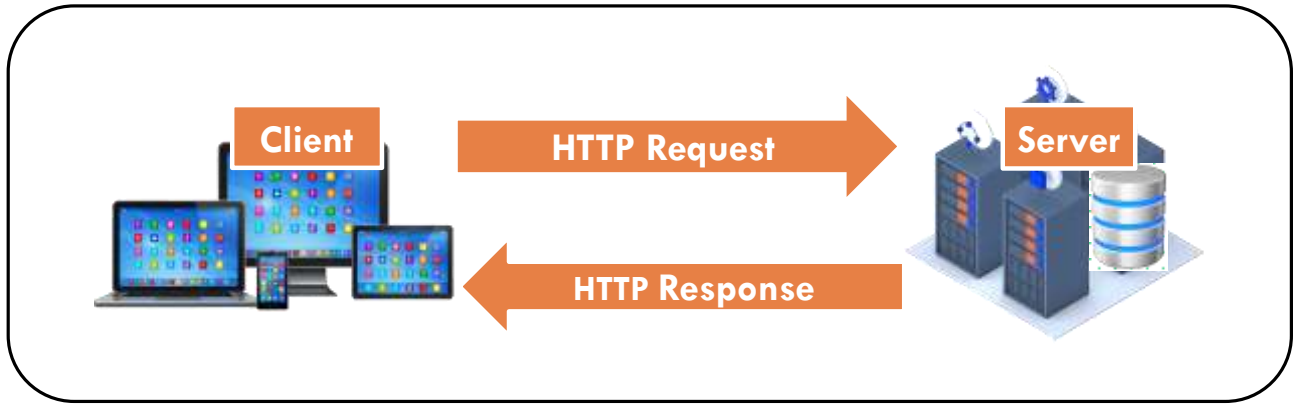
- Growing concerns about user consent, data collection, and the ethical use of personal information.

Misinformation

- Proliferation of misinformation on the internet.
- Requires strategies to promote media literacy and fact-finding

Digital Divide

- Creating disparities in internet access and digital skills
- Need inclusive connectivity and digital literacy initiatives



CLIENT SERVER ARCHITECTURE

- The client computer sends a request for information to the server through the internet.
- The server accepts the requested, process it and deliver the requested information back to the client

KEY COMPONENTS OF CLIENT-SERVER ARCHITECTURE

Clients and Servers

Consists of clients (end-user devices) and servers (Computing resources) as the primary components.

Network infrastructure

Facilitates communication between clients and servers

Protocols and communication standards

To enable seamless communication between clients and servers.

WEB BROWSER

Client system used to access the content of web page.

Software used to find, retrieve, view, and send information over the Internet.

The browser allows you to:

- Send and receive e-mail.
- Read messages from newsgroups (or forums)
- Browse the Web where you can find a rich variety of text, graphics, and interactive information.

ROLE OF CLIENTS

Initiates communication

- To access resources or services

Sends requests and display results

- They send requests for data or actions from the servers and display the results to the client.

Reliance on servers

- Clients rely on servers for data storage, processing, and management of applications or services.

WEB SERVER

- Responsible for processing client requests via basic internet protocols.
  - Refers to a computer system that accepts and processes HTTP requests.
- We can have both the web client and web server on the same system.
  - Web server on the local system is called localhost.
- Web pages are saved on the Web server and are sent back as responses to HTTP request by client.
- Web server should always be connected to internet.
  - Every Web server is assigned a unique IP address that the client mentions in the HTTP request.

ROLE OF SERVERS

Data storage and management

- Act as powerful computers or specialized hardware to store data, manage resources, and ensure efficient data management.

Request handling and computation

- They responds to client requests, perform computations, and efficiently handle incoming and outgoing data traffic.

Service delivery and security

- Deliver services to clients and ensure data security through robust measures and protocols.

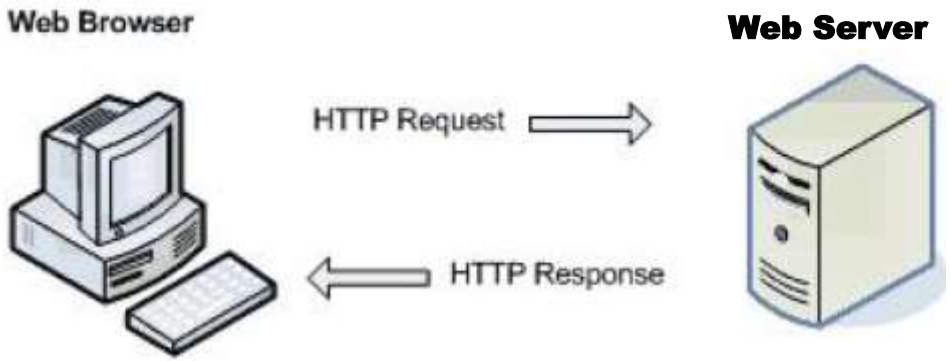
Categorization of servers

- Servers can be categorized based on their specific functions, such as web servers, database servers, file servers, and application servers.

EXAMPLES OF WEB SERVER

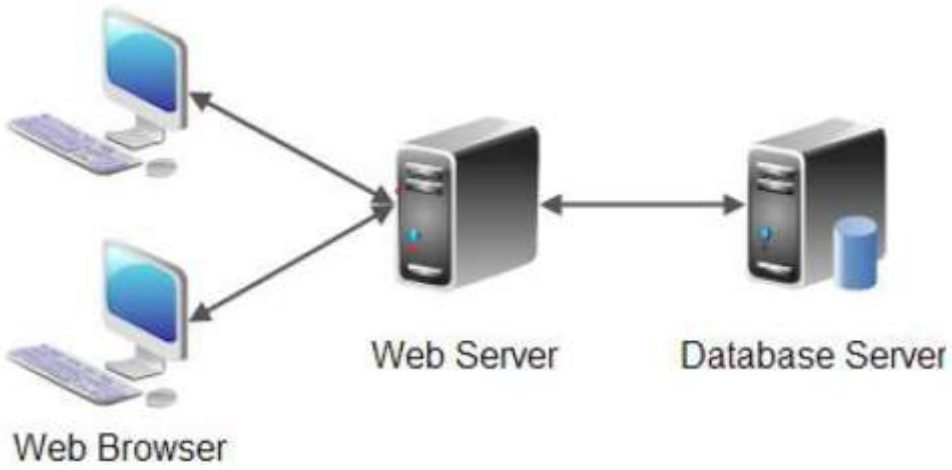
- Apache Server
- Microsoft IIS Server
- Java Server Pages (JSP)

TWO-TIER SYSTEM.



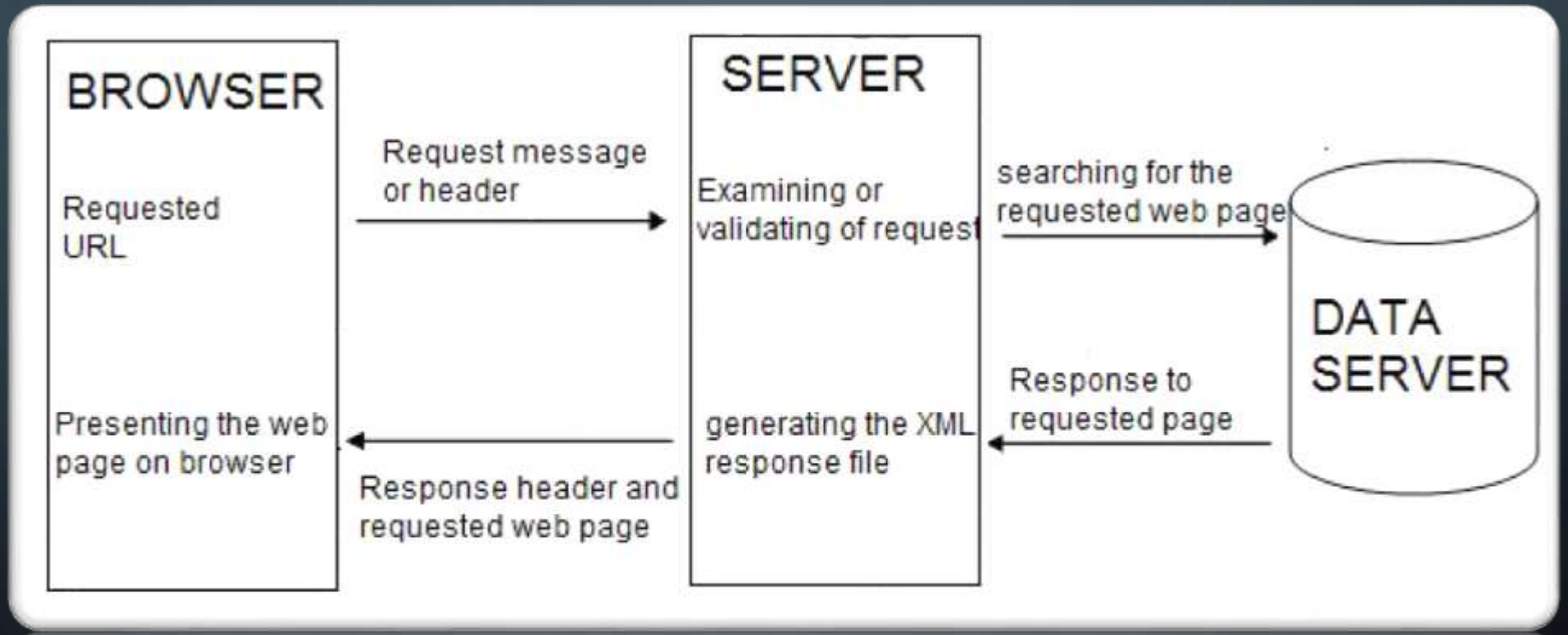
- The most basic architecture consisting of a client and a server.
- Main responsibility of a server is data storage and processing capability.
  - The server acts as some database from which a client requests information.
  - Heavy processing takes place on the server.
- Web browser is responsible for the display of web page to the client using a Graphical User Interface (GUI)

THREE-TIER SYSTEM.



- As more servers are added, the client/server system evolves into a three-tier client/server architecture.
- The web server is divided into two distinct entities
  - Processing tier (Web Server) and
  - Data storage tier (Database Server).
- The processing tier is also known as middle tier and is responsible for handling the interaction between the client and the data storage tier.
- The client tier makes a request for the database to a Web server by using the web browser.
- The processing tier makes all necessary processing before the request is forwarded to the data storage tier for read or write operation.
- The processing tier is then responsible for generating the response header and the database.

COMMUNICATION PROTOCOL BETWEEN A BROWSER AND A WEB SERVER



ADVANTAGES OF CLIENT SERVER ARCHITECTURE

Centralized data management

- Allowing for easier data access and control.

Improved reliability

- Through fault tolerance and load balancing mechanisms.

Enhanced security measures

- Provides robust security features, safeguarding data and resources from unauthorized access.

Efficient resource utilization

- By distributing tasks between clients and servers, leading to improved performance.

Easier maintenance and updates.

- Changes can be implemented centrally on the server.

Seamless integration of new technologies

- Ensures compatibility and scalability

CHALLENGES AND LIMITATIONS OF CLIENT-SERVER ARCHITECTURE

Network congestions and single points of failure.

- This can impact system performance and reliability.

Dependency on server availability and scalability limitations.

- Is dependent on server availability, leading to potential downtime
- May encounter scalability limitations as the number of clients increases.

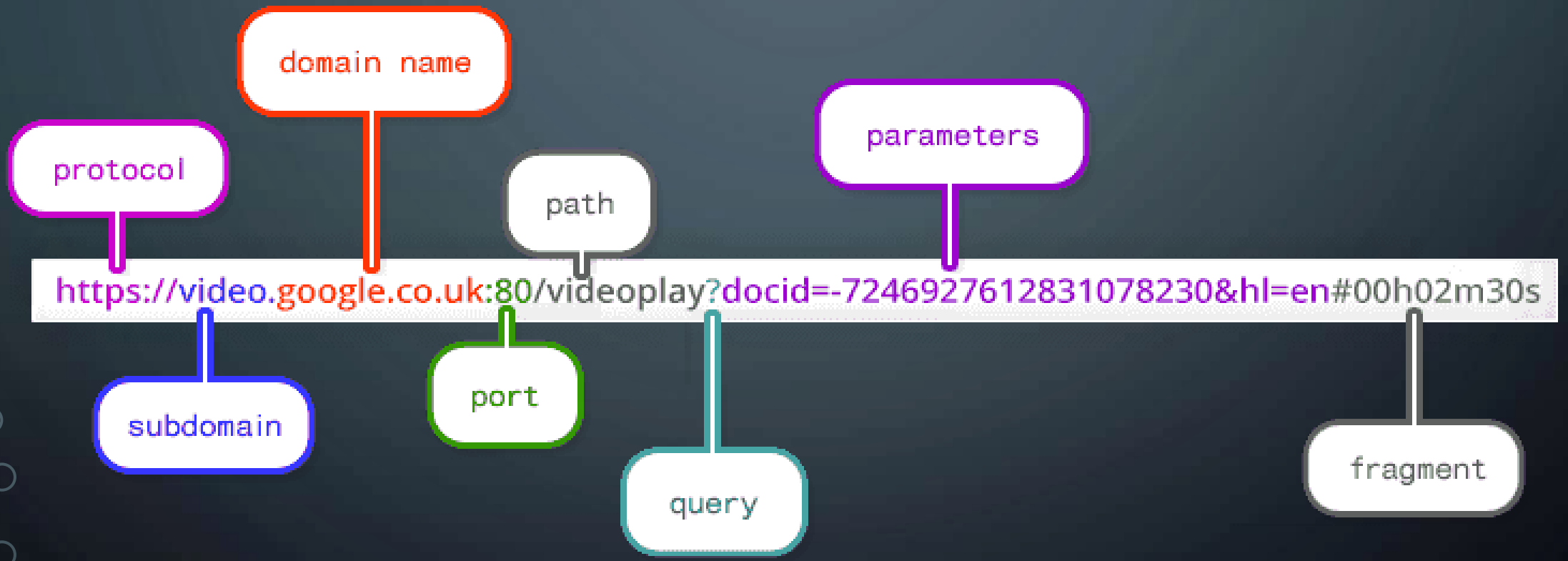
Managing a large number of clients and ensuring consistent performance.

- To manage a large number of clients effectively while ensuring consistent performance across varied user loads.

Addressing compatibility issues with diverse client devices.

- Requires comprehensive testing and support for various platforms.

UNIFORM RESOURCE LOCATOR (URL)



UNIFORM RESOURCE LOCATOR (URL)

The complete address or location of the website (resource) we want to access.

Each website has a unique address.

Without specifying a valid URL, we cannot access a particular site.

A URL is made up of the following components:

- Protocol: The format of the resource depends entirely on the protocol used.
- Host Name: This is the domain name of the machine on which the resource lives.
- Port Number: The port number to which to connect *(optional)*.
- Filename: The pathname to the file on the machine.
- Reference: A reference to a named anchor within a resource that usually identifies a specific location within a file *(optional)*.

PROTOCOL

- A protocol is a set of rules which enables a node of one network to communicate with a node of another network.

Examples of protocols

Transfer Control Protocol / Internet Protocol (TCP/IP)

Hyper-Text Transfer Protocol (HTTP)

Simple Mail Transfer Protocol (SMTP)

Point –to-Point Protocol (PPP)

DOMAIN NAME

Are used in various networking contexts and addressing purposes.

Represents an Internet Protocol (IP) resource, such as a personal computer used to access the Internet or a server hosting a web site.

Provide an easily recognizable and memoizable names to the numerically addressed Internet resources.

Is used by an organizational entity to identify its website.

Each Internet address is translated into a series of numbers called an IP address.

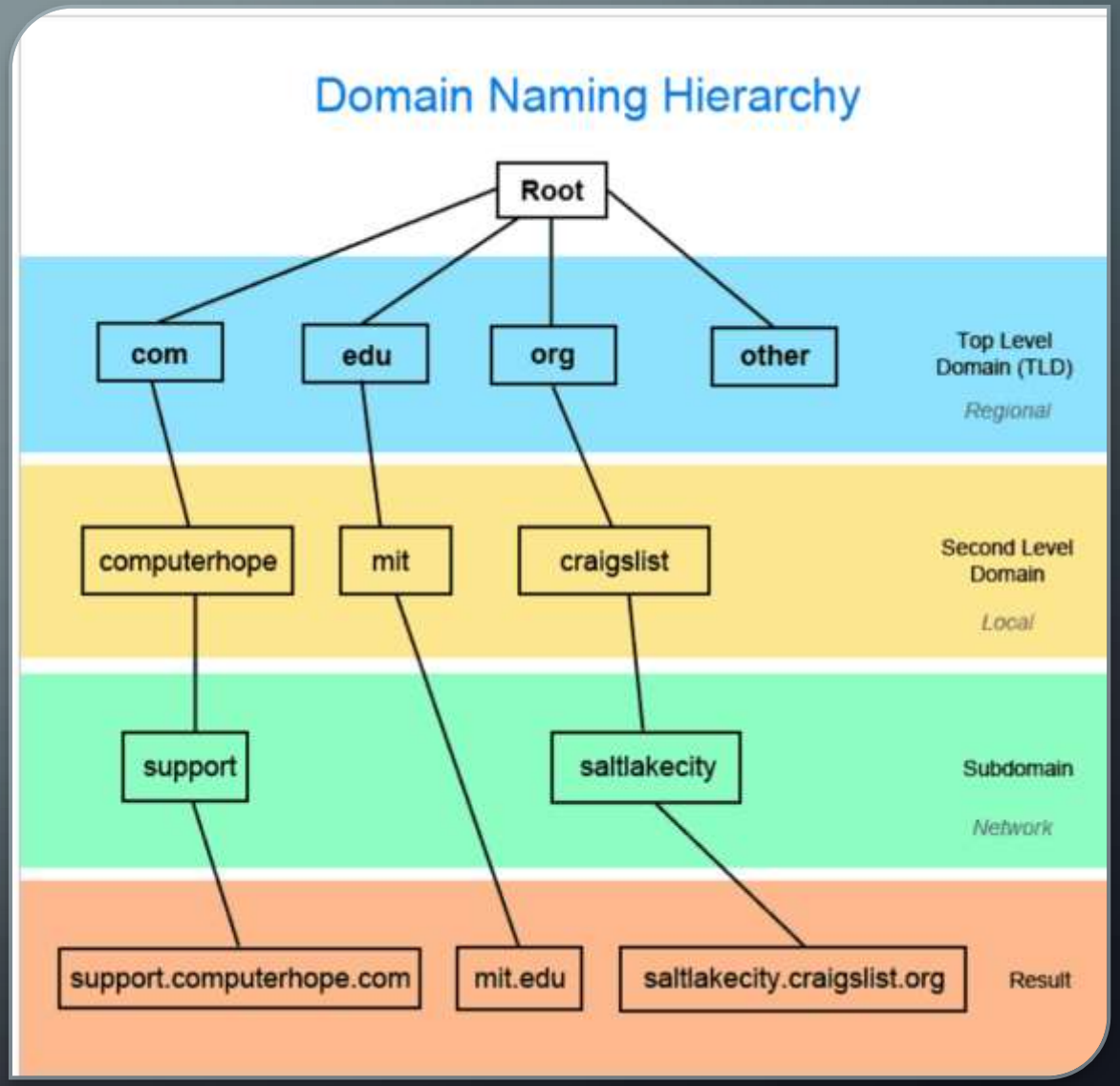
Domain names are formed by the rules and procedures of the Domain Name System (DNS).

DOMAIN NAME SERVER

- Nodes of the domain name system which are responsible for allotting names and mapping (translating) these names to IP addresses.
- It is a hierarchical naming system built on a distributed database
- Each domain has at least one authoritative DNS server that publishes information about that domain and the name servers of any domains subordinate to it.
- The top of the hierarchy is served by the root nameservers.

DNS HIERARCHY

- Root Domain
  - Managed by Internet Assigned Numbers Authority (IANA)
  - Contain the authoritative name servers for all top-level domains.
- Top-Level Domains (TLDs)
  - Include generic TLDs and country-code TLDs
  - Can further be categorized into various subgroups.
- Second-Level Domains
  - Directly follow TLDs in the hierarchy.
  - Used to register unique domain names for organizations, businesses or individuals.
- Subdomains
  - Subdivisions of a domain.
  - Provide a way to create unique web addresses for different sections of a website or for specific use cases



DNS RESOLUTION PROCESS

Querying DNS Servers

When a user enters a domain name (in the web browser), the DNS resolution process involves querying the DNS servers to map the domain name to its corresponding IP address.

Involvement of multiple servers

The process includes querying the recursive resolver, authoritative name server, and the root server if necessary.

DNS RECORDS

A Records (IPv4)

- Maps domain names to IPv4 addresses

AAAA Records (Ipv6)

- Maps domain names to IPv6 addresses

Cname Records

- Creates aliases from one domain name to another
- This is useful when you want to use multiple domain names to point to the same website or server.

MX Records

- Identify mail servers responsible for receiving email on behalf of the domain

TXT Records

- Stores text-based information associated with a domain

DNS PERFORMANCE OPTIMIZATION FOR BETTER USER EXPERIENCE.

Reducing DNS Lookup times.

Efforts taken to minimize the time taken for DNS lookups, enhancing overall performance.

Minimizing Latency

Strategies to decrease latency in DNS resolution processes for faster responses.

Implementing caching

Utilizing caching techniques to store DNS records locally, reducing query times for frequently accessed domains.

Utilizing Load Balancing

Deploying Load Balancing mechanisms to efficiently distribute DNS queries across multiple servers, optimizing performance.

Integrating Content Delivery Networks (CDNs)

Leveraging CDNs to distribute DNS contents geographically for improved speed and reliability of responses.

CHALLENGES IN DNS MANAGEMENT

Ensuring high availability.

Guaranteeing continuous availability of DNS services to prevent disruptions in network operations.

Maintaining accurate and up-to-date DNS records.

Ensuring the correctness and currency of DNS records despite dynamic changes in network environment.

Mitigating DNS-related attacks.

Implementing robust security measures to safeguard against DNS vulnerabilities and potential cyber threats.

Managing DNS configurations across distributed networks.

Efficiently handling DNS settings and configurations across geographically dispersed network infrastructures.

IP ADDRESS

Internet address follows the TCP/IP suite hence, it is also known as the IP address.

Numerical label assigned to each device in a network

The basic function of IP address are

Identifying a device/node on the network.

Location addressing

IP address can be either static or dynamic.

Static IP address is persistent configuration (does not change when booting the node)

Dynamic IP address – a new IP address is assigned to the node each time.

UNIFORM RESOURCE IDENTIFIERS (URI)

An important function of domain names is to provide easily recognizable and memoizable names to numerically addressed Internet resources.

This abstraction allows any resource to be moved to a different physical location.

Such a move usually requires changing the IP address of a resource and the corresponding translation of this IP address to and from its domain name.

INTERNET SERVICE PROVIDER (ISP)

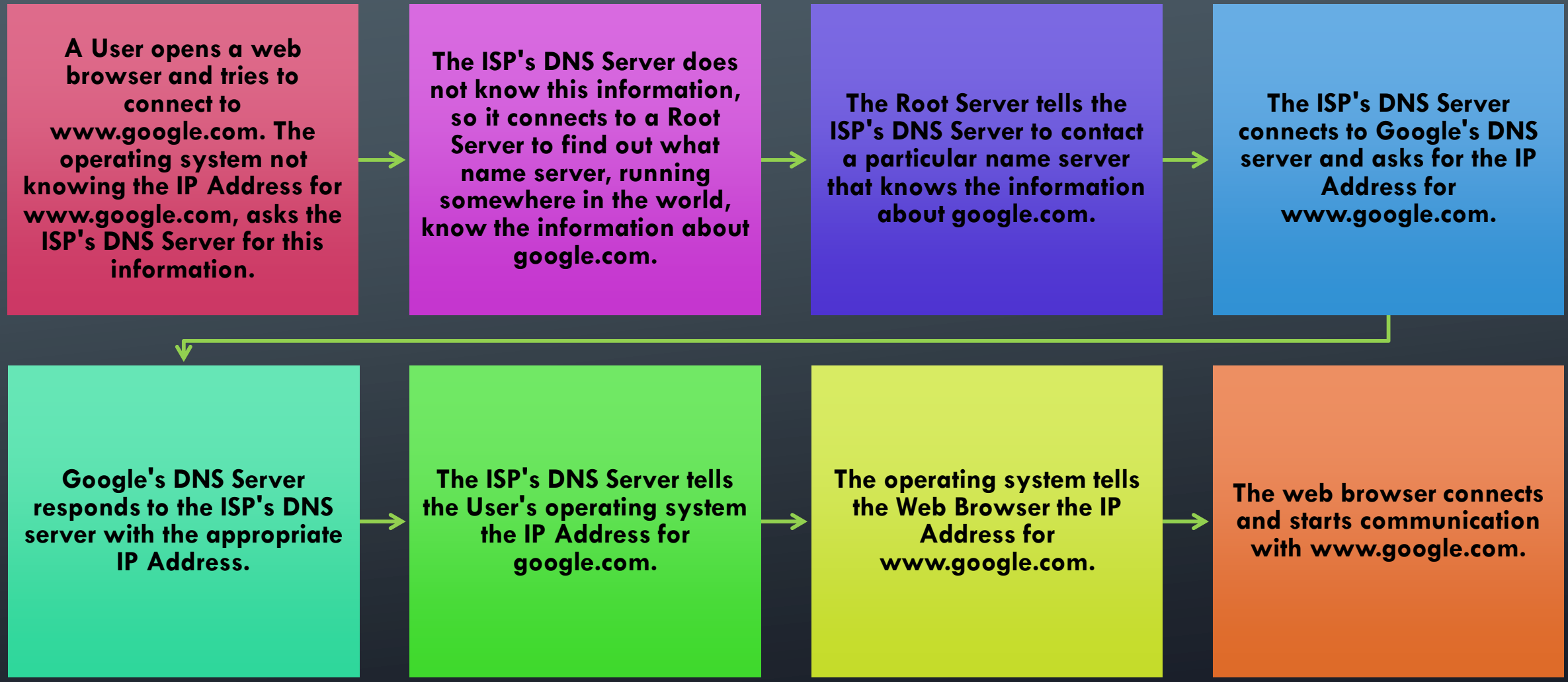
A company that provides access to the Internet, hosts data, or does both through their server.

ISP is also known as (internet access provider)

Connect customers to the Internet using copper, wireless or fibre connections.

Hosting Services: lease server space for smaller businesses and host other servers.

REAL LIFE EXAMPLE – TRYING TO CONNECT TO www.google.com



PAGE LOADING ON THE BROWSER

The web browser then initiates a series of communication messages in order to fetch and display the information.

The domain-name portion of the URL is resolved into an IP address using the Domain Name System (DNS).

The browser then requests the resource by sending an HTTP request to the Web server at that particular address.

The HTML text of the page is requested first and parsed immediately by the web browser, which then makes additional requests for images and any other files of that page.

While receiving these files, browsers may progressively render the page onto the screen as specified by its HTML, Cascading Style Sheets (CSS), or other page composition languages.

Any images and other resources are incorporated to produce the onscreen web page that the user sees.

Most web pages contain a collection of useful, related resources, interconnected via hypertext links

WEB PROGRAMMING

- More than creating and formatting webpages and websites.
- With the use of scripting languages such as JavaScript and PHP, it is possible to add a lot more functionalities to a web site to make it more interactive.

WEB PAGES

Web pages are what make up the World Wide Web.

Web pages are written in HTML (Hypertext Markup Language) and are translated by the Web browser.

Web pages can either be static or dynamic.

- Static pages show the same content each time they are viewed.
- Dynamic pages have content that:
  - Can change each time they are accessed.
  - These pages are typically written in scripting languages such as JavaScript, PHP, ASP, JSP, etc.
  - Some types of processing are applied either at **client side** (example, JavaScript) or **server side** (example, PHP, Perl, ASP, JSP, etc.).

Web page structure is made up of several components, which affects performance in terms of bandwidth consumption.

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