Chapter 5: Naming and Locating Mobile Entities

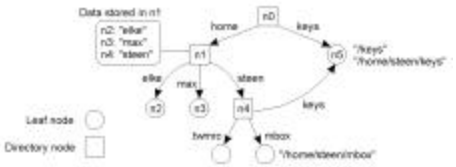
Name: a unique (abstract) identifier to refer an entity in a system.

- Naming space: a closed/open space in which all names are meaningful and no ambiguity.
- Name resolution: a process to map a name to its identified entity.

Commonly used naming methods

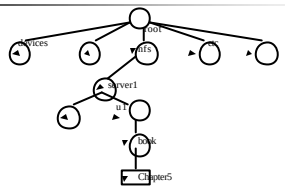
- Address: an access point
  - entity:address → 1:1 or 1:M
  - address could be static or dynamic
- Identifier: an integer or a binary string
  - an ID refers to at most one entity
  - each entity is referred to by at most one ID
  - An ID always refers to the same entity
- Textual name: a human-friendly symbolic string
  - location independent
  - many different forms: file names, DNS names

Name Spaces



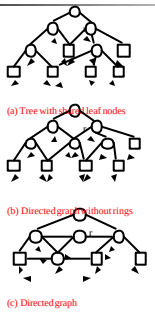
A general naming graph with a single root node.

Path names



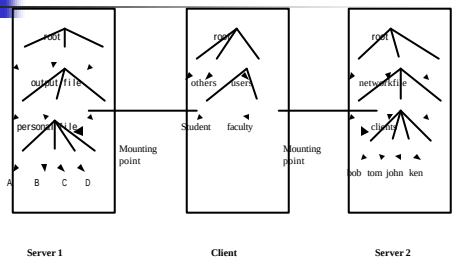
Path: a sequence of directed links(labels)
UNIX absolute path: /nfs/server1/u1/book/Chapter5/
UNIX relative path: book/Chapter5
DOS absolute path: C:\u1\book\Chapter
MacOS relative path: u1:book:Chapeter5

Possible topologies of naming space



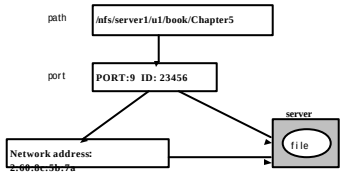
- Global name: denotes the same entity, no matter where the name is used (absolute path)
- Local name: interpretation depends on where the name is used (relative path)
- Root: the name whose node has no incoming edges

Linking and Mounting



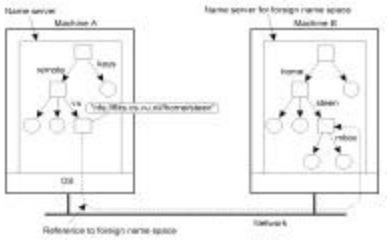
Linking: allow multiple absolute path names to refer to the same node
Mounting: allow a node to refer to a node from a different name space

NFS: from name to entity

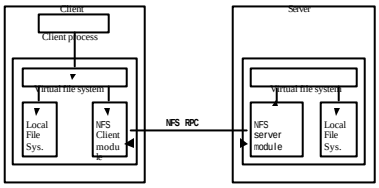


NFS: Network File System
name resolution process maps an absolute path name to a physical file over the network

NFS: access remote name space

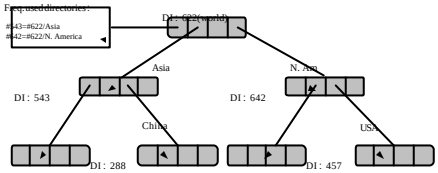


NFS: software architecture



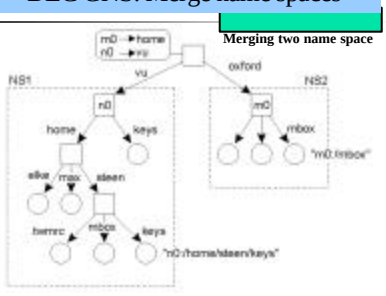
NFS RPC:
open/close, read/write, rename, set attributes, etc.

Organization of the DEC GNS

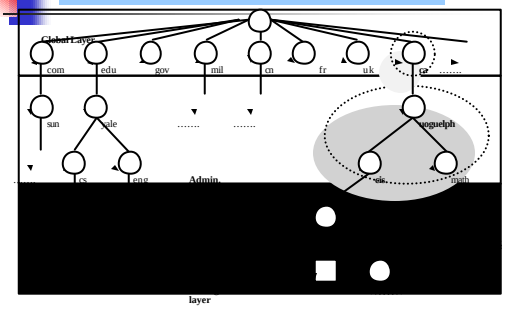


DEC: Digital Equipment Co.
GNS: Global Name Service

DEC GNS: Merge name spaces



DNS: Domain Name System



DNS: logical layers

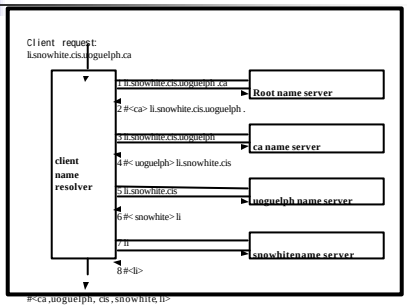
- Global layer:
  formed by highest-level nodes, such as com, edu, gov, int, cn, ca, us, …; directory tables are rarely changed, nodes represent organizations, or groups.
- Administrational layer:
  formed by nodes within a single organization, such as universities, companies, …; directory tables are relatively stable.
- Managerial layer:
  formed by nodes that may typically change regularly, such as users, student accounts, email accounts, …

DNS: A comparison of logical layers

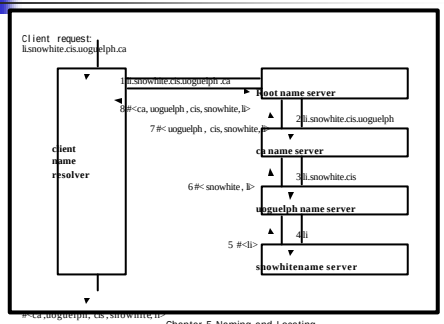
Item	Global	Administrational	Managerial
Geographical scale of network	Worldwide	Organization	Department
Total number of nodes	Few	Many	Vast numbers
Responsiveness to lookups	Seconds	Milliseconds	Immediate
Update propagation	Lazy	Immediate	Immediate
Number of replicas	Many	None or few	None
Is client-side caching applied?	Yes	Yes	Sometimes

- **Zone: a part of name space that is implemented by a separate name server**
- **Domain: a sub-tree of DNS name space**
- **Domain Name: a path name in DNS name space (either absolute or r elative)**

DNS: name resolution (iterative)



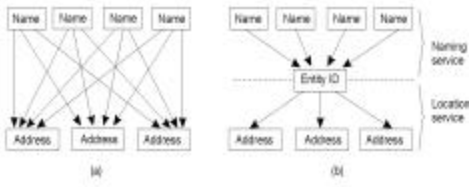
DNS: name resolution (recursive)



DNS: resource record types

Type of record	Associated entity	Description
SOA	Zone	Holds information on the represented zone
A	Host	Contains an IP address of the host this node represents
MX	Domain	Refers to a mail server to handle mail addressed to this node
SRV	Domain	Refers to a server handling a specific service
NS	Zone	Refers to a name server that implements the represented zone
CNAME	Node	Symbolic link with the primary name of the represented node
PTR	Host	Contains the canonical name of a host
HINFO	Host	Holds information on the host this node represents
TXT	Any kind	Contains any entity-specific information considered useful

Naming versus Locating Entities



a) Direct, single level mapping between names and addresses.
b) Two-level mapping using identities.

Locating Mobile Entities

- The name resolution module is responsible for concerting an Internet name to network address for a specific physical entity. However, how about this entity is moving from one network to another?
- DHCP(Dynamical Host Configuration Protocol) enables a newly connected computer to dynamically acquire an IP address in the local subnet, and access naming services.
- But for mobile users, they may want a fixed IP when they are moving around (like the cell phone numbers)
- In addition, mobile agents may migrate from a server to another, how to locate them?

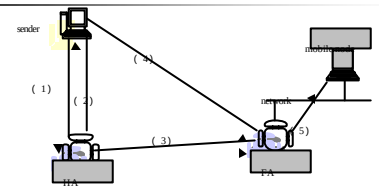
Mobile IP (1)

- Mobile IP allows IP communication continues when a mobile computer moves between subnets at different locations.
- When the mobile host is connected at its home network, packets are routed in the normal way. When it moves to another subnet, two agents take responsible for rerouting: Home Agent(HA) and Foreign Agent (FA).

Mobile IP (2)

- 1996, the first draft of MobileIP is proposed by IETF.
- The MA is responsible for holding up-to-date knowledge of the mobile node's current location. If a mobile node leaves it home site, it should inform the HA.
- When the mobile node arrives a new site, it informs the FA at that site. The FA allocates a " care-of address" to it. The FA then contacts the HA giving it required information.
- MobileIP is effective, but hardly efficient.

Mobile IP (3)

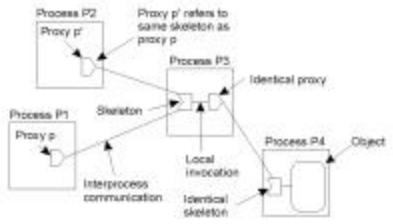


(1) Sender sends the first IP packet to receiver's host.
(2) HA behaves as a proxy: responds to sender the address of FA, and
(3) HA forwards the IP packet to FA.
(4) Sender sends subsequent IP packets to FA (tunnelling technique).
(5) FA unpacks IP packets and delivers to the mobile node.

Locating a Mobile Agents

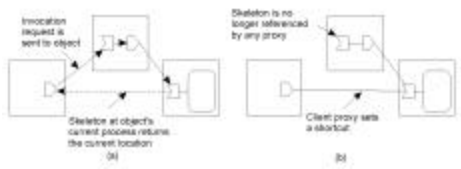
- Broadcasting:
  a message containing the ID of the entity is broadcast to each machine and each machine is requested to check whether it has that entity. Suitable for local network. How about moving?
- Forward pointer:
  when an entity moves from A to B, it leaves behind a reference to its new location at B. Chain problem, broken link.
- Home Based:
  a home location keeps track of the current location of an entity. Triangle communication. How about moving?

Forwarding Pointers (1)



The principle of forwarding pointers using (*proxy*, *skeleton*) pairs.

Forwarding Pointers (2)



Redirecting a forwarding pointer, by storing a shortcut in a proxy.

Home-Based Approach