# **Application Layer: Overview**

- Principles of network applications
- Web and HTTP
- E-mail, SMTP, IMAP
- The Domain Name System DNS

- P2P applications
- video streaming and content distribution networks
- socket programming with UDP and TCP



## DNS: Domain Name System

#### *people:* many identifiers:

• SSN, name, passport #

#### Internet hosts, routers:

- IP address (32 bit) used for addressing datagrams
- "name", e.g., cs.umass.edu used by humans
- <u>Q</u>: how to map between IP address and name, and vice versa ?

### Domain Name System:

- distributed database implemented in hierarchy of many name servers
- application-layer protocol: hosts, name servers communicate to resolve names (address/name translation)
  - note: core Internet function, implemented as application-layer protocol
  - complexity at network's "edge"

## DNS: services, structure

### **DNS** services

- hostname to IP address translation
- host aliasing
  - canonical, alias names
- mail server aliasing
- Ioad distribution
  - replicated Web servers: many IP addresses correspond to one name

### Q: Why not centralize DNS?

- single point of failure
- traffic volume
- distant centralized database
- maintenance

### A: doesn't scale!

 Comcast DNS servers alone: 600B DNS queries per day

### DNS: a distributed, hierarchical database



Client wants IP address for www.amazon.com; 1<sup>st</sup> approximation:

- client queries root server to find .com DNS server
- client queries .com DNS server to get amazon.com DNS server
- client queries amazon.com DNS server to get IP address for www.amazon.com

### DNS: root name servers

- official, contact-of-last-resort by name servers that can not resolve name
- incredibly important Internet function
  - Internet couldn't function without it!
  - DNSSEC provides security (authentication and message integrity)
- ICANN (Internet Corporation for Assigned Names and Numbers) manages root DNS domain

13 logical root name "servers" worldwide each "server" replicated many times (~200 servers in US)

