


Understanding Networks

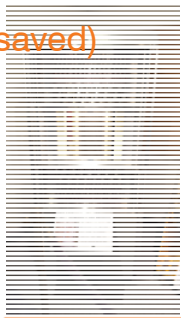
IT4GIS
Keith T. Weber, GISP
GIS Director
ISU-GIS Training and Research Center

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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



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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**



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How to Facilitate Sharing...

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



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In the beginning...

- There were floppy disks
- And the “Sneaker Net”

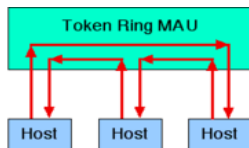


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Then along came...

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

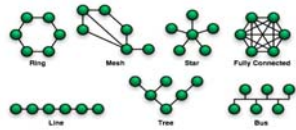


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Ethernet

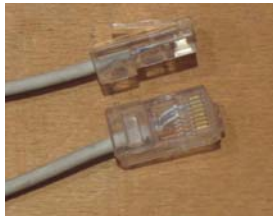
- Developed by Xerox
- Uses Star-topology
- And twisted pair cabling



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Cabling



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

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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

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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

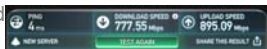
- Data rates of 1, 10, 40, or 100 Gbps
- **1 Gbps is supported by Cat5E cabling**
 - A good GIS workstation option
 - Gigabit to the desktop
- 10 Gbps supported by Cat 6 and Cat 6a cabling
- 100 Gbps requires fiber optic cabling

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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 speeds can 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).

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What's Next...

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

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Advantages/Limitations of Wi-Fi for GIS

Brain-storm

- | | |
|---|---|
| <ul style="list-style-type: none"> • Advantages <ul style="list-style-type: none"> - No cabling - Fairly inexpensive | <ul style="list-style-type: none"> • Disadvantages <ul style="list-style-type: none"> - Security - Traffic can congest at the 2.4 Ghz frequency - Size of transmission (shared bandwidth) |
|---|---|

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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???

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Getting Data from Here to There

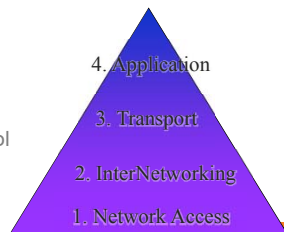
- Recap...
 - We know something about the history of networks
 - We know about current Ethernet, Fast Ethernet, and Gigabit Ethernet technologies
 - We know about Wi-Fi capabilities
- These are the *Data Link* and *Physical Layers*, referred to as the *Network Access Layer*.
- But, how does the GIS Data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

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Good Question!


- Packets and Protocols
 - TCP-IP is most common protocol
 - Transmission Control Protocol- Internet Protocol



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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

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Transport Layer







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

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Application Layer



- You know these well...
 - HTTP
 - SMTP
 - FTP

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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

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The Internet *Highway*

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

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Various Backbones

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



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Undersea Fiber Optics

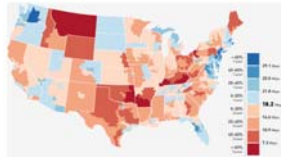


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Internet Bandwidth (Data Rates)

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

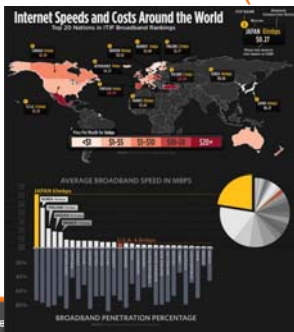


Visit <http://www.speedtest.net> to test your internet

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Internet Bandwidth (cont'd)



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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

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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"

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Participatory Web

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



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Web 3.0

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

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GIS and the Web



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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

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Questions...



Get ready for the 2-minute write

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