CS321: Computer Networks

DNS

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DOMAIN NAME SYSTEM (DNS)

- To identify an entity, TCP/IP protocols use the IP address.
- People prefer to use names instead of numeric addresses.
- Therefore, the Internet needs to have a directory system that can map a name to an address.

- The Internet is so huge today, a central directory system cannot hold all the mapping.

- A better solution is to distribute the information among many computers in the world.

- The host that needs mapping can contact the closest computer holding the needed information. This method is used by the Domain Name System (DNS).

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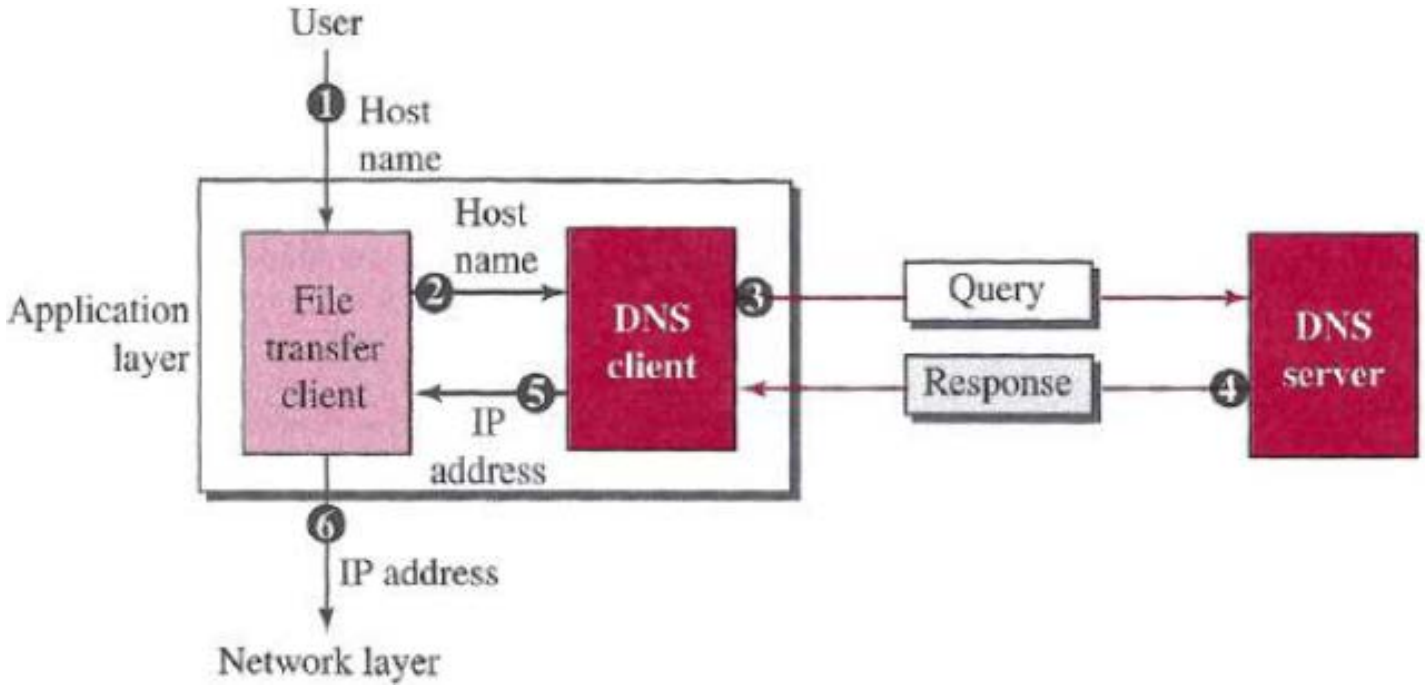


- the purpose of accessing the Internet is to make a connection between the file transfer client and server,
- but before this can happen, another connection needs to be made between the DNS client and DNS server

Name Space

- 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
  - hierarchical

- *flat name space*
  - a name is assigned to an address
  - a name is a sequence of characters without structure
  - The names may or may not have a common section

  - Disadvantage: it cannot be used in a large system such as the Internet because it must be centrally controlled to avoid ambiguity and duplication

Cont…

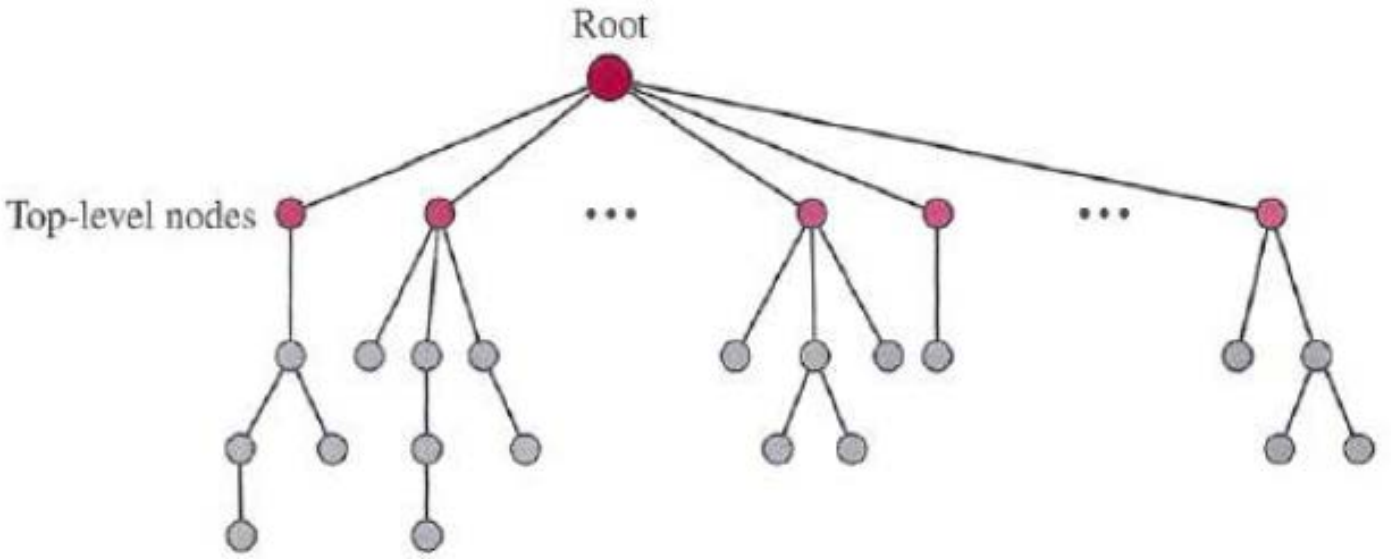
- *hierarchical name space*
  - each name is made of several parts
  - the first part can define the nature of the organization
  - the second part can define the name of an organization
  - the third part can define departments in the organization
  - so on…

  - *Advantages:* the authority to assign and control the name spaces can be decentralized.

- A central authority can assign the part of the name. E.g, name & nature of the organization
- Rest of the name can be assigned by the organization itself

Domain Name Space

- the names are defined in an inverted-tree structure with the root at the top.



Cont…

- *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).
- *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).

- Fully qualified domain name (FQDN): If a label is terminated by a null string. Else, Partially qualified domain name (PQDN)

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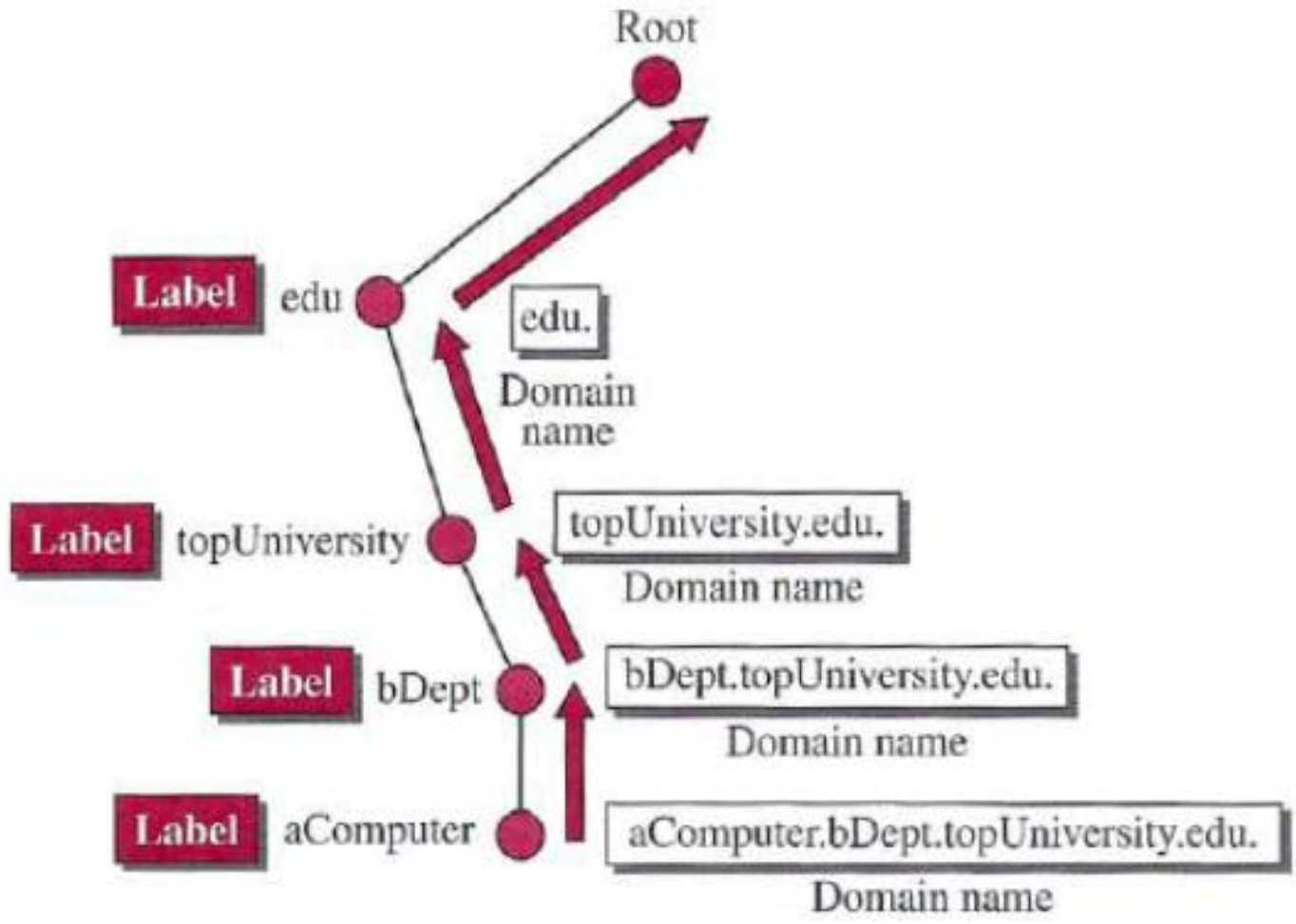
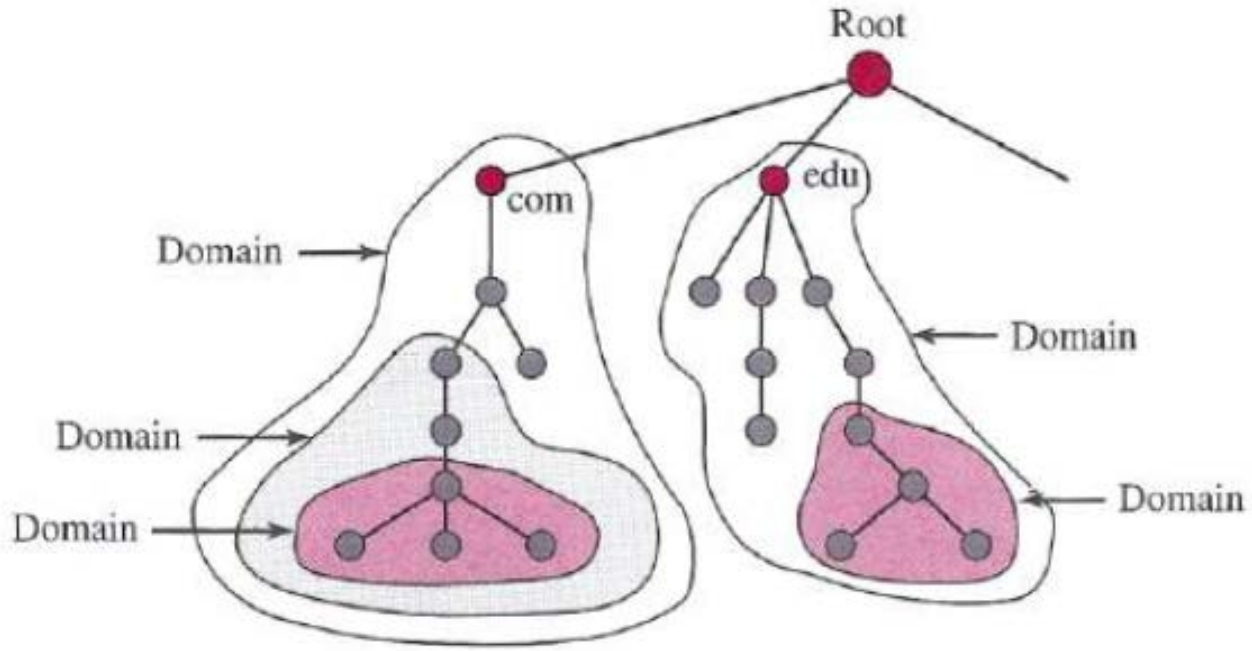

Root
Label
edu
edu.
Domain name
Label
topUniversity
topUniversity.edu.
Domain name
Label
bDept
bDept.topUniversity.edu.
Domain name
Label
aComputer
aComputer.bDept.topUniversity.edu.
Domain name

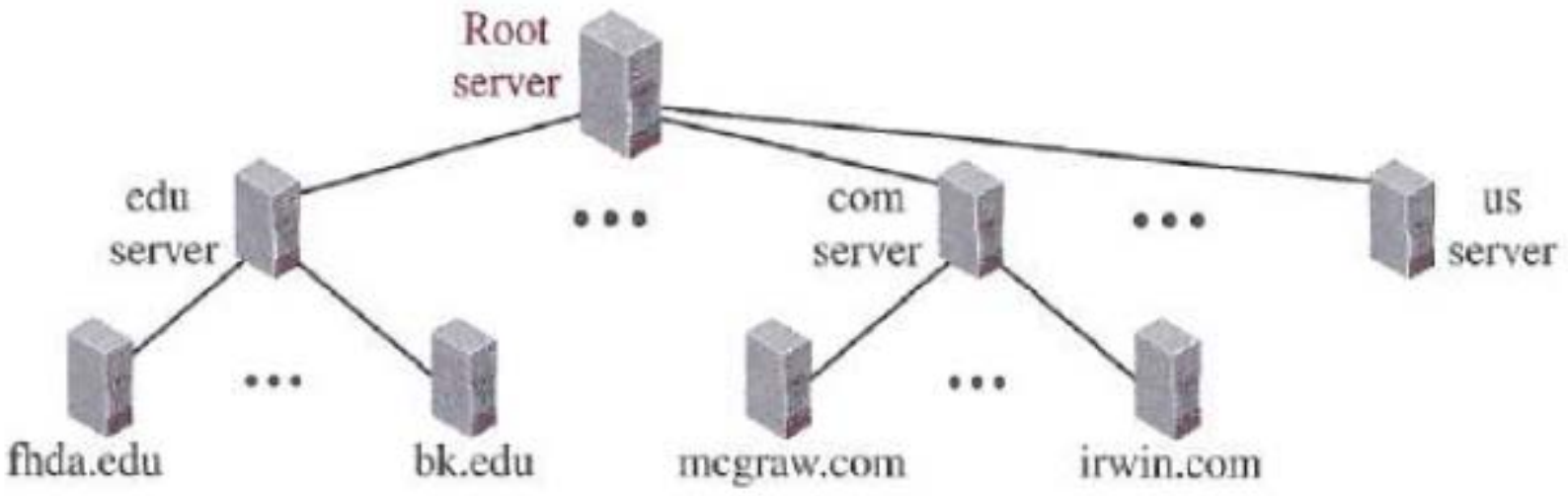
Domain

- A domain is a subtree of the domain name space



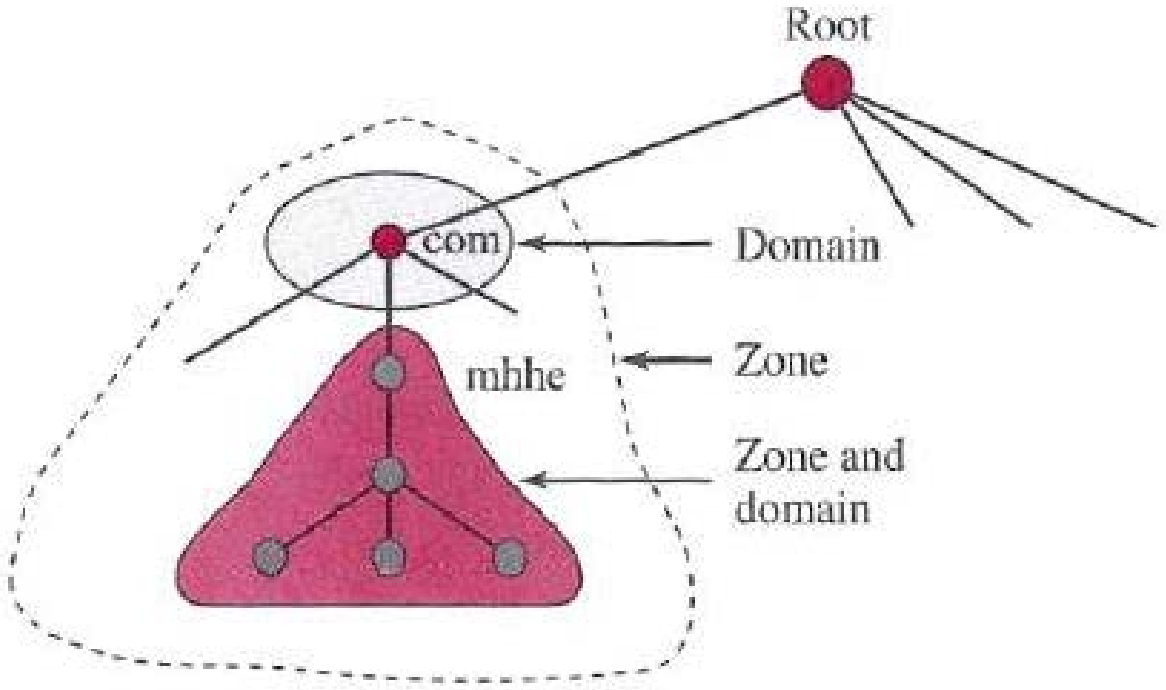
Distribution of Name Space

- The information contained in the domain name space must be stored.
- It is very inefficient and also not reliable to have just one computer store such a huge amount of information
- Soln: *Many DNS Servers following a hierarchy*



Cont…

- Zone: What a server is responsible for or has authority over is called a zone.
- A root server is a server whose zone consists of the whole tree.



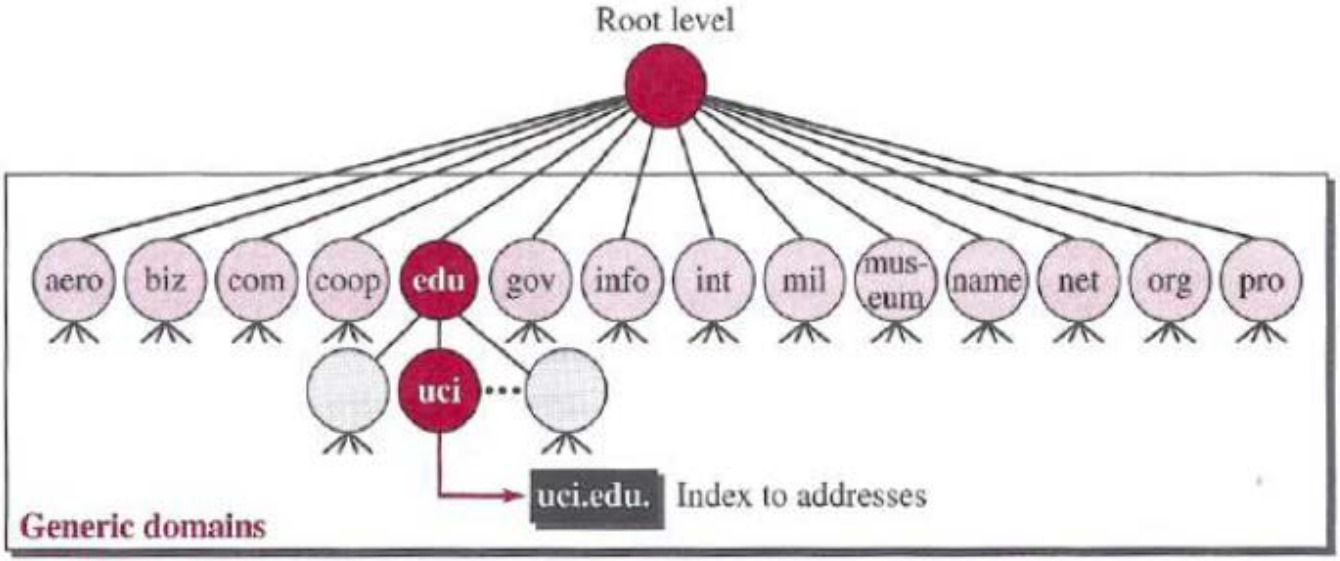
DNS in the Internet

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

Note: The inverse domains are now deprecated.

Generic Domains

- The generic domains define registered hosts according to their generic behavior.

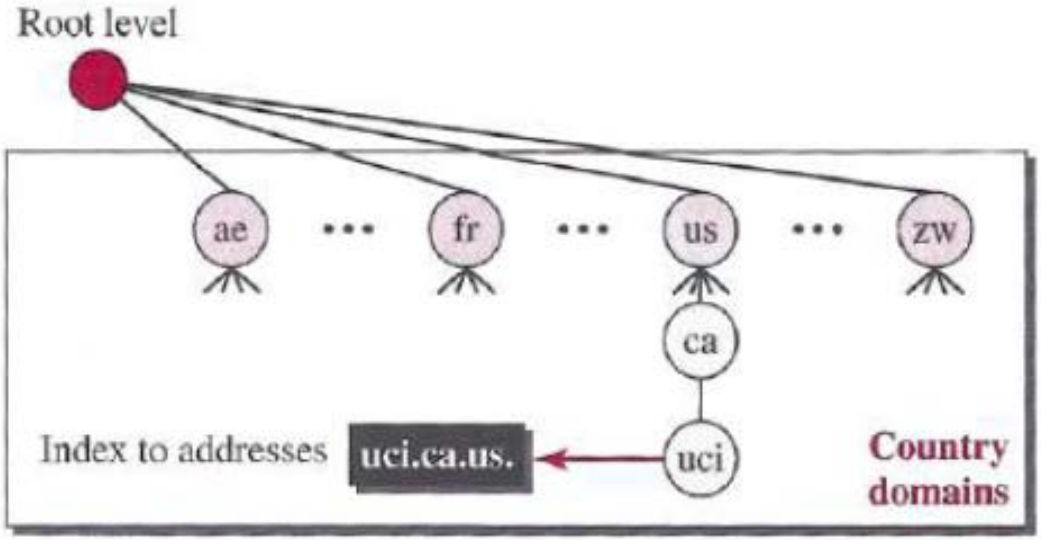


Label	*Description*	*Label*	*Description*
aero	Airlines and aerospace	**int**	International organizations
biz	Businesses or firms	**mil**	Military groups
com	Commercial organizations	**museum**	Museums
coop	Cooperative organizations	**name**	Personal names (individuals)
edu	Educational institutions	**net**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

Country Domains

- The country domains section uses two-character country abbreviations.
- Second labels can be organizational, or they can be more specific national designations.

- E.g., The address *uci.ca.us.* can be translated to University of California, Irvine, in the state of California in the United States.



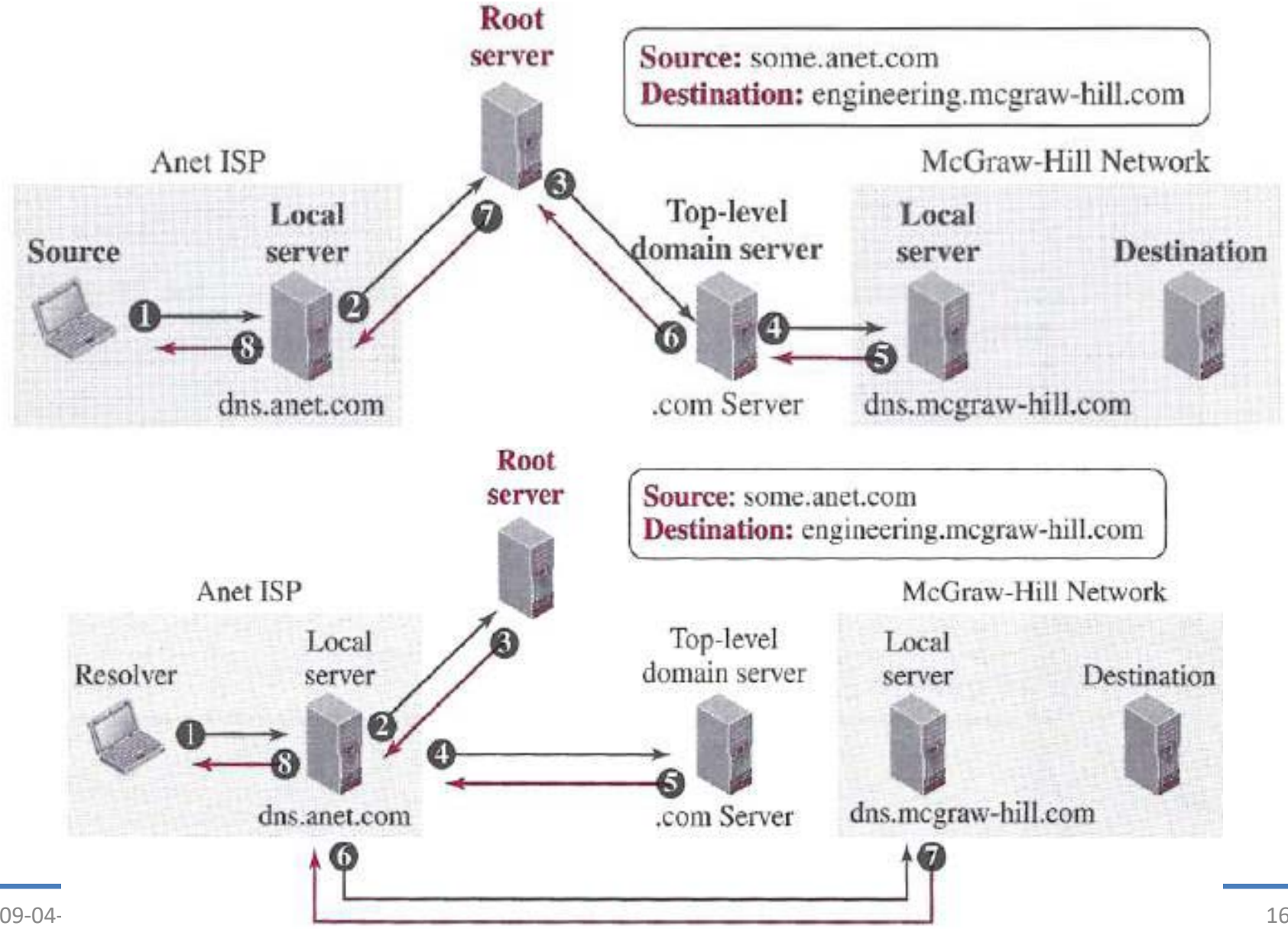
Name-Address Resolution

- Mapping a name to an address is called *name-address resolution*
- DNS is designed as a client-server application.

- The resolver (DNS client) accesses the closest DNS server with a mapping request.
- If the server has the information, it satisfies the resolver;
- otherwise, it either refers the resolver to other servers or asks other servers to provide the information.

- A resolution process can be
  - Recursive
  - Iterative

Recursive vs Iterative Resolution



Caching

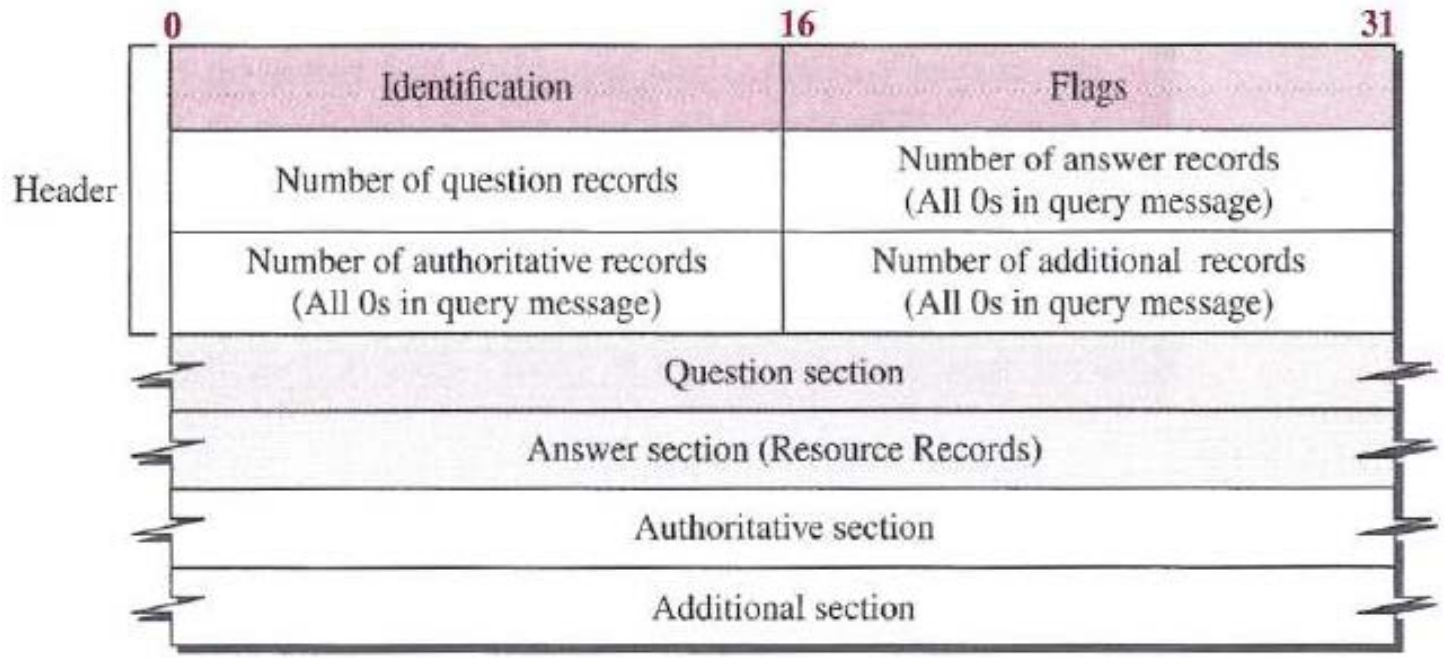
- Each time a server receives a query for a name that is not in its domain, it needs to search its database for a server IP address.
- Reduction of this search time would increase efficiency.

- DNS handles this with a mechanism called *caching*

- Caching speeds up resolution, but it can also be problematic.
- If a server caches a mapping for a long time, it may send an outdated mapping to the client.
- To counter this, TTL (time-to-live) based technique is used.

DNS Messages

- The identification field is used by the client to match the response with the query.
- The flag field defines whether the message is a query or response.



Note:
The query message contains only the question section.
The response message includes the question section,
the answer section, and possibly two other sections.

Cont…

- DNS can use either UDP or TCP. In both cases the well-known port used by the server is port 53.

- Example:
  - In UNIX and Windows, the *nslookup* utility can be used to retrieve address/name mapping.

```
$nslookup www.forouzan.biz
Name:  www.forouzan.biz
Address: 198.170.240.179
```

DNS Security

Thanks!