

# **Communication Networks: Technology & Protocols**



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**Lecture 7**  
**September 8**

# Logistics



- Web site:
  - [www.cs.berkeley.edu/~amc/eecs122](http://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](http://www.mhhe.com)

# Names and IP addresses



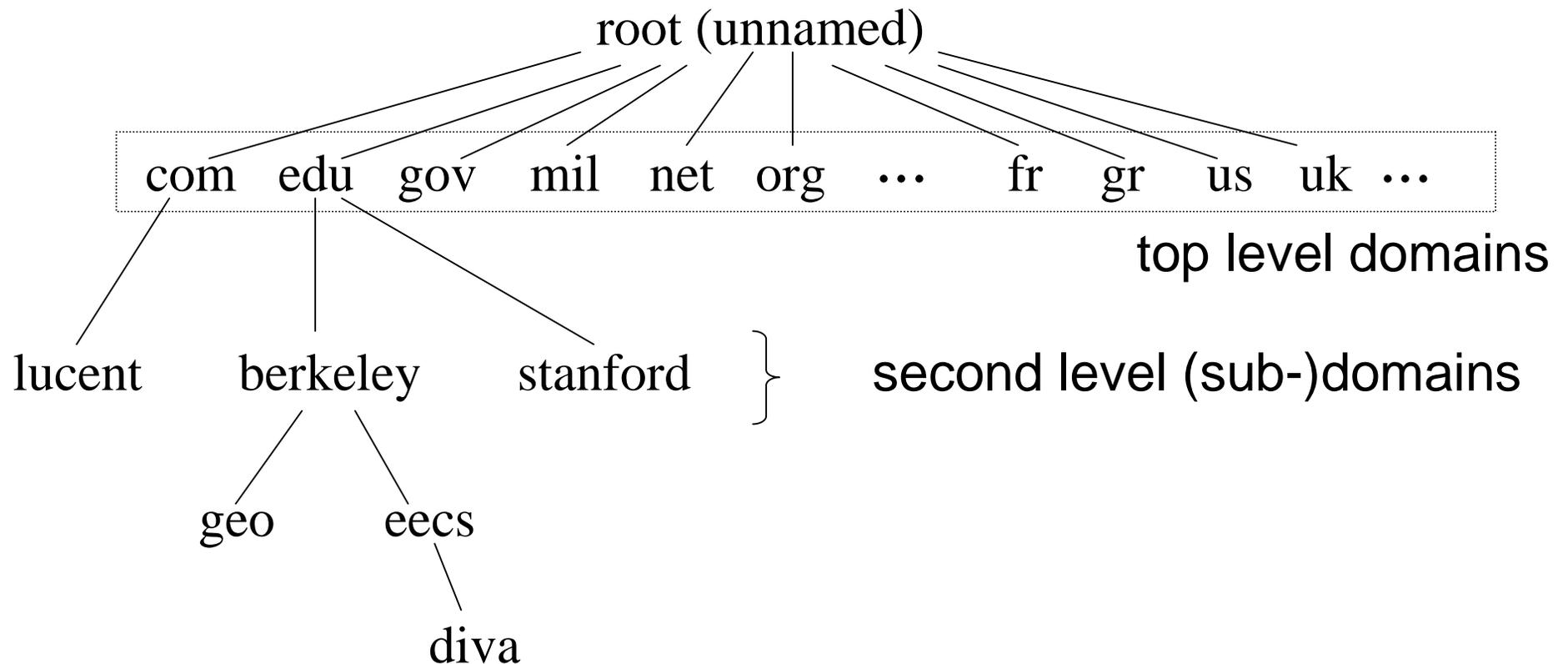
- Domain Name System (DNS)
  - Hierarchical naming space
  - Name-granting authorities
  - DNS servers and name resolution
- IP addressing
  - Hierarchical structure
  - Class-based
  - Subnetting
  - Classless

# Names and addresses: why both?

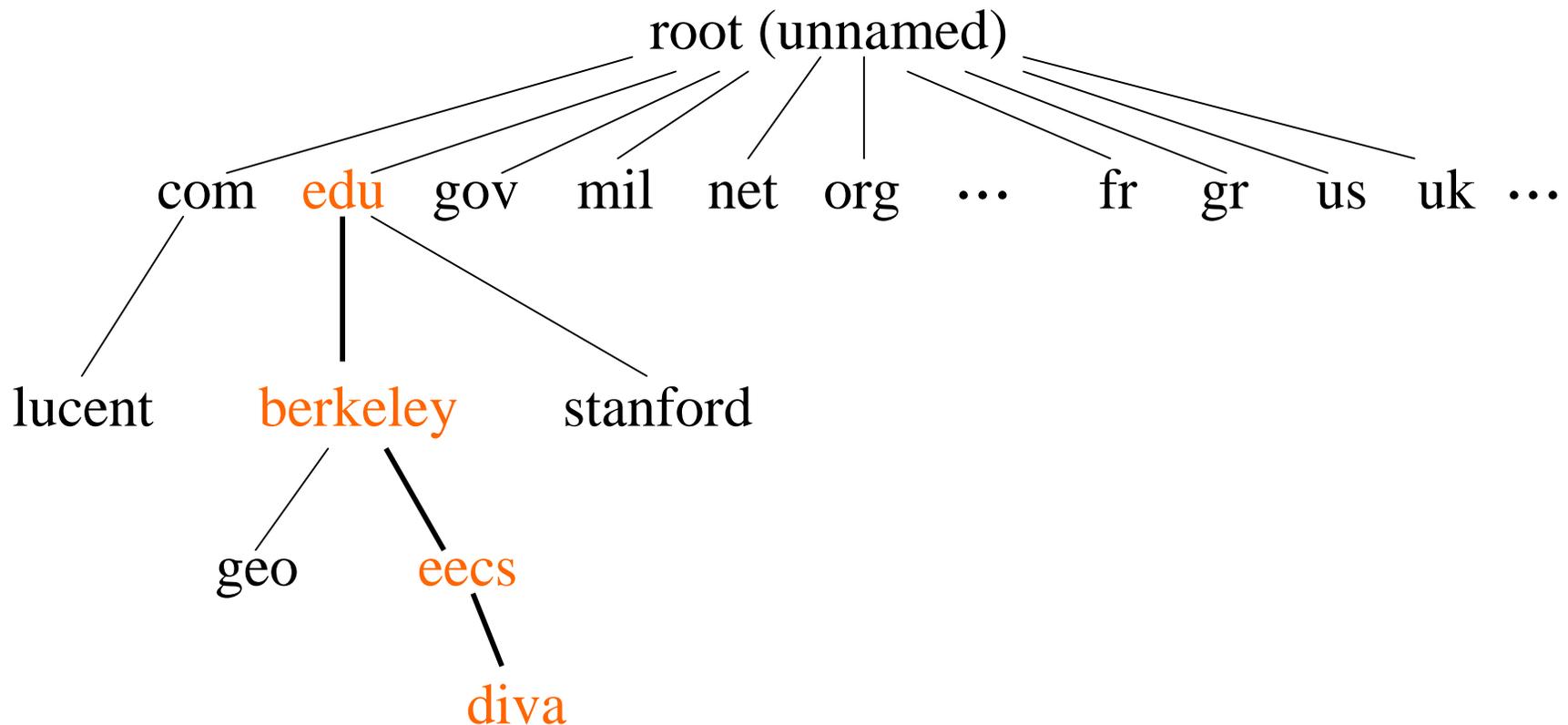


- Name: stout.eecs.berkeley.edu
- IP address: 128.32.239.44
  - (Also Ethernet or other link-layer addresses.)
- IP addresses are fixed-size numbers.
  - 32 bits. 128.32.239.44 =  
10000000.00100000.11101111.00101100
- Names are memorizable, flexible:
  - Variable-length
  - Many names for a single IP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

# Domain name structure

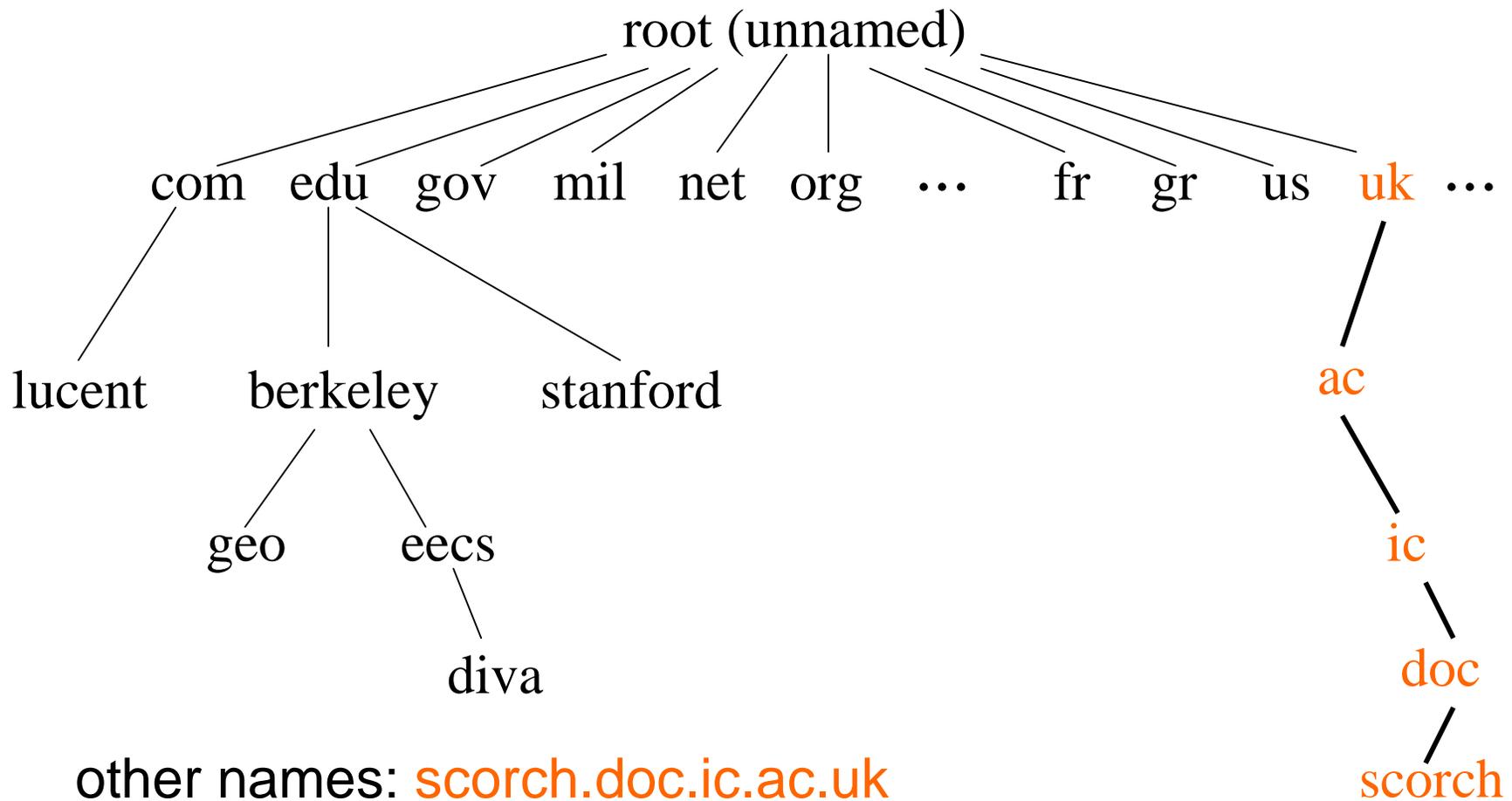


# Domain name structure



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

# Domain name structure

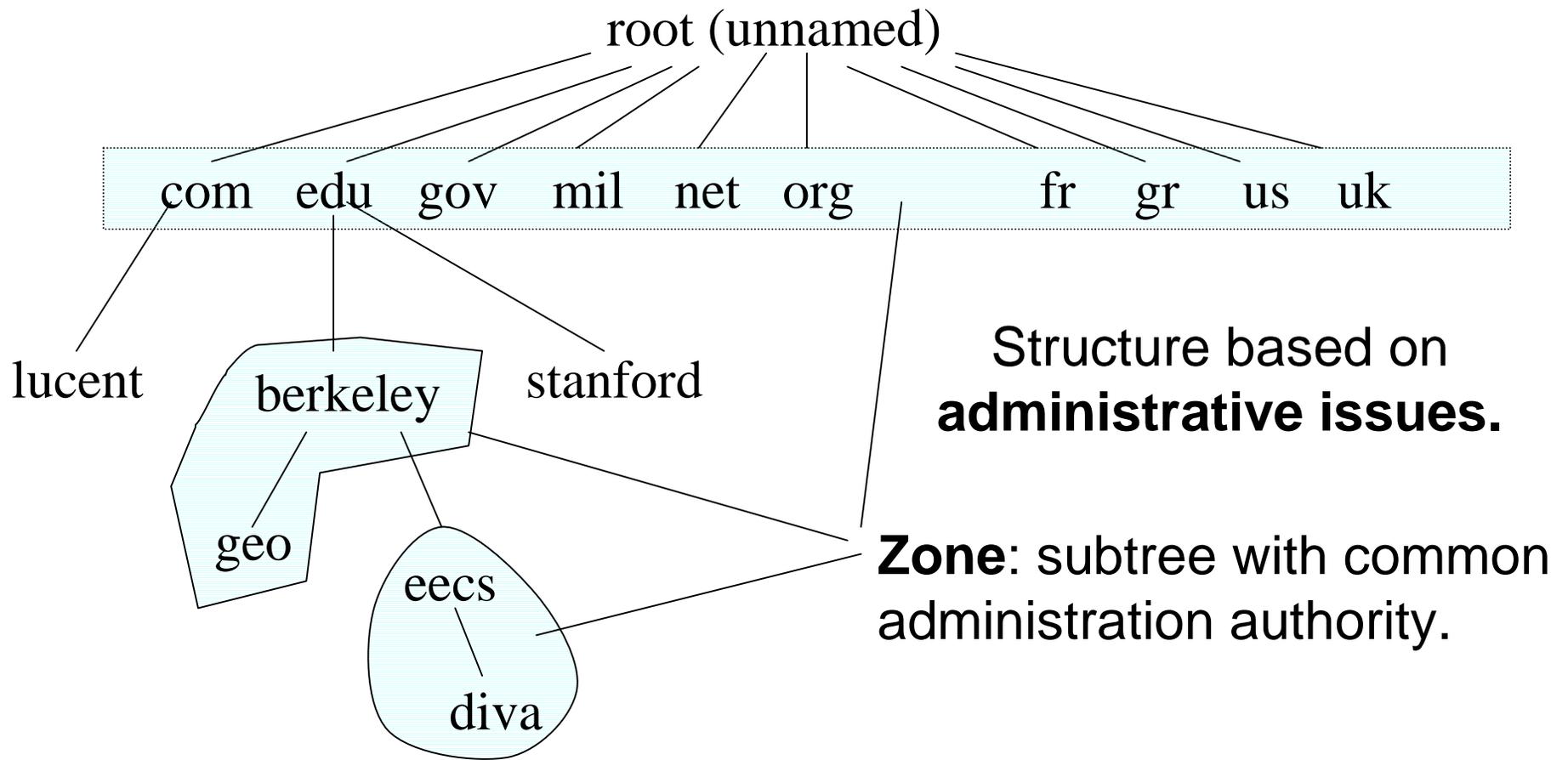


# Name-granting authorities

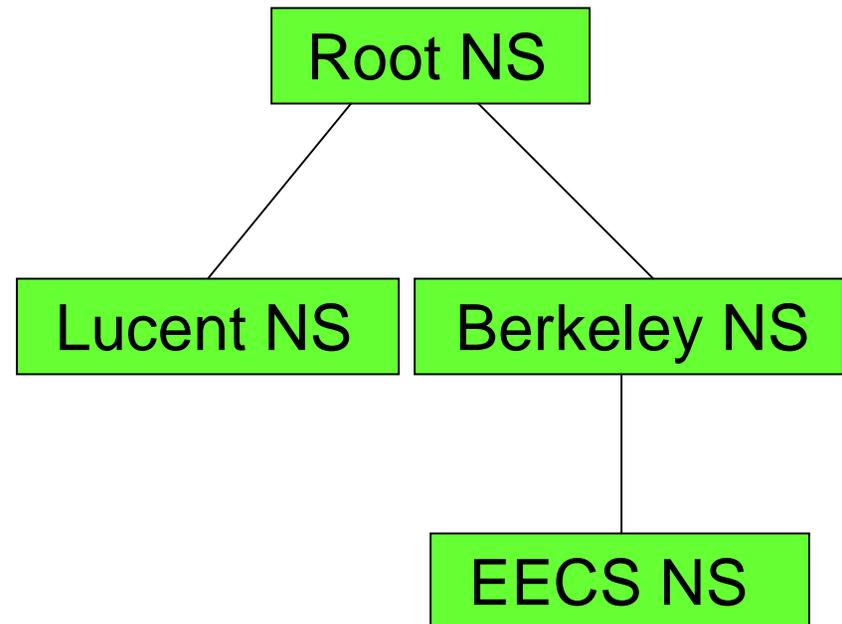
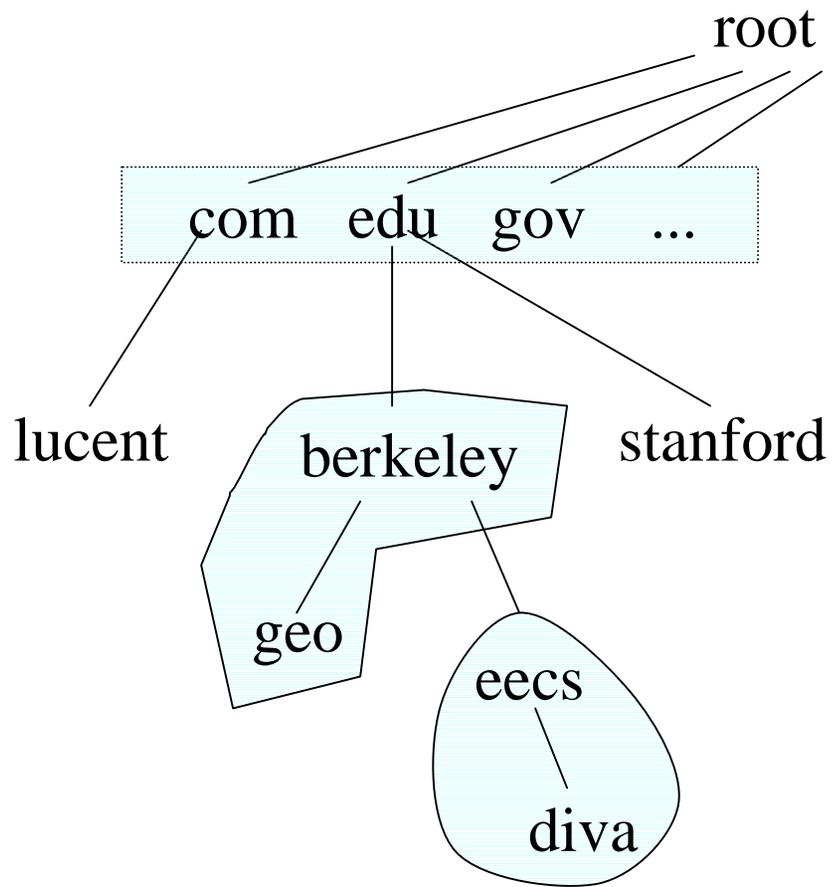


- Name management: Internet Assigned Number Authority, [www.iana.org](http://www.iana.org), to be replaced by Internet Corporation for Assigned Names and Numbers, [www.icann.org](http://www.icann.org).
- Internet Registries:
  - RIPE for Europe, [www.ripe.net](http://www.ripe.net)
  - APNIC for Asia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

# Domain name structure



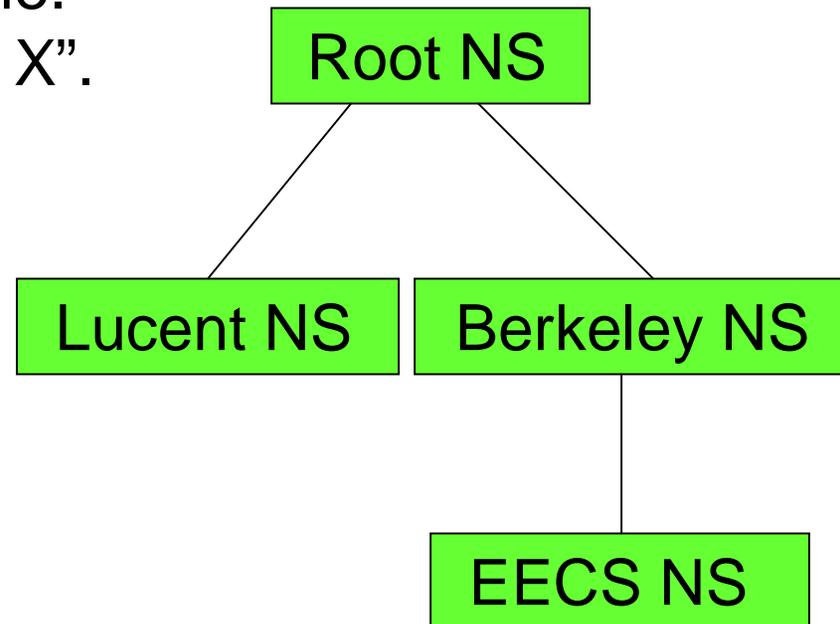
# Name Servers (NS)



# 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

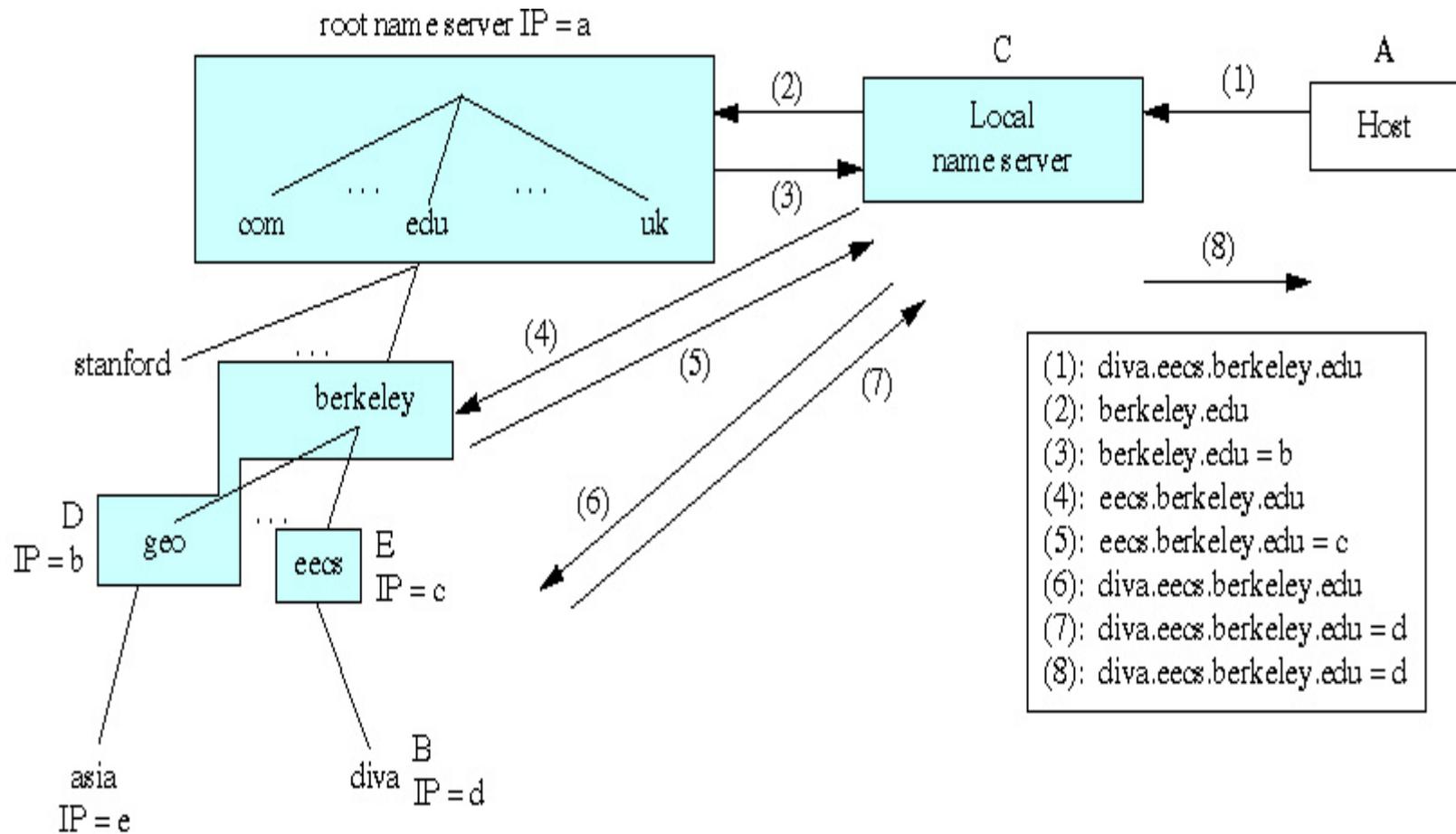


# Name Servers (NS)



- 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

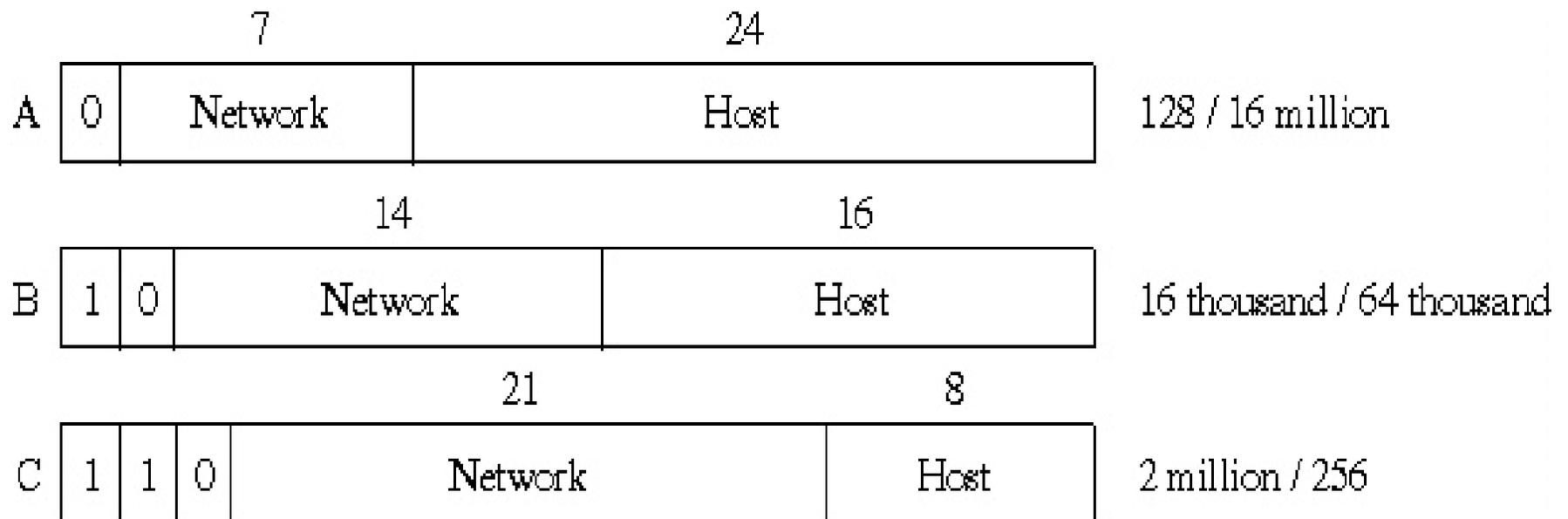


# IP addressing



- **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:

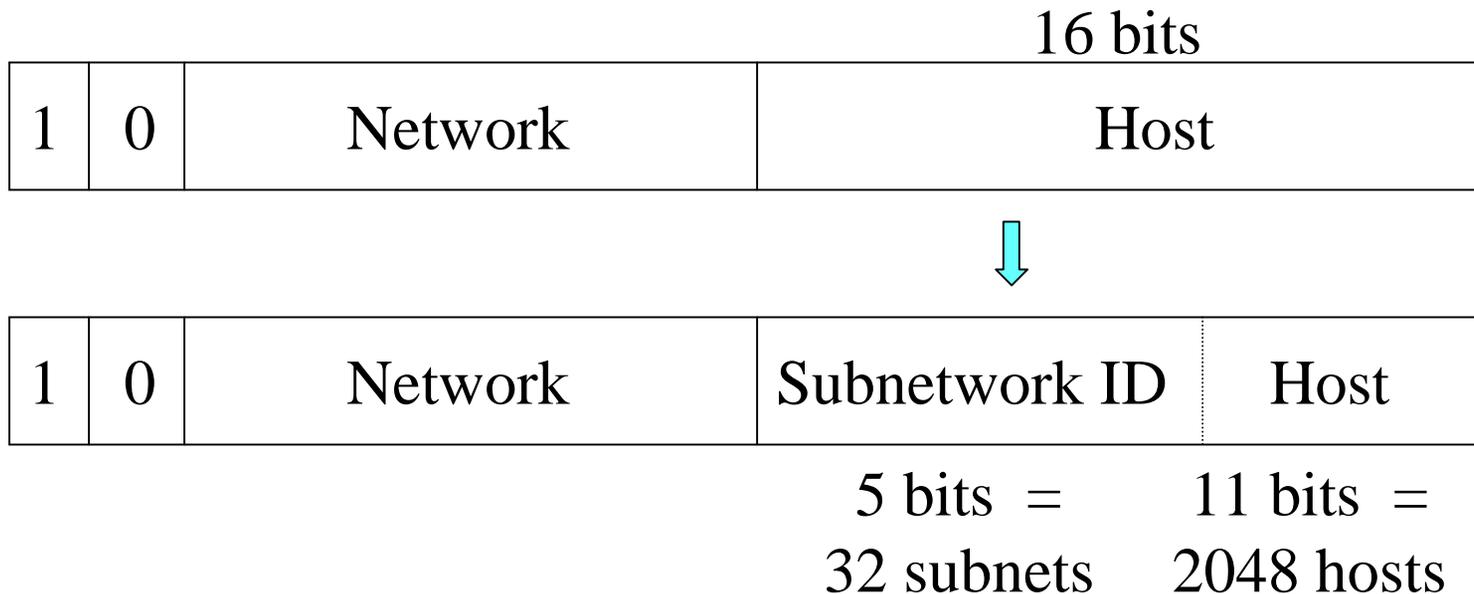
128.32 = 10000000.00100000 (class B network).

# 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:
  - $128 \times 16 \text{ million} + 16,000 \times 64,000 + 2 \text{ million} \times 256$   
 $\approx 4 \text{ billion !!!}$   
⇒ 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

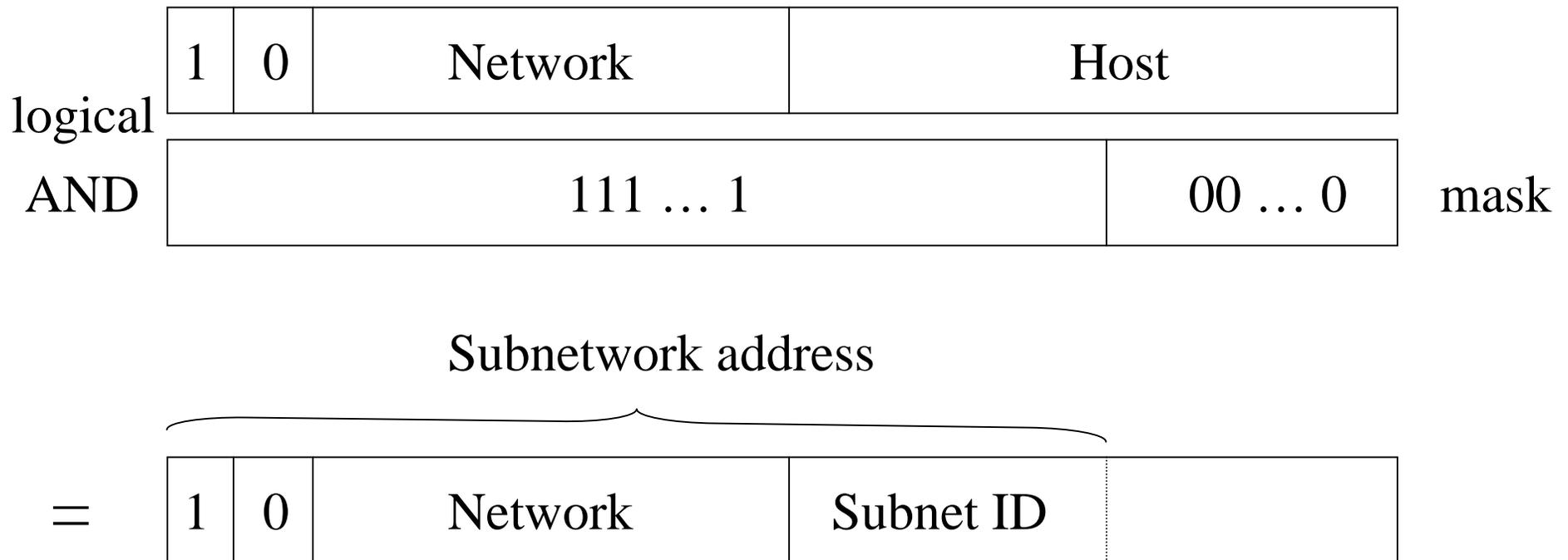
- Idea: 10 depts. x 2000 hosts per dept.  
= 1 class B network address (instead of 10)



# Subnetting

## Implementation:

Subnetwork address = IP address AND mask



# 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.