National Institute of Technology Karnataka Surathkal
Department of Information Technology

IT 200 **Computer Communication and Networking**

Application Layer (1)

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Syllabus

- **Evolution of Data Communication and Networks,**
- **Transmission Fundamentals:** Signaling Schemes, Encoding and Modulation,
- Data Transmission over Networks – Switching Techniques, Layered Architecture of Computer Networks,
- OSI & TCP/IP Architectures and Layers with protocols,
- Data Link Control and Protocols, Error Detection and Correction,
- Internetworking & Routing,
- Transport Layer Protocols,
- **Applications: DNS, E-Mail, HTTP, WWW, Multimedia;**
- Implementation of Signaling and Modulation, Bit, Byte & Character Stuffing and Error Detection/Correction Coding Techniques, TCP/IP Level Programming, Routing Algorithms, Exercises comprising simulation of various protocols.

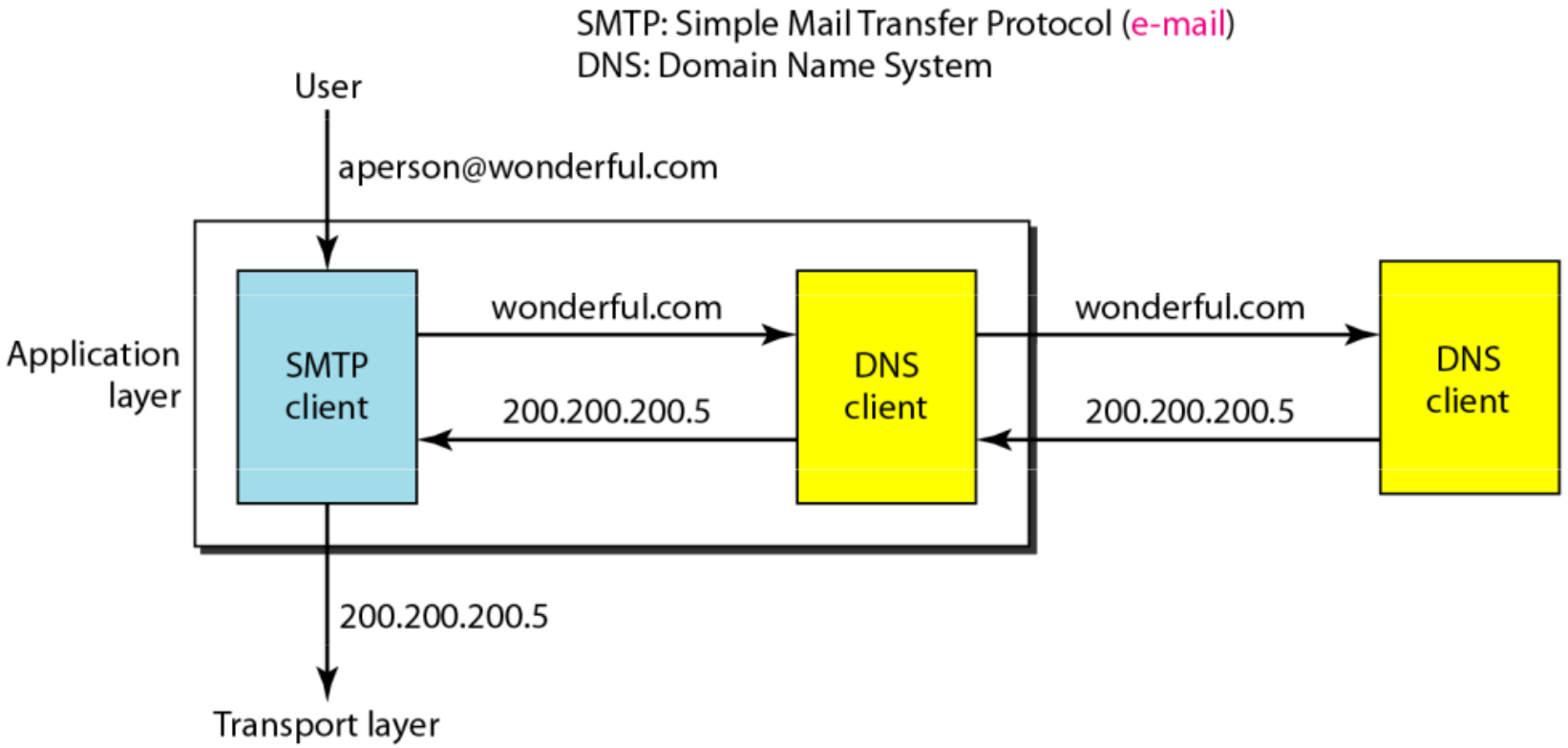
Index

Application Layer

- DNS : Domain Name System
- Email
- HTTP
- WWW
- Multimedia

1. Domain Name System

- URL: Uniform Resource Locator : A URL is nothing more than the address of a given unique resource on the Web. Eg: www.yahoo.com/index.html



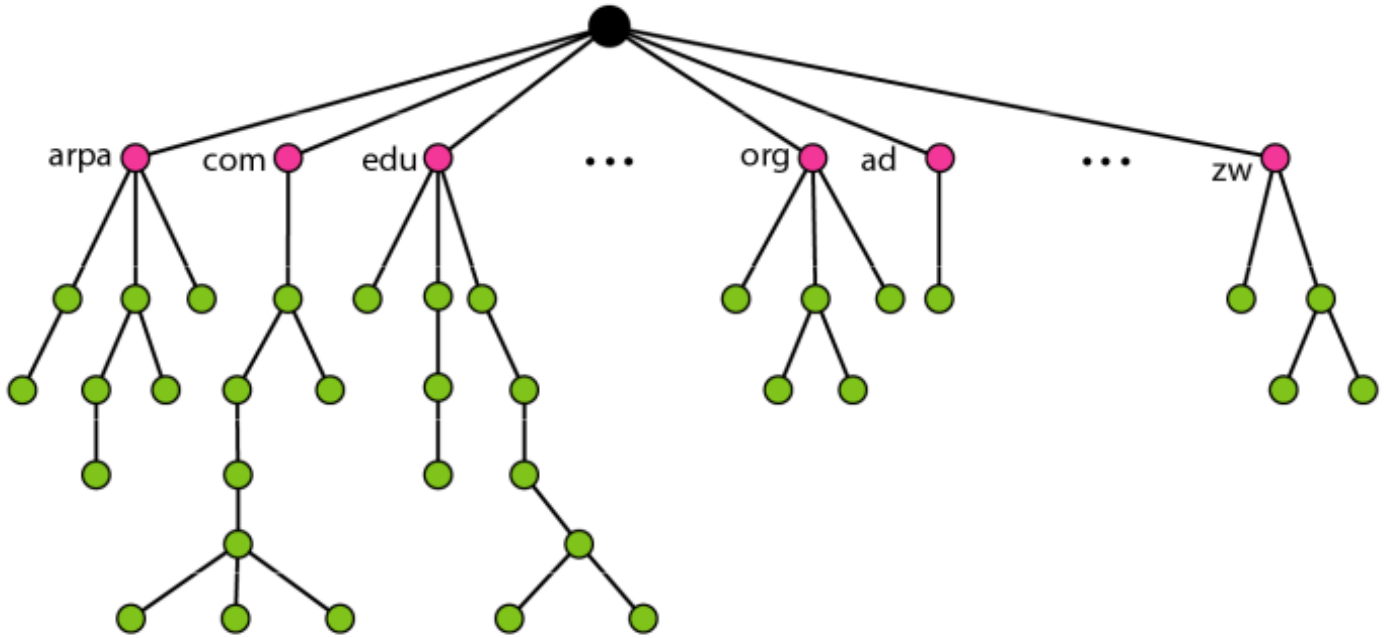
1. Domain Name System

- **Name Space:** To be unambiguous , the names assigned to machines must be carefully selected from a name space with complete control over the binding between the names and the IP address

- **Domain Name Space:** To have hierarchical name space, a domain name space was designed. In this design the names are defined in an inverted-tree structure with the root at the top. The tree can have only 128 levels: level 0 (root) to level 127.

1. Domain Name System

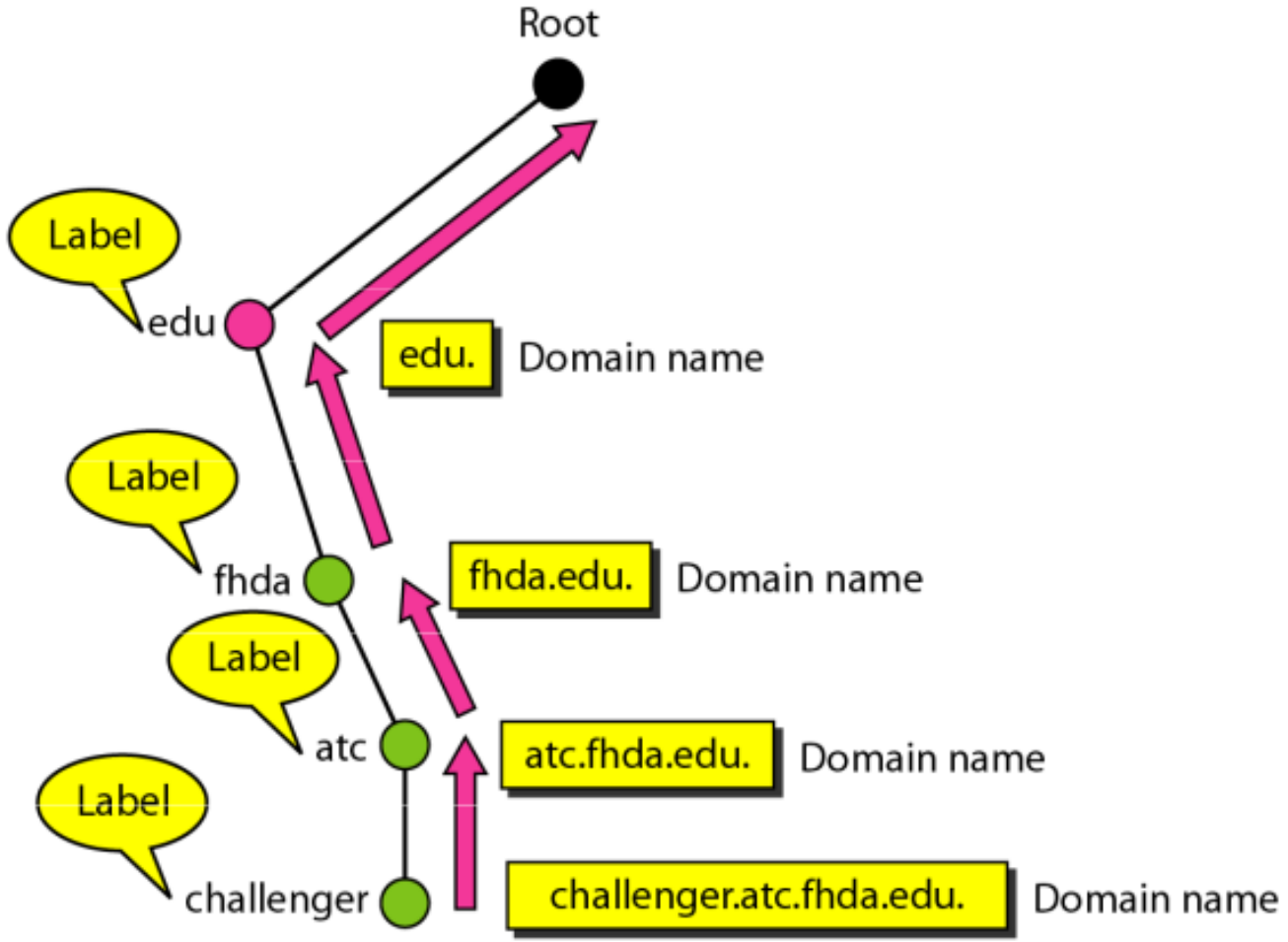
- Domain Name Space



1. Domain Name System

Domain Names and labels

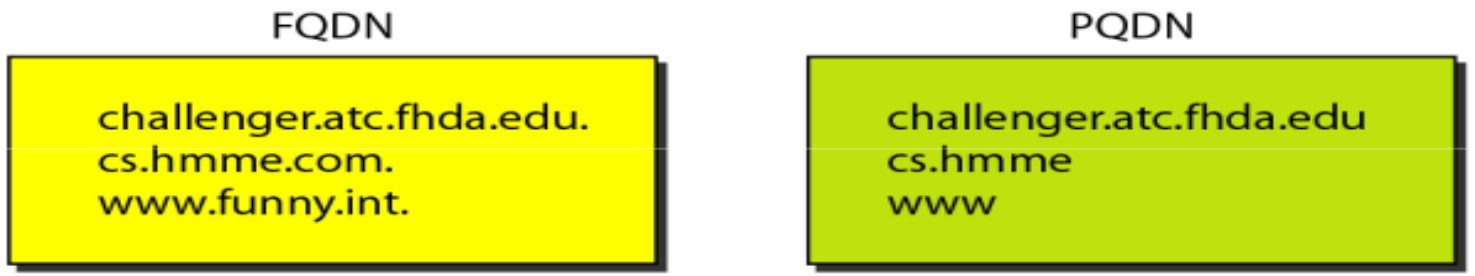
- The domain name contains all the labels from leaf node to root node



1. Domain Name System

FQDN

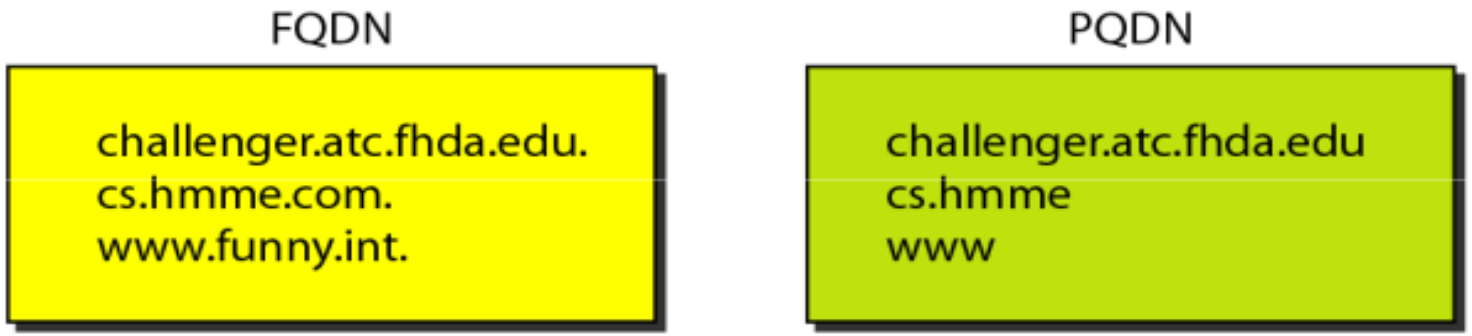
- Fully Qualified Domain Name (FQDN) of a host in the **DNS namespace hierarchy** consists of all the labels from the node, up to the root of the namespace, separated by periods (".").
- Fully Qualified Domain Name (FQDN) must end with a empty string, which represents the Root. Since there is no need to represent empty string, Fully Qualified Domain Name (FQDN) ends with a period (.). The trailing period (".") for the root domain is usually omitted in day-to-day use, but the DNS Resolver (Client) and DNS Servers must use it during actual DNS name queries.



1. Domain Name System

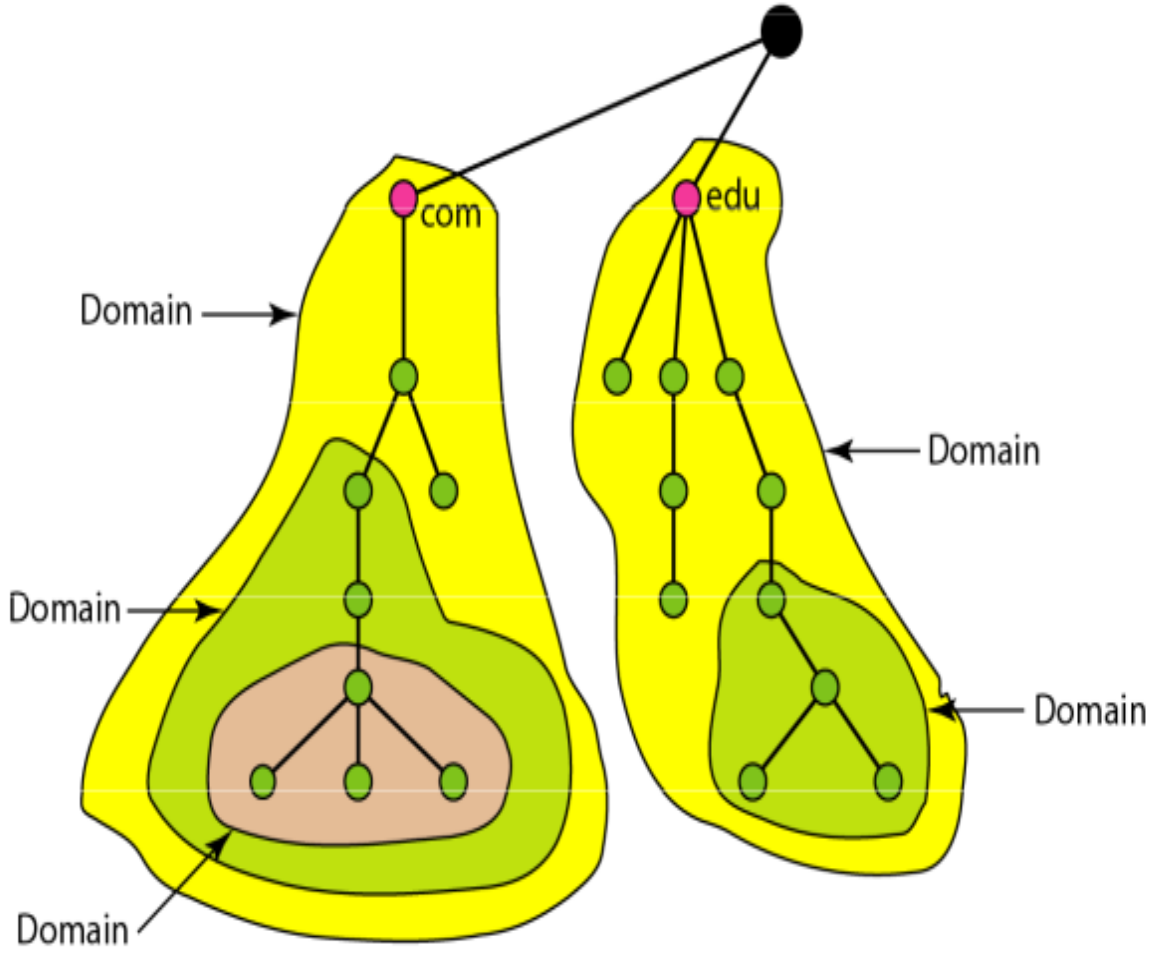
PQDN

- A Partially Qualified Domain Name (PQDN) is used to specify a portion of a domain name, normally the host portion of it. A Partially Qualified Domain Name (PQDN) starts with a host name, but it may not reach up to the root.
- Usually the computers will add the DNS suffix along with Partially Qualified Domain Name (PQDN) before sending a DNS query for name resolution.



1. Domain Name System

Domains



1. Domain Name System

- **Distribution of Name Space:**

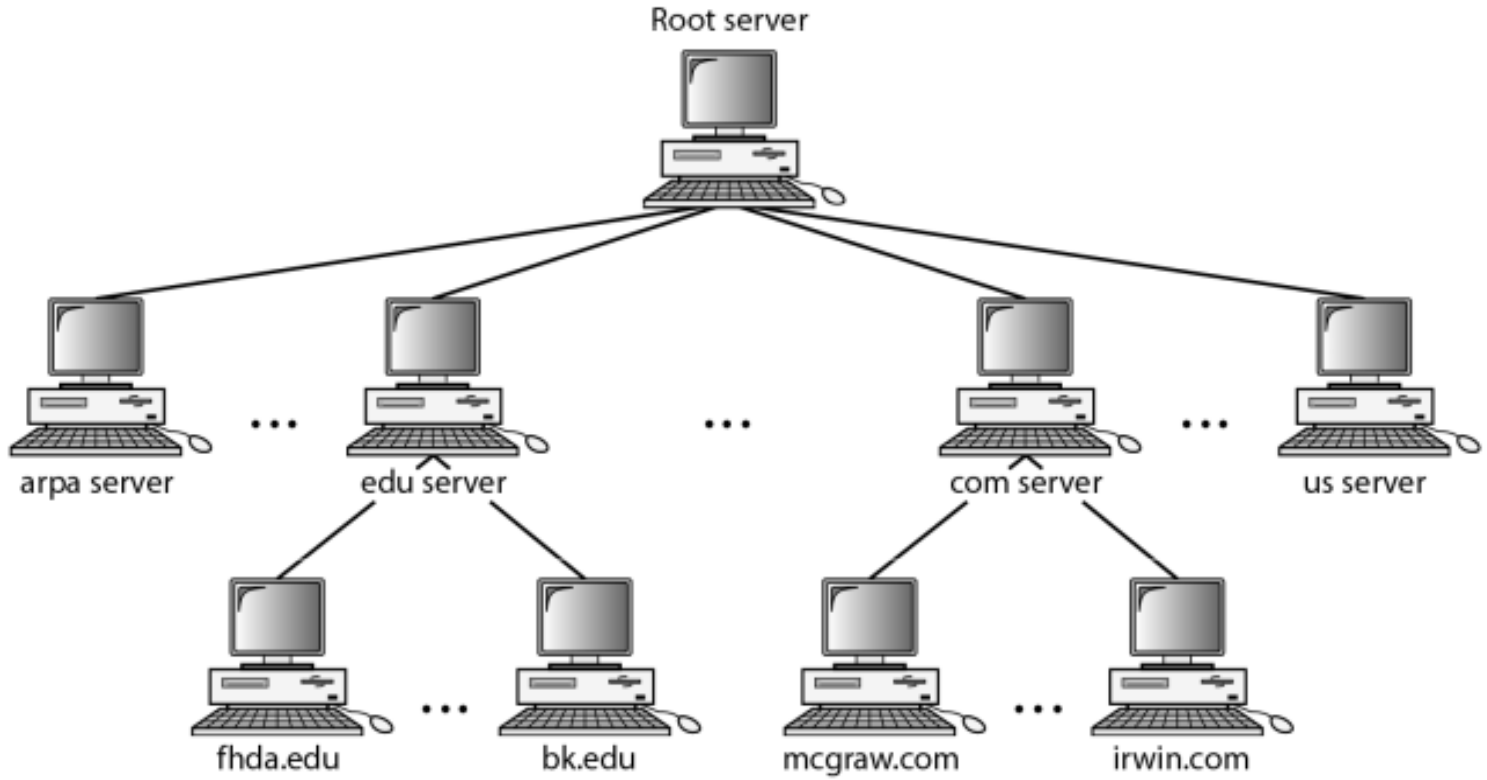
The information contained in the domain name space must be stored.

However, it is very inefficient and also unreliable to have just one computer store such a huge amount of information .

How to maintain distribution of the domain name space ?

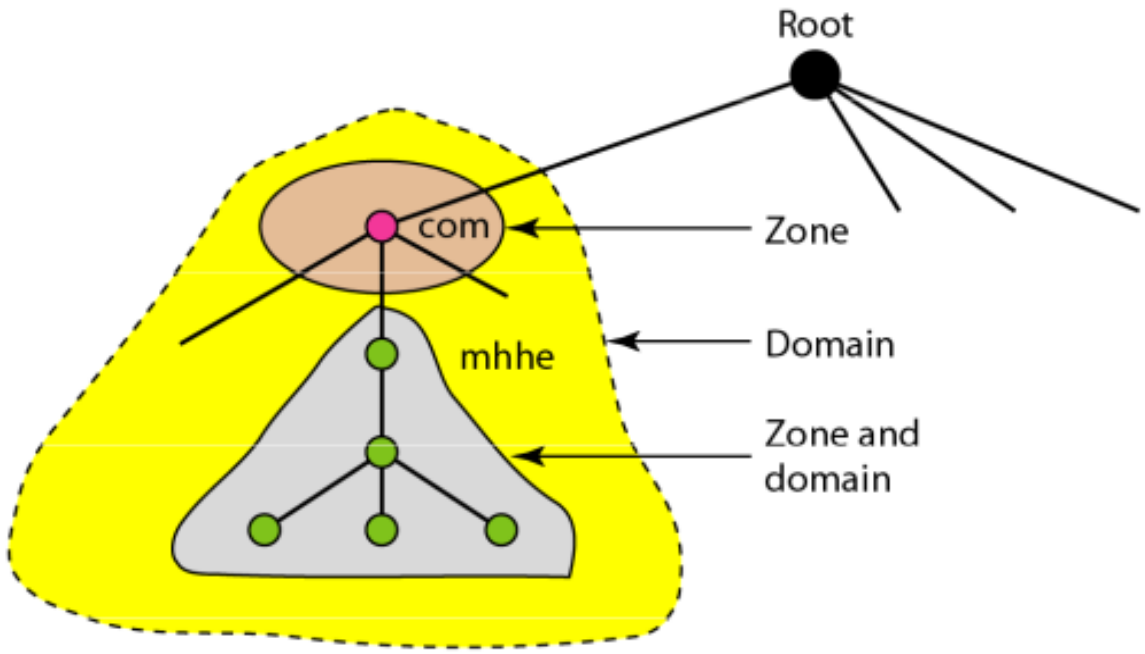
1. Domain Name System

Hierarchy of Name Servers



1. Domain Name System

Zones and Domains



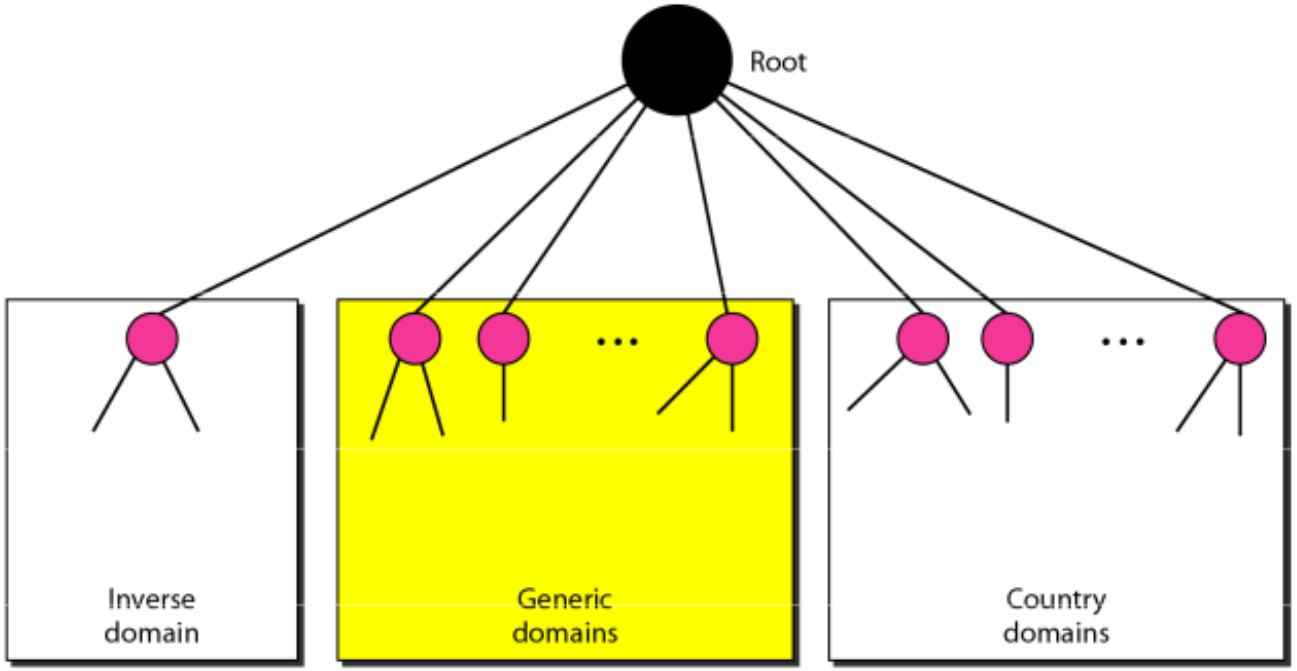
A primary server loads all information from the disk file; the secondary server loads all information from the primary server.

When the secondary downloads information from the primary, it is called zone transfer.

1. Domain Name System

- **DNS in the Internet**

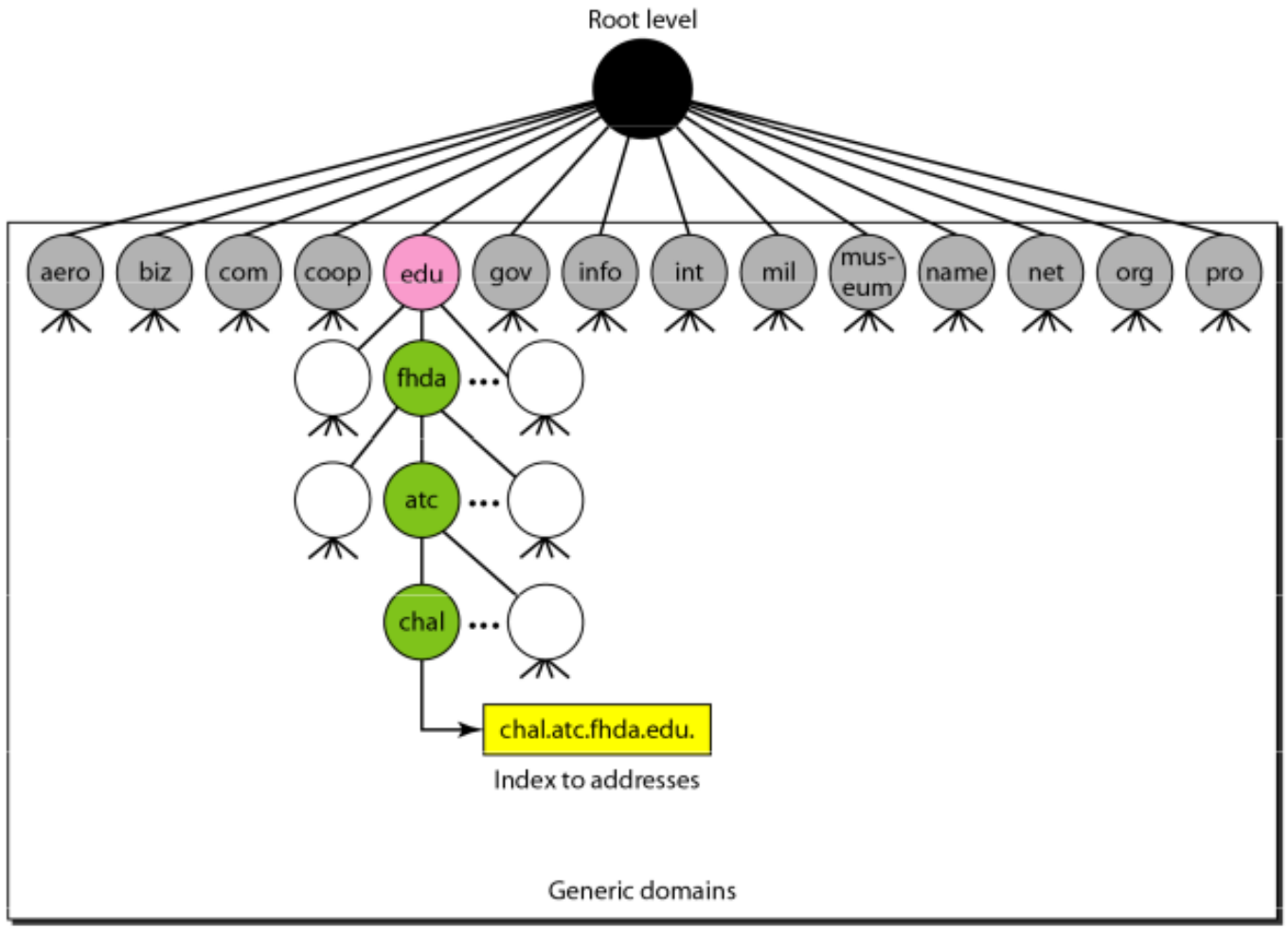
DNS is a protocol that can be used in different platforms. In the Internet, the domain name space platforms (tree) is divided into three different sections : generic domains, country domains, and the inverse domain.



1. Domain Name System

- **DNS in the Internet**

generic domains, country domains, and the inverse domain.



1. Domain Name System

- **DNS in the Internet**

generic domains, country domains, and the inverse domain.

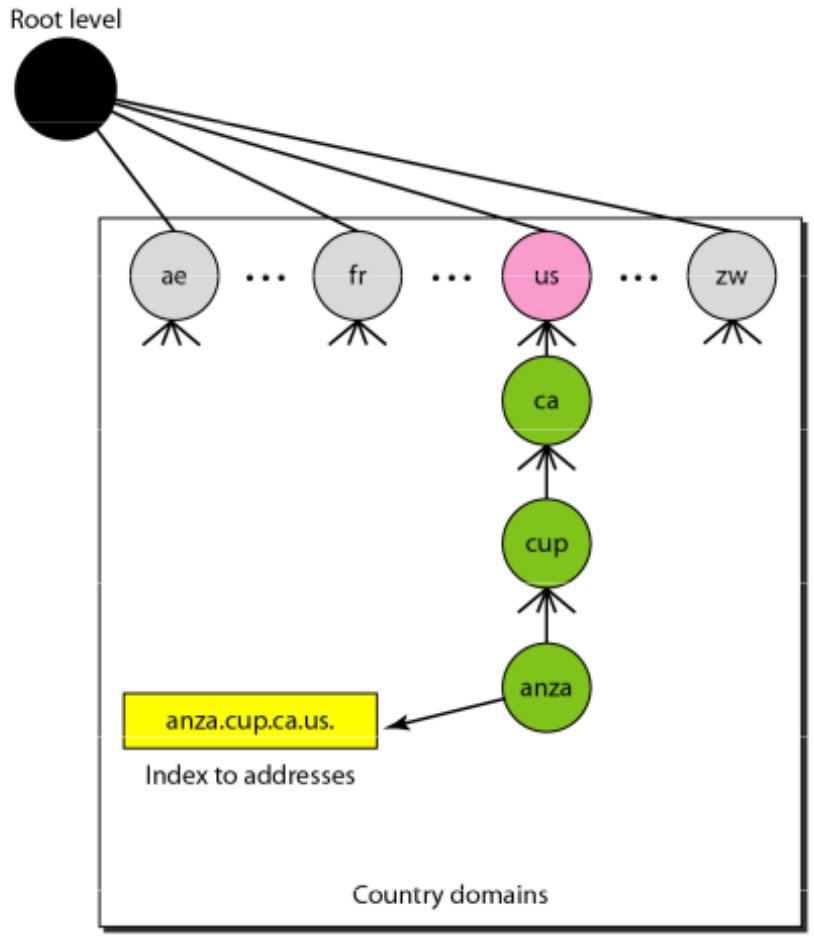
Table 25.1 ***Generic domain labels***

Label	*Description*
aero	Airlines and aerospace companies
biz	Businesses or firms (similar to "com")
com	Commercial organizations
coop	Cooperative business organizations
edu	Educational institutions
gov	Government institutions
info	Information service providers
int	International organizations
mil	Military groups
museum	Museums and other nonprofit organizations
name	Personal names (individuals)
net	Network support centers
org	Nonprofit organizations
pro	Professional individual organizations

1. Domain Name System

- **DNS in the Internet**

generic domains, **country domains,** and the inverse domain.

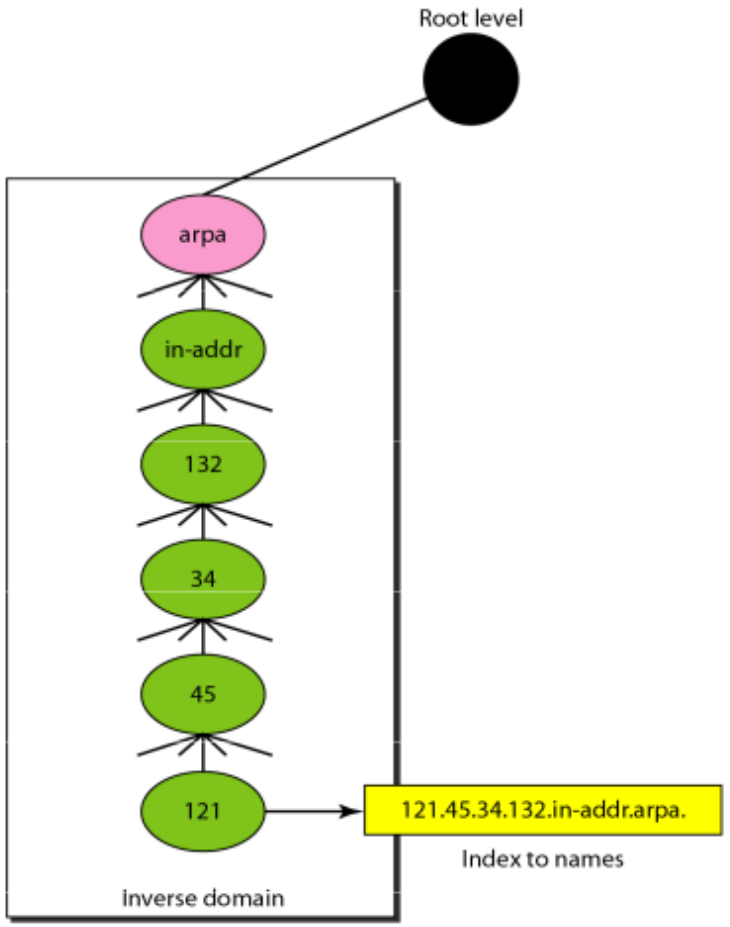


1. Domain Name System

- **DNS in the Internet**

generic domains, country domains, and the **inverse domain.**

The inverse domain is used for mapping an address to a name. When the server has received a request from the client, and the server contains the files of only authorized clients. To determine whether the client is on the authorized list or not, it sends a query to the DNS server and ask for mapping an address to the name.

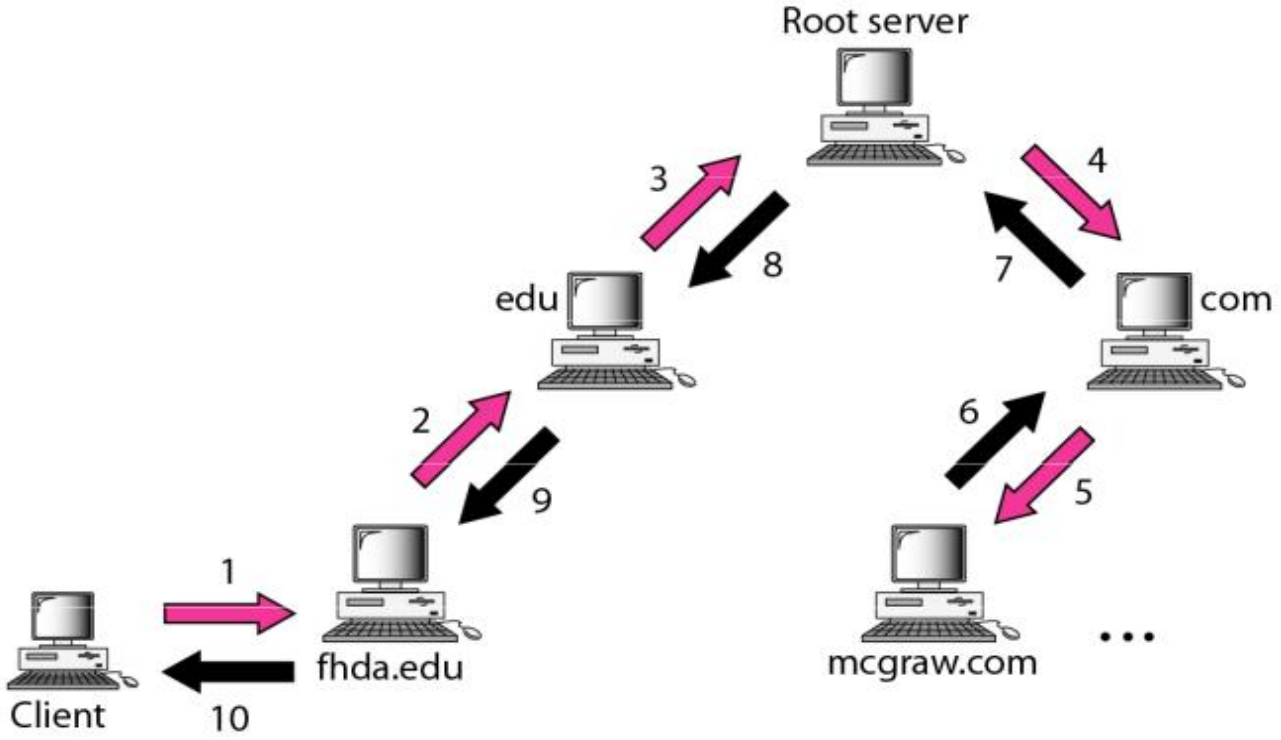


1. Domain Name System

- **Resolution**

Mapping a name to an address or an address to a name is called **name address resolution.**

Recursive Resolution:

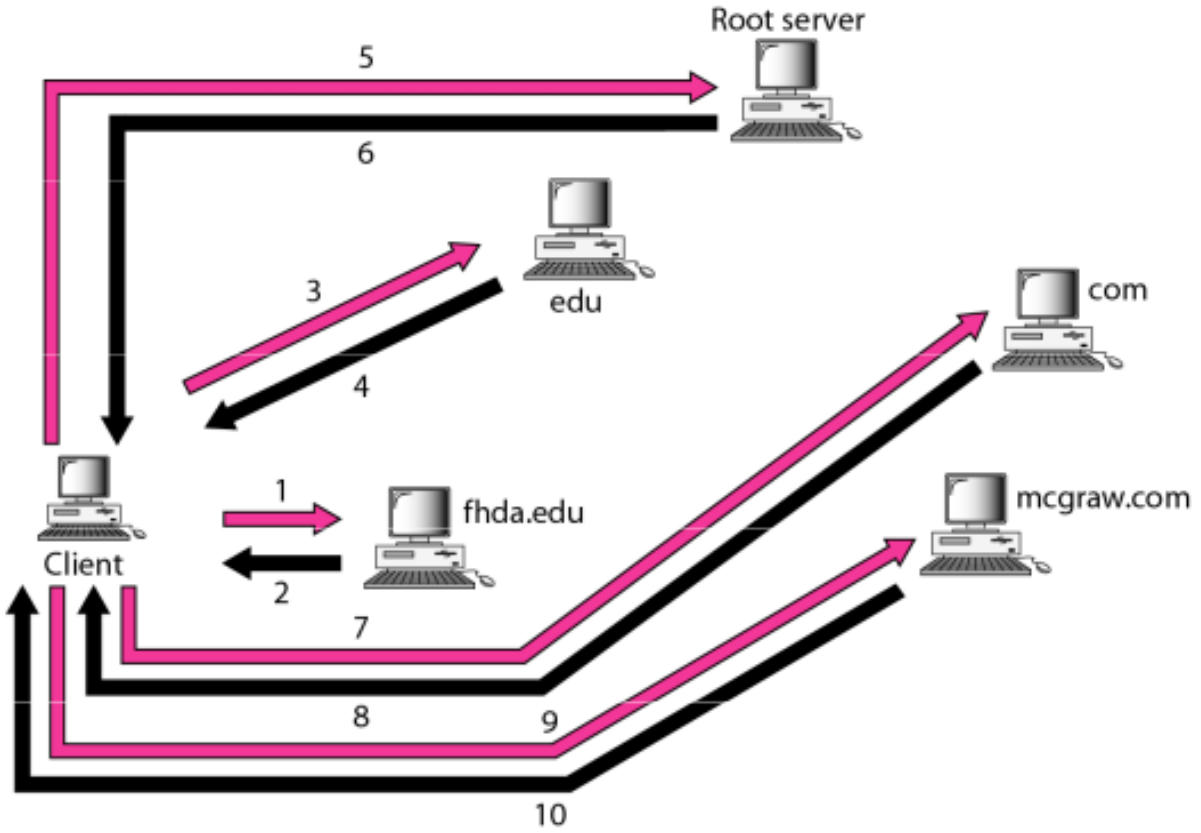


1. Domain Name System

- **Resolution**

Mapping a name to an address or an address to a name is called **name address resolution.**

Iterative Resolution:



1. Domain Name System

- **DNS Messages**

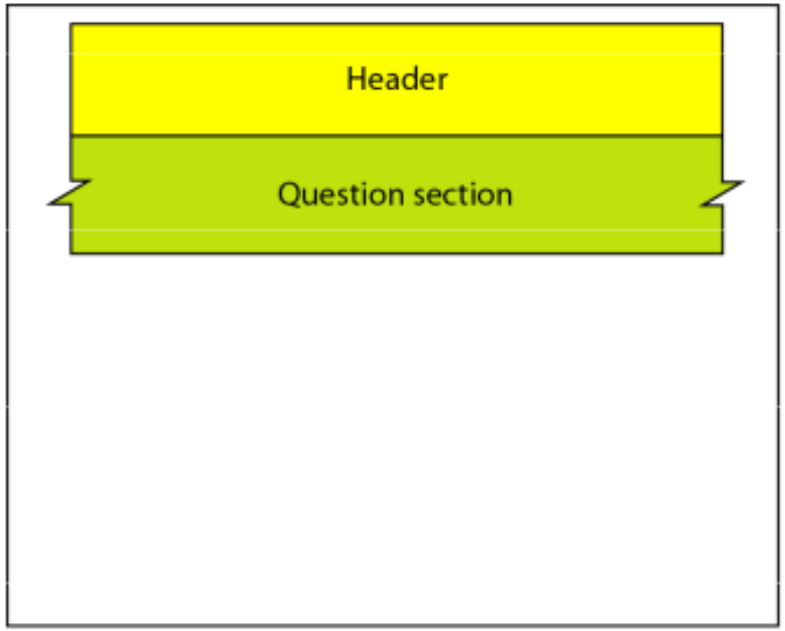
DNS has two types of messages messages: query and response Both types have the same format . The query message consists of a header and question records ; the response message consists of a header, question

Records, answer records, authoritative records, and additional records.

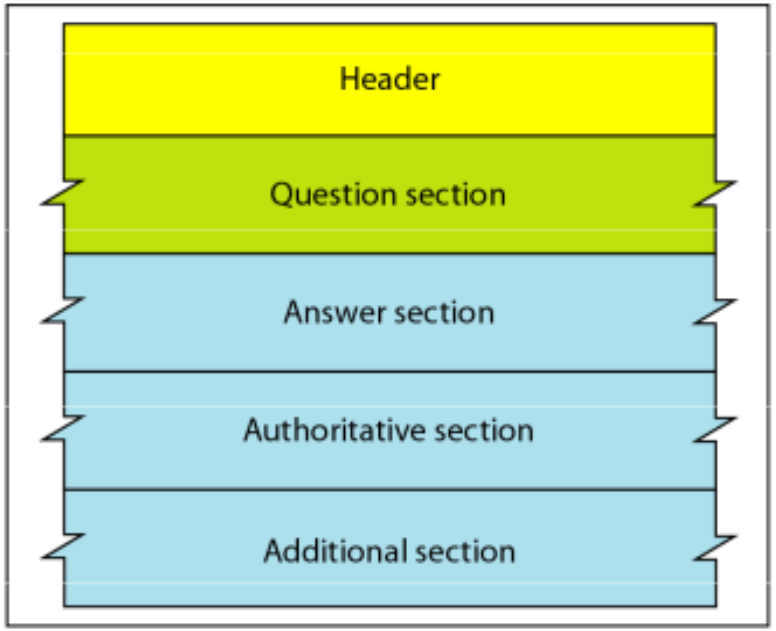
1. Domain Name System

- **DNS Messages**

DNS has two types of messages messages: query and response



a. Query



b. Response

1. Domain Name System

- **DNS Messages**

DNS has two types of messages messages: query and response

Header Format

Identification	Flags
Number of question records	Number of answer records (all 0s in query message)
Number of authoritative records (all 0s in query message)	Number of additional records (all 0s in query message)

1. Domain Name System

- **Registrars**

How are new domains added to DNS? This is done through a registrar, a commercial entity accredited by ICANN. A registrar first verifies that the requested domain name is unique and then enters it into the DNS database. A fee is charged.

1. Domain Name System

- **Domain Name Systems**

The DNS master file must be updated dynamically. The Dynamic Domain Name System (DDNS) therefore was devised to respond to this need. In DDNS, when a binding between a name and an address is determined, the information is sent, usually by DHCP to a primary DNS server. The primary server updates the zone. The secondary servers are notified either actively or passively.

1. Domain Name System

- **Encapsulation**

DNS can use either UDP or TCP. In both cases the well-known port used by the server is port 53. UDP is used when the size of the response message is less than 512 bytes because most UDP packages have a 512-byte packet size limit. If the size of the response message is more than 512 bytes, a TCP connection is used.

DNS can use the services of UDP or TCP using the well-known port 53.

1. Domain Name System

```
itadmin@itadmin-HP-ProDesk-600-G5-MT:~$ dig nitk.ac.in

; <<>> DiG 9.11.3-1ubuntu1.18-Ubuntu <<>> nitk.ac.in
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 19427
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;nitk.ac.in.                    IN      A

;; ANSWER SECTION:
nitk.ac.in.             19      IN      A       10.11.0.79

;; Query time: 0 msec
;; SERVER: 127.0.0.53#53(127.0.0.53)
;; WHEN: Tue Oct 18 10:01:49 IST 2022
;; MSG SIZE  rcvd: 55

itadmin@itadmin-HP-ProDesk-600-G5-MT:~$
```

1. Domain Name System

```
itadmin@itadmin-HP-ProDesk-600-G5-MT:~$ dig

; <<>> DiG 9.11.3-1ubuntu1.18-Ubuntu <<>>
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 58792
;; flags: qr rd ra; QUERY: 1, ANSWER: 13, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;.                              IN      NS

;; ANSWER SECTION:
.                       56167   IN      NS      a.root-servers.net.
.                       56167   IN      NS      b.root-servers.net.
.                       56167   IN      NS      c.root-servers.net.
.                       56167   IN      NS      d.root-servers.net.
.                       56167   IN      NS      e.root-servers.net.
.                       56167   IN      NS      f.root-servers.net.
.                       56167   IN      NS      g.root-servers.net.
.                       56167   IN      NS      h.root-servers.net.
.                       56167   IN      NS      i.root-servers.net.
.                       56167   IN      NS      j.root-servers.net.
.                       56167   IN      NS      k.root-servers.net.
.                       56167   IN      NS      l.root-servers.net.
.                       56167   IN      NS      m.root-servers.net.

;; Query time: 0 msec
;; SERVER: 127.0.0.53#53(127.0.0.53)
;; WHEN: Tue Oct 18 10:02:26 IST 2022
;; MSG SIZE  rcvd: 239
```

Reference

- “Data Communications and Networking”, Behrouz A. Forouzan, 5th Edition, McGraw Hill, 2017.

Thank You