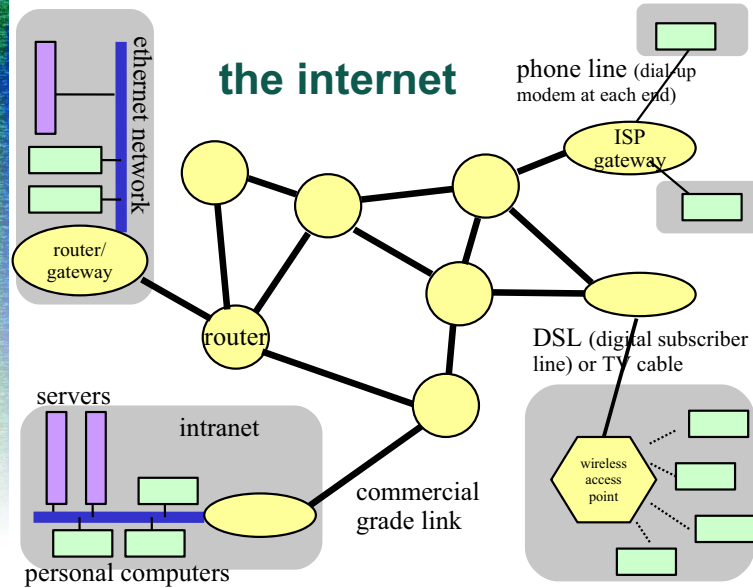


Making the Connection

or: How does the internet work?



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?

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

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

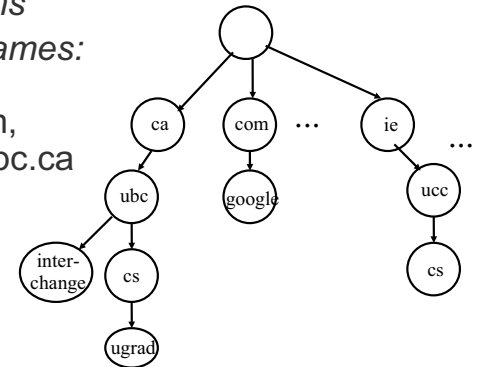
- *application layer*: e.g., web browsers, e-mail
- *intermediate layers* put the data into the right format for routing by the network.
- *network layer*: routes data from source to destination
- *yet lower layers* are concerned with physical links and errors.

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

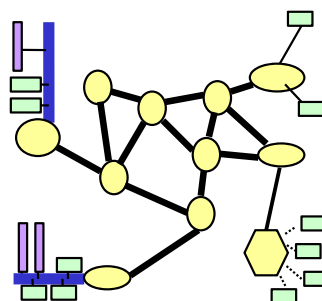
URLs (uniform resource locators)

- 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

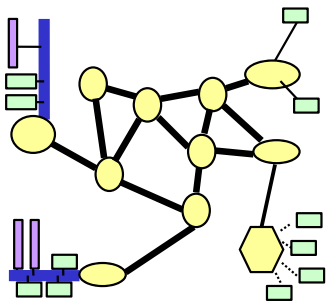
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network layer



- 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

IP addresses ...



- identify nodes (computers) on a network
- consist 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
- DNSs 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/URLs
 - 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?

