



Domain Name System (DNS) in Application Layer

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The Domain Name System (DNS) is like the internet's phone book. It helps you find websites by translating easy-to-remember names (like `www.example.com`) into the numerical IP addresses (like `192.0.2.1`) that computers use to locate each other on the internet. Without DNS, you would have to remember long strings of numbers to visit your favorite websites.

Domain Name System (DNS) is a hostname used for **IP address** translation services. DNS is a distributed database implemented in a hierarchy of name servers. It is an application layer protocol for message exchange between clients and servers. It is required for the functioning of the Internet.

What is the Need for DNS?

Every host is identified by the IP address but remembering numbers is very difficult for people also the IP addresses are not static therefore a mapping is required to change the domain name to the IP address. So DNS is used to convert the domain name of the websites to their numerical IP address.

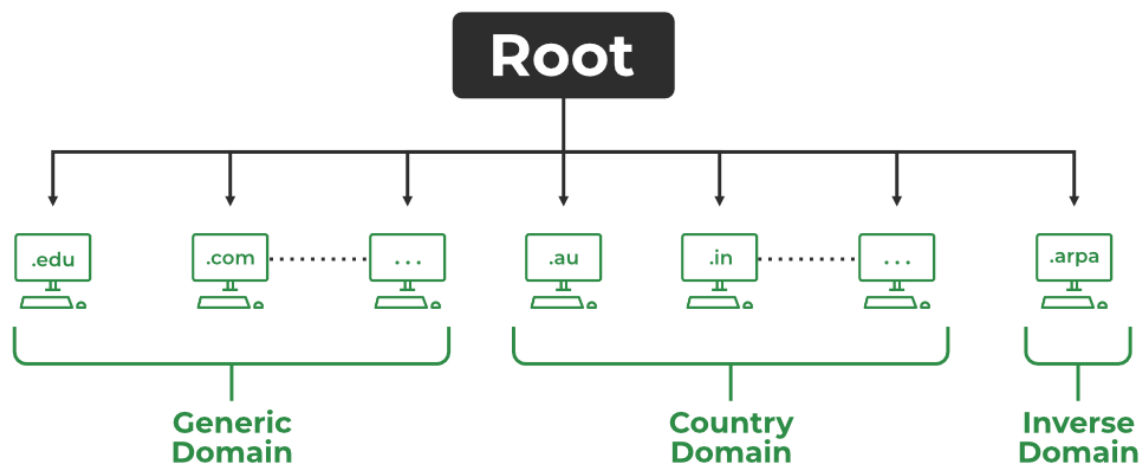
Types of Domain

There are various kinds of domains:

- **Generic Domains:** `.com`(commercial), `.edu`(educational), `.mil`(military), `.org`(nonprofit organization), `.net`(similar to commercial) all these are

website. IP to domain name mapping. So DNS can provide both the mapping for example to find the IP addresses of geeksforgeeks.org then we have to type

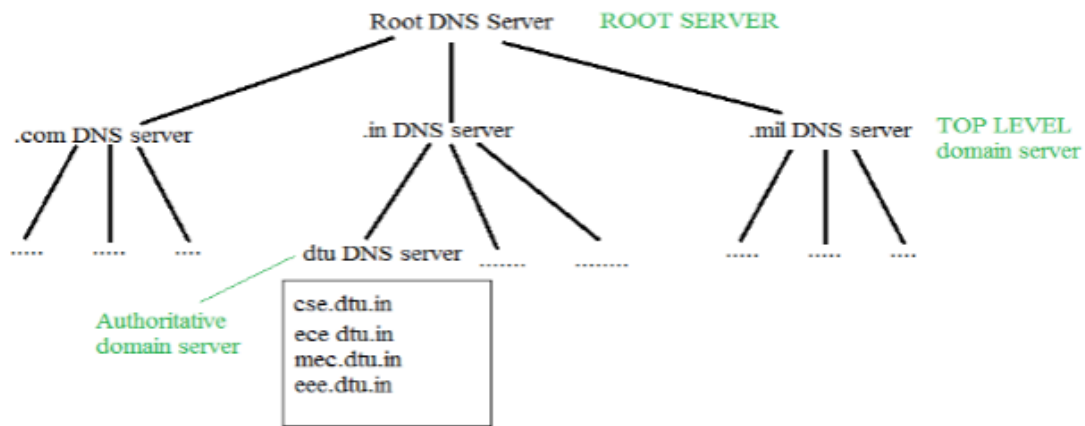
```
nslookup www.geeksforgeeks.org
```



Types of DNS

Organization of Domain

It is very difficult to find out the IP address associated with a website because there are millions of websites and with all those websites we should be able to generate the IP address immediately, there should not be a lot of delays for that to happen organization of the database is very



Root DNS Server

- **DNS Record:** Domain name, IP address what is the validity? what is the time to live? and all the information related to that domain name. These records are stored in a tree-like structure.
- **Namespace:** Set of possible names, flat or hierarchical. The naming system maintains a collection of bindings of names to values – given a name, a resolution mechanism returns the corresponding value.
- **Name Server:** It is an implementation of the resolution mechanism.

DNS = Name service in Internet – A zone is an administrative unit, and a domain is a subtree.

Name-to-Address Resolution

The host requests the DNS name server to resolve the domain name. And the name server returns the IP address corresponding to that domain name to the host so that the host can future connect to that IP address.

A host wants the IP address of cse.dtu.in



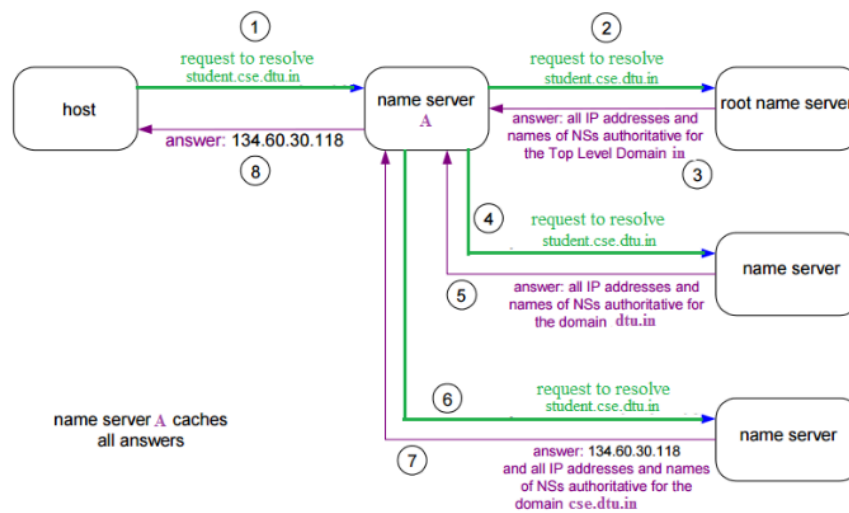
Name-to-Address Resolution

- **Hierarchy of Name Servers Root Name Servers:** It is contacted by name servers that can not resolve the name. It contacts the authoritative name server if name mapping is not known. It then gets the mapping and returns the IP address to the host.
- **Top-level Domain (TLD) Server:** It is responsible for com, org, edu, etc, and all top-level country domains like uk, fr, ca, in, etc. They have info about authoritative domain servers and know the names and IP addresses of each authoritative name server for the second-level domains.
- **Authoritative Name Servers** are the organization's DNS servers, providing authoritative hostnames to IP mapping for organization servers. It can be maintained by an organization or service provider. In order to reach cse.dtu.in we have to ask the root DNS server, then it will point out to the top-level domain server and then to the authoritative domain name server which actually contains the IP address. So the authoritative domain server will return the associative IP address.

Domain Name Server

The client machine sends a request to the local name server, which, if the root does not find the address in its database, sends a request to the root name server, which in turn, will route the query to a top-level domain (TLD) or authoritative name server. The root name server can also contain some hostName to IP address mappings. The Top-level domain (TLD)

server always knows who the authoritative name server is. So finally the IP address is returned to the local name server which in turn returns the IP address to the host.



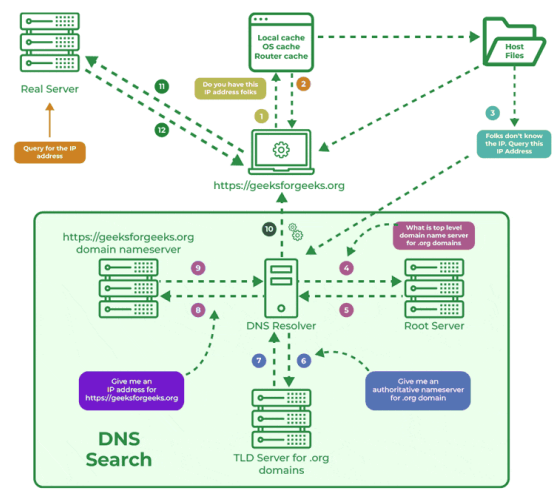
Domain Name Server

How Does DNS Work?

The working of DNS starts with converting a hostname into an IP Address. A domain name serves as a distinctive identification for a website. It is used in place of an IP address to make it simpler for consumers to visit websites. Domain Name System works by executing the database whose work is to store the name of hosts which are available on the Internet. The top-level domain server stores address information for top-level domains such as `.com` and `.net`, `.org`, and so on. If the Client sends the request, then the DNS resolver sends a request to DNS Server to fetch the IP Address. In case, when it does not contain that particular IP Address with a hostname, it forwards the request to another DNS Server. When IP Address has arrived at the resolver, it completes the request over [Internet Protocol](#).

For more, you can refer to [Working of DNS Server](#).

How Does DNS Works



How Does DNS Works?

Authoritative DNS Server Vs Recursive DNS Resolver

Parameters	Authoritative DNS Server	Recursive DNS Resolver
Function	Holds the official DNS records for a domain	Resolves DNS queries on behalf of clients
Role	Provides answers to specific DNS queries	Actively looks up information for clients
Query Handling	Responds with authoritative DNS data	Queries other DNS servers for DNS data
Client Interaction	Doesn't directly interact with end-users	Serves end-users or client applications
Data Source	Stores the DNS records for specific domains	Looks up data from other DNS servers

Parameters	Authoritative DNS Server	Recursive DNS Resolver
Caching	Generally, doesn't perform caching	Caches DNS responses for faster lookups
Hierarchical Resolution	Does not participate in the recursive resolution	Actively performs recursive name resolution
IP Address	Has a fixed, known IP address	IP address may vary depending on ISP
Zone Authority	Manages a specific DNS zone (domain)	Does not manage any specific DNS zone

What is DNS Lookup?

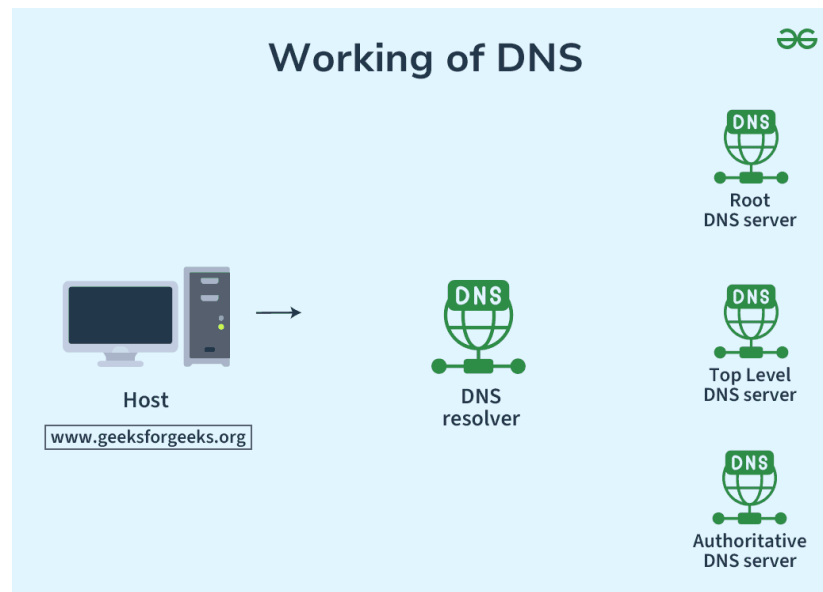
DNS Lookup or DNS Resolution can be simply termed as the process that helps in allowing devices and applications that translate readable domain names to the corresponding IP Addresses used by the computers for communicating over the web.

What Are The Steps in a DNS Lookup?

Often, DNS lookup information is stored temporarily either on your own computer or within the DNS system itself. There are usually 8 steps involved in a DNS lookup. If the information is already stored (cached), some of these steps can be skipped, making the process faster. Here is an example of all 8 steps when nothing is cached:

1. A user types "example.com" into a web browser.
2. The request goes to a DNS resolver.
3. The resolver asks a root server where to find the top-level domain (TLD) server for .com.
4. The root server tells the resolver to contact the .com TLD server.

5. The resolver then asks the .com TLD server for the IP address of “example.com.”
6. The .com TLD server gives the resolver the IP address of the domain’s nameserver.
7. The resolver then asks the domain’s nameserver for the IP address of “example.com.”
8. The domain’s nameserver returns the IP address to the resolver.



Working of DNS

DNS Servers Involved in Loading a Webpage

Upon loading the webpage, several DNS Servers are responsible for translating the domain name into the corresponding IP Address of the web server hosting the website. Here is the list of main DNS servers involved in loading a Webpage.

- Local DNS Resolver
- Root DNS Servers
- Top-Level Domain (TLD) DNS Servers
- Authoritative DNS Servers
- Web Server

This hierarchical system of DNS servers ensures that when you type a domain name into your web browser, it can be translated into the correct

IP address, allowing you to access the desired webpage on the internet.

For more information you can refer [DNS Look-Up](#) article.

What is DNS Resolver?

[DNS Resolver](#) is simply called a DNS Client and has the functionality for initiating the process of DNS Lookup which is also called DNS Resolution. By using the DNS Resolver, applications can easily access different websites and services present on the Internet by using domain names that are very much friendly to the user and that also resolves the problem of remembering IP Address.

What Are The Types of DNS Queries?

There are basically three types of DNS Queries that occur in DNS Lookup. These are stated below.

- **Recursive Query:** In this query, if the resolver is unable to find the record, in that case, DNS client wants the DNS Server will respond to the client in any way like with the requested source record or an error message.
- **Iterative Query:** Iterative Query is the query in which DNS Client wants the best answer possible from the DNS Server.
- **Non-Recursive Query:** Non-Recursive Query is the query that occurs when a DNS Resolver queries a DNS Server for some record that has access to it because of the record that exists in its cache.

What is DNS Caching?

[DNS Caching](#) can be simply termed as the process used by DNS Resolvers for storing the previously resolved information of DNS that contains domain names, and IP Addresses for some time. The main principle of DNS Caching is to speed up the process of future DNS lookup and also help in reducing the overall time of DNS Resolution.

Conclusion