

Lecture 12: Naming

123 Computer Networks

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CSE 123: Computer Networks
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Lecture 12 Overview



- Clicker frequency DD
- User-friendly names (DNS)
- Discovering addresses (DHCP/ARP)
- Network address translation (NAT)



Layers of Identifiers

- **Link-layer (MAC) address** (e.g., 58:B0:35:F2:3C:D9)
 - ◆ Used by *network adaptors* to identify interesting frames
 - ◆ Unique, hard-coded identifier “burned into” network adaptor
 - ◆ Flat name space (of 48 bits in Ethernet)
- **IP address** (e.g., 128.54.70.238)
 - ◆ Used by *routers* to forward packets
 - ◆ Unique, topologically meaningful locator
 - ◆ Hierarchical namespace of 32 bits
- **Host name** (e.g., www.ucsd.edu)
 - ◆ Used by *humans* to specify host of interest
 - ◆ Unique, selected by host administrator
 - ◆ Hierarchical, variable-length string of alphanumeric characters



Naming Hierarchy for Scale

- MAC addresses: 58:B0:35:F2:3C:D9
 - ♦ OUIs: assigned to vendors by the IEEE
 - ♦ Adapters: assigned by the vendor from its block
- IP addresses: 128.54.70.238
 - ♦ Prefixes: ICANN, regional Internet registries, and ISPs
 - ♦ Hosts: static configuration, or dynamic using DHCP
- Host name: www.ucsd.edu
 - ♦ Domain: registrar for each top-level domain (e.g., .edu)
 - ♦ Host name: local administrator assigns to each host

Which “names” CANNOT be used to address packets/frames?

- A. MAC addresses
- B. IP addresses
- C. Host names
- D. None of the above



Mapping Between Identifiers

- Domain Name System (**DNS**)
 - ◆ Given a host name, provide the IP address
 - ◆ Given an IP address, provide the host name
- Address Resolution Protocol (**ARP**)
 - ◆ Given an IP address, provide the MAC address
 - ◆ To enable communication within the Local Area Network
- Dynamic Host Configuration Protocol (**DHCP**)
 - ◆ Automates host boot-up process
 - ◆ Given a MAC address, assign a unique IP address
 - ◆ ... and tell host other stuff about the Local Area Network

Which devices run ARP?

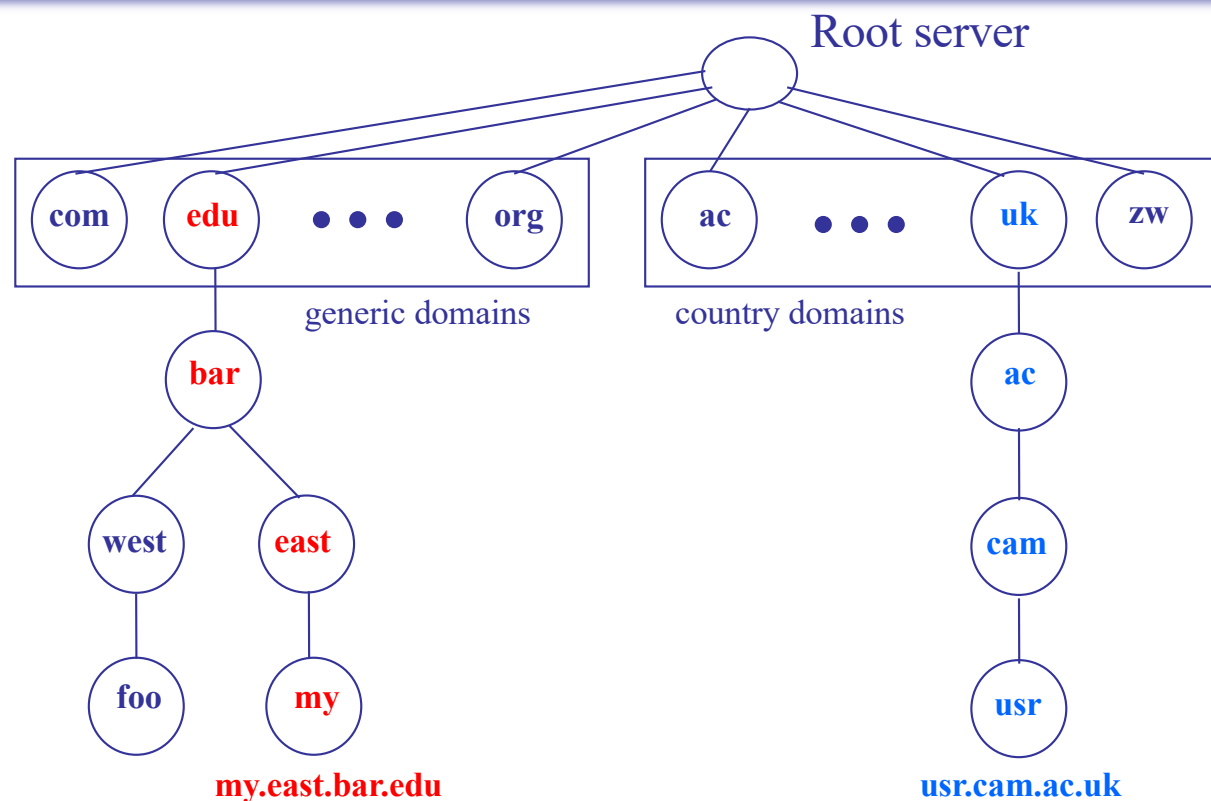
- A. Hosts**
- B. Routers**
- C. Bridges**
- D. A & B**
- E. A, B & C**



Domain Name System (DNS)

- Distributed administrative control
 - ◆ Hierarchical name space divided into zones
 - ◆ Distributed over a collection of DNS servers
- Hierarchy of DNS servers
 - ◆ Root servers
 - ◆ Top-level domain (TLD) servers
 - ◆ Authoritative DNS servers
- Performing the translations
 - ◆ Local DNS servers
 - ◆ Resolver software

DNS: Distributed Database



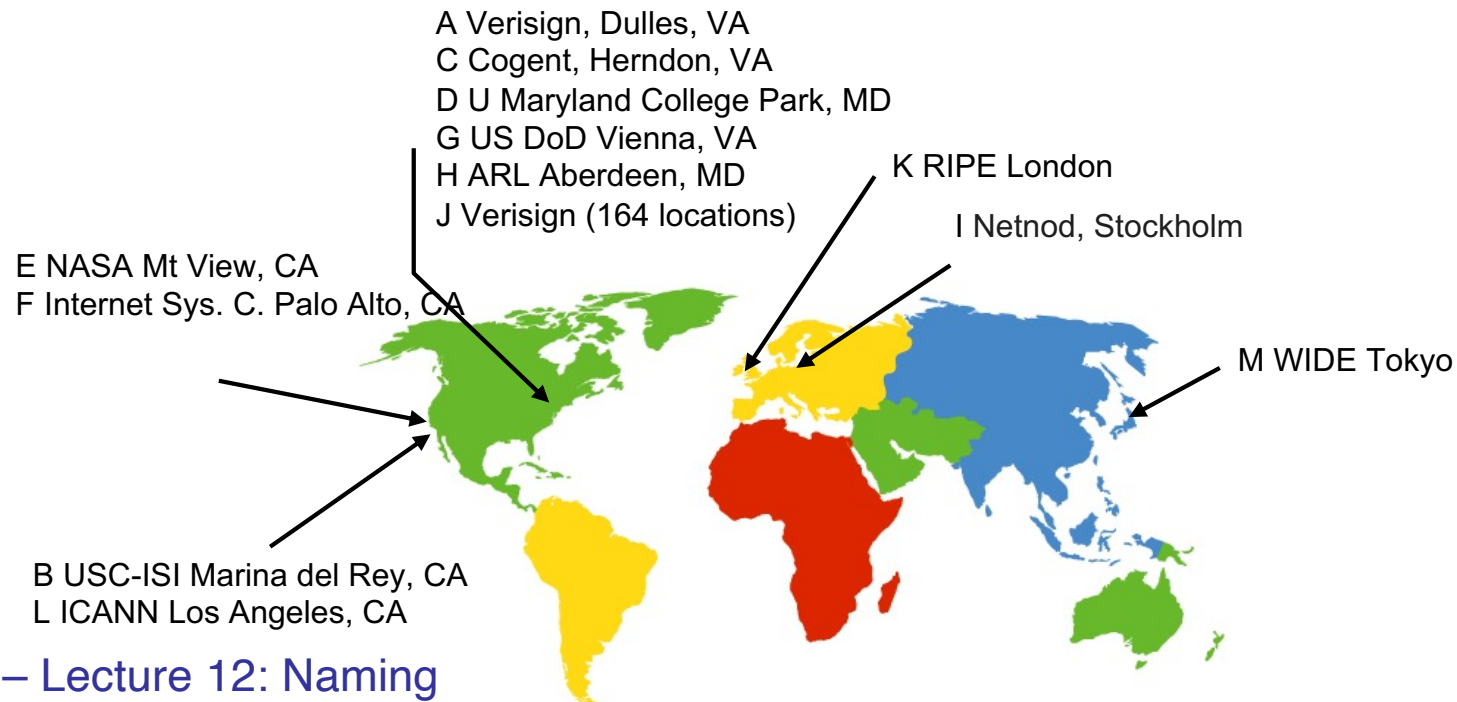
To which TLD does UCSD belong?

- A. .edu
- B. .us
- C. Both
- D. Neither

DNS Root Servers



- 13 root servers (see <http://www.root-servers.org/>)
 - ♦ Labeled A through M



Using DNS

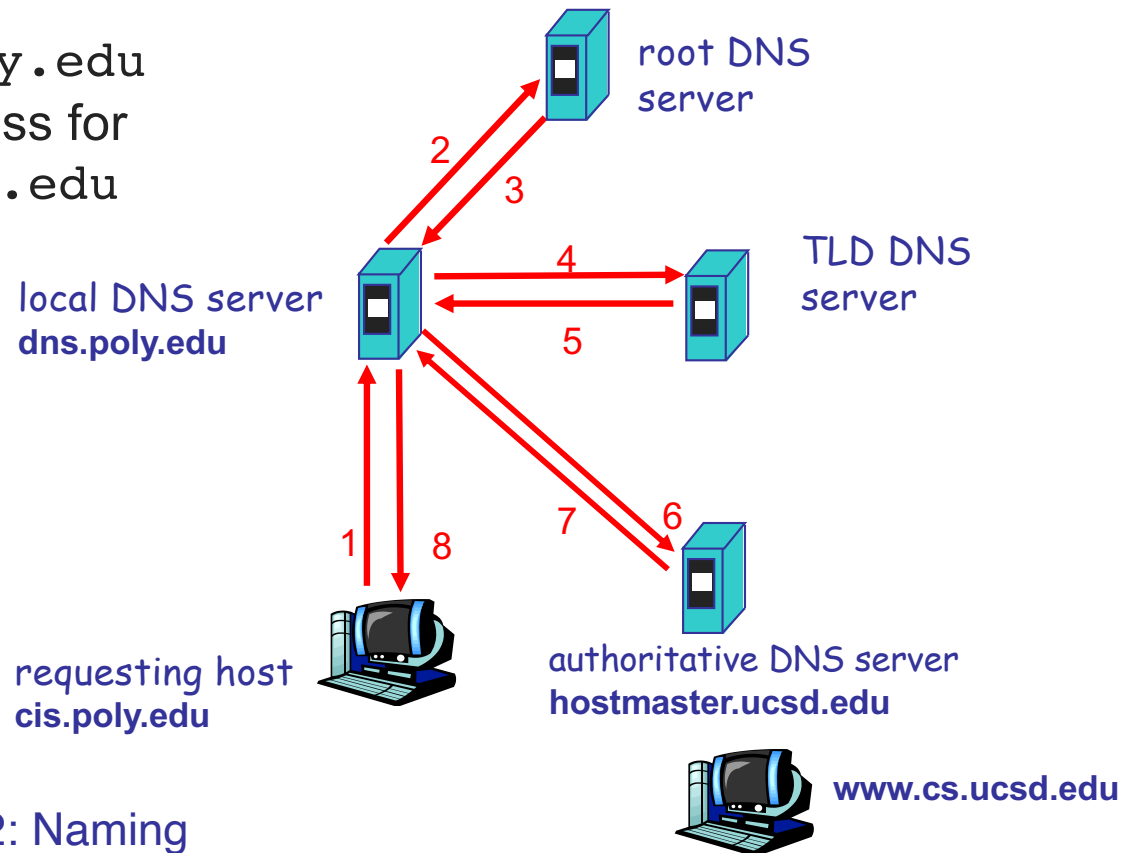


- Local DNS server (“default name server”)
 - ◆ Usually near the end hosts who use it
 - ◆ Local hosts configured with local server (e.g., `/etc/resolv.conf`) or learn the server via DHCP
- Client application
 - ◆ Extract server name (e.g., from the URL)
 - ◆ Do *gethostbyname()* to trigger resolver code
- Server application
 - ◆ Extract client IP address from socket
 - ◆ Optional *gethostbyaddr()* to translate into name

Example



Host at `cis.poly.edu`
wants IP address for
`www.cs.ucsd.edu`



Reliability



- DNS servers are replicated
 - ◆ Name service available if at least one replica is up
 - ◆ Queries can be load balanced between replicas
- UDP used for queries
 - ◆ Need reliability: must implement this on top of UDP
 - ◆ Try alternate servers on timeout
 - ◆ Exponential backoff when retrying same server
- Cache responses to decrease load
 - ◆ Both at end hosts and local servers



Whence come IP Addresses?

- You already have a bunch from the days when you called Jon Postel and asked for them (e.g. BBN)
- You get them from another provider
 - ◆ E.g. buy service from Sprint and get a /24 from one of their address blocks
- You get one directly from a routing registry
 - ◆ ARIN: North America, APNIC (Asia Pacific), RIPE (Europe), LACNIC (Latin America), AFRINIC (Africa)
 - ◆ Registries get address from IANA (Internet Assigned Numbers Authority)



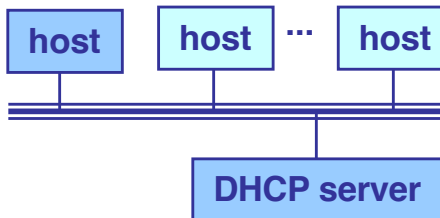
How Do You And I Get One?

- Well from your provider!
- But how do you know what it is?
- Manual configuration
 - ◆ They tell you and you type that number into your computer (along with the default gateway, DNS server, etc.)
- Automated configuration
 - ◆ Dynamic Host Resolution Protocol (DHCP)



Bootstrapping Problem

- Host doesn't have an IP address yet
 - ♦ So, host doesn't know what source address to use
- Host doesn't know who to ask for an IP address
 - ♦ So, host doesn't know what destination address to use
- Solution: shout to discover a server who can help
 - ♦ Install a special server on the LAN to answer distress calls



DHCP



- Broadcast-based LAN protocol
 - ◆ Host broadcasts “DHCP discover” on LAN (e.g. Ethernet broadcast)
 - ◆ DHCP server responds with “DHCP offer” message
 - ◆ Host requests IP address: “DHCP request” message
 - ◆ DHCP server sends address: “DHCP ack” message w/IP address
- Easy to have fewer addresses than hosts (e.g. UCSD wireless) and to *renumber* network (use new addresses)
- What if host goes away (how to get address back?)
 - ◆ Address is a “lease” not a “grant”, has a timeout
 - ◆ Host may have different IP addresses at different times?

For Next Time



- Finish up Project 1b; due TONIGHT
- Midterm FRIDAY
- Discussion tomorrow a great place to start studying!