Names & Addresses

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

Names vs. Addresses

Weather a string is a name or address may depend on context

Identity

- Name that uniquely identify an entity
  - E.g., your SSN
- Identifier properties:
  - An identifier refers to at most one entity
  - Each entity is referred to by at most one identifier
  - An identifier always refers to the same entity (i.e., it is never reused)
Internet Centric View

- **Addresses:**
  - Says how to reach an object ➔ it has location semantics associated to it
  - Usually, a format easy to process by computers
- **Name:**
  - Does not have any location semantics associated to it
  - Usually, 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 and their relationship
  - Hierarchical (e.g., Unix and Windows file names)
  - Flat
- **Bindings:** the mapping between names and values (e.g., addresses or other names)
  - 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

Binding and Resolution in the Internet

- In general there are multiple mappings

```
Host name: arachne.berkeley.edu
IP address: 169.229.131.109
ARP (Address Resolution Protocol)
Ethernet MAC address: 12:34:56:78:90:12
```

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 Space

- A general naming graph with a single root node

Linking and Mounting (1)

- Symbolic link in a naming graph
Linking and Mounting (2)
- Mounting remote name spaces through a specific process protocol

Domain Name System (DNS) Hierarchy (1)
- 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

DNS Top Level Domains

<table>
<thead>
<tr>
<th>Domain Name</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>com</td>
<td>Commercial</td>
</tr>
<tr>
<td>edu</td>
<td>Educational</td>
</tr>
<tr>
<td>gov</td>
<td>Government</td>
</tr>
<tr>
<td>mil</td>
<td>Military</td>
</tr>
<tr>
<td>net</td>
<td>Network</td>
</tr>
<tr>
<td>org</td>
<td>Other organizations</td>
</tr>
<tr>
<td>country code</td>
<td>au, uk, ca, …</td>
</tr>
</tbody>
</table>

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
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”