# EE 122: Domain Name Server (DNS)

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(* based in part on on-line slides by J. Kurose & K. Rose and Raj Jain)

## Names & Addresses

- What is a name?
- What is an address?
- What is the difference between names and addresses?



## Internet Centric View

- Addresses:
  - Says how to reach an object → it has location semantics associated to it
  - It's in a format easy to process by computers
- Name:
  - Does not have any location semantics associated to it
  - It's in a format easier to understand/read/remember by people
- Examples:
  - IP address: 169.229.131.109
  - Name: arachne.berkeley.edu

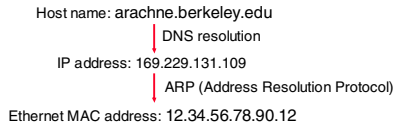


## Name Service

- Name space: define the set of possible names
  - Hierarchical (e.g., Unix and Windows file names)
  - Flat
- Bindings: the mapping between names and values (e.g., addresses)
  - Bindings can be implemented by using tables
- Resolution: procedure that, when invoked with a name, returns the corresponding value
- Name server: specific implementation of a resolution mechanism that is available on the network and that can be queried by sending messages

## General View

- In general there are multiple mappings



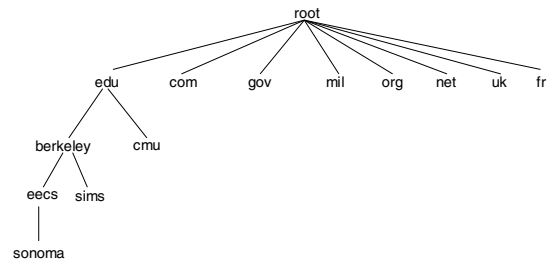



## Mapping

- Multiple names can map onto the same address
  - Example: www.berkeley.edu and arachne.berkeley.edu maps to the same machine (i.e., the same IP address)
- One name can map onto multiple addresses
  - Example: www.yahoo.com can be mapped to multiple machines



## Name Hierarchy






## Name Hierarchy

- Unique domain suffix is assigned by the Internet Authority
- The domain administrators have complete control over the domain
- No limit on the number of subdomains or number of levels
- Name space is not related with the physical interconnection
- Geographical hierarchy is allowed (e.g., cnri.reston.va.us)
- A name could be a domain or an individual objects

## Top Level Domains

| Domain Name | Assignment |
|---|---|
| com | Commercial |
| edu | Educational |
| gov | Government |
| mil | Military |
| net | Network |
| org | Other organizations |
| country code | au, uk, ca, … |



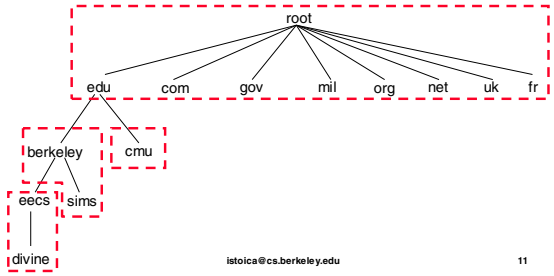
## DNS Name Servers

- Why not centralize DNS?
  - Single point of failure
  - Traffic volume
  - Distant centralized database
  - Maintenance
- Doesn't scale!



## Server Hierarchy: Zones

- A zone corresponds to an administrative authority that is responsible for that portion of the hierarchy






## Server Hierarchy

- Server are organized in hierarchies
- Each server has authority over a portion of the hierarchy
  - A single node in the name hierarchy cannot be split
  - A server maintains only a subset of all names
  - It needs to know other servers that are responsible for the other portions of the hierarchy

## Server Hierarchy

- Authority: each server has the name to address translation table for all names in the name space it controls
- Every server knows the root
- Root server knows about all top-level domains



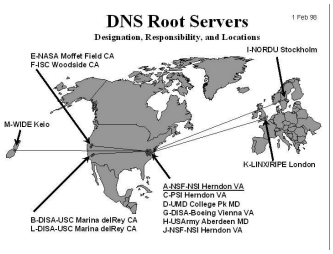
## DNS Name Servers

- No server has all name-to-IP address mappings
- Local name servers:
  - Each ISP (company) has local (default) name server
  - Host DNS query first go to local name server
- Authoritative name servers:
  - For a host: stores that host's (name, IP address)
  - Can perform name/address translation for that host's name



## DNS: Root Name Servers

- Contacted by local name server that can not resolve name
- Root name server:
  - Contacts authoritative name server if name mapping not known
  - Gets mapping
  - Returns mapping to local name server
- ~ Dozen root name servers worldwide

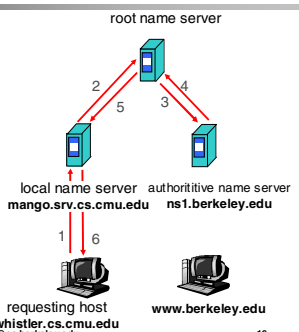





## Simple DNS Example

Host `whsitler.cs.cmu.edu` wants IP address of `www.berkeley.edu`

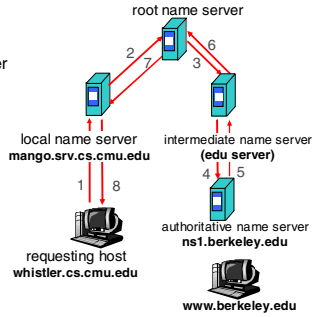
1. Contacts its local DNS server, `mango.srv.cs.cmu.edu`
2. `mango.srv.cs.cmu.edu` contacts root name server, if necessary
3. Root name server contacts authoritative name server, `ns1.berkeley.edu`, if necessary



## DNS Example

Root name server:

- May not know authoritative name server
- May know intermediate name server: who to contact to find authoritative name server?





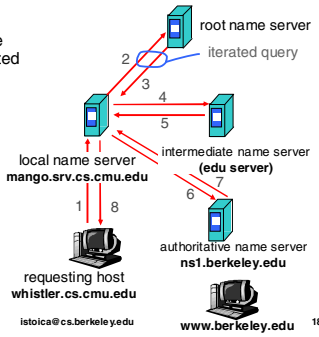

## DNS: Iterated Queries

Recursive query:

- Puts burden of name resolution on contacted name server
- Heavy load?

Iterated query:

- Contacted server replies with name of server to contact
- "I don't know this name, but ask this server"






## Discussion

- Robustness
  - Use multiple replicas, but…
  - …what if someone mounts a denial of service attack to all root servers?
- Performance:
  - Use caching to speed-up subsequent queries to the same name
- What about update/notify?
  - Mechanisms under design by IETF (RFC 2136; http://www.ietf.org/html.charters/dnsind-charter.html)



## Summary

- DNS: maps names onto IP address
- Name space and the administration are both hierarchical
- Replication: used to increase robustness
- Caching: used to increase the performance