

NOS 116, 118, 218, 222

Lecture Internet

BACKGROUND

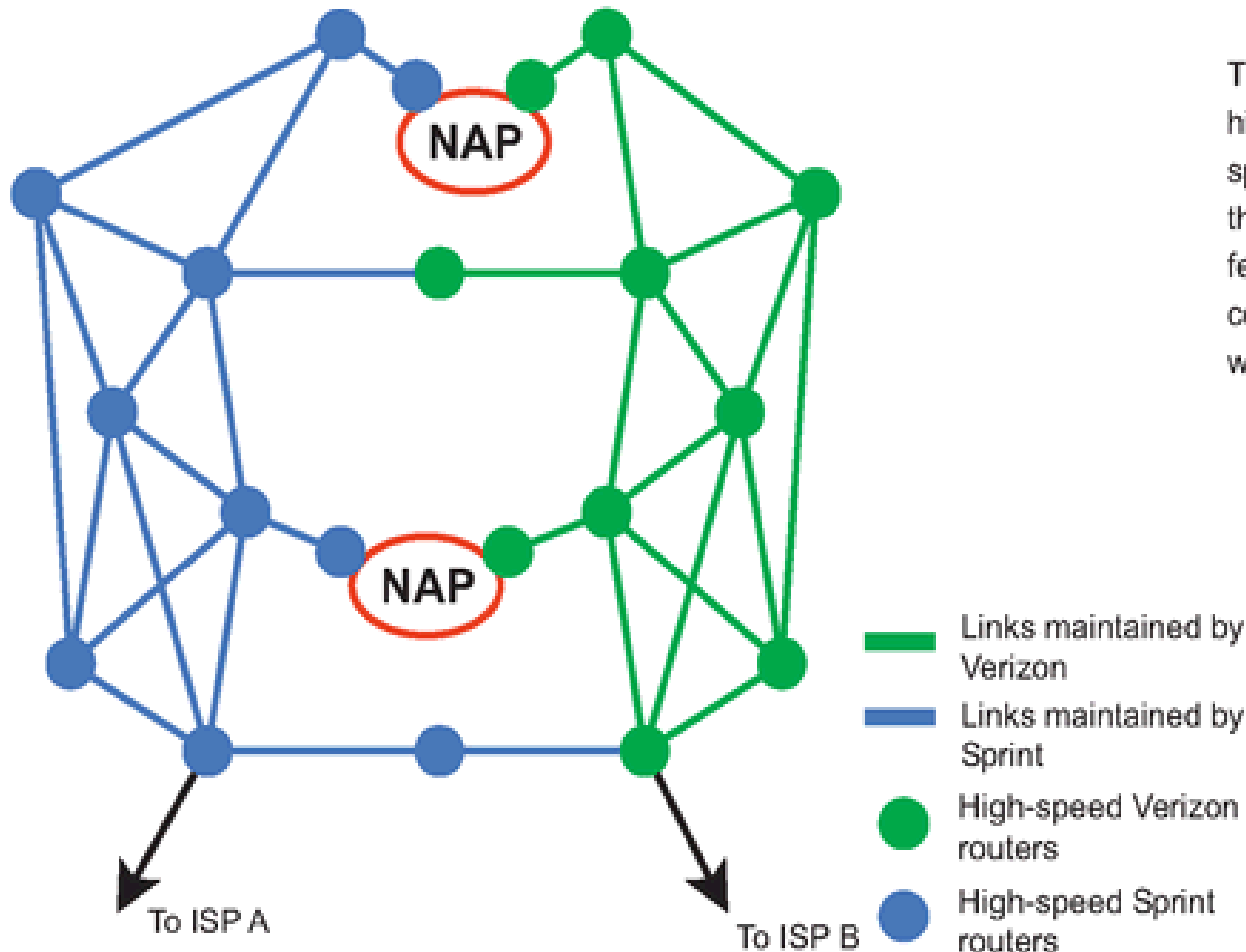
- 1957 – Soviet Union's Sputnik satellite
- 1969 – APRA (Advanced Research Project Agency) created APRANET
- 1985 – National Science Foundation (NSF) created a larger network
- Now called InternetPopular
- 1990s, user-friendly Internet access tools
- Internet accounts available
- Estimated 500 million nodes and more than 1 billion users
- Internet handles more than an exabyte a day (1.074 billion gigabytes)

INTERNET INFRASTRUCTURE (organization)

- **Internet backbone** – network of high-capacity communications links that provides the main routes for data traffic across the Internet
- Backbone links and routers are mainly by Network service providers (**NSPs**)
- NSP equipment and links are tied together by network access points (**NAPs**)
- **Internet Service Provider (ISPs)** - company that offers Internet access to users

INTERNET INFRASTRUCTURE

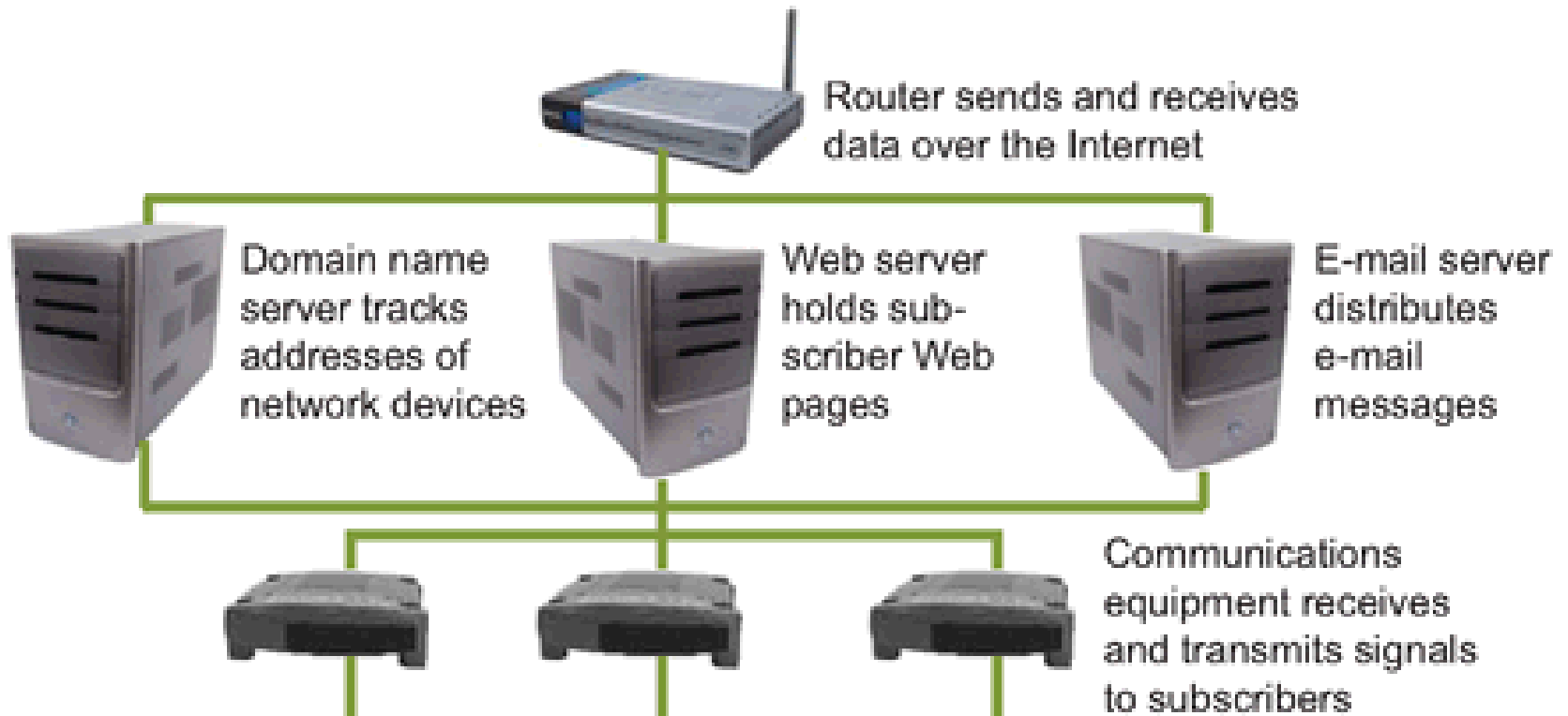
The Internet backbone includes high-speed routers and high-speed fiber-optic links. Parts of the backbone maintained by different communications companies are connected at network access points (NAPs).



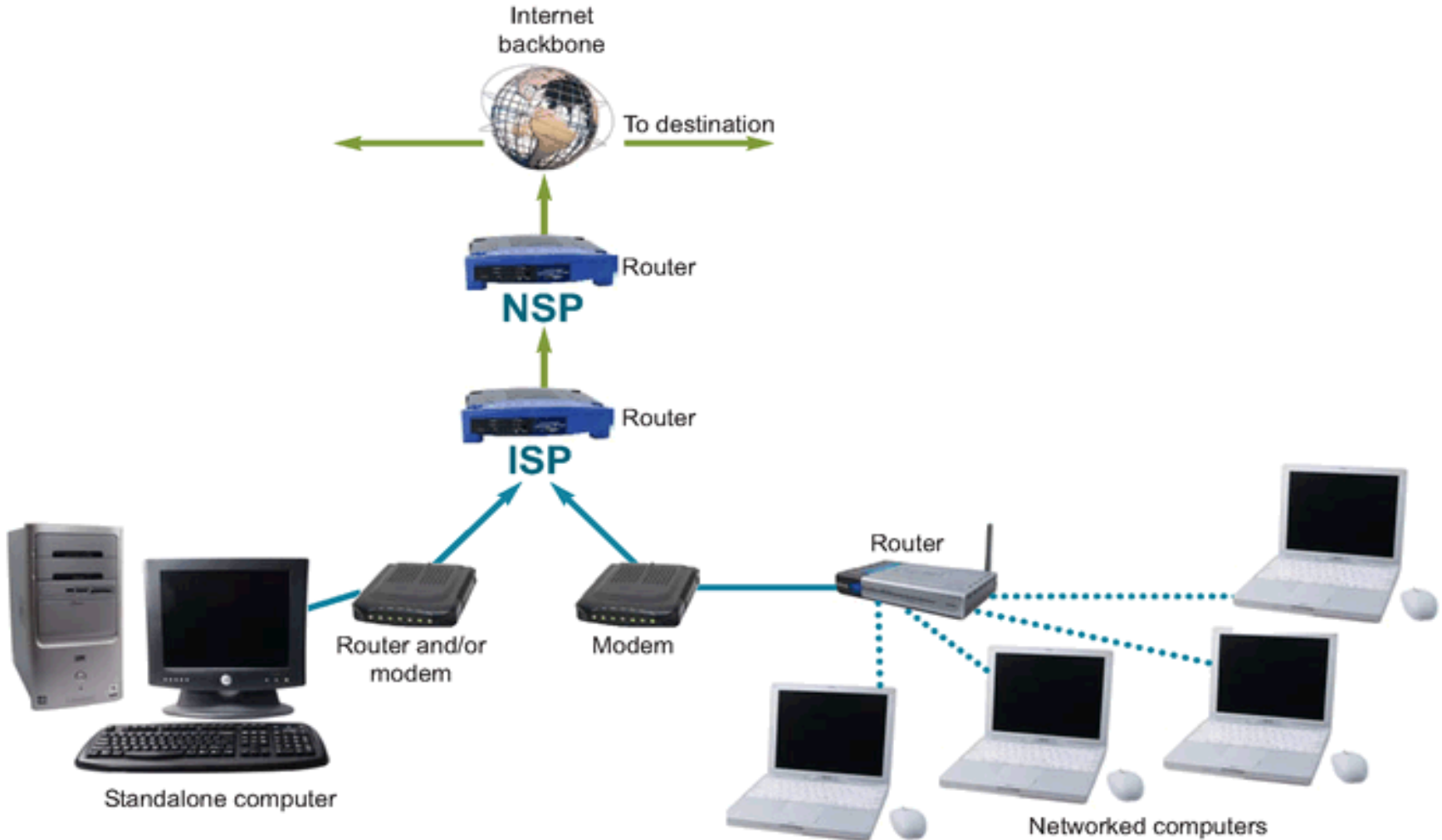
ISP devices

- Routers
- Communication equipment
- Network devices
- E-mail servers
- Web servers for subscriber Web sites
- Server that translates an address
- Maintain servers for chat groups etc

ISP devices



Computer connected to internet



INTERNET PROTOCOLS, ADDRESSES, AND DOMAINS

Protocol	Name	Function
TCP	Transmission Control Protocol	Creates connections and exchanges packets of data
IP	Internet Protocol	Provides devices with unique addresses
UDP	User Datagram Protocol	An alternative data transport to TCP used for DNS, Voice over IP, and file sharing
HTTP	Hypertext Transfer Protocol	Exchanges information over the Web
FTP	File Transfer Protocol	Transfers files between local and remote host computers
POP	Post Office Protocol	Transfers mail from an e-mail server to a client Inbox
SMTP	Simple Mail Transfer Protocol	Transfers e-mail messages from client computers to an e-mail server
VoIP	Voice over Internet Protocol	Transmits voice conversations over the Internet
IRC	Internet Relay Chat	Transmits text messages in real time between online users
BitTorrent	BitTorrent	Distributes files using scattered clients rather than a server

TCP/IP

- **TCP/IP** – protocol suite
- Protocol suite – combination of protocols that work together
- TCP – breaks a message or file into packets
- IP – address packets so they can be routed to destination
- TCP/IP provides protocol standard for the Internet

TCP/IP

- IP addresses are used to identify computers on the Internet as well as on LANs. Usually called TCP/IP address
- E.g. 204.127.129.1 (32 bits long, written as decimal numbers and divided into four octets by periods.
- Static and dynamic IP address.

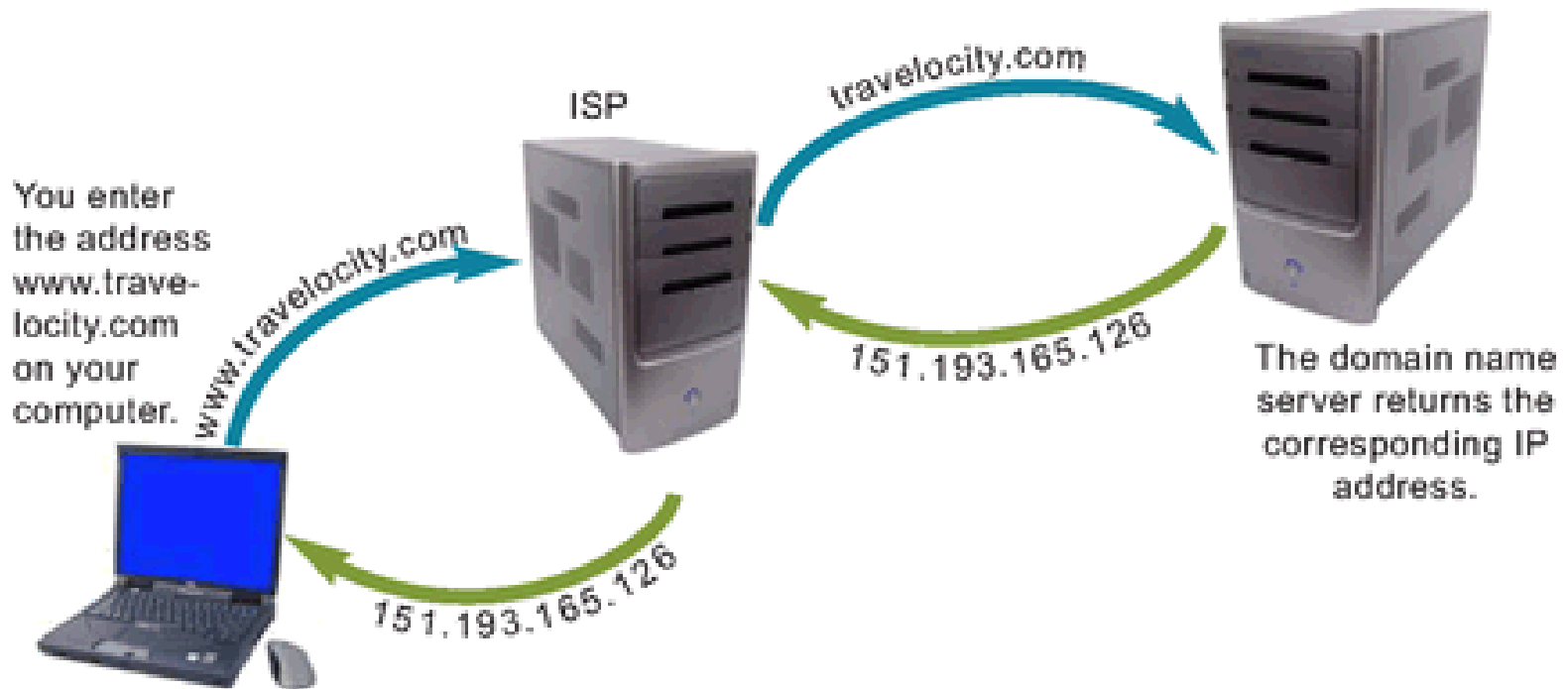
DOMAIN NAME

- Easy-to-remember name such as *nike.com* that replaces long strings of numbers that is difficult to remember
- www.tihe.org, domain name is *tihe.org*
- Domain name ends with an extension that shows **top-level domain**

Domain name extensions

Domain	Description
biz	Unrestricted use; usually for commercial businesses
com	Unrestricted use; usually for commercial businesses
edu	Restricted to North American educational institutions
gov	Restricted to U.S. government agencies
info	Unrestricted use
int	Restricted to organizations established by international treaties
mil	Restricted to U.S. military agencies
net	Unrestricted use; traditionally for Internet administrative organizations
org	Unrestricted use; traditionally for professional and nonprofit organizations

Domain and IP address



http://, www, ftp

- Correspond to protocols, ports, and services offered by the Internet computers
- **Port** – virtual device because it is not a physical circuit or mechanism, just an idea that allows a computer to do more than one type of service
- **Port 80** – corresponds to Web services/Websites
- **Port 110** – email uses
- **Port 20 and 21** – host FTP downloads

REGISTERING DOMAIN NAMES

- **ICANN** is the global organization that coordinates technical management of the Internet's Domain Name System
 - To register, find out whether the name is available using the Accredited Domain Registrar Web site
 - Annual fee of US\$10 to US\$500,000

CONNECTION SPEED

- **Latency** – elapsed time for data to make a round trip from point A to point B and back to point A. Averages to less than 100 ms
- **Ping** – local Internet utility which sends a signal to a specific Internet address and waits for a reply.
- **Traceroute** – utility that records a packet's path in addition to its round-trip speed

Connection Speed

- Measured in Kbps or Mbps
- Offered by ISPs and varies
- 56 Kbps to 10,000 Kbps
- High-speed connections can display things quickly
- Speed depends on the type of connection, interference. Also, upstream speed can also differ from downstream speed

Connection Speed

- **Upstream speed:** rate of data transmitted from your computer to the Internet
- **Downstream speed:** rate of data arriving at your computer
- ISP controls this speed. Normally upstream is slower than downstream
- **Assymetric Internet connection:** upstream and downstream differ in speed
- **Symmetric Internet connection:** upstream and downstream speeds same

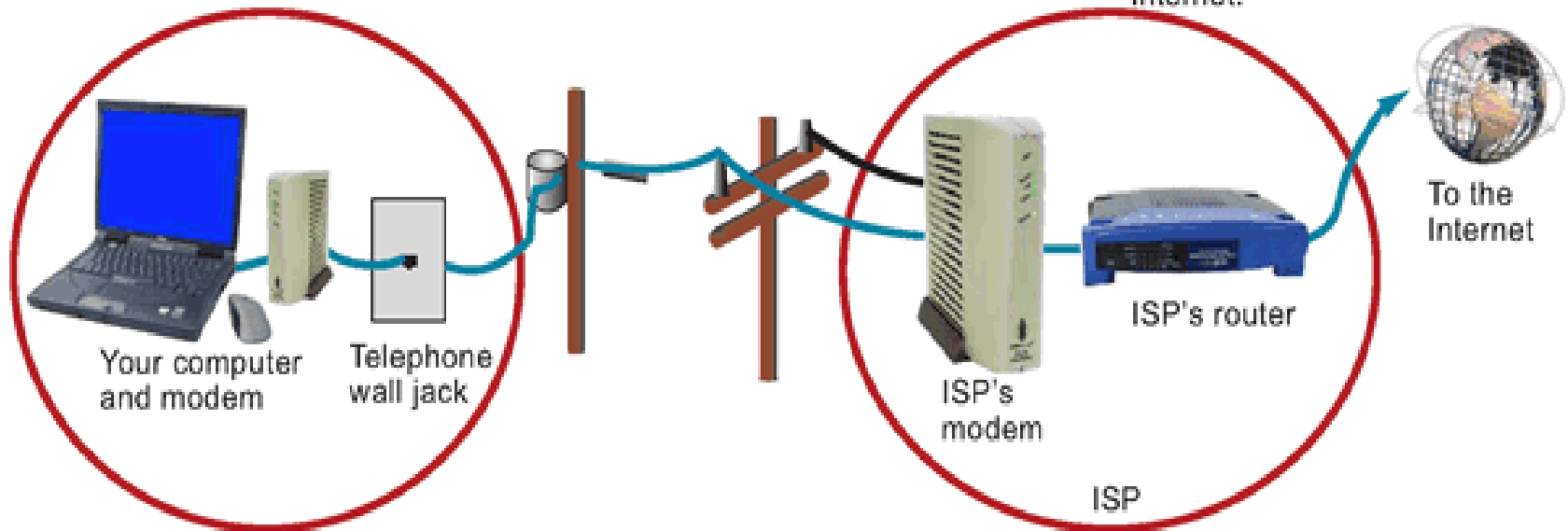
Connection options

- **Fixed Internet access:** links computer to ISP from a stationary point (E.g. roof-mounted antenna)
- **Portable Internet access:** allows access device to move (E.g. vehicle mounted satellite)
- **Mobile Internet Access:** Internet on the go (E.g. cell phone)

Dial-up

- **Dial-up connection:** uses voiceband modem and telephone lines to transport data (ISP providing this service—NetZero, AOL, EarthLink)

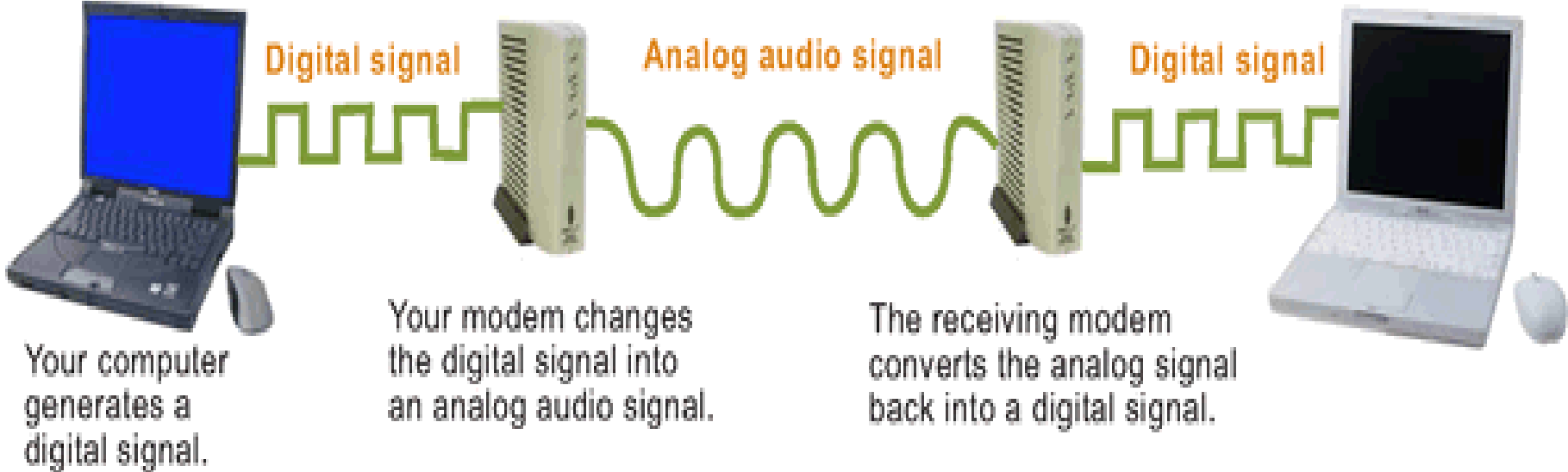
When you use a dial-up connection to access the Internet, your data travels over local telephone lines to your ISP, which sends it onto the Internet.



Dial-up connections

- **Voiceband modem** (modem): converts the signals from your computer into signals that can travel over the telephone lines (0 – 1,070Hz, 1 – 1,270Hz)
- **Max speed:** 56 Kbps
- Most computers have a built-in voiceband modem circuitry (RJ-11 connector)

When you transmit data, your voiceband modem modulates the signal that carries your data. A modem at the other end of the transmission demodulates the signal.



DSL, ISDN, AND DEDICATED LINES

- Dedicated lines that offer high-speed digital communications links for voice and data
- T1, T3, and T4 are dedicated lines that can be leased
- **Speed ranges** from 1.544 Mbps to 274 Mbps
- Leased by cooperations because it's expensive

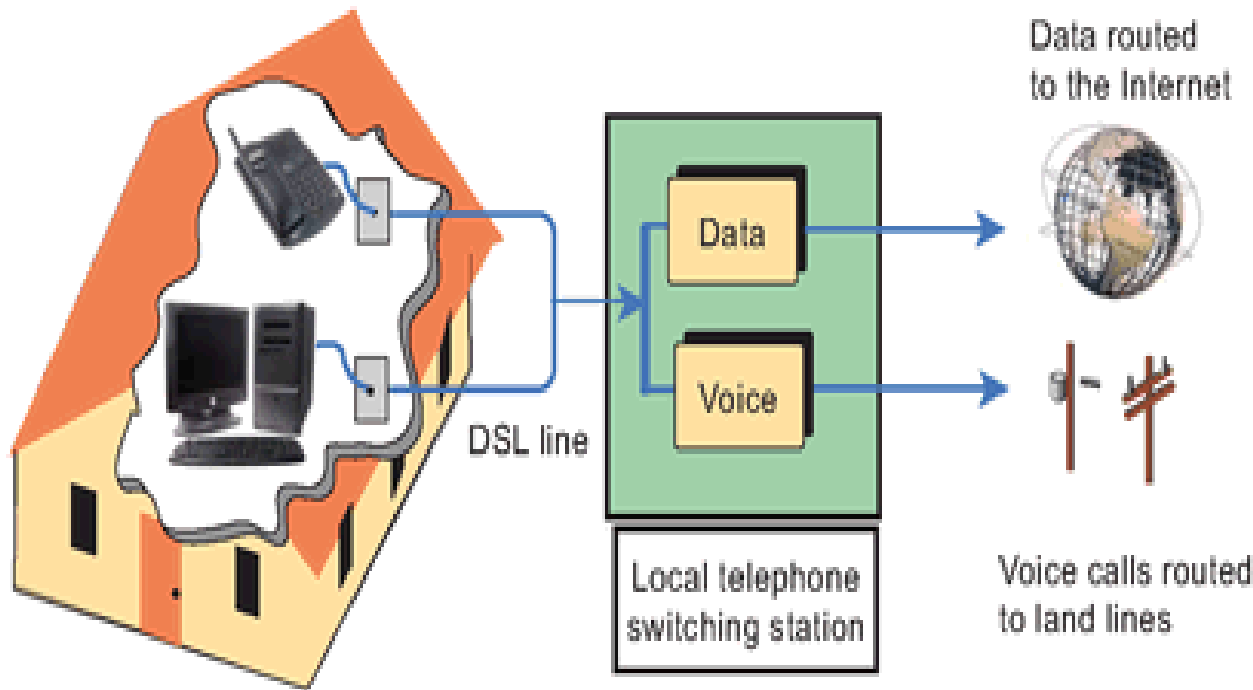
ISDN (Integrated Services Digital Network)

- **Speed:** 64 Kbps or 128 Kbps over telephone lines. Can get it from ISDN service provider
- Use **ISDN terminal adapter**. It is not a modem!
- **AO/DI:** a service that stays connected to an ISP
- **Adv:** use a telephone line, faster than dial-up and not expensive

DSL (digital subscriber line)

- High-speed, digital, always-on. Runs over standard phone lines
- **Adv:** fast and affordable
- E.g. – ADSL, SDSL, HDSL, VDSL, and DSL Lite
- **Speed** is up to 6 Mbps downstream for a distance of about 1.25 miles (2 km). Deteriorates with distance
- Get DSL service from Telephone and ISP joint venture
- Use a DSL modem
- DSL filters prevent voiceband signals from interfering with DSL signals.

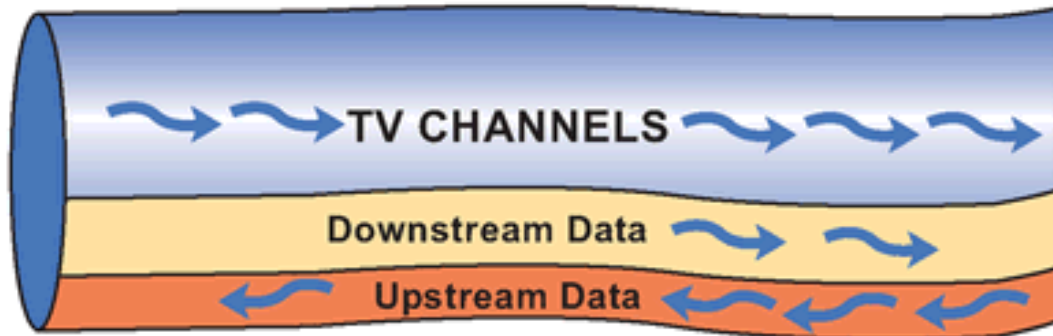
DSL CONNECTION



Voice and data signals travel over DSL to a special device at the local telephone switching station, where they are divided and routed to an ISP or to the regular telephone network.

CABLE INTERNET SERVICE

- always-on broadband Internet access
- Distributed over T.V. cables
- Currently offers the fastest access speeds
- Part of a neighborhood LAND joined by wiring for the cable TV
- **Speed ranges** from 10 Mbps to 30 Mbps
- Cables not vulnerable to interference, but shared with neighbors and affects connection speed



A CATV cable has enough bandwidth to support TV channels and data flowing downstream as well as data flowing upstream.

Requires

- Cable modem
- Circuitry to handle Ethernet protocols

Can be rented from companies such as Linksys, Motorola, D-Link and other companies

Before it was not secure

Today, DOCSIS-compliant cable modems block crossover. It has security filters.

SATELLITE INTERNET SERVICE

- Always-on, high-speed asymmetric Internet access by broadcasting signals to and from a personal satellite dish
- **Adv:** Farthest range and ability to reach remote areas.
- **Speed**, upstream: 1.0 to 1.5 Mbps, downstream: 100 to 256 Kbps
- Can be disrupted by weather conditions
- Subject to latency delays
- Connection needs a **satellite dish** and **modem**

FIXED WIRELESS SERVICE

- Aka wireless broadband service
- MAN standards
- E.g. WiMAX (Worldwide Interoperability for Microwave Access)
- Data transmitted over mounted antennae, using microwave links
- Can transmit at 70 Mbps. Affected by distance, weather and usage
- **Speed:** 1 to 5 Mbps
- Less latency than satellite Internet service
- Needs a wireless modem and also an antenna

FIXED INTERNET CONNECTION ROUNDUP

	Dial-up	ISDN	DSL	Cable	Satellite	WiMAX
Downstream speed (max.)	56 Kbps	128 Kbps	384 Kbps–6 Mbps	10–30 Mbps	1–1.5 Mbps	70 Mbps
Upstream speed (max.)	33 Kbps	128 Kbps	128 Kbps–6 Mbps	256 Kbps–2 Mbps	100–256 Kbps	70 Mbps
Downstream speed (actual)	44 Kbps	128 Kbps	2–5 Mbps	3–10 Mbps	400–800 Kbps	1–5 Mbps
Latency	100–200 ms	10–30 ms	10–20 ms	10–20 ms	1–3 seconds	10–50 ms
Short video (72 MB) download	4 hours	78 minutes	5 minutes	3.2 minutes	24 minutes	6.4 minutes
Requirements	Telephone line, ISP, voiceband modem	Telephone line, ISDN service, ISDN terminal adapter	Computer located within 3 miles of local telephone switch; DSL modem	CATV service that provides Internet access; cable modem	Clear view of southern sky; satellite dish and modem	WiMAX modem, line-of-sight to WiMAX tower for distances > 3 miles
Monthly fee	\$5–\$25	\$50–\$150	\$30–\$200	\$20–\$50	\$35–\$80	\$0–\$60
Installation cost	\$0	\$0–\$200	\$0–\$100	\$0–\$50	\$200–\$300	\$50–\$150
Always-on	N	N	Y	Y	Y	Y

PORTABLE AND MOBILE INTERNET ACCESS

- **Portable Internet Access:** Ability to easily mover Internet service from one location to another
 - E.g. Wi-Fi, portable satellite, portable wireless
- Offers continuous Internet connection
- Most popular and promising portable and mobile Internet access TECHNOLOGY
 - Wi-Fi hotspot, Portable and Mobile WiMax, Portable Satellite Service, Cellular Data service

Wi-Fi Hotspots

- Area in which the public can access a Wi-Fi network that offers Internet service
- To access you must have a Wi-Fi card
- Speed depends on distance from access point, number of people logged in, interference from other networks
- Not secure

PORTABLE AND MOBILE WiMAX

- WiMAX available because of a tower's coverage area
- Must have WiMAX circuitry and antennas.
- **Adv:** use the same Internet service provider
- **Disadv:** not yet widespread
- Mobile WiMAX is on the rise

PORTABLE SATELLITE SERVICE

- Great if Internet access is required as you travel to remote locations (ski, hike, research)
- Usually mounted on a vehicle
- Transmits signals to and receives signals from a geostationary satellite
- **Disadv:** locating satellite signal is sometimes hard
- Downstream speeds to 400 to 2,000 Kbps
- Upstream speeds of 50 to 500 Kbps
- expensive

CELLULAR DATA SERVICE

Cellular Network Technologies

Generation	Service	Speed *	Features
1G	AMPS	<10 Kbps	Analog voice service; No standalone data service
2G	CDMA PDC GSM	14.4 Kbps 9.6 Kbps 9.6–14.4 Kbps	Digital voice service; 9.6 Kbps–14.4 Kbps speed; Enhanced calling features, such as caller ID; No always-on data connection
2.5G	GPRS	56–114 Kbps	Adds always-on data transfers at 171.2 Kbps to CDMA and GSM networks
3G	UMTS EDGE EV-DO HSUPA	2 Mbps 384 Kbps 2.4 Mbps 5.76 Mbps	Superior digital voice service; Broadband multimedia data services

* Maximum theoretical speed; actual speeds are slower

CELLULAR DATA SERVICE

- Most cellular service providers offer e-mail and Internet services.
- **WAP:** communications protocol that provides Internet access from handheld devices
- WAP-enabled devices have microbrowsers that displays simplified versions of popular Web sites
- To access the “real” Internet, must have mobile broadband.
- Fastest cellular technologies
 - EDGE, EV-DO, and HSUPA

CELLULAR DATA SERVICE

- To use the internet you must subscribe to a Mobile phone provider
- Built-in Wi-Fi
- PDAs include browser and e-mail software

INTERNET SERVICES

- **Real-time messaging system:** allows people to exchange short messages while they're online
- **Instant messaging (IM):** one-on-one messaging
- **Chat:** group communications
- Vulnerable to instant message viruses and spyware. Important to use antispymware.

VOICE OVER IP

- VoIP a technology in which a broadband Internet connection is used to place telephone calls instead of the regular phone system
- Used to call from one computer to another, receive calls from land line telephones
- VoIP system convert voice communications to data packets.
- Use an inexpensive ATA, IP phone, wireless IP phone, or USB phone
- E.g. Vonage or Skype

VoIP pros and cons

- Pros
 - Unlimited local and long distance calls in certain countries
 - Offer flexibility (use the same number anywhere)
 - Phones that offer Wi-Fi as well as cellular phone service can be used to make VoIP or cellular service
- Cons
 - quality can vary depending on internet connection speed
 - Can let down in an emergency e.g. no power

GRID COMPUTING

- Def: Network of computers harnessed together to perform processing tasks
- Two types
 - **Distributed grids:** (CPU scavenging grids) tap into thousands of PCs and Macs with Internet connections whose owners donate their computers' idle hours to a grid processing task
 - **Cloud computing:** concept depends on a grid of servers and storage devices that offer Inter-accessible computing services ranging from office productivity applications to complex corporate data processing

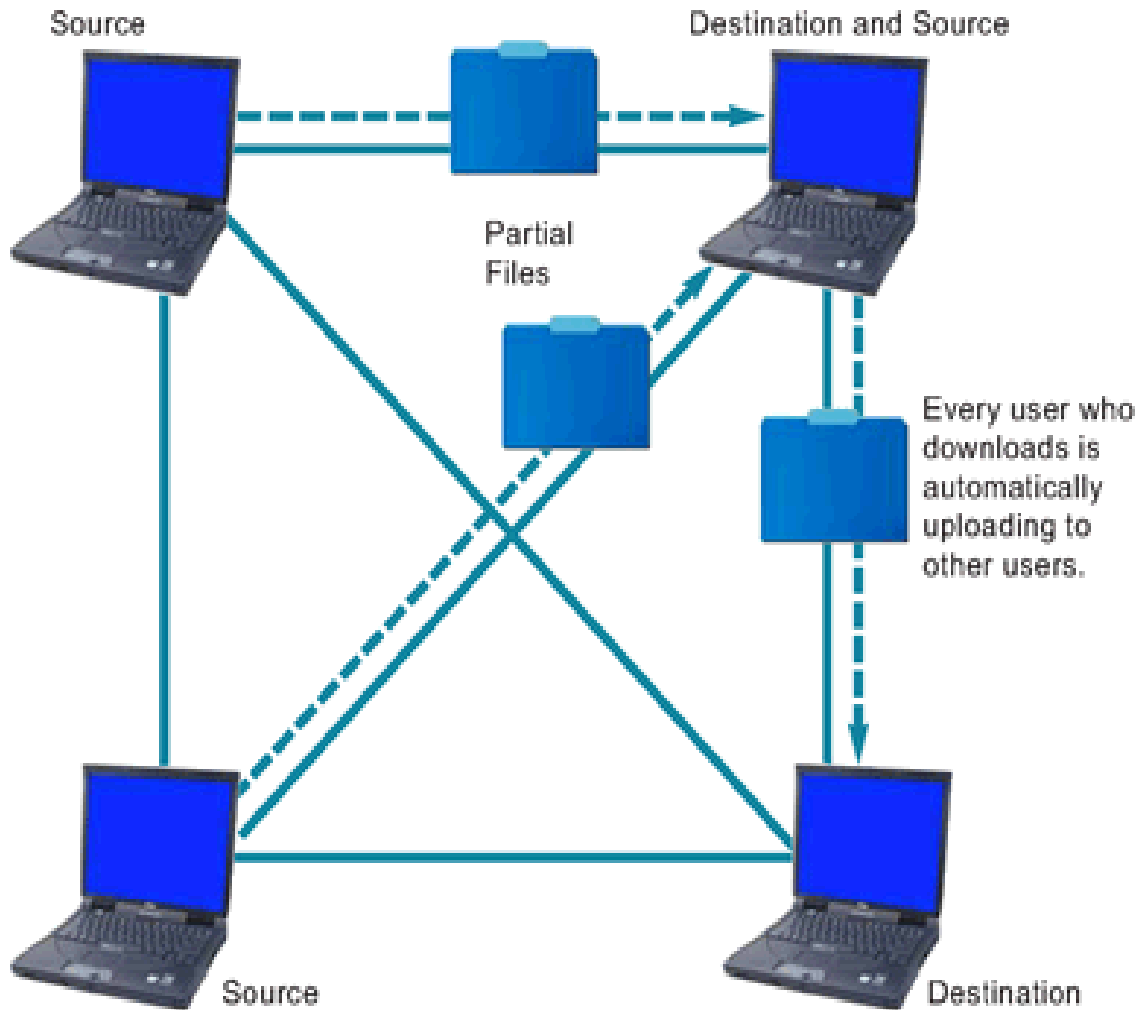
FTP (file transfer protocol)

- Provides a way to transfer files from one computer to another over any TCP/IP network, such as a LAN or Internet
- Easy to upload and download files
- Convenient
- Used for sharing large files (too large for email)
- FTP server resides on a computer containing files that remote users might want to access. Request arrives must have valid identification (log in) to be able to get data
- You can access with FTP client software or browser. E.g. WS-FTP, FTP Voyager, CuteFTP

FILE SHARING

- Sometimes called **P2P** file sharing (peer-to-peer protocols)
- Originated on FTP-style servers
- E.g. Napster, Gnutella, eDonkey, BitTorrent
- BitTorrent is a file sharing protocol that distributes the role of file server across a collection of dispersed computers
- To use this you must install BitTorrent client software. Use it to download from any BitTorrent-enabled site.
- Source of adware and spyware. Computer must be well protected with a security software suite.

BitTorrent



BitTorrent protocols dissect files into small chunks that might reside on different computers. Source computers have received parts of a file from a server. They then distribute these parts to other computers in the swarm.

Internet Security

- Intrusion is any access to data or programs by hackers, criminals, or other authorized persons.
- Data can be stolen or altered, system configurations can be changed to allow even more intrusions, and software can be surreptitiously installed and operated under the remote control of a hacker.

Hacker intrusion

- Ports used in web requests is used by hackers to gain access to your computer.
- **Port probe:** use of automated software to locate computers that have open ports
- Check your computer for open ports using software tools such as Steve Gibson's ShieldsUP!
At www.grc.com

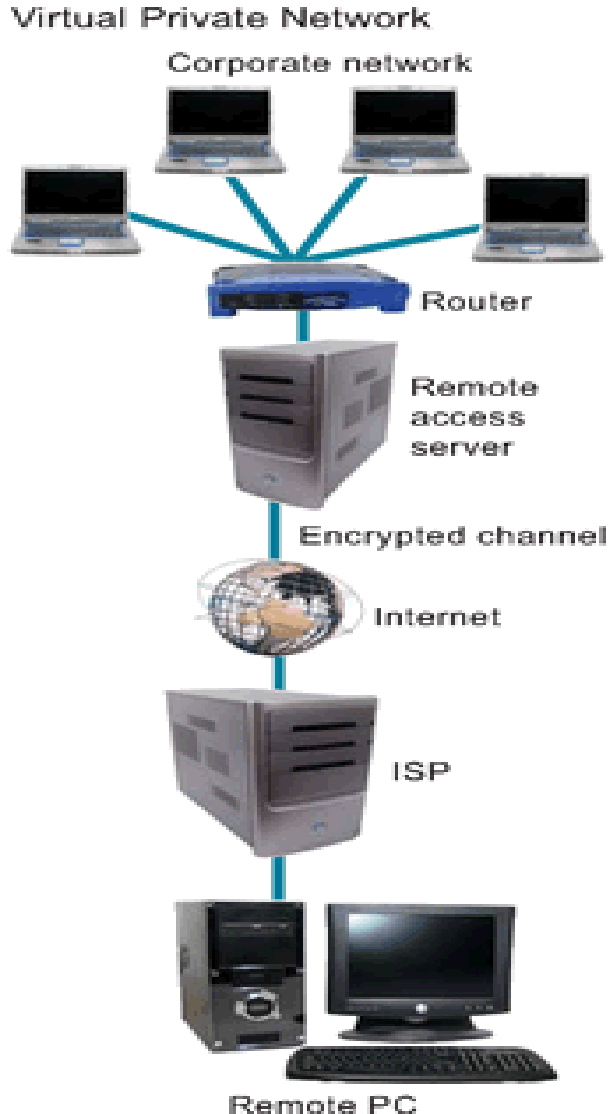
Securing Ports

- Turn it off when you're not using it
- Keep operating system up-to-date
- Use a firewall (software or hardware designed to filter out suspicious packets attempting to enter or leave a computer.
- Firewall
 - Makes sure that incoming information was requested
 - Blocks suspicious IP addresses, and reports intrusion

Other Windows security options

- Turn off file sharing if you don't need to share files with other network users
- Use a router: they can screen IP addresses to keep locally addressed packets within the LAN not over the Internet and back.
- Network address translation (NAT): process router uses to keep track of packets and their corresponding private or public IP addresses

VIRTUAL PRIVATE NETWORKS (VPN)



Access to a VPN is by invitation only.

If you need to access a VPN you need to have

- Instructions, addresses, and passwords to make connections.