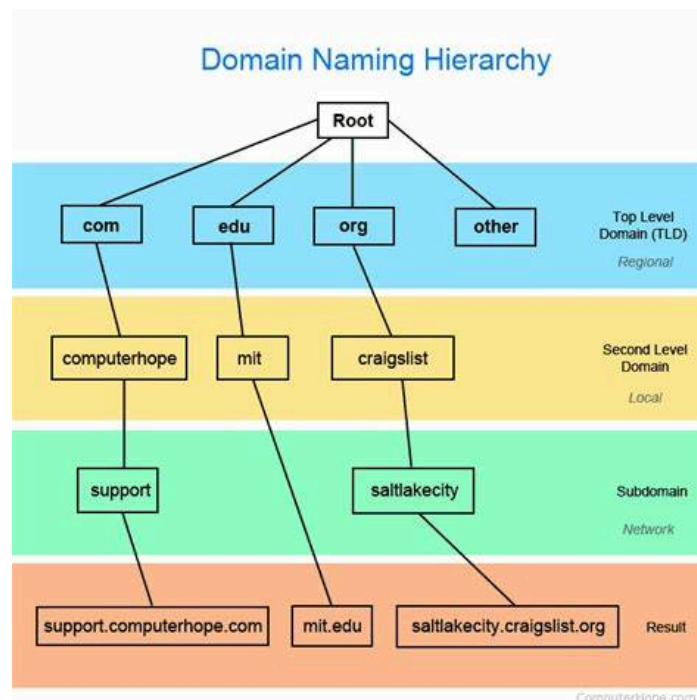
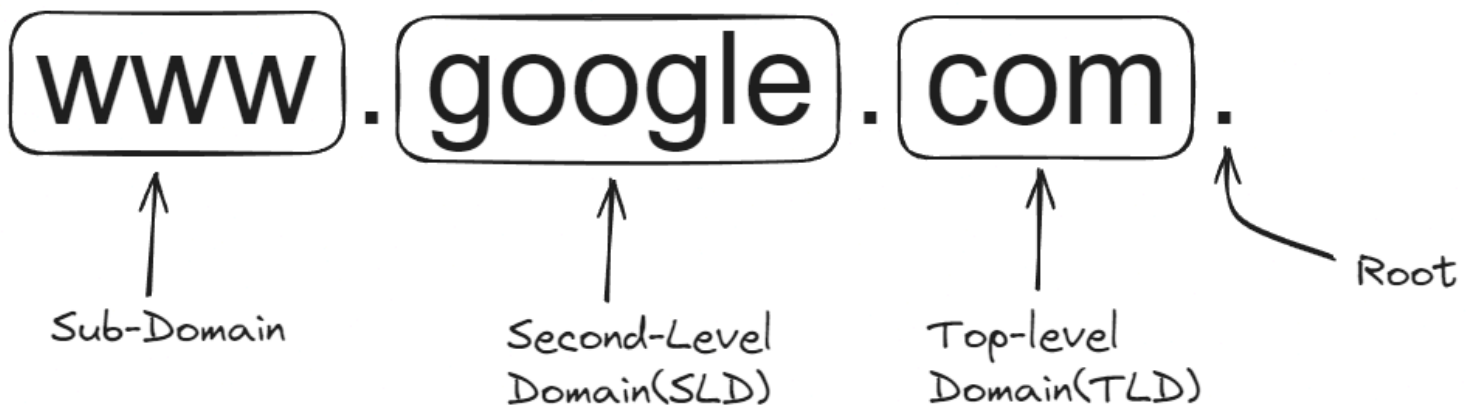


## Unit-5 Application Layer

### DNS (Domain Name System)

- Any Electronic device that can be connected to a network, is assigned a unique 32-bit (ipv4) number known as an IP Address.
- Similarly, A website is hosted on a server, and every server has an IP Address.
- Hence, the hosted website can be loaded on the client's web browser, by using the server's IP Address.
- But, as there are a large number of websites, it becomes difficult for a human to remember the IP addresses.
- To resolve this issue, DNS was introduced.
- DNS is a hierarchical and decentralized system which maps IP Addresses to Domains.
- It is nothing but a set of servers working together, to generate a unique domain name for a provided IP Address.
- A Domain is nothing but a unique alphanumeric sequence.
- DNS is decentralized because it is not controlled by a single entity/organization. It is controlled by several organizations.
- DNS is hierarchical because the generated domain consists of several (3 by default) levels. And each level has a specific role. And every level is a server.



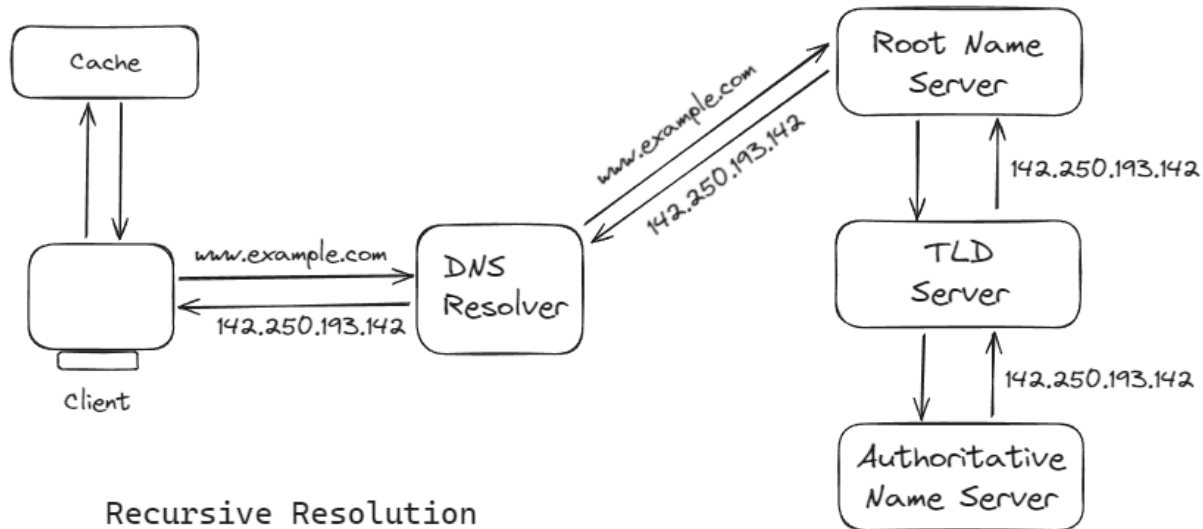
- A Root Server provides the root domain, which is represented as a dot. The root domain does not contribute to a domain but serves as the starting point for DNS resolution. And It maintains a list of references to other (TLD) servers of DNS.
- TLD(Top-Level-Domain) Server provides the TLDs to the domains, such as .com, .in, .org, .net, etc.

- Second-level Domain and Sub-domain are other parts of a domain, provided by the Authoritative Name Server.
- Authoritative Name Server contains the DNS records. Each DNS record contains an IP Address with its corresponding registered domain name. Hence it provides the IP Address when a Domain name is provided as input.

#### - DNS Resolution Types:

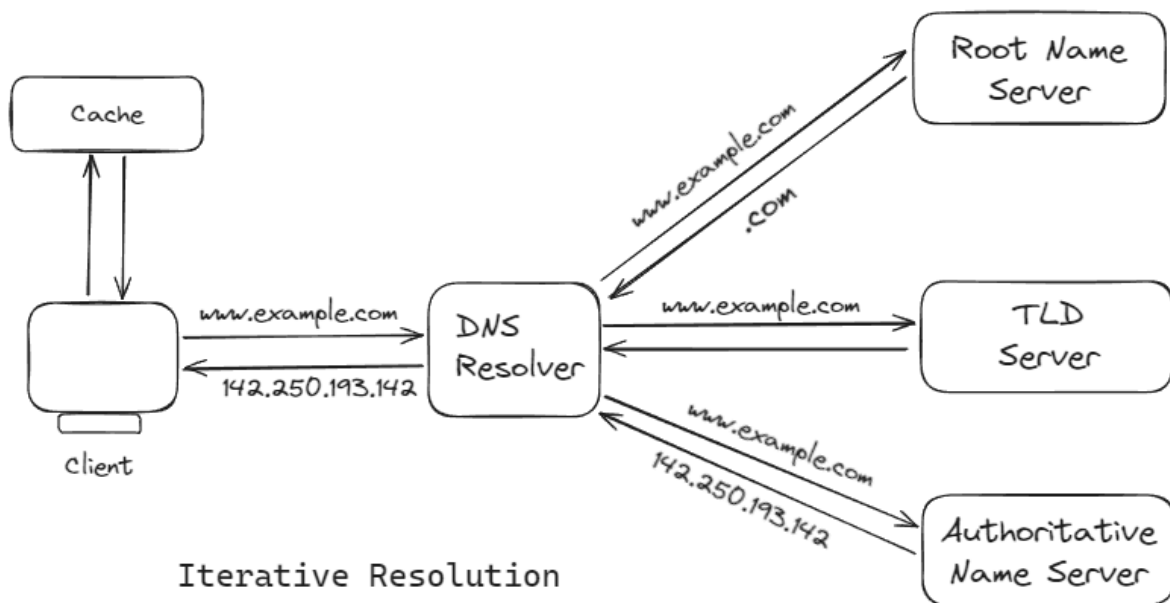
- + DNS resolution refers to the process of converting domain names into IP addresses, which enables communication between devices on the internet. There are two main types of DNS resolution: recursive and iterative.

#### 1. Recursive DNS Resolution:



- In recursive resolution, a DNS resolver is responsible for handling the entire resolution process on behalf of the client. When a client device sends a DNS query to a resolver, the resolver performs all necessary steps to obtain the IP address associated with the domain name.
- The resolver begins by querying root DNS servers to determine the authoritative name servers for the requested domain. It then recursively queries the authoritative name servers and any intermediate DNS servers until it receives the IP address.
- Once the resolver obtains the IP address, it caches the information for future use and returns the result to the client.
- Recursive resolution is typically used by client devices, such as computers and smartphones, to resolve domain names when accessing websites or other online services.

#### 2. Iterative DNS Resolution:



- In iterative resolution, the DNS resolver does not perform the entire resolution process on behalf of the client. Instead, it provides the client with the information necessary to continue the resolution process independently.
- When a client sends a DNS query to an iterative resolver, the resolver queries root DNS servers to determine the authoritative name servers for the requested domain. However, instead of recursively querying authoritative name servers, the resolver provides the client with the IP addresses of the authoritative name servers.
- The client then sends subsequent DNS queries directly to the authoritative name servers, continuing the resolution process iteratively until it receives the IP address.
- Iterative resolution is commonly used between DNS servers, allowing them to collaborate in resolving domain names. It is also used in scenarios where the client device has its own DNS resolver capable of handling the resolution process independently.

#### - Working of DNS:

- + A user or application initiates a DNS query by requesting access to a domain name (e.g., [www.example.com](http://www.example.com)).
- + The client device, such as a computer or smartphone, first checks its local DNS resolver cache to see if it already has the IP address corresponding to the domain name. If the information is not cached or has expired, it proceeds to the next step.
- + If the local resolver does not have the required information, the client sends a recursive DNS query to a recursive DNS resolver (typically provided by the Internet Service Provider or configured by the network administrator).
- + The recursive resolver, upon receiving the query, checks its cache to see if it already has the IP address of the requested domain. If not, it starts the resolution process by querying the root DNS servers.
- + The root DNS servers respond with the IP addresses of the Top-Level Domain (TLD) servers responsible for the specific top-level domain of the requested domain name (e.g., .com, .org, .net).
- + The recursive resolver then queries the TLD servers to obtain the IP addresses of the authoritative DNS servers responsible for the second-level domain (e.g., example.com).
- + The recursive resolver sends a query to one of the authoritative DNS servers for the domain name. These authoritative servers hold the definitive information about the IP addresses associated with domain names.
- + The authoritative DNS server responds with the IP address of the requested domain name back to the recursive resolver.
- + The recursive resolver caches the IP address received from the authoritative DNS server and sends the response back to the client device that initiated the query.

