The Internet/WWW

- **Network**
  ◦ Collection of connected computers
  ◦ Communicate and share resources

- **Protocol**
  ◦ Set of rules that govern communication
  ◦ The "language" spoken by the computers in a network

- **Transmission Control Protocol/Internet Protocol (TCP/IP)**
  ◦ Format for transmitting and receiving small packets of data
The Internet/WWW

- The Internet
  - Global network using TCP/IP
  - All the hardware and software that runs the network

- Hypertext Transfer Protocol (HTTP)
  - Format for requesting and providing files
  - Operates using TCP

- The World Wide Web
  - All the data provided to users by the Internet
    - What you see when you browse
    - Requests for data (usually) made using HTTP

A Brief History

- Origins with the United States DoD (1960s)
  - Design a large-scale computer network
    - Provide communications and remote access
  - Required to withstand physical attack
    - No central structure or control
    - Add and remove computers on the fly
  - Dubbed ARPAnet
    - Funded by Advanced Research Projects Agency (ARPA)

- Use at ARPA-funded research institutions (1970s)
  - UCLA was the first connected in 1969
  - Some competing networks at other universities
A Brief History

- Growing audience (1980s)
  - National Science Foundation created NSFNet in 1986
    - Over one million computers connected by 1992
    - Some commercial networks, e.g., AOL, CompuServe
  - Group led by Tim Berners-Lee at CERN
    - Conseil Européen pour la Recherche Nucléaire
    - Could search for documents on any document server
    - Documents featured embedded links (hypertext)

IP Addresses

- Every machine on the Internet has an IP address
  - We'll talk about IPv4
  - IPv6 is not commonly used
- Composed of four integers A.B.C.D
  - Range in value from 0 to 255
  - D is a machine
  - C is a subnet of B
  - B is a subnet of A
  - A is typically a regional designation
IP Addresses

- You can determine your machine's IP address
  - Windows: ipconfig
  - Mac/Linux: ifconfig

130.15.15.22

Queen's University  CASLAB  The CISC 282 Machine

- IP addresses are assigned
  - CASLAB assigns 22 to the CISC 282 machine
  - Queen's assigns 15 to CASLAB
  - Another entity assigns 130.15 to Queen's

- Who's in charge of IP addresses?
  - Internet Corporation for Assigned Names and Numbers (ICANN)
  - Assigns address blocks to Regional Internet Registries (RIRs)
    - Canada is served by the American Registry for Internet Numbers (ARIN)
Domain Name System

- IP addresses are rarely used to browse
  - One website may be served by many machines with many IP addresses
    - e.g., google.ca is hosted on many machines
  - One machine with one IP address may serve many different websites
    - e.g., sites.cs.queensu.ca and flux.cs.queensu.ca are hosted on the same machine

- Websites are associated with domain names

- The domain name system (DNS) does the conversion
  - Name servers translate names into IP addresses
    - e.g., cisc282.caslab.queensu.ca → 130.15.15.22

Domain Name System

- Domain name servers are widespread
  - All subnets have them to serve their network
  - There are 13 root name servers
    - Queried as a “last resort”

- Who's in charge of domain names?
  - Internet Corporation for Assigned Names and Numbers (ICANN)
  - Provides accreditation for domain name registrars
    - You register domain names with one of these companies
    - Listing at http://www.internic.net/origin.html
  - Responsible for operating the 13 root name servers
### Uniform Resource Locators

- **Who's in charge of top-level domains?**
  - Internet Assigned Numbers Authority (IANA)
  - Delegates management of each domain to other organizations
  - .ca: Canadian Internet Registration Authority (CIRA)
  - .com: VeriSign Global Registry Services

### Internet Hardware

- **Modem**
  - Translates packets into a transmissable signal
  - e.g., fiber-optic, wireless

- **Switch**
  - Sends and receives packets

- **Router**
  - Routes packets
  - Provides an entry and exit point for a subnet
  - Route packets to/from subnet and parent network
Internet Hardware

- Server
  - A machine with an IP address
  - Runs software that provides different services
    - Web server: manages HTTP requests
    - Domain name server: answers DNS queries
    - Mail server: handles Simple Mail Transfer Protocol (SMTP) requests
    - ...
  - Can provide any number of these

When You Browse ...

[Diagram showing internet hardware and browsing process]
When You Browse …

1) You type a URL into your browser or click on a link

When You Browse …

2) The router queries the DNS for the IP address of the right web server
3) The request goes to your "nearest" domain name server (likely at your ISP)

3.1) If that server can resolve the name, it returns the IP address
When You Browse ...

3.2) If not, it sends the DNS request up the chain (possibly reaching a root name server) until the name is resolved and the IP address is returned.
4) Your computer sends packets with your request to the web server at the given IP address

5) The Internet funnels your packets through switches and routers to the web server
6) The web server sends packets with the information you requested back to your machine

7) Your browser displays the information