STEVENS
INSTITUTE of TECHNOLOGY
THE INNOVATION UNIVERSITY

CS 146: Intro to Web Programming and Project Development

Instructor: Iraklis Tsekourakis

Lieb 213

Email: itsekour@stevens.edu

DNS

Objectives

Students will be able to:

- Explain the old hostname system
- Describe the DNS namespace
- Explain how DNS is used to give a computer the IP address corresponding to an FQDN

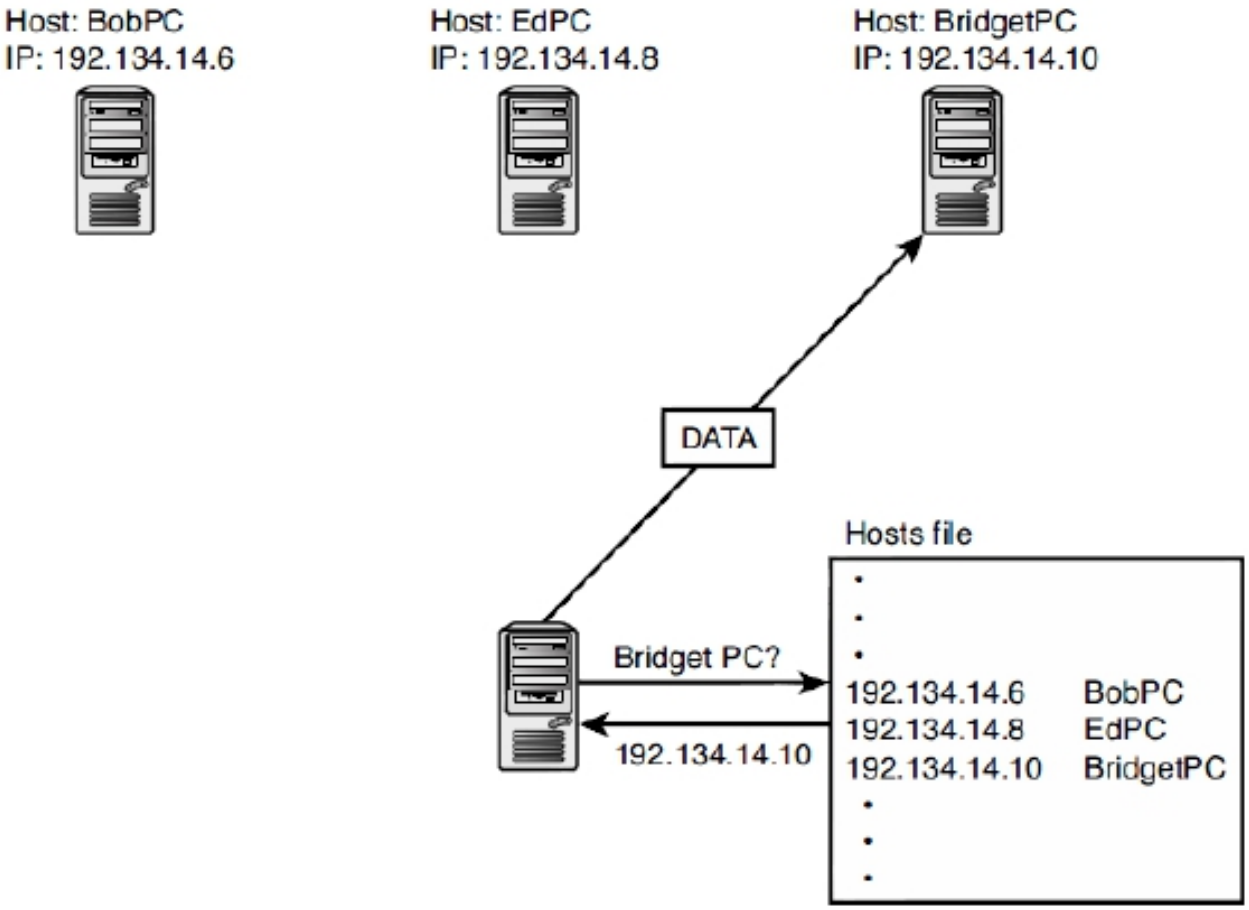
What is Name Resolution?

- In early days of TCP/IP, users had to remember the IP address of every computer on the network
  - Obviously this system could not be sustained
- Programmers developed a system of associating a user-friendly name to a computer that computers on the network could then associate with an address

Hostname System

- Simple name resolution technique developed early in the history of TCP/IP
- Each computer is assigned an alphanumeric name called a **hostname**
- If the operating system encounters an alphanumeric name where it is expecting an IP address, the operating system consults a **hosts file**

Hostname Resolution



Example: Hosts File

```
Text file with IP address to name associations:
127.0.0.1     localhost      # this machine
198.1.14.2    bobscomputer   # Bob's workstation
198.1.14.128 r4downtown      # gateway
```

Moving Onward…

- The hosts file system worked well (and still does) on small local networks
- This system becomes inefficient on larger networks
- The host-to-address associations have to reside in a single file, and the search efficiency of that file diminishes as the file expands
- In the ARPAnet days, a single master file called hosts.txt maintained a list of name-to-address associations, and local administrators had to continually update hosts.txt to stay current
- Furthermore, the hosts name space was essentially flat

Introducing Domain Name System (DNS)

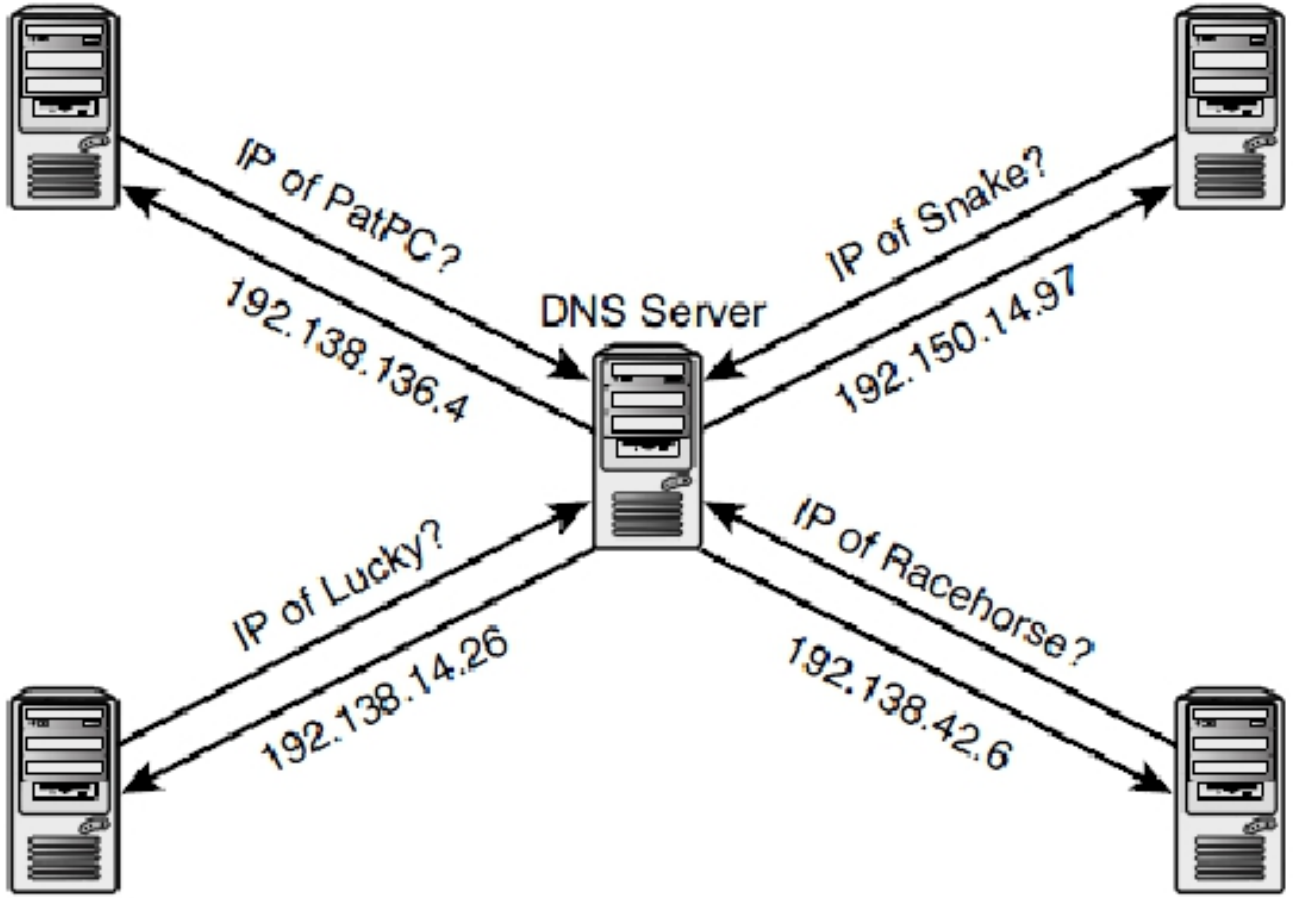
- DNS is the name resolution method used on the Internet and is the source of common Internet names such as www.reddit.com and www.slashdot.org
- DNS divides the namespace into hierarchical entities called **domains**
- The **domain name** can be included with the hostname in what is called a **fully qualified domain name (FQDN)**
  - For instance, a computer with the hostname maybe in the domain whitehouse.gov would have the FQDN maybe.whitehouse.gov
- Now let's open a browser…**

How does it work?

- Instead of host files kept on individual computers, DNS places name resolution data on one or more special servers
- The DNS servers provide name resolution services for the network
- If a computer on the network encounters a hostname where it is expecting an IP address, it sends a query to the server asking for the IP address associated with the hostname
- If the DNS server has the address, it sends the address back to the requesting computer
- The computer then invisibly substitutes the IP

Who needs a break?

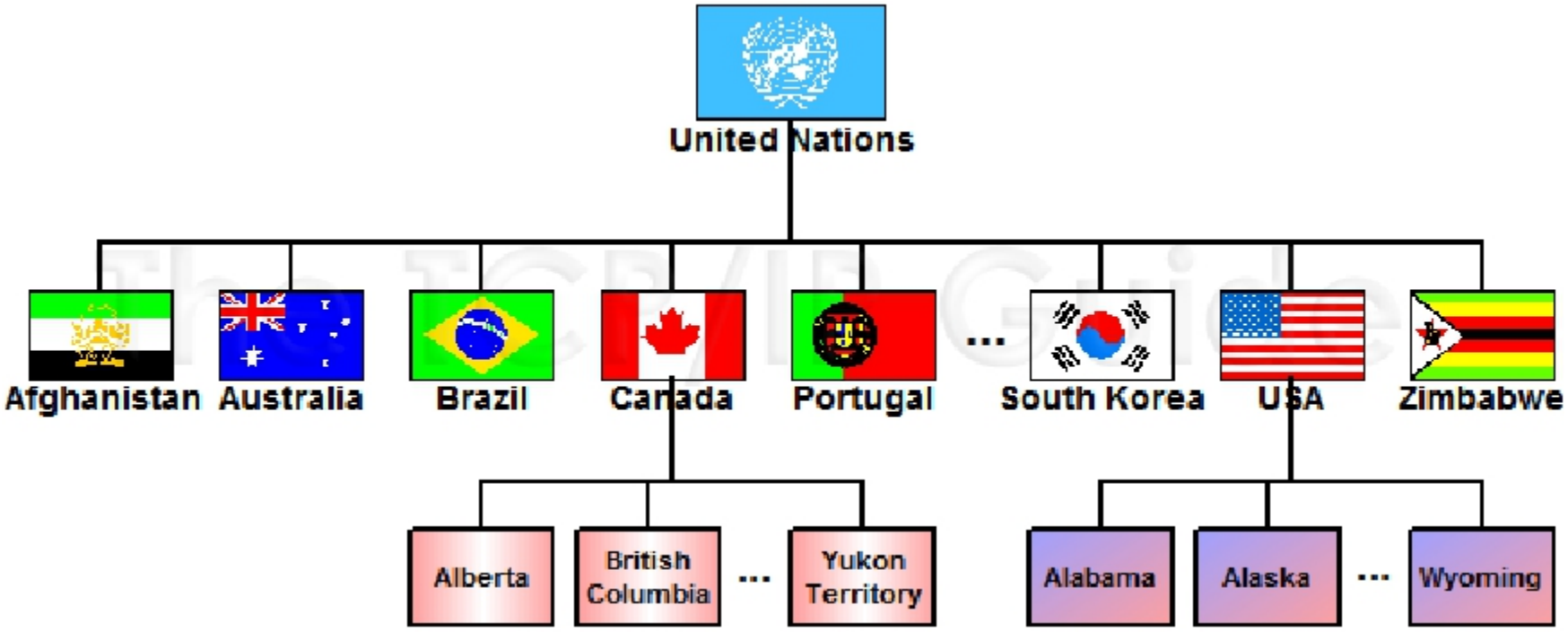
Internal DNS Server



What happens when…

- … the name server cannot find the address in its own records
- It queries other name servers to find the address and then sends the address to the client
- This query process is closely associated with the design of the DNS namespace
- DNS works with FQDNs. An FQDN consists of both a hostname and a name specifying the domain

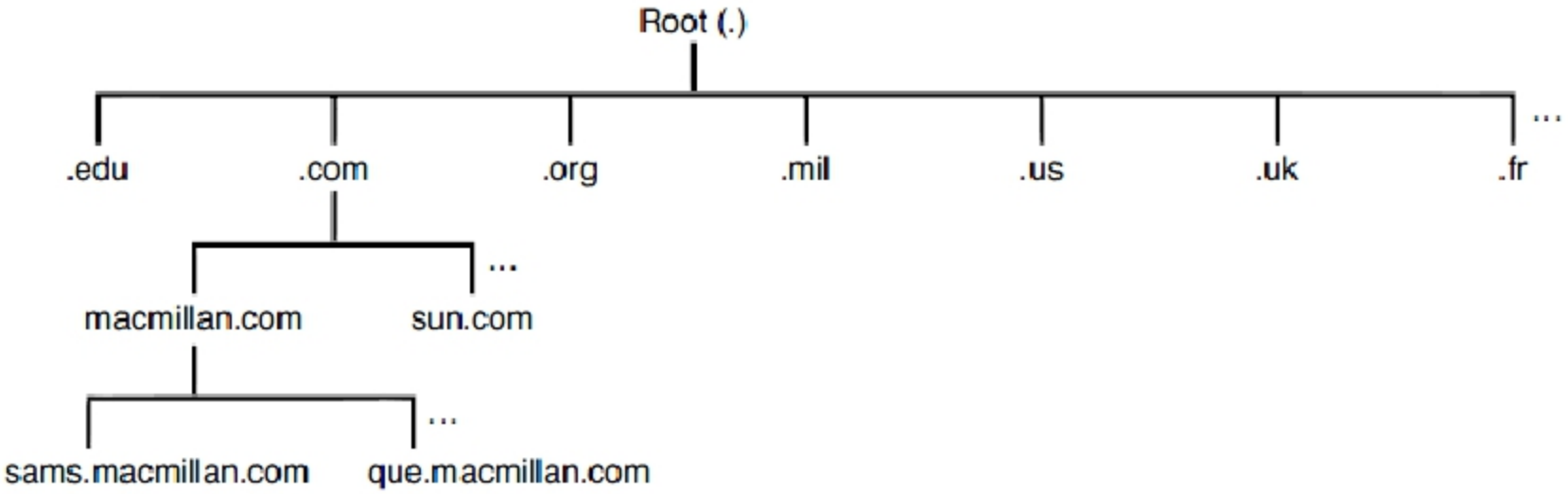
DNS-Like Tree Hierarchy



DNS Namespace

- The DNS namespace is a multi-tiered arrangement of domains
- At the top of the DNS tree is a single node known as **root**
  - Root is sometimes shown as a dot (.), although the actual symbol for root is a null character
- Beneath root is a group of domains known as top level domains (TLDs)
- Beneath each of these TLDs is another tier of domains that (in the case of the Internet) are operated by companies, institutions, or organizations
- The organization with authority over a domain can create one or more additional tiers of subdomains

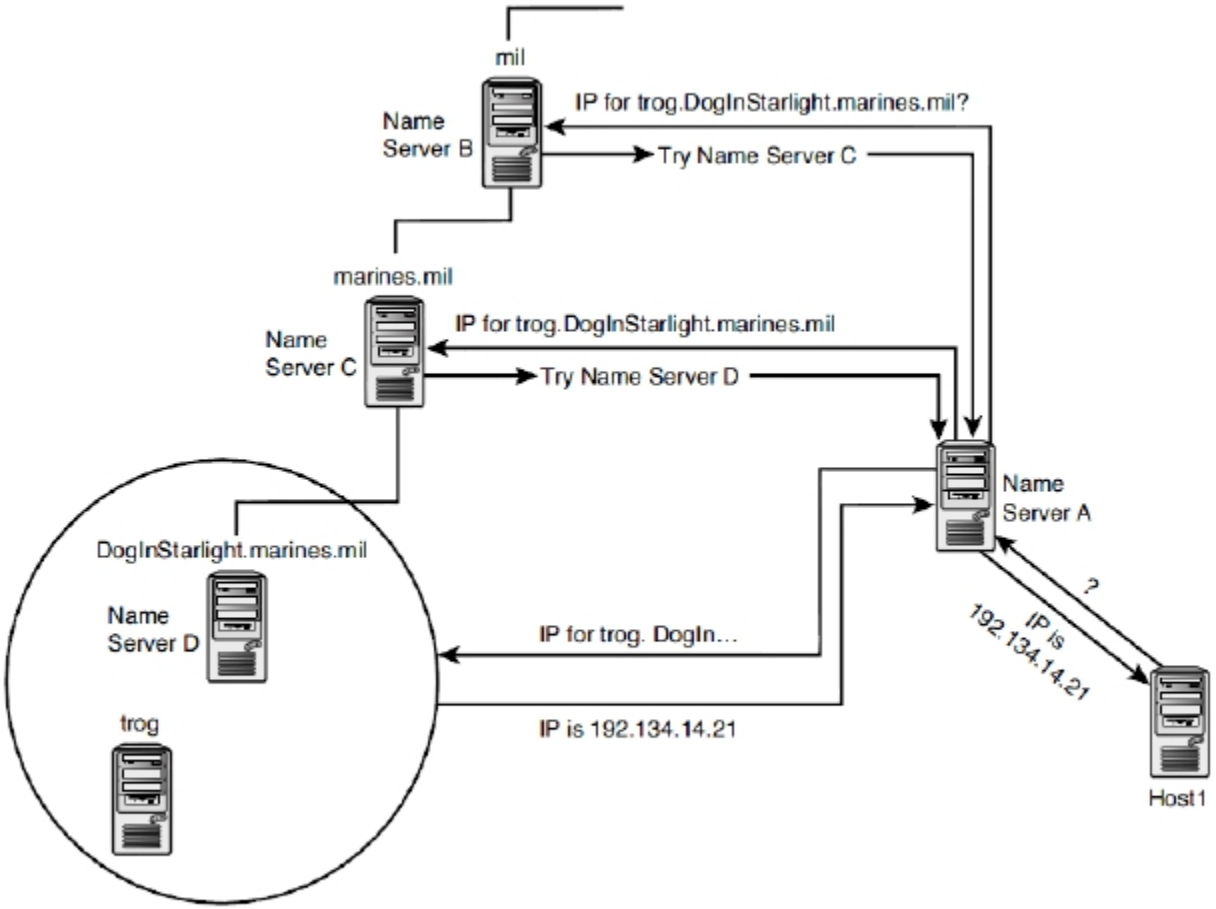
DNS Namespace



Restrictions on Hostnames

- Hierarchy goes right to left with a maximum of 127 levels
- Each level can have up to 63 characters
- Total name including delimiting dots cannot exceed 255 characters
- Even though any valid ASCII character could be used, it is usually limited to case-insensitive letters, numbers, and hyphens '-'

Name Resolution Process



Authoritative Domain Name Server

- An authoritative name server is the one sending an authoritative response
  - It provides original and definitive answers to DNS queries
  - It does not provide just cached answers that were obtained from another name server
  - Therefore it only returns answers to queries about domain names that are installed in its configuration system
- They are like Yellow Pages
- Every domain registered is associated with a primary name server and at least one secondary NS

Recursive Domain Name Server

- When your browser sends out a DNS query — assuming the browser doesn't already have the mapping stored in its cache — it is sent to a recursive DNS server
- Recursive servers are the part of the DNS that provides the required information to web clients
- They are usually managed by ISPs or the organizations that own the domain from which the connection is being made
- Authoritative responses have a TTL (time-to-live), so the recursive servers must not send back outdated information to the client
- They are like the phone operators looking up a phone number from multiple phone books