



# Data Communications and Networking

Fourth Edition

Forouzan

## Application Layer

### Topics to be covered

**Application layer protocols such as HTTP, FTP, and SMTP**

**Peer-to-Peer File Sharing Protocols and Architectures,  
ISPs and Domain name systems.**

**Concept of Socket API.**

# Application Layer

The application layer enables the user, whether human or software, to access the network.

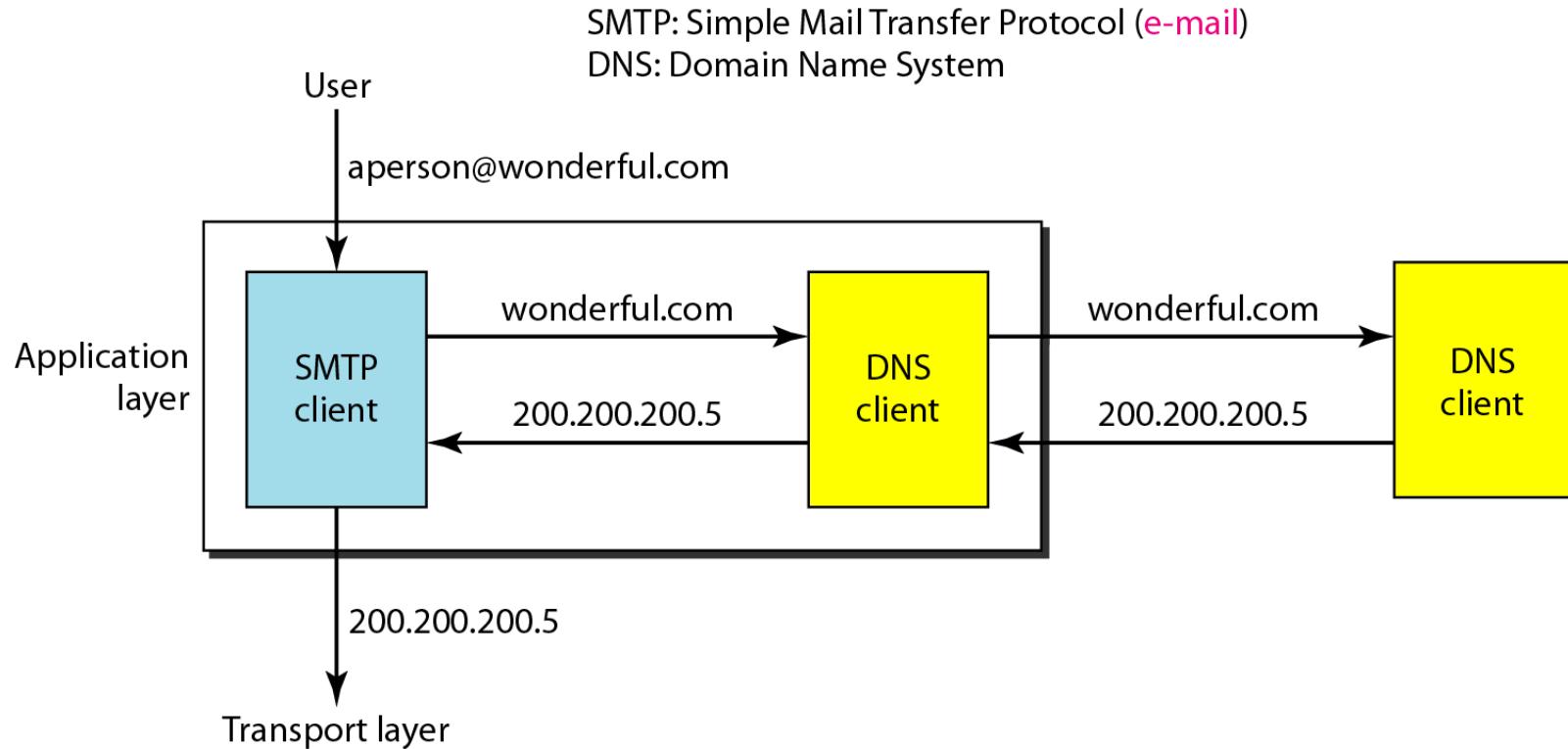
It provides user interfaces and support for services such as electronic mail, file access and transfer, access to system resources, surfing the world wide web, and network management.

# Domain name System

- There are several applications in the application layer of the Internet model that follow the client/server paradigm. The client/server programs can be divided into two categories:
- Those that can be directly used by the user, such as e-mail, and those that support other application programs.

The Domain Name System (DNS) is a supporting program that is used by other programs such as e-mail.

## Figure Example of using the DNS service



# 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 IP addresses.*

*In other words, the names must be unique because the addresses are unique. A name space that maps each address to a unique name can be organized in two ways: flat or hierarchical.*

**Topics discussed in this section:**

**Flat Name Space**

**Hierarchical Name Space**

# DOMAIN NAME SPACE

*To have a 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.*

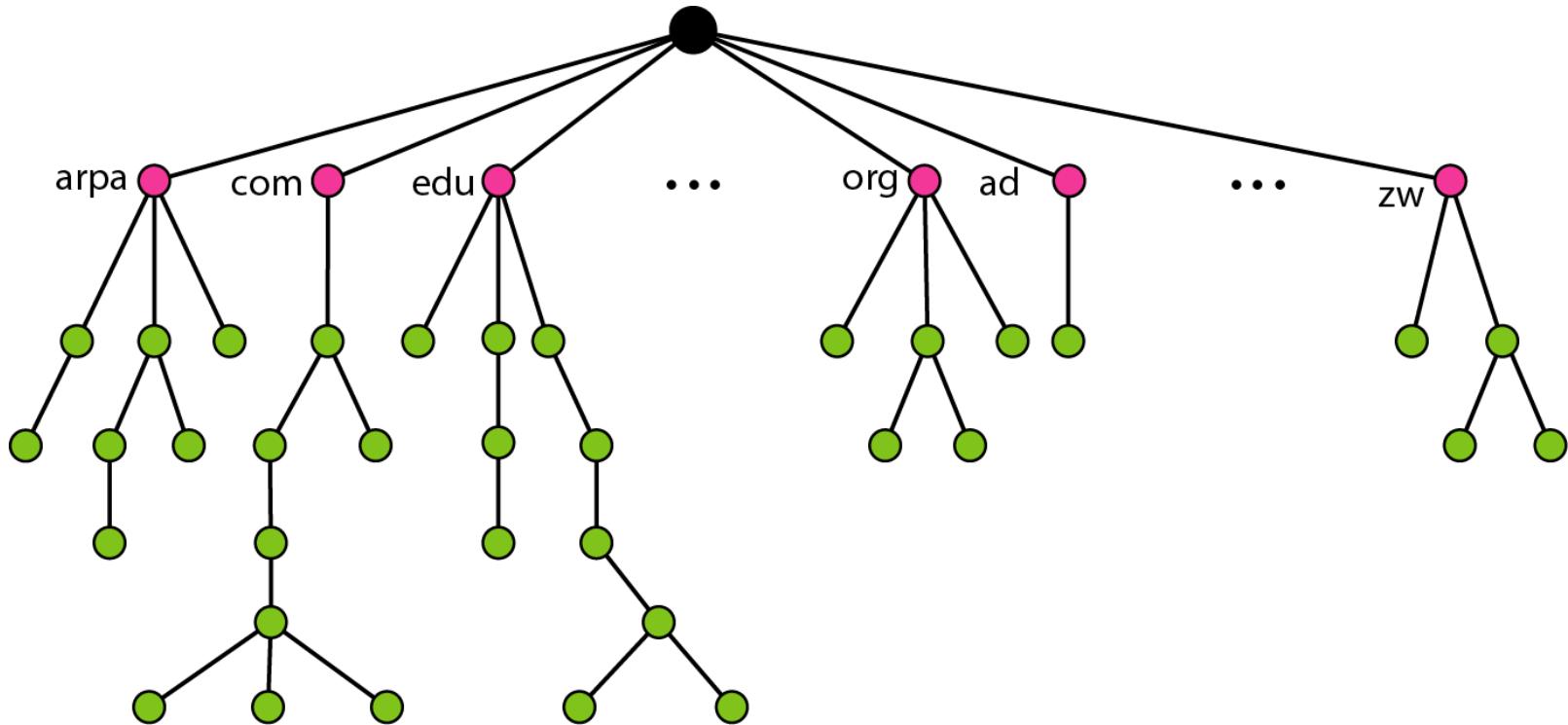
## **Topics discussed in this section:**

**Label :** Each node in a tree has a label which is a string of ( max. 63 characters)

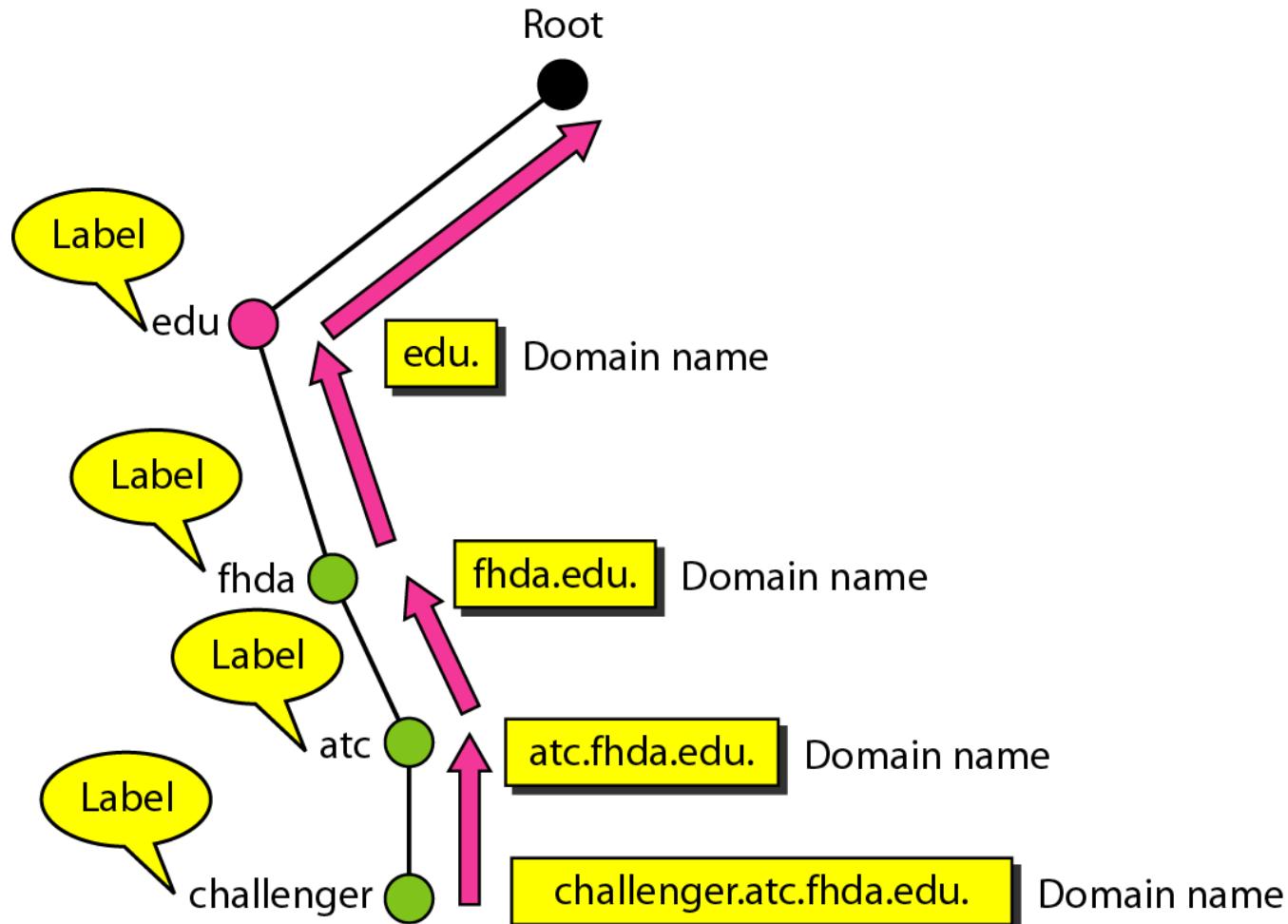
**Domain Name:** A full domain name is a sequence of labels seperated by dots. ( always read from the node upto the root.)

**Domain:**

**Figure Domain name space**

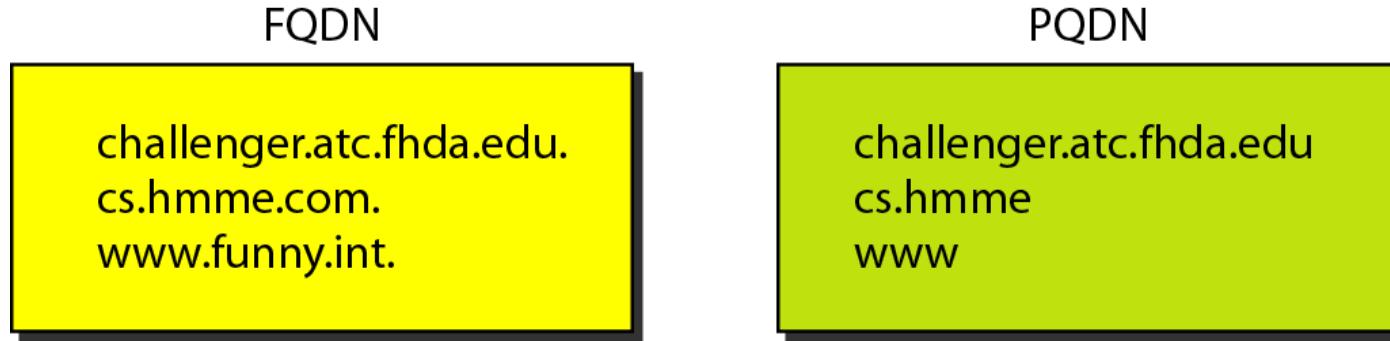


## Figure Domain names and labels



## **Figure FQDN and PQDN**

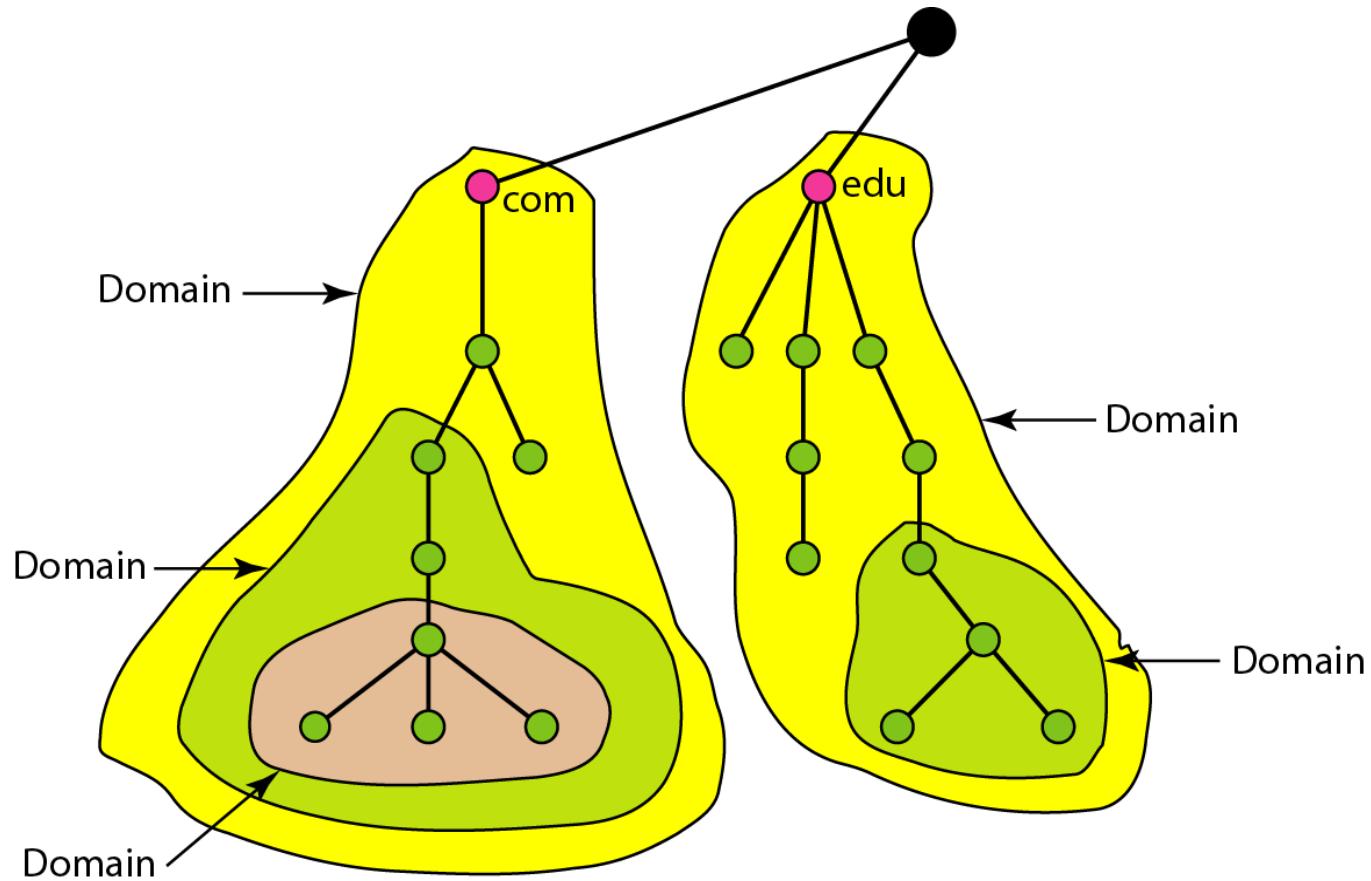
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**FQDN: Fully qualified domain name**

**PQDN: Partially qualified domain name**

## Figure Domains



# 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. In this section, we discuss the distribution of the domain name space.*

## **Topics discussed in this section:**

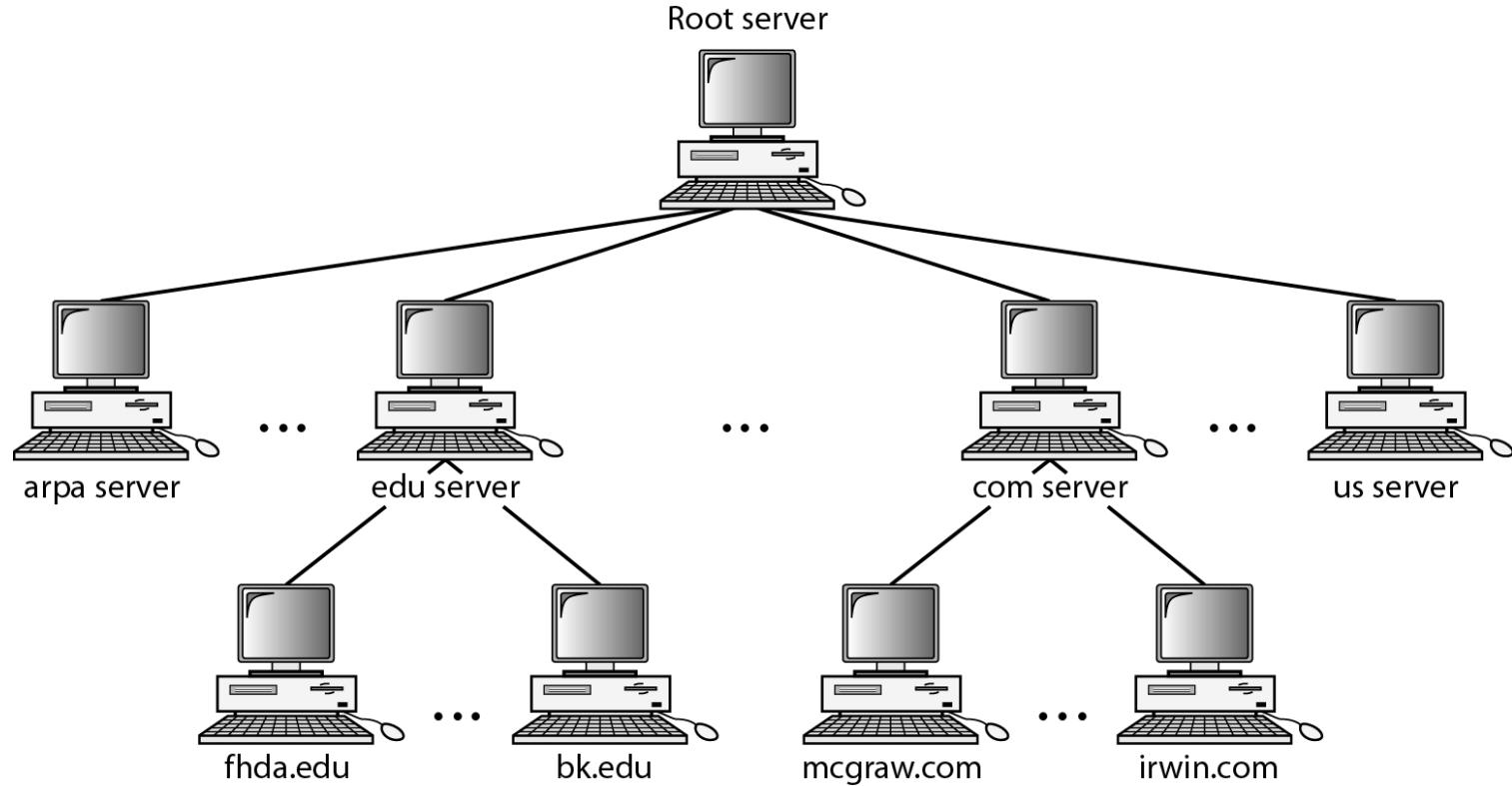
Hierarchy of Name Servers

Zone

Root Server

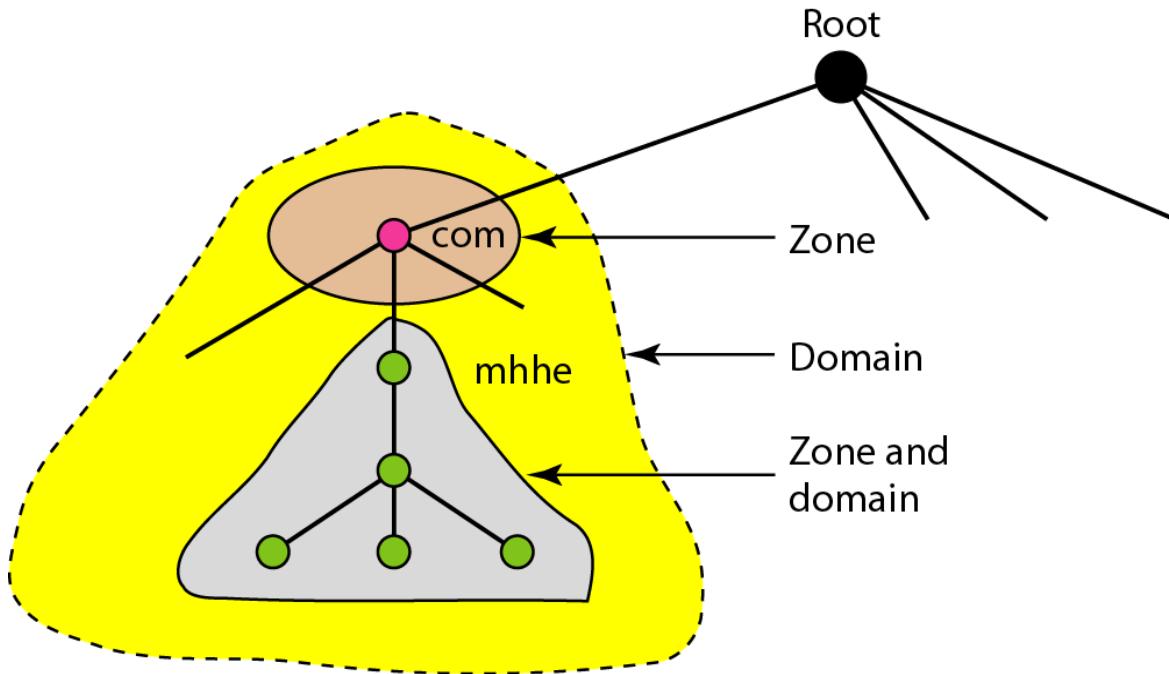
Primary and Secondary Servers

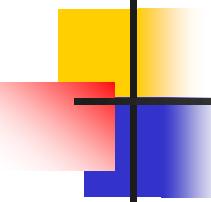
**Figure Hierarchy of name servers**



## Figure *Zones and domains*

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**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.**

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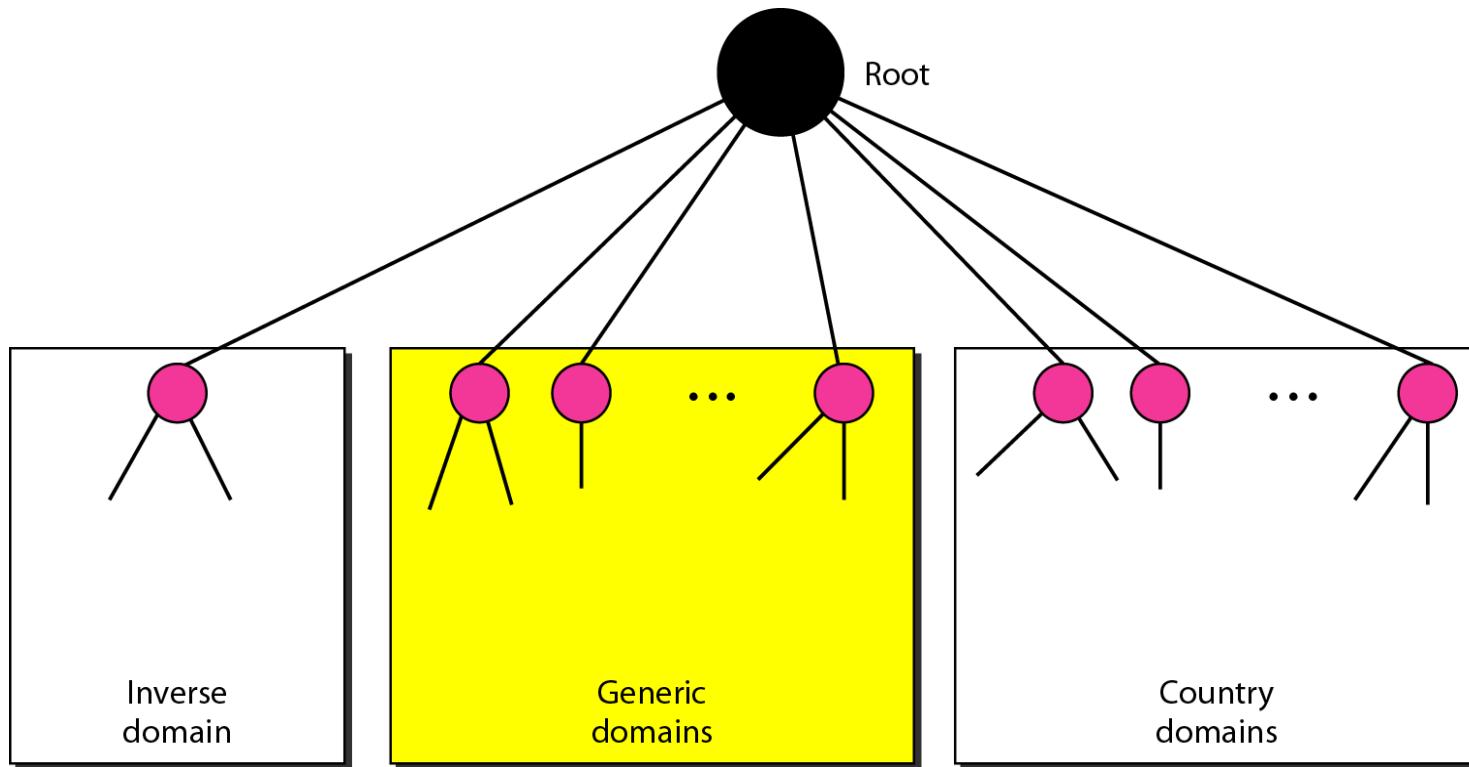
# DNS IN THE INTERNET

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

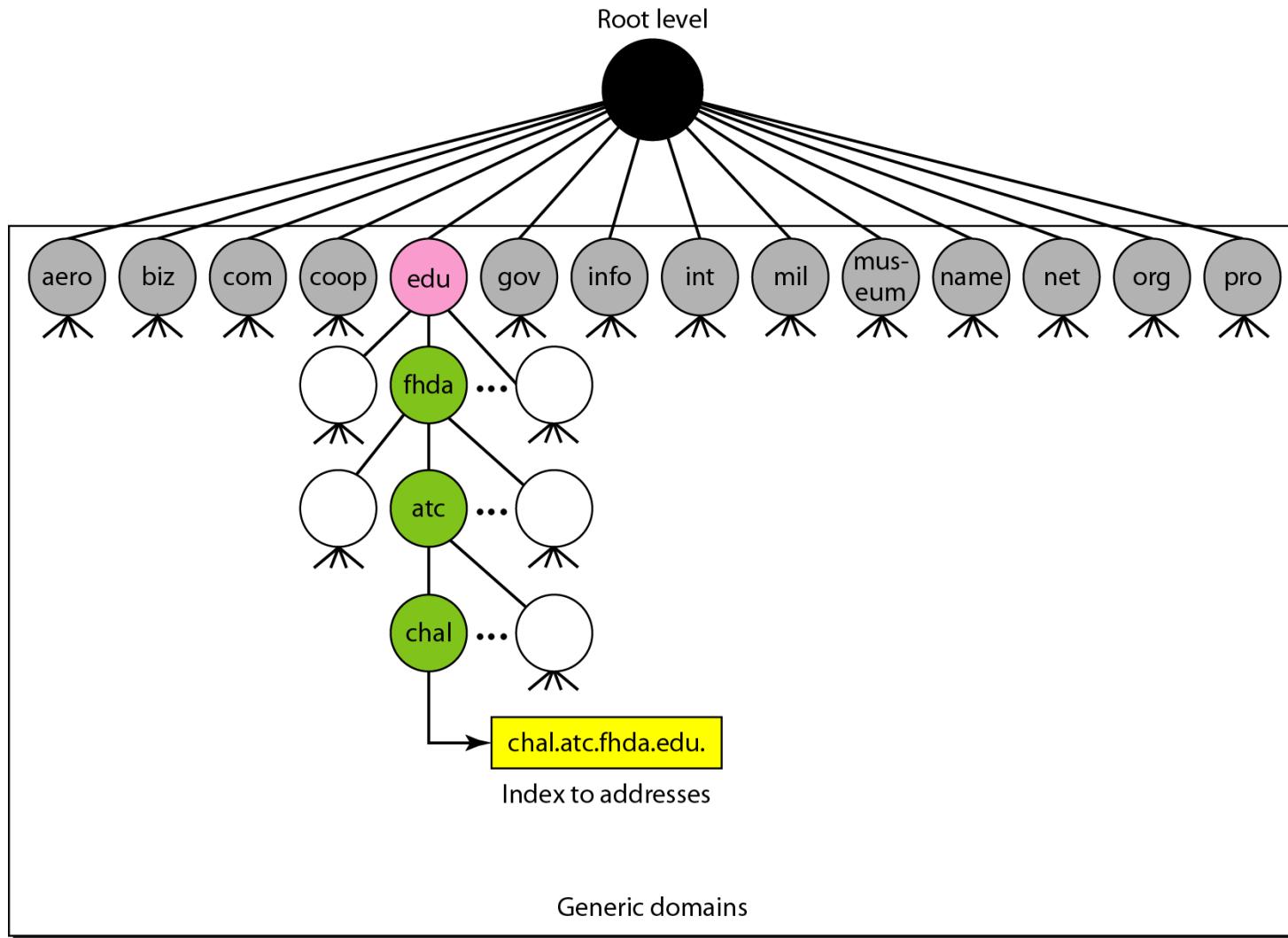
## **Topics discussed in this section:**

- Generic Domains**
- Country Domains**
- Inverse Domain**

## Figure DNS IN THE INTERNET



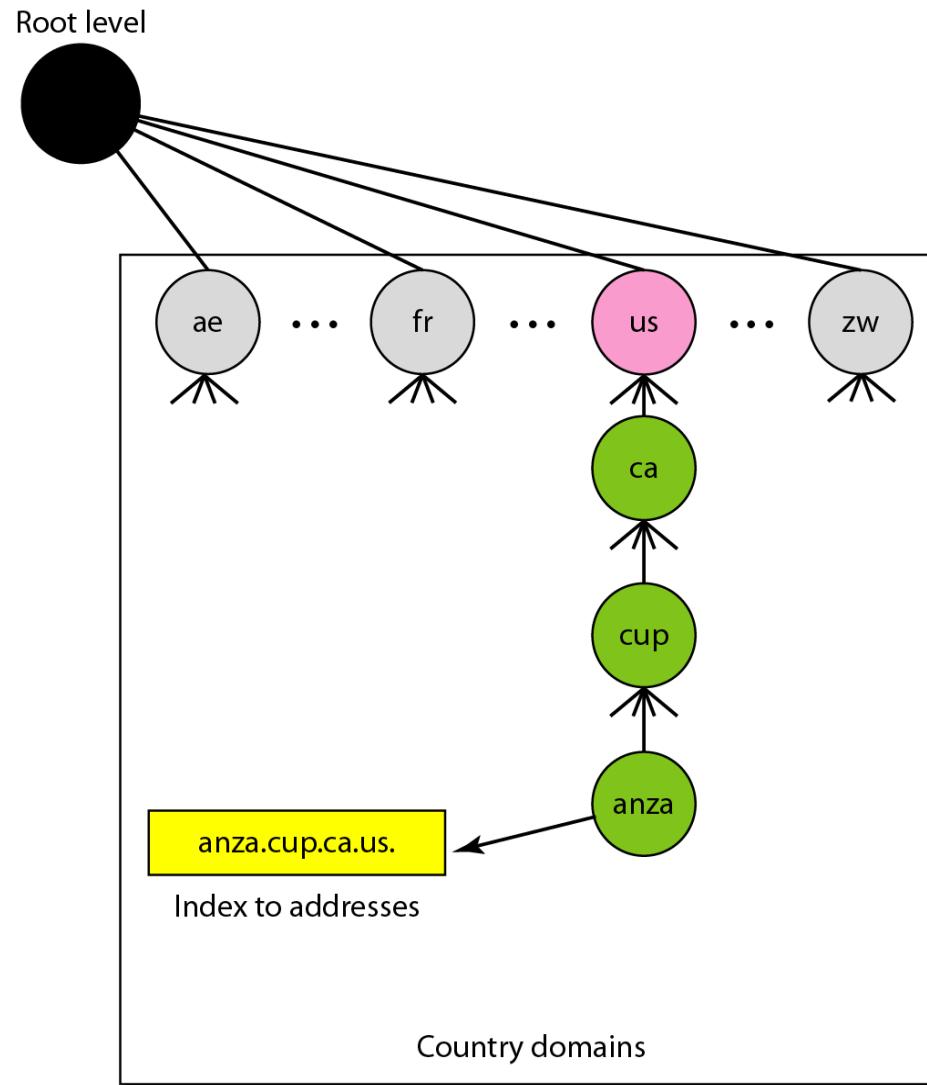
## Figure Generic domains



**Table** *Generic domain labels*

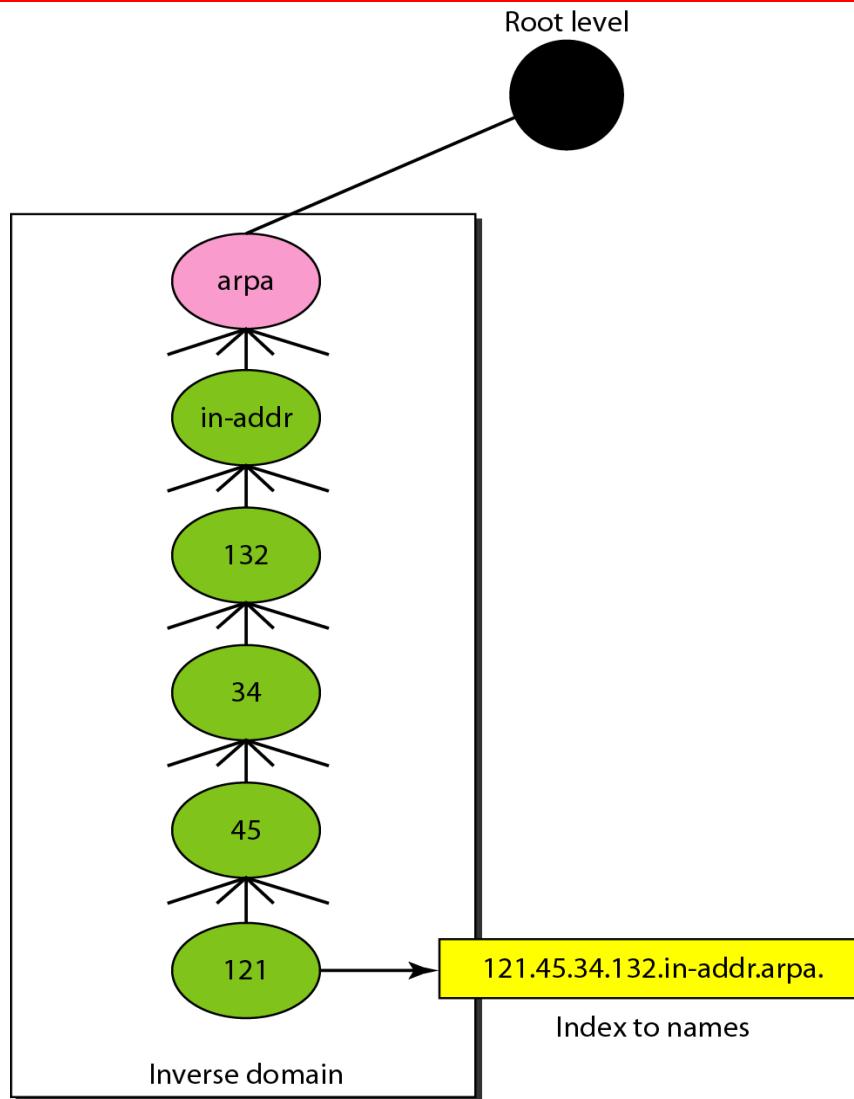
<i>Label</i>	<i>Description</i>
<b>aero</b>	Airlines and aerospace companies
<b>biz</b>	Businesses or firms (similar to “com”)
<b>com</b>	Commercial organizations
<b>coop</b>	Cooperative business organizations
<b>edu</b>	Educational institutions
<b>gov</b>	Government institutions
<b>info</b>	Information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

## Figure *Country domains*



## Figure *Inverse domain*

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# **RESOLUTION**

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

## **Topics discussed in this section:**

**Resolver**

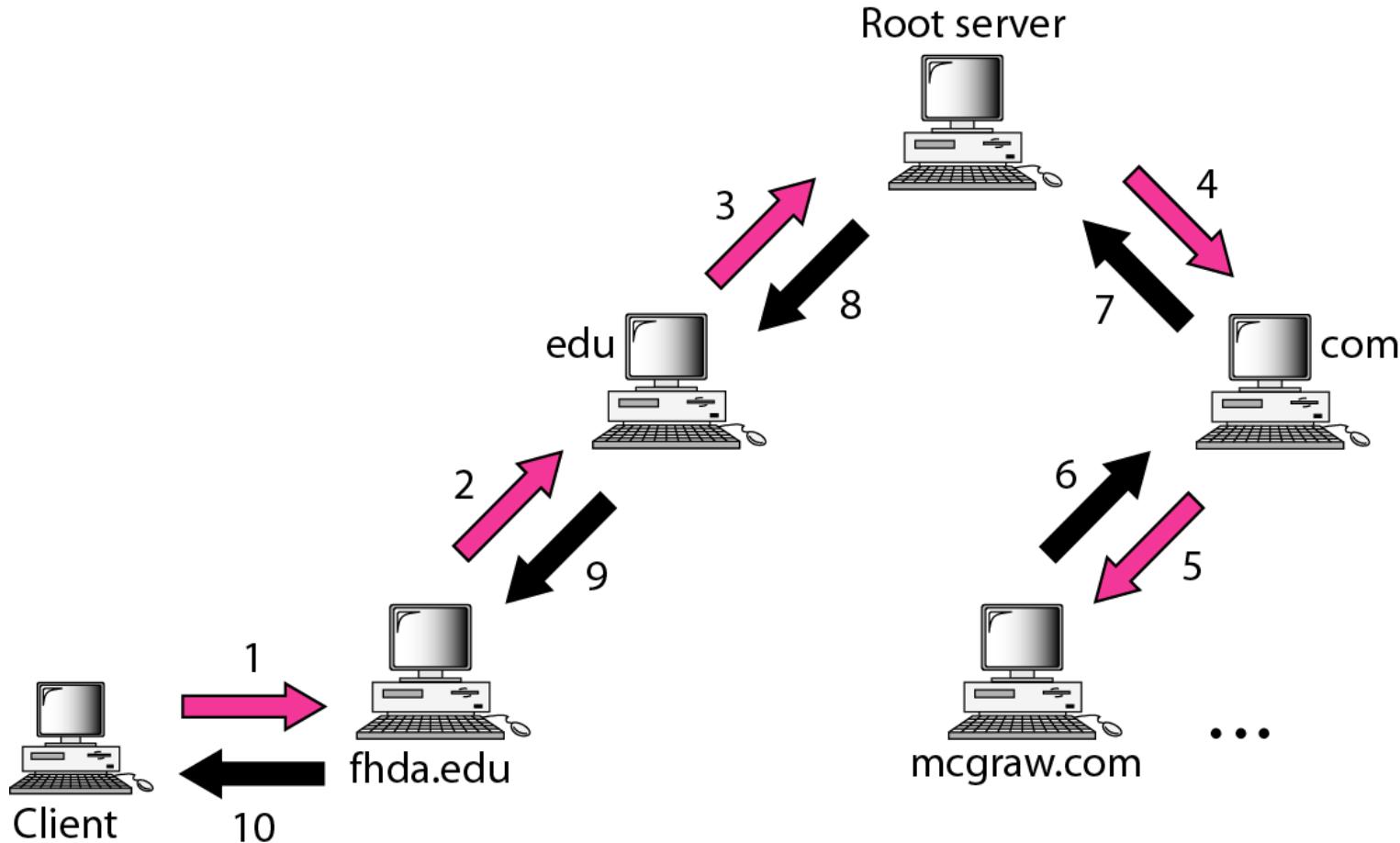
**Mapping Names to Addresses**

**Mapping Addresses to Names**

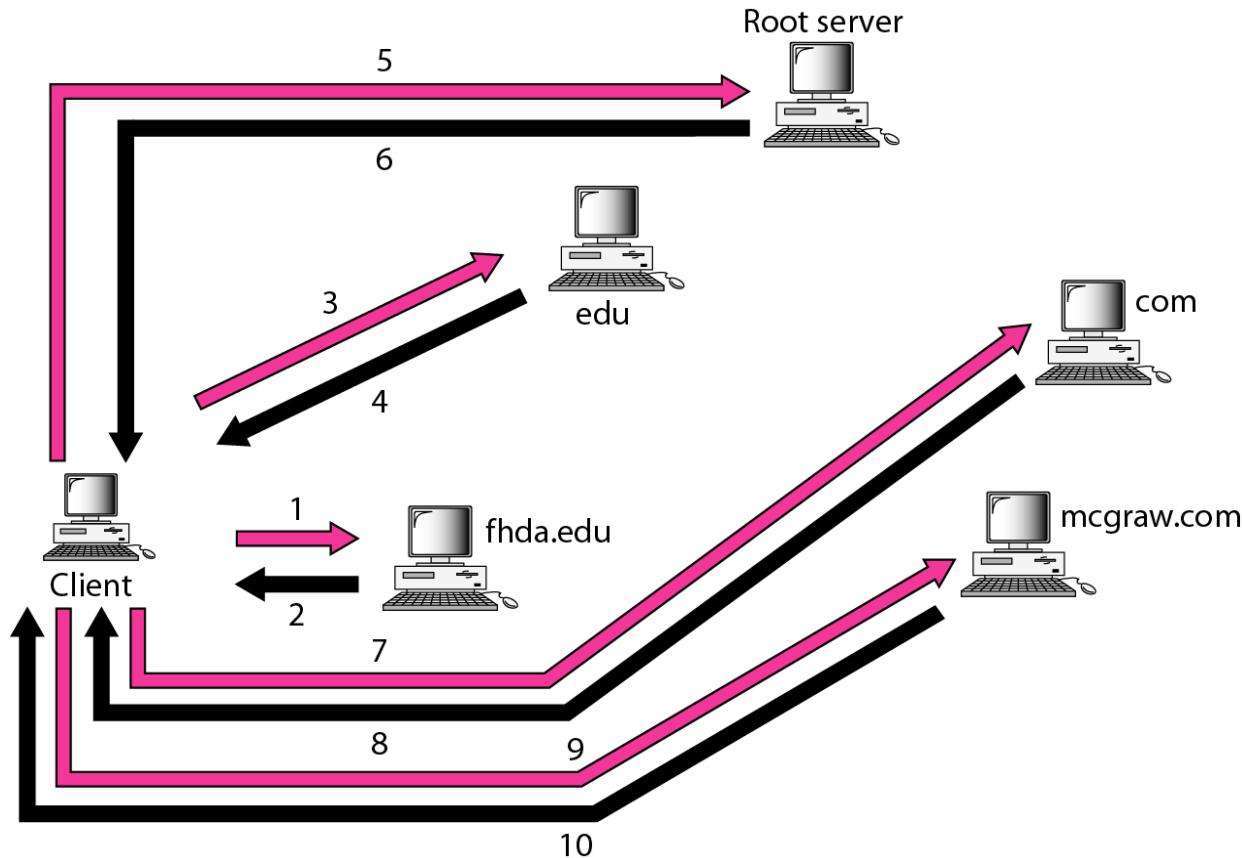
**Recursive Resolution**

**Caching**

**Figure Recursive resolution**



## Figure *Iterative resolution*



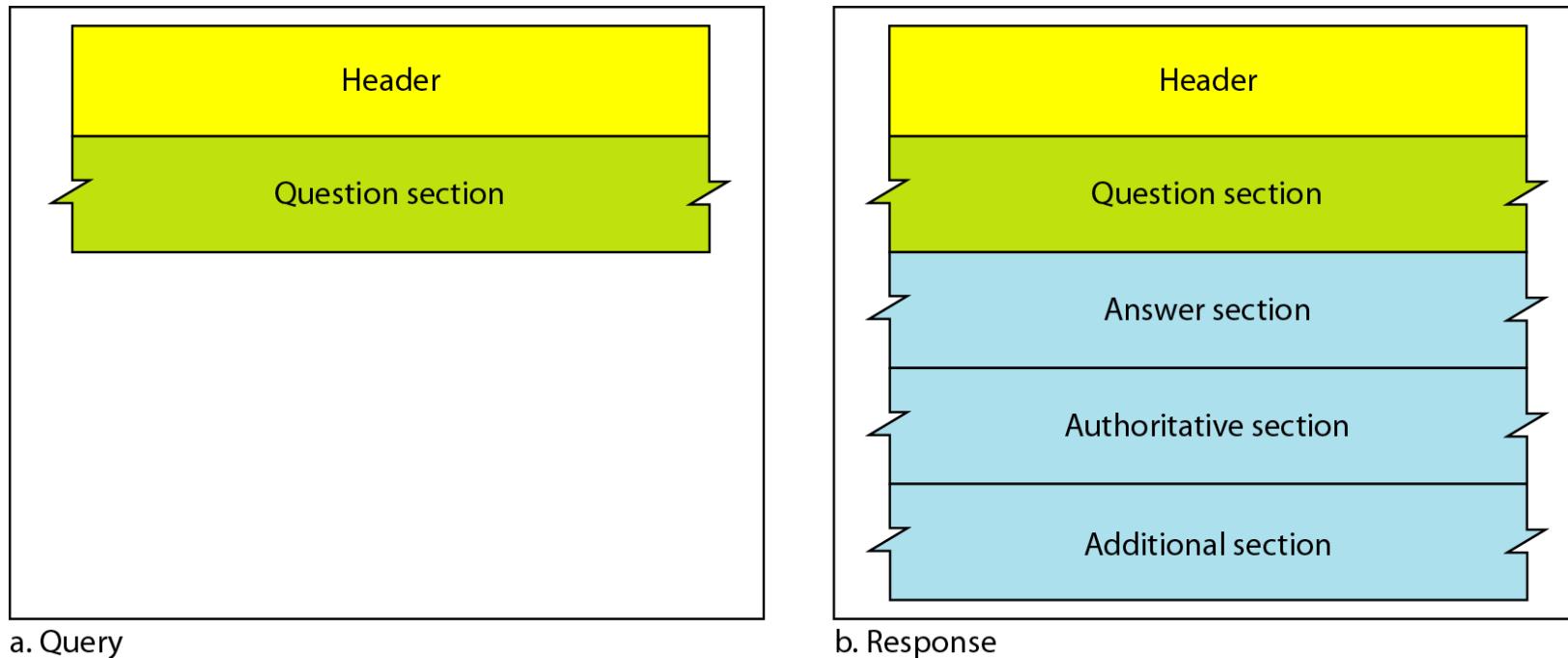
# DNS MESSAGES

*DNS has two types of 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.*

## **Topics discussed in this section:**

**Header**

## Figure *Query and response messages*



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## Figure *Header format*

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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)

# TYPES OF RECORDS

*As we saw, two types of records are used in DNS. The question records are used in the question section of the query and response messages. The resource records are used in the answer, authoritative, and additional information sections of the response message.*

## **Topics discussed in this section:**

**Question Record**

**Resource Record**

# REGISTRARS

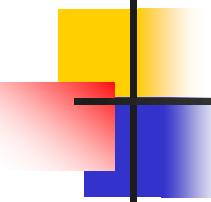
*How are new domains added to DNS? This is done through a registrar, a commercial entity accredited by ICANN. A registrar first verifies that the requested domain name is unique and then enters it into the DNS database. A fee is charged.*

# DYNAMIC DOMAIN NAME SYSTEM (DDNS)

*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.*

# 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.*



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

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