

Communication Networks: Technology & Protocols



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Lecture 7
September 8

Logistics



- Web site:
 - www.cs.berkeley.edu/~amc/eecs122
- **Homework 2** available on web-site.
 - Homework 1 due this Friday (9/10):
will count for enrollment.
 - Homework 2 due Monday 9/13.
- Textbook: check publisher's web-site for errata, on-line material, etc:
www.mhhe.com

Names and IP addresses



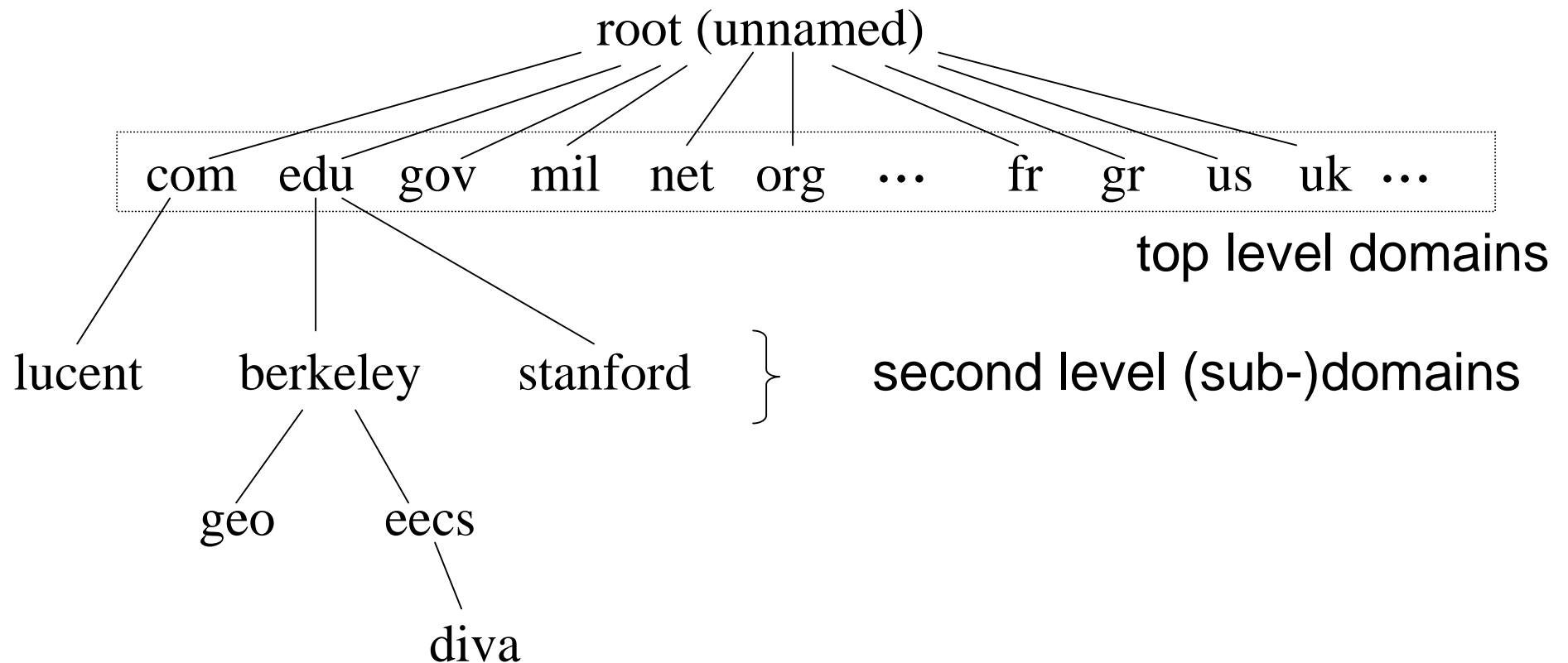
- Domain Name System (DNS)
 - Hierarchical naming space
 - Name-granting authorities
 - DNS servers and name resolution
- IP addressing
 - Hierarchical structure
 - Class-based
 - Subnetting
 - Classless

Names and addresses: why both?

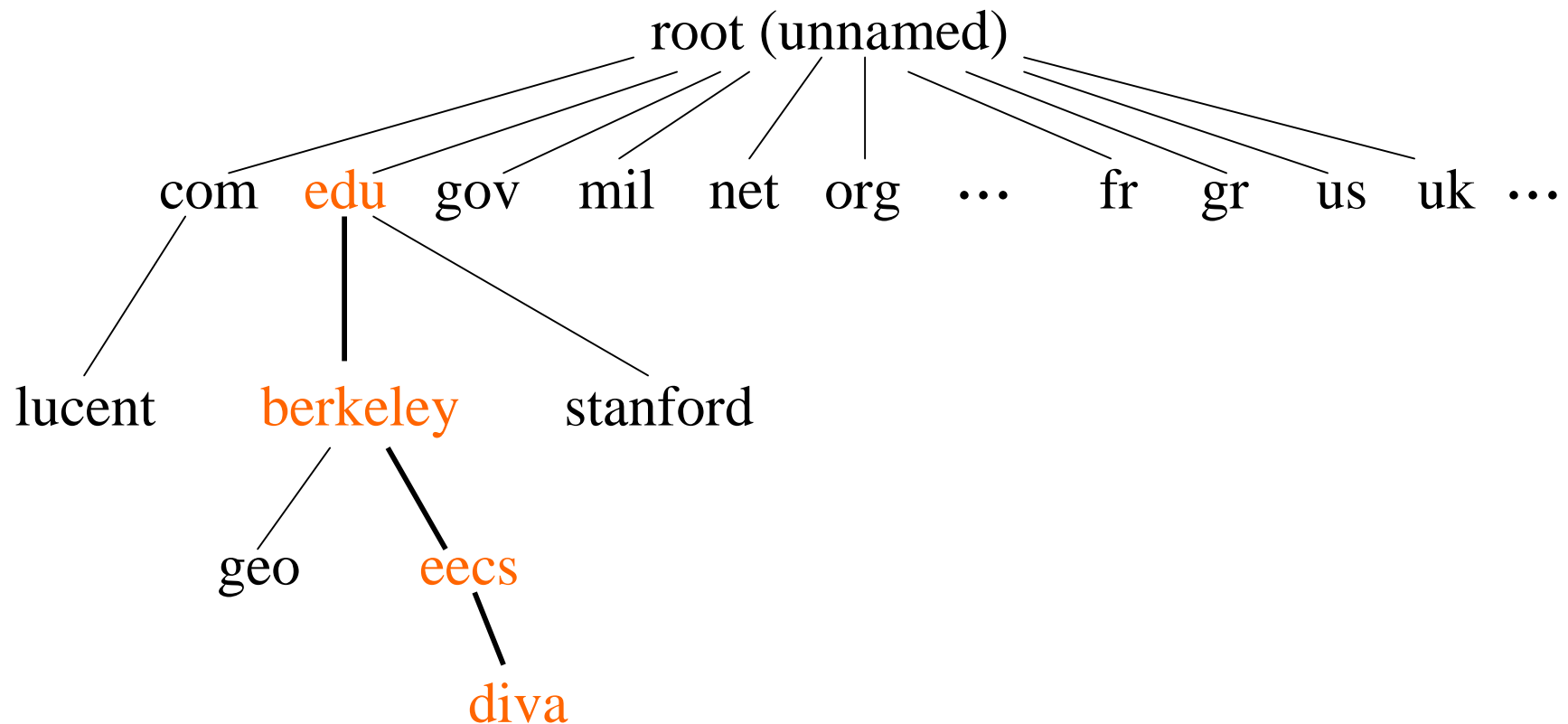


- Name: stout.eecs.berkeley.edu
- IP address: 128.32.239.44
 - (Also Ethernet or other link-layer addresses.)
- IP addresses are fixed-size numbers.
 - 32 bits. 128.32.239.44 =
10000000.00100000.11101111.00101100
- Names are memorizable, flexible:
 - Variable-length
 - Many names for a single IP address.
 - Change address doesn't imply change name.

...and the fact that the *Journal* is a journal of the American Psychological Association, the largest and most prestigious of the psychological organizations in the United States, is a source of great pride for me.

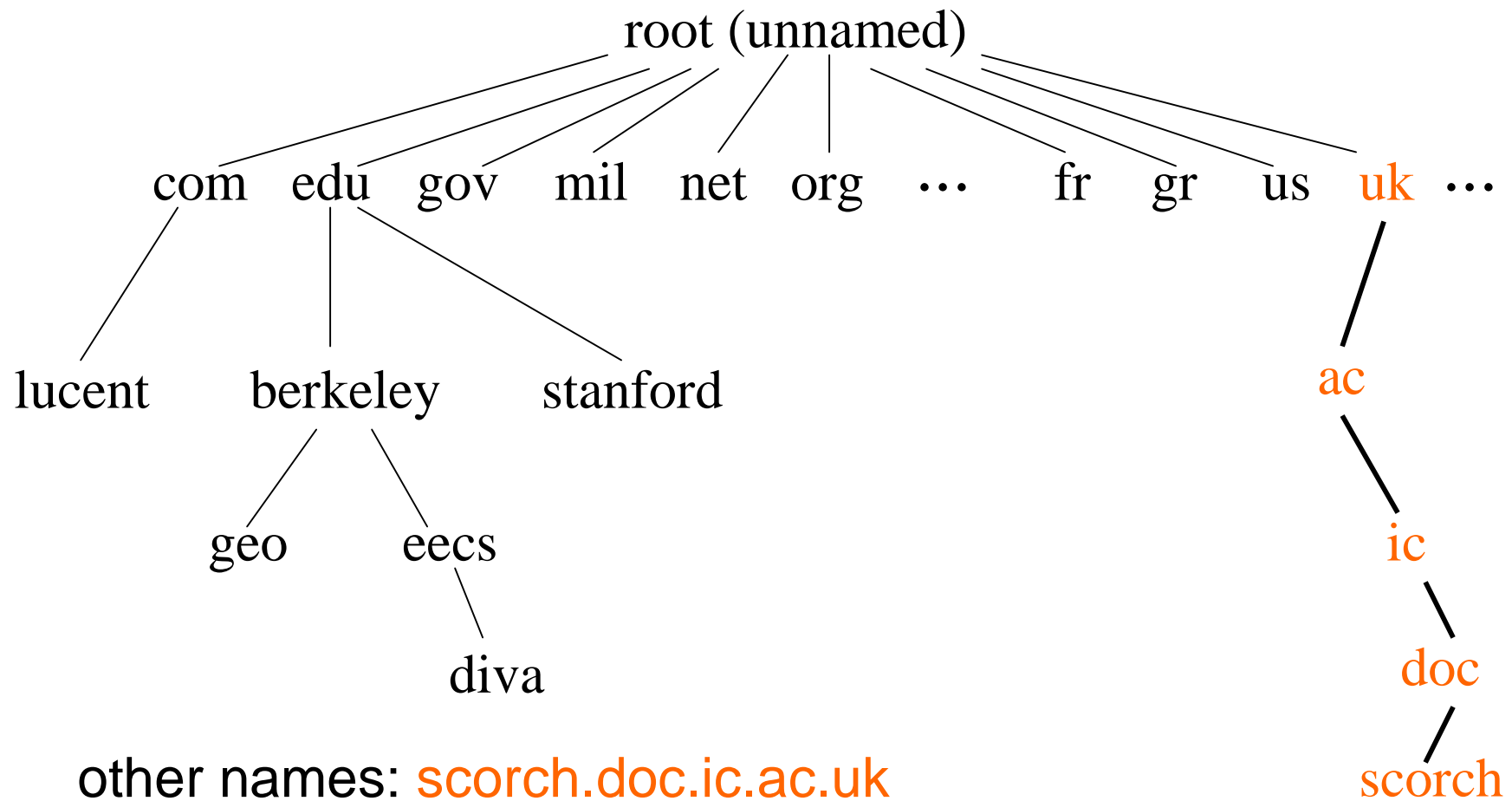


Domain name structure



Full name: **diva.eecs.berkeley.edu**

Domain name structure

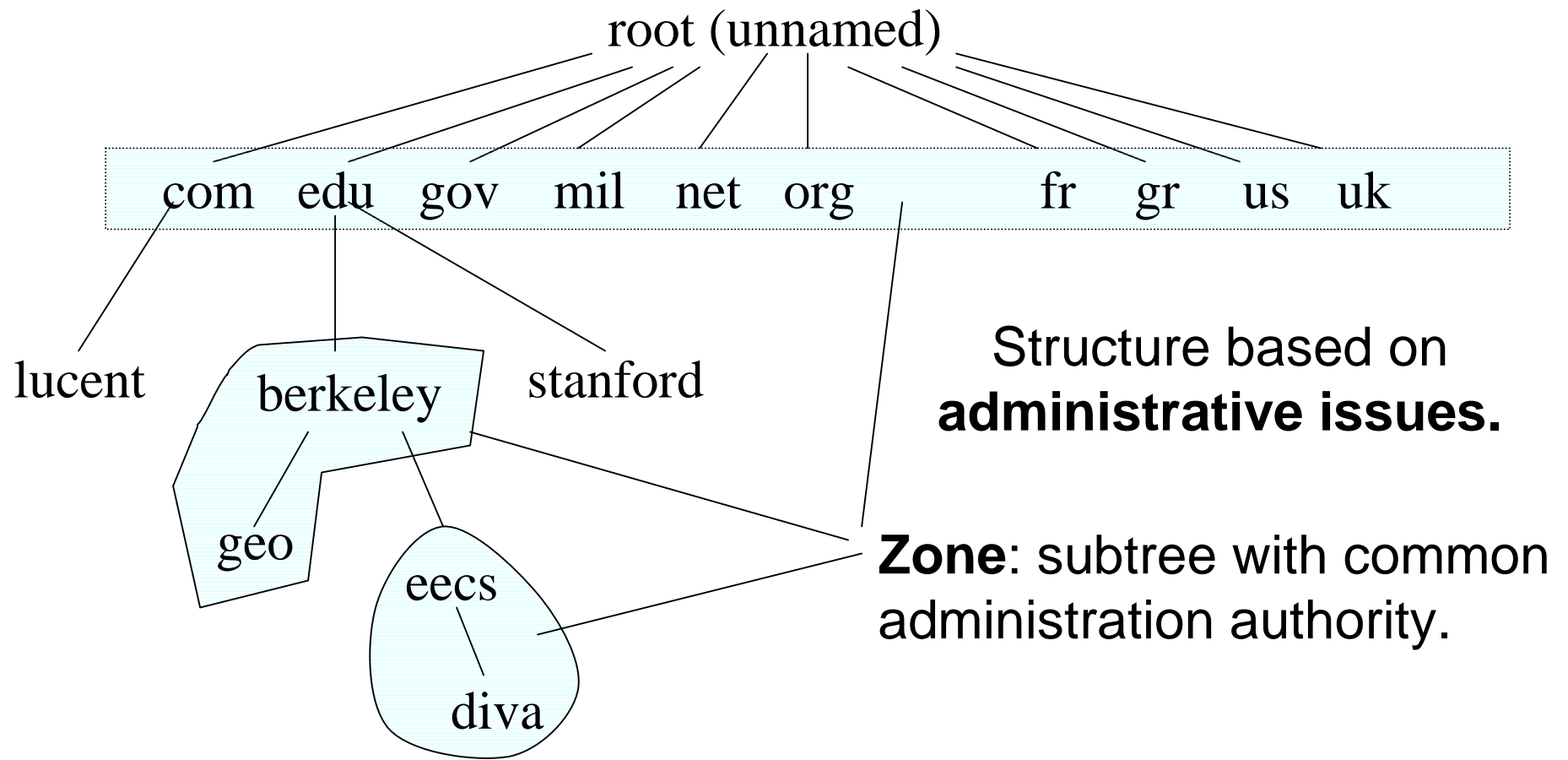


Name-granting authorities

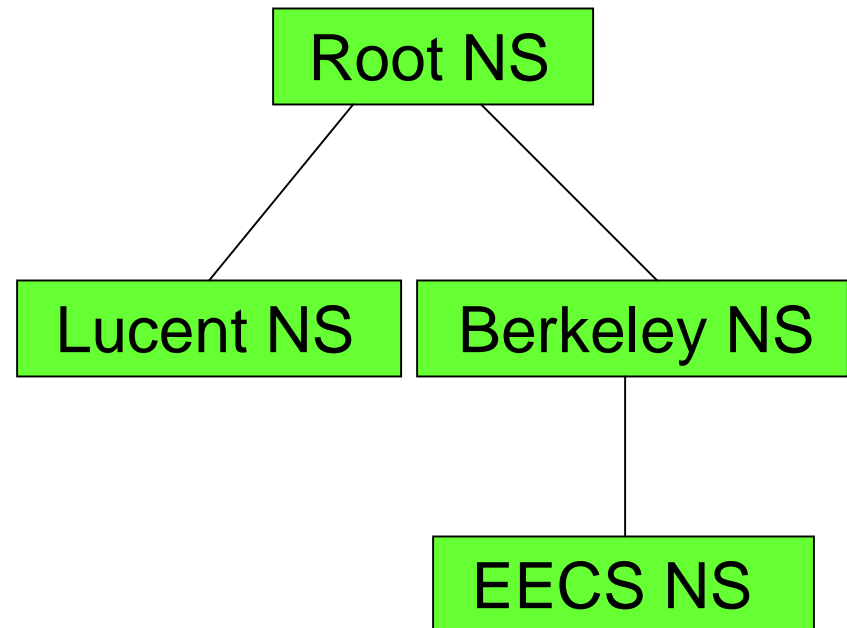
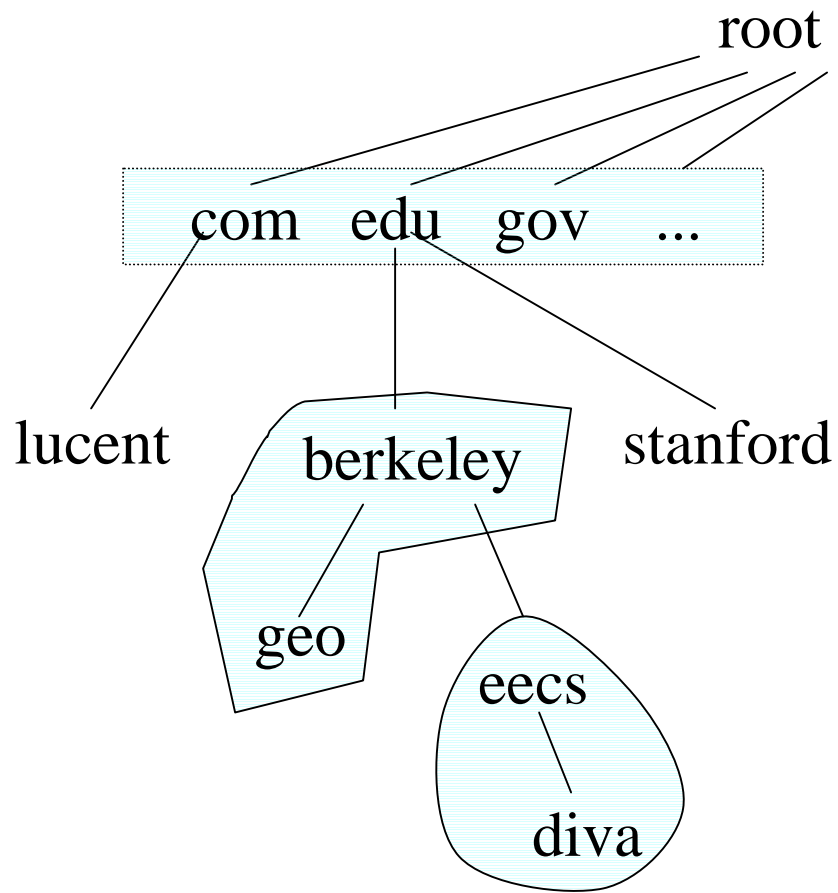


- Name management: Internet Assigned Number Authority, www.iana.org, to be replaced by Internet Corporation for Assigned Names and Numbers, www.icann.org.
- Internet Registries:
 - RIPE for Europe, www.ripe.net
 - APNIC for Asia and Pacific, www.apnic.net
 - InterNIC for US and the rest, www.apnic.net
(in fact, today it is NetworkSolutions.com)

Domain name structure



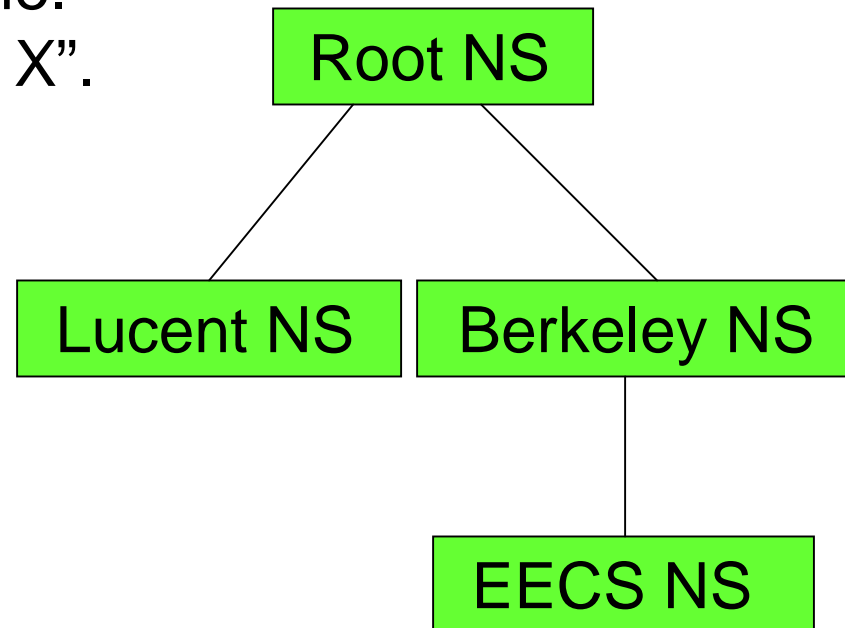
Name Servers (NS)



Name Servers (NS)

- NS: a process running on a host.
- Maps names to IP addresses (**name resolution**).
- Each NS is responsible for a zone.
- Request: “give me IP address of X”.
- Response:
 - either A (IP address of X)
 - or “contact name server N to get the address of X”.

- A, N = IP addresses
- X = name

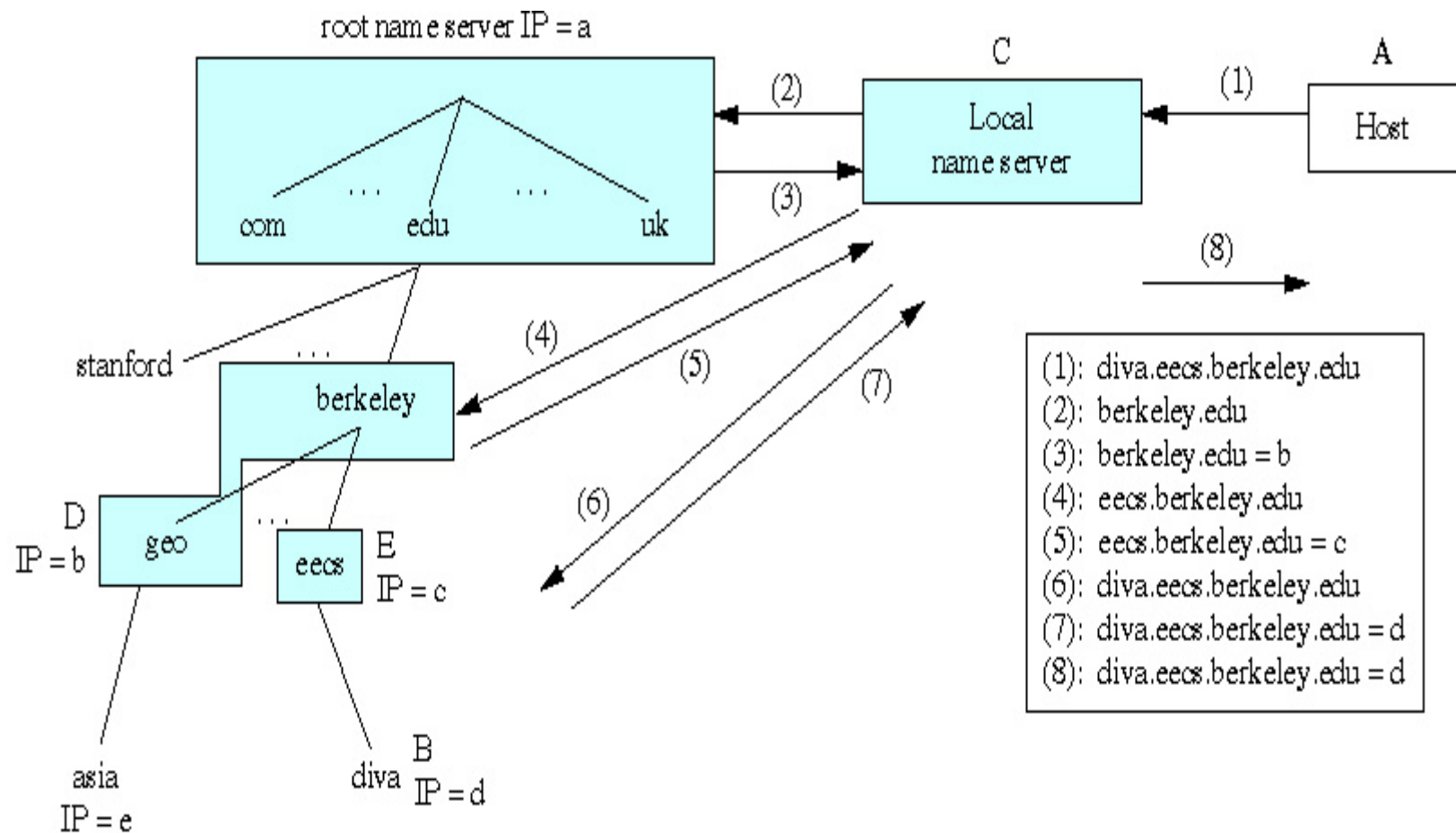


Name Servers (NS)



- NSs are **deduplicated** for reliability.
- Anonymous ftp from:
ftp.rs.internic.net, netinfo/root-server.txt
gives the current root NSs (about 10).
- Each host knows the IP address of the **local** NS.
- Each NS knows the IP addresses of all root NSs.
- **Caching** is used.

Name resolution: example

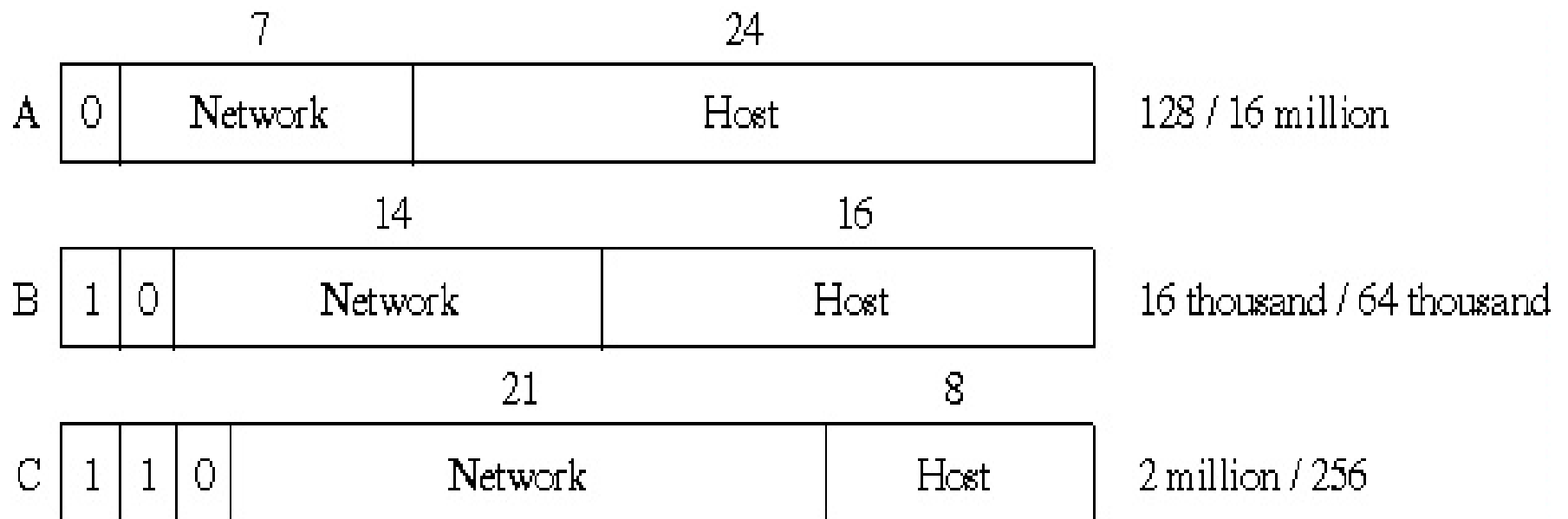


IP addressing



- **Hierarchical**, based on geographical location, like telephone numbers: +1 510 642 5649
 - Scalability in **routing**.
 - Scalability in assigning addresses.
- 3 stages:
 - class-based
 - subnetting
 - classless

Class-based addressing



E.g., UC Berkeley network address:

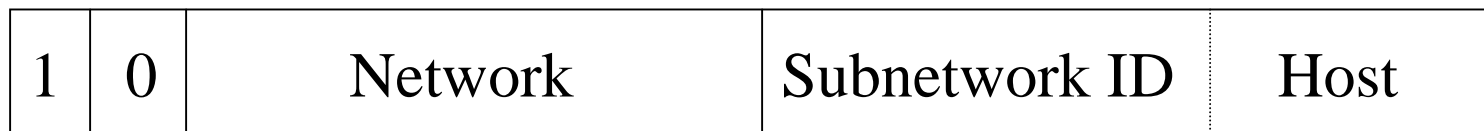
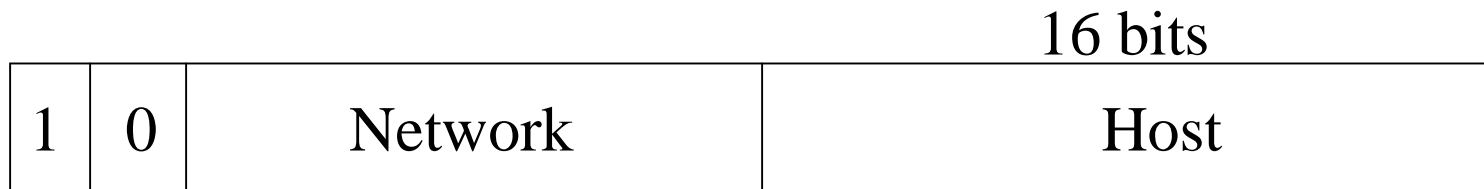
128.32 = 10000000.00100000 (class B network).

Class-based addressing: problems

- Class A networks: too big, too few.
- Class C networks: too small, too many.
- Class B networks: not enough (run out of already).
- However:
 - $128 \times 16 \text{ million} + 16,000 \times 64,000 + 2 \text{ million} \times 256$
 $\approx 4 \text{ billion !!!}$
 \Rightarrow should have enough addresses for everybody.
- Problem: bad utilization.
- Question: how to have an addressing scheme that meets exactly the needs of the users ?

Subnetting

- Idea: 10 depts. x 2000 hosts per dept.
= 1 class B network address (instead of 10)



5 bits = 32 subnets 11 bits = 2048 hosts

Subnetting

■ Implementation:

Subnetwork address = IP address AND mask

logical AND	1	0	Network	Host	
	111 ... 1			00 ... 0	mask

Subnetwork address				
=	1	0	Network	Subnet ID

Subnetting: problem



- Relatively small networks (between 256 and 1000 hosts) still need at least a class B network address. (In fact, so does any network that could prospectively have more than 255 hosts.)

Classless addressing (supernetting)

- Idea: aggregate many class C networks under a common network address, e.g., get 16 consecutive class C addresses: $192.4.16-31 = 16 \times 256 = 4096$ hosts.
- All addresses share common **prefix**: first 20 bits:
11000000.00000100.0001xxxx
- This prefix is the "supernet" address (it defies class boundaries, something between class B and class C network).

Classless addressing (supernetting)



- Generalization of subnetting:
 - Subnetting: split class-based address to multiple subnet addresses.
 - Supernetting: also allow aggregation of multiple class-based addresses into a supernet address.
- Current Internet routing protocols use subnetting and supernetting (CIDR):
 - View a collection of subnets as a single IP address.
 - View a collection of IP addresses as a single supernet address.