

CS 194:
Distributed Systems:
Naming

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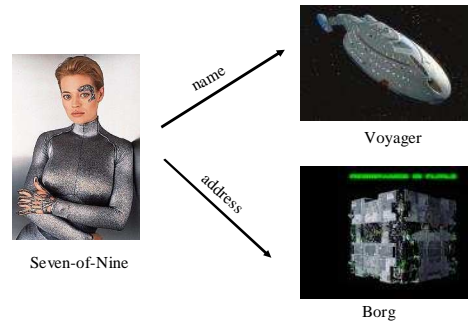
Names & Addresses

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

Names & Addresses

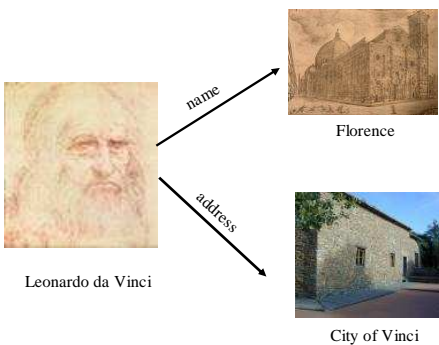
- Name: string of bits that refer to an entity
 - E.g., your name
- Address: string of bits that have location semantics
 - E.g., your home address, your phone #

Names vs. Addresses



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

Names vs. Addresses



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

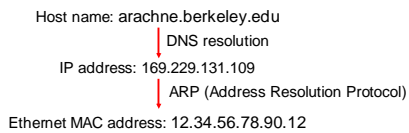
- Addresses:
 - Says how to reach an object → it has location semantics associated to it
 - Usually, a format easy to process by computers
- Name:
 - Does not have any location semantics associated to it
 - Usually, a format easier to understand/read/remember by people
- Examples:
 - IP address: 169.229.131.109
 - 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

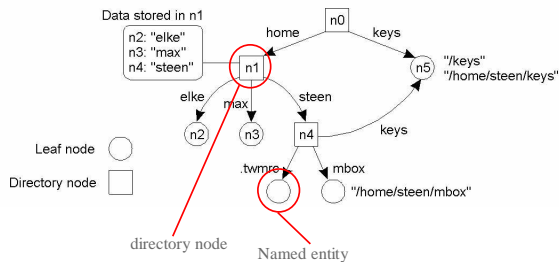


Mapping

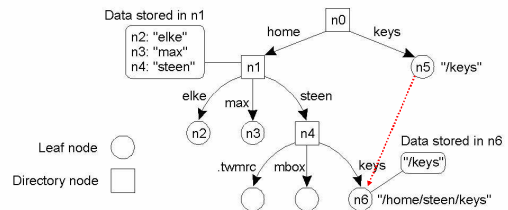
- Multiple names can map onto the same address
 - Example: www.berkeley.edu and arachne.berkeley.edu maps to the same machine (i.e., the same IP address)
- One name can map onto multiple addresses
 - Example: www.yahoo.com can be mapped to multiple machines

Name Space

- A general naming graph with a single root node



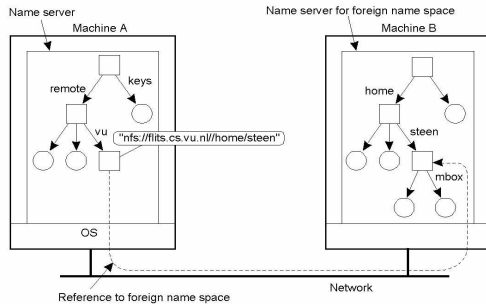
Linking and Mounting (1)



- Symbolic link in a naming graph

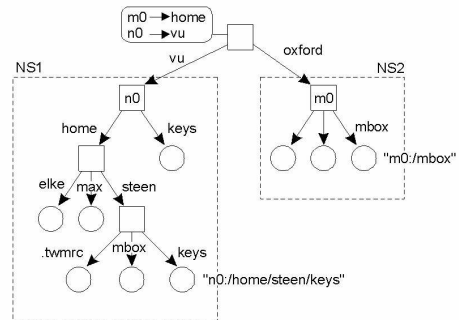
Linking and Mounting (2)

- Mounting remote name spaces through a specific process protocol

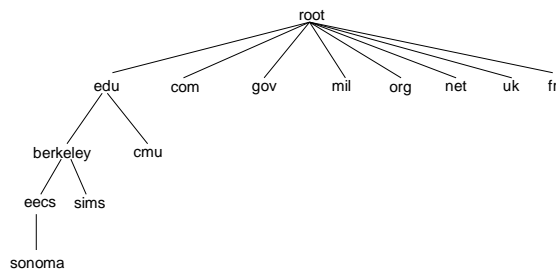


Linking and Mounting (3)

- Organization of the DEC Global Name Service



Domain Name System (DNS) Hierarchy(1)



DNS Hierarchy (2)

- 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

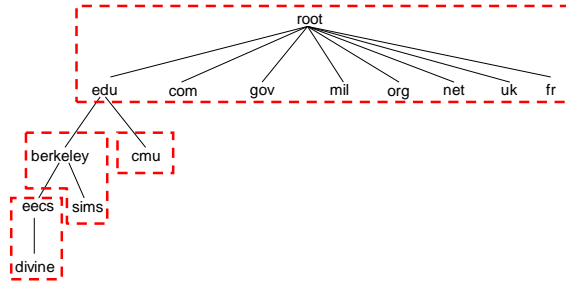
Domain Name	Assignment
com	Commercial
edu	Educational
gov	Government
mil	Military
net	Network
org	Other organizations
country code	au, uk, ca, ...

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

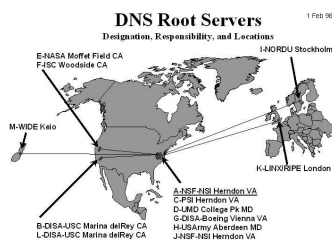
- No server has all name-to-IP address mappings
- Local name servers:
 - Each ISP (company) has local (default) name server
 - Host DNS query first go to local name server
- Authoritative name servers:
 - For a host: stores that host's (name, IP address)
 - Can perform name/address translation for that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

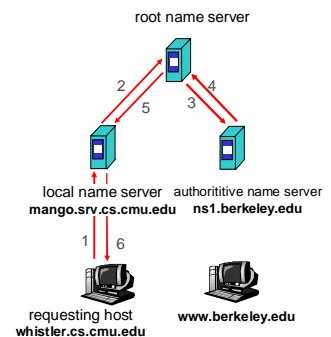
• ~ Dozen root name servers worldwide



Simple DNS Example

Host **whistler.cs.cmu.edu** wants IP address of **www.berkeley.edu**

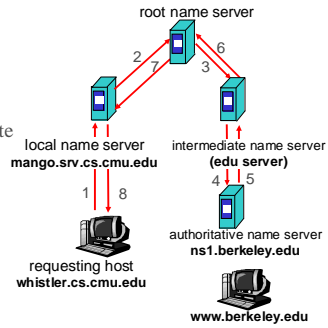
1. Contacts its local DNS server, **mango.srv.cs.cmu.edu**
2. **mango.srv.cs.cmu.edu** contacts root name server, if necessary
3. Root name server contacts authoritative name server, **ns1.berkeley.edu**, if necessary



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"

