CSci 5105

Introduction to Distributed Systems

Naming

Last Time

- Advanced Communication
- Communicating to whom?
- How are the parties named, located?

Today

- Naming
- Chapter 5 TVS

Naming

- Name refers to an entity or class of entities
  - files, machines, users
- Key component of distributed systems
  - scalable
  - transparent: e.g. location transparency
  - sharing
- Name
  - human-readable text: ".login", "caesar"
  - system/low-level names: bit pattern (Amoeba)
  - multi-level name: caesar.cs.umn.edu

Entity

- Entity has an address
  - serves as the access point for the entity
  - entity Jon_Server; address 192.44.33.64, 333
  - can change over time
- Entity may have attributes
  - Jon_Server
  - Owner: jon
  - Lifetime: 1 hour

Identifiers

- Identifier
  - 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

Binding and Resolution

- To use an entity, need to find an access point
- Binding: associate {name, address}
  - usually maintained by a Name Server
- Resolution: name -> address
  - sometimes this is called navigation
  - name -> Name Server1 -> Name Server2 -> ... Address

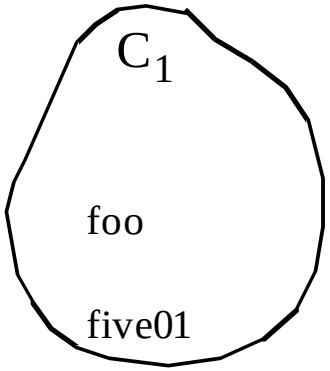
Naming Service

- Two types of naming service
  - white-pages: look up by name only
  - yellow-pages: look up by attribute
- Potential Wish list:
  - general: support different classes of resources
  - multiple names/aliases (many -> 1)
  - global name space
  - support multiple contexts for names
  - **location transparency/independent**
  - support relocation of entities
  - support group naming (multicast groups)

Name Space Organization

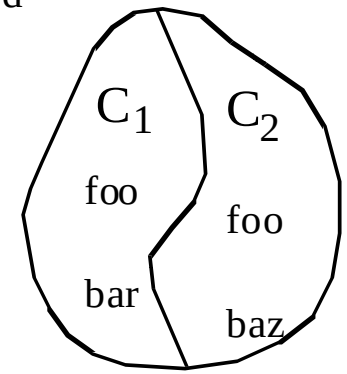
- Name space
  - Flat : all names at same level
  - Partitioned : domains/contexts

Flat



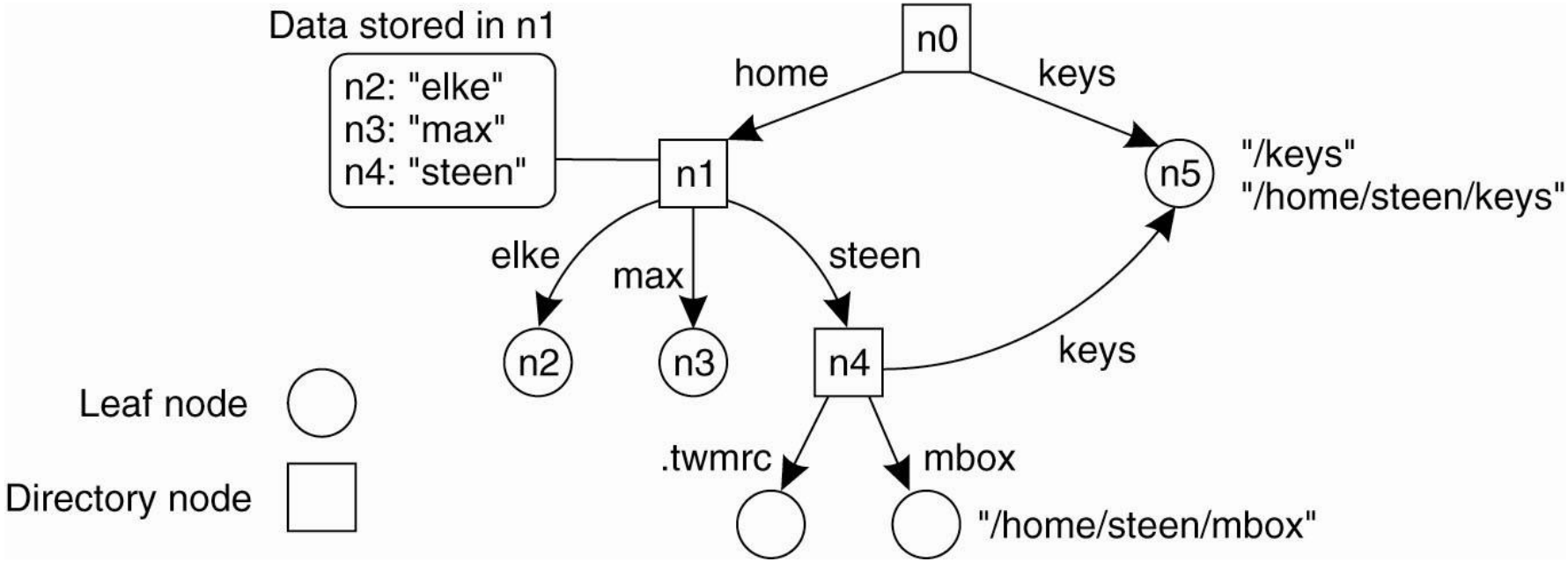
problems: scale {E.g. lookup is expensive}

Partitioned

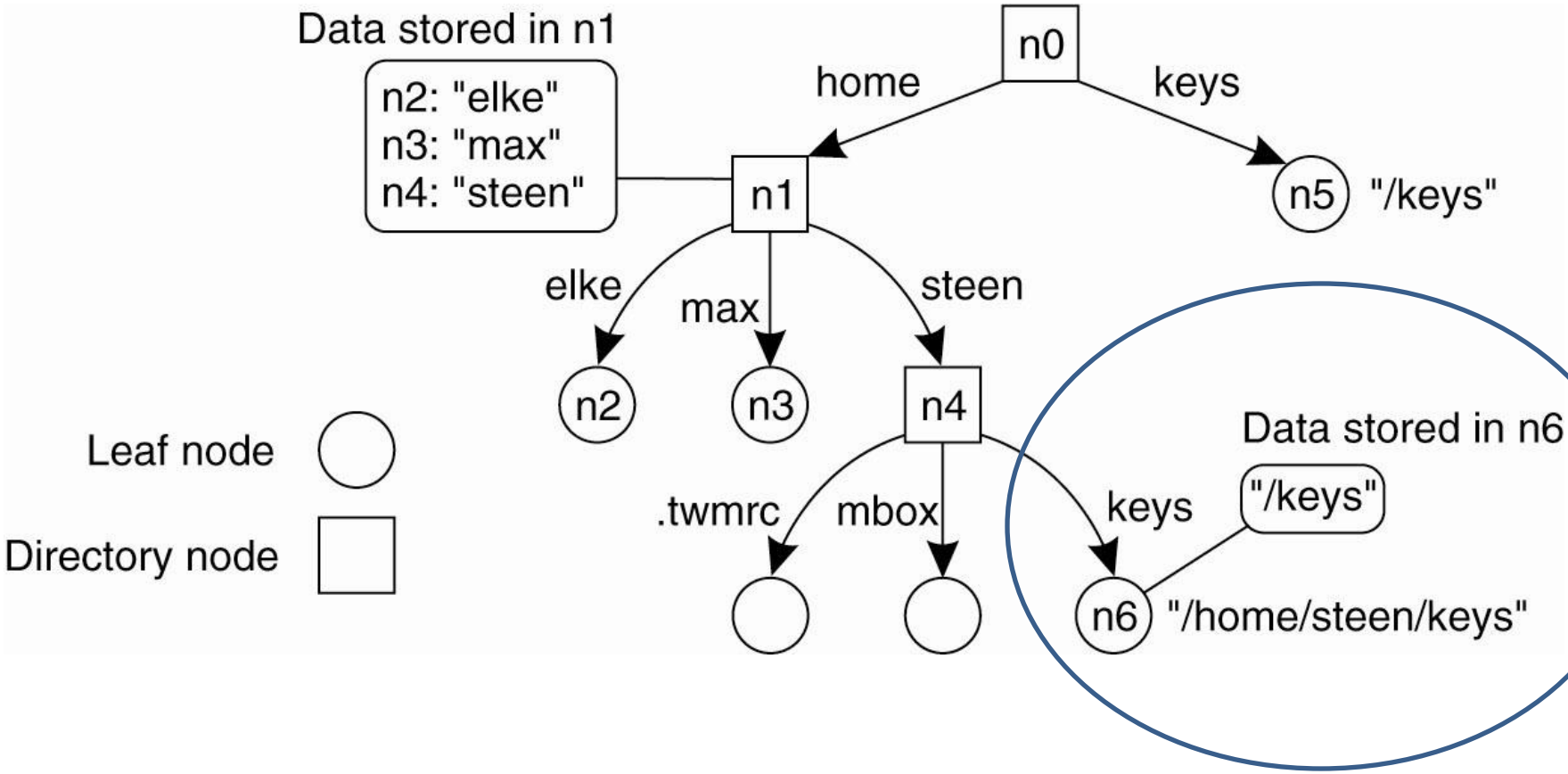


E.g. C_1 and C_2 are directories

Example: Directories

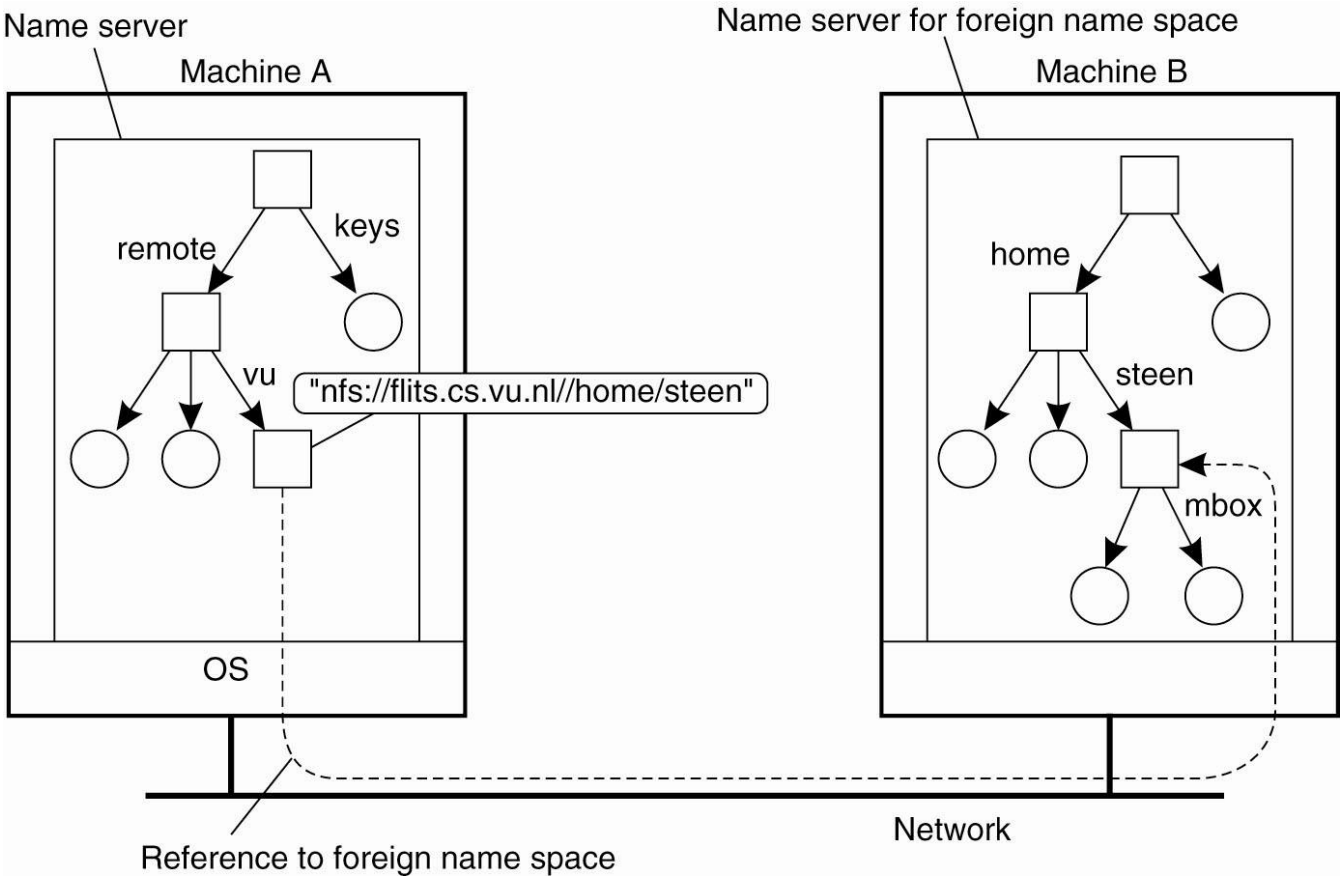


Aliasing

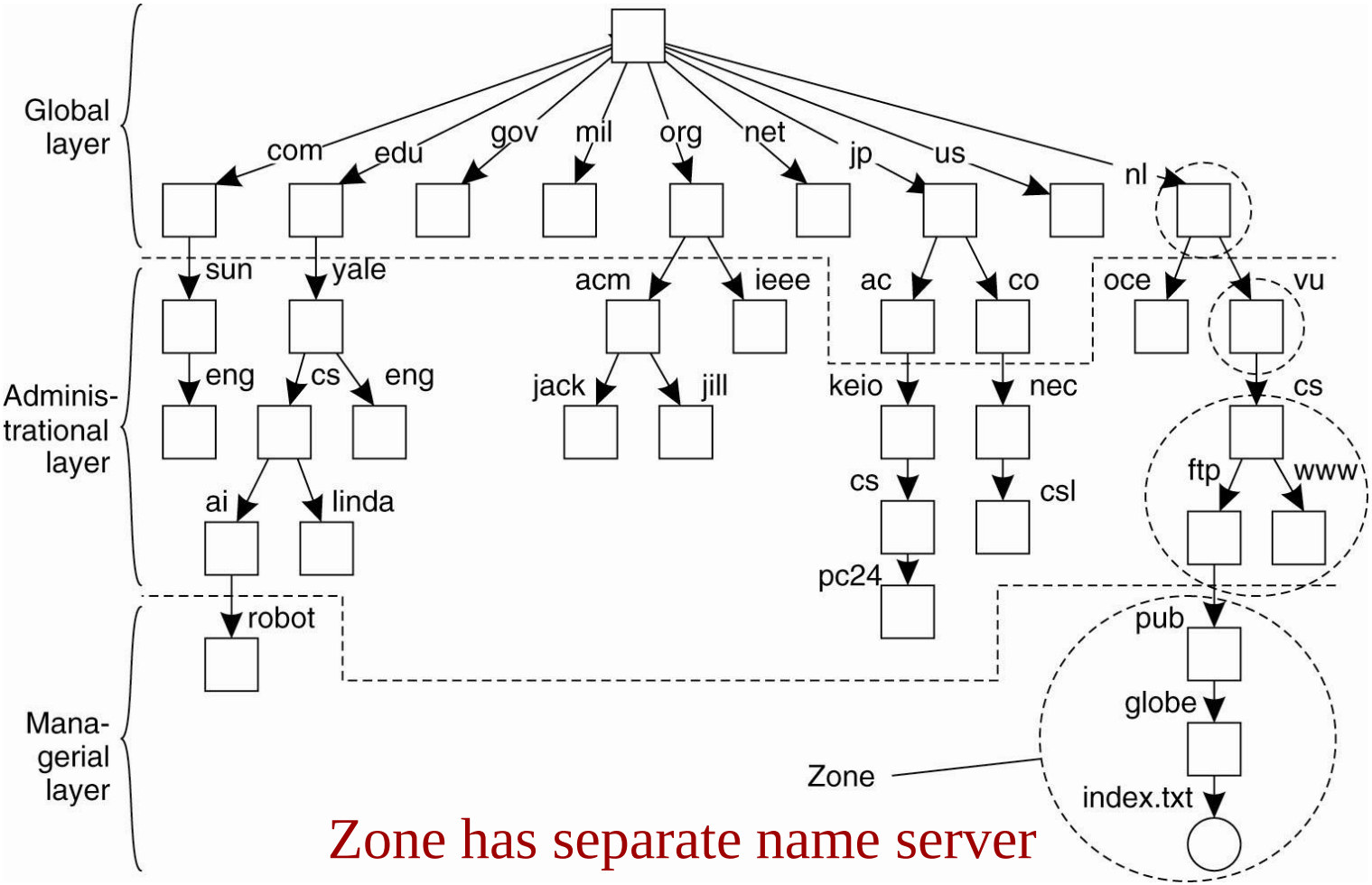

Data stored in n1
n2: "elke"
n3: "max"
n4: "steen"
n0
home
keys
n1
n5
"/keys"
elke
max
steen
n2
n3
n4
Data stored in n6
"/keys"
keys
.twmrc
mbox
n6
"/home/steen/keys"
Leaf node
Directory node

Extending Name Spaces

- Mounting example



Name Space Distribution: DNS



Zone has separate name server

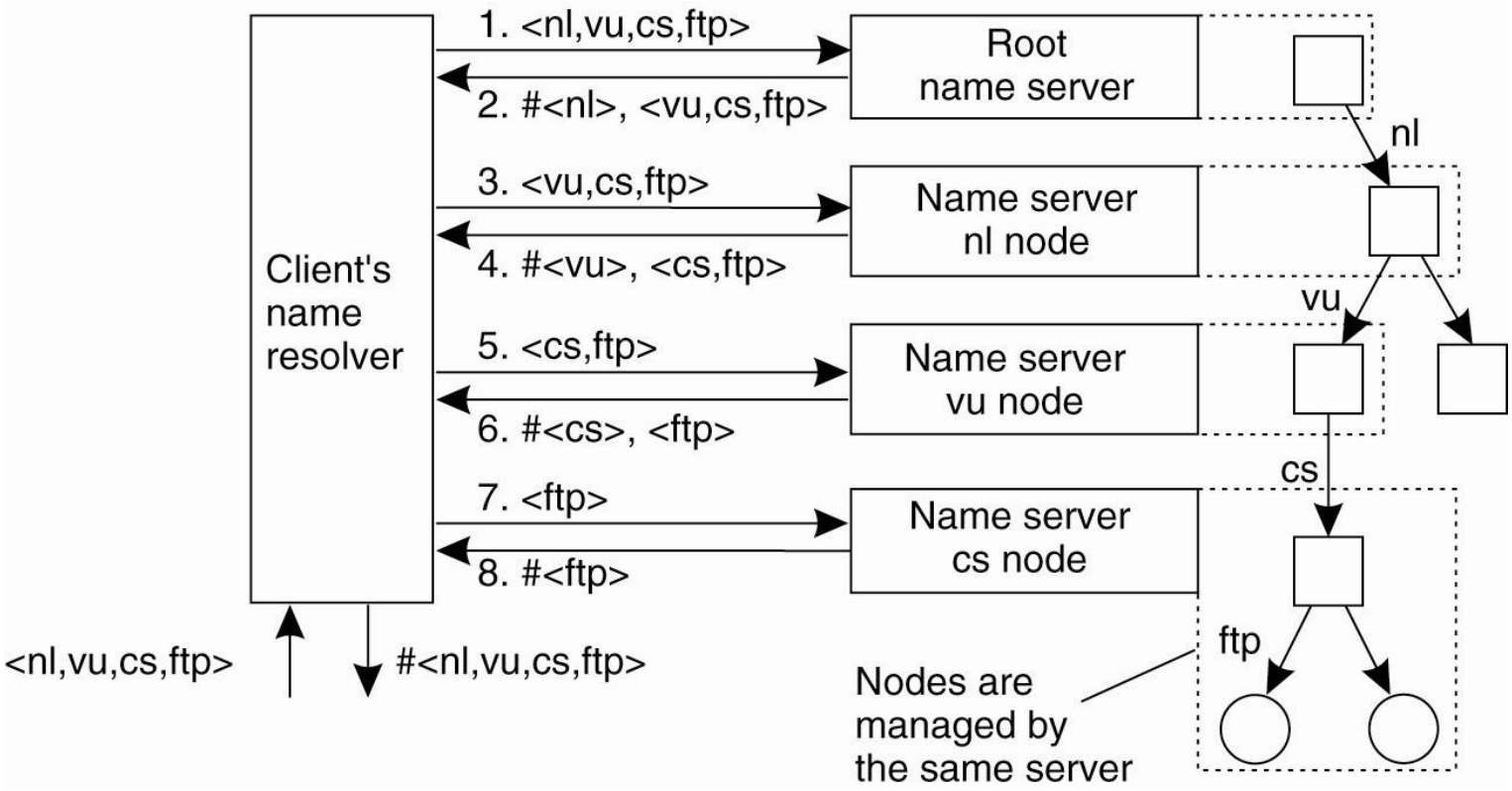
DNS Scaling

- Client caching of bindings (name, IP)
- Sever replication
- Eventually consistent
  - bindings change slowly

Specific policies

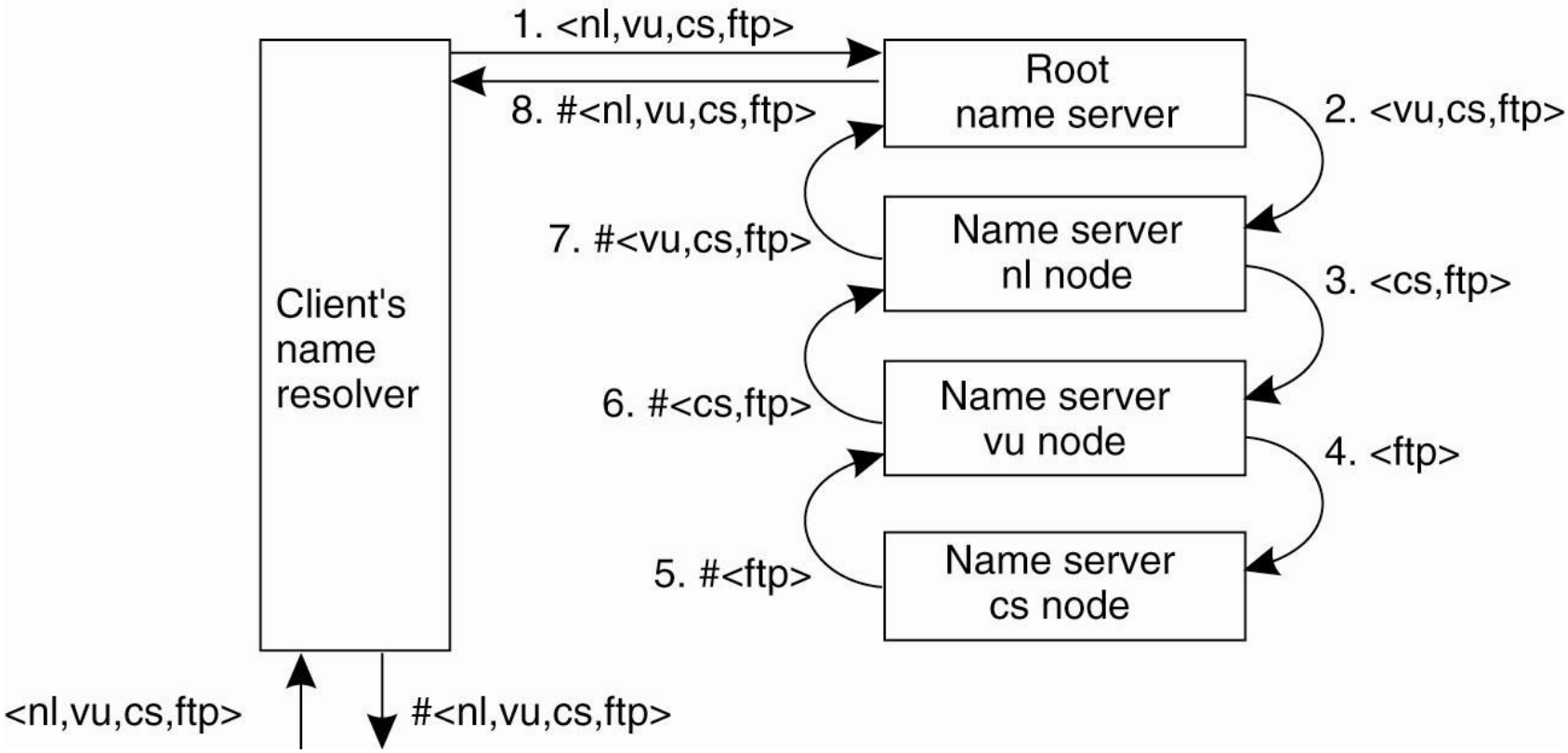
Item	Global	Administrational	Managerial
Geographical scale of network	Worldwide	Organization	Department
Total number of nodes	Few	Many	Vast numbers
Responsiveness to lookups	Seconds	Milliseconds	Immediate
Update propagation	Lazy	Immediate	Immediate
Number of replicas	Many	None or few	None
Is client-side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

Name Resolution: Structured Names



- Iterative

Name Resolution



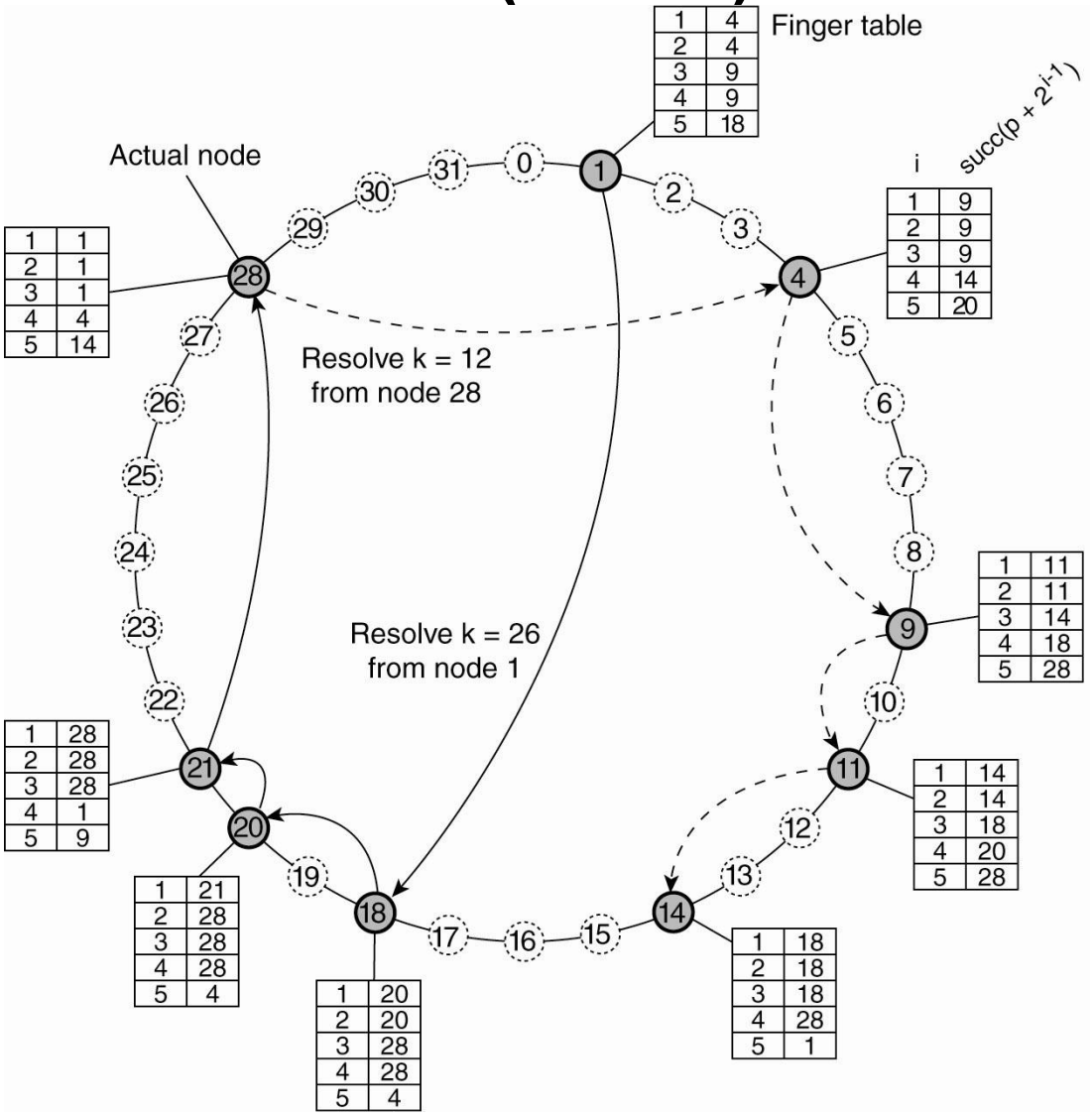
- Recursive

Comparison?

Server for node	Should resolve	Looks up	Passes to child	Receives and caches	Returns to requester
cs	<ftp>	#<ftp>	—	—	#<ftp>
vu	<cs,ftp>	#<cs>	<ftp>	#<ftp>	#<cs> #<cs, ftp>
nl	<vu,cs,ftp>	#<vu>	<cs,ftp>	#<cs> #<cs,ftp>	#<vu> #<vu,cs> #<vu,cs,ftp>
root	<nl,vu,cs,ftp>	#<nl>	<vu,cs,ftp>	#<vu> #<vu,cs> #<vu,cs,ftp>	#<nl> #<nl,vu> #<nl,vu,cs> #<nl,vu,cs,ftp>

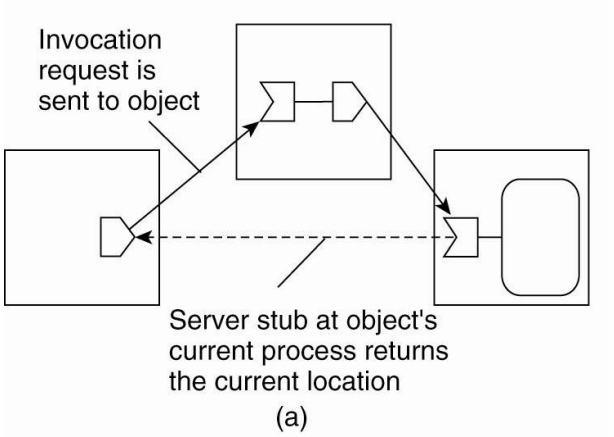
Resolution: P2P (DHT)

- Resolving key 26 from node 1 and key 12 from node 28 in Chord
- Many variations



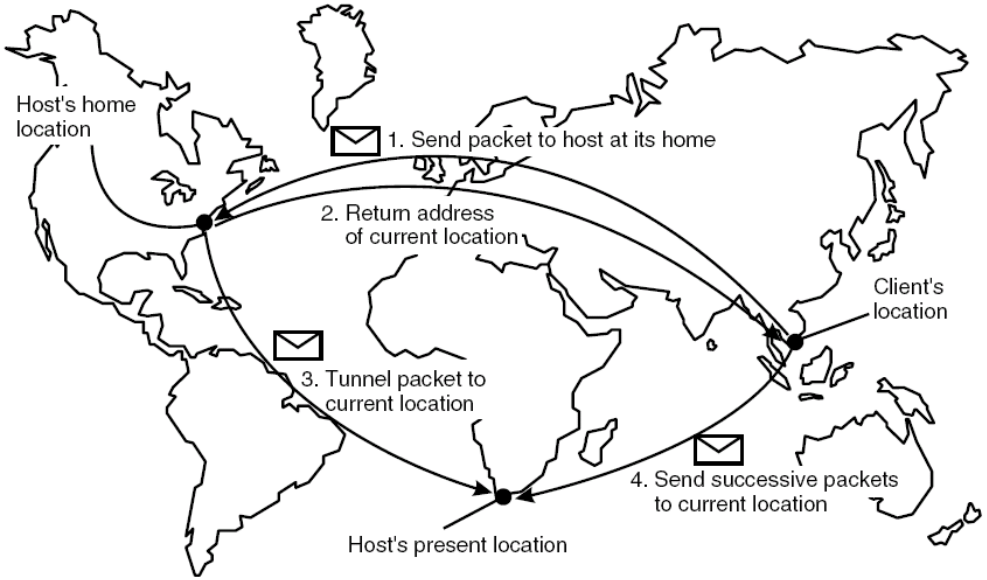
Relocation

- Forwarding pointers
  - leave a stub behind (draw)
  - problems?

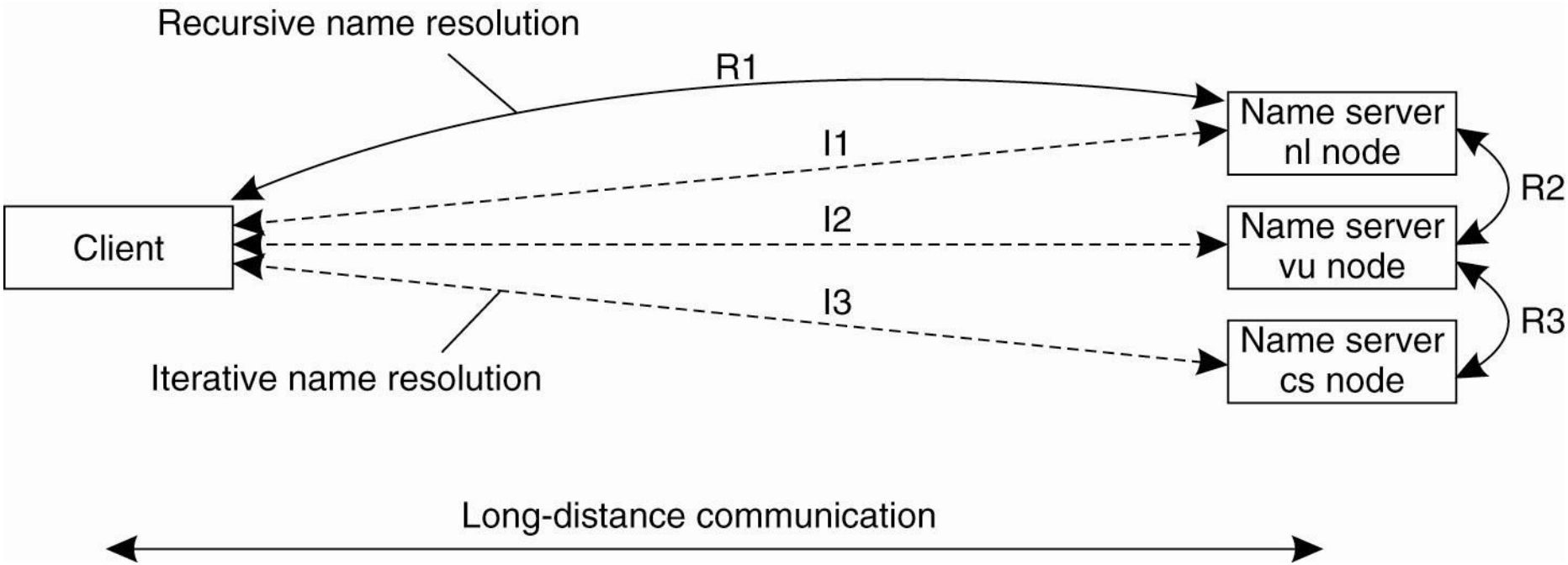


Home-Based Approaches: Mobile IP

- Home always tracks current location



Example: DNS



- Does both

The DNS Name Space

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

Resource records associated with every node in a DB

DNS Implementation at VU

Name	Record type	Record value
cs.vu.nl.	SOA	star.cs.vu.nl. hostmaster.cs.vu.nl. 2005092900 7200 3600 2419200 3600
cs.vu.nl.	TXT	"Vrije Universiteit - Math. & Comp. Sc."
cs.vu.nl.	MX	1 mail.few.vu.nl.
cs.vu.nl.	NS	ns.vu.nl.
cs.vu.nl.	NS	top.cs.vu.nl.
cs.vu.nl.	NS	solo.cs.vu.nl.
cs.vu.nl.	NS	star.cs.vu.nl.
star.cs.vu.nl.	A	130.37.24.6
star.cs.vu.nl.	A	192.31.231.42
star.cs.vu.nl.	MX	1 star.cs.vu.nl.
star.cs.vu.nl.	MX	666 zephyr.cs.vu.nl.
star.cs.vu.nl.	HINFO	"Sun" "Unix"
zephyr.cs.vu.nl.	A	130.37.20.10
zephyr.cs.vu.nl.	MX	1 zephyr.cs.vu.nl.
zephyr.cs.vu.nl.	MX	2 tornado.cs.vu.nl.
zephyr.cs.vu.nl.	HINFO	"Sun" "Unix"

DNS Implementation (cont'd)

ftp.cs.vu.nl.	CNAME	soling.cs.vu.nl.
www.cs.vu.nl.	CNAME	soling.cs.vu.nl.
soling.cs.vu.nl.	A	130.37.20.20
soling.cs.vu.nl.	MX	1 soling.cs.vu.nl.
soling.cs.vu.nl.	MX	666 zephyr.cs.vu.nl.
soling.cs.vu.nl.	HINFO	"Sun" "Unix"
vucs-das1.cs.vu.nl.	PTR	0.198.37.130.in-addr.arpa.
vucs-das1.cs.vu.nl.	A	130.37.198.0
inkt.cs.vu.nl.	HINFO	"OCE" "Proprietary"
inkt.cs.vu.nl.	A	192.168.4.3
pen.cs.vu.nl.	HINFO	"OCE" "Proprietary"
pen.cs.vu.nl.	A	192.168.4.2
localhost.cs.vu.nl.	A	127.0.0.1

Next Time

Next topic: More naming, Active Names

Read NAM* papers on line