Domain Name Servers

COMP476
Networked Computer Systems

Internet Names

Hierarchical starting from the right

`host.subnet.organization.type`

Names are case insensitive and can be in either upper or lower case.

Domain names are assigned by the *Internet Corporation for Assigned Names and Numbers (ICANN)* **`www.icann.org`**

Domain Name	Assigned To
aero	Air transport industry
arpa	Infrastructure domain
biz	Businesses
com	Commercial organization
coop	Cooperative associations
edu	Educational institution
gov	United States Government
info	Information
int	International treaty organizations
mil	United States military
museum	Museums
name	Individuals
net	Major network support center
org	Non-commercial organizations
pro	Credentialed professionals
country code	A country

WWW host names

- Many web servers have a host name of WWW.
- There is nothing special about the host name WWW. Web servers do not have to have this name.
- You can name any computer WWW even if it does not have a web server.

Mapping Between Addresses

- Humans use Internet Names. The hardware uses the MAC addresses.
- Internet Names are converted to Internet Addresses by a Domain Name Server (DNS)
- Internet Addresses are converted to MAC addresses by using the Address Resolution Protocol (ARP).

Domain Name Servers

- Domain Name Servers (DNS) map Internet Names to Internet Addresses.
- A DNS maintains a distributed database of names and addresses.
- Computers can send a request to a DNS to get the IP address of a computer.
- Hosts and DNS cache addresses they have found.
- DNS do **NOT** provide physical addresses.

`getbyname`

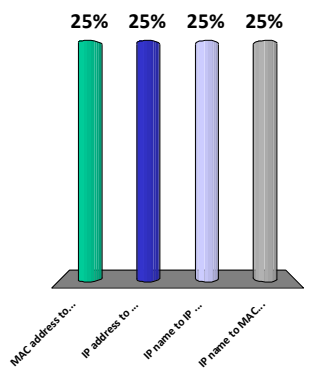
- Programs can convert an IP name to an IP address using the getbyname method

```
hostent =
  java.net.InetAddress.getbyname("w.e.com");
```

- returns a InetAddress object

A DNS converts

1. MAC address to IP name
2. IP address to IP name
3. IP name to IP address
4. IP name to MAC address

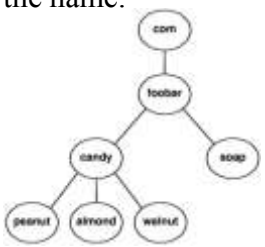


Global DNS Structure

DNS are hierarchical.

- Each server must know about all of the servers directly below it in the hierarchy.
- A server must also know a root server to ask when it doesn't know the name.

* Graphical representation that illustrates one way a DNS hierarchy might be structured.



Local DNS Zones

- An Internet domain can be divided into multiple zones.
- Each zone has a DNS that is responsible for all names in the zone.
- A zone may have multiple DNS.

The DNS Hierarchy

- DNS is designed to allow each organization to assign names to computers or to change those names without informing a central authority
- To achieve autonomy, each organization is permitted to operate DNS servers for its part of the hierarchy
  - A&T operates a server for names ending in *ncat.edu*
- Each DNS server contains information that links the server to other domain name servers up and down the hierarchy

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Replication

- A DNS server can be replicated, such that multiple physical copies of the server exist
- Replication is useful for heavily used servers, such as root servers that provide information about top-level domains
  - administrators must guarantee that all copies are coordinated so they provide exactly the same information
- A&T has several DNS servers to provide redundancy

DNS Requests

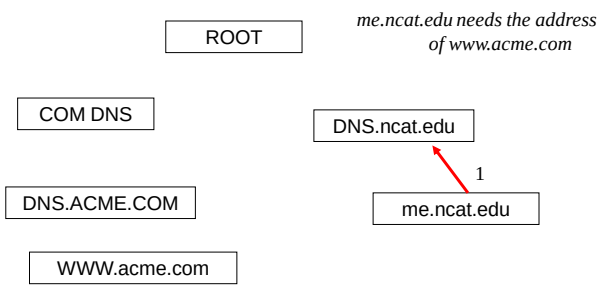
There are two basic types of requests that can be sent to a DNS.

1. A **recursive request** will respond with the answer or an error message if the host is not known. This is the type of request made by a client when the user program executes a "gethostbyname" function.
2. An **iterative request** will respond with the answer or the name of a DNS that may be able to answer the question. This type of request is usually used between Domain Name Servers.

DNS Search Path

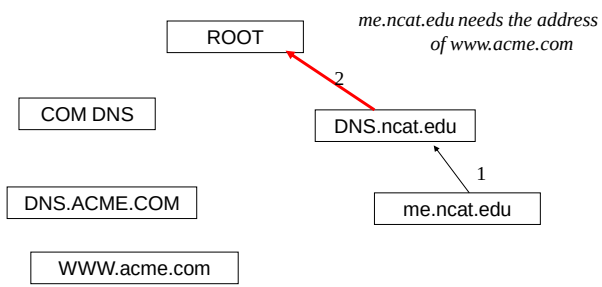
- When a client sends a DNS a request, the DNS will send the response if it has that information.
- The DNS will follow the hierarchy tree until it finds the name.
- The primary DNS for a domain is responsible for knowing the IP names and addresses of all computers in its domain

DNS Search Example



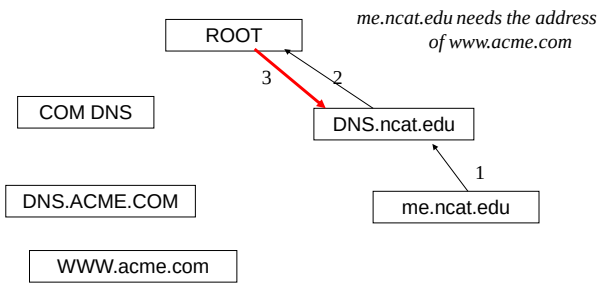
An application on me.ncat.edu calls gethostbyname("www.acme.com")

DNS Search Example



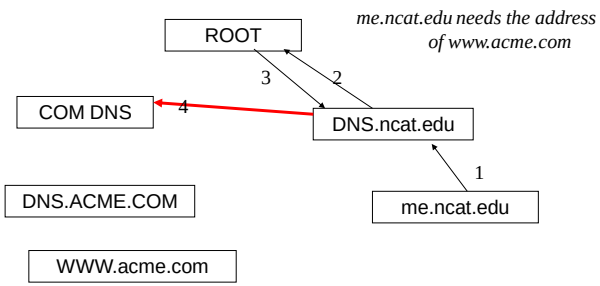
The local DNS asks the Internet root DNS for the address of www.acme.com

DNS Search Example



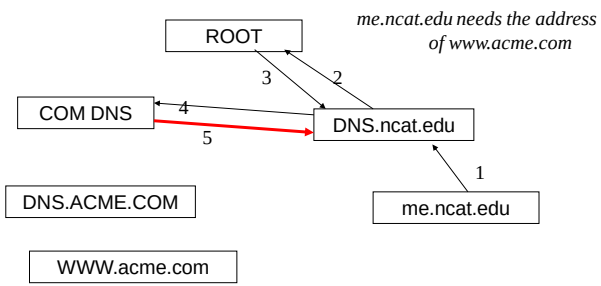
The Root returns a message telling the local DNS to ask the .com DNS

DNS Search Example



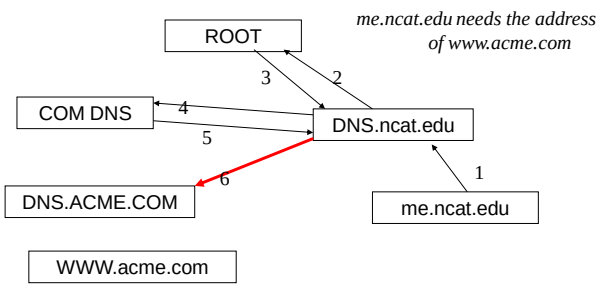
The local DNS asks the .com DNS the address of www.acme.com

DNS Search Example



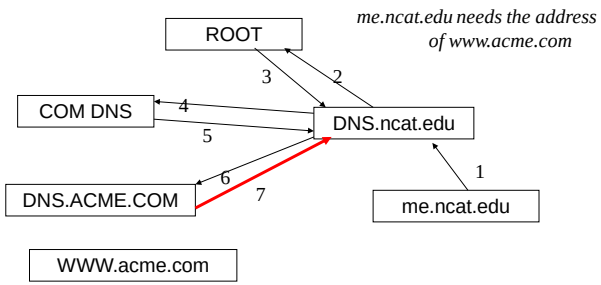
The .com DNS returns a message telling the local DNS to ask the acme.com DNS

DNS Search Example



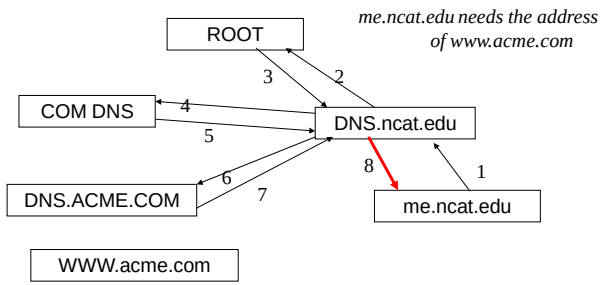
The local DNS asks the acme.com DNS the address of www.acme.com As the primary DNS for the domain, it has this.

DNS Search Example



The acme.com DNS returns the IP address of www.acme.com to the local DNS.

DNS Search Example

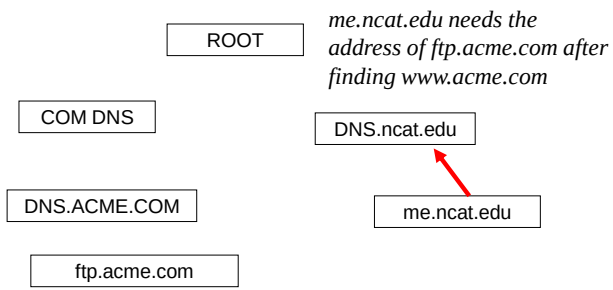


The local DNS returns the IP address of www.acme.com to the calling application

Caching

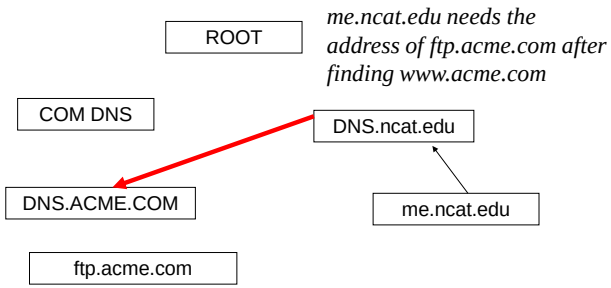
- A domain name server saves the information it finds from a search
- It caches name and address pairs as well as the IP addresses of other DNS

Second DNS Search Example



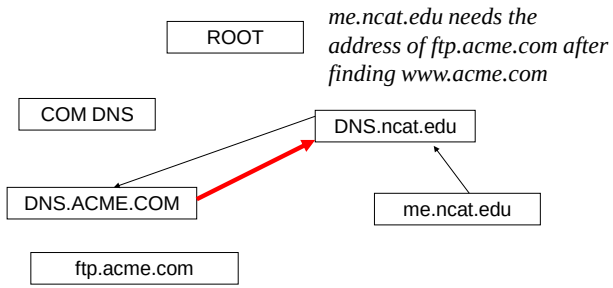
An application on me.ncat.edu calls gethostbyname(“ftp.acme.com”)

Second DNS Search Example



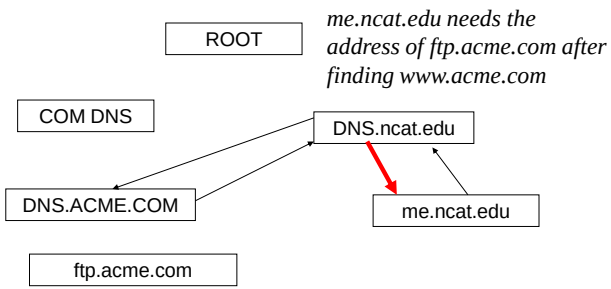
The local DNS sends a request to the acme.com DNS using the known address

Second DNS Search Example



The acme.com DNS returns the IP address of ftp.acme.com

Second DNS Search Example



The local DNS returns the IP address of ftp.acme.com to the calling application.

DNS Server Entries

- Domain Name Servers get their information from a database maintained by the domain administrator.
- A client sends a message to the DNS using the UDP protocol.
- A server has different types of entries.

DNS Resource Records (RR)

- Start of Authority (SOA) – denotes the primary DNS and time limits.
- Address (A) – supplies a host name's IP address
- Canonical Name (CNAME) – provides alias host names
- Mail Exchanger (MX) – defines a domain's mail systems
- Name Server (NS) – defines a domain's name servers

RR Example

```
acme.com.     IN SOA  dns.acme.com. dnsowner.acme.com. (
                 20010313   ; serial # (date format)
                    10800   ; refresh (3 hours)
                     3600   ; retry (1 hour)
                   604800   ; expire (1 week)
                    86400)  ; TTL (1 day)
acme.com.       IN NS      dns.acme.com.
                IN NS      ns1.isp.net.
acme.com.       IN MX  20  mail.acme.com.
                IN MX  40  mail.isp.com.
dns.acme.com.   IN A       192.168.210.2
mail            IN A       192.168.210.4
www.acme.com.   IN A       192.168.210.5
ftp.acme.com.   IN CNAME   www.acme.com.
pc              IN A       192.168.210.6
```