Making the Connection

or: How does the internet work?

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the internet

ethernet network

router/gateway

router

servers

intranet

personal computers

commercial grade link

phone line (dial up modem at each end)

ISP gateway

DSL (digital subscriber line) or TV cable

wireless access point

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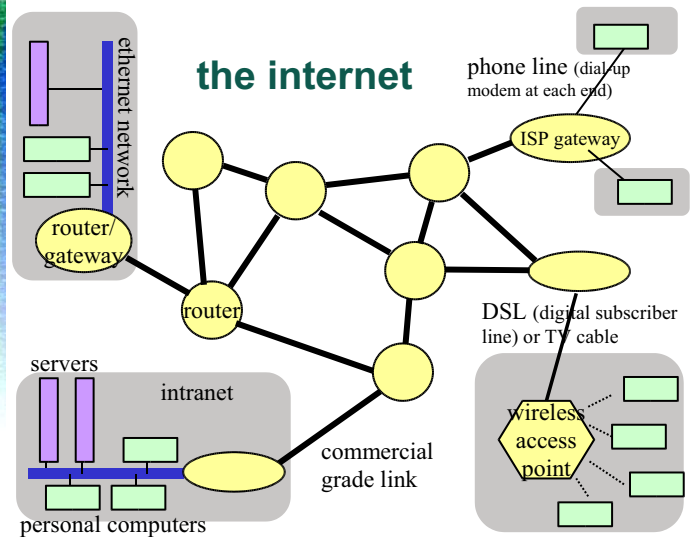
the internet supports *point-to-point* and *broadcast* communication

- essential ingredients of a point to point system:
  - unique IDs for users (user computers)
  - links (possibly via additional "nodes") connecting all users
  - methods for routing data along links

- other examples of point to point communication?
  - postal systems
    early example: Qajar dynasty (Iran, 6th century BCE)
    http://www.qajarpages.org/qajpost.html
  - telephone switching networks

- examples of broadcast communication?

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levels of abstraction

- different *levels of abstraction* are useful in thinking about communication systems

- the higher the level of abstraction, the more details of the system that are hidden

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levels of abstraction in postal system

- *high level:* a letter, labeled with address or recipient, is placed in a postbox, arrives at destination

- *lower level:* models the network of "nodes" at which the letter may stop

- *even lower level:* models the mechanism for transporting the letter between nodes (by foot, horse, train, truck, airplane…)

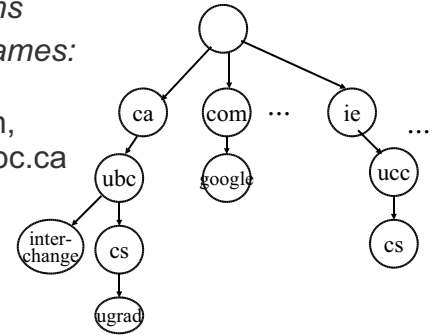# levels/layers of abstraction in computer networks

- *application layer:* e.g., web browsers, e-mail

- *intermediate layers* are put the data into the right format for routing by the network.

- *network layer*: routes data from source to destination

- *yet lower layers* are concerned with physical links and errors.

application layer

- *Domain names* identify computers (which may be sources of information), *e-mail addresses* identify people, *URLs* identify web pages.

- *Software*, such as a browser, provides the functionality needed to create, send, read messages, to specify the e-mail address of the recipient of a message, or to specify a web page at a domain.

- Details of data transmission along links are transparent (invisible) to user.

domain names

- computer names are hierarchically grouped into *domains*
- *example names:* cs.ubc.ca, google.com, ugrad.cs.ubc.ca

e-mail addresses

- two parts, separated by "@":

  - userID (resolved at the receiving computer)

  - destination domain name address (resolved at the sending computer)

- *example:* hoos@cs.ubc.ca

URLs (uniform resource locators)

- a URL addresses a web page

- *example:* http://www.google.ca/index.html

  - *http* refers to a protocol for transferring files

  - www.google.ca is a … what?

  - index.html is a *file name* (at the google.ca domain)

## layers of abstraction in computer networks

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network layer
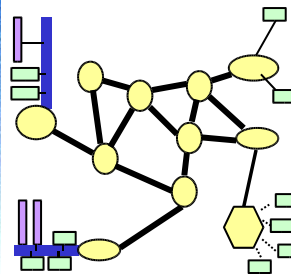
- the internet is a collection of *nodes* and *links*

- computer-friendly IDs called *IP addresses* identify network nodes

- data is routed along links from node to node in the network

an IP address
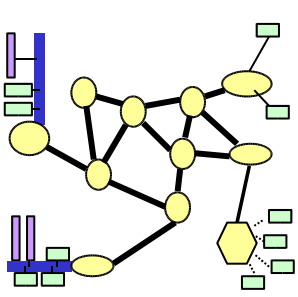
- identifies nodes (computers) on a network

- consists of four numbers: 128.95.1.4 (future version will have 16 numbers)

- may be permanent, or assigned temporarily by an ISP (internet service provider) during a session

domain name servers: bridging the application and network layers

- domain name servers (DNSs) keep a directory of pairs *(domain name, IP address)*

- every computer connected to the internet knows the IP address of its nearest DNS

- this DNS is used to *resolve*, or translate, a domain name to an IP address

- DNS's need to be constantly updated

summary so far

- each layer of abstraction of the internet is concerned with
  - identification of computers/users
  - methods for transmitting data

- application layer
  - computers/users/web pages are identified using domain names/email addresses/URL's
  - browser or email software provides simple functions for sending/receiving data

- network layer
  - computers are identified using IP addresses
  - route of data along links in the network is specified

the routing problem

How should data be routed along links of a computer network?