



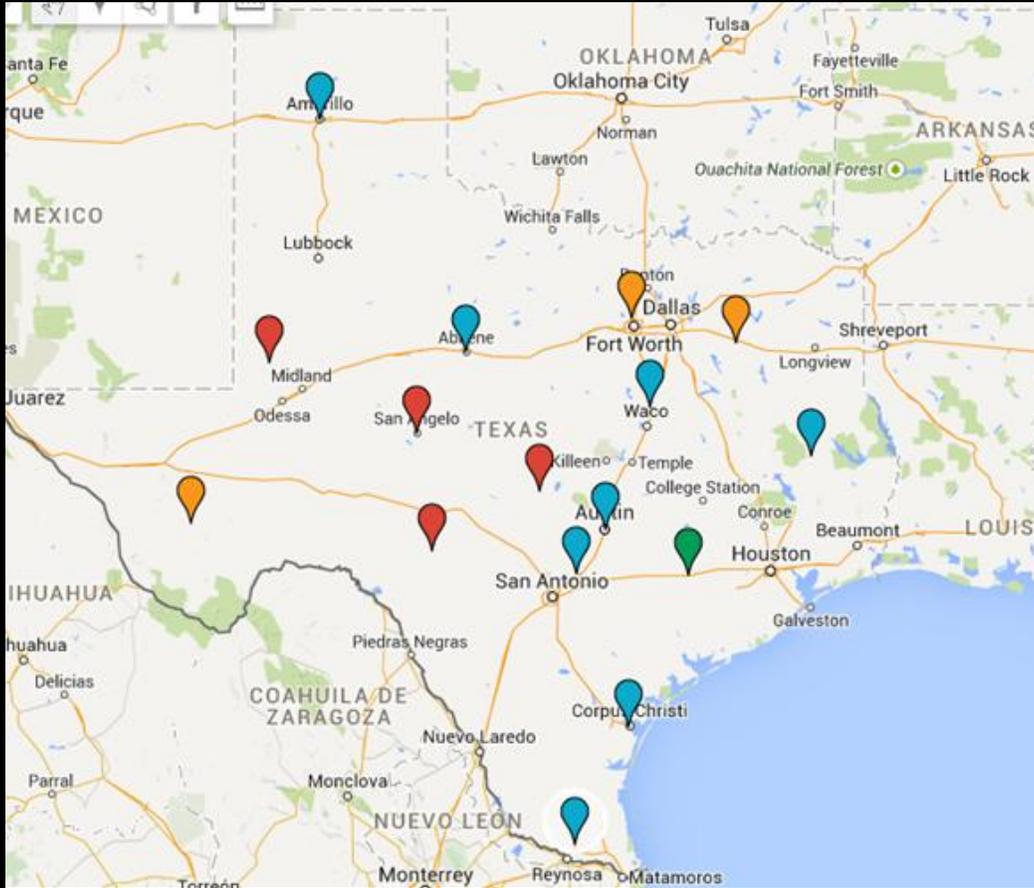
You Can Do I.T. Basic Network Technology for Libraries

Instructor: Carson Block
@CarsonBlock



**Carson Block
Consulting Inc.**
Technology Vision. Technology Power. Your Library.
<http://www.carsonblock.com/>

What is Basic Network Technology for Libraries?



- 16 sites, Spring and Fall

- **Course Objectives:**

Workshop participants will be able to:

- Define common terms used in computer networking
- Understand broadband options available and find ISPs serving their library and/or community
- Demonstrate the ability to conduct speed checks to monitor broadband service in their library
- Identify hardware devices used/needed in a computer network
- Understand the functions and/or purpose of common network devices
- Understand modern cabling design and specifications, and best practices to use when installing network cabling
- Configure typical wired and wireless routers
- Implement basic backups, security and restoration procedures



Meet your instructor: Carson Block



- Who I am

- What I believe

- What I do



We want **you** to be **successful!**



Icebreaker

- Tell us **who you are**, **where you are from**, and a little about your **library job**!
- Tell us about your **worst** and **best** experience with technology!

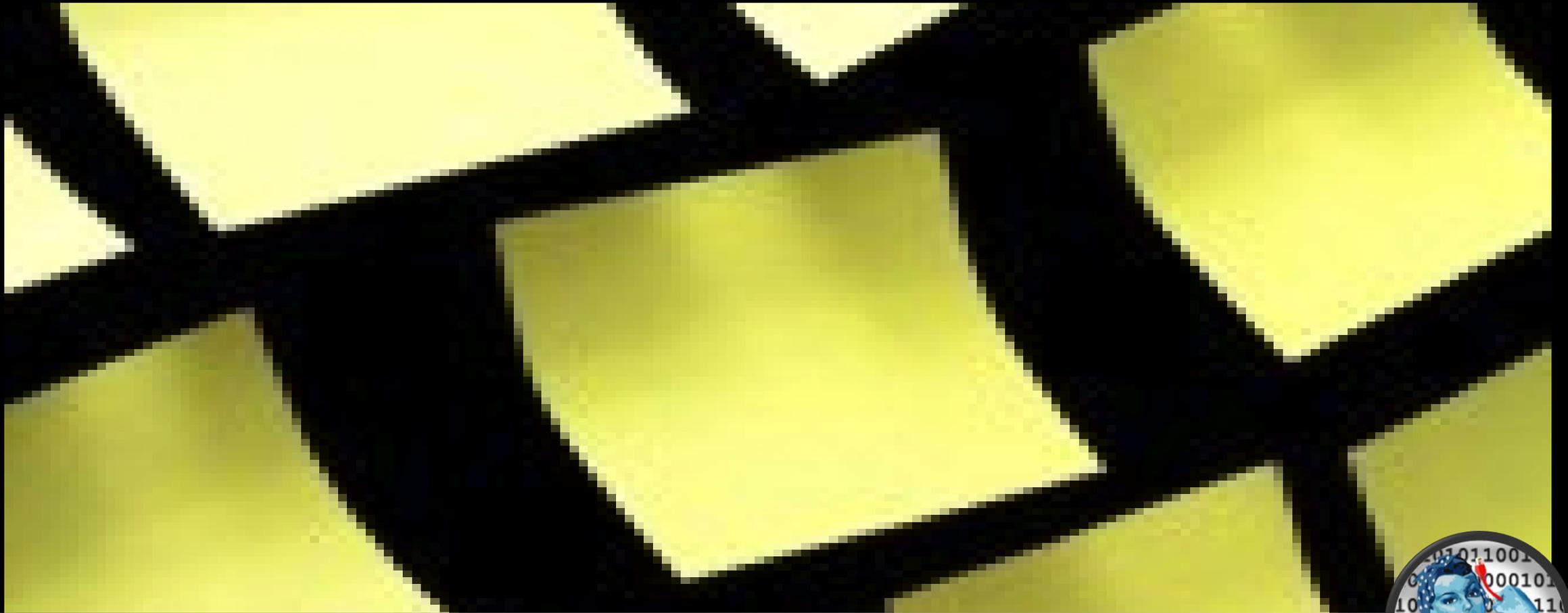


Get ready to engage

- Show and Tell
- Hands on
- Interactive!
- Collaborative
- Conversational
- Safe to explore
- Take comfort breaks when needed



Your thought collector



Workshop Schedule

- | | |
|----------------|--|
| 9:00-11:30 AM | Section I: Network Hardware, Cabling and Internet Service Providers (ISPs) |
| 11:30-12:45 PM | Lunch Break (On Own) |
| 12:45-4:45 PM | Section II: Networking Configuration and Security Skills |



Handouts

- Glossary of Common I.T. Terms
- Broadband Tips
- Morning Quiz (“First Quiz”)
- Basic WiFi Router Setup Guide
- Simple Network Diagram
- Segmented Network Diagram
- Afternoon Quiz (“Final Quiz”)
- Take-Home Checklist



Section I: Network Hardware, Cabling and Internet Service Providers (ISPs)



Section I Outline

- Alphabet Soup – Technology Edition!
- Broadband – Options and Availability
- Speed Check!
- Break
- Network Spaghetti – Hardware and Functions
- Geek Out: TCP/IP and why UC (U Care :0)
- Quiz

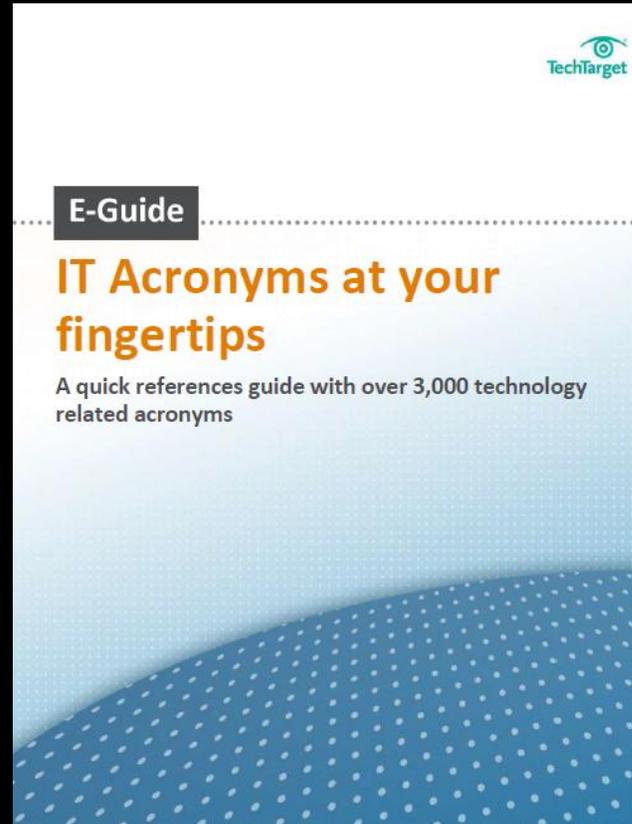


Alphabet Soup—Technology Edition!



Alphabet Soup—Technology Edition!

- Two glossaries:
 - Terms used in this class (for use now)
 - The big “phone book” of IT acronyms (for use later)



You Can Do I.T.
Glossary
Texas State Library and Archives Commission
DRAFT date- 2015

Carson Block Consulting Inc.
Technology Needs, Technology Pains, Total Library.
<http://www.carsonblock.com>

Glossary

Broadband	Operating at, responsive to, or comprising a wide band of frequencies <a broadband radio antenna> ; of, relating to, or being a high-speed communications network and especially one in which a frequency range is divided into multiple independent channels for simultaneous transmission of signals (as voice, data, or video)
Scalability	The ability of a system, network, or process to handle a growing amount of work in a capable manner or its ability to be enlarged to accommodate that growth. For example, it can refer to the capability of a system to increase its total output under an increased load when resources (typically hardware) are added.
802.11a	A specification developed by the IEEE for wireless LAN (WLAN) technology. 802.11 specifies an over-the-air interface between a wireless client and a base station or between two wireless clients. The 802.11a specification uses an orthogonal frequency division multiplexing encoding scheme rather than FHSS or DSSS and provides up to 54 Mbps in the 5GHz band.
802.11ac	A wireless LAN (WLAN) specification under development by the IEEE (Institute of Electrical and Electronics Engineers) that delivers wireless data transfer rates in the range of 433 Mbps (Megabits per second) per spatial stream. With support for up to eight streams, the 802.11ac specification offers a theoretical maximum data transfer speed of more than 3Gbps (Gigabits per second), and can deliver 1.3Gbps transfer speeds with a more common three-antenna (three streams) design.
802.11b	Also referred to as 802.11 High Rate or Wi-Fi, it is an extension to 802.11 specification



Alphabet Soup—Technology Edition!

Please take a look at the glossary.

(hint: you may want to page through and skim first)

- Do you see any terms you are familiar with?
- How about terms that are new to you?



Broadband – Options and Availability



Why are we taking this class? :0)

What is “Broadband?” It’s Fast!

broadband 

adjective | broad·band | \ˈbrɒd-,ˈbænd\

Definition of BROADBAND

- 1 : operating at, responsive to, or comprising a wide band of frequencies <a *broadband* radio antenna>
- 2 : of, relating to, or being a high-speed communications network and especially one in which a frequency range is divided into multiple independent channels for simultaneous transmission of signals (as voice, data, or video)

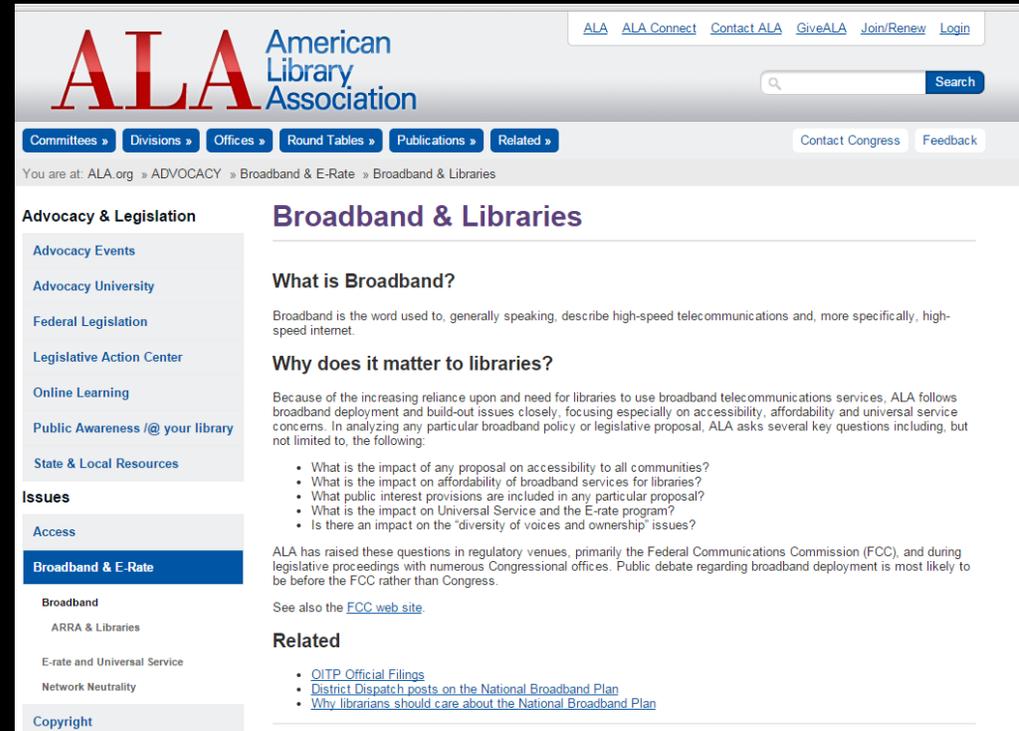
— **broadband** | *noun*



What is “Broadband?”

It’s Fast!

- Broadband is the word used to, generally speaking, describe high-speed telecommunications and, more specifically, high-speed internet.
- In January the FCC determined that a **broadband connection is at least 25 Mb/sec**



The screenshot shows the ALA American Library Association website. The header includes the ALA logo and navigation links such as 'ALA', 'ALA Connect', 'Contact ALA', 'GiveALA', 'Join/Renew', and 'Login'. A search bar is located on the right. Below the header, there are navigation tabs for 'Committees', 'Divisions', 'Offices', 'Round Tables', 'Publications', and 'Related'. The main content area is titled 'Broadband & Libraries' and contains the following text:

What is Broadband?
Broadband is the word used to, generally speaking, describe high-speed telecommunications and, more specifically, high-speed internet.

Why does it matter to libraries?
Because of the increasing reliance upon and need for libraries to use broadband telecommunications services, ALA follows broadband deployment and build-out issues closely, focusing especially on accessibility, affordability and universal service concerns. In analyzing any particular broadband policy or legislative proposal, ALA asks several key questions including, but not limited to, the following:

- What is the impact of any proposal on accessibility to all communities?
- What is the impact on affordability of broadband services for libraries?
- What public interest provisions are included in any particular proposal?
- What is the impact on Universal Service and the E-rate program?
- Is there an impact on the "diversity of voices and ownership" issues?

ALA has raised these questions in regulatory venues, primarily the Federal Communications Commission (FCC), and during legislative proceedings with numerous Congressional offices. Public debate regarding broadband deployment is most likely to be before the FCC rather than Congress.

See also the [FCC web site](#).

Related

- [OITP Official Filings](#)
- [District Dispatch posts on the National Broadband Plan](#)
- [Why librarians should care about the National Broadband Plan](#)

The left sidebar of the website lists various categories under 'Advocacy & Legislation' and 'Issues', with 'Broadband & E-Rate' highlighted in blue.



Why is faster broadband desirable?

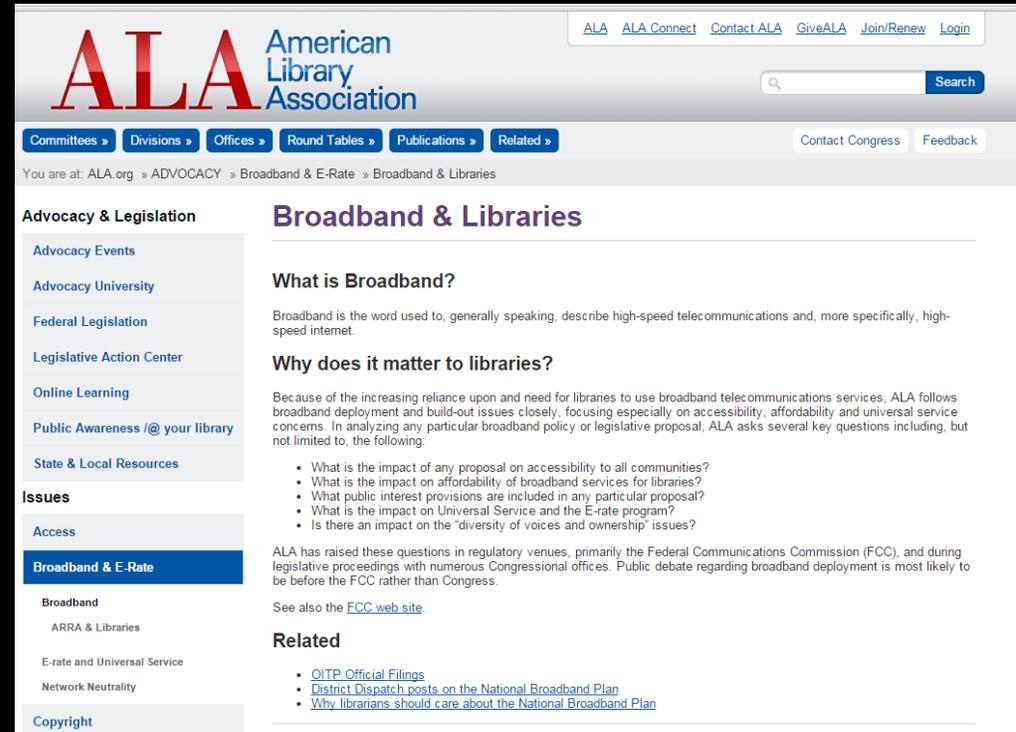
How can I choose the broadband speed for my library?

Two Key Factors:

- What is available in your area? (more on that in a bit)
- What can you afford? (and don't forget E-Rate!)

EDGE Formula Calculator:

<http://impact.ischool.uw.edu/calc.html>



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How is speed measured? (And what do you mean by “big pipe” Internet?)

- Bits per second (bps) - sloooooow
- Kilobits per second (kbps) – dial up modem speed
- Megabits per second (Mbps) – “Broadband”
- Gigabits per second (Gbps) – Fast (think the Google Fiber project in Austin).



Hands on: How can I check my speed?

<http://www.speakeasy.net/speedtest/>

The screenshot shows the MegaPath website's speed test interface. At the top, the MegaPath logo is displayed with the tagline "DATA · VOICE · SECURITY". Below the logo is a navigation menu with links for "DATA & NETWORKING", "VOICE", "SECURITY & MPLS", "HOSTED IT", "SOLUTIONS", "PARTNERS", and "ABOUT". The main heading is "SPEAKEASY SPEED TEST". Below this, the date and time "Thursday 26-Feb 2015, 02:30:08 PM" and the user's IP address "Your IP: 50.134.251.0" are shown. A "CHOOSE A LOCATION" section lists several cities: Seattle, WA; San Francisco, CA; Los Angeles, CA; Dallas, TX; Chicago, IL; Atlanta, GA; New York, NY; and Washington, DC. In the center, there is a promotional banner for "Enterprise-Class Email HOSTED EXCHANGE" with the price "Only \$5.95 + Free Email Migration" and a "Learn More >" link. Below the banner, the "YOUR SPEED RESULTS:" section displays "61.15 Mbps" for "DOWNLOAD SPEED" and "22.84 Mbps" for "UPLOAD SPEED". At the bottom, there is a link to "LEARN MORE ABOUT YOUR BROADBAND SPEED" and the OOKLA logo.

<http://www.speedtest.net/>

The screenshot shows the Speedtest.net website's speed test interface. At the top, there are links for "ADVERTISE", "BECOME A HOST", "MY RESULTS", and "SUPPORT". The main heading is "Test Your Connectivity" with a subtext "Free test to determine how quick your connection is. Check it out!". Below this is a large "BEGIN TEST" button. The interface features a futuristic, glowing blue and green design with a world map. A tooltip for "Estes Park, CO" is visible, indicating it is "Hosted by RMDAS". At the bottom left, the user's IP address "50.134.251.0" and ISP "Comcast Cable" are shown, along with a "Rate Your ISP" link. At the bottom right, a large green number "7,032,256,561" is displayed.



Hands on Speed test: 1 user vs. many users

<http://www.speakeasy.net/speedtest/>

The screenshot shows the MegaPath website's speed test interface. At the top, the MegaPath logo is displayed with the tagline "DATA · VOICE · SECURITY". Below the logo is a navigation menu with links for "DATA & NETWORKING", "VOICE", "SECURITY & MPLS", "HOSTED IT", "SOLUTIONS", "PARTNERS", and "ABOUT". The main heading is "SPEAKEASY SPEED TEST". Below this, the date and time "Thursday 26-Feb-2015, 02:30:08 PM" and the user's IP address "Your IP: 50.134.251.0" are shown. A "CHOOSE A LOCATION" section lists several cities: Seattle, WA; San Francisco, CA; Los Angeles, CA; Dallas, TX; Chicago, IL; Atlanta, GA; New York, NY; and Washington, DC. To the right of this list is a promotional banner for "Enterprise-Class Email HOSTED EXCHANGE" with the text "Only \$5.95 + Free Email Migration" and a "Learn More >" link. Below the banner, the "YOUR SPEED RESULTS:" section displays "61.15 Mbps" for "DOWNLOAD SPEED" and "22.84 Mbps" for "UPLOAD SPEED". At the bottom of the results section is a link: "<< LEARN MORE ABOUT YOUR BROADBAND SPEED >>".

<http://www.speedtest.net/>

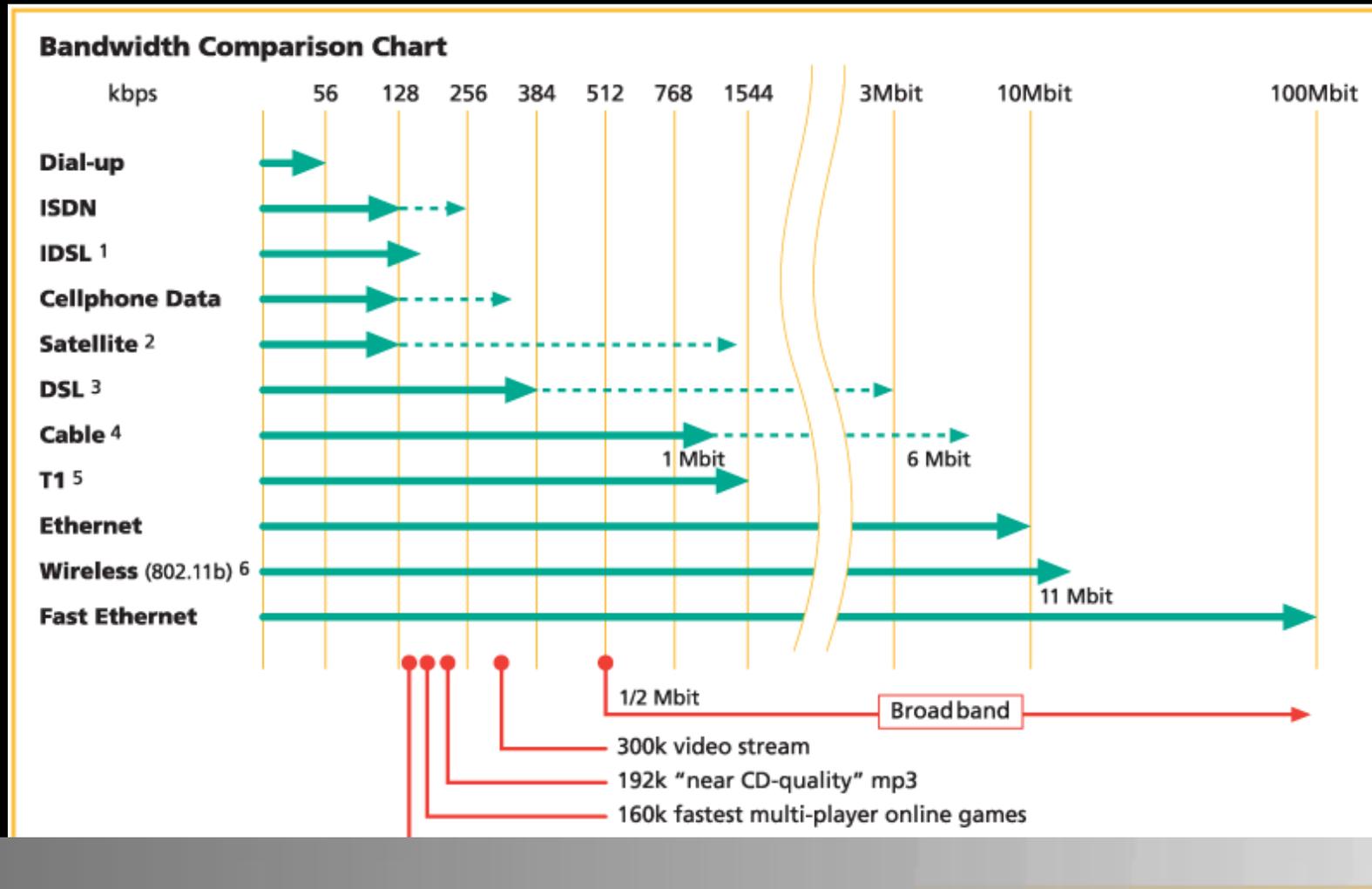
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Handout: Broadband Tips



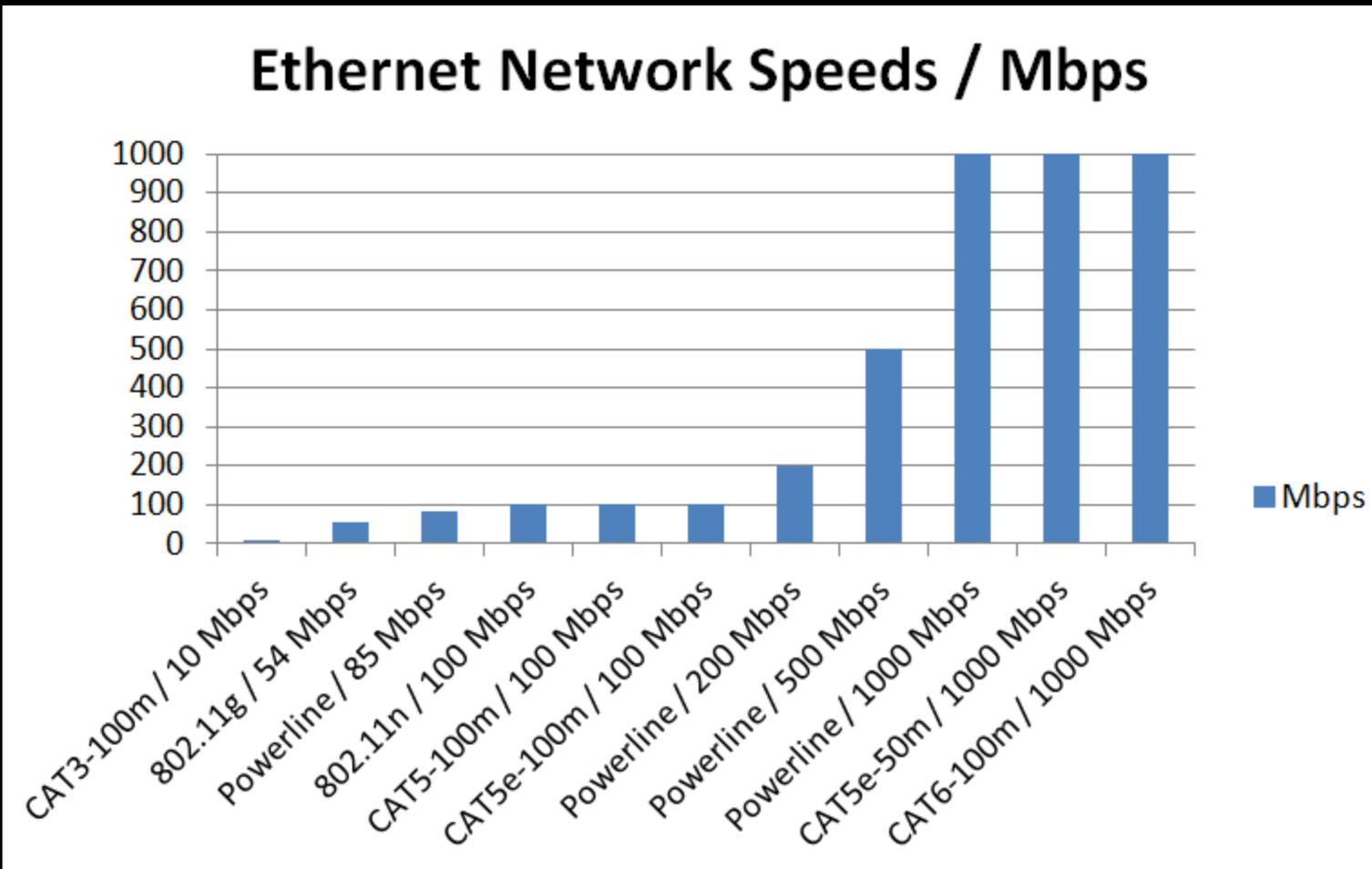
Comparisons of Internet Speeds*



This chart is slightly outdated (does not account for Gig Ethernet or 4G Wireless) but provides a basis to understand where we started...



Comparison of Ethernet Speeds



Comparison of “cell” Wireless Generations

Generation	Speed	Technology	Features
2G	9.6/14.4 kbps	TDMA, CDMA	2G capabilities are achieved by allowing multiple users on a single channel via multiplexing. 2G enabled mobile phones can be used for data along with voice communication.
3G	3.1 Mbps (peak) 500-700 Kbps	CDMA 2000 (1XRTT, EVDO) UMTS, EDGE	3G provides amazing internet browsing speeds. Opens the door to a whole bag of oppurtunities with video calling, video streaming, etc. In 3G, universal access ad portability across different device types are made possible. (Telephone & PDA's)
3.5G	14.4 Mbps (peak) 1-3 Mbps	HSPA	3.5G supports even higher speeds and enhances higher data needs.
4G	100-300 Mbps (peak) 3-5 Mbps	WiMAX LTE	Speeds for 4G are increased to lightning fast in order to keep up with data access demand used by various services. It also supports HD streaming. HD phones can be fully utilized on a 4G network.



How much bandwidth (or speed) do we need?
The answer is always “more.”



**MORE
MORE
MORE**



What is “Scalability,” and why does it matter?

scalable 

adjective | scal·able | \ˈskā-lə-bəl |  

: easy to make larger, more powerful, etc.

 Beat your friends at SCRABBLE® with our official [Word Finder Tool](#) »

Full Definition of SCALABLE

- 1 : capable of being scaled
- 2 : capable of being easily expanded or upgraded on demand <a scalable computer network>

— scal·abil·i·ty  | \,ska-lə-ˈbi-lə-tē | *noun*



What is an Internet Service Provider (ISP)?

Noun \ 'in-tər-ˌnet\ \ 'sər-vəs\ \prə-'vī-dər\

: An organization that provides services for accessing, using, or participating in the Internet.

Internet service providers may be organized in various forms, such as commercial, community-owned, non-profit, or otherwise privately owned.



What are the different types on Internet Connections available?

Typical connections available to libraries include:

- Municipal or school connection (Government)
- Telephone Company (Dedicated circuit or Digital Subscriber Line – DSL)
- Cable Company
- Wireless - “WiFi” or shortwave

- Satellite (mostly just in rural areas)



Hands On: How do I Find Broadband?

<http://broadbandmap.gov/>

County Info // Explore Your Community

Colorado County

County Maps



Broadband Service Inventory



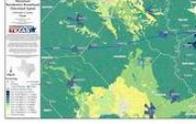
Broadband Service Inventory (Advised Speeds of at Least 3 Mbps Downstream and 768 Kbps Upstream)



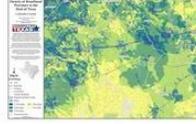
Broadband Service Inventory (Advised Speeds of at Least 10 Mbps Downstream and 1.5 Mbps Upstream)



Density of Households



Maximum Advertised



Density of Providers

• <http://www.connectedtx.org/>

NBM National Broadband Map
How connected is my community?

Homepage · About · Contact Us

529 washington street, columbus, texas 78934

Search Results: Broadband Providers for this Area

Below is the list of broadband providers operating in all or part of the census block for the address above. If you entered a zip code or city name, the list below only displays the broadband providers offering service in the Census Block that is in the center of that zip code or city. See About and the FAQ to learn more about the data gathering process.

Help improve this data by confirming the availability and speed information. This dataset is updated approximately every six months and your input is important to us. Click **Expand All** to see details about each provider and to give us feedback.

Show All · Show Wired · Show Wireless Expand All

Advised Speeds Above 3 Mbps

Data as of: 12/31/13

Verizon Communications Inc.	10 - 25 Mbps	»
AT&T Inc.	10 - 25 Mbps	»
Time Warner Cable Inc.	10 - 25 Mbps	»
JAB Wireless, Inc.	10 - 25 Mbps	»
T-Mobile	6 - 10 Mbps	
Sprint Nextel Corporation	6 - 10 Mbps	

Advised Speeds Above 768 kbps and Below 3 Mbps

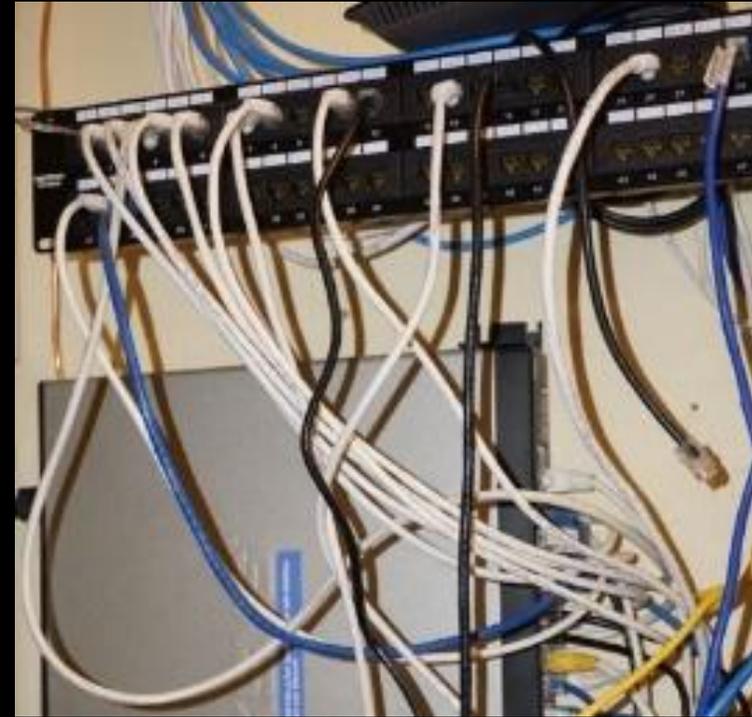
Data as of: 12/31/13

TheSPECnet, Inc.	1.5 - 3 Mbps	
Leap Wireless International, Inc.	768 kbps - 1.5 Mbps	

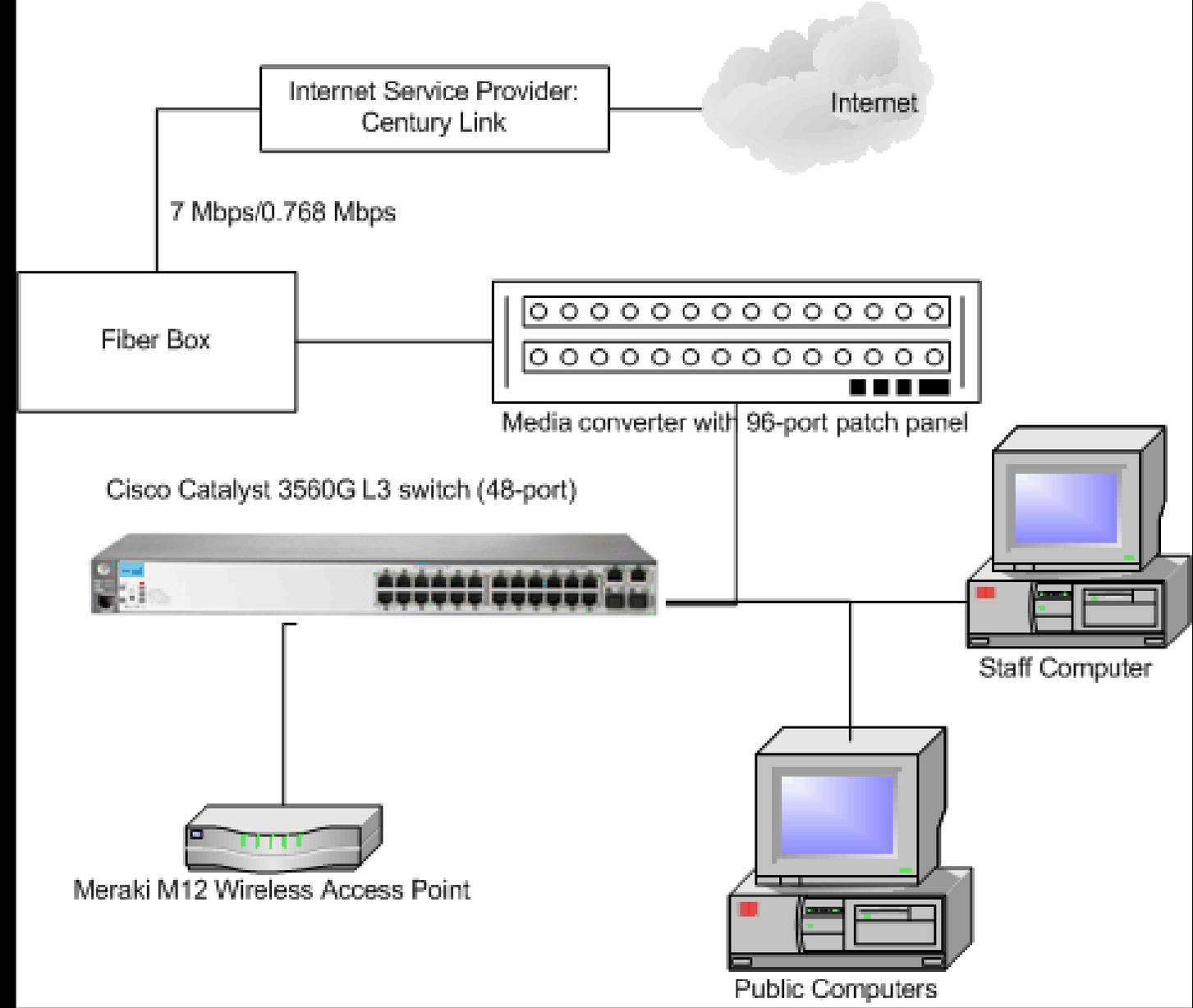
Most Common Speed: 10 Mbps Data Source · Download · API Call



Network Spaghetti – Hardware and Functions



Simple Network Diagram



A diagram of your network is essential for you and others to see something is mostly invisible to the naked eye – the route your data travels.

Many networks share similarities, but few are exactly the same.

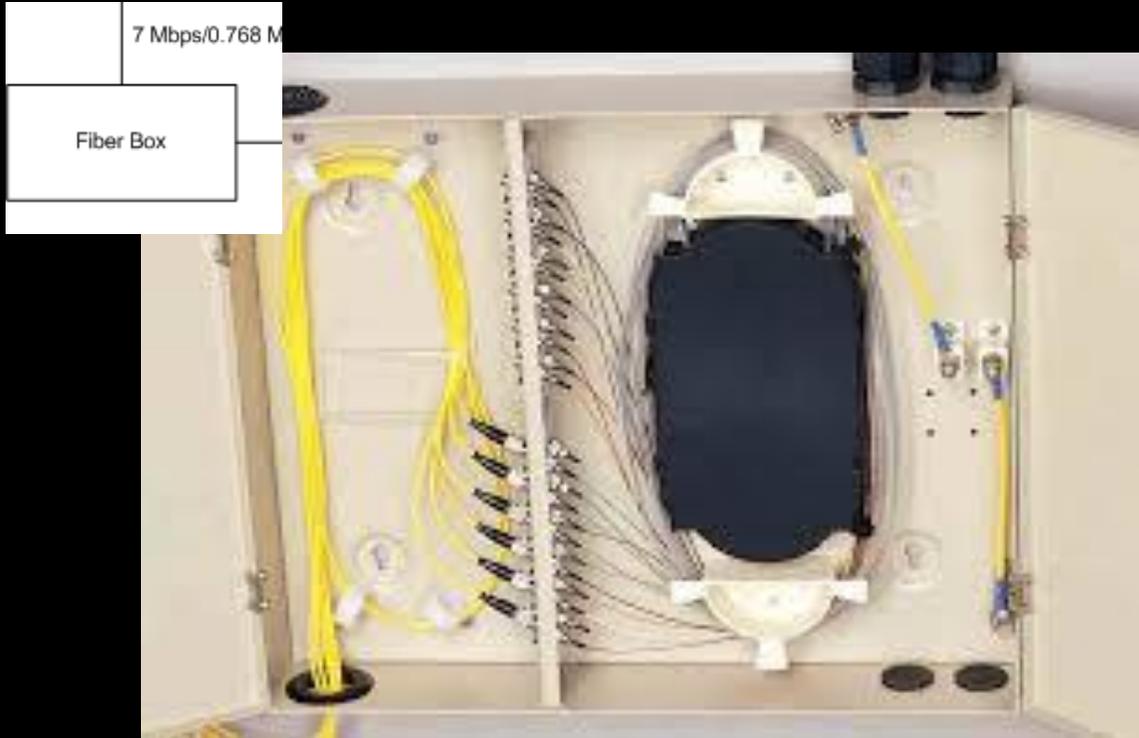
Let's draw a network together as we go....



The Internet (a.k.a. “The Cloud”)



Fiber Box



- From Wikipedia: First developed in the 1970s, fiber-optic communication systems have revolutionized the telecommunications industry and have played a major role in the advent of the Information Age. Because of its advantages over electrical transmission, optical fibers have largely replaced copper wire communications in core networks in the developed world. Optical fiber is used by many telecommunications companies to transmit telephone signals, Internet communication, and cable television signals.



Ethernet

Noun \ 'ē-thər-,net \

: a computer network architecture consisting of various specified local-area network protocols, devices, and connection methods



Category 5 Cable (Cat 5)



Cat 5 is a twisted pair cable for carrying signals. This type of cable is used in structured cabling for computer networks such as Ethernet. The cable standard provides performance of up to 100 MHz and is suitable for 10BASE-T, 100BASE-TX (Fast Ethernet), and 1000BASE-T (Gigabit Ethernet). Cat 5 is also used to carry other signals such as telephony and video.



Category 5e Cable (Cat 5e)

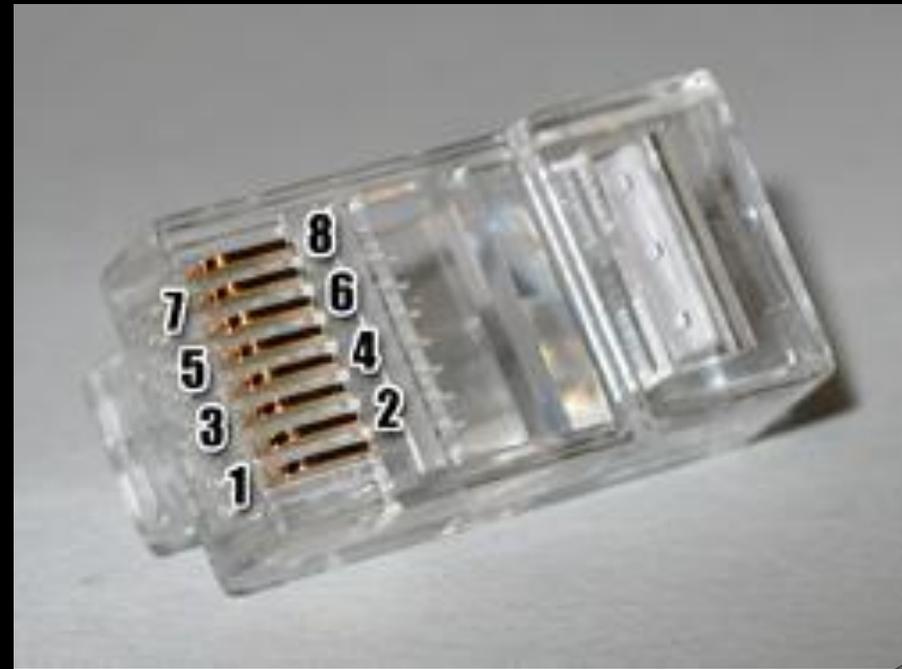


The category 5e specification improves upon the category 5 specification by tightening some crosstalk specifications and introducing new crosstalk specifications that were not present in the original category 5 specification. The bandwidth of category 5 and 5e is the same – 100 MHz. The differences between category 5 and category 5e are in their transmission performance. Category 5e components are most suitable for a high-speed Gigabit Ethernet. While category 5 components may function to some degree in a Gigabit Ethernet, they perform below standard during high-data transfer scenarios.



Category 6 Cable (Cat 6)

Cat 6 cable is a standardized cable for Gigabit Ethernet and other network physical layers that is backward compatible with the Category 5/5e and Category 3 cable standards. Compared with Cat 5 and Cat 5e, Cat 6 features more stringent specifications for crosstalk and system noise. The cable standard provides performance of up to 250 MHz and is suitable for 10BASE-T, 100BASE-TX (Fast Ethernet), 1000BASE-T/1000BASE-TX (Gigabit Ethernet) and 10GBASE-T (10-Gigabit Ethernet).



Wireless Access Point (AP)

Noun \ 'wī(-ə)r-ləs\ \ 'ak-,ses\ \ 'pōint\

: a device that allows wireless devices to connect to a wired network using Wi-Fi, or related standards. The AP usually connects to a router (via a wired network) as a standalone device, but it can also be an integral component of the router itself.



What is a Switch?



Noun

\'swich\'

: a network switch is a computer networking device that connects devices together on a computer network, by using packet switching to receive, process and forward data to the destination device.

Syn: switching hub; bridging hub; MAC bridge



“Endpoint”

Noun \ 'end\ \ 'pɔɪnt\

: anything that attached to the network, including PC, laptop, tablet, phone, ipod, etc.



Geek Out: TCP/IP and why UC (U Care :0)



Transmission Control Protocol/Internet Protocol (TCP/IP)



Noun \TCP\ \IP\

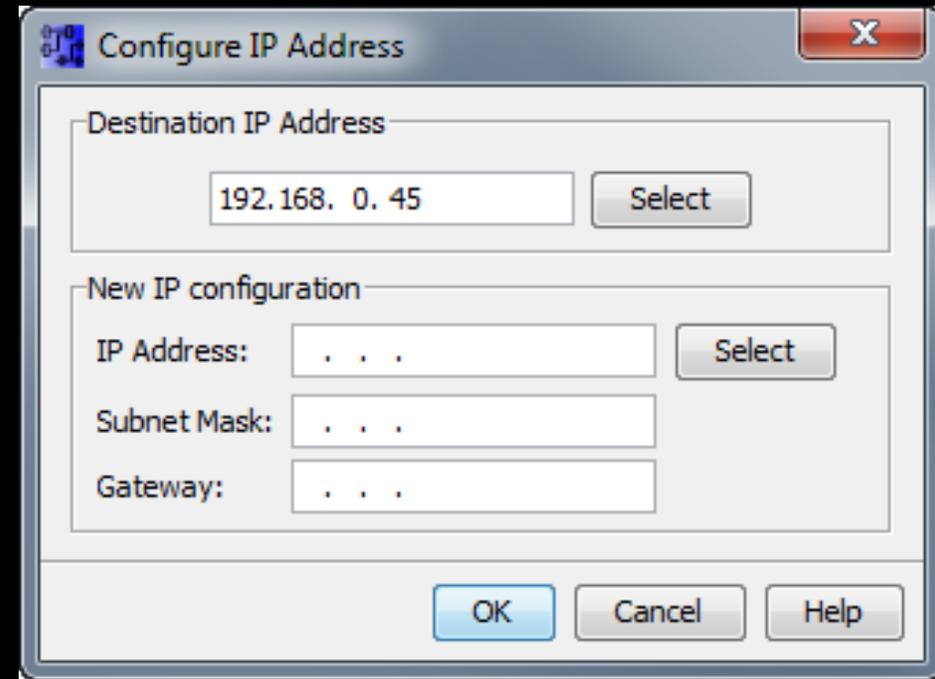
: the suite of communications protocols used to connect hosts on the Internet. TCP/IP uses several protocols, the two main ones being TCP and IP. TCP/IP is built into the UNIX operating system and is used by the Internet, making it the standard for transmitting data over networks.



What is an IP Address?

Noun \I P'a-,dres\
/

: a unique string of numbers separated by periods that identifies each computer using the Internet Protocol to communicate over a network.



What is a Subnet Mask?

Noun \ 'səb-,net\\ 'mask\

: a mask (a filter that selectively includes or excludes certain values) used to determine what subnet an IP address belongs to. An IP address has two components, the network address and the host address.

Subnetting 131.100.0.0/20
 255.255.240.0

No. of Subnets = $2^{4-2} = 14$

No. of hosts/subnet = $2^{12-2} = 4094$

block size = $256 - 240 = 16$

Block	Valid IP range	N/W Address	B/C address
16	131.100.16.1 - 131.100.31.254	131.100.16.0	131.100.31.255
32	131.100.32.1 - 131.100.47.254	131.100.32.0	131.100.47.255
48	131.100.48.1 - 131.100.63.254	131.100.48.0	131.100.63.255
64	131.100.64.1 - 131.100.79.254	131.100.64.0	131.100.79.255
80	131.100.80.1 - 131.100.95.254	131.100.80.0	131.100.95.255
96	131.100.96.1 - 131.100.111.254	131.100.96.0	131.100.111.255
112	131.100.112.1 - 131.100.127.254	131.100.112.0	131.100.127.255
128	131.100.128.1 - 131.100.143.254	131.100.128.0	131.100.143.255
144	131.100.144.1 - 131.100.159.254	131.100.144.0	131.100.159.255
160	131.100.160.1 - 131.100.175.254	131.100.160.0	131.100.175.255
176	131.100.176.1 - 131.100.191.254	131.100.176.0	131.100.191.255
192	131.100.192.1 - 131.100.207.254	131.100.192.0	131.100.207.255
208	131.100.208.1 - 131.100.223.254	131.100.208.0	131.100.223.255
224	131.100.224.1 - 131.100.239.254	131.100.224.0	131.100.239.255



Well, uh.....?

Think of **the IP address** as the **number on a house**.

Think of the **subnet mask** as the **name of the street** the house is on.

The post office needs to **know both** to **deliver a letter**.

(Yes, this letter is from Elvis)



What is a gateway?

Noun \ 'gāt-, wā\

A gateway routes packets from a wireless LAN to another network, wired or wireless WAN. It may be implemented as software or hardware or combination of both. Wireless gateways combine the functions of a wireless access point, a router, and often provide firewall functions as well.

For our purposes today, our router
is our gateway.



What is a “public” IP address?

Public addresses are assigned by InterNIC and **consist of class-based network IDs that are guaranteed to be globally unique to the Internet.**

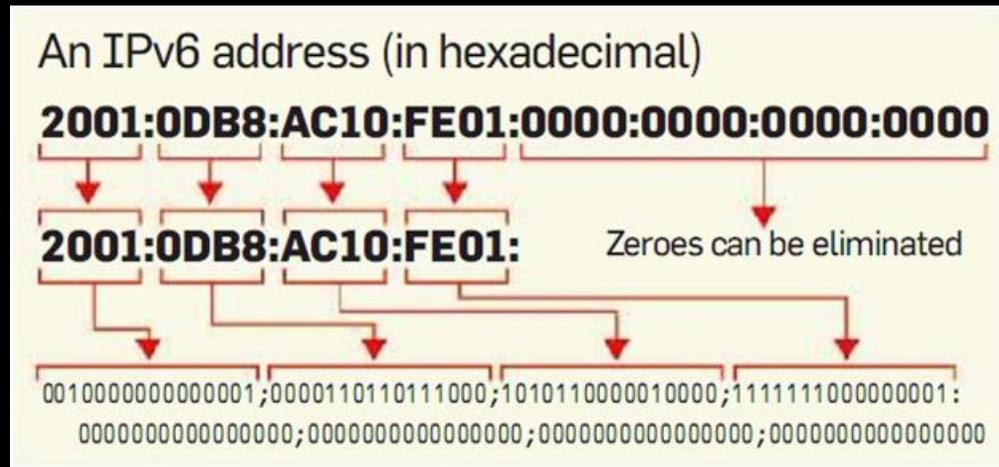
When the public addresses are assigned, routes are programmed into the routers of the Internet so that traffic to the assigned public addresses can reach their locations. Traffic to destination public addresses are reachable on the Internet.



Public IP address are also called “routable IPs”



IP addresses and IPv6



Internet Protocol version 6 (IPv6) is the latest version of the Internet Protocol (IP), the communications protocol that provides an identification and location system for computers on networks and routes traffic across the Internet. IPv6 was developed by the Internet Engineering Task Force (IETF) to deal with the long-anticipated problem of IPv4 address exhaustion. IPv6 is intended to replace IPv4.



What is a “private” IP address?

- A private IP address is a non-Internet facing IP address on an internal network. Private IP addresses are provided by network devices, such as routers, using network address translation (NAT).



“Private” IP addresses are we most often use for our internal networks.



What is NAT (Network Address Translation)?

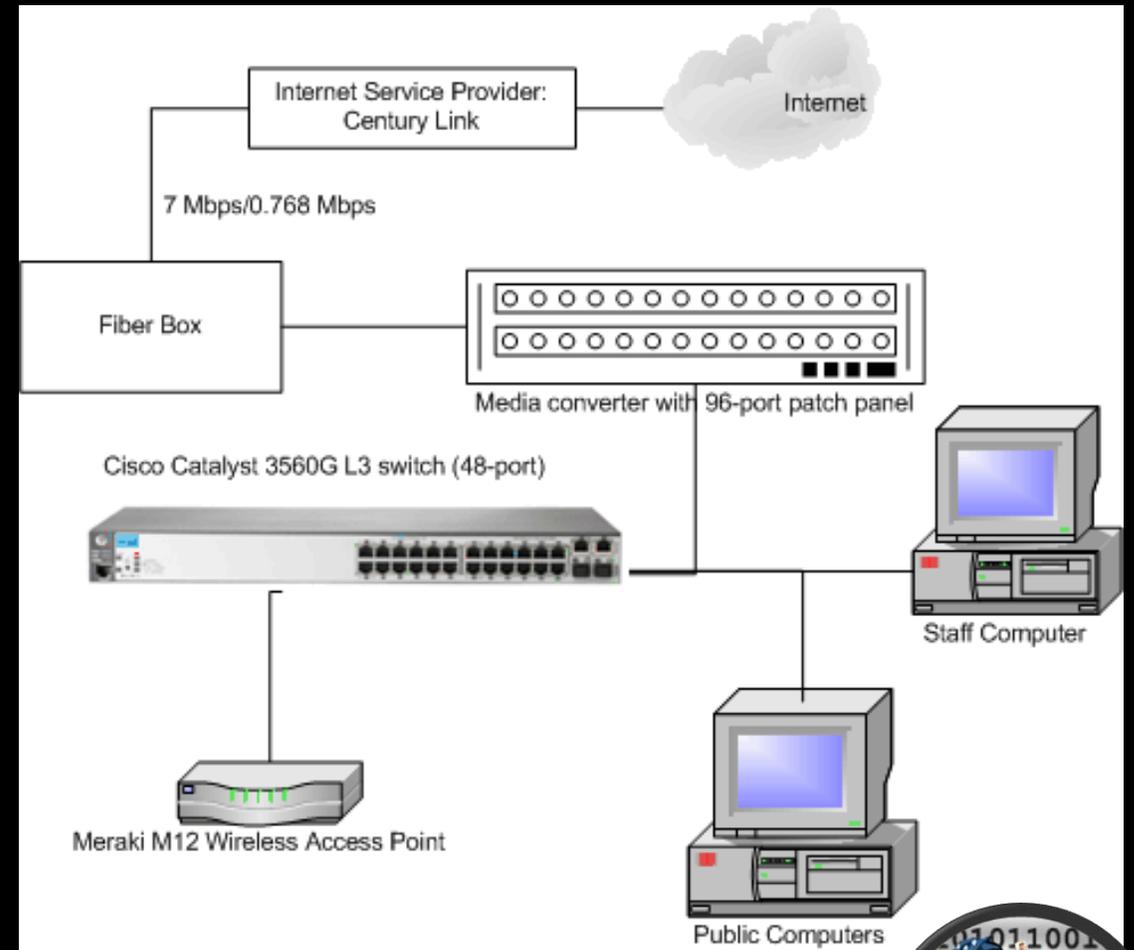
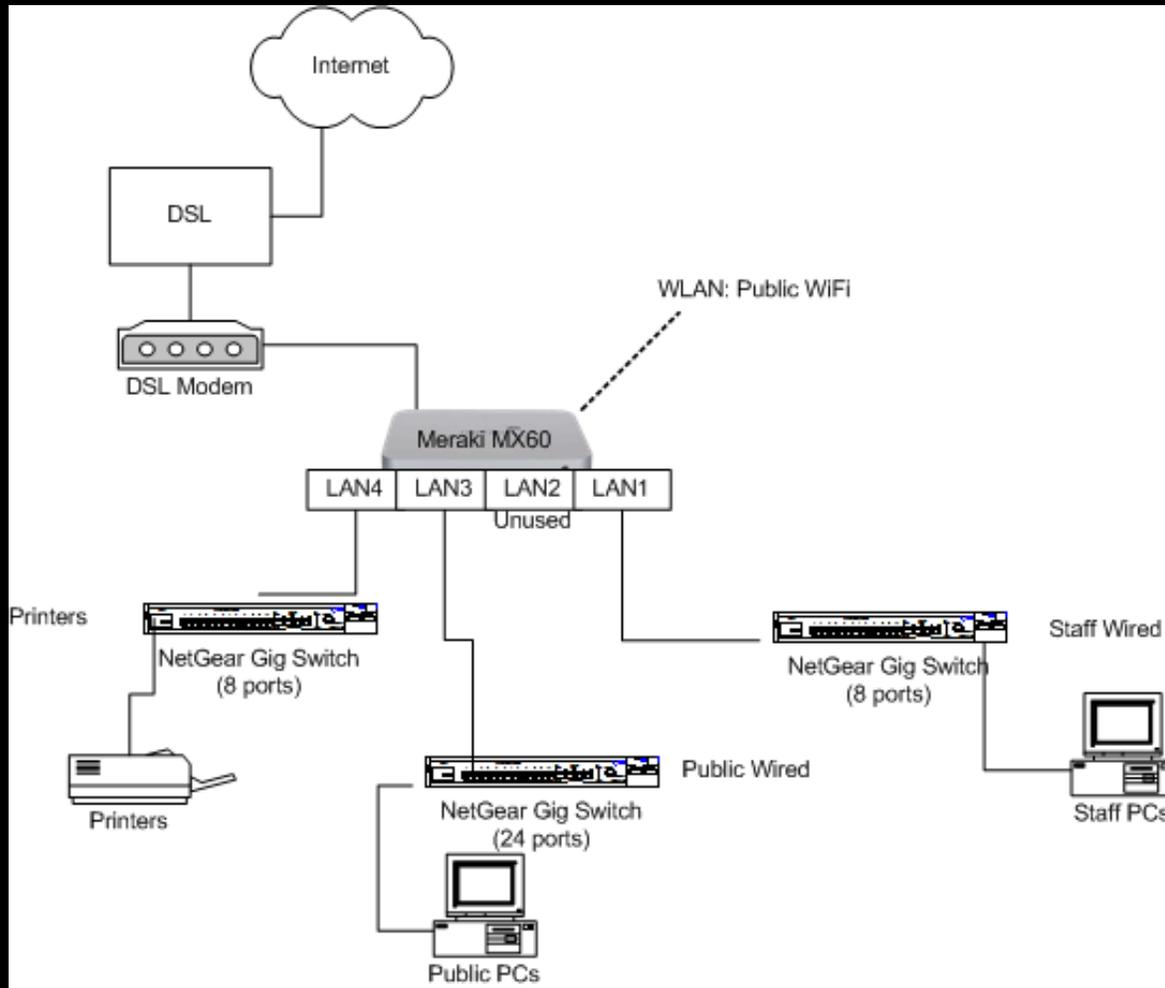
NAT (Network Address Translation or Network Address Translator) is the translation of an Internet Protocol address (IP address) used within one network to a different IP address known within another network. One network is designated the inside network and the other is the outside. **The router or gateway provides NAT.**



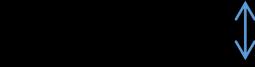
And why do you care? :0)



Public and Private IP addresses in action!



Krum Public Library
As of 2011



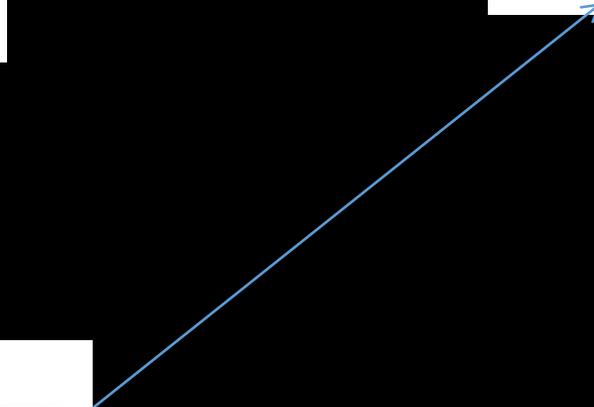
Emberq 660 DSL **Modem Gateway**



Linksys E2000 **Router**
with Firewall



dLink WBR 1310
Wireless Access Point



Cisco SBS SD2008
Switch

- Server
- Printer
- 5 Staff Computers



Speedstream
Public Switch

- 8 Public Computers
- 1 Children's Computer

QUIZ



Lunchtime!
Please return at 12:45

Section II: Networking Configuration and Security Skills



Section II Outline

- Invisible but Powerful: Wireless Networks
- Geek Out: Hands on with network equipment
- Sometimes Splitting Up is the Best Choice: Segmenting Networks
- Break
- Computer Security 101
- File Sharing and Backups 101
- Distribute and explain Take-Home Checklist
- Recap, Farewell and final questions
- Final Quiz



Invisible but Powerful: Wireless Networks



What is WiFi (802.11x wireless)?

802.11 and 802.11x refers to a family of specifications developed by the IEEE for wireless LAN (WLAN) technology. 802.11 specifies an over-the-air interface between a wireless client and a base station or between two wireless clients. The IEEE accepted the specification in 1997. **WiFi uses tiny radios to send and receive information.**



WiFi comes in **flavors**?



802.11a

The Earliest “WiFi”

A specification developed by the IEEE for wireless LAN (WLAN) technology. 802.11 specifies an over-the-air interface between a wireless client and a base station or between two wireless clients. When the 802.11a specification was created it provided a 5 Mbps connection - today it provides up to 54 Mbps in the 5GHz band.



802.11b -- Faster!



Also referred to as 802.11 High Rate or Wi-Fi, it is an extension to 802.11 specification developed by the IEEE for wireless LAN (WLAN) technology that applies to wireless LANs and provides 11 Mbps transmission (with a fallback to 5.5, 2 and 1 Mbps) in the 2.4 GHz band. 802.11b was a 1999 ratification to the original 802.11 standard, allowing wireless functionality comparable to Ethernet.



802.11g -- even faster than b!

An extension to 802.11 specification developed by the IEEE for wireless LAN (WLAN) technology that is used for transmission over short distances at up to 54-Mbps in the 2.4 GHz bands.



802.11n – even faster (and farther) than g!



An extension to 802.11 specification developed by the IEEE for wireless LAN (WLAN) technology. 802.11n builds upon previous 802.11 standards by adding multiple-input multiple-output (MIMO). The additional transmitter and receiver antennas allow for increased data throughput through spatial multiplexing and increased range. The speed is 100 Mbit/s, and so up to 4-5 times faster than 802.11g. 802.11n also offers a better operating distance than current networks.



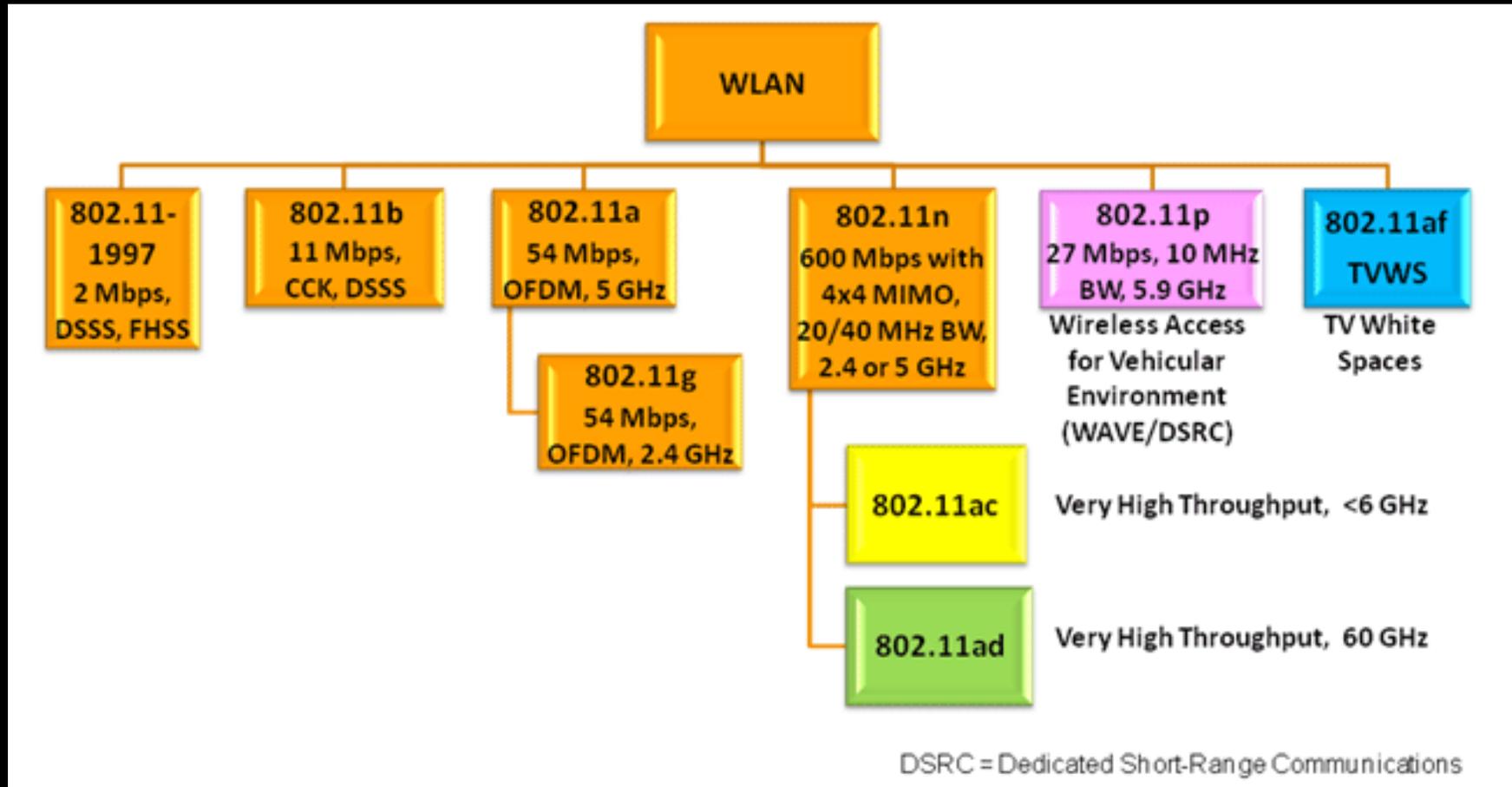
802.11ac – and this is the fastest (for now)!

A wireless LAN (WLAN) specification under development by the IEEE (Institute of Electrical and Electronics Engineers) that delivers wireless data transfer rates in the range of 433 Mbps (Megabits per second) per spatial stream. With support for up to eight streams, the 802.11ac specification offers a theoretical maximum data transfer speed of more than 3Gbps (Gigabits per second), and can deliver 1.3Gbps transfer speeds with a more common three-antenna (three streams) design.

802.11ac extends earlier 802.11 specifications, including 802.11n, and provides backwards compatibility with previous 802.11 specs. The 802.11ac specification operates only in the 5 GHz frequency range (where there is currently far less potential for interference), as opposed to the 802.11n spec, which operates in both 5 GHz and 2.4 GHz ranges.



WiFi comes in flavors?



What is an SSID?

- Stands for **S**ervice **S**et **I**dentifier
- It is the “name” of the wireless network that you see listed when browsing networks.
- Questions: What SSID are you using now?



WiFi Security

- Passwords for access to the WiFi Access Point
- Passwords and encryption of the connection



What about the “wired” ports on a WiFi Router?

- The “**WAN**” (*Wide Area Network*) or “**Internet**” port is special – it connects the router to the Internet!
- The other ports are available to connect wired devices to your network, including switches, PCs and other devices.



User Authentication – Local

The Local Authentication framework provides facilities for requesting authentication from users with specified security policies. A local user record often consists of a username, the user's full name, and the user's password.



Device Authentication – MAC Address

Is used to authenticate devices based on their physical media access control (MAC) address. While not the most secure and scalable method, MAC-based authentication implicitly provides an additional layer of security authentication devices. MAC-based authentication is often used to authenticate and allow network access through certain devices while denying access to the rest. For example, if clients are allowed access to the network via station A, then one method of authenticating station A is MAC-based. Clients may be required to authenticate themselves using other methods depending on the network privileges required.



User Authentication – enterprise

This profile defines a means to establish one name per user that can be used on all of the devices and software that participate in this integration profile. It greatly facilitates centralized user authentication management and provides users with the convenience and speed of a single sign-on. User authentication is a necessary step for most application and data access operations and streamlines workflow for users.



RADIUS Server--Remote Authentication Dial-In User Service

RADIUS is often used by Internet authenticate and authorize users. It's often used in for staff WiFi in larger libraries.

A RADIUS server receives user credentials and connection information from clients and authenticates them to the network.



WiFi Security & Encryption – What and Why



How does encryption work?

<https://www.youtube.com/watch?v=3QnD2c4Xovk>



Types of WiFi Security

- **Open** is generally used for public WiFi access points (we'll talk about why in a bit)
- **WEP** and **TKIP** (also called WPA-PSK) are old and not considered secure – do not use!
- **WPA2-PSK (AES)** is the recommended option.
- When in doubt, talk with your tech.



Open Public WiFi

- Why do we do it?
- Is it OK?



Geek Out: Hands on with network equipment



Note On Network Configuration

- Think of this as a “sample approach” to setting up a simple network
- These instructions are specific to our activities today – they may or may not be directly applicable when using different equipment in a different environment.

Update to Written Instructions

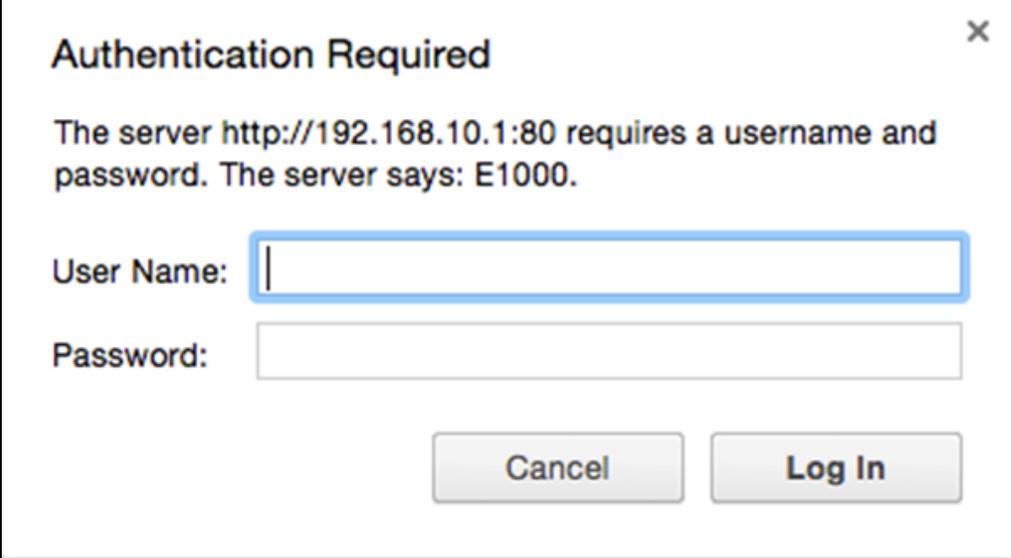
1. We will not be using a wired connection to the router today.
2. You will log in using a special IP address based on the router your team is using:

SSID	Gateway
CiscoRED	192.168.10.1
CiscoGREEN	192.168.20.1
CiscoYELLOW	192.168.30.1
CiscoBLUE	192.168.40.1



Network Configuration

1. Connect power to the router
2. Connect the library's Ethernet cable to the WAN port (this connects your router to the Internet)
3. Using another Ethernet cable, connect the laptop to one of the Ethernet ports on the router
4. Open a web browser (internet explorer, Firefox, etc.) on the laptop.
 - Log in to the router by entering **192.168.10.1** into the address bar
5. With this router, the first time you log in you will see this box:



Authentication Required

The server http://192.168.10.1:80 requires a username and password. The server says: E1000.

User Name:

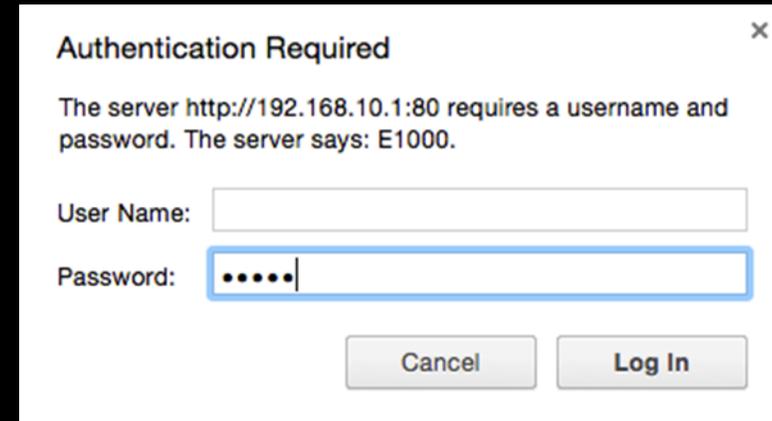
Password:

Cancel Log In



Network Configuration

For this first login, leave the username empty and type in “admin” for the password.



Authentication Required

The server `http://192.168.10.1:80` requires a username and password. The server says: E1000.

User Name:

Password:

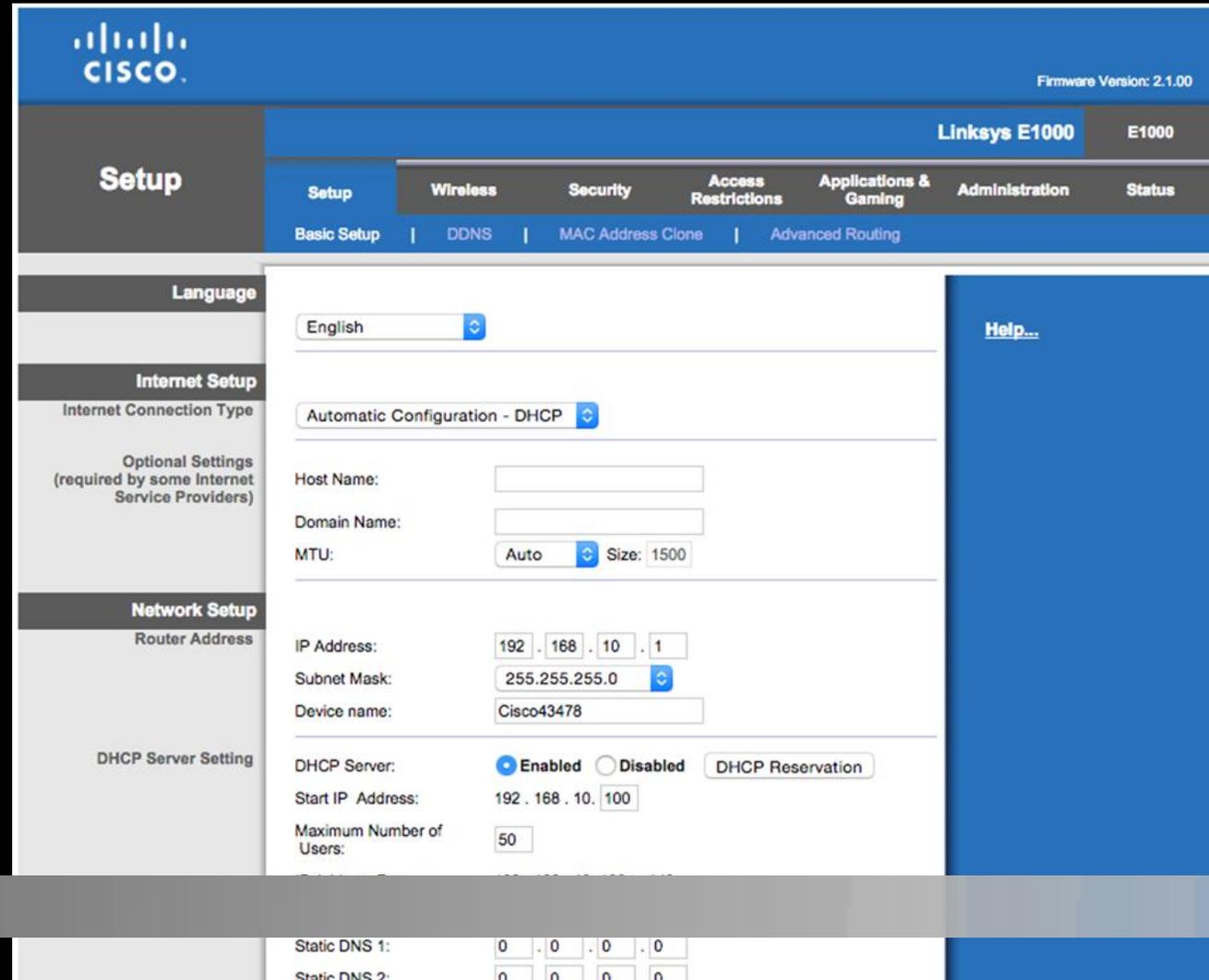
Cancel Log In

The image shows a standard Windows-style dialog box titled "Authentication Required". It contains a message from a server at IP 192.168.10.1:80 asking for a username and password. Below the message are two input fields: "User Name" (empty) and "Password" (containing six dots). At the bottom are "Cancel" and "Log In" buttons.



Network Configuration

This is the first screen you see



The screenshot displays the Cisco Linksys E1000 web interface. The top navigation bar includes the Cisco logo, the model name "Linksys E1000", and the firmware version "2.1.00". The main navigation menu is divided into "Setup" (selected), "Wireless", "Security", "Access Restrictions", "Applications & Gaming", "Administration", and "Status". Under "Setup", there are sub-menus for "Basic Setup", "DDNS", "MAC Address Clone", and "Advanced Routing".

The "Setup" page is organized into sections on the left and a main configuration area on the right. The left sidebar contains sections for "Language", "Internet Setup", "Network Setup", and "DHCP Server Setting".

The main configuration area shows the following settings:

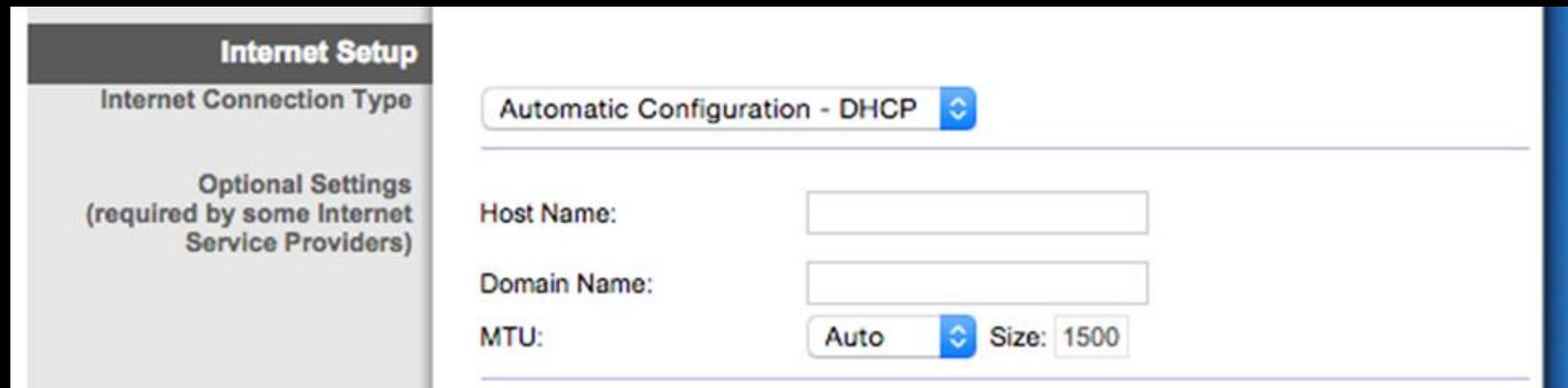
- Language:** English
- Internet Connection Type:** Automatic Configuration - DHCP
- Optional Settings (required by some Internet Service Providers):**
 - Host Name: []
 - Domain Name: []
 - MTU: Auto (Size: 1500)
- Router Address:**
 - IP Address: 192 . 168 . 10 . 1
 - Subnet Mask: 255.255.255.0
 - Device name: Cisco43478
- DHCP Server Setting:**
 - DHCP Server: Enabled Disabled
 - Start IP Address: 192 . 168 . 10 . 100
 - Maximum Number of Users: 50
 - Static DNS 1: 0 . 0 . 0 . 0
 - Static DNS 2: 0 . 0 . 0 . 0

A "Help..." link is visible on the right side of the page.



Network Configuration

This section is where you tell your router how it will get its own IP address so that it can communicate to the network. We will leave it at DHCP (dynamic host control protocol), which will allow it to get its address from an upstream DHCP server.



The screenshot shows a web interface for "Internet Setup". On the left is a sidebar with "Internet Setup" at the top, "Internet Connection Type" below it, and "Optional Settings (required by some Internet Service Providers)" further down. The main content area shows "Automatic Configuration - DHCP" selected in a dropdown menu. Below this are three fields: "Host Name:" with an empty text box, "Domain Name:" with an empty text box, and "MTU:" with a dropdown menu set to "Auto" and a "Size:" field containing the value "1500".



Network Configuration

This section is where you set up your local area network (LAN).

Network Setup	
Router Address	
IP Address:	192 . 168 . 10 . 1
Subnet Mask:	255.255.255.0
Device name:	Cisco43478
DHCP Server Setting	
DHCP Server:	<input checked="" type="radio"/> Enabled <input type="radio"/> Disabled DHCP Reservation
Start IP Address:	192 . 168 . 10 . 100
Maximum Number of Users:	50
IP Address Range:	192 . 168 . 10 . 100 to 149
Client Lease Time:	0 minutes (0 means one day)
Static DNS 1:	0 . 0 . 0 . 0
Static DNS 2:	0 . 0 . 0 . 0
Static DNS 3:	0 . 0 . 0 . 0
WINS:	0 . 0 . 0 . 0



Network Configuration

This is a very important part of the setup:

It shows the address of the router (also called the gateway) and you will notice that it is the same address you see in the location bar of your web browser! This area also contains the subnet mask and the name of the device.

Network Setup	
Router Address	
IP Address:	<input type="text" value="192"/> . <input type="text" value="168"/> . <input type="text" value="10"/> . <input type="text" value="1"/>
Subnet Mask:	<input type="text" value="255.255.255.0"/> <input type="button" value="↕"/>
Device name:	<input type="text" value="Cisco43478"/>



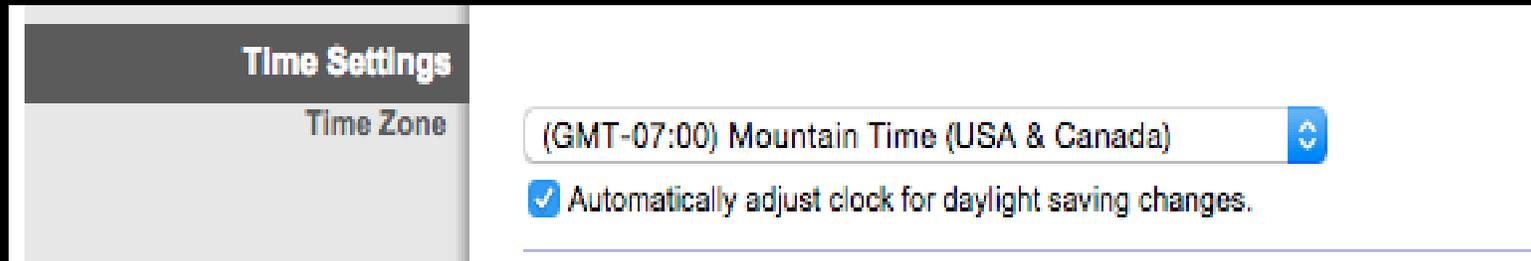
Network Configuration

Next is the DHCP server settings—this is the section that allows your router to create a local area network (LAN) using DHCP. For our purposes today, we will use the default settings, which allow us a DHCP pool of 50 addresses, starting with 192.168.10.100 and ending with 192.168.10.149. This section would also allow us to enter static DNS Servers. Since we are getting out DNS information automatically from an “upstream server” we can leave those blank for now.

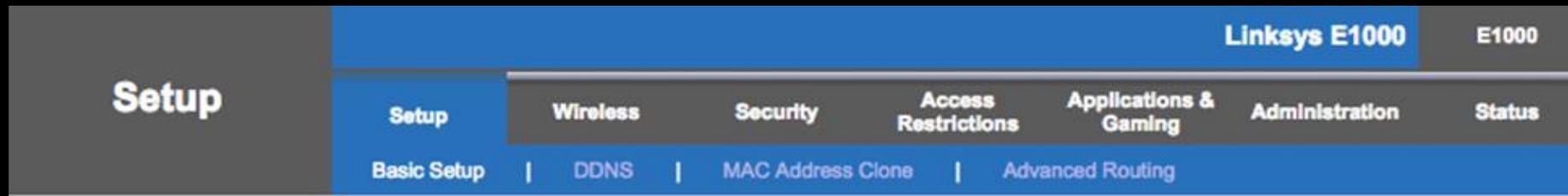
DHCP Server Setting	
DHCP Server:	<input checked="" type="radio"/> Enabled <input type="radio"/> Disabled DHCP Reservation
Start IP Address:	192 . 168 . 10 . <input type="text" value="100"/>
Maximum Number of Users:	<input type="text" value="50"/>
IP Address Range:	192 . 168 . 10 . 100 to 149
Client Lease Time:	<input type="text" value="0"/> minutes (0 means one day)
Static DNS 1:	<input type="text" value="0"/> . <input type="text" value="0"/> . <input type="text" value="0"/> . <input type="text" value="0"/>
Static DNS 2:	<input type="text" value="0"/> . <input type="text" value="0"/> . <input type="text" value="0"/> . <input type="text" value="0"/>
Static DNS 3:	<input type="text" value="0"/> . <input type="text" value="0"/> . <input type="text" value="0"/> . <input type="text" value="0"/>
WINS:	<input type="text" value="0"/> . <input type="text" value="0"/> . <input type="text" value="0"/> . <input type="text" value="0"/>



Time settings—do you see anything wrong with this picture?



With our basic setup complete, we will now set up our wireless network.

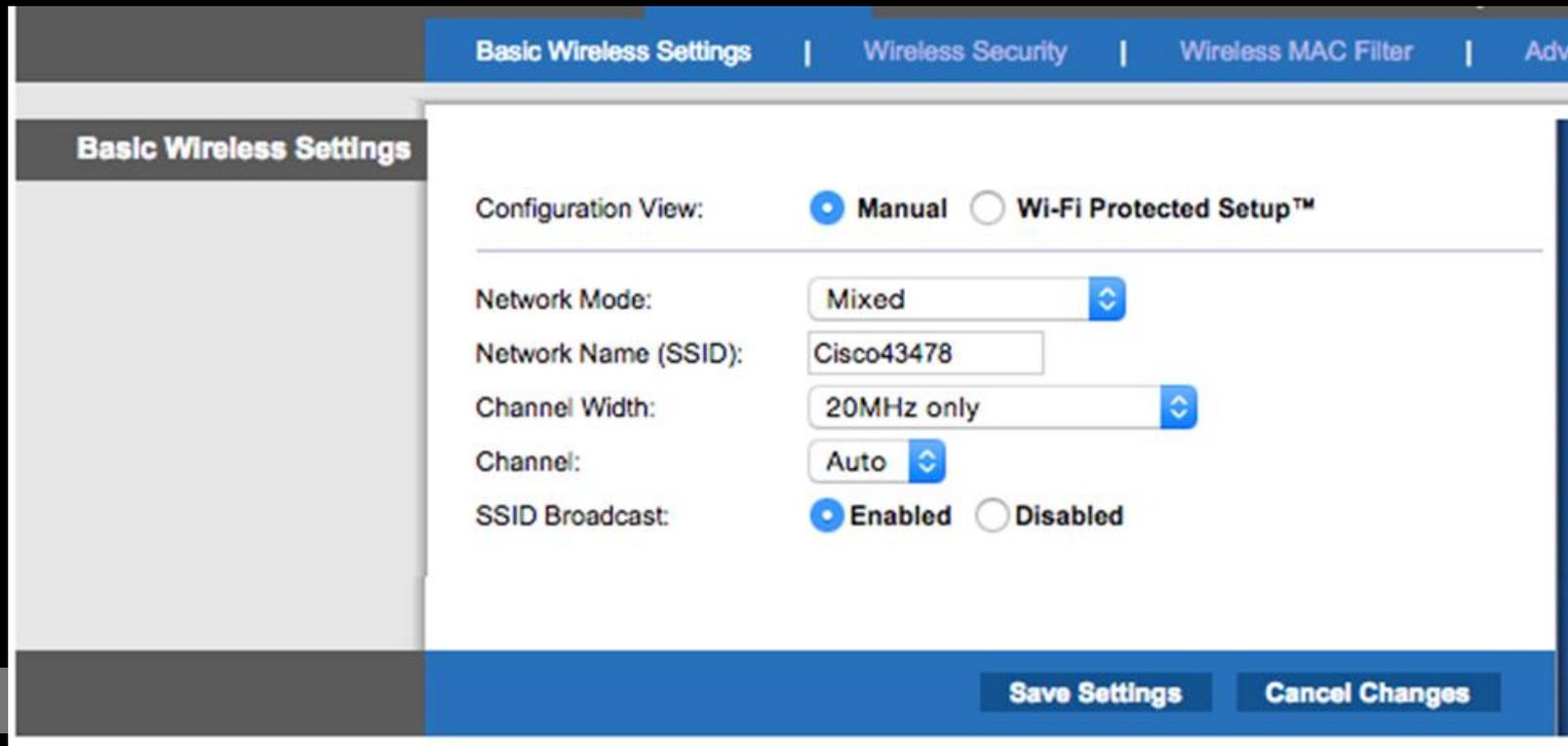


Please notice: for each tab, there is a sub-menu of options. Under the wireless tab, we have several options.



Network Configuration

Some routers, like this one, have a simplified setup (called “WiFi Protected Setup”) that includes simplified security and other settings. For the purpose of our class, we will use manual settings.



The screenshot displays the 'Basic Wireless Settings' page of a router's web interface. The page is divided into several sections:

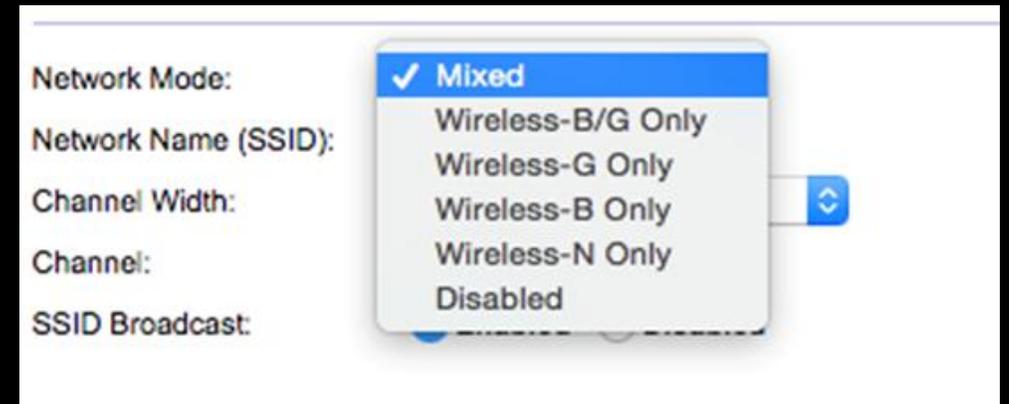
- Configuration View:** Two radio buttons are present: 'Manual' (selected) and 'Wi-Fi Protected Setup™'.
- Network Mode:** A dropdown menu is set to 'Mixed'.
- Network Name (SSID):** A text input field contains 'Cisco43478'.
- Channel Width:** A dropdown menu is set to '20MHz only'.
- Channel:** A dropdown menu is set to 'Auto'.
- SSID Broadcast:** Two radio buttons are present: 'Enabled' (selected) and 'Disabled'.

At the bottom of the page, there are two buttons: 'Save Settings' and 'Cancel Changes'.



Network Configuration

Under Network Mode, we can see that this router supports several flavors of 802.11x WiFi: we want to allow all possible choices here—so we will leave it at “mixed,” which will support B, G, and N.



Network Configuration

This is the default SSID—also known as the name of the wireless network. How boring!

Action Step: Let's change it to something better!

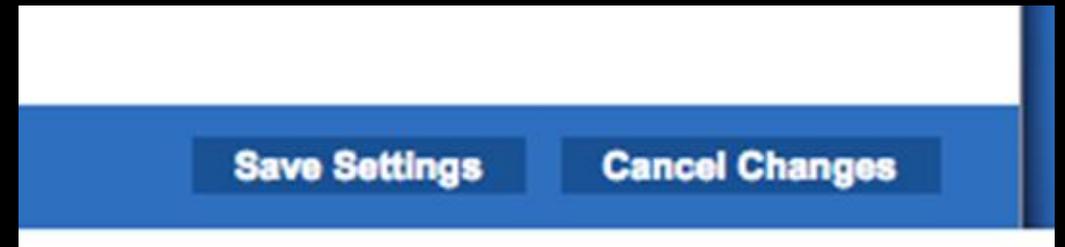
Network Name (SSID): Cisco43478

Network Name (SSID): GeeWhilikers



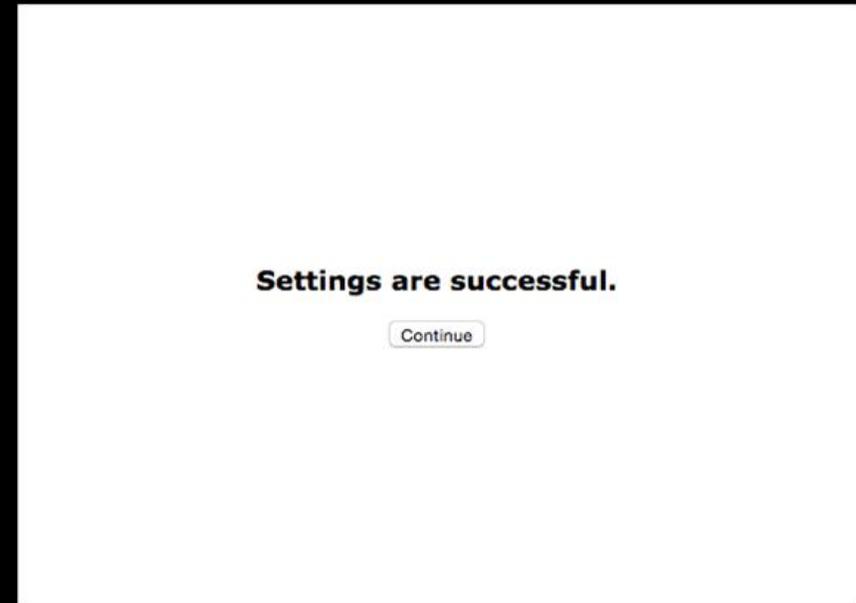
Network Configuration

Whenever you make a change to the router, you always have to “save” for the new settings to take effect. Here, the save button is at the bottom of the page.



Network Configuration

Since we are configuring this using the router's wireless connection, we will be disconnected after making a major change like this.



We will leave the rest of these settings just as they are for now.

Basic Wireless Settings

Configuration View: Manual Wi-Fi Protected Setup™

Network Mode:

Network Name (SSID):

Channel Width:

Channel:

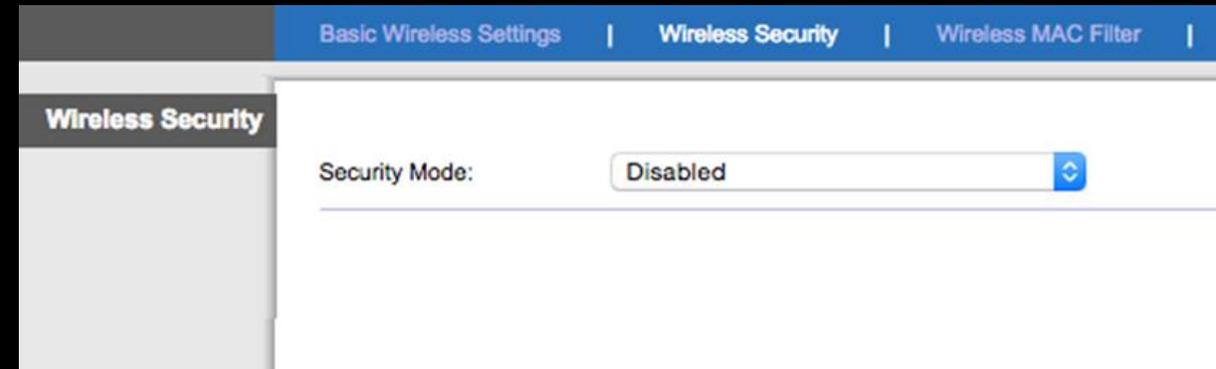
SSID Broadcast: Enabled Disabled

Save Settings **Cancel Changes**

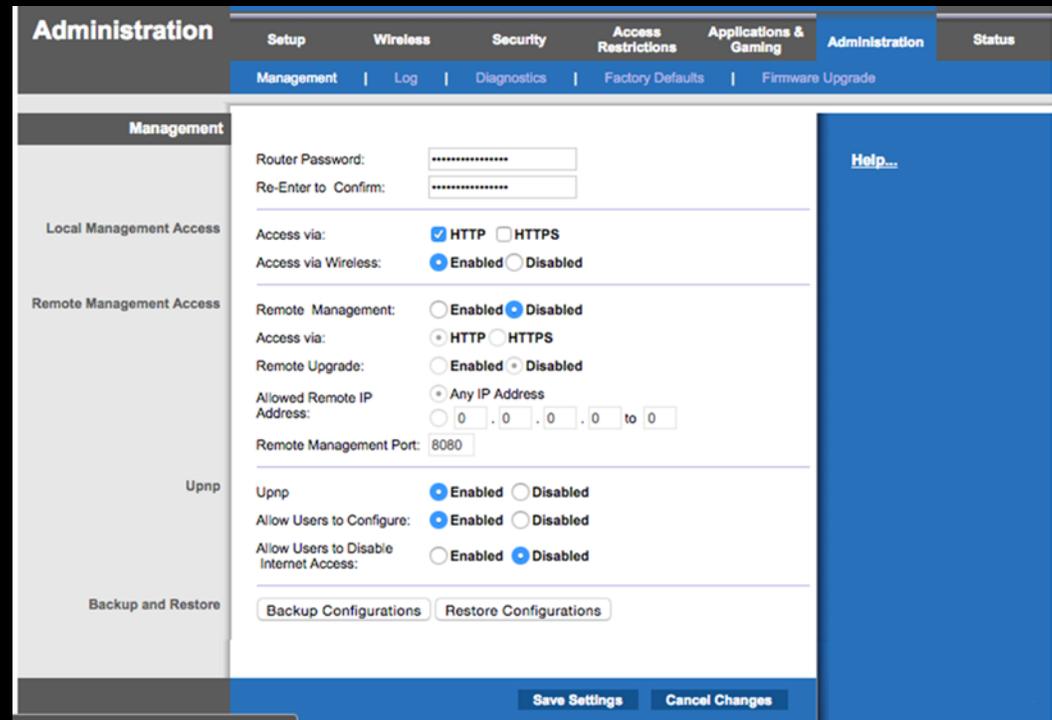


Network Configuration

In this tab, we would have the opportunity to require a password to allow use of the WiFi systems. Since we want to have user-friendly services, we will not require a password for this router. **Please note: if you have wireless access for staff, it is strongly recommended that those connections be encrypted and secured.**



Even consumer routers have a simple firewall to help protect devices on your LAN. On this router, the administration panel is a key piece of basic security.



The screenshot displays the 'Administration' section of a router's web interface. The top navigation bar includes 'Setup', 'Wireless', 'Security', 'Access Restrictions', 'Applications & Gaming', 'Administration', and 'Status'. Below this, a sub-menu shows 'Management', 'Log', 'Diagnostics', 'Factory Defaults', and 'Firmware Upgrade'. The main content area is titled 'Administration' and contains several sections:

- Router Password:** Two password input fields, one for the current password and one for re-entry.
- Local Management Access:** 'Access via:' with radio buttons for HTTP and HTTPS.
- Access via Wireless:** Radio buttons for Enabled and Disabled.
- Remote Management Access:** 'Remote Management:' with radio buttons for Enabled and Disabled.
- Access via:** Radio buttons for HTTP and HTTPS.
- Remote Upgrade:** Radio buttons for Enabled and Disabled.
- Allowed Remote IP Address:** Radio buttons for Any IP Address and [IP Address Range].
- Remote Management Port:** A text input field containing '8080'.
- Upnp:** Radio buttons for Enabled and Disabled.
- Allow Users to Configure:** Radio buttons for Enabled and Disabled.
- Allow Users to Disable Internet Access:** Radio buttons for Enabled and Disabled.
- Backup and Restore:** Two buttons: 'Backup Configurations' and 'Restore Configurations'.

At the bottom of the page, there are two buttons: 'Save Settings' and 'Cancel Changes'. A 'Help...' link is visible on the right side of the page.



Security

Setup | Wireless | **Security** | Access Restrictions | Applications & Gaming

Firewall | VPN Passthrough

Firewall

SPI Firewall Protection: Enabled Disabled

- Filter Anonymous Internet Requests
- Filter Multicast
- Filter Internet NAT Redirection
- Filter IDENT (Port 113)

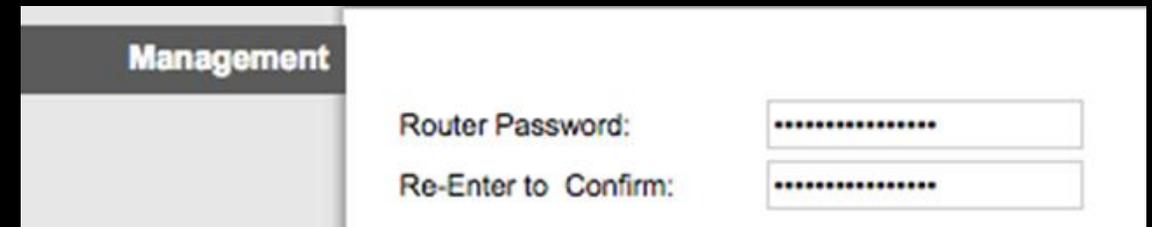
Proxy Java ActiveX Cookies

Save Settings **Cancel Changes**



Network Configuration

- This is a place where you can set a password for your router.
- **It is essential for you to change the default password**
- Default passwords for common routers are easy to find on the internet, which is why you must change yours!



The screenshot shows a web interface for router management. On the left, there is a dark grey sidebar with the word "Management" in white. The main content area is white and contains two rows of text and input fields. The first row is labeled "Router Password:" followed by a text input field containing ten asterisks. The second row is labeled "Re-Enter to Confirm:" followed by another text input field containing ten asterisks.



What if you get stuck or make a mistake?

The “reset” button will help you start again! It will erase all settings and bring you back to the factory defaults.



Now, let's set up our laptops
to connect!



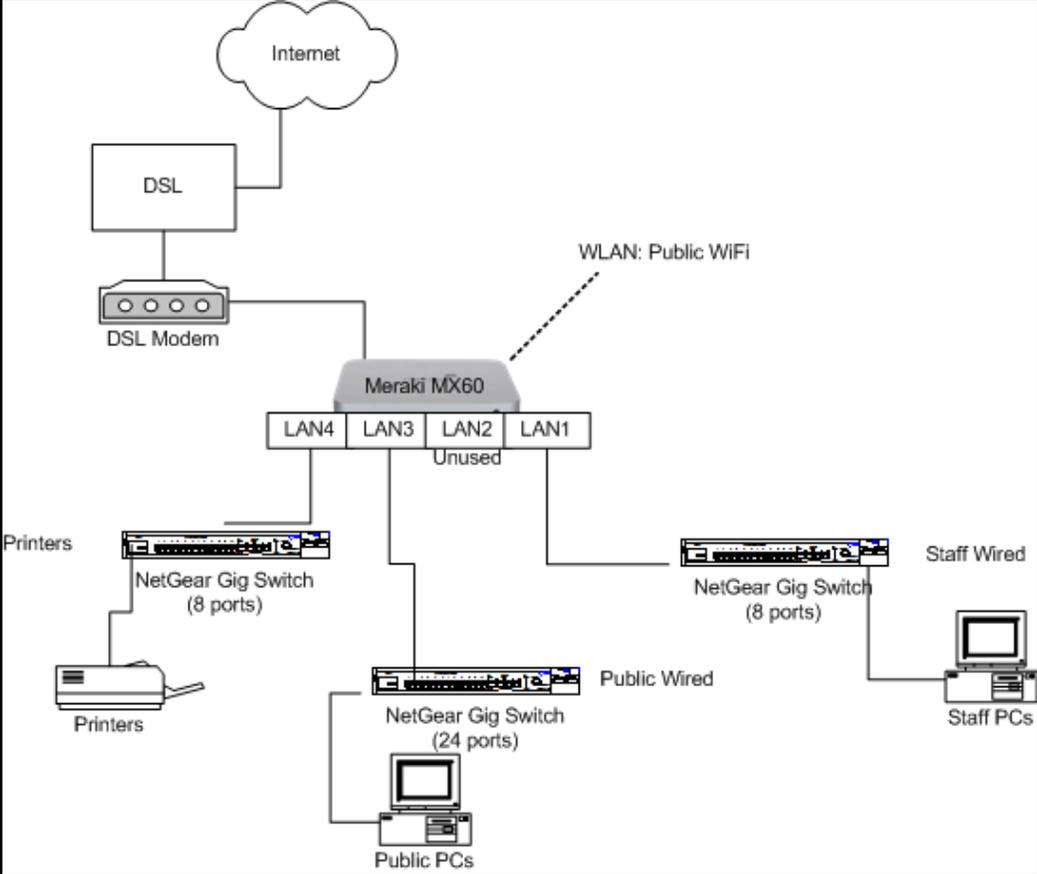
Let's do a quick test — can we connect to the internet?



Break!



Sometimes Splitting Up is the Best Choice: Segmenting Networks



How are networks split?

- Physically
- Electronically (Virtual Local Area Networks – or VLANs)

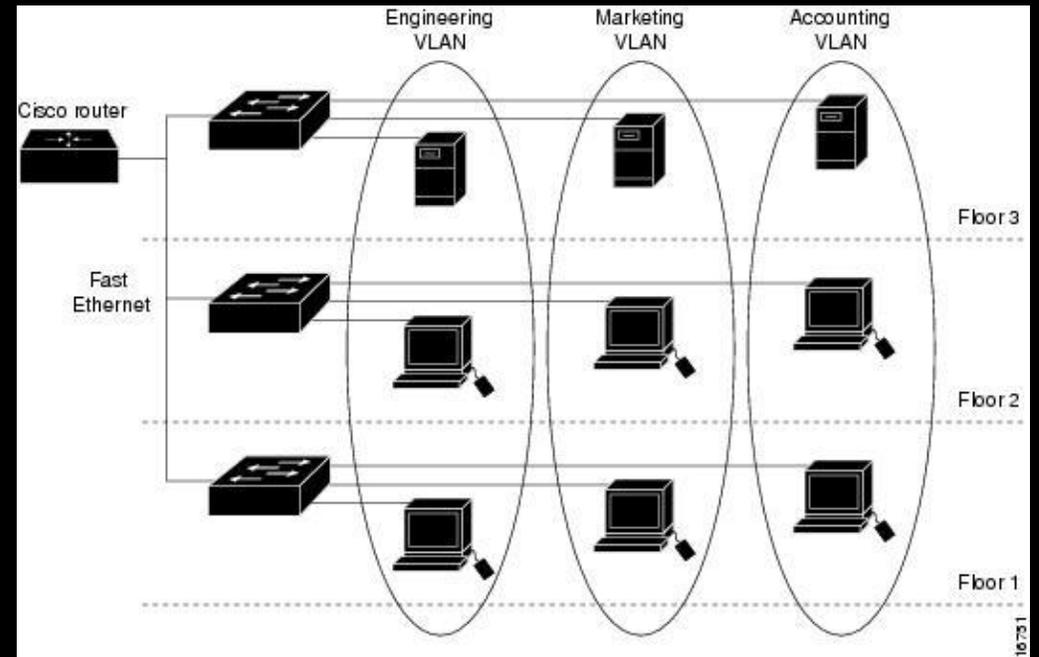


What's a "Virtual LAN" (VLAN)?

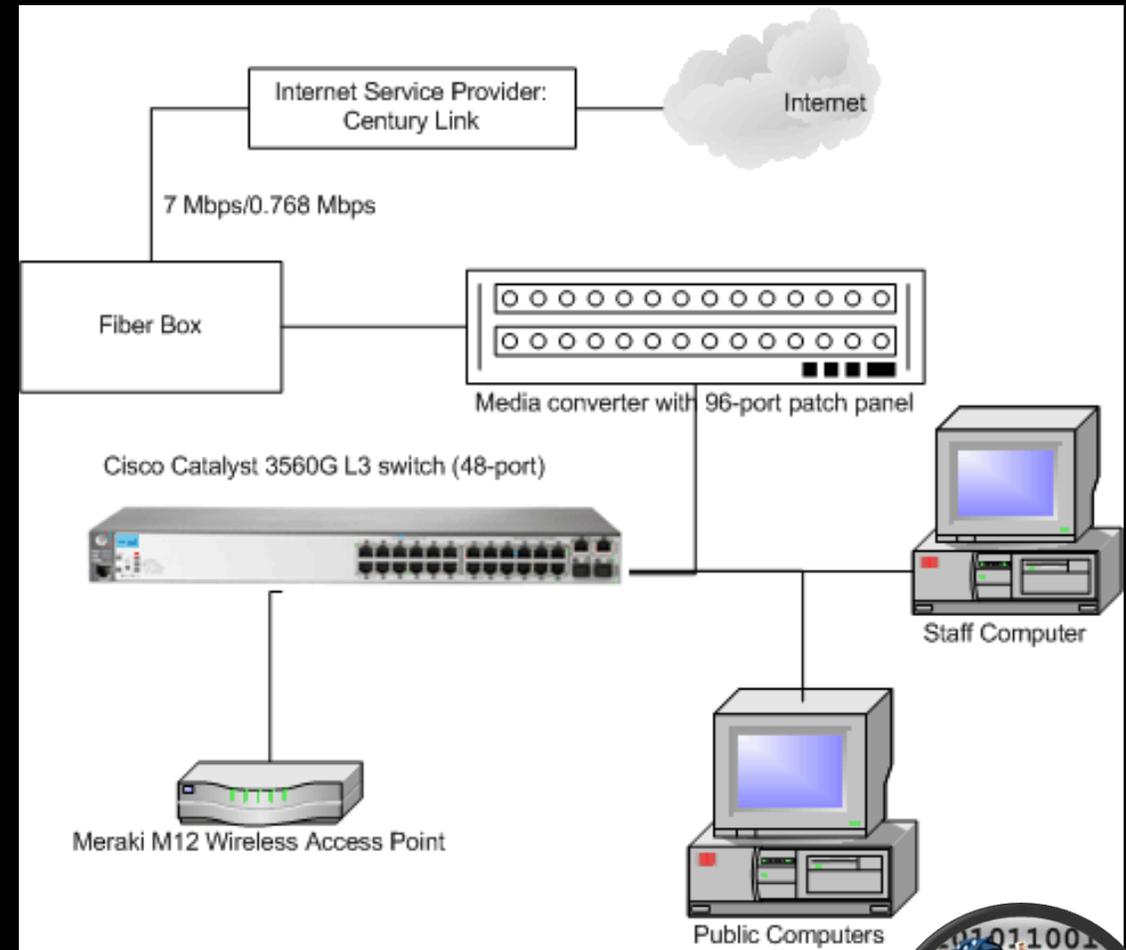
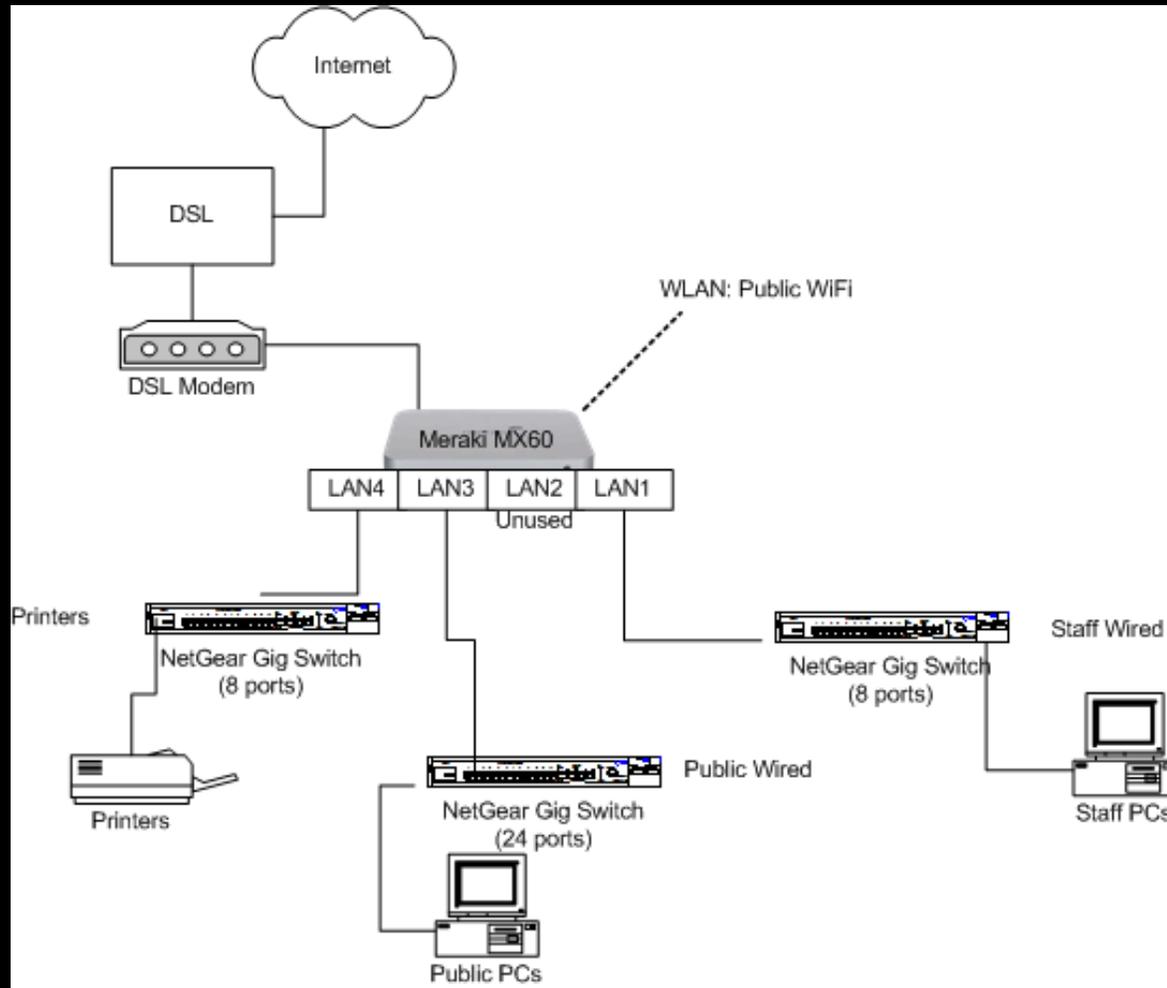
Noun

\VLAN\

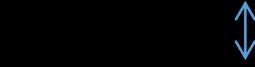
: a VLAN has the same attributes as a physical local area network (LAN), but it allows for end stations to be grouped together more easily even if they are not on the same network switch. VLAN membership can be configured through software instead of physically relocating devices or connections.



Public and Private IP addresses in action!



Krum Public Library
As of 2011



Emberq 660 DSL **Modem Gateway**



Linksys E2000 **Router**
with Firewall



dLink WBR 1310
Wireless Access Point



Cisco SBS SD2008
Switch



Speedstream
Public Switch

- 8 Public Computers
- 1 Children's Computer

- Server
- Printer
- 5 Staff Computers

Computer Security 101



Basic PC Security

A look at
Microsoft Security
Essentials



What about Antivirus software?



I've set up my security – am I safe now?



Security is an ongoing process
– it is not “set and forget.”



Security is best
applied in
layers.....



File Sharing and Backups 101

Class Discussion:
Fire Sharing



What is a backup?

- It's a copy of your data!
- It can be on a variety of media, including:
 - *External Hard Drive*
 - *Thumb Drive*
 - *CD-R or DVD-R*
- It can be in a variety of places:
 - Attached to your computer
 - Attached to your network
 - Attached to the Internet (cloud)



The Rule of 3-2-1 (or “Rule of 3”)

- Always have **3 copies** of anything you really care about
- Use **2 types** of **backup media**
- At least **1 Copy** should be **stored offsite**

Now – let’s sketch some scenarios together to see if they follow the 3-2-1 rule!



Testing recovery of your backups

This is something even the professionals forget to do sometimes....



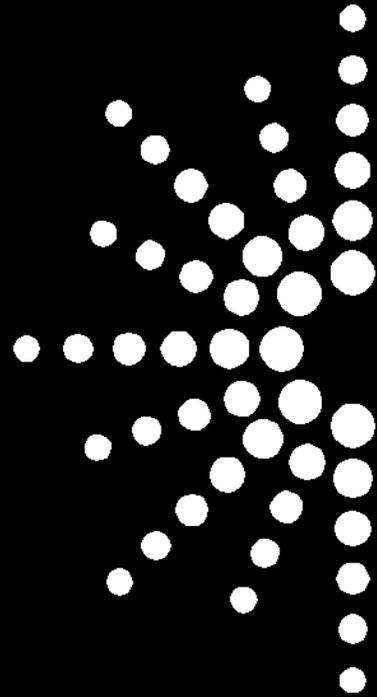
Your Take – Home Checklist!



The tail end...



This workshop is made possible by a grant from the Institute of Museum and Library Services to the Texas State Library and Archives Commission under the provisions of the Library Services and Technology Act. (2015)



INSTITUTE *of*
Museum and **Library**
SERVICES



Program Credits

- CB for content
- MGW for graphics and assembly of learning materials
- TSLAC for lots & lots of stuff....



Graphics Credit

- File:Icebreaker Polar Star somewhere on the Antarctic Peninsula ...1024 x 686 · 73 kB · jpeg
<https://geolocation.ws>
- Filed under: Exhibitions , Interactive , Motion , Works451 x 338 · 131 kB · jpeg tomator.com
- PQ to Extend Language Laws to Letters in Alphabet Soup625 x 370 · 28 kB · jpeg montreal.mediacoop.ca
- Playalong para Bateria de “Rebel Yell” - Billy Idol500 x 500 · 45 kB · jpegdanielbatera.com.br
- http://upload.wikimedia.org/wikipedia/commons/thumb/d/d1/CAT5e_Cable.jpg/220px-CAT5e_Cable.jpg
- Photo: en.wikipedia.org/wiki/Wireless_access_point
- http://www.globalsensortech.com/media/catalog/product/cache/1/image/9df78eab33525d08d6e5fb8d27136e95/b/s/bs903_2.jpg
- www.howtogeek.com%2F148664%2Fhow-and-why-all-devices-in-your-home-share-one-ip-address%2F&ei=eb_qVN2QEIV5yASb3oHQCA&bvm=bv.86475890,d.aWw&psig=AFQjCNHVziXV9KbdYVVWeWWggoCLCvGa-w&ust=1424756912767649
- <http://freemagazinedownloads.blogspot.com/2010/11/what-is-ipv6-why-we-need-ipv6-and.html>
- <http://dawnsdavies.com/2014/12/10-ways-to-beat-distraction-master-your-time-management-and-improve-your-writing-productivity-2/>

