UNIT 5- APPLICATION LAYER
Domain Name System

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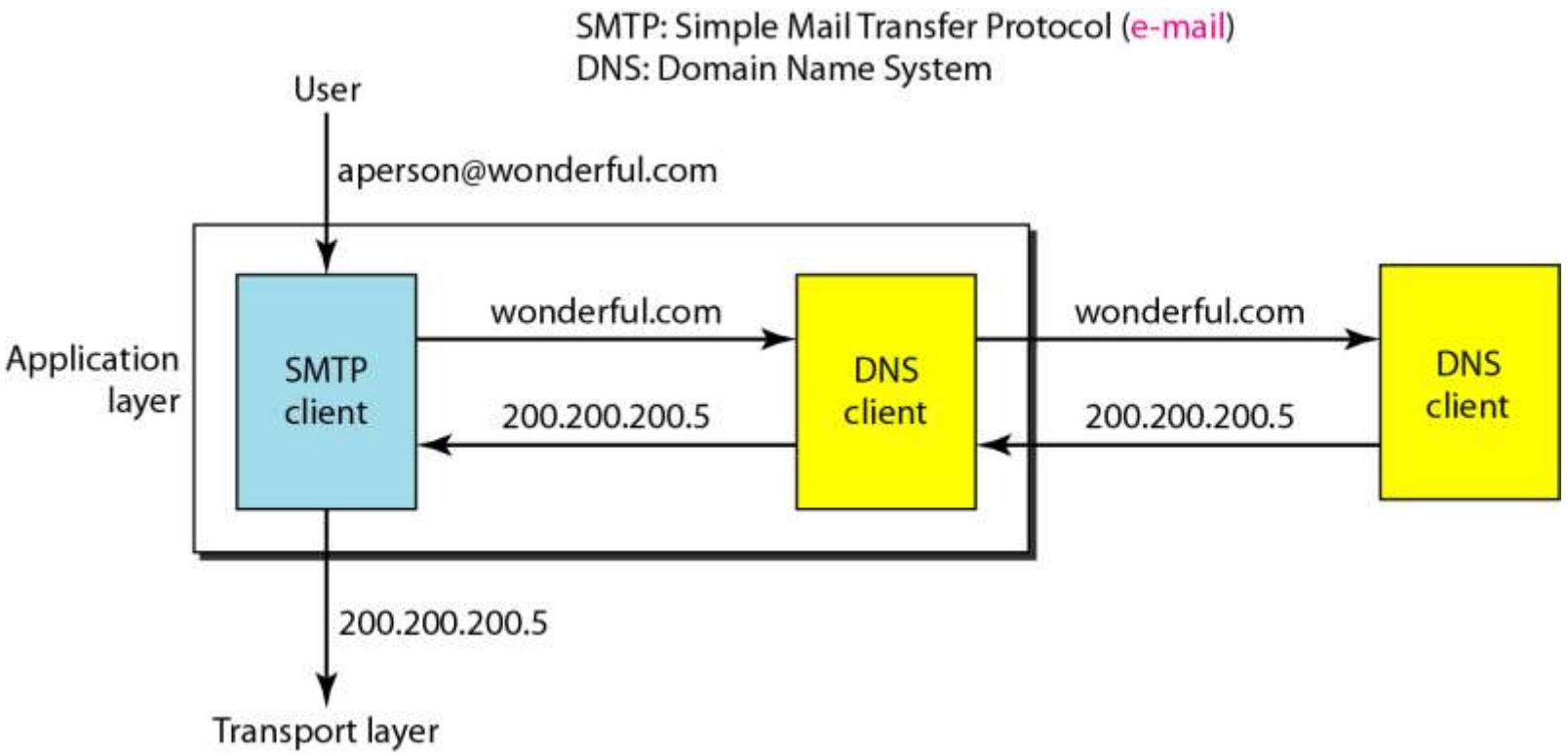
- There are several applications in the application layer of the Internet model that follow the client/server paradigm
- The client/server programs can be divided into two categories:
- that can be directly used by the user, such as e-mail, and those that support other application programs
- The Domain Name System (DNS) is a supporting program that is used by other programs such as e-mail.

- Figure 25.1 shows an example of how a DNS client/server program can support an e-mail program to find the IP address of an e-mail recipient.
- A user of an e-mail program may know the e-mail address of the recipient; however, the IP protocol needs the IP address.
- The DNS client program sends a request to a DNS server to map the e-mail address to the corresponding IP address.

Figure 25.1 *Example of using the DNS service*



- To identify an entity, TCP/IP protocols use the IP address, which uniquely identifies the connection of a host to the Internet.
- However, people prefer to use names instead of numeric addresses.
- Therefore, we need a system that can map a name to an address or an address to a name.
- When the Internet was small, mapping was done by using a host file.
- The host file had only two columns: name and address.
- Every host could store the host file on its disk and update it periodically from a master host file.
- When a program or a user wanted to map a name to an address, the host consulted the host file and found the mapping.

- Today, however, it is impossible to have one single host file to relate every address with a name and vice versa.
- The host file would be too large to store in every host.
- In addition, it would be impossible to update all the host files every time there was a change
- One solution would be to store the entire host file in a single computer and allow access to this centralized information to every computer that needs mapping.
- But we know that this would create a huge amount of traffic on the Internet.
- Another solution, the one used today, is to divide this huge amount of information into smaller parts and store each part on a different computer
- In this method, the host that needs mapping can contact the closest computer holding the needed information. **This method is used by the Domain Name System (DNS).**

25-1 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.

Topics discussed in this section:

Flat Name Space
Hierarchical Name Space

Flat Name Space:

- In a flat name space, a name is assigned to an address.
- A name in this space is a sequence of characters without structure.
- The names may or may not have a common section; if they do, it has no meaning.
- The main disadvantage of a flat name space is that it cannot be used in a large system such as the Internet because it must be centrally controlled to avoid ambiguity and duplication.

Flat Name space

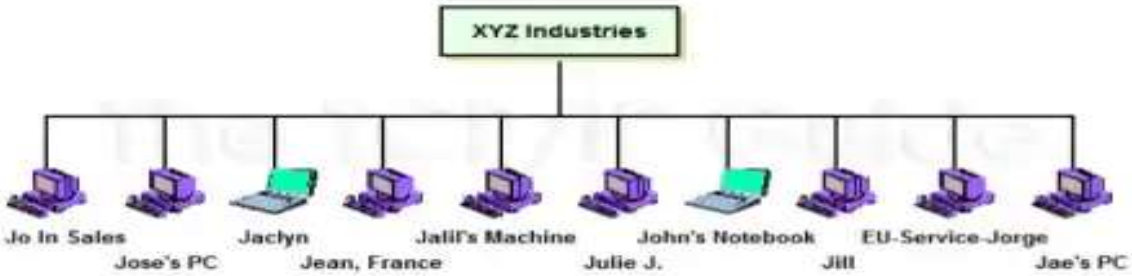


Figure 232: Flat Name Architecture (Flat Name Space)

Hierarchical Name Space :

- In a hierarchical name space, each name is made of several parts. The first part can define the nature of the organization,
- the second part can define the name of an organization,
- the third part can define departments in the organization, and so on.
- In this case, the authority to assign and control the name spaces can be decentralized.

- A central authority can assign the part of the name that defines the nature of the organization and the name of the organization
- The responsibility of the rest of the name can be given to the organization itself.
- The organization can add suffixes (or prefixes) to the name to define its host or resources.
- The management of the organization need not worry that the prefix chosen for a host is taken by another organization
- because, even if part of an address is the same, the whole address is different.
- For example, assume two colleges and a company call one of their computers challenger

- The first college is given a name by the central authority such as fhda.edu,
- the second college is given the name berkeley.edu, and the company is given the name smart. com.
- When these organizations add the name challenger to the name they have already been given, the end result is three distinguishable names:
- challenger.fhda.edu, challenger.berkeley.edu, and challenger.smart.com.
- The names are unique without the need for assignment by a central authority.
- The central authority controls only part of the name, not the whole

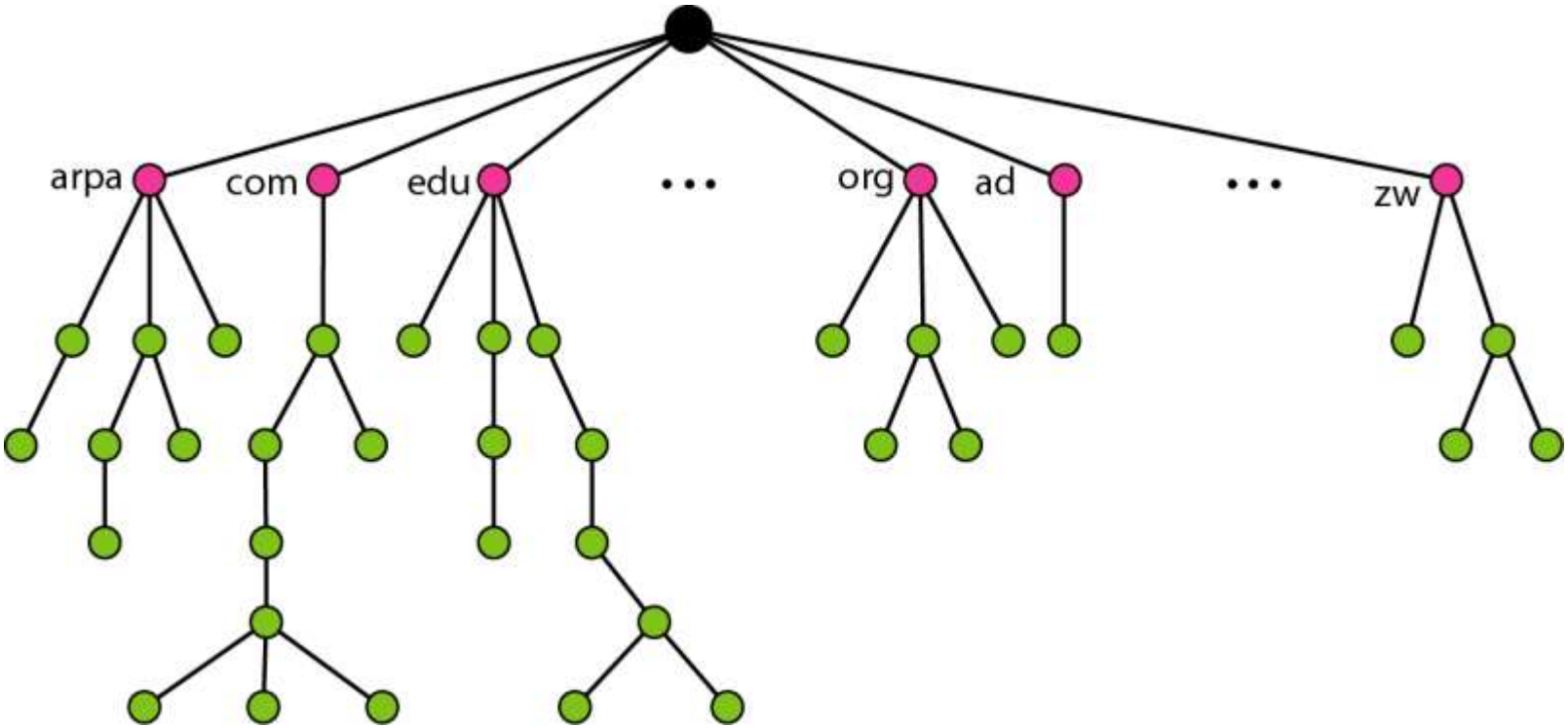
25-2 DOMAIN NAME SPACE

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
Domain Name
Domain

Figure 25.2 *Domain name space*



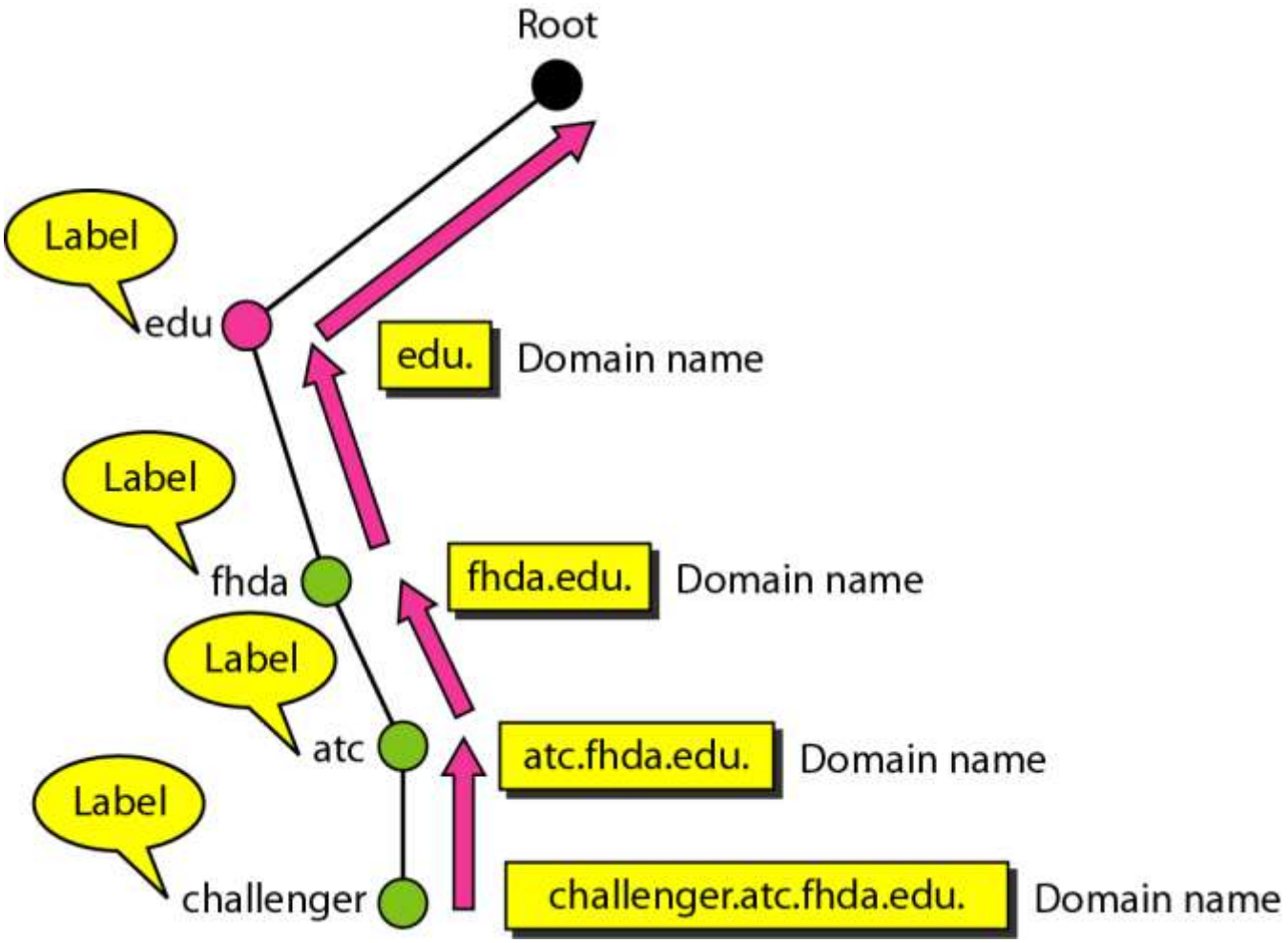
Label:

- Each node in the tree has a label, which is a string with a maximum of 63 characters.
- The root label is a null string (empty string).
- DNS requires that children of a node (nodes that branch from the same node) have different labels, which guarantees the uniqueness of the domain names.

Domain Name:

- Each node in the tree has a domain name. A full domain name is a sequence of labels separated by dots (.).
- The domain names are always read from the node up to the root. The last label is the label of the root (null).
- This means that a full domain name always ends in a null label, which means the last character is a dot because the null string is nothing.

Figure 25.3 *Domain names and labels*



Fully Qualified Domain Name

- If a label is terminated by a null string, it is called a fully qualified domain name (FQDN).
- An FQDN is a domain name that contains the full name of a host.
- It contains all labels, from the most specific to the most general, that uniquely define the name of the host.
- For example, the domain name challenger.atc.fhda.edu.

is the FQDN of a computer named challenger installed at the Advanced Technology Center (ATC) at De Anza College.

A DNS server can only match an FQDN to an address.

Note that the name must end with a null label, but because null means nothing, the label ends with a dot (.)

Partially Qualified Domain Name: If a label is not terminated by a null string, it is called a partially qualified domain name (PQDN). A PQDN starts from a node, but it does not reach the root. It is used when the name to be resolved belongs to the same site as the client. Here the resolver can supply the missing part, called the suffix, to create an FQDN. For example, if a user at the fhda.edu. site wants to get the IP address of the challenger computer, he or she can define the partial name challenger

Figure 25.4 *FQDN and PQDN*

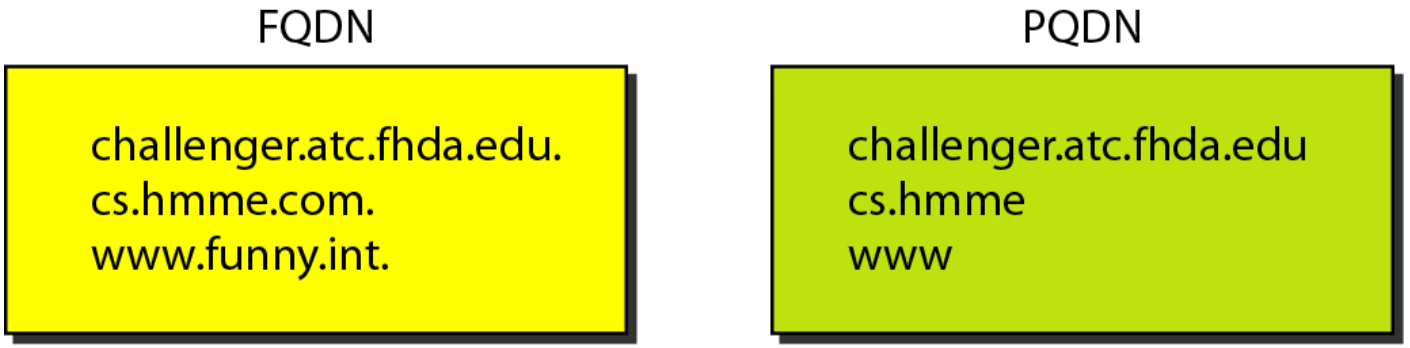
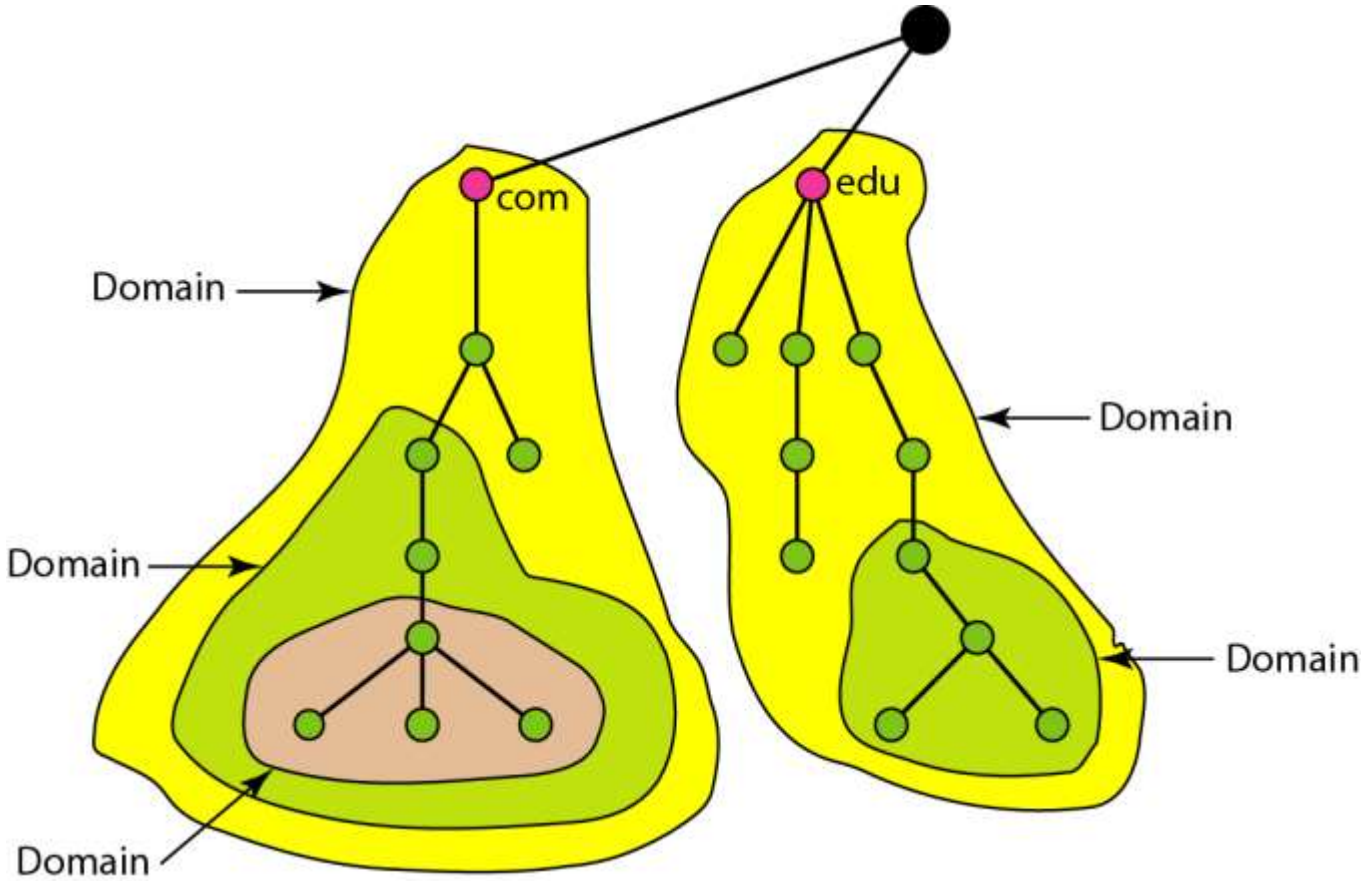


Figure 25.5 *Domains*



25-3 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 25.6 *Hierarchy of name servers-DNS SERVERS*

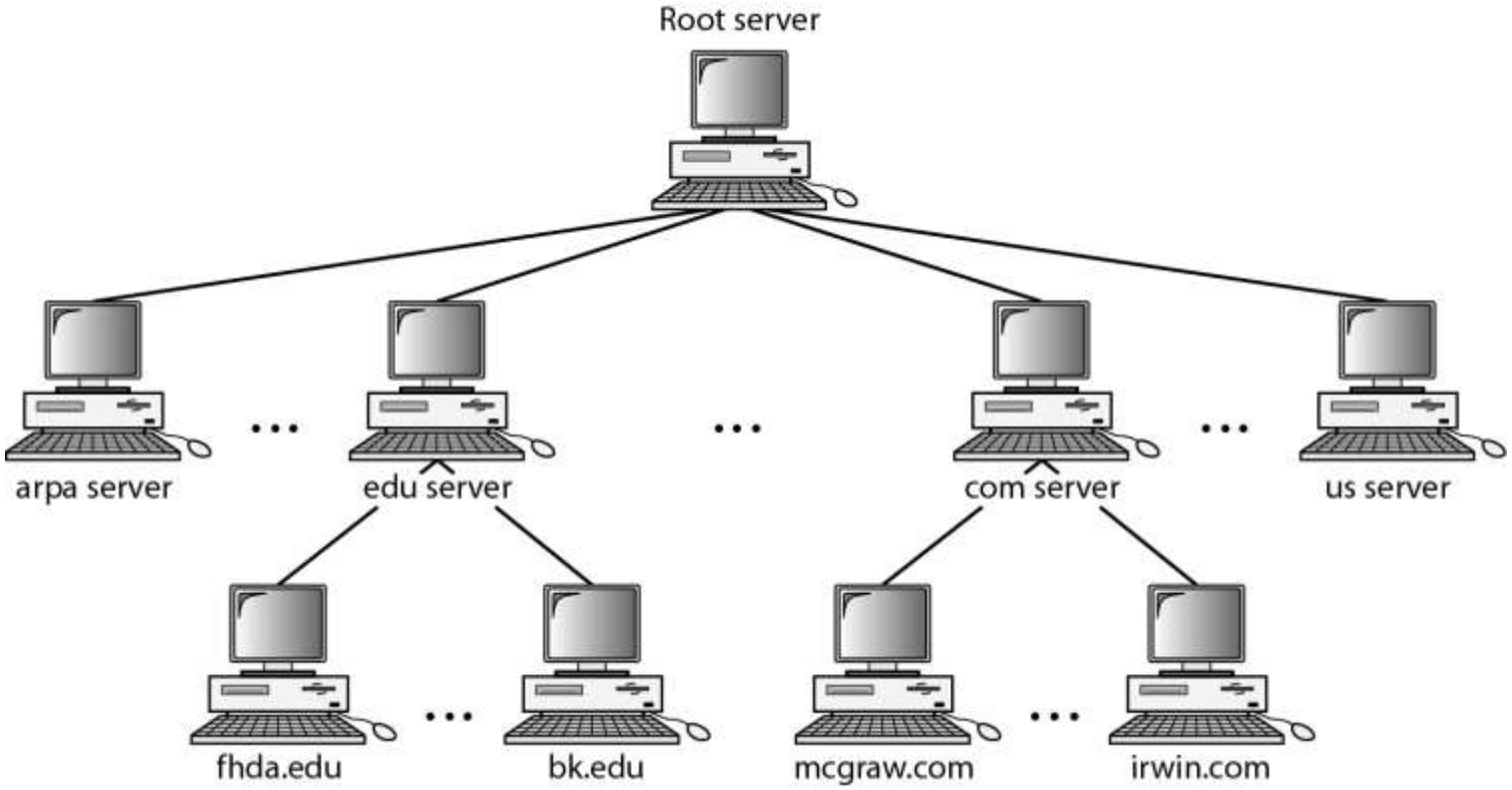
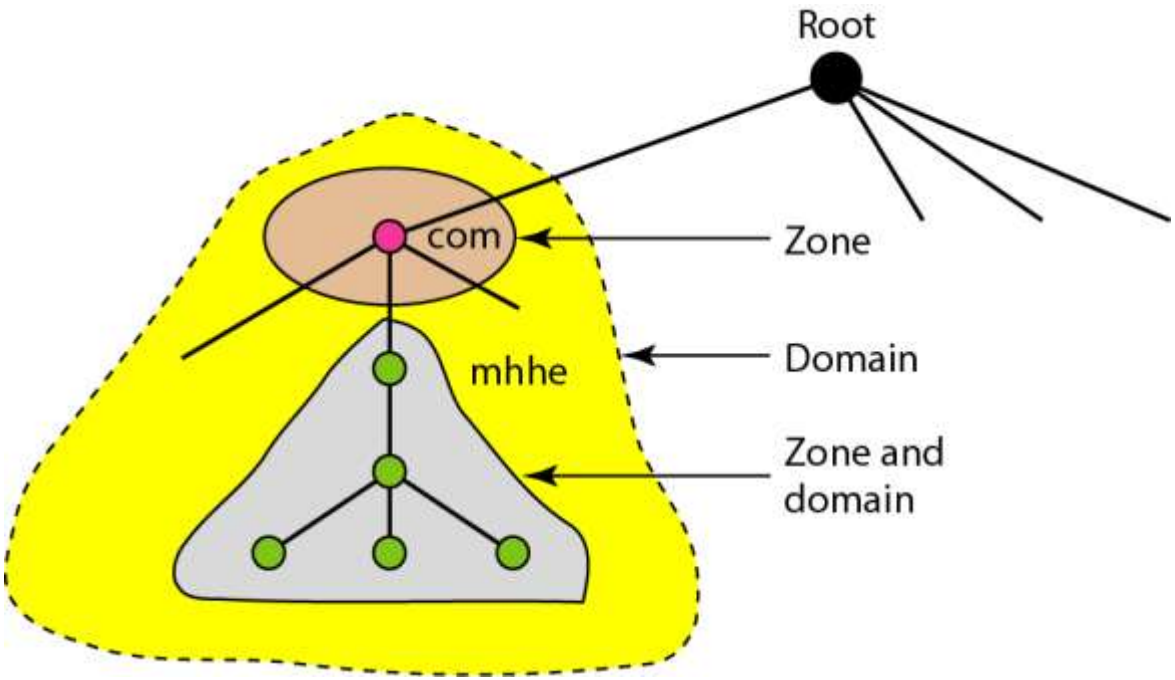


Figure 25.7 *Zones and domains- Server has an authority*



Note

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.

25-4 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 25.8 *DNS IN THE INTERNET*

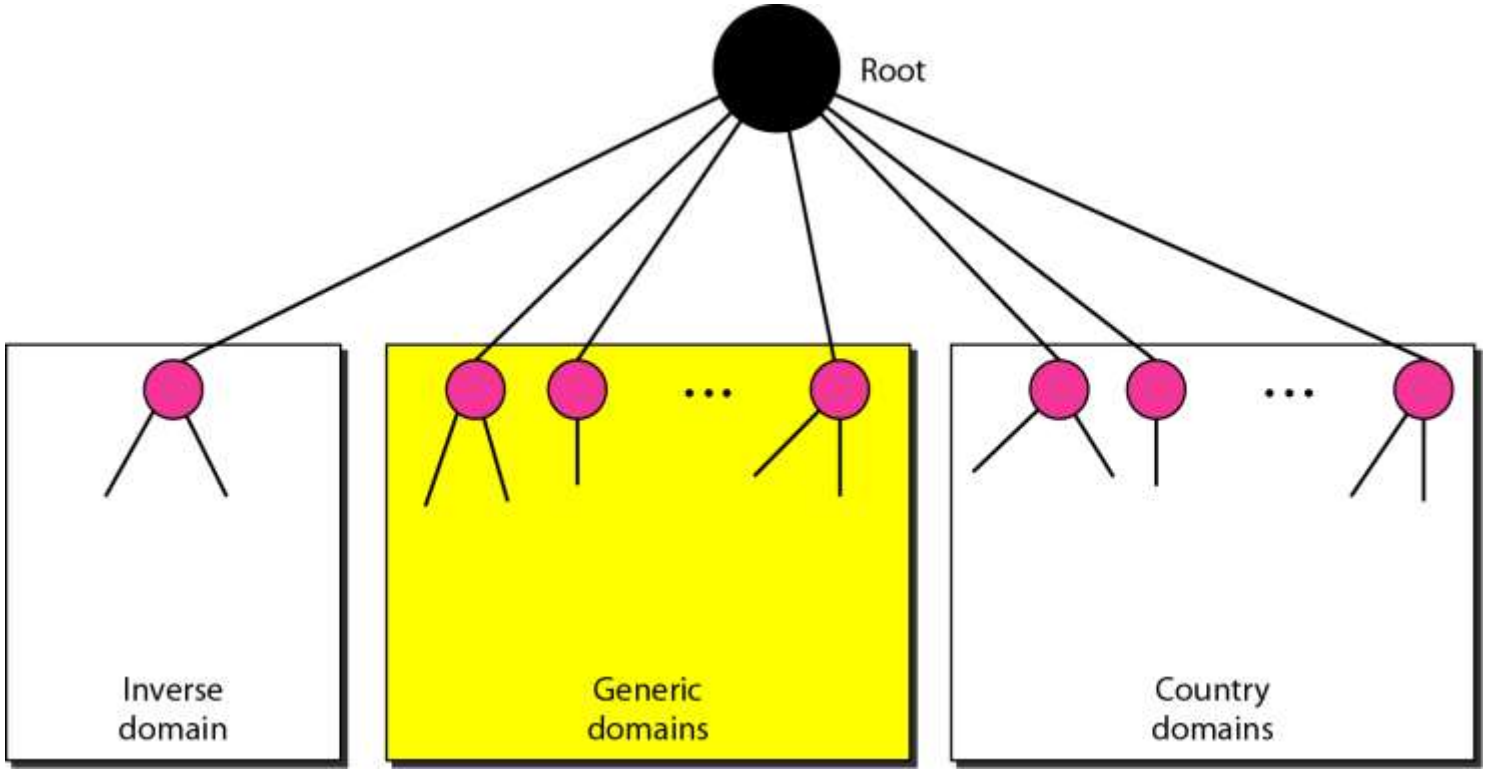


Figure 25.9 *Generic domains-registered hosts according to their generic behavior*

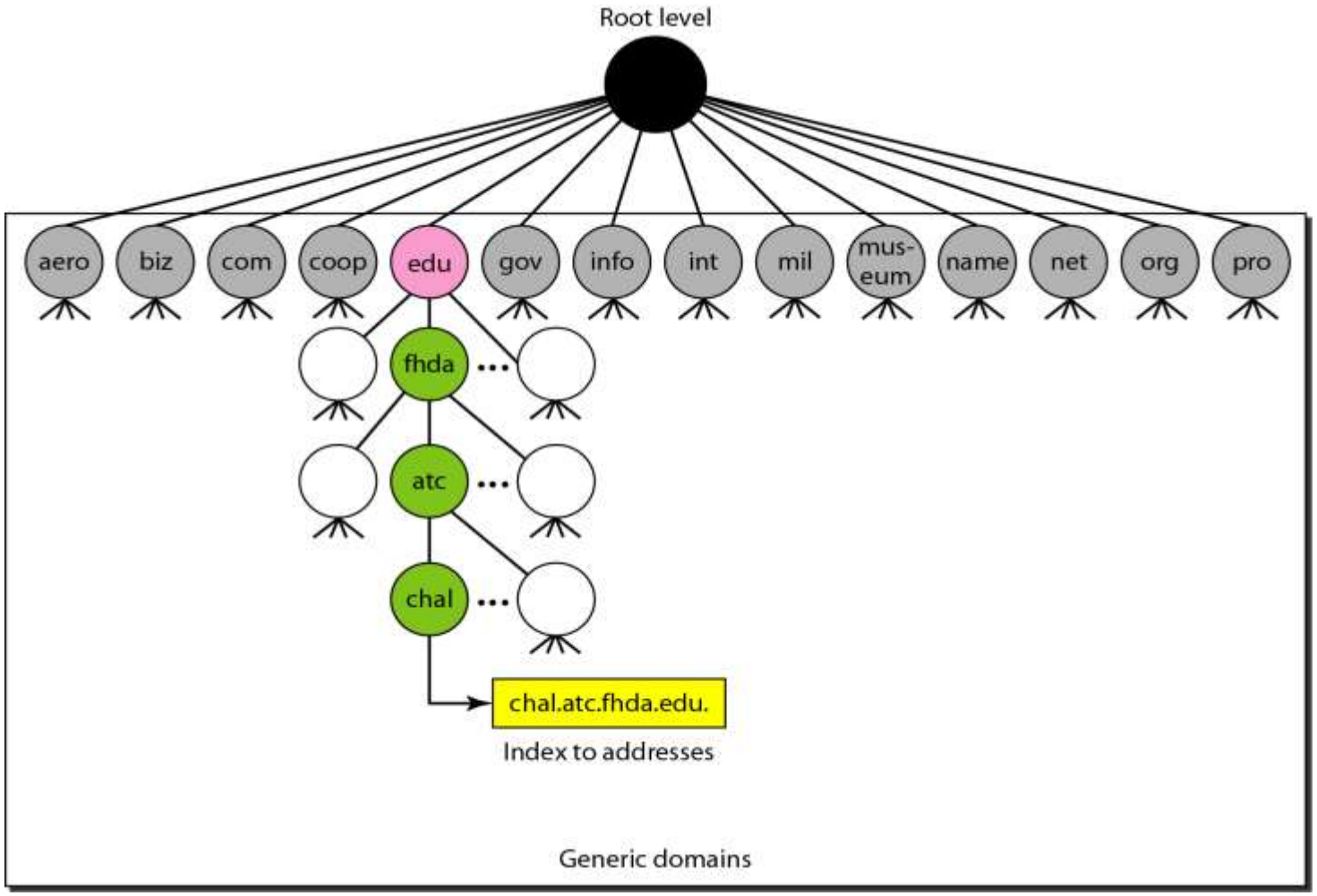


Table 25.1 *Generic domain labels*

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

Figure 25.10 *Country domains- 2 character country observations*

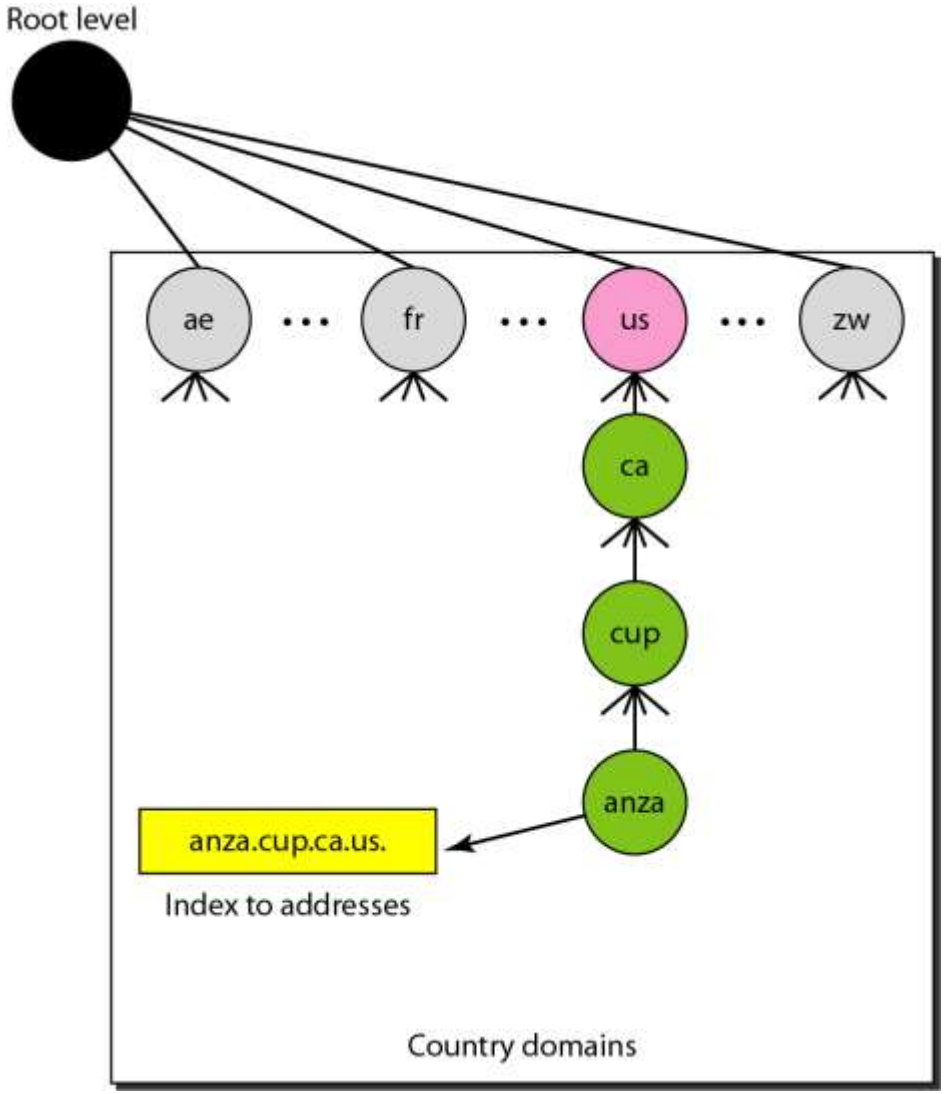
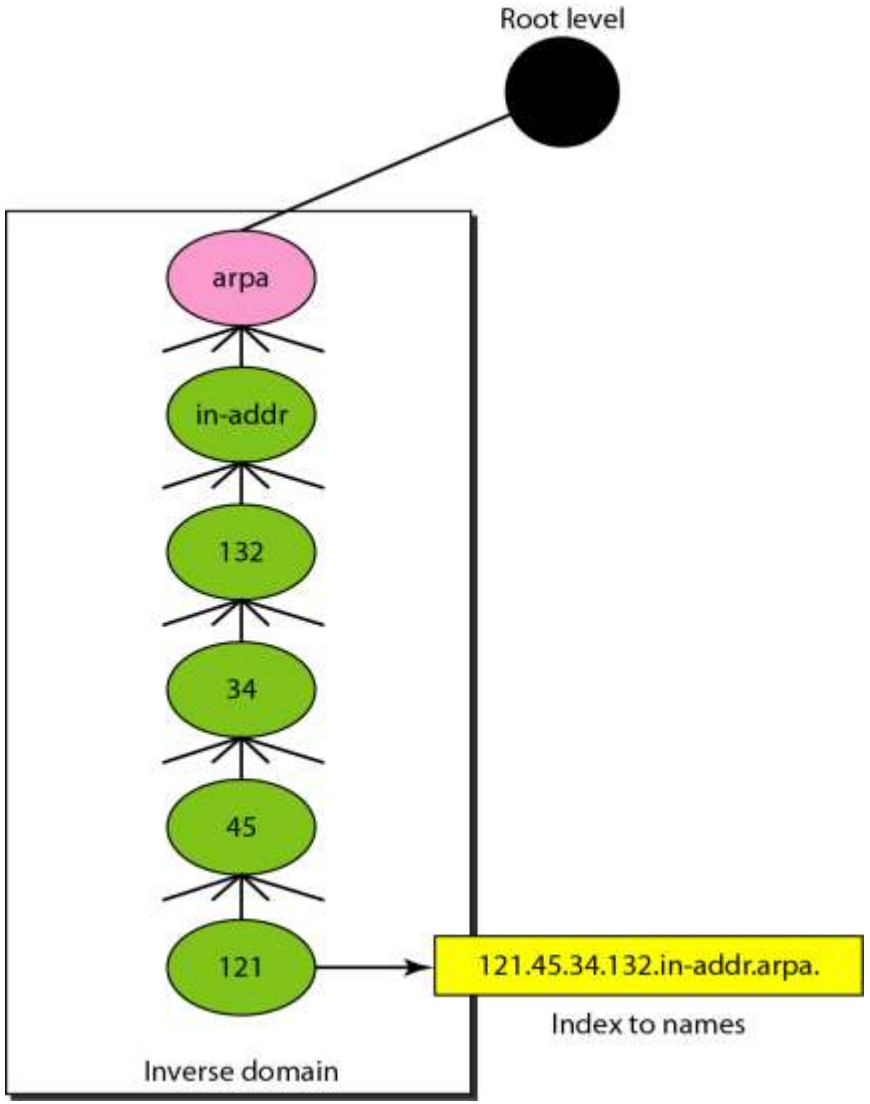


Figure 25.11 *Inverse domain- maps an address to a name*



25-5 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 25.12 *Recursive resolution-recursive answer from a name server*

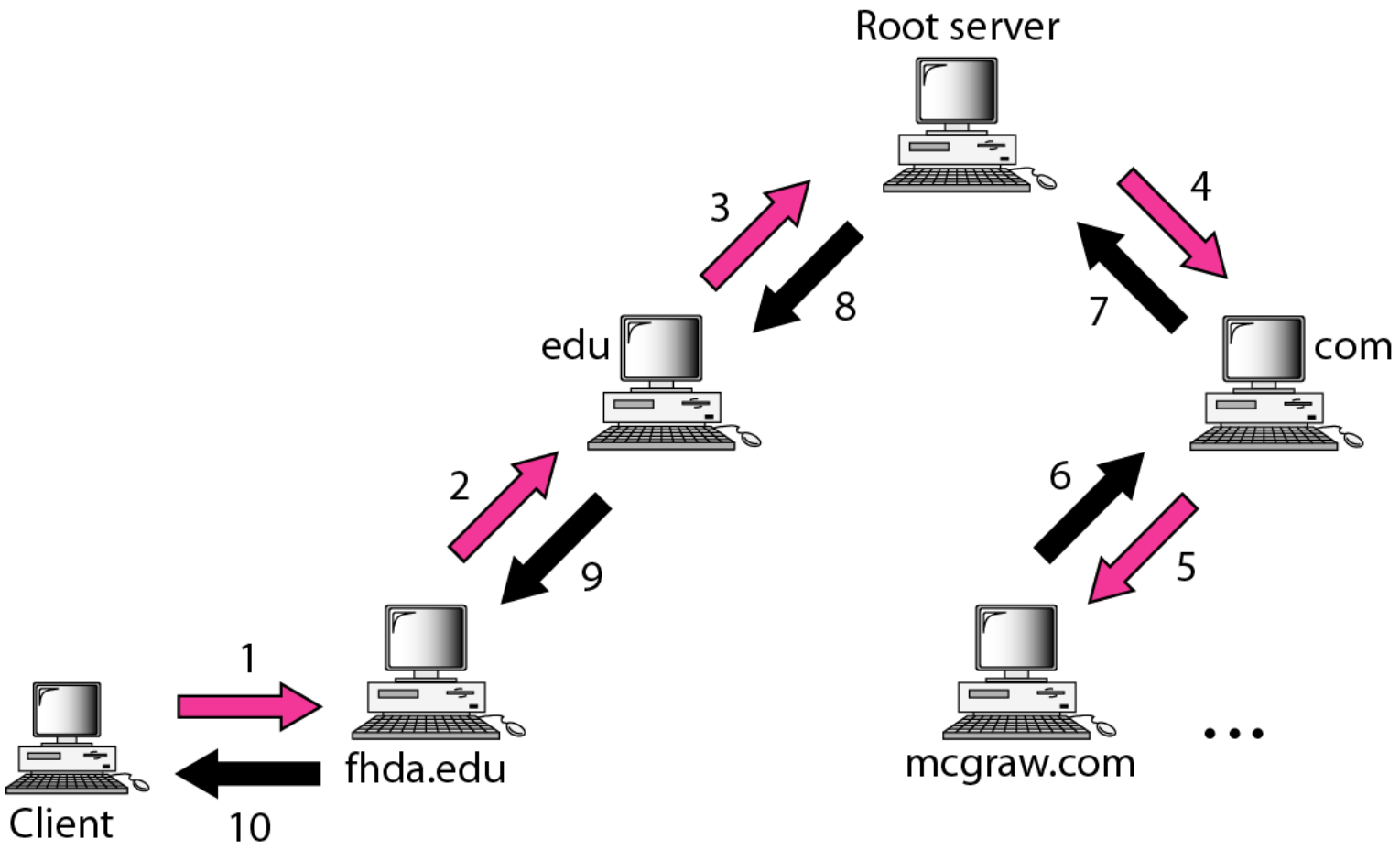
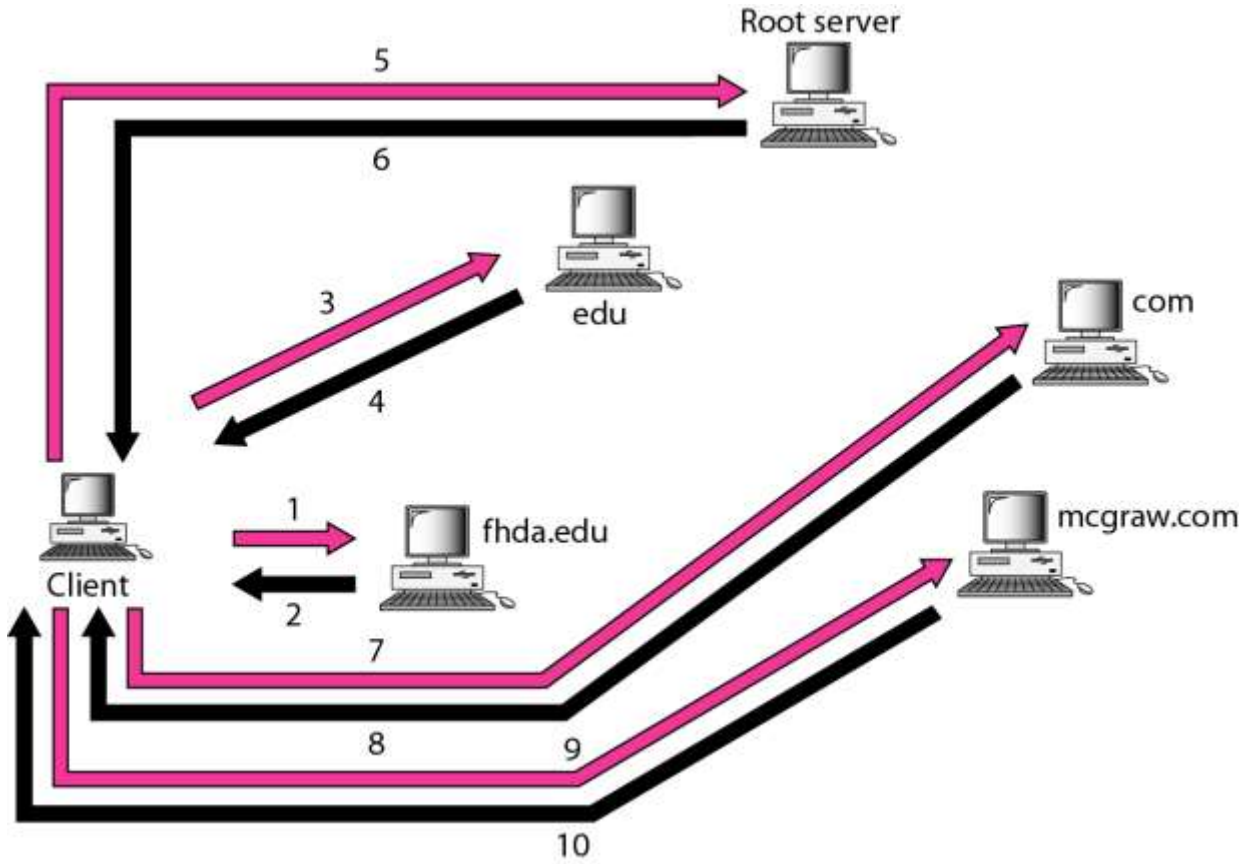


Figure 25.13 *Iterative resolution*



25-6 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 25.14 *Query and response messages*

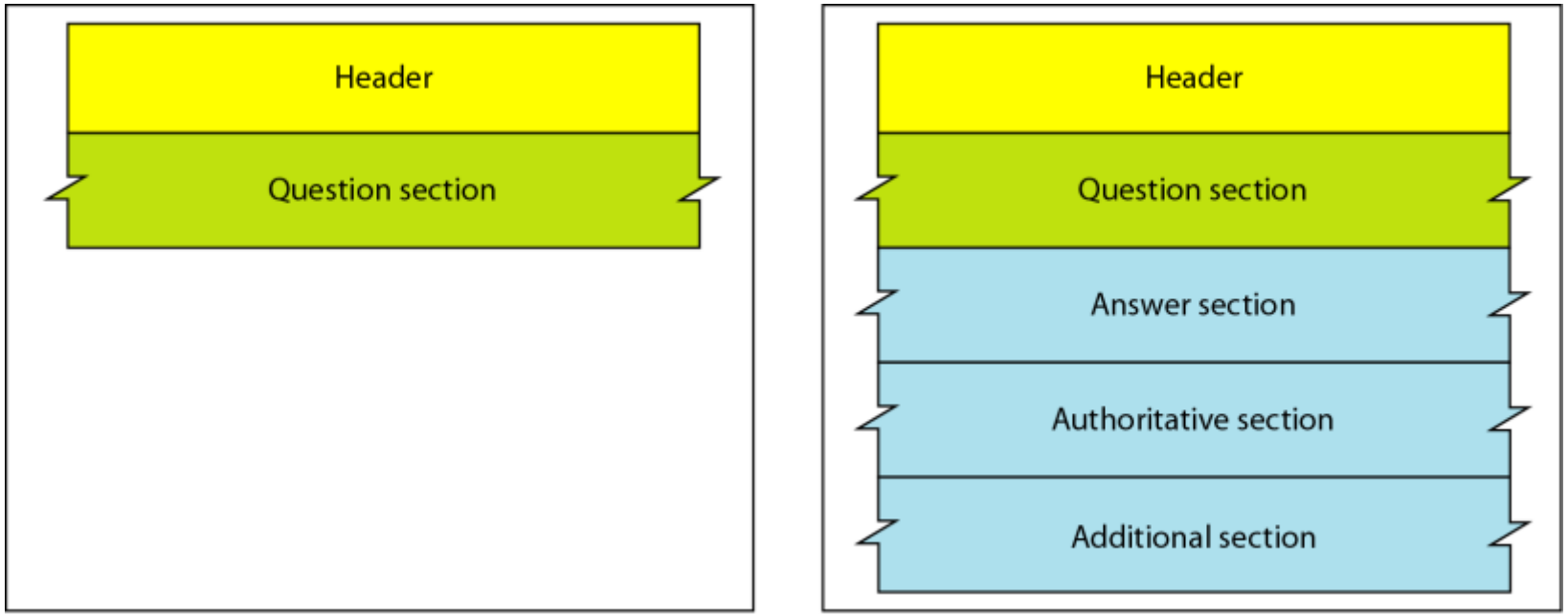


Figure 25.15 *Header format-12 bytes*

Client Uses Identification Number- Each time it sends a query and Server duplicates this number in response

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)

25-7 TYPES OF RECORDS

As we saw in Section 25.6, 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.

Question Record-Used by client to get information from a server
Resource Record- what is returned by the server to the client

25-8 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.

Domain Name- ws.wonderful.com

IP address:- 200.200.200.5

25-9 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.

25-10 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.

Note

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