Introduction to Home Networks

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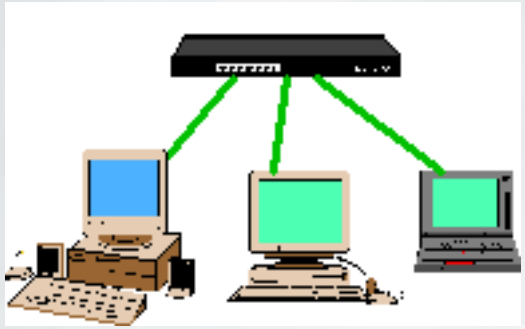

WiFi and Bluetooth

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Author's Note

Parts of this presentation were delivered in conjunction with another presentation titled Domestic Routers and other material created in real-time on flip-charts and a white-board

Why Would I Want a Home Network?

A network allows you to:

- Share one Internet connection between several computers
- Share files between computers
- Share one or more printers between all computers
- Store media (TV, music) and stream it from one computer to any other computer on the network
- Add a wireless access point to give you a wireless network - usually known as WiFi
  - A wireless network allows you to use your laptop computer anywhere in your home without having to connect to the Internet by an Ethernet cable
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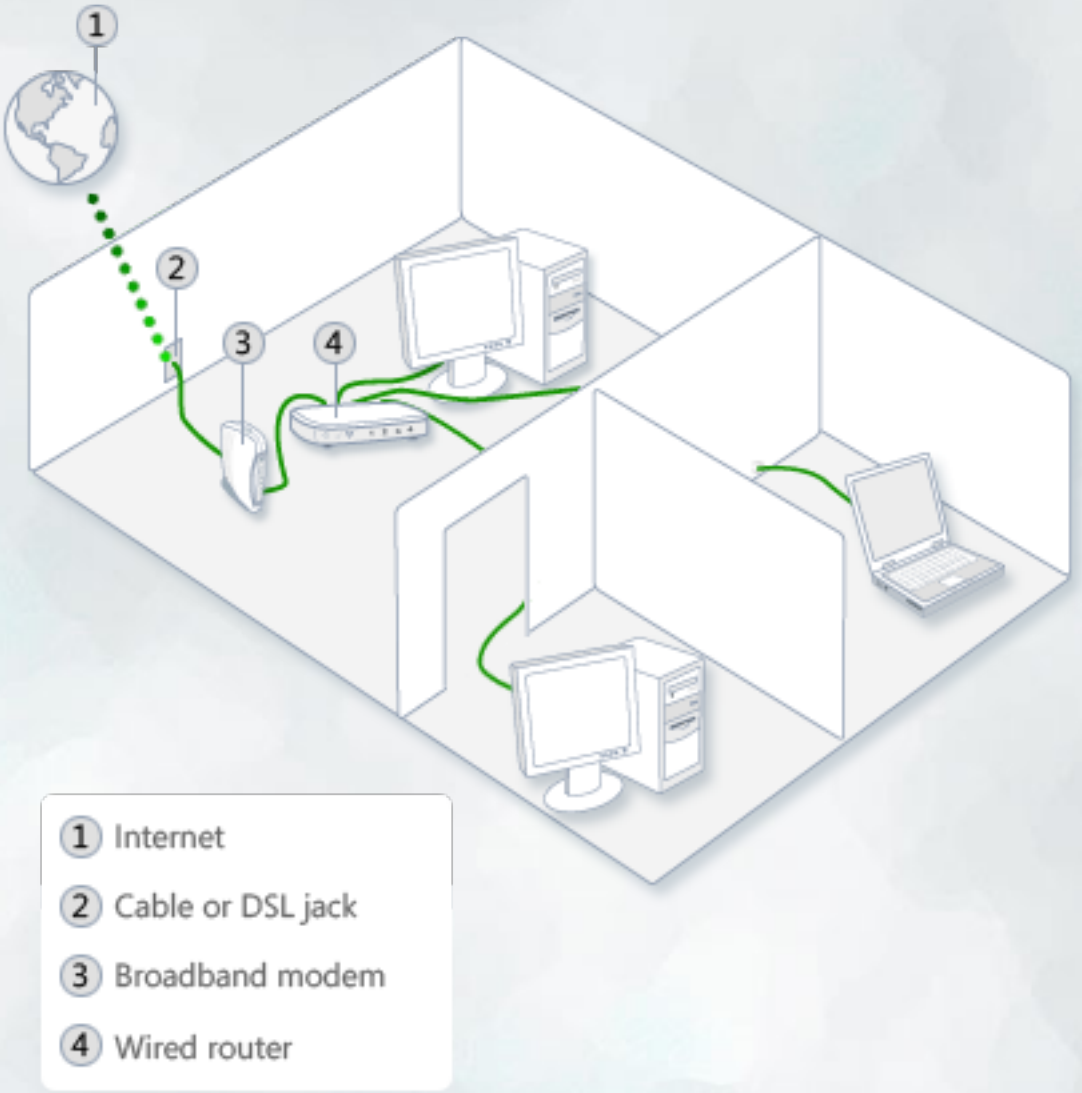
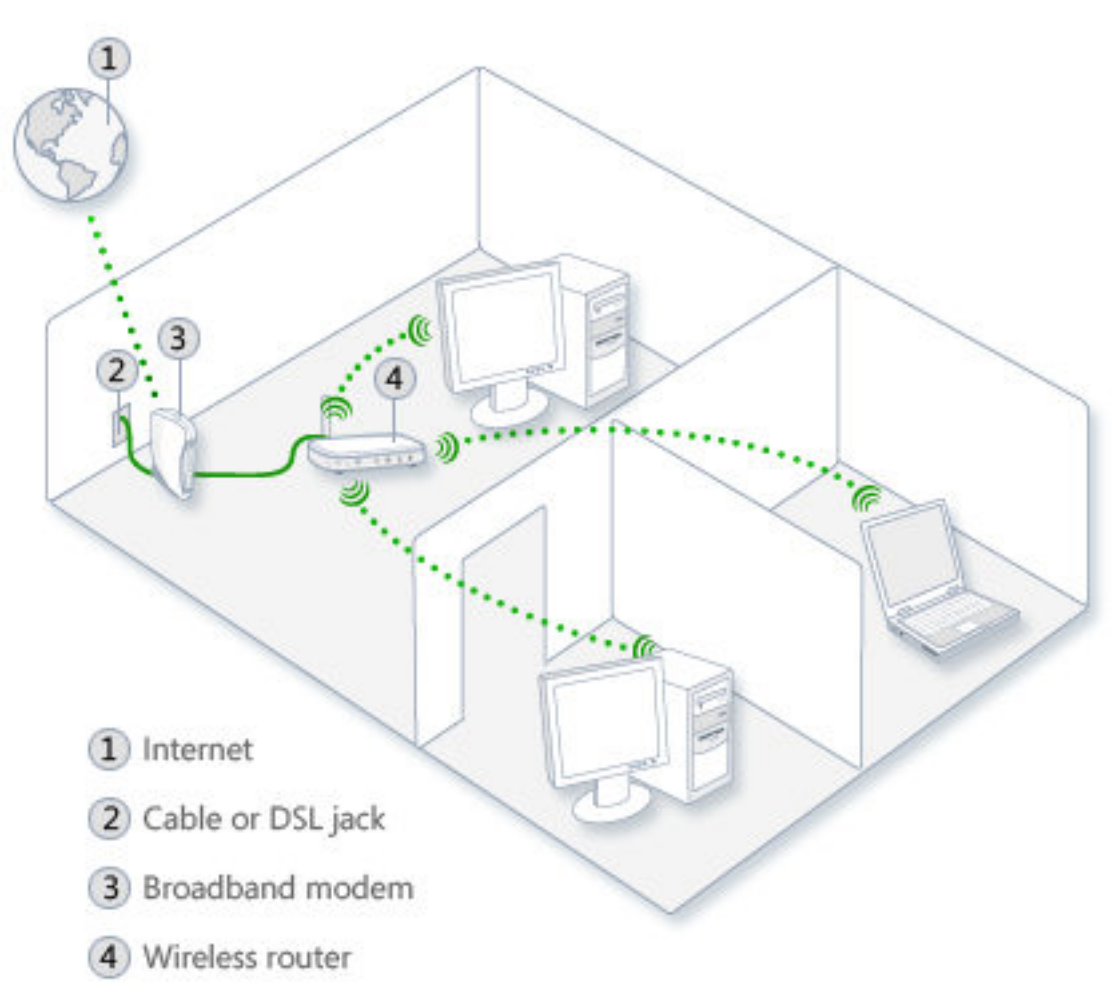
Simple Cable-connected Network

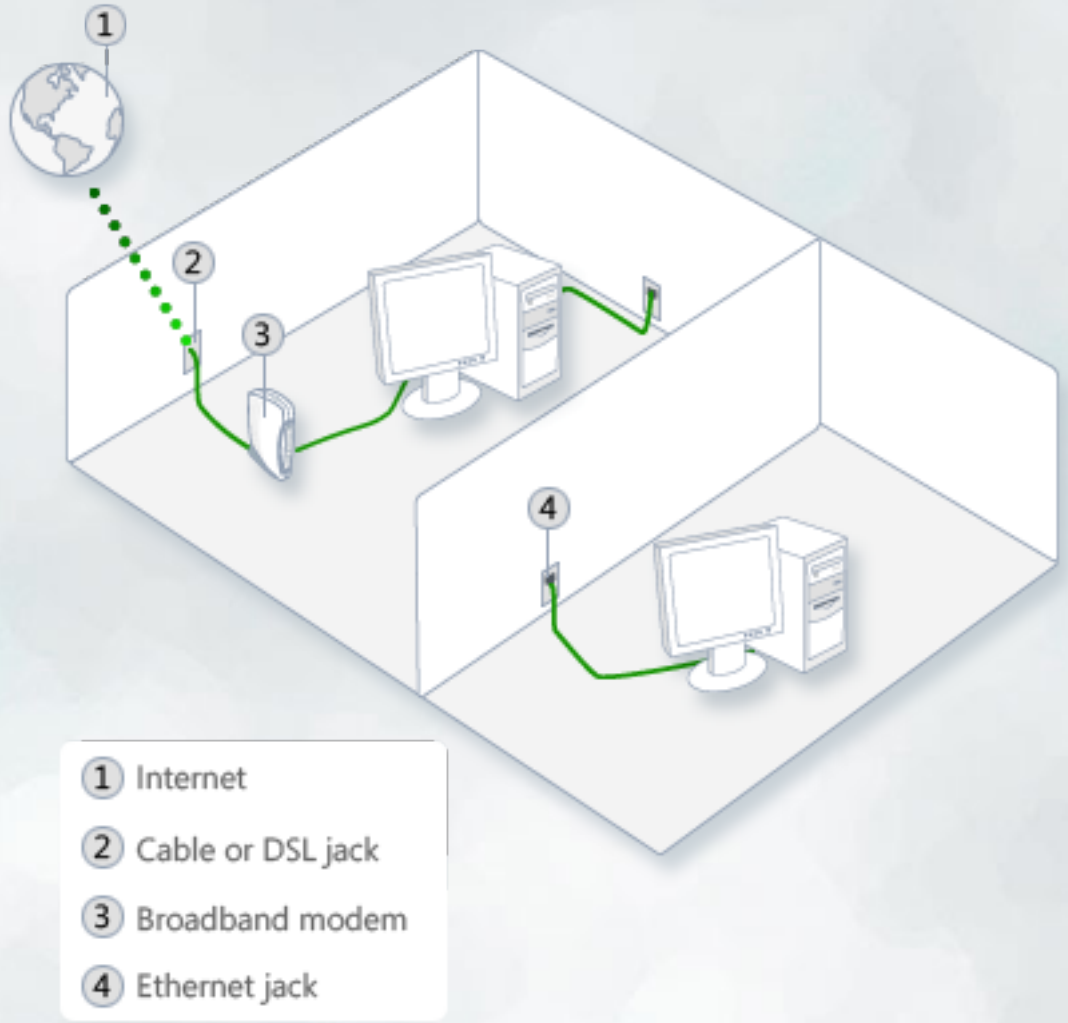


Simple Wireless-connected Network



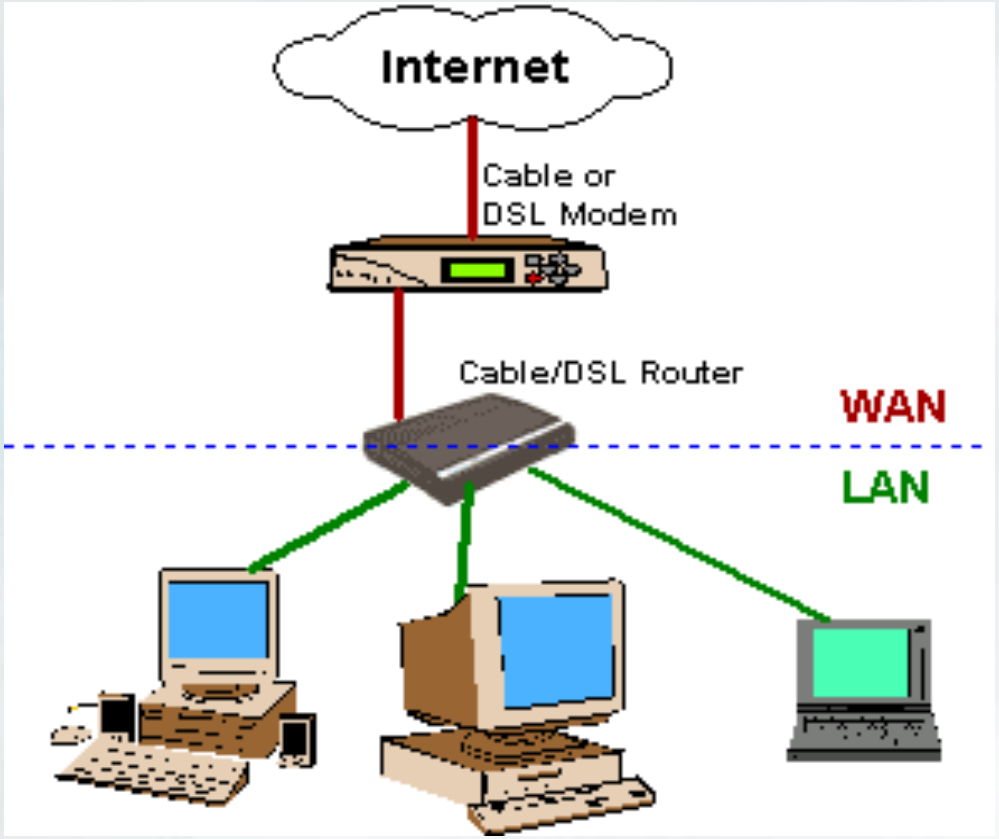
Usually, at least one computer should be connected to the router by an Ethernet cable and there will be at least one printer on the network. Your network can be "mixed"- wired and wireless

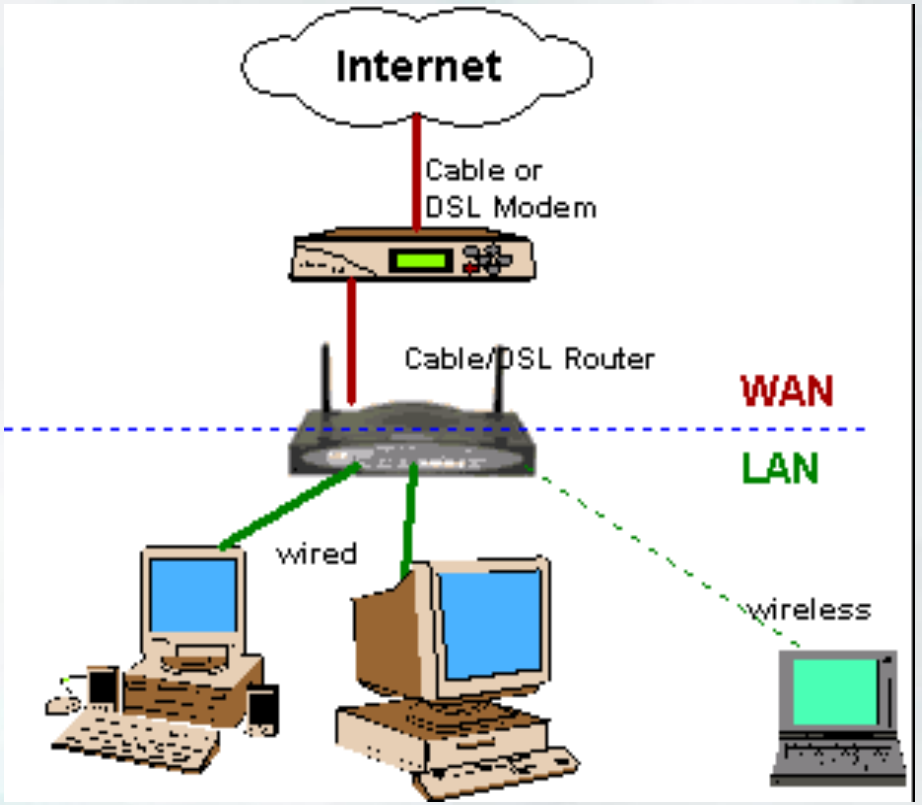
Installed Cable Wall-Jacks



WAN and LAN

With and without a Wireless Access Point





Major Options from the ISP

1. DSL - This provides the slowest connections speeds but is the least expensive. With this technology, the Internet data is carried by your existing telephone line.
2. Cable - The provides intermediate connections speeds and is more expensive than DSL. With this technology, the Internet data is carried by your existing TV cable.
3. Fiber-optic (Verizon FiOS and RCN?) - This provides the fastest connection speeds and is generally the most expensive. With this technology, Internet data (plus TV and Phone) is carried by an optical fiber. Also, Verizon has to install a new (optical fiber) line to your home.

Note: With FiOS a range of upload and download speeds are avilable at different prices.

How Do I Select Which Technology

- If your use of the Internet is minimal and you are happy with your current TV service, you might choose DSL or Cable
- If you want to see TV shows using the Internet, you should probably select Cable or FiOS
- If you'd like a snappy Internet connection and Internet TV and the convenience of one bill, select FiOS. There may be a "bundle" (Phone, TV and Internet) that is attractive.
- Check your budget ;-)

What do I need for a simple network?

1. A fast Internet connection - DSL, Cable, or Fiber-optic (FiOS)
2. A "modem" usually supplied by the Internet Service Provider (ISP) Locally - RCN, Comcast, Verizon
3. A router (with/without a Wireless Access Point)

In the case of DSL and Cable service (RCN - Comcast) the ISP may provide one "box" that contains the modem and the router.

In the case of Verizon FiOS there will be a large box with battery backup (usually in the basement) and the router will usually be installed near your primary computer (frequently a desktop system)

If you are planning a renovation, you might consider locating the router/wireless access point centrally in the house and running a few Ethernet cables.

How Do I Get One?

(Don't try this with Dial-Up)

- If you are happy with your current DSL/Cable you can elect to:
  - add a router/wireless access point yourself or
  - call your ISP and they will schedule an installation
- If you want to upgrade to FiOS, call Verizon and they will schedule an installation.
  - Remember that they will want to do the installation in one visit so it would be prudent to have some idea where each of the two pieces of Verizon equipment will be located by the time the technician arrives at your home

Adding More Computers

- Desktop and laptop computers can be connected to the network by cable or by wireless
- Modern laptops have wireless capability built-in
- Most desktop computers and old laptop computers do not have wireless capability built-in but....
- Wireless capability can be added to desktop and laptop computers for a moderate expense

Adding a Printer to the Network

- A printer can be connected to a network in one of two ways:
  1. Connecting directly to one of the computers
  2. Connecting directly to the network
- NOTE:
  - Option 1 requires the computer connected to the printer to be "always" ON
  - Option 2 does not

- All consumer-printers can be connected directly to a computer (usually via a USB cable)
- Some printers can be connected directly to the network
  - by Ethernet cable
  - by wireless link
    - Details.....

Expanding the Network

More devices can be added to the network

- computers
- printers
- scanners
- X-box and other gaming systems
- Network hard disk drives (NAS)

This may require the use of:

- Ethernet hub
- Ethernet switch
- A wireless access point

All operate in a "similar" way to a power strip in that they increase the number of ports (connections) available

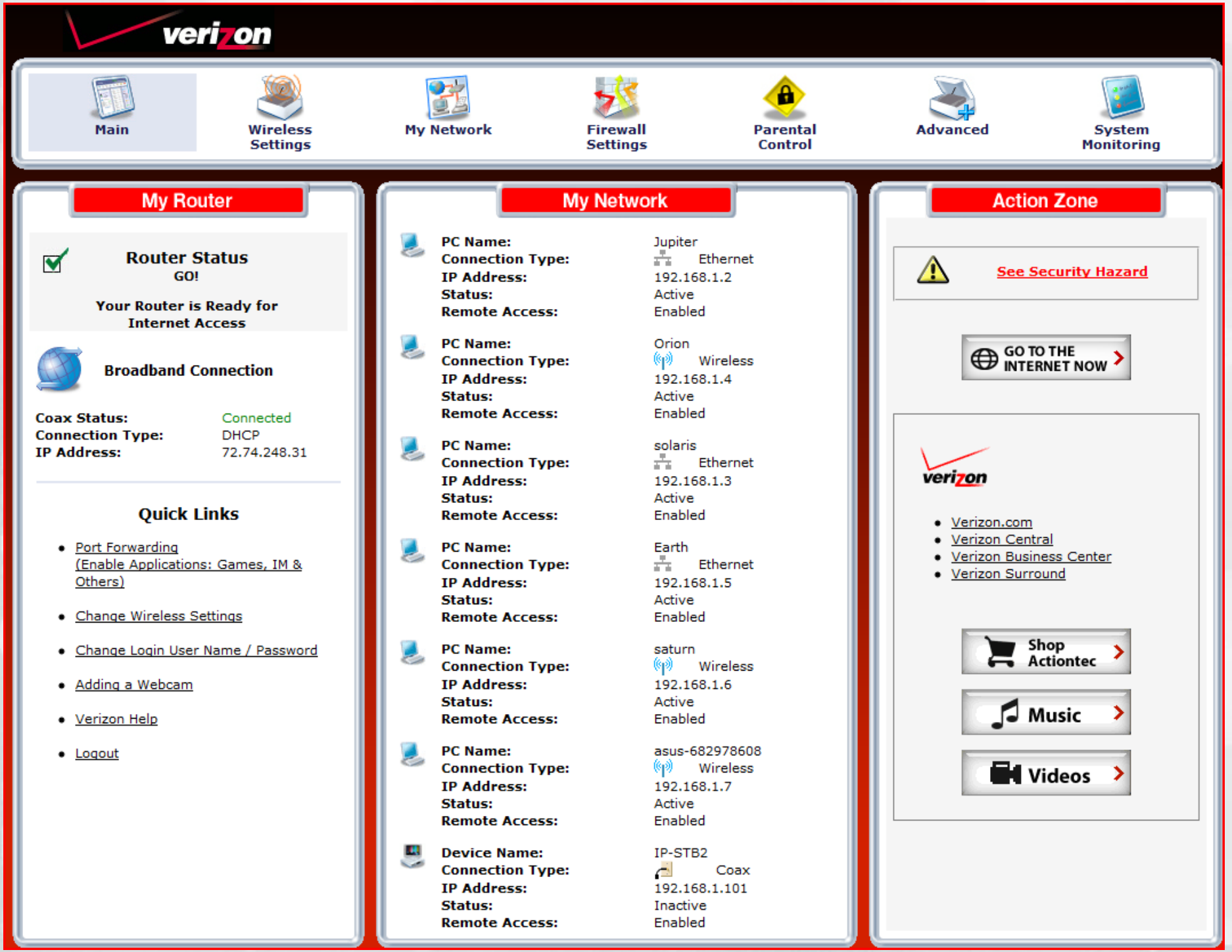
Wireless Networks (WiFi)

- In a wireless network, a radio transmitter-receiver pair located inside the Wireless Access Point replace the Ethernet cable
- The wireless "service" is usually given a name (by the owner) this name is called the SSID
- The service is usually given an encryption key or password to prevent unauthorized use of the service (by hackers)
- Some networks are not protected by such a key and are said to be Open Networks (for example in a cafe like Panera)
- A list of available open networks can be found on the web

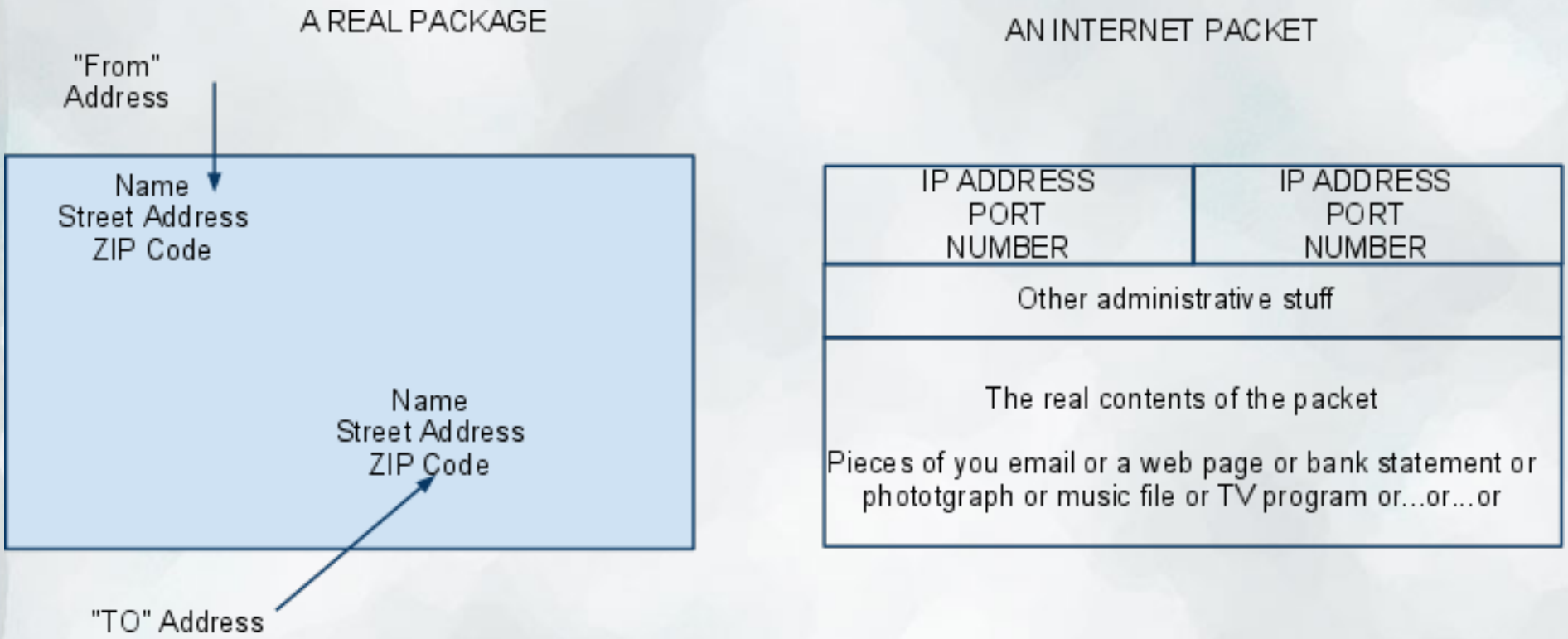
Inside Your Home Router

- In the "old days" electronic boxes had knobs, switches and dials.
- These days many electronic boxes are managed by a computer interface. That is, you examine the status and change the settings of the box by using a keyboard and mouse
- This is done by designing a "web server" into the electronic box. In our case the box is the router.
- The owner or technician "talks" to the box by using a browser program to connect to the web server in the router.
- (Try typing 192.168.1.1 into your browser)
- Usually the web server will require a user name and password to by given to gain access. (It would be usefull for you to know that information for your router)

ActionTec Wireless Router - screen



Compare Real Package and Internet Packet



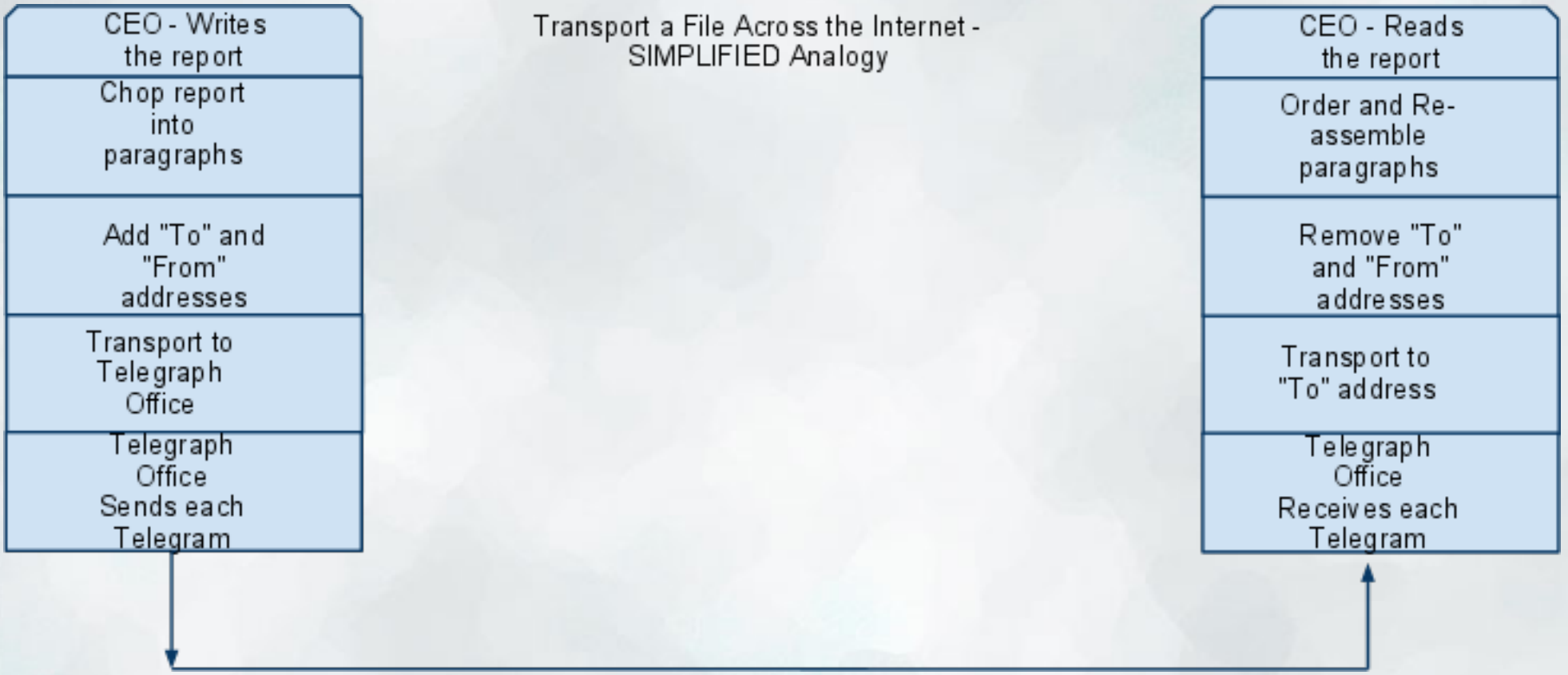
Name <=> Port number
Street Address <=> IP Address

The Telegram Analogy

Send a 10-page report using a series of telegrams

Pacific Coast

Atlantic Coast



Postal System Analogy

See Flip-chart or White-board

IP Address

- Equivalent to your street address - unique in the world
- 32-bit binary number
- Human-readable form - divide 32 into 4 eight-bit parts
  11111111 : 00000000 :11111111 :00000000
- 8-bits convey numbers from zero to 255
- So 255 X 255 X 255 X 255 is a large number ;-)
- *(a small number of IP addresses are reserved for special purposes eg - 192.168.0.0 thru 192.168.255.255*
- **eg the IP address of the router in my home is:**
- **173.76.203.188**
- An international system exists for distributing these numbers between countries around the world

Port Numbers

- These are the software-equivalent of the hardware sockets (ports) on the back of your computer (or other stuff)
- 0 thru 65535 - with hundreds of categories including Unallocated - 49125 - 65535
- When a packet comes into the computer with this port number it means "pass this packet to this program"
- For example"
  - Port 25 is for email
  - Port 80 is for HTTP - Web server
- See:

  http://en.wikipedia.org/wiki/List_of_TCP_and_UDP_port_numbers

Router Operation

Back to Router Presentation

Router Operation

Three main functions:

1. Allocates non - routable numbers to each computer connected to it eg
   192.168.1.1
   192.168.1.2
   192.168.1.3
2. Translate the Return address of out-going packets to routable IP addresses with a new port number
3. Translate the IP address and port number of incomming packets to match the local computer's IP address and port number

Workgroup - HomeGroup - Domain

There are 3 ways computers can be associated in a network:

- Workgroup
- Homegroup
- Domain

In a workgroup

- All computers are peers; no computer has control over another computer.
- Each computer has a set of user accounts. To log on to any computer in the workgroup, you must have an account on that computer.
- There are typically no more than twenty computers.
- A workgroup is not protected by a password.
- All computers must be on the same local network or subnet.

In a homegroup:

- Computers on a home network must belong to a workgroup, but they can also belong to a homegroup. A homegroup makes it easy to share pictures, music, videos, documents, and printers with other people on a home network.
- A homegroup is protected with a password, but you only need to type the password once, when adding your computer to the homegroup.

In a domain:

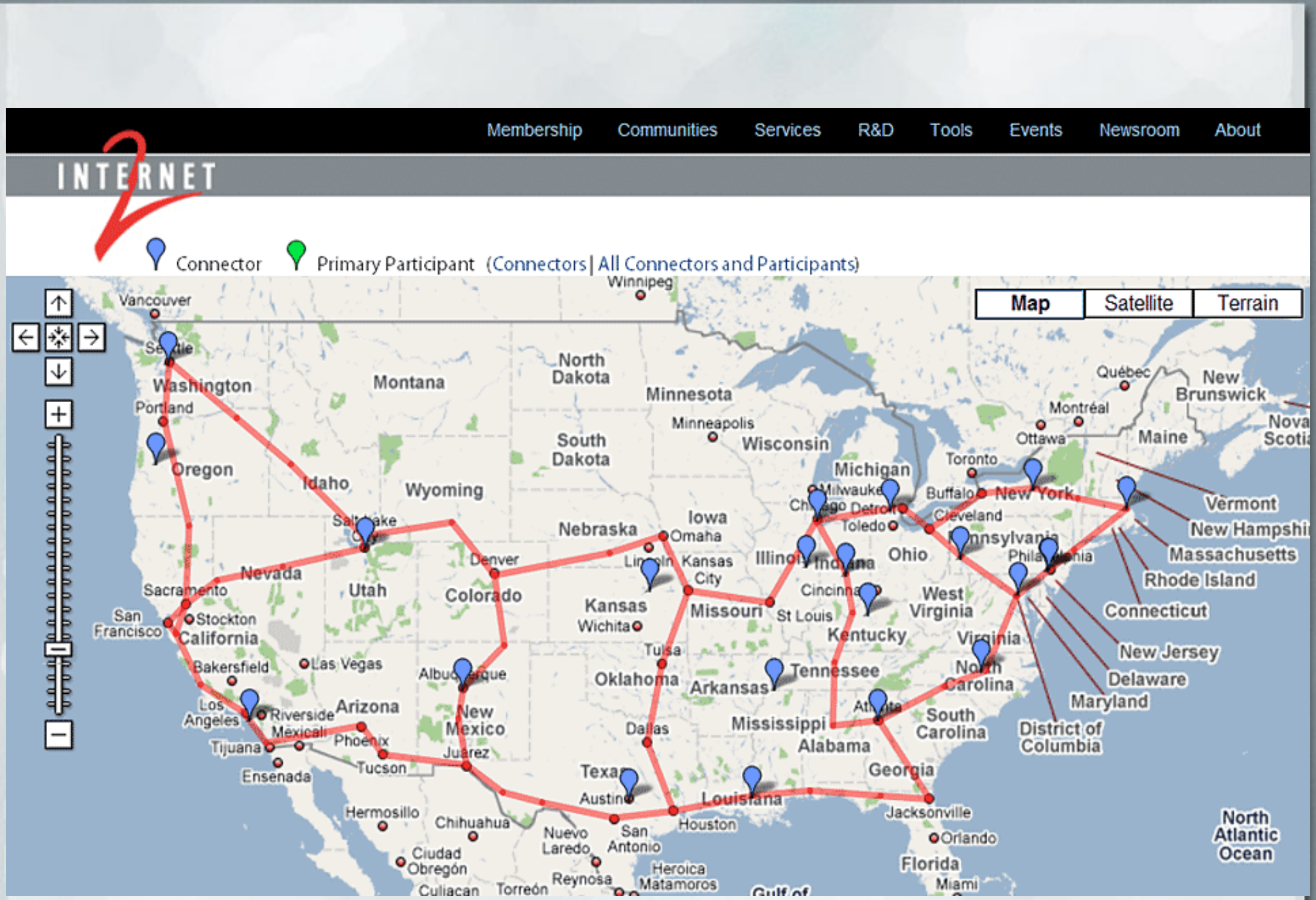
- One or more computers are servers. Network administrators use servers to control the security and permissions for all computers on the domain. This makes it easy to make changes because the changes are automatically made to all computers.
- If you have a user account on the domain, you can log on to any computer on the domain without needing an account on that computer.
- You probably can make only limited changes to a computer's settings because network administrators often want to ensure consistency among computers.
- There can be thousands of computers in a domain.

How Does it All Work?

Answer - Just like the regular mail system ;-)
How does a package get across the country to your home?

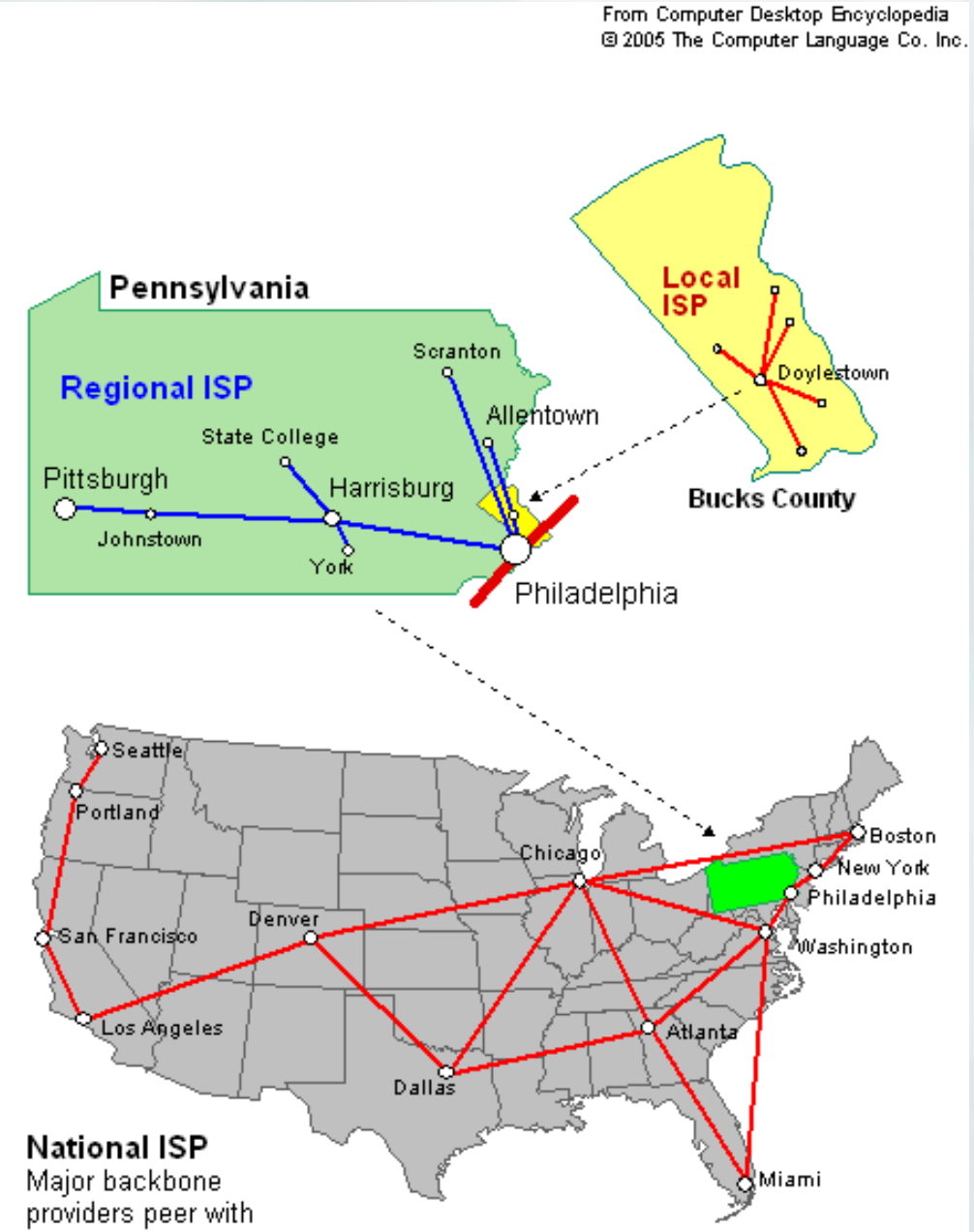
The telegram analogy
TCP/IP Packets and ports
OSI Model Layers
IP Addresses
DNS resolution
NAT and IP address sharing

Verizon Global Backbone


Membership
Communities
Services
R&D
Tools
Events
Newsroom
About
INTERNET 2
Connector
Primary Participant
(Connectors | All Connectors and Participants)
Map
Satellite
Terrain
Vancouver
Winnipeg
Seattle
Washington
Portland
Oregon
Montana
North Dakota
Minnesota
South Dakota
Minneapolis
Wisconsin
Michigan
Idaho
Wyoming
Nebraska
Omaha
Iowa
Denver
Colorado
Nevada
Utah
Sacramento
San Francisco
Stockton
California
Bakersfield
Las Vegas
Los Angeles
Riverside
Arizona
Mexicali
Tijuana
Ensenada
Phoenix
Tucson
New Mexico
Albuquerque
Juarez
Kansas
Wichita
Kansas City
Missouri
St Louis
Illinois
Indiana
Ohio
Cincinnati
West Virginia
Kentucky
Virginia
North Carolina
Tennessee
Arkansas
Oklahoma
Tulsa
Dallas
Texas
Austin
Houston
Louisiana
Mississippi
Alabama
Georgia
South Carolina
Jacksonville
Orlando
Florida
Miami
Hermosillo
Chihuahua
Ciudad Obregón
Culiacan
Nuevo Laredo
San Antonio
Reynosa
Heroica Matamoros
Torreón
Gulf of
Québec
Montréal
Ottawa
Toronto
Buffalo
Cleveland
Toledo
Detroit
New York
Maine
New Brunswick
Vermont
New Hampshire
Massachusetts
Rhode Island
Connecticut
New Jersey
Delaware
Maryland
District of Columbia
North Atlantic Ocean

US Backbone

Diagram for ONE ISP
Other ISPs have similar Backbones which will approximately overlap this



Bluetooth - Main points

Bluetooth is a short range wireless digital communication technology. It was developed as a low cost, low power way of removing many of the data wires between devices. This concept is called a PAN or Personal Area Network.
Bluetooth can remove the wires from your printer allowing your computers or PDA to print directly to it wirelessly. It can remove the wires from your mouse, your joystick, your digital camera and can replace the cradle you drop your PDA into to synchronize your calendar. On an even more personal level, it can remove the wires between your cell phone and a hands-free headset.

Bluetooth has a range of about 30 feet. It also has a maximum throughput of 1.5Mbps. Bluetooth might be good to put in a Webpad to surf the internet, but it's too slow to move good size files between your computers. A typical MP3 file is 3Mb. That would take about 20 seconds or so to move between two bluetooth devices. In contrast, 802.11b could have moved 5-7 of those files in that time.
http://www.bluetooth.com/English/Pages/default.aspx

Links to related web pages

Setting up a home network
http://windows.microsoft.com/en-US/windows-vista/Setting-up-a-home-network

How Stuff Works
http://computer.howstuffworks.com/home-network.htm

About Networks
http://www.microsoft.com/windowsxp/using/networking/default.mspx

Hubs Switches and Routers
http://www.duxcw.com/faq/ics/diffrout.htm
http://duxcw.com/faq/network/hubsw.htm

More Links to Related Web Sites

TCP/IP Guide

http://www.tcpipguide.com/free/t_MessagesPacketsFramesDatagramsandCells-2.htm

http://images.google.com/imgres?imgurl=http://www.windowsnetworking.com/img/upl/image0011210155736818.jpg&imgrefurl=http://www.windowsnetworking.com/articles_tutorials/OSI-Reference-Model-Layer1-hardware.html&usg=__x-E8nDNc_T8y9PEl1vv9SjHcnoE=&h=423&w=541&sz=97&hl=en&start=1&sig2=6Fm-bbT-RzclutJEPKXeEw&um=1&itbs=1&tbnid=p47tl2rGH3Q-qM:&tbnh=103&tbnw=132&prev=/images%3Fq%3Dosi%2Breference%2Bmodel%2Bdiagram%26um%3D1%26hl%3Den%26sa%3DX%26tbs%3Disch:1&ei=w4G4S9_WKYeglAeJo_iXCg

http://nsgn.net/osi_reference_model/

http://www.howstuffworks.com/lan-switch.htm

Geographic Location of IP Addresses
http://www.ip2location.com/demo.aspx

Dec 2010 - Networking computers running different versions of Windows (also list of ports to open on 3rd party firewalls)

http://windows.microsoft.com/en-us/windows7/Networking-home-computers-running-different-versions-of-Windows