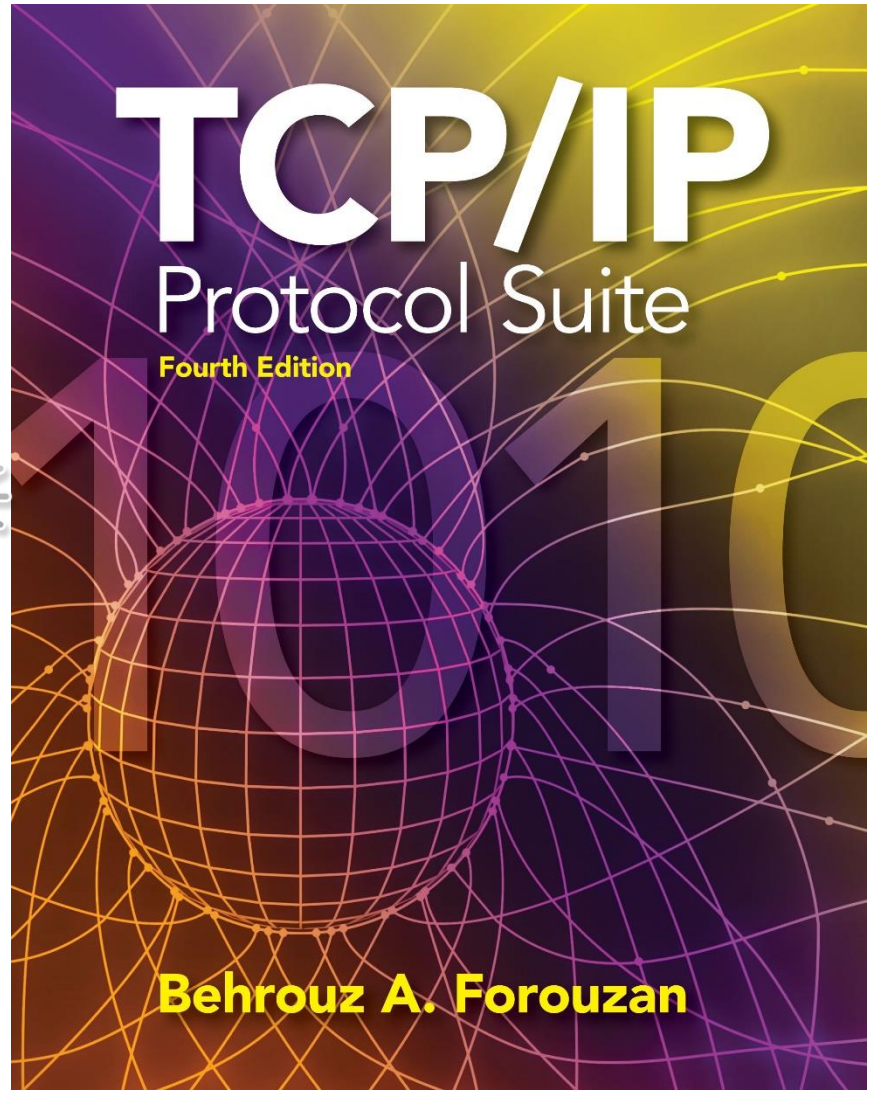
Chapter 19

Domain Name System (DNS)



OBJECTIVES:

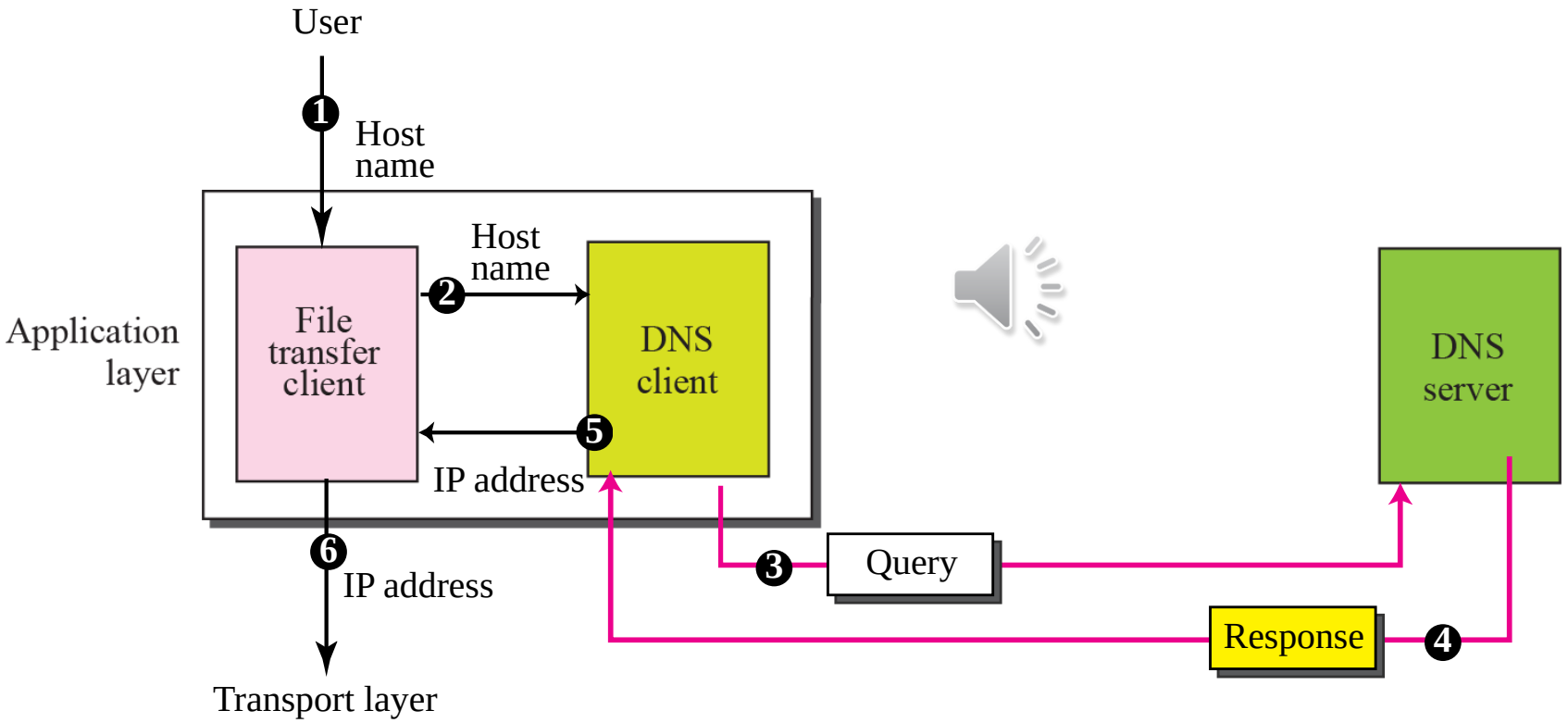
- To describe the purpose of DNS.
- To define the concept of domains and domain name space.
- To describe the distribution of name spaces and define zones.
- To discuss the use of DNS in the Internet and describe three categories of domains: generic, country, and reverse.
- To discuss name-address resolution and show the two resolution methods: recursive and iterative.
- To show the format of DNS message

Chapter Outline

19-1 NEED FOR DNS

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.

Figure 19.1 *Purpose of DNS*



19-2 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 the Section

- ✓ **Flat Name Space**
- ✓ **Hierarchical Name Space**
- ✓ **Domain Name Space**
- ✓ **Domain**
- ✓ **Distribution of Name Space**

Figure 19.2 *Domain name space*

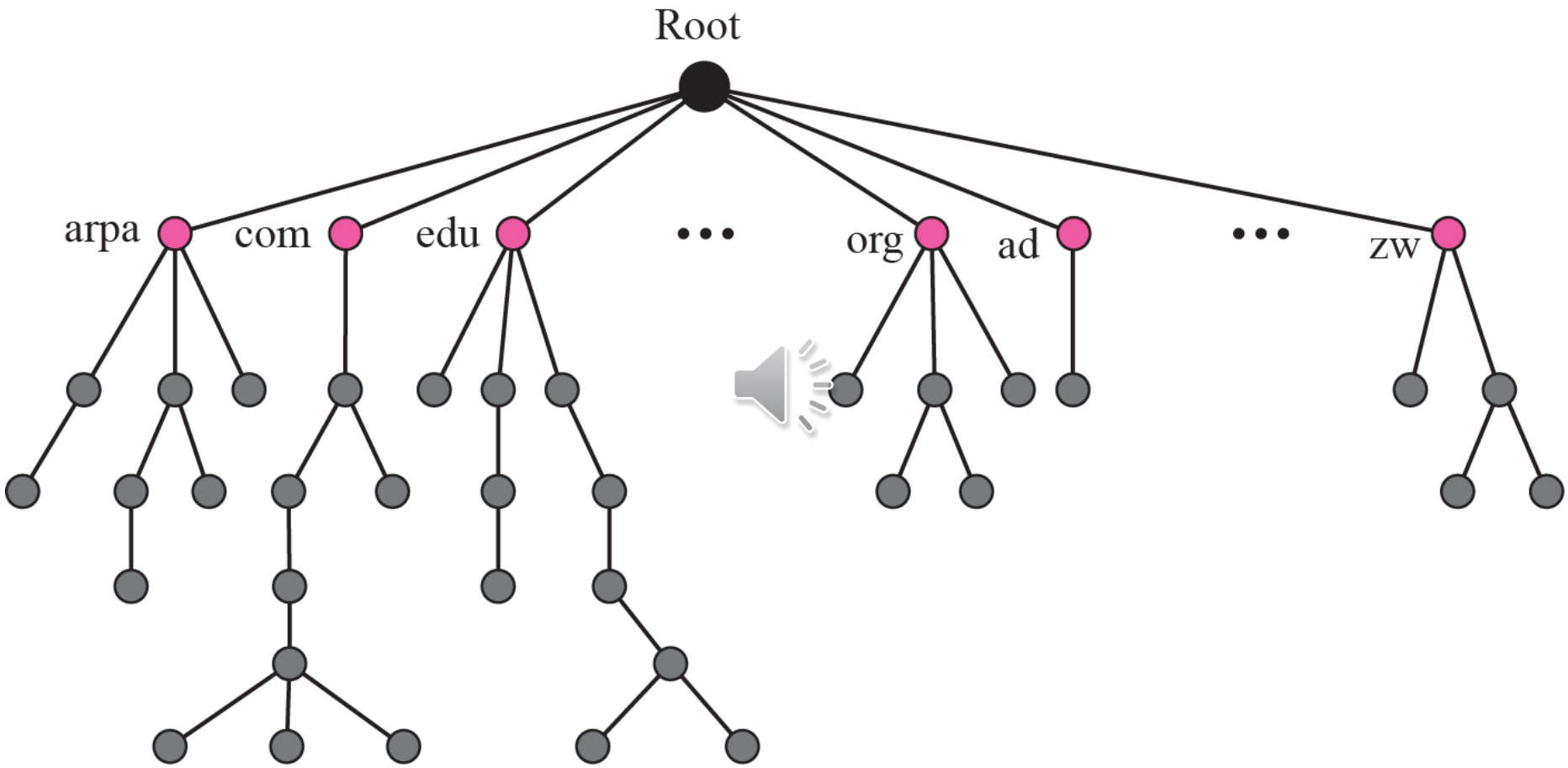


Figure 19.3 *Domain names and labels*

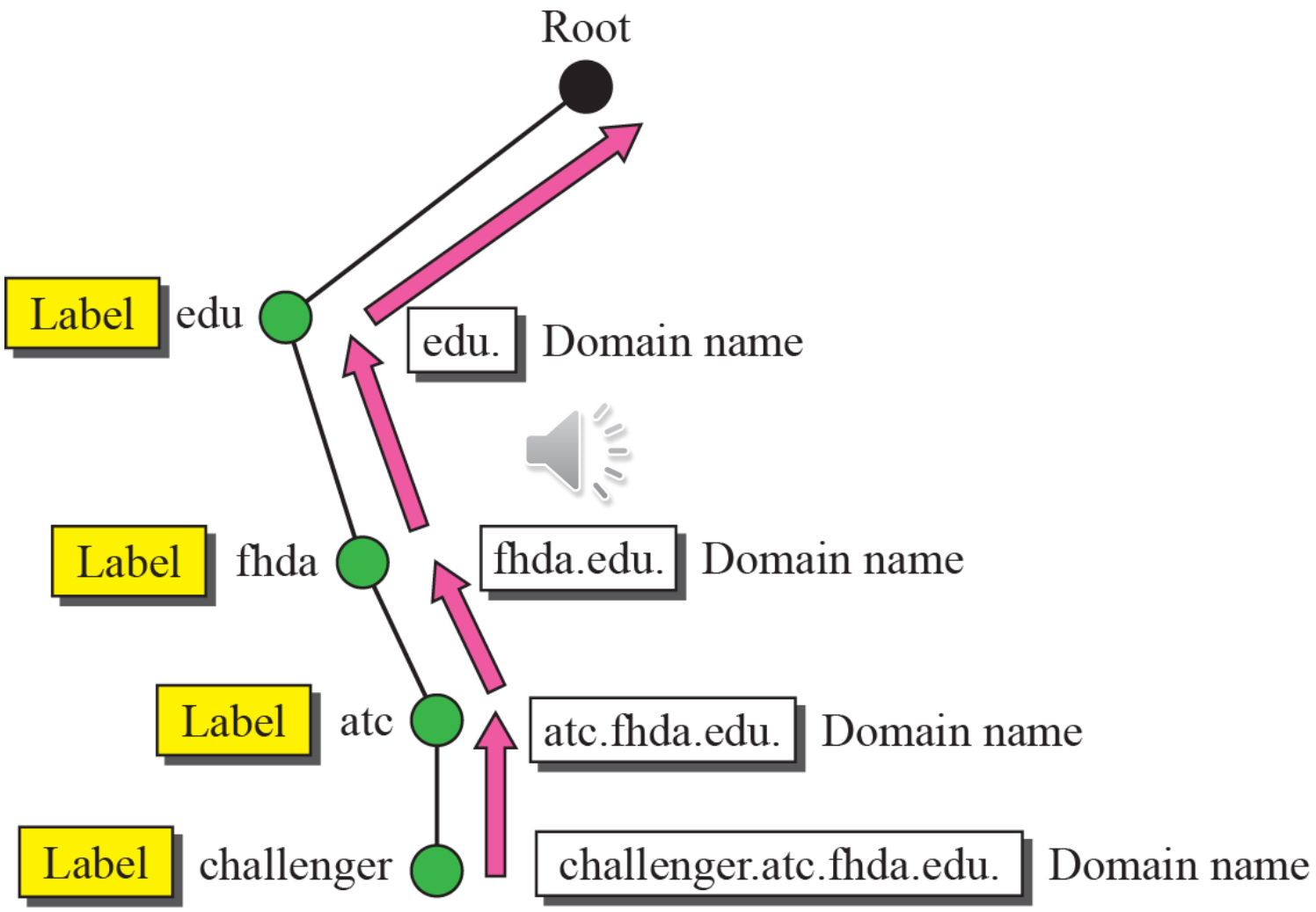


Figure 19.4 *FQDN and PQDN*

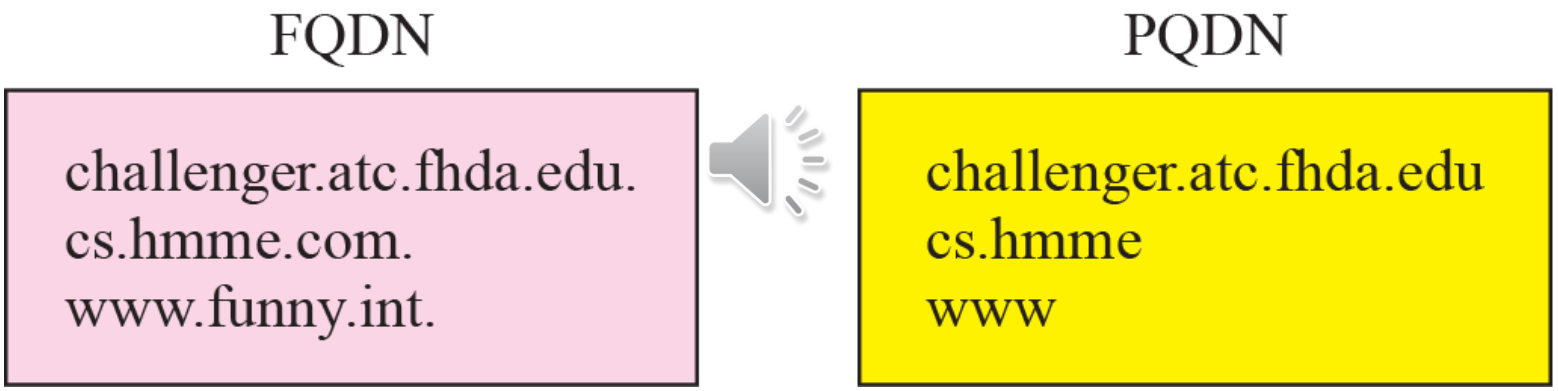


Figure 19.5 *Domains*

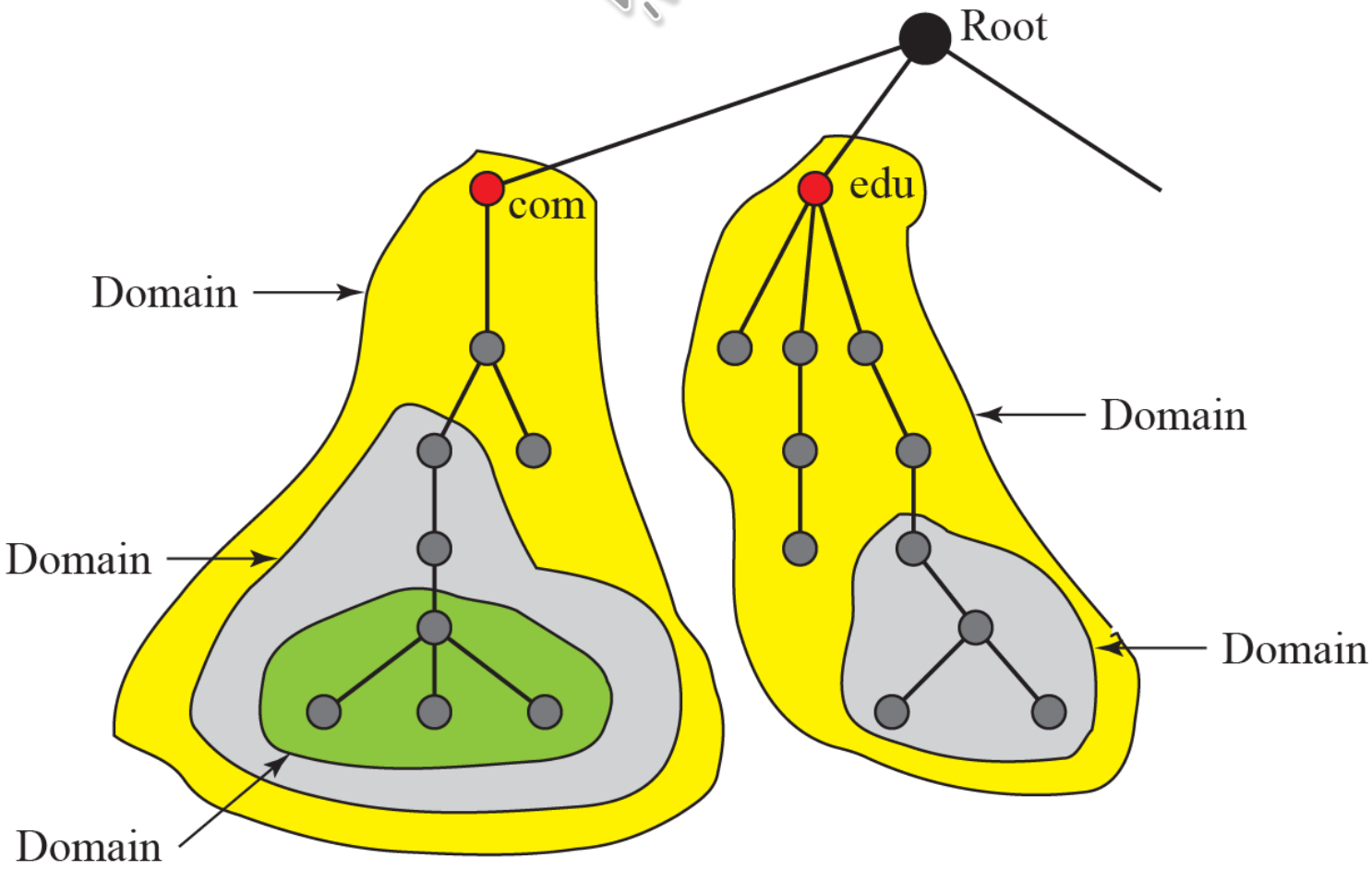


Figure 19.6 *Hierarchy of name servers*

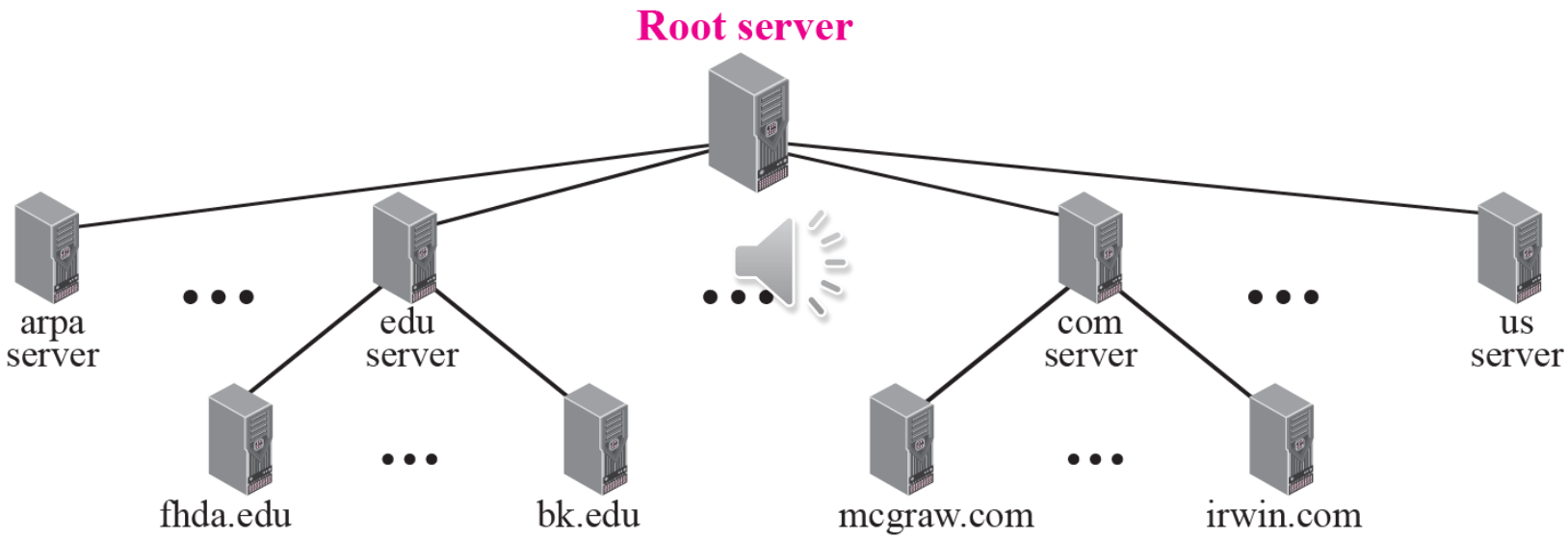


Figure 19.7 *Zones and domains*

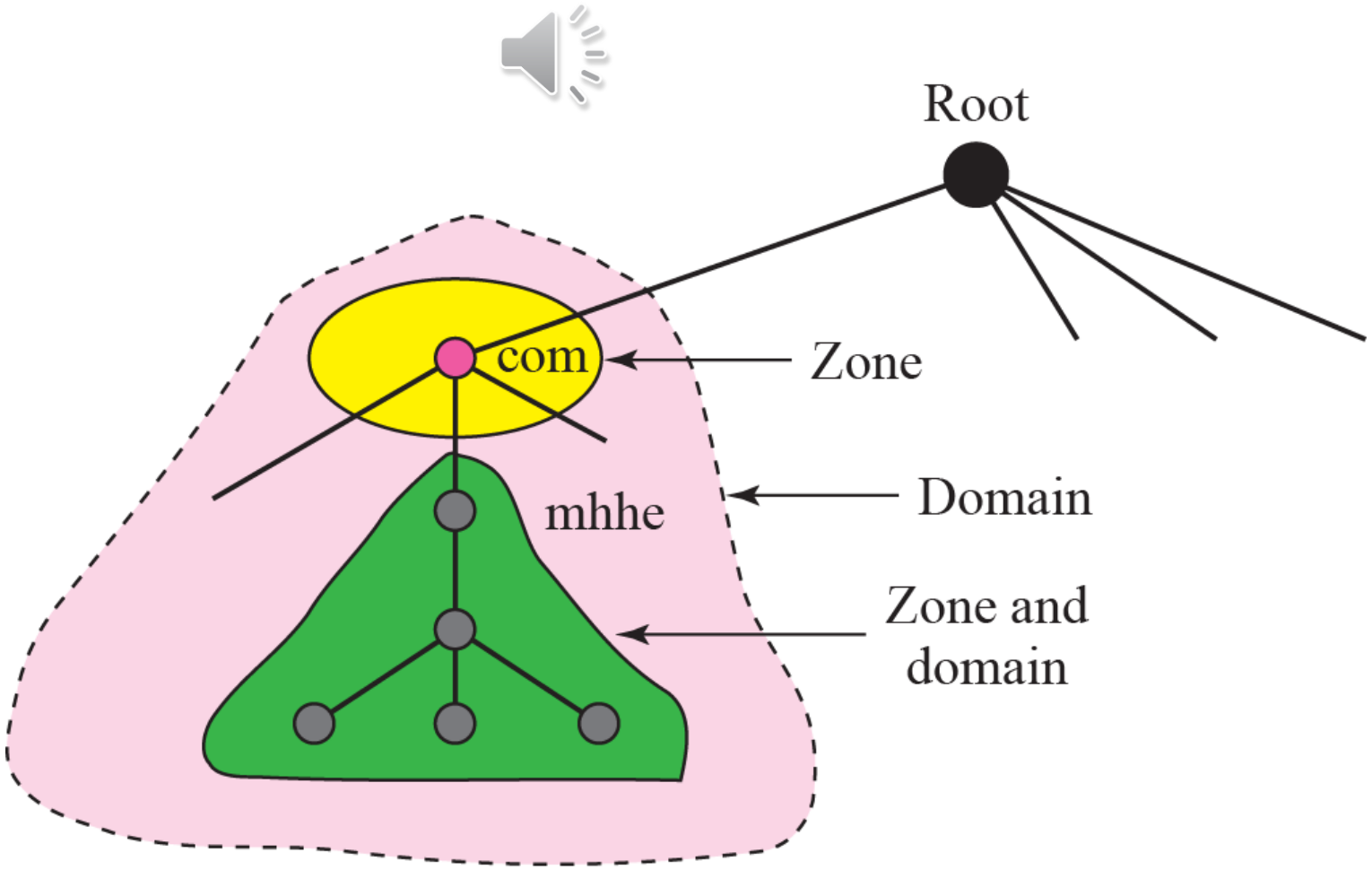
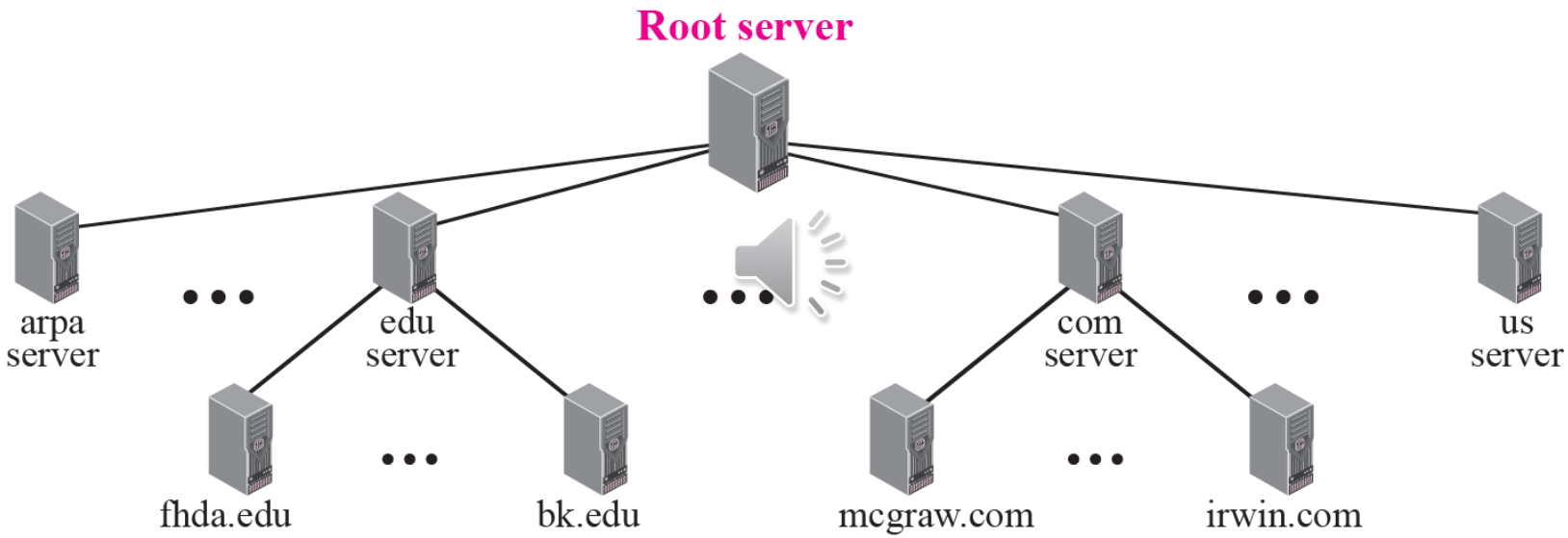


Figure 19.6 *Hierarchy of name servers*



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.

19-3 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 (see Figure 19.8).

Topics Discussed in the Section

- ✓ **Generic Domains**
- ✓ **Country Domains**
- ✓ **Inverse Domain**
- ✓ **Registrar**

Figure 19.8 *DNS used in the Internet*

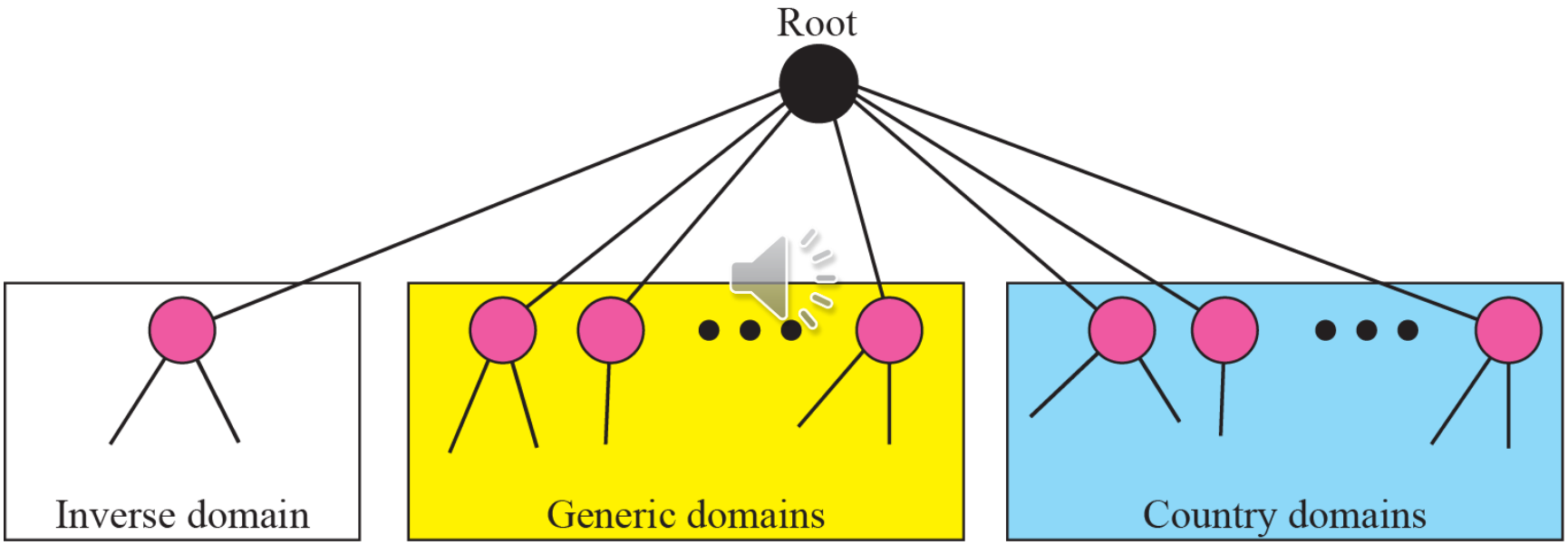


Figure 19.9 *Generic domains*

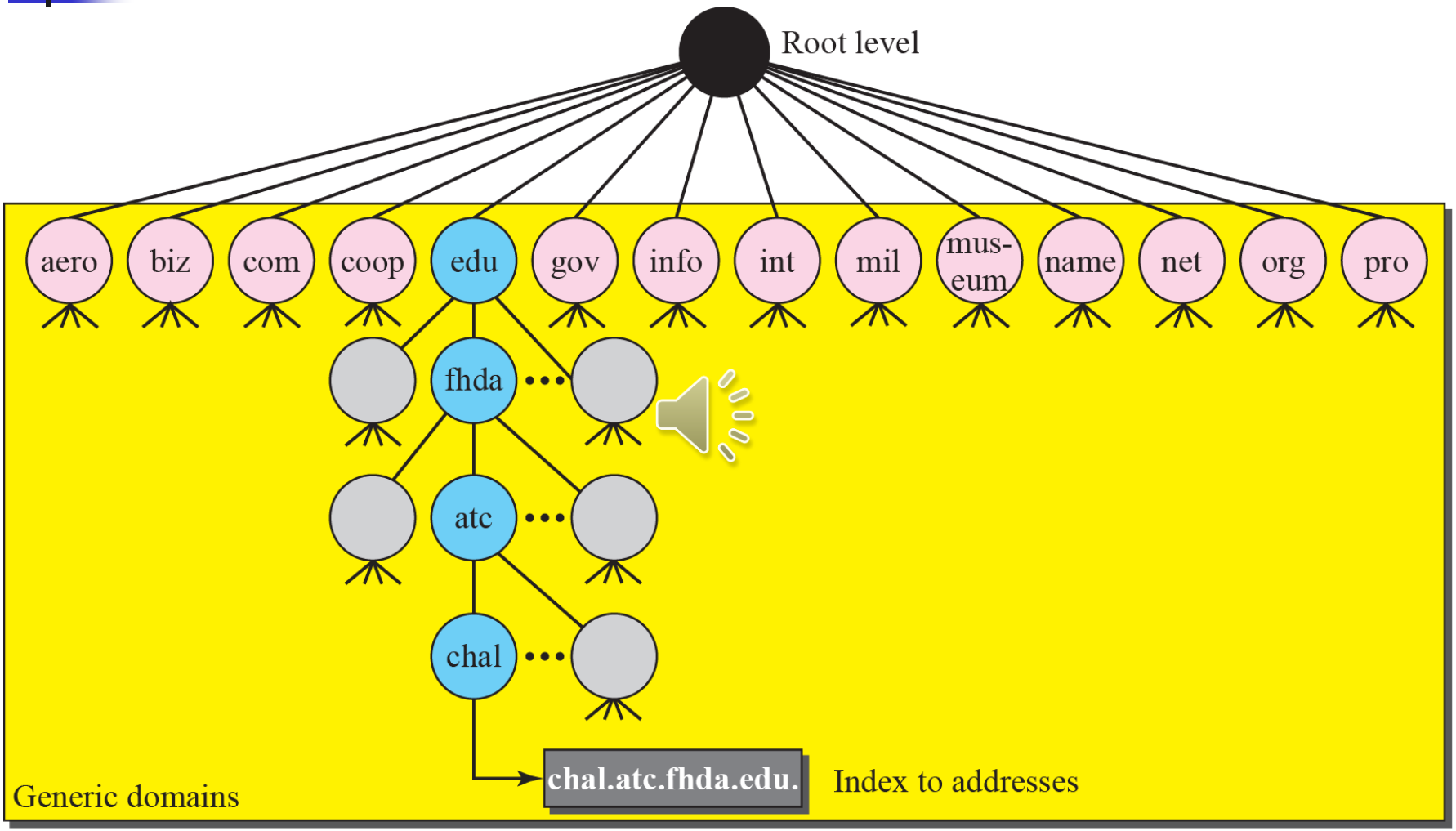


Table 19.1 *Generic domain labels*

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 non-profit organizations
name	Personal names (individuals)
net	Network support centers
org	Nonprofit organizations
pro	Professional individual organizations

Figure 19.10 *Country domains*

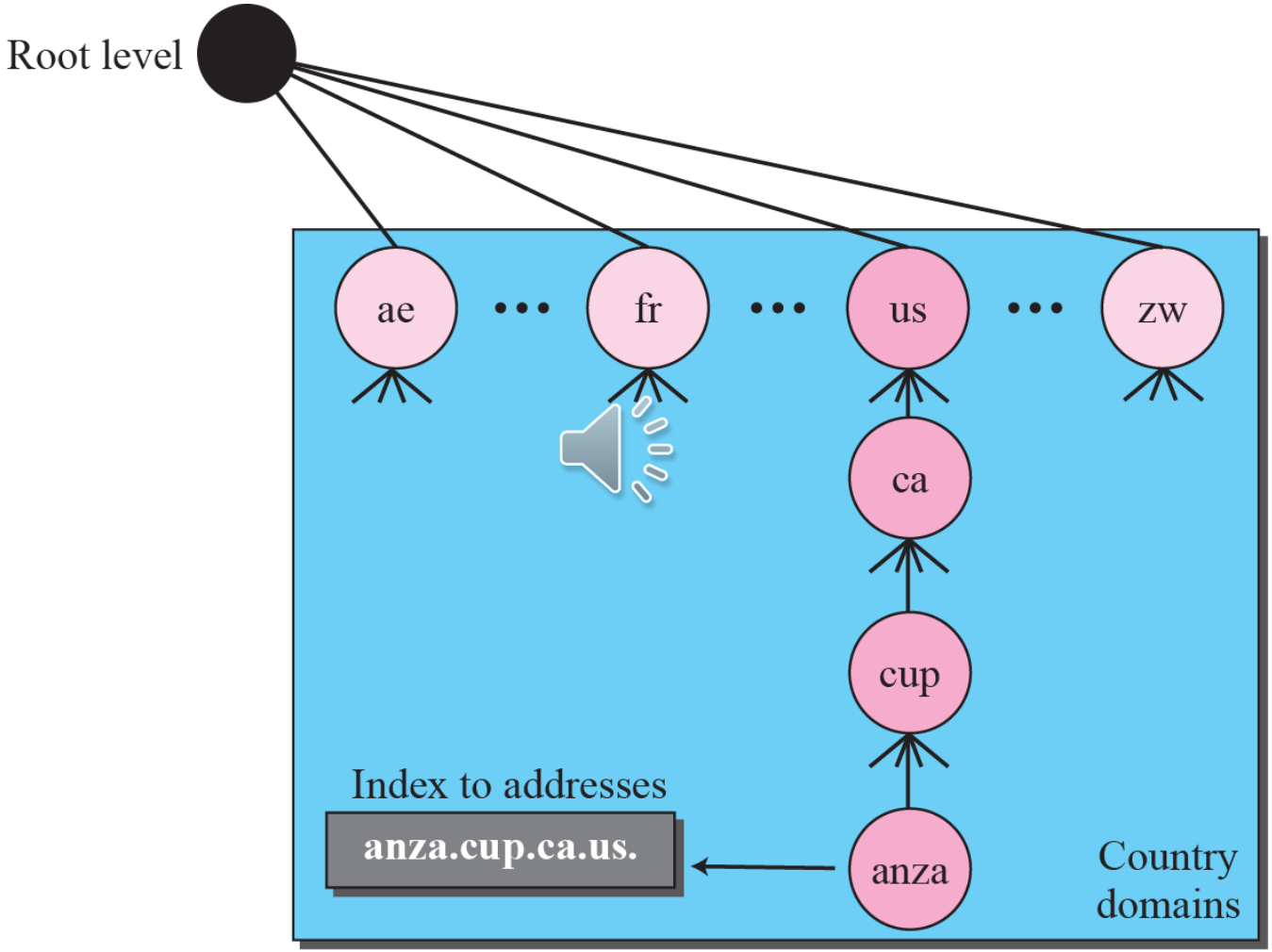
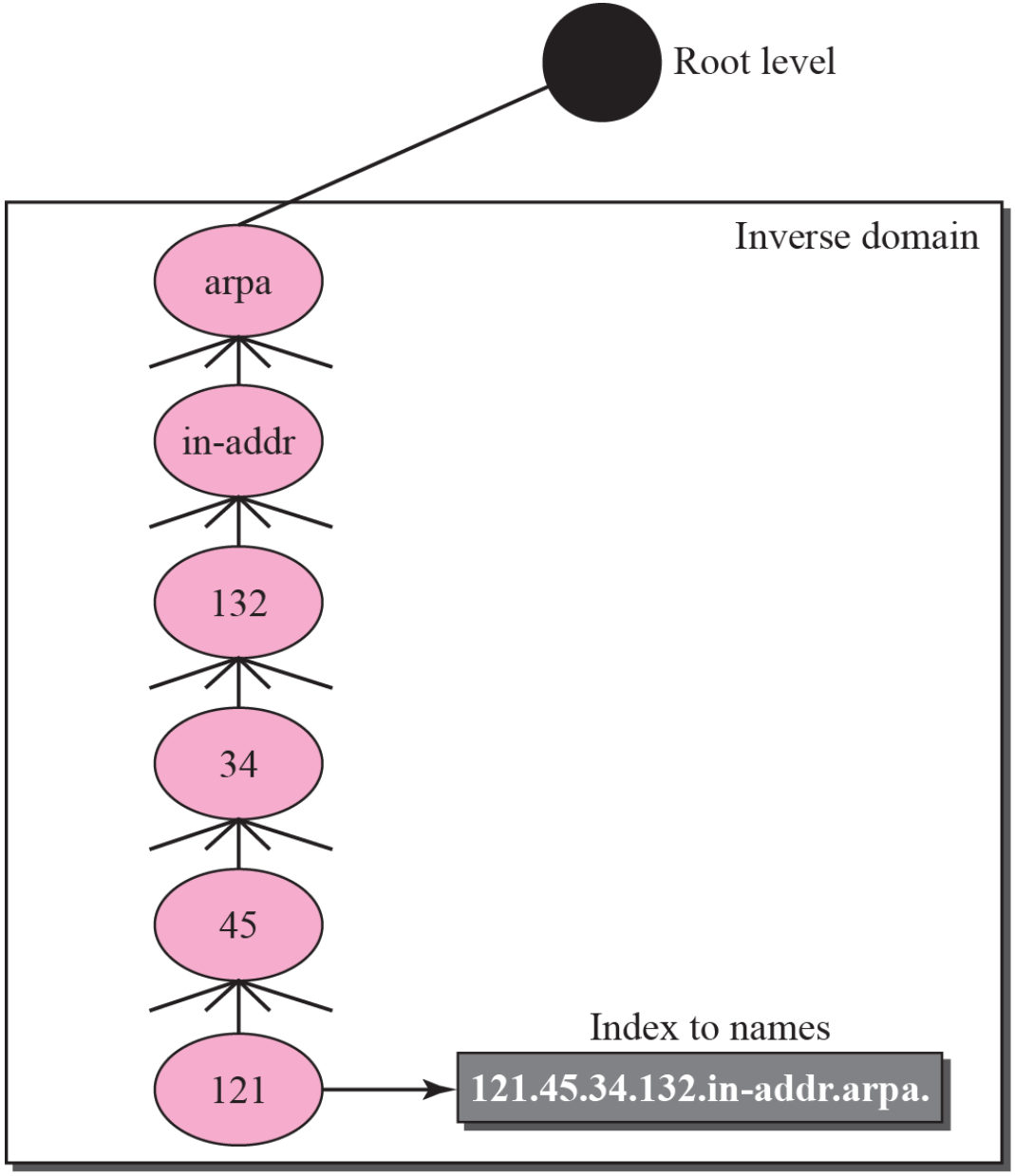


Figure 19.11 *Inverse domain*



19-4 RESOLUTION

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

Topics Discussed in the Section

- ✓ **Resolver**
- ✓ **Mapping Names to Addresses**
- ✓ **Mapping Addresses to Names**
- ✓ **Recursive Resolution**
- ✓ **Iterative Resolution**
- ✓ **Caching**

Figure 19.12 *Recursive resolution*

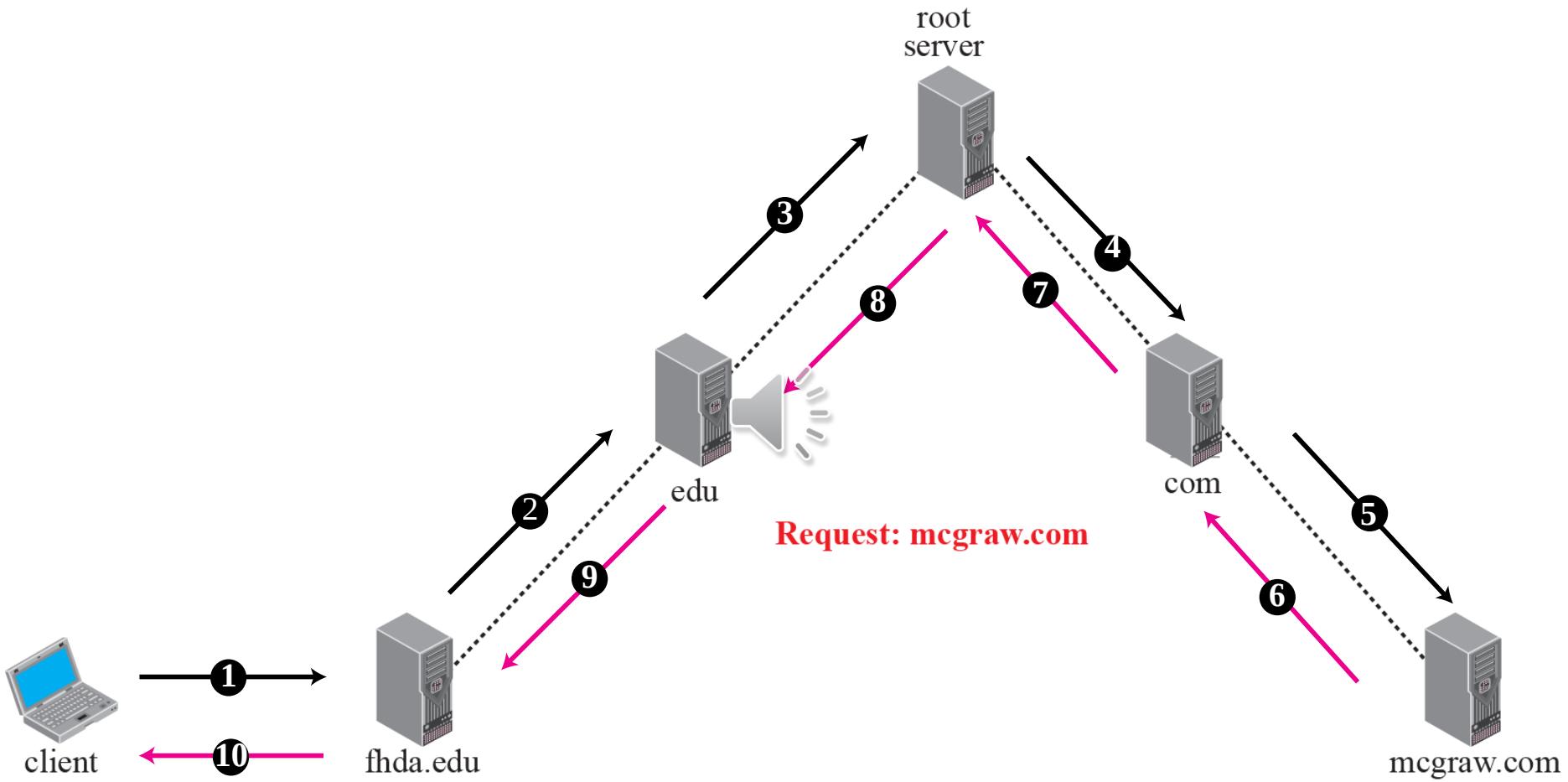
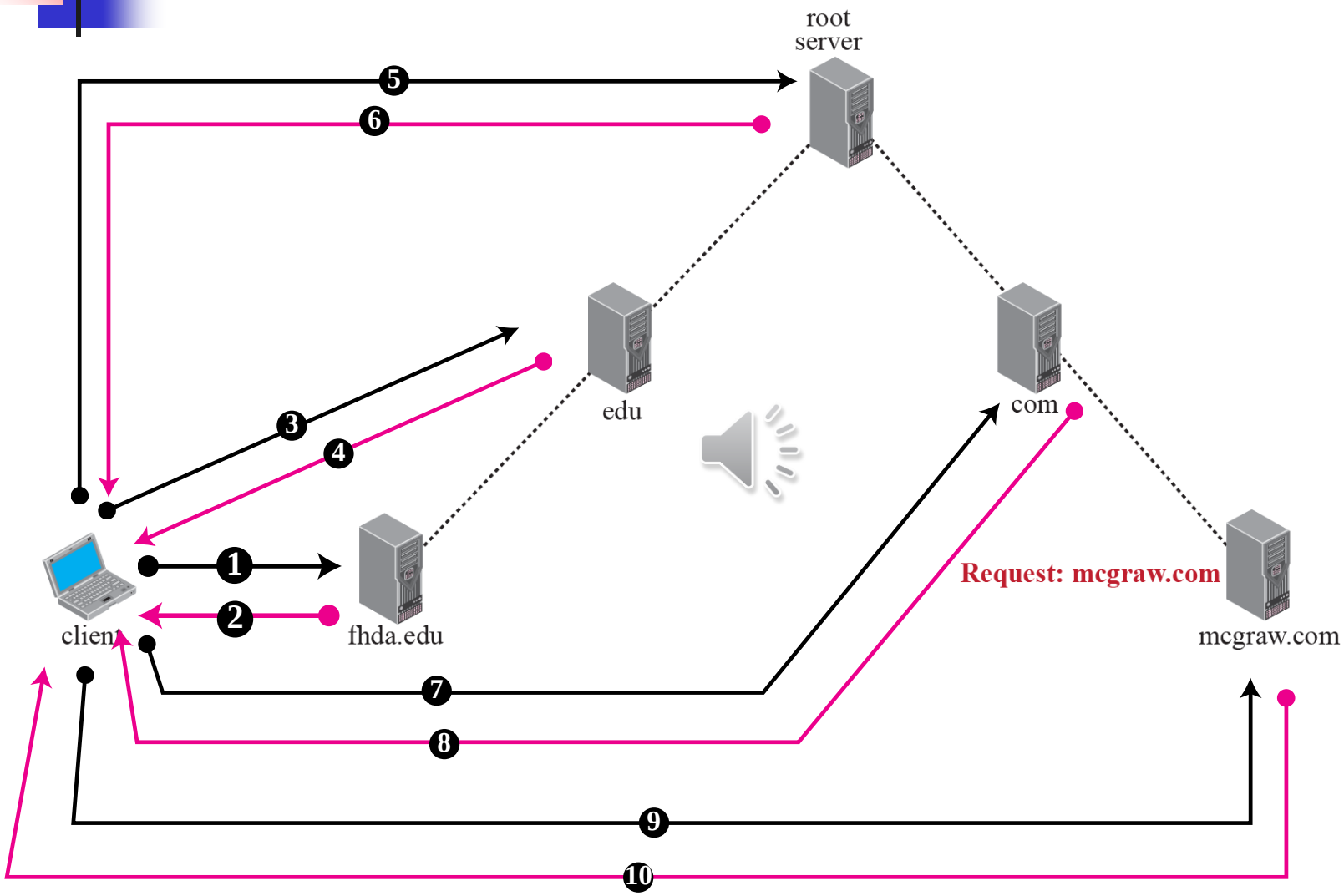


Figure 19.13 *Iterative resolution*



19-5 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 (see Figure 19.14).

Topics Discussed in the Section

- ✓ **Header**

Figure 19.14 *Query and response messages*

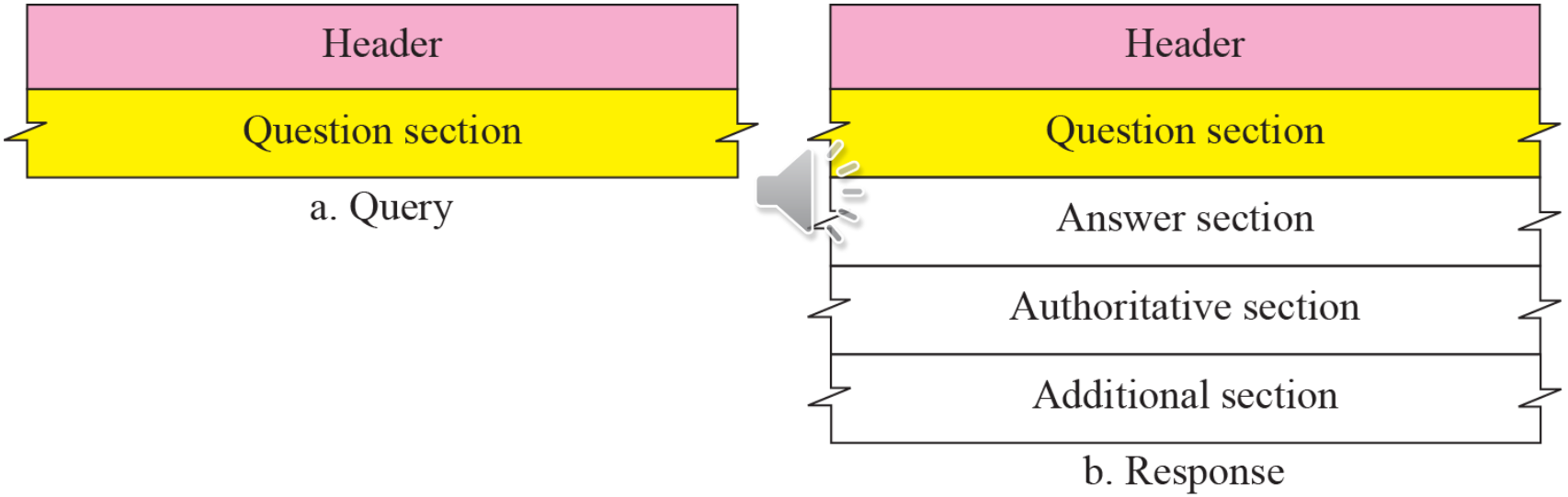


Figure 19.15 *Header format*

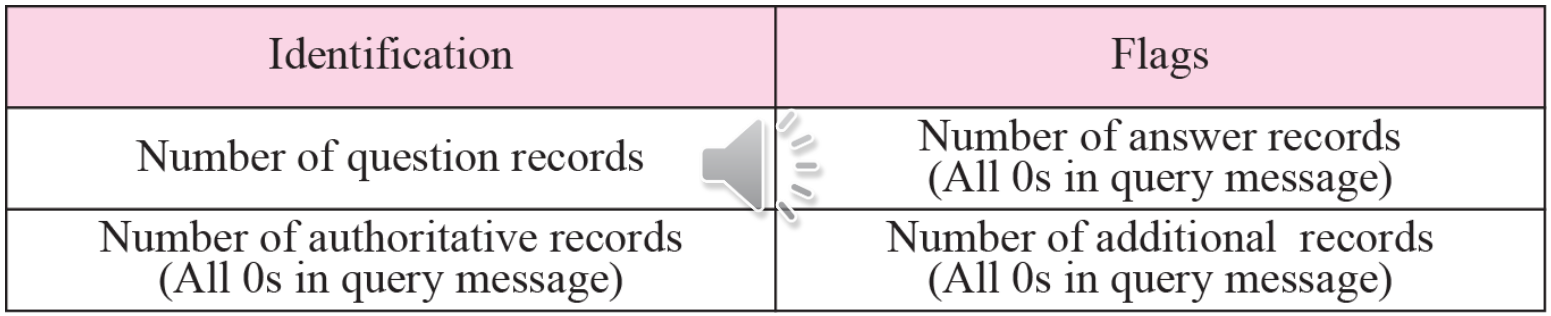


Figure 19.16 *Flags field*

Table 19.2 *Values of rCode*

Value	*Meaning*	*Value*	*Meaning*
0	No error	4	Query type not supported
1	Format error	5	Administratively prohibited
2	Problem at name server	6–15	Reserved
3	Domain reference problem		

19-6 TYPES OF RECORDS

As we saw in the previous section, 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 the Section

- ✓ **Question Record**
- ✓ **Resource Record**

Figure 19.17 *Question record format*

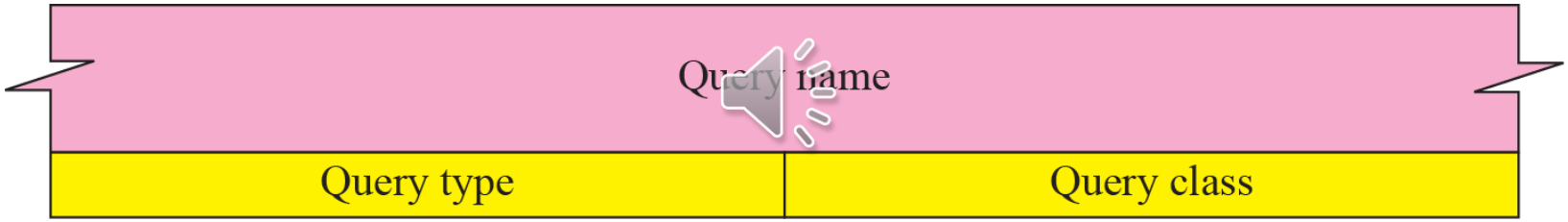


Figure 19.18 *Query name format*

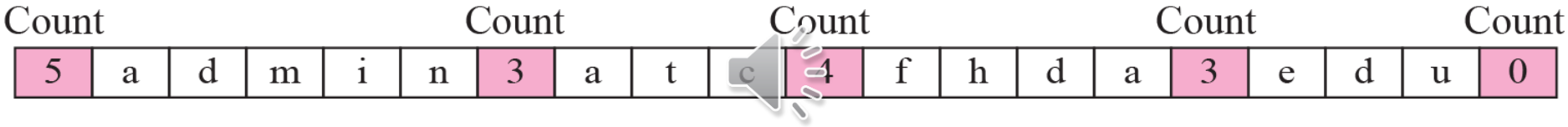


Table 19.3 *Types*

Type	*Mnemonic*	*Description*
1	A	**Address.** A 32-bit IPv4 address. It converts a domain name to an address.
2	NS	**Name server**. It identifies the authoritative servers for a zone.
5	CNAME	**Canonical name**. It defines an alias for the official name of a host.
6	SOA	**Start of authority**. It marks the beginning of a zone.
11	WKS	**Well-known services**. It defines the network services that a host provides.
12	PTR	**Pointer.** It is used to convert an IP address to a domain name.
13	HINFO	**Host information.** It defines the hardware and operating system.
15	MX	**Mail exchange**. It redirects mail to a mail server.
28	AAAA	**Address.** An IPv6 address (see Chapter 26).
252	AXFR	A request for the transfer of the entire zone.
255	ANY	A request for all records.

Table 19.4 *Classes*

Class	*Mnemonic*	*Description*
1	IN	Internet
2	CSNET	CSNET network (obsolete)
3	CS	The COAS network
4	HS	The Hesiod server developed by MIT

Figure 19.19 *Resource record format*