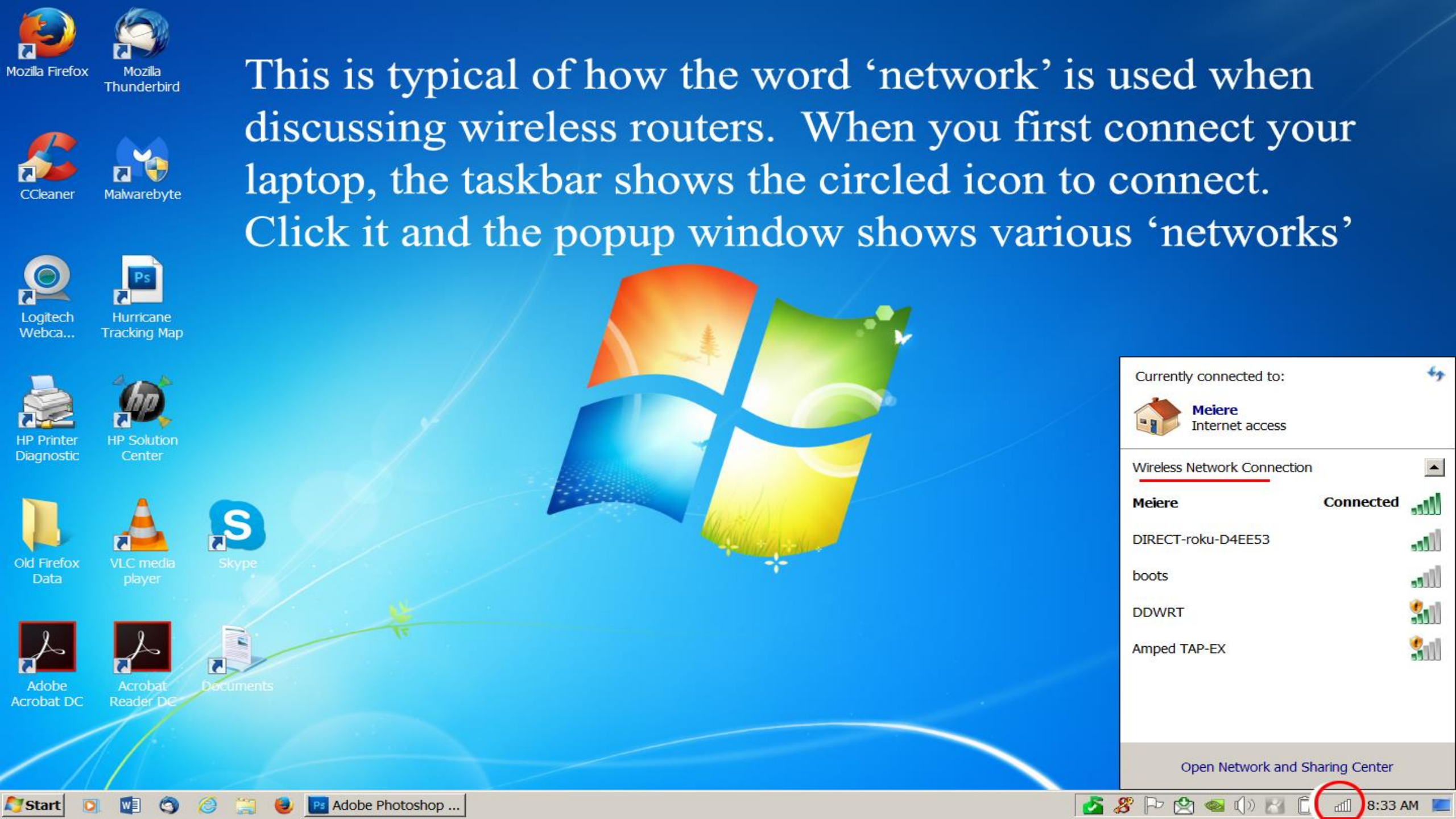


This is typical of how the word ‘network’ is used when discussing wireless routers. When you first connect your laptop, the taskbar shows the circled icon to connect. Click it and the popup window shows various ‘networks’



Today's Talk

- 1) Clarify the word 'network' as applied to routers
- 2) List some of the many devices using wireless routers
- 3) The 3 different wireless routers in use today
- 4) Setup and programming wireless routers
- 5) **Congestion and Interference; explanation and avoidance**
- 6) Wi-Fi Sniffers (show all 'active' networks)
- 7) Security →

Wi-Fi Devices

- 1) Connect Laptop to Internet
- 2) Stream Video to your TV
- 3) Connect your wireless printer or other peripherals
- 4) Show your Webcam, e.g. security camera
- 5) Alternate to cellular connection - possibly reduce your bill
- 6) Suggestions from Audience

Cellular connections are not Wi-Fi

KEY WORDS

- 1) Streaming video services: Netflix, Hulu, Amazon Prime, other?
- 2) Streaming video devices: Roku, Apple TV, Google Chrome, dual purpose devices such as DVD players can stream video, other?
- 3) Cellular devices with Wi-Fi:
Smart Phone (iPhone, Galaxy, other?), Tablet (iPad, Surface), iPod, ??
- 4) Suggestions from Audience

Disclaimer

I have tailored this talk to the audience;
one modem for Internet, one wireless router, multiple
devices communicate with router.

3 different types of Wireless Routers

Wireless routers have been around for a long time. I won't discuss the obsolete ones. Pretty sure yours is NOT obsolete.

- ▶ Single Band. These operates on frequencies near 2.4 GHz.
- ▶ Dual Band (“old protocol”). These operate with frequencies 2.4 and 5 GHz.
- ▶ Dual Band (“new protocol”). Also 2.4 and 5 GHz but with additional features which appeal to high end users running multiple devices.

The “buzz words” refer to the protocol. 802.11b and 802.11g allow only 1 band. 802.11n is the most popular and allows for dual bands. If buying a new router you probably want this one. 802.11ac is the latest. If you want the best, buy this. It is doubtful that you will use its capabilities in the next few years but you will be ready for the future. By then, there may be a newer protocol, of course.

If you are not interested in details, you can just ignore the 802.11 whatever. You can make intelligent choices without looking at the details at all. →

What are the main differences

- ▶ Price: Not surprisingly the fancier the device the more it costs.
- ▶ I will discuss Netgear since those are the ones I have bought.
- ▶ Single Band: Price Range \$20 to \$50. If you have one, keep it.
This is mine - works fine for everything from laptops to Netflix.



Side Trip - What about Speed?

Bottom line: Even the \$20 router has an intrinsic speed which is faster than your Internet connection. I pay extra for High Speed Internet from TW which gives me 20 Mbps download speed. Netflix streams 1080p video at 3 Mbps so I should be OK except for uploading huge amounts of data. That could affect someone who backups their whole computer to the cloud (not me).

Of course, it is possible to “mess up” the way you USE your router. We will fix that today, but you don’t have to worry about the intrinsic router speed.

Brief comment: In the US we get slower Internet speeds at twice the cost of what they should be compared to other developed countries. The providers are in bed with the corrupt politicians so there is no competition and they charge outrageous prices. Router technology is free market with plenty of completion and we get great performance for low prices. My \$50 router would cost \$500 if it came from Time Warner.

You may want to look here:

<http://www.pbs.org/newshour/updates/internet-u-s-compare-globally-slower-expensive/>

The Most Popular

- Dual Band: (802.11n) Not the latest but probably the best buy.
- Price: \$75 - \$100 for N750 Numerous models similar to this



- These can operate on two bands at once (2.4 GHz and 5.0 GHz). Typically, your device will choose which band to use. If your device uses only 2.4 GHz, it will use that band. Normally, the device will choose 5.0 GHz if it can. For some devices, the human user chooses. Therefore, if you are buying a new router, choose this over the single band router.
- Make sure you get a true dual-band router; not a *selectable* dual-band router. →

The Best

- ▶ Buzz Word 801.11ac Typical cost \$200 - \$350
- ▶ Really neat features if you are a techie or a gamer.
- ▶ Four people can have their own data stream without interfering with others.
- ▶ Signals can be directed electronically to a specific client.
- ▶ **Nighthawk AC1900 (My dream) \$200**



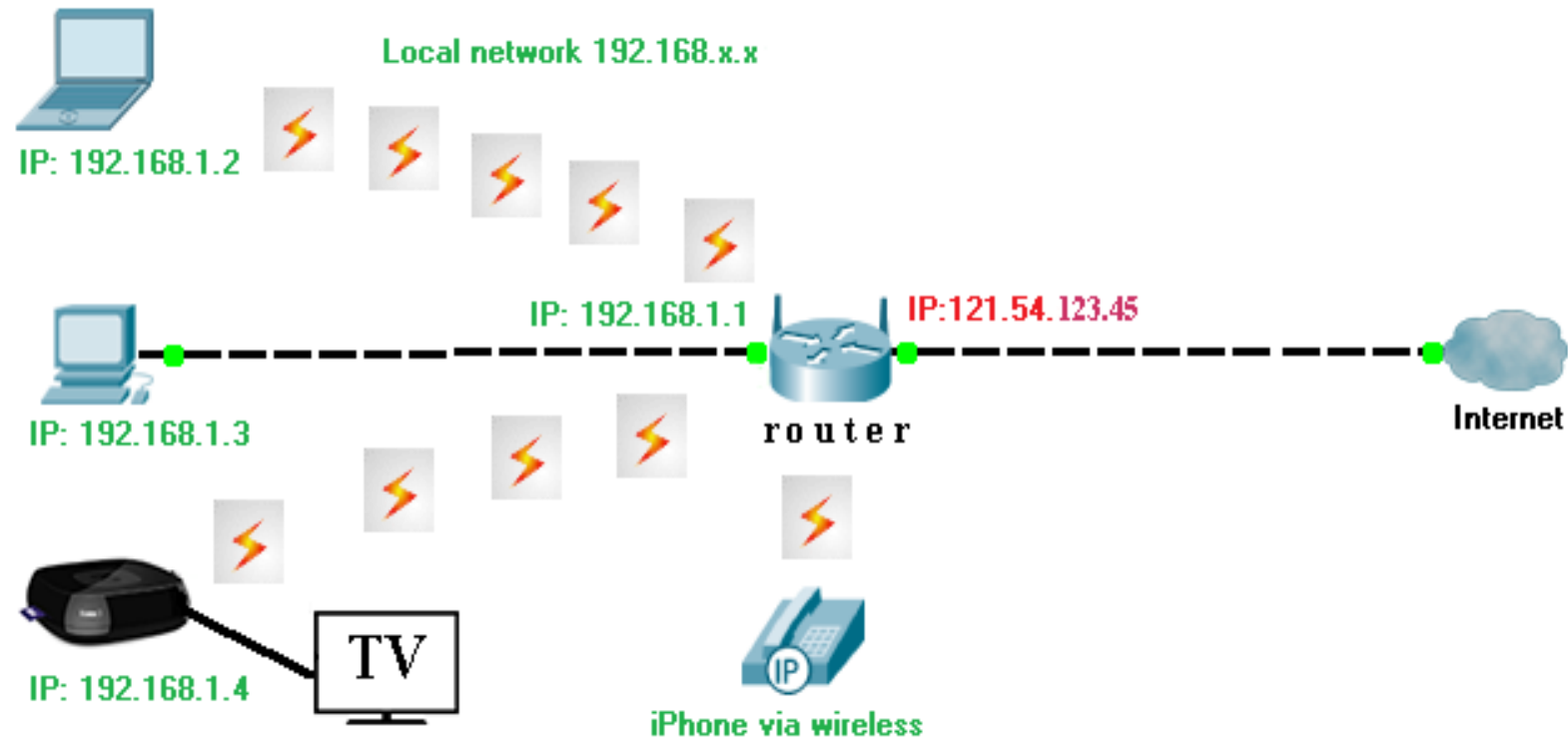
Wireless Router / Cable Modem Combo

- ▶ Some Internet Providers will supply a cable modem with a wireless router
- ▶ Time Warner in some areas does this. Does anyone have this?
- ▶ Comcast seems to do this in larger metro areas.
- ▶ Setup is basically the same but the devil is in the details. Read manual. →

Some Terminology

- 1) **Access Point** (abbreviated AP in most articles)
For us, this is just your wireless router.
In general, any device that connects wireless devices to a wired network.
- 2) **SSID** (*service set identifier*) For us, this is the ‘network’ you connect to.
Laptop: your wireless icon on the task bar will say ‘Connections Available’ and show one or more ‘network’ names. These are SSIDs.
Roku and other devices: Usually the setup shows these ‘network’ names.
- 3) **Internet Address** (IP) A long number which identifies your device.
This probably seems familiar to most of you. Good luck! (complicated)
There are two versions currently in use; IPv4 and IPv6. Both have ‘internal’ addresses used only locally, typically 192.168.0.1 for IPv4. Your computer probably has an ‘external’ IP address used for the Internet, typically 75.182.20.123. There are tons of website which will show yours; e.g. <http://whatismyipaddress.com/>. The words ‘external’ and ‘private’ are used in different and confusing ways in various articles.

Typical Setup



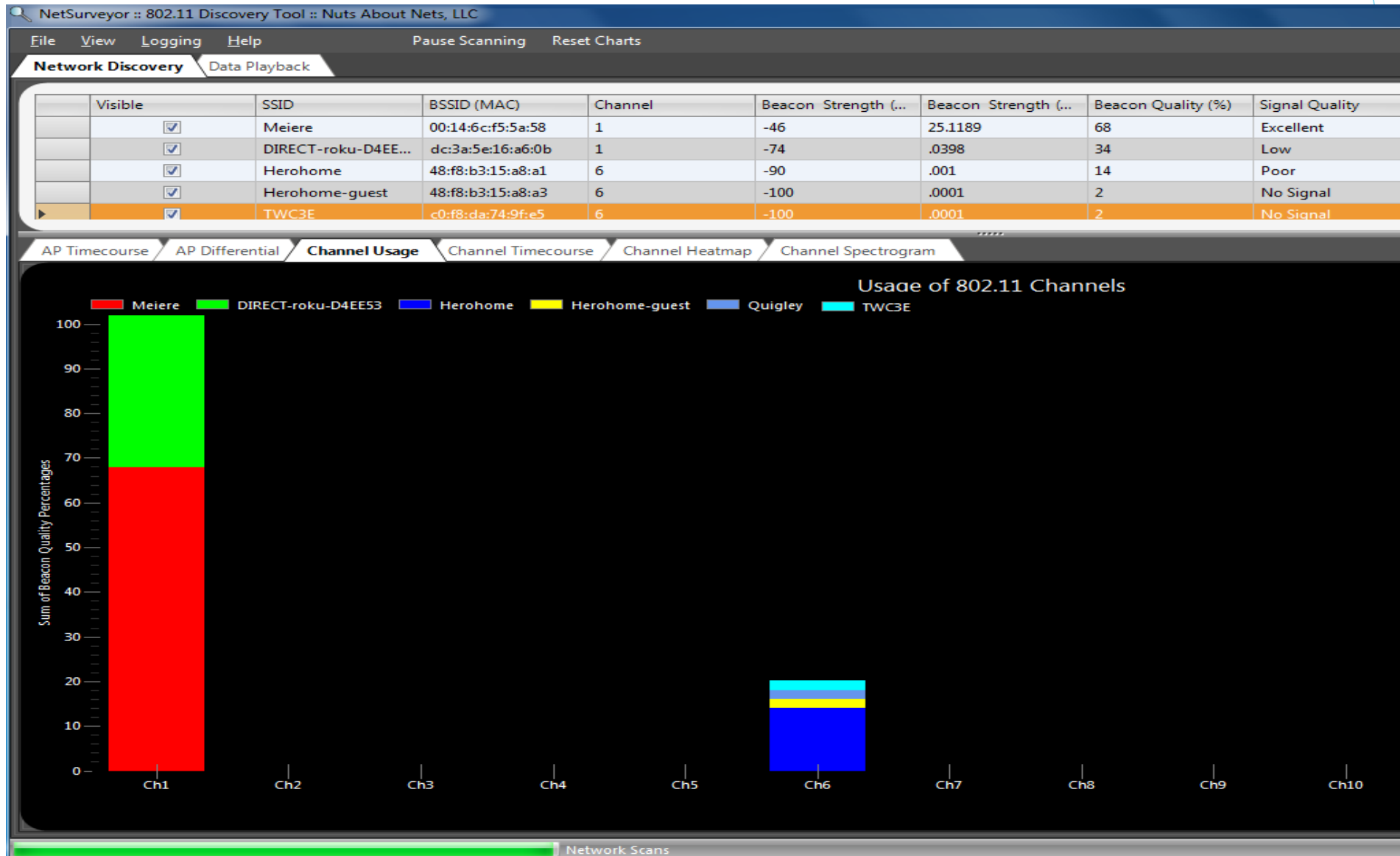
Setup Your Router

- ▶ I assume that everyone here has a working router. Therefore, it has been setup already, probably with many options set to their default value.
- ▶ We don't have time to go over all the options (which can be tedious). I will give some details at the end which you can read at home, if interested. Hopefully, you know that all my presentations are on-line. This is true of almost all Technology Club presentations for the past umpteen years.
- ▶ There is one option which you really want to understand if you do streaming video. It can be important in areas where your devices see many routers ('networks'). That involves 'channels', crucial for '**Congestion**' and '**Interference**'. →

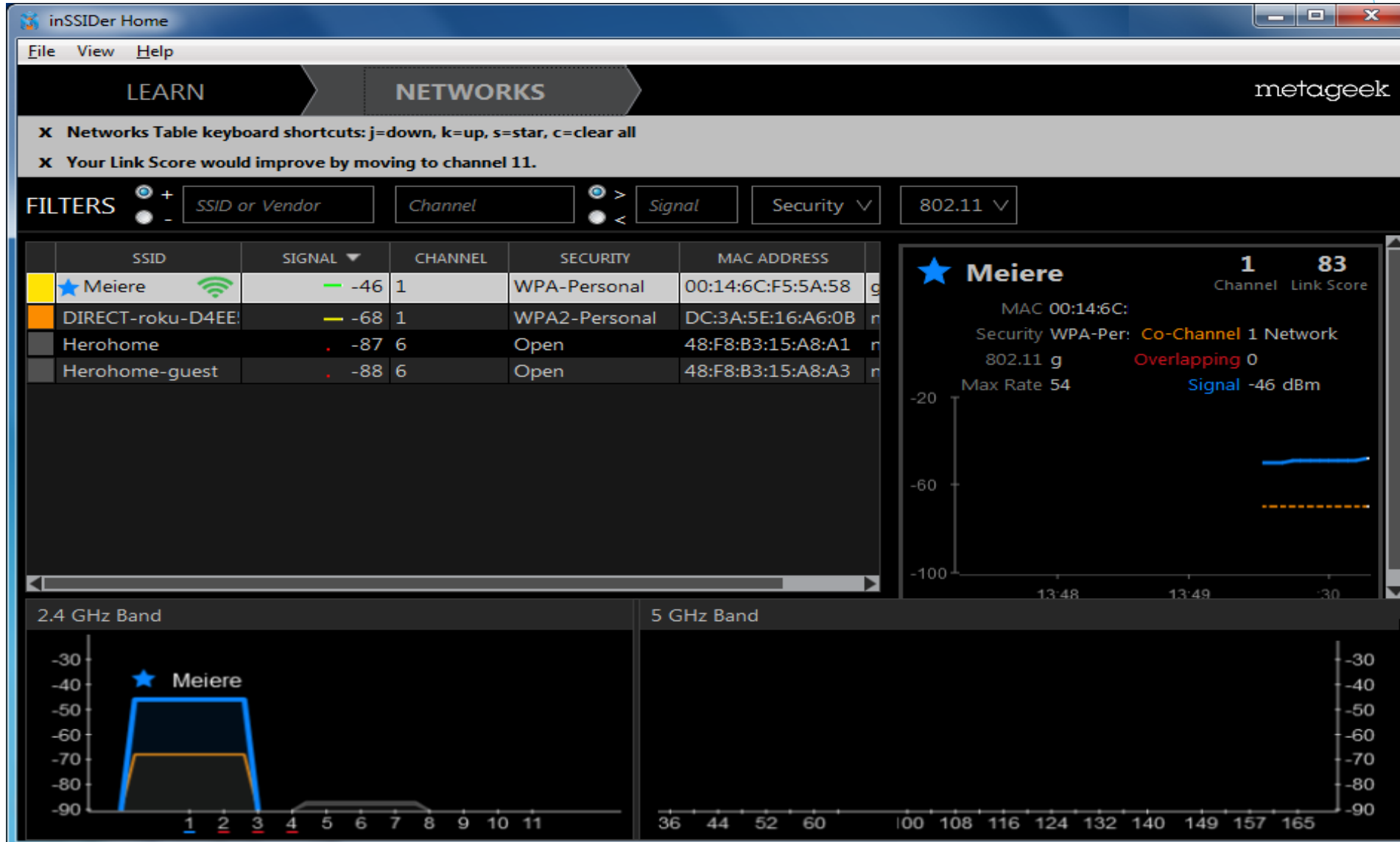
Channels

- ▶ As mentioned at the beginning, there are two ‘bands’ available for wireless communication using your router; 2.4 GHz and 5.0 GHz. Your router can certainly use the 2.4 GHz band; it may or may not be able to use the 5.0 GHz band.
- ▶ 2.4 GHz band. This is the easiest to understand. There are 11 different frequencies available. These are called ‘channels’ when discussing Wi-Fi. *(In principle there are 14 but you can only use 11. I will oversimplify all discussions from now on and will NOT keep inserting details like this.)*
- ▶ You really want to know which channels you are using and whether or not your neighbors are using the same channels. Each ‘network’ or SSID has its own channel but you can have several ‘networks’ running on your router. Thus you have quite a bit of flexibility.
- ▶ Get a Wi-Fi Sniffer which shows which channel you are using. There are several free ones available. I use
NetSurveyor www.nutsaboutnets.com/netsurveyor-wifi-scanner/
inSSIDer Home <http://www.techspot.com/downloads/5936-inssider.html>

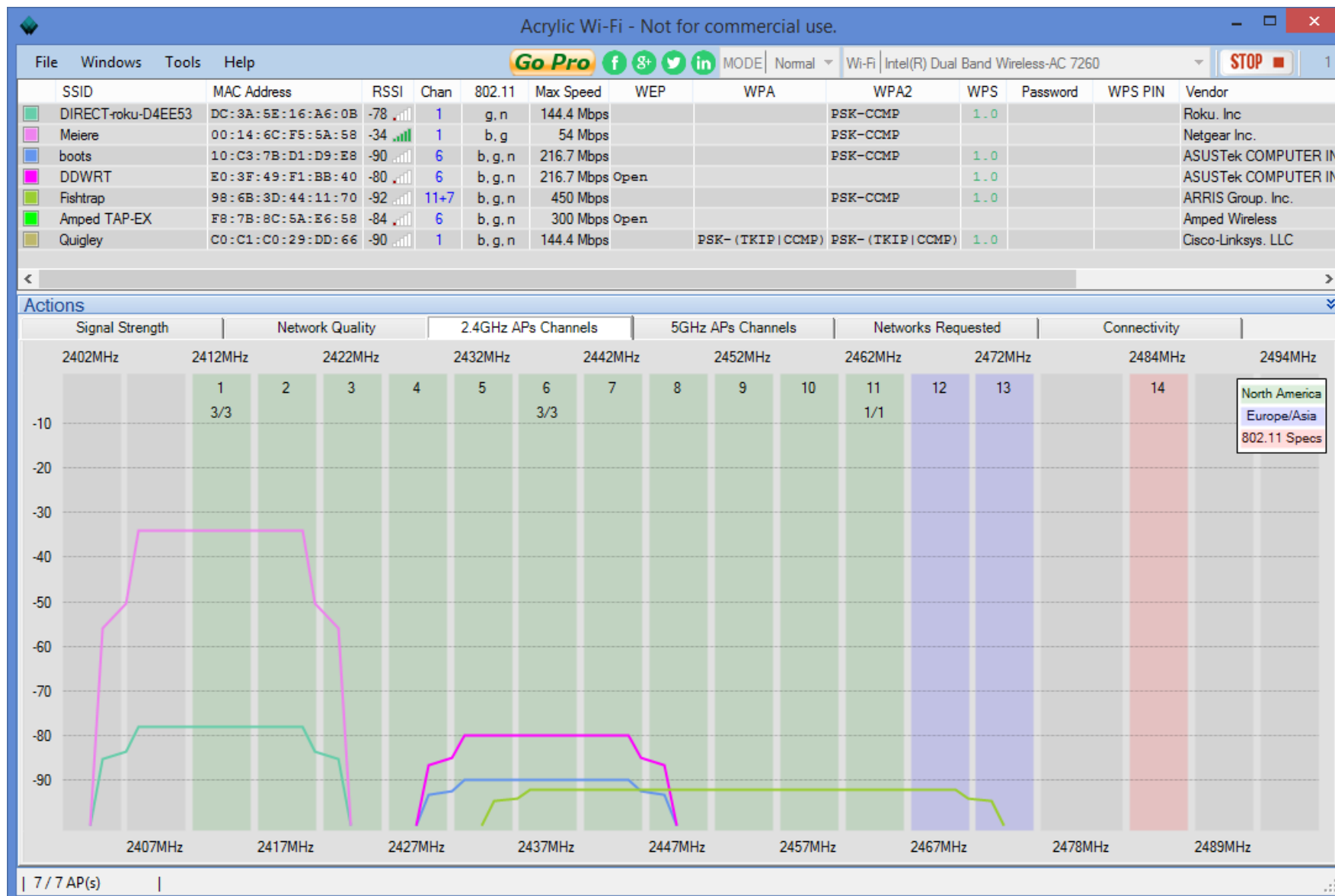
Net Surveyor



inSSIDer



Acrylic Wi-Fi



Congestion and Interference

- ▶ Congestion happens when two or more devices use the same channel. Users have to wait their turn. This can happen for the 2.4 GHz band; very unlikely for the 5.0 GHz band.
- ▶ Interference happens when devices use channels (i.e. frequencies) which overlap. Non-digital devices such as microwave ovens can cause interference. This can be a problem for the 2.4 GHz band, not 5.0 GHz. May not want to make popcorn while watching Netflix. →

Now What?

- ▶ At this point, “The devil is in the details”. Everyone will have a slightly different situation. The general idea is to avoid using the same channel as your neighbor.
- ▶ A typical default is channel 6 so you may have two or three people on 6. Note, that you need to check at several different days at different time. For streaming video, clearly check when you typically view movies.
- ▶ Two people streaming on the same channel can result in pauses in your movies. Change to a different channel. Unfortunately, you should use only 1,6 or 11. Otherwise, you will overlap someone else, leading to interference which can be much worse than delays.
- ▶ How do you change channel? (I will show the general idea.)
- ▶ *If all else fails, read the manual! →*

Single Band Router

- ▶ Open a browser and type the address of your router. If you don't want to look it up, type 192.168.1.1/ or 192.168.0.1. Alternatively, try “routerlogin.net” or “routerlogin.com”. Enter the username and password.
- ▶ Believe it or not, the default username ‘admin’ and the default password of either ‘password’ or ‘123456’ is fine. It is very hard for an outside hacker to get to your router software via the Internet. This completely different from an outside hacker **USING YOUR NETWORK ROUTER**. (More on this later.)
I change this info for my router but leave the default for friends I help.

Wireless Network

Name (SSID):

Meiere

Region:

Change to

United States ▼

Channel:

Channel 1

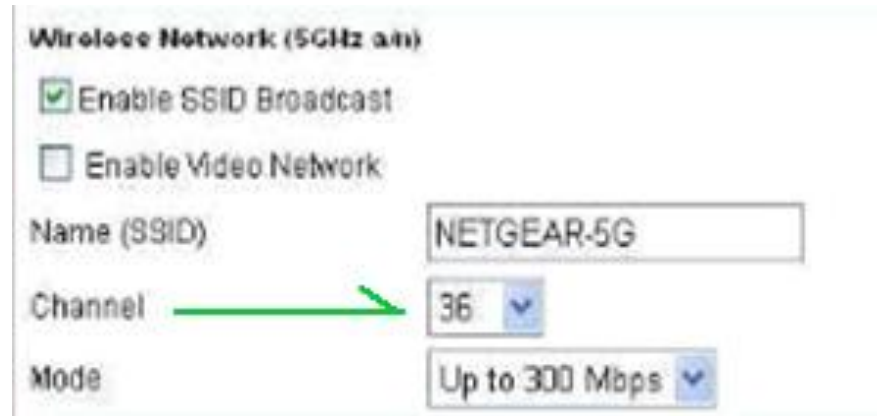
06 ▼

Mode:

g and b ▼

Dual Band Routers

- For the 2.4 GHz band, choose “Auto” or “1”.
- For the 5.0 GHz band, choose anything except the default. If you don’t know the default choose some low number.



The screenshot shows the configuration interface for a 5GHz wireless network. It includes the following settings:

- Wireless Network (5GHz an):**
 - Enable SSID Broadcast
 - Enable Video Network
- Name (SSID):** NETGEAR-5G
- Channel:** 36 (indicated by a green arrow pointing to the dropdown menu)
- Mode:** Up to 300 Mbps

- You have so many choices, you can avoid everybody. Use your Sniffer.
- You don’t have to worry about interference so you can choose a channel close to one in use. However, just on general principle, get away from others. →

Advantages and Disadvantages of each band?

- 2.4 GHz: Long range but Slow. Channels can overlap so only 3 real choices. Many devices such as microwave ovens, cordless phones, ... can interfere.
- 5.0 GHz: Fast but Short range. Channels do not overlap; 23 choices. Essentially no interference from other devices. This band does not go through walls very well. →

Which Devices Use Each Band?

There are no hard and fast rules and this list is evolving.

- Older iPhone and Galaxy Phone, iPod, iTouch, newer Roku devices and HP wireless printers only use 2.4 GHz.
- AppleTV, iPhone5, Galaxy S3 and up and many webcams can use 5.0 GHz.
- Newer Laptops can use either Band. There are so many laptops in use, no general statement can be made. →

Security

IMPORTANT POINT

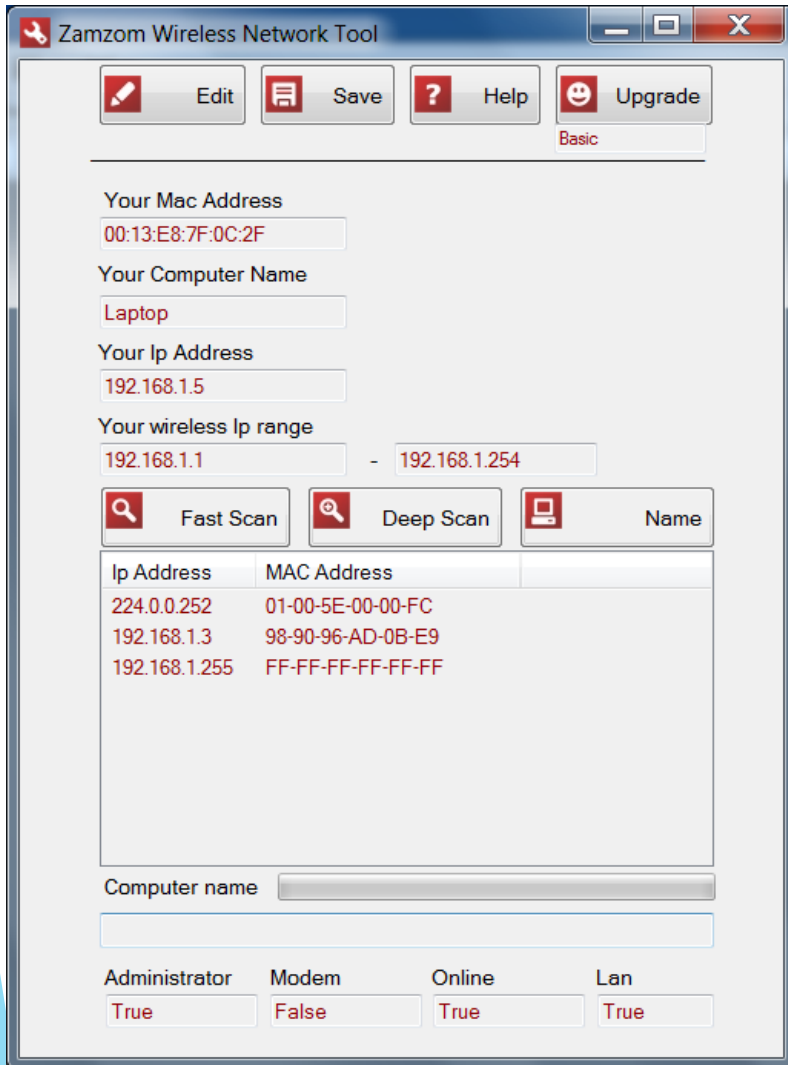
- ▶ It is possible to ‘setup’ your router (in some sense ‘program’ it) and it possible for devices to ‘use’ your router to communicate with the Internet or other devices.
- ▶ When you ‘setup’ your router you create a ‘network’ (SSID) which establishes how this ‘network’ will communicate wirelessly. To do this, you need to contact your router (its IP address) and enter a username and password. Typically you setup your router and don’t do this again for a very long time.
- ▶ Once your router is setup, devices establish a wireless connection to your router by choosing a network name and entering a passphrase (i.e. a password). This may happen with many devices many times a day. The username/password to setup your router and the network name/passphrase to use your router are **different**.
- ▶ I mentioned that it is very hard to PROGRAM your router remotely; i.e. via the Internet, so you don’t have to worry about having a secure username/password. In fact, many routers allow you to permit Remote Access. In that case you have to be much more careful. My advice - don’t permit this. If you do, you are on your own.

Network Security

- ▶ Some people choose a name (SSID) which does not identify them. In fact, anyone who wants to can probably figure out where your router is so the name is not crucial (note on this later). On the other hand, choose your passphrase carefully. You may think that **2jbg@JFg** is secure. It is not. On the other hand, some really long gibberish will probably be a real nuisance. Try “I used to live in Nantucket”. You can remember it but the hacker who can break 2jbg@JFg probably won’t break “I used to live in Nantucket”.
- ▶ If you are really paranoid, you can “hide” your network name. Devices can still connect if they type in your network name and passphrase but outsiders will not see your network name (without special software). One of the options when you setup your network is something like “Broadcast my network name”. It is set by default. Uncheck this to hide your network name. →

Is a Stranger using your Network?

- ▶ There are programs which will display information about who is using your router.



Zamzom has a free version which looks like this:

The paid version gives more info; e.g. Name

Here you see:

192.168.1.5 is my laptop (running this program)

192.168.1.3 is my Desktop

192.168.1.255 is the local broadcast address.

Packets sent here are sent to ALL internal devices

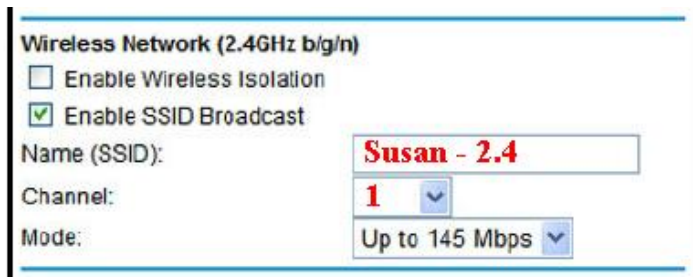
224.0.0.252 is the multicast address for Internet Group Management Protocol. This is normal traffic, and it stays on your local network. Most people will not see this.

(There is a good chance you would never see the last two IP addresses. Included here so you won't panic if you see them.) →

Various Technical Details

Probably save this for the website

- ▶ Internal IP addresses (sometimes called ‘Private’ - confusing word)
 - 192.168.0.0 - 192.168.255.255 Typically Netgear routers
 - 172.16.0.0 - 172.31.255.255 ??
 - 10.0.0.0 - 10.255.255.255 Typically free Comcast routers
- ▶ You don’t really care about the rest of the world, just your router.
- ▶ Programming your particular router, what are the options?
These vary a bit by manufacturer and by model. However, lot in common.
- ▶ We have mentioned SSID. Your device will probably call this ‘network’ and your software will probably just give you a choice like this:



Wireless Network (2.4GHz b/g/n)

Enable Wireless Isolation

Enable SSID Broadcast

Name (SSID):

Channel:

Mode:

You can type anything you want for ‘Name’.
Choose a Channel that is not being used.
We discussed these earlier.
Note the ‘Enable SSID Broadcast’ →

Programming Choices

Security Options refers to encryption of your signal. Anyone with a receiver can detect your signal so you should encrypt it so the bad guys can't use it.

➤ **Bottom Line: Choose the option shown**

➤ WPA and WPA2 are very common choices.

Older routers offer WEP - AVOID WEP

➤ WPA (Wi-Fi Protected Access)

WEP (Wired Equivalent Privacy)

➤ TKIP (Temporal Key Integrity Protocol)

AES (Advanced Encryption Standard)

There is no sense using old, insecure technology if you can avoid it.

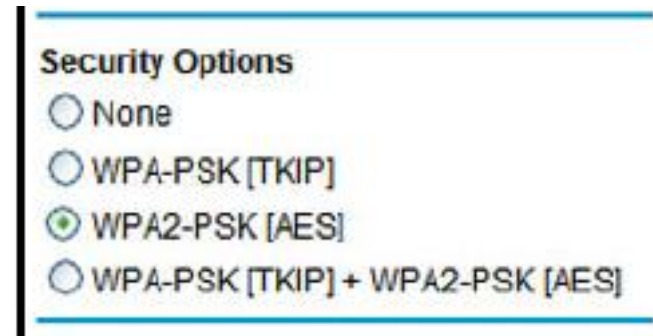
➤ PSK (pre-shared key) This just means you use a passphrase.

➤ WPA2 uses the more advanced AES and WPA uses the old TKIP

Choose WPA2 over WPA if you can for that reason alone.

Even worse, 802.11n does not allow WPA so choosing that will slow down your router to 802.11g speeds. Not a problem in practice because 802.11g is still faster than your Internet connection. Just go with the best if you can.

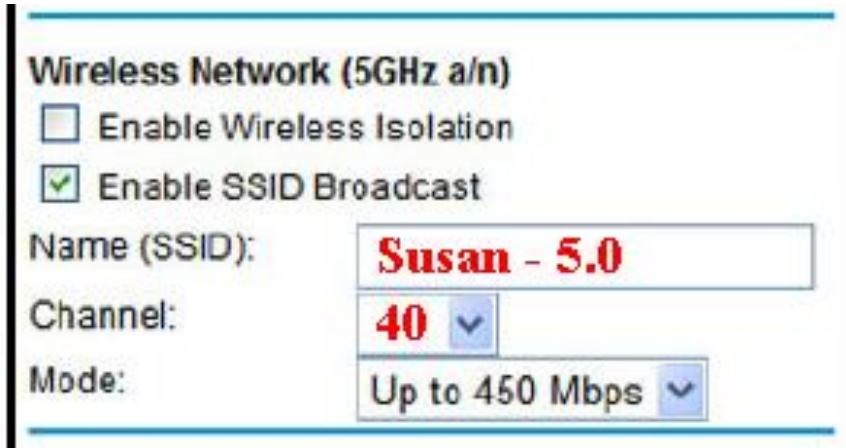
➤ Why both? This just is a compatibility issue; maybe an old device requires WPA. Very unlikely. This just slows your router down. →



(This is Netgear N740)

5.0 GHz

Program 5.0 GHz the same way you did 2.4 GHz except choose a different channel.



The screenshot shows a configuration window for a wireless network. The title is "Wireless Network (5GHz a/n)". There are two checkboxes: "Enable Wireless Isolation" which is unchecked, and "Enable SSID Broadcast" which is checked. Below these are three fields: "Name (SSID)" with the text "Susan - 5.0" in red, "Channel" with a dropdown menu showing "40" in red, and "Mode" with a dropdown menu showing "Up to 450 Mbps".

You can type anything you want for 'Name'. Suggest you don't duplicate names.

Choose a Channel that is not being used. You can choose one close to your neighbor. You probably won't see anyone else.

If you do, I would not get close.

Security Options (Encryption) should be the same as for 2.4 GHz. →

Miscellaneous Other Topics

Extenders and Repeaters (used to extend the range of your router)

- These perform similar functions; repeating the signals from your router.
- Repeaters simply duplicate the router signals; same SSID, same channel.
- Extenders have more flexibility, in general, but details vary by vendor.
Some Extenders allow you to use a different SSID and/or channel
Some are more restrictive
- If the difference in price is small, I would choose an Extender.

How to setup an Extender

- These are programmed much the same way you program your router.
- What SSID to use? What Channel?
- George and Forrest agree that using the same SSID is a good idea.
If your granddaughter connects her iPad upstairs with your extender and brings it downstairs to show you and she needs your router, this will happen automatically if you have the same SSID. There may be trouble otherwise.
- They agree that using the same channel is best. This is more a general feeling than knowledge of a specific problem. Your choice. → (end) →