Understanding Networks

IT4GIS

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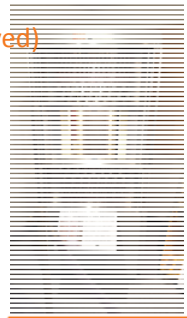
Once Data is Created (saved)



- Someone will want a copy (sharing)
  - BTW, this entire refrigerator-sized memory bank stored 4KB of data
  - That's 0.000004 GB

Why is Networking Important?

- GIS has always been *cursed* with the need to use large files
- GIS'ers have always acted as a community
- **Sharing is normal**

How to Facilitate Sharing…

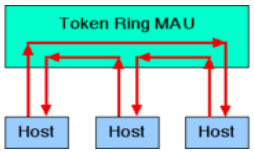
- Floppy disks
- Bernouli disks
- Zip disks
- Jazz disks

In the beginning…

- There were floppy disks
- And the "Sneaker Net"

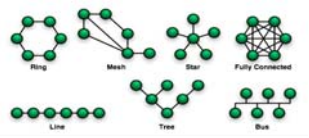
Then along came…

- Networks
  - Cabling that allowed computers to connect to one another
  - Token ring
    - Developed by IBM
    - Using coaxial cable
  - And then…

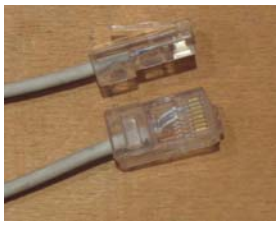


Ethernet

- Developed by Xerox
- Uses Star-topology
- And twisted pair cabling



Cabling



- Twisted pair cabling can be either unshielded (UTP) or,
- Shielded
- IT4GIS will focus on UTP

Capabilities

- Ethernet is described by its **data rate** and **range**
- For instance:
  - 10Base-2
    - 10 (data rate, 10Mb/s)
    - Base (base band)
    - 2 (range, 200 meter runs)
  - 10GBase-T

Ethernet and GIS

- Data rates are 10, 100, 1000, and 10000
  - 10 = 10 Mb/s: Cat 3 cabling
  - 100 = 100 Mb/s, called Fast Ethernet: Uses Cat 5
  - **1000 = 1 Gb/s: Uses Cat 5E**
  - **10000 = 10 Gb/s: Uses Cat 6 and Cat 6a**

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Gigabit Ethernet

- Data rates of 1, 10, 40, or 100 Gbps
- **1 Gbps is supported by Cat5E cabling**
  - **A good GIS workstation option**
  - **Gigabit to the desktop**
- 10 Gbps supported by Cat 6 and Cat 6a cabling
- 100 Gbps requires fiber optic cabling

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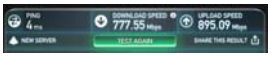
Quantifying Data Rate

- Think of Gbps (or Mbps) as describing the highway
- To measure the actual speed messages are travelling is best described by **PING** (measured in milliseconds (*ms*))
- Think of Ping as describing *your* car's speed on the highway
- Download and Upload (data rate) may be very different



- Try it out at home using http://www.speedtest.net/

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Ethernet and GIS

- Ranges are 2, 5, T
  - 2 = ~ 200 m
  - 5 = ~ 500 m
  - T = well… (for Cat 6/6a, T is about 100 m)
    - It stands for twisted pair. Cable testing tools will determine how long a run can be and still pass "characteristics" test (based on standards)
    - Runs as long as 150 m can be used (Cat 5e).

What's Next…

- Wi-Fi (wireless-fidelity)
- Developed by Cisco, 3Com, Lucent, Nokia, and others
- Specs are described under the IEEE 802.11 group.

Advantages/Limitations of Wi-Fi for GIS

Brain-storm

- **Advantages**
  - No cabling
  - Fairly inexpensive
- **Disadvantages**
  - Security
  - Traffic can congest at the 2.4 Ghz frequency
  - Size of transmission (shared bandwidth)

A Look at 802.11

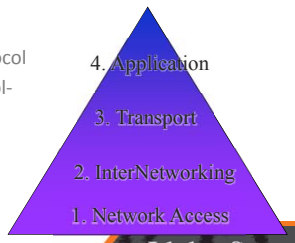
- B=11 Mb/s
- G=54.0 Mb/s
- N=200 Mb/s (2007), approved for 300 Mb/s
  - Operates at the 2.4Ghz or 5Ghz freq.
- A(C-Y)=1 Gbps+ (future)
- AY (2017) will allow 100 Gbps
- *Achievable throughput*
- How do these compare for GIS???

Getting Data from Here to There

- Recap…
  - We know something about the history of networks
  - We know about current Ethernet, Fast Ethernet, and Gigabit Ethernet technologies
  - We know about Wi-Fi capabilities
- These are the *Data Link* and *Physical* Layers, referred to as the *Network Access* Layer.
- But, how does the GIS Data get from here to there on the network…regardless of the type of network

Good Question!

- Packets and Protocols
  - TCP-IP is most common protocol
  - **T**ransmission **C**ontrol **P**rotocol-**I**nternet **P**rotocol



InterNetworking Layer

- Internet Protocol addressing
  - Currently IP v4 is common. This is a 32bit system allowing 4.2B addresses.
    - Example: 134.50.74.10
  - IP v 6 is newer, 128-bit addressing. Allowing 2^{128} addresses.
    - Example: 00-B0-D0-86-BB-F7

Transport Layer

- TCP
  - Transmission Control Protocol
  - Phases of operation
    - Establish connection
    - Transfer data
    - Terminate connection

Application Layer

- You know these well…
  - –HTTP
  - –SMTP
  - –FTP

Where's the Network

- Recap
  - We have now learned how the data moves in packets from our computer through the layers of the TCP-IP model onto the Internet
- But, where's The Internet

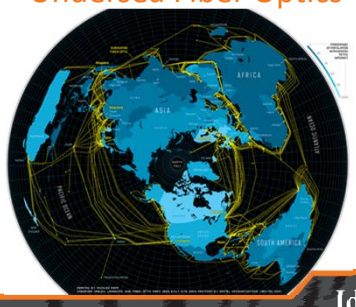
The Internet *Highway*

- From your workstation
- LAN
- Backbone at the Point of Presence
  - AKA…ISP
  - AKA…PoP

Various Backbones

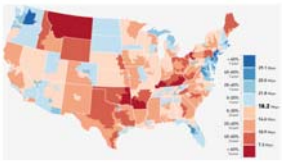
- Redundancy through
  - ARPANet
  - NSFNet
  - Abilene (I2)
  - National LambdaRail
- What is IRON?

Undersea Fiber Optics



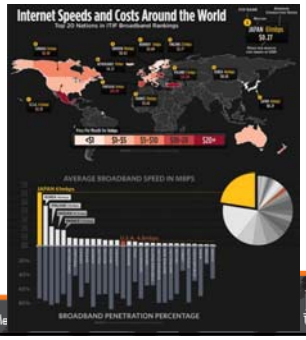
Internet Bandwidth (Data Rates)

- Nationally
  - US Average is 18 Mbps
  - Idaho is below average



Visit http://www.speedtest.net to test your internet

Internet Bandwidth (cont'd)



We could go on forever…

- For IT4GIS, we have gone far enough…
- But today's discussion of networks would not be complete without mention of the second-generation Internet, Web2.0

Web2.0

- Is not :
  - Internet2
  - Is not hardware
  - Is not software
- It is…a whole new way that the Internet is used.
  - Participatory
  - Users are now "prosumers" instead of "consumers"

Participatory Web

- Examples:
  - Wikipedia
  - Flicker
  - Etc.
- What will this mean for GIS?

Web 3.0

- We will cover this in greater detail later in the semester
- For now, what is it?

GIS and the Web

Key Concepts

- Understand how data moves over a network
- Understand the importance of **data rate** for GIS applications.
- Watch the potential of wireless for GIS
- Understand the roles of the various layers within the TCP-IP model
- Understand new terminology like PoP and GigaPoP
- The network is typically the **bottleneck** for GIS
- Contemplate the affect of Web2.0

Questions…

Get ready for the 2-minute write