Data Communication & Networks

Part 6: Application Layer (Behrouz Ferozan)

Application Layer

- An application layer is an **abstraction** layer that specifies the shared communications protocols and interface methods used by hosts in a **communications network.**
- The application layer abstraction is used in both of the **standard models of computer networking**.
- The Internet Protocol Suite **(TCP/IP) and the OSI** model.
- Although both models use the same term for their respective **highest-level layer.**

Application Layer

Services of Application Layers

- File Transfer
- Addressing
- Mail Services
- Directory Services
- Authentication

Application Layer Protocol Systems

- **DNS**
- **E-Mail Protocol**
- **WWW**
- **SNMP**
- **SMTP**
- **Security**
- **Threats and Services**
- **Cryptography**
- **DES**
- **RSA**

Application Layer

DNS

- **(Domain Name System)** The Internet's system for converting **alphabetic names into numeric IP addresses.**
- For example, when a Web address (URL) is typed into a browser, DNS servers return the IP address of the Web server associated with that name.
- In this example, the DNS converts the URL **www.company.com** into the IP address **204.0.8.51.**

Application Layer

A Hierarchy of Servers

- The DNS system is a hierarchy of duplicated database servers worldwide that begin with the **"root servers"** for the **top-level domains (.com, .net, .org, .gov, .edu, .mil, etc.)**. The root servers point to the "**authoritative**" servers located in ISPs,
- **Example :**

www.yahoo.com

www --------> Host Name

Yahoo--------> Server Name

com ---------> Domain Name

Application Layer

- Fully Qualified Domain Name (FQDN): If a label is terminated by a null string.

challenger.ate.tbda.edu.

- Partially Qualified Domain Name (PQDN)

atc.fhda.edu

fhda.edu

Application Layer

Working of DNS

- **User Input:** You enter a website address (for example, www.geeksforgeeks.org) into your web browser.

- **Local Cache Check:** Your browser first checks its local cache to see if it has recently looked up the domain. If it finds the corresponding IP address, it uses that directly without querying external servers.

- **DNS Resolver Query:** If the IP address isn't in the local cache, your computer sends a request to a DNS resolver. The resolver is typically provided by your Internet Service Provider (ISP) or your network settings.

Application Layer

Working of DNS

- **Root DNS Server:** The resolver sends the request to a root DNS server. The root server doesn't know the exact IP address for www.geeksforgeeks.org but knows which Top-Level Domain (TLD) server to query based on the domain's extension (e.g., .org).
- **TLD Server:** The TLD server for .org directs the resolver to the authoritative DNS server for geeksforgeeks.org.
- **Authoritative DNS Server:** This server holds the actual DNS records for geeksforgeeks.org, including the IP address of the website's server. It sends this IP address back to the resolver.
- **Final Response:** The DNS resolver sends the IP address to your computer, allowing it to connect to the website's server and load the page.

Application Layer

Structure of DNS

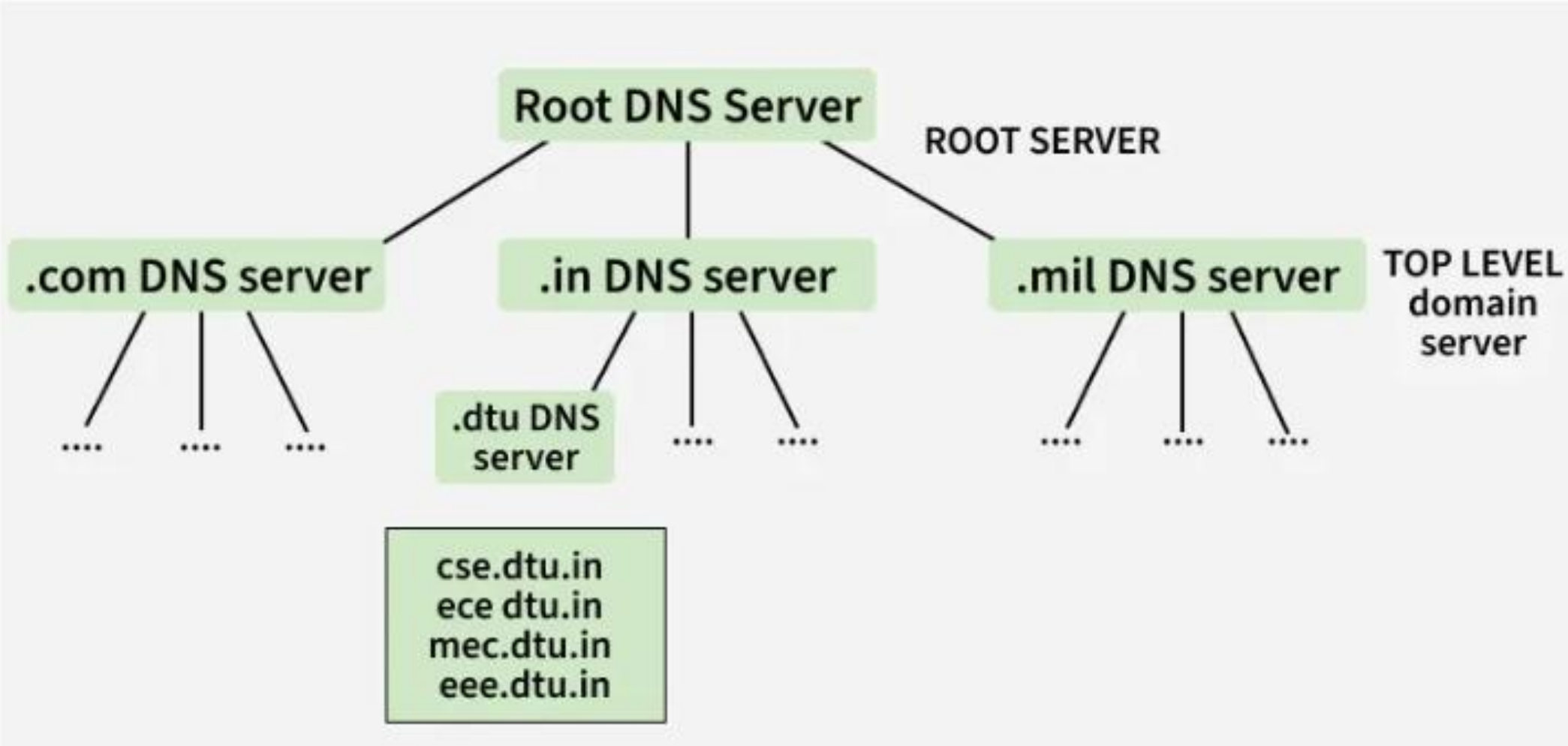
Structure of DNS

DNS operates through a hierarchical structure, ensuring scalability and reliability across the global internet infrastructure. Here's how it's organized:

- **Root DNS Servers:** These are the highest-level DNS servers and know where to find the TLD servers. They are crucial for directing DNS queries to the correct locations.
- **TLD Servers:** These servers manage domain extensions like .com, .org, .net, .edu, .gov and others. They help route queries to the authoritative DNS servers for specific domains.
- **Authoritative DNS Servers:** These are the servers that store the actual DNS records for domain names. They are responsible for providing the correct IP addresses that allow users to reach websites.

Application Layer

Structure of DNS



Application Layer

Types of Domain

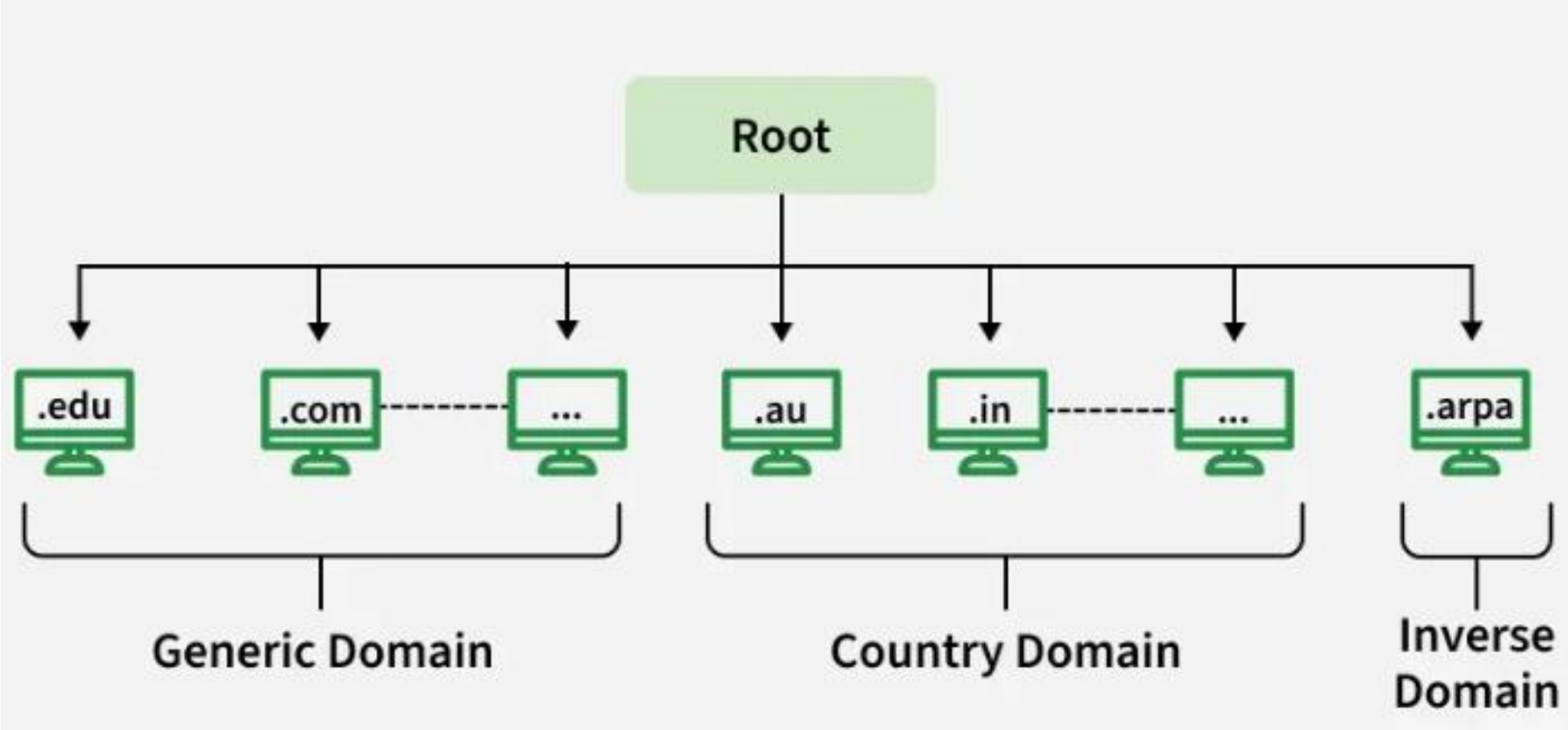
Types of Domains

DNS helps manage a wide variety of domain types to organize the vast number of websites on the internet. Here are the primary categories:

- **Generic Domains:** These include top-level domains like .com, .org, .net and .edu. These are widely used and recognized across the world.
- **Country Code Domains:** These domains represent specific countries or regions, such as .in for India, .us for the United States, .uk for the United Kingdom and .jp for Japan.
- **Inverse Domains:** Used for reverse DNS lookups, these domains help map IP addresses back to domain names. Reverse DNS lookups are useful for diagnostics and security purposes, ensuring that the source of network traffic is legitimate. So DNS can provide both the mapping for example to find the IP addresses of geeksforgeeks.org then we have to type

Application Layer

Types of Domain



Application Layer Service: Email

E-Mail

- Electronic Mail or E-Mail is a method of sending and receiving messages (Mail) electronically over a Computer Network.
- E-Mail is a system allows a person or a group to electronically communicate to others through Internet.
- It is method of **exchanging message** between people using electronic devices.
- Exchanging message as **Text files** and **non-text files** (images, graphics Image, files so on..)

Application Layer Service: Email

Components of Email System

- **Mail Server**

  Receive, Store and Deliver the mail

- **DNS**

  Find and match the IP Address of the Mail Server

- **Mailbox**

  It is a Folder contains Emails and their information.

Application Layer Service: Email

E-Mail Protocol

The E-Mail communication is done via **three protocols** in general. They are,

1.SMTP (Simple Mail Transfer Protocol)

2.POP (Post Office Protocol)

3.IMAP (Internet Mail Access Protocol)

Application Layer Service: Email

SMTP (Simple Mail Transfer Protocol)

- The SMTP stands for **Simple Mail Transfer Protocol.**
- Email is sent using this protocol.
- Is an internet standard communication protocol for **electronic mail transmission.**
- Mail servers and other message transfer agents use SMTP to send and receive mail messages.

Application Layer Service: Email

❖ POP (Post Office Protocol):

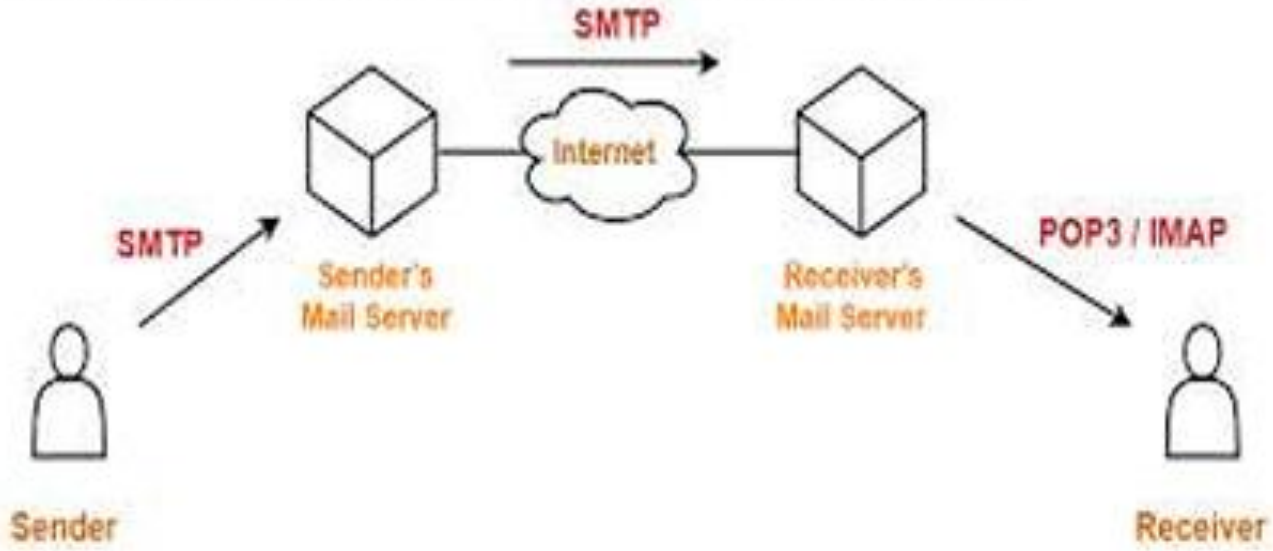
- This protocol is also used for **incoming emails.**
- The main difference with the both protocols is that POP downloads the entire email into the local computer and deletes the data on the server once it is downloaded.
- This is helpful in a server with **less free memory.**
- Current version of POP is **POP3 .**

POP Protocol Communication Process

Application Layer Service: Email

❖ **IMAP(Internet Mail Access Protocol)**

- This protocol is used while **receiving an email**.
- When one uses **IMAP,** the emails will be present in the server and not get downloaded to the user`s mail box and deleted from the server.
- This helps to have less memory used in the local computer and server memory is increased.



Application Layer Service: WWW

WWW

- The World Wide Web is the universe of network-accessible information.
- In simple terms, The World Wide Web is a way of exchanging information between computers on the Internet.
- The **World Wide Web is based on several different Technologies** : **Web browsers, Hypertext Markup Language (HTML) and Hypertext Transfer Protocol (HTTP).**

Application Layer Service: WWW

Features of WWW

- HyperText Information System
- Cross-Platform
- Distributed
- Open Standards and Open Source
- Uses Web Browsers to provide a single interface for many services
- Dynamic, Interactive and Evolving.
- “Web 2.0”

Application Layer Service: WWW

- **There are 5 Components of WWW:**

1. Uniform Resource Locator (URL): serves as system for resources on web.

2. HyperText Transfer Protocol (HTTP): specifies communication of browser and server.

3. Hyper Text Markup Language (HTML): It Defines structure, organisation and content of webpage.

4. Web Server : A web server is computer software and underlying hardware that accepts requests via HTTP, the network protocol created to distribute web pages.

Application Layer Service: WWW

Components of WWW

5. Web Browser : A web browser (commonly referred to as a browser or internet browser).

- It is an application software for accessing the World Wide Web.
- When a user requests a web page from a particular website, the web browser retrieves the necessary content from a web server and then displays the page on the user's device.

Application Layer Service: WWW