Demystifying Marine Wireless

Wireless Networking
"Tips and Tricks" to stay connected afloat!

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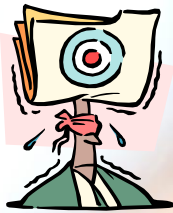www.Twixter.Us

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Agenda:

- **Overview**
  - What is WiFi, and how does it work?
- **WiFi Connection and Finding A Hotspot**
- **Connections & Security**
- **Hardware: Extending Your WiFi Range**
  - **Adapters**
  - **Antennas and Boosters**
- **Solution Examples**
- **Configuring for a Connection**
  - **Adapter Properties**
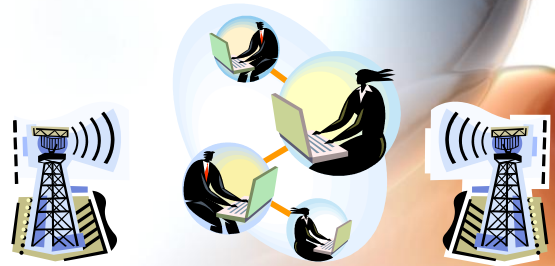 - **Address Configuration**
- **General Q & A**

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Expectations?

1 ⟷ 10

Where do you fall?

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Overview

What is Wireless or "WiFi"
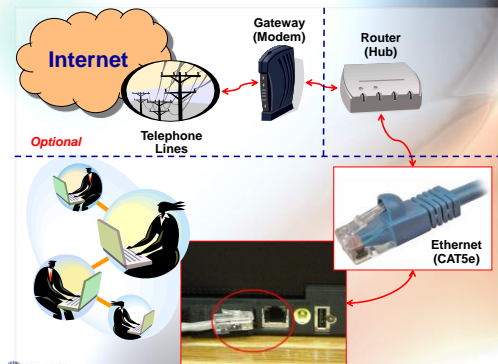
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What is Wi-Fi?

Wi-Fi is a trademarked term to categorize wireless technology intended to extend Local Area Network (LAN) infrastructure and improve the interoperability of wireless products.
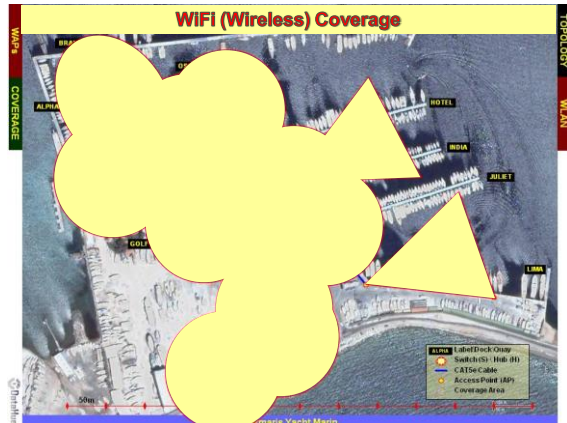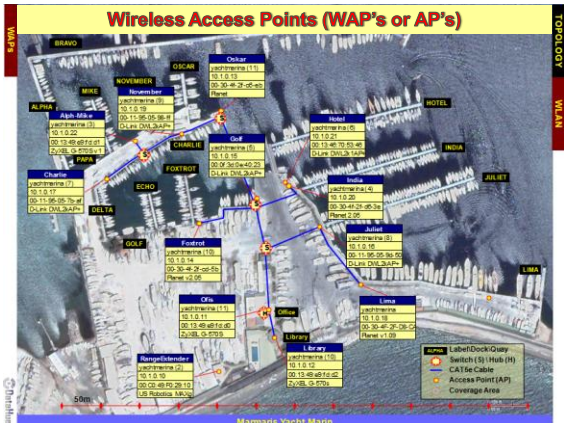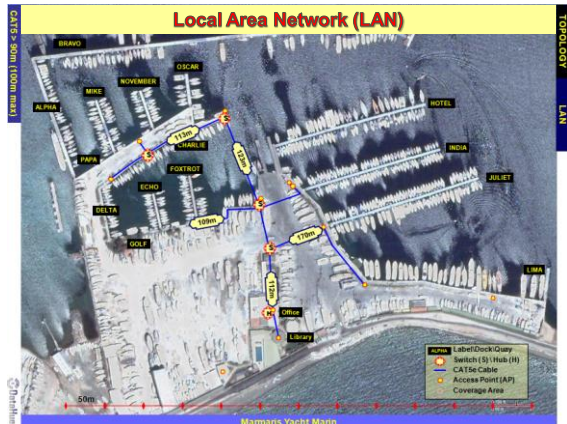
Wi Fi ™

…It is a local INTRAnet Networking component NOT an INTERnet component!

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LAN Infrastructure

Internet

Gateway (Modem)

Router (Hub)

Optional

Telephone Lines

Ethernet (CAT5e)

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1

1

1

1

1

1

1

1

1

1

1

1

1

1

1

1

1

1

1

1

1

1

WiFi Channels (2.4 GHz 802.11b/g/n)

Wireless uses *Direct-Sequence Spread Spectrum (DSSS)* modulation assignments and channel limitations are **NOT** consistent worldwide:

- USA (*Channels* **1-11**)
- Europe (*Channels* **1–13**)
- Japan (*Channels* **1–14**)

A Wi-Fi signal actually occupies five channels in the 2.4 GHz band resulting in only three non-overlapped channels in the U.S.: 1, 6, 11, and three or four in Europe: 1, 5, 9, 13.
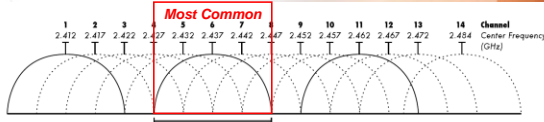
Most Common

Slow Internet?
Check your adapter settings…

TIP: Set Roaming to "Low"

Other Common Settings...

Compatibility Mode: BROAD

Transmit Power: HIGH

Power Saving: OFF

Preamble: LONG

TIP: Radio Spectrum & Interference

								WiFi Band		
ELF	SLF	ULF	VLF	LF	MF	HF	VHF	UHF	SHF	EHF
3 Hz	30 Hz	300 Hz	3 kHz	30 kHz	300 kHz	3 MHz	30 MHz	300 MHz	3 GHz	30 GHz
30 Hz	300 Hz	3 kHz	30 kHz	300 kHz	3 MHz	30 MHz	300 MHz	3 GHz	30 GHz	300 GHz

- **Electronic Interference can be caused by:**
  - Satellite Television\Dish
  - Microwave Ovens
  - Mobile phones
  - Other Wireless LAN's
  - Bluetooth & GPS Devices
  - Two-Way Radios
  - Most modern Radars
  - Power lines

What about my Cell Phone?

- **Tethering**: Using a mobile device to gain Internet access for another device. It works by connecting a device that can access the Internet, through Bluetooth wireless technology or cables (*such as USB*), acting as a modem.

- **International Telecommunication Union (ITU)** which includes: GSM, EVDO, EDGE, UMTS, CDMA, HSDPA\3G\3GS, DECT, WiMAX, Etc…

It's wireless but NOT Wi-Fi!

Finding a Hotspot

Finding Open WiFi Access or "Hotspots"

Finding a Wireless Network

- **Hotspot Detectors**

Use a "Network Stumbler"

Where's your strongest signal?
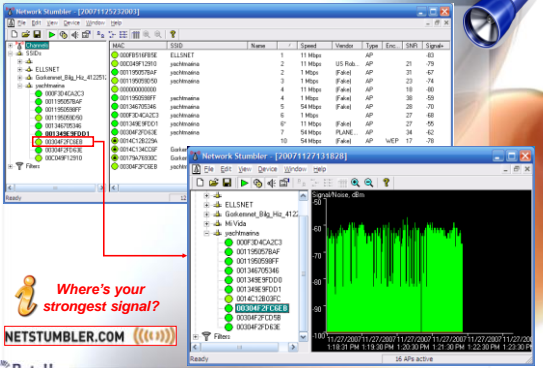
NETSTUMBLER.COM ((( )))

Use a "Spectrum Analyzer"

inSIDer:
www.metageek.net
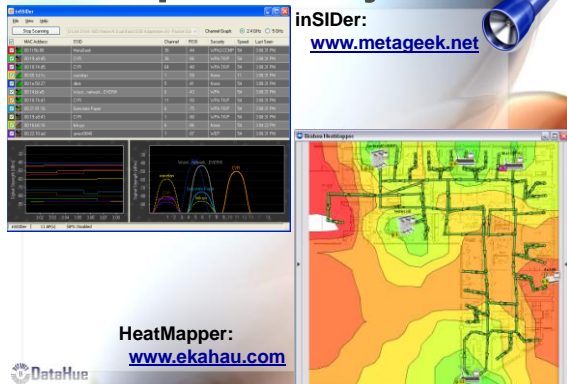
HeatMapper:
www.ekahau.com

TIP: War Driving...uh...Sailing?

- **NetStumbler\iStmbler & "War Driving"**

War "Chalking"

	ssid
open node	)(
	bandwidth
closed node	ssid ◯
	ssid access contact
WEP node	W
	bandwidth

TIP: Download Sites

www.Download.com
www.tucows.com
www.NetStumbler.com
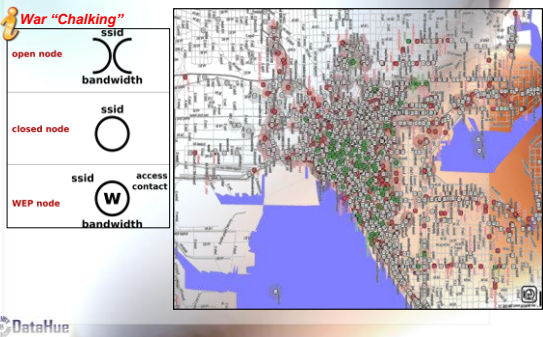
TIP: www.Wiggle.net
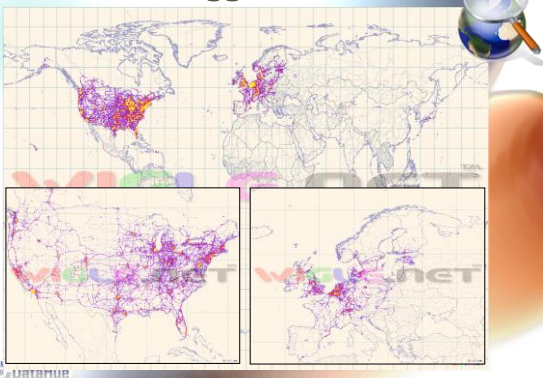
TIP: WiFi Phone (ala SKYPE)

- A WiFi phone is a wireless telephone that looks similar to a Mobil Phone but places calls via WiFi
- Current WiFi phones use **Skype** or **Vonage** for their voice over IP service.
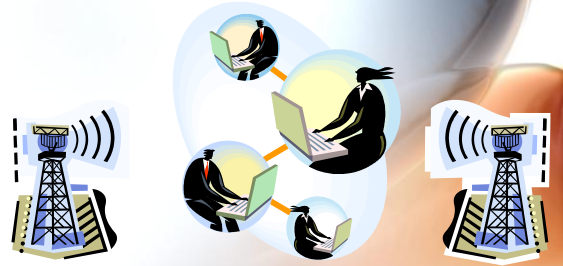- To compete with WiFi phones, several cellular carriers have created **"Dual Mode"** Phones, which can be easily switched between using a WiFi connection when one is available and a traditional cellular network connection when WiFi is not available.

MYTH: Skype consumes a lot of bandwidth…No!

They also work great as a WiFi Detector!

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Connecting

What's the best way to connect?

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Wireless Access Point (WAP)

- **One WAP can typically communicate with 30 client systems located within a radius of 100m (*average*).**
- **The actual range of communication can vary significantly, depending on such variables as:**
  - **Placement**
  - **Height above ground**
  - **Nearby obstructions**
  - **Other electronic devices**
  - **and the Weather!**
- **Wireless range can be extended through the use of Repeaters and "Reflectors", which can bounce or amplify radio signals that ordinarily would go un-received.**

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Wireless Security

- **OPEN (No Security!)**
- **WEP: Wired Equivalent Privacy**

(sometimes incorrectly referred to as *Wireless Encryption Protocol*)

WEP can be "cracked" fairly easily within about 5 minutes!

- **WPA: Wi-Fi Protected Access (WPA)**
  - **WPA is designed to work with all adapters, but not necessarily with first generation WAPs.**
  - **WPA2 implements the full standard, but will not work with some older network cards. Both WPA & WPA2 provide good security!**
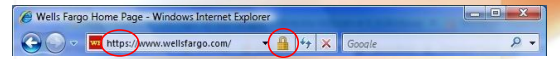

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Secure Connection!

A Secure Access Point IS NOT a secure connection!

Secure Sockets Layer (SSL) & *Transport Layer Security (TLS)* are cryptographic protocol that provide secure communications on the Internet.

HTTPS (Hypertext Transfer Protocol over Secure Socket Layer) is used to indicate a secure connection. It is an additional encryption/authentication layer to provide encrypted communication and is widely used on the World Wide Web for security-sensitive communication such as payment transactions and corporate logons.
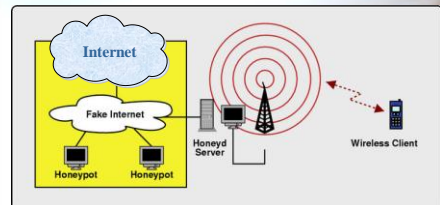
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Welcome to Free Internet…

…OR welcome to my Honeypot?

Honeypot: A wireless honeypot is simply a wireless access point that waits for users to connect. It monitors all traffic for data and scans connected systems for information.

Honeypots are used as both a "Theft of Services" deterrent and hacking tool!
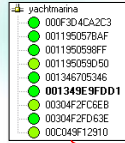
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SSID – What's in a name?

- **Service Set Identifier (SSID) is a code attached to all AP's on a network. All wireless devices attempting to communicate with each other must share the same SSID\BSSID.**

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What is Association?

yachtmarina
- 000F3D4CA2C3
- 001195057BAF
- 0011950598FF
- 001195059D50
- 001346705346
- **001349E9FDD1**
- 00304F2FC6EB
- 00304F2FD63E
- 00C049F12910

Multiple AP's, Different Channels and One Network Name (SSID):

SSID	Name	/	Speed	Vendor	Type	Enc...	SNR	Signal+
ELLSNET		1	11 Mbps		AP			-83
yachtmarina		2	11 Mbps	US Rob...	AP		21	-79
yachtmarina		2	1 Mbps	(Fake)	AP		31	-67
yachtmarina		3	1 Mbps	(Fake)	AP		23	-74
		4	11 Mbps	(Fake)	AP		18	-80
yachtmarina		4	1 Mbps	(Fake)	AP		38	-59
yachtmarina		5	54 Mbps	(Fake)	AP		28	-70
yachtmarina		6	1 Mbps		AP		27	-68
yachtmarina		6*	11 Mbps	(Fake)	AP		27	-55
yachtmarina		7	54 Mbps	PLANE...	AP		34	-62

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Windows Zero Configuration

- **Windows Zero Configuration (WZC) - With the release of Windows XP, it makes configuring and connecting to wireless networks very easy.**

 *However, WZC does not always make correct decisions!*

- **In some hotspots multiple APs are used. Frequently these APs all broadcast the same SSID. WZC is programmed to automatically connect to the one with the strongest signal. Every few minutes WZC "Scans" to see if anything better is out there, which can interrupt a perfectly functioning connection (*Set Roaming to LOW*).**

- **The most common sign that WZC is roaming aggressivly is when Windows pops up its friendly taskbar balloon announcing "*One or more wireless networks is available*" or "*Windows has successfully connected to a network*" (even if *you're already connected to a network*)**

- **Some adapters provide their own wireless connection management utilities that can replace Microsoft's Wireless Zero Configuration. However, an increasing number of wireless adapters rely on WZC…**

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TIP: Disabling\Enabling WZC

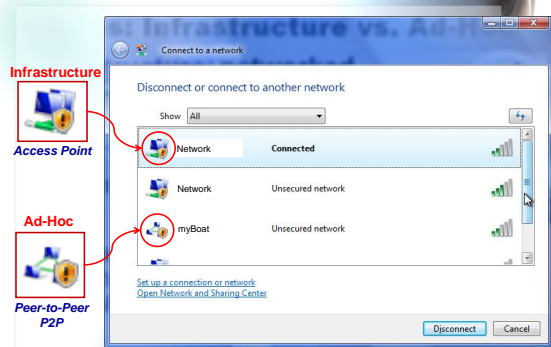**Before using any third-party connection manager, you should first disable WZC:**
1. **Open the Administrative Tools control panel**
2. **Choose Services. Scroll down the list of services and double-click Wireless Zero Configuration.**
3. **Click Stop to end the service now.**
4. **Select Manual (or Disabled) for the Startup Type.**
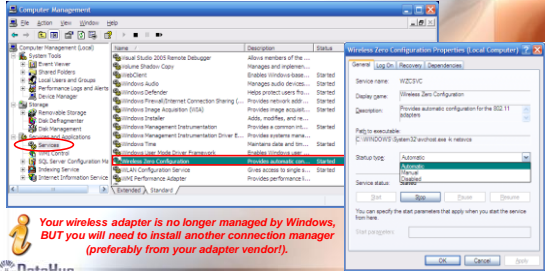
Your wireless adapter is no longer managed by Windows, BUT you will need to install another connection manager (preferably from your adapter vendor!).
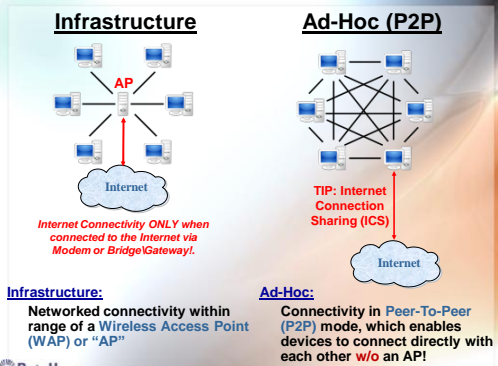
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Modes: Infrastructure vs. Ad-Hoc

Infrastructure

Access Point

Ad-Hoc

Peer-to-Peer P2P

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Modes: Infrastructure vs. Ad-Hoc

Infrastructure   **Ad-Hoc (P2P)**

AP

Internet

Internet Connectivity ONLY when connected to the Internet via Modem or Bridge\Gateway!.

TIP: Internet Connection Sharing (ICS)

Internet

Infrastructure:
Networked connectivity within range of a **Wireless Access Point (WAP) or "AP"**

Ad-Hoc:
Connectivity in **Peer-To-Peer (P2P) mode, which enables** devices to connect directly with each other **w/o an AP!**

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Internet Connection Sharing (ICS)

- **2 Adapters are required!**

Internet

Adapter 2 Connects to the Peer(s)

Peer-to-Peer / Ad-Hoc

Adapter 1 Connects to the AP

Your PC Becomes the AP!

Engenius WiFi Properties

Networking | Sharing

Internet Connection Sharing

☐ Allow other network users to connect through this computer's Internet connection

Home networking connection:
Select a private network connection ▼

☐ Allow other network users to control or disable the shared Internet connection

Using ICS (Internet Connection Sharing)   Settings...

Home networking connection:
Select a private network connection ▼
Select a private network connection
LAN
Internal WiFi

OK   Cancel

MAC? Who's Mac, and why do I care?

- **Media Access Control (MAC)** Address: is a unique number for all network adapters. Two of the same type of network adapters will have unique MAC addresses.

WiFi Status — General

Connection
IPv4 Connectivity: Internet
IPv6 Connectivity: Local
Media State: Enabled
SSID: yachtmarina
Duration: 02:15:51
Speed: 2.0 Mbps
Signal Quality:

Details...   Wireless Properties

Activity
            Sent — Received
Bytes: 2,313,403   14,948,490

Properties   Disable   Diagnose

Close

Network Connection Details

Network Connection Details:

Property	Value
Connection-specific DN...	yachtmarin.com
Description	Intel(R) PRO/Wireless 3945ABG Netw
Physical Address	
DHCP Enabled	Yes
IPv4 IP Address	
IPv4 Subnet Mask	255.255.0.0
Lease Obtained	Tuesday, November 03, 2009 1:43:40
Lease Expires	Tuesday, November 03, 2009 5:43:45
IPv4 Default Gateway	10.1.0.7
IPv4 DHCP Server	10.1.0.7
IPv4 DNS Servers	4.2.2.2
	4.2.2.6
IPv4 WINS Server	
NetBIOS over Tcpip En...	Yes
Link-local IPv6 Address	fe80::7405:dc:7f:fb:ddf9%64
IPv6 Default Gateway	

Close

- **MAC addresses are uniquely assigned to each adapter, so using MAC filtering on a network permits and denies network access to specific devices through the use of "blocking" lists. (*in comes Spoofing!*)**

Speed & Signal Strength

Maximum Data Rate *of the AP - NOT the* Actual Throughput!

Engenius WiFi Status — General

Connection
IPv4 Connectivity: Internet
IPv6 Connectivity: Local
Media State: Enabled
SSID: yachtmarina
Duration: 00:04:13
Speed: 54.0 Mbps
Signal Quality:

Details...   Wireless Properties

Activity
            Sent — Received
Bytes: 4,276   4,835

Properties   Disable   Diagnose

Close

54.0 Mbps
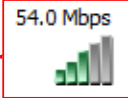
"Bars" don't actually measure connection quality ONLY signal strength.

They're a Passive, not Active measurement of received signal strength (Rx) only.

MYTH: He's "hogging" the Internet

- **Some WiFi AP's do use "contention" access — Every PC that wishes to pass data through the AP is competing on a random interrupt basis. This can cause PC's distant from the AP to be repeatedly interrupted by closer stations, greatly reducing their throughput.**

   MYTH: This is a signal SPEED not STRENGTH contention. Your "Neighbor" with the big antenna cannot "Steal" your signal or bandwidth! *Nor can a big antenna at a longer distance improve connection Speed!*

   So…Closer is usually better!

   Being closer also reduces interference issues.

TIP: Bandwidth Meters

A typical method of performing a measurement is to transfer a 'large' file and measure the time taken to do so. The throughput is then calculated by dividing the file size by the time to get the throughput in megabits (Mbps), kilobits (Kbps), or bits per second (bps).

http://reviews.cnet.com/7004-7254_7-0.html

Bandwidth meter

Bandwidth calculation is measured against that of CNET's Internet Services. Bandwidth may be higher or lower depending on Internet congestion. Calculated tests do not reflect server reliability and speed.

Connection Type	Connection Speed	Faster Providers
28.8 Kbps	Dial-up 28.8k	
33.6 Kbps	Dial-up 33.6k	
53.3 Kbps	Dial-up 56k	
107.4 Kbps — You	107.4 kbps	
384.0 Kbps	DSL/Cable 384k	Find ISP
768.0 Kbps	DSL/Cable 768k	Find ISP
1500.0 Kbps	Cable/DSL 1.5Mbps	Find ISP
1544.0 Kbps	Full T1 1.544Mbps	Covad
3000.0 Kbps	N x T1 3.0Mbps	Bandwidth.com
6000.0 Kbps	T3 6.0Mbps	Bandwidth.com
15000.0 Kbps	T3 15Mbps	Bandwidth.com
30000.0 Kbps	T3 30Mbps	Bandwidth.com

http://speedtest.net

Throughput..or…Bandwidth?

Throughput corresponds to bandwidth consumption and is the amount of data that is passing through the network. Sometimes called the "pipe".

- Network throughput is usually measured in **BITS**:
   – bits per second (**bps** or **bit/s**), kilobits per second (**Kbps** or **Kbit/s**), megabits per second (**Mbps** or **Mbit/s**) and Gigabits per second (**Gbps** or **Gbit/s**).

IMPORTANT! File sizes are typically measured in **BYTES** - kilobytes, megabytes, and gigabytes A byte is eight (8) bits!

MYTH: *Downloading and Skype take up all the bandwidth and I cannot get to my web sites!* A network is a "Packet Sharing" concept. Unless otherwise configured, one user does not have "Priority" over another – All connections share the same bandwidth equally!

The whole World Wide Web (Internet) shares the same "pipes"!

Whatever… …I'm connected but it still doesn't work!

7

What's My Address???

Bad Configuration!

TIP: IPCONFIG…

C:\> ipconfig /all

TIP: Jumpstart the DHCP…

C:\> ipconfig /renew

TIP: Checking the DNS…

C:\> PING www.google.com

Speed = 16ms to 32ms

Isn't Working - Bad DNS…Bad!

TIP: Checking the DNS…

C:\> PING 66.249.91.103

Means it's not working!

TIP: PING and TRACERT…

C:\> TRACERT www.microsoft.com

Hardware: Adapters

What hardware should I use?

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What's The Difference?

WiFi is based on the 802.11x standards:
- 802.11a: 1997 (*Obsolete\Rarely Used*)
- 802.11b: 1999
- 802.11g : 2003
- 802.11b\g (*Most Common*)

What's New?
- 802.11n: 2007
- 802.11a\b\g\n: 2008

What's Confusing!
- 802.11x MIMO: 2007
- 802.16x or WiMAX (NOT WiFi)

Which Adapter Should I Buy?

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802.11x and What's the Difference?

- **802.11x is a protocol used a variety of ways:**
  - Peer-to-Peer Networking
  - Wireless Local Area Networks (WLANs)
  - Wireless "Hotspots"
  - Wireless Audio\Video (VoIP)

The primary difference between 802.11x is Range and Speed! (New 802.11n adds Both!)

- **Typical indoor range is 30m and outdoor range of 90m. (*The greater the distance the slower the speed!*)**
- **The overall bandwidth is shared across all the users on a channel.**
- **With high-gain external antennas, the protocol can also be used in Wireless Wide Area Networks (WANs), typically at ranges up to 8km**

Success of point-to-point at ranges up to 80 –120km where line of sight (LOS) can be established and the signal amplified!

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TIP: When Buying An Adapter

When you buy a Wireless Network "Adapter", make sure:
- It is certified by the WiFi Alliance, and has a "standard" Chipset (Atheros or Prism)
- It Supports Mixed 802.11 a\b\g (or a\b\g\n)
- It Supports WEP, WPA, WPA-2 (Security)
- Comes w/ External Antenna Option
- Has a Strong Power Output (200mw)
- ++ Comes w/ MIMO Technology
- ++ Hub: Power Over Ethernet (PoE)

Note: US\EU Regulations!

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Let's be clear...

Wireless Network Adapter

Antenna

w/ External Antenna

Most Common Type
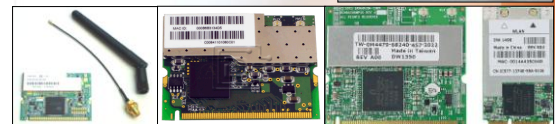
NETGEAR

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Internal WiFi Adapters

- **Internal Adapters & PCI**
  - Integrated (PCI Bus) but Proprietary!
  - Powerful, but Limited mobility.
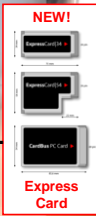 - Cannot easily upgrade!
  - PCI Ext. Antenna…

"Flash" Upgrade your BIOS\Adapter!

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PCMCIA (CardBus) Adapters

- **PCMCIA or "PC Card" (**50€ and 75€**)**
  - Fast and Standard.
  - Good power and range, but fixed point.
  - Good Performance and configuration.
  - Poor Extendibility (Ext. Antennas)

NEW!

Express Card

Buffalo WLI-CB-G54HP   **Netgear WPNT511**   **Belkin Pre-N PC**   **Linksys WPC300N**

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USB Adapters USB

- **USB (**15€ and 75€**)**
  - Standard (USB) w/ many "options"
  - Good power, range and mobility
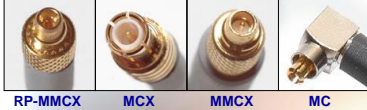 - Good extendibility (Cable & Ext. Antenna)

Hawking HWUG1A

Hawking HWU54D high-gain

Trendnet TEW-429UB w/ WiFi Finder

Netgear WG111

Buffalo WLI-USB-G54 Air Station

Linksys WUSBF54G w/ Wi-Fi Finder

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TIP: Add an External Antenna!

Make sure your adapter has and external anntana option!

Make sure you get the right Connector!

RP-MMCX   **MCX**   **MMCX**   **MC**

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Extended WiFi Kits...

Long-Range Kit 230€ to 250€   **Mobil WiFi Kit** 100€ to 120€   **USB Antenna** 140€ to 160€   **Notebook WiFi Kit** 90€ to 110€

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Wireless Hubs & Routers

- **Hubs (**40€ and 100€**)**
  - Standard Ethernet w/ many "options"
  - Really good power, range and mobility (PoE)
  - Good extendibility (Cable & Ext. Antenna)
  - No Software Installation Required
  - Multiple concurrent computers (100m Range)
  - Somewhat complicated setup & maintenince

DLINK Airplus 54g   Linksys WRTG54A   Linksys WRTG54C

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TIP: Plug & Play (PnP)!

- Simple, Easy-to-Use Packaged Solution
- Integrated USB WiFi Adapter & Anntena
- Good Range & Signal

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TIP: When Buying An Adapter

Good Websites for Researching and buying Equipment:

- **www.radiolabs.com**
- **www.antennasystems.com**
- **www.hawkingtech.com**
- **www.wirelessnetworkproducts.com**
- **www.outpost.com**

TIP: Turn Off Your Adapters!

- **Many laptops have a switch somewhere on the case for turning on and off the internal Wi-Fi antenna.**

- **One way to squeeze a little extra life out of your laptop battery is to turn that switch off when you're not going to need Internet access; for example, when you're on a plane.**

- **Even if your system doesn't have a physical switch, you can disable the Wi-Fi connection from within the Windows control panel.**

Hardware: Antennas

How to enhance and extend your wireless

Line of Sight & Fresnel zones

If unobstructed **Line-of-Sight (LOS),** radio waves will travel in a straight line from the transmitter to the receiver. But if there are obstacles near the path, the radio waves reflecting off those objects may arrive out of phase with the signals that travel directly and reduce the power of the received signal.
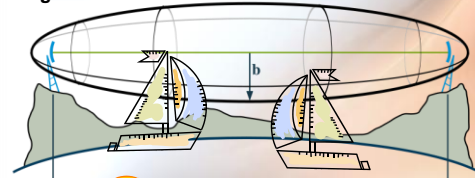
HEY, Stay out of my Zone!
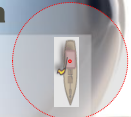
Directional vs. Omni-Directional

- •Focused (**45˚ to 60˚**)
- •Increased Directional Range

- •Flexible
- •Wide Coverage (**360˚**)
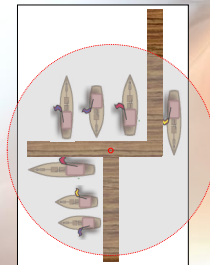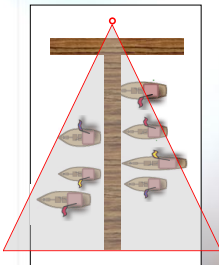
Omni-Directional Antenna

- **Indoor (Wide Coverage)**
- **Mobile\Roaming**
- **Outdoor (Wide Coverage)**

Vertical "Whip"	Mini Desktop	Magnetic Mount	Vertical
1.5dB to 5dB	5dB to 7dB	6dB to 8dB	8dB to 15dB
20€ to 40€	30€ to 50€	30€ to 50€	60€ to 150€

Directional Antenna

- **Indoor**
- **Point-to-Point**
- **Outdoor (Fixed)**
- **Multiple\Array's**

Flat Directional	**Dish Directional**	**Corner Angle**	**Directional**
10dB to 15dB	12dB to 18dB	15dB to 18dB	8dB to 10dB
45€ to 70€	50€ to 75€	50€ to 75€	25€ to 35€

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Parabolic\Grid & Yagi Antennas

- **Specially-shaped antennas can be used to increase the range of a Wi-Fi without a drastic increase of transmission power.**
- **Parabolic high-gain antennas allow transmitting a narrow beam over distances of several kilometers.**
- **A low-cost approach can be used very simple enhanced antennas!**
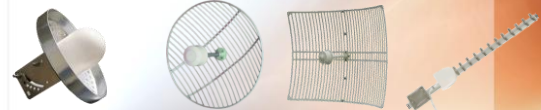
"Backfire"	**Parabolic**	**Grid**	**Yagi**
15dB to 18dB	20dB to 25dB	20dB to 25dB	14dB to 18dB
50€ to 70€	200€ to 250€	100€ to 150€	50€ to 70€

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Cables and Connectors

type	core	overall diameter [in]	overall diameter [mm]	loss
LMR-200 HDF-200 CFD-200	1.12 mm Cu	0.195	4.95	low loss communications, 0.554 dB/meter @ 2.4 GHz
LMR-400 HDF-400 CFD-400	2.74 mm Cu clad Al	0.405	10.29	low loss communications, 0.223 dB/meter @ 2.4 GHz
LMR-600	4.47 mm Cu clad Al	0.590	14.99	low loss communications, 0.144 dB/meter @ 2.4 GHz
LMR-900	6.65 mm BC tube	0.870	22.10	low loss communications, 0.098 dB/meter @ 2.4 GHz
LMR-1200	8.86 mm BC tube	1.200	30.48	low loss communications, 0.075 dB/meter @ 2.4 GHz
LMR-1700	13.39 mm BC tube	1.670	42.42	low loss communications, 0.056 dB/meter @ 2.4 GHz

10m LMR-400
20€ to 30€

10m LMR-200
15€ to 20€

Loss = 0.30 dB @ 2.4 GHz   1€ to 3€
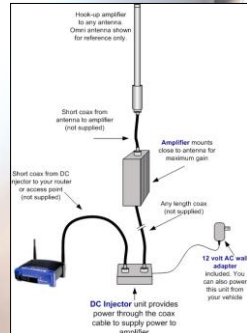
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Amplifiers\Boosters

Hawking 100-500mW Amplifier
50€ to 100€

1watt Amplifier w/ DC Injector
250€ to 300€

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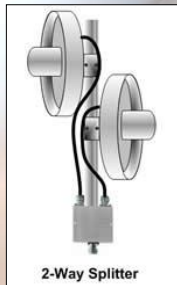## TIP: Splitters

Add multiple Directional and\or Omni-Directional antennas to one adapter!

2-Way Splitter
45€ to 60€

2-Way Splitter

DataHue

TIP: USB Extenders

USB Cable Length Limitations: high speed (USB 2.0) devices to 5 meters and for low speed devices 3 meters.
  - This means you can't just connect a bunch of USB cables together and run them 30 feet to another room - BUT you can connect a 6 foot and 10 foot cable for a total of 16 feet.
  - Most USB products are USB 2.0 and have the 5 meter limit. Low speed devices are generally keyboards and mice.

In order to go beyond these limits you need to use:

- **USB Hubs** - you can use extension cables and up to 5 USB hubs connected together to extend USB's range up to 30 meters (The distance between each hub can be no more than 5 meters).
- **Active Extension Cables** - contain electronics which regenerate the USB signal. These cables are essentially 1 port USB hubs and will allow you to go up to 30 meters!

Micro, Mini, B-type, A-type (F/M)	**3m USB Cable**	**USB Active Extension**	**4-Port USB Hub**
	5€ to 10€	10€ to 25€	5€ to 15€

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TIP: Remote Power (PoE)

Power over Ethernet (PoE): is a technology to transmit electrical power AND data to remote devices over standard CAT5 (Twisted-Pair) cable (*usually in an Ethernet network*).

- PoE is useful for powering appliances where it would be inconvenient, expensive or infeasible to supply power separately.

- The technology is somewhat comparable to telephones, which also receive power and data (although analog) through the same cable. It works with an unmodified Ethernet cabling infrastructure

How do I get power to that booster all the way up the mast?

Power Over Ethernet (PoE)
25€ to 40€

Finding MIMO...

- **Multiple-Input and Multiple-Output (MIMO): refers to the use of multiple antennas both at the transmitter and receiver to improve the performance of radio communication systems. It is one of several forms of "Smart Antenna" (SA) technology!**

Wireless Repeaters

A repeater is a device that receives a signal and retransmits it at a higher level or higher power, or onto the other side of an obstruction, so that the signal can cover longer distances without degradation.

– Repeaters may be used to achieve Non-Line of Sight (NLOS) links by positioning it at a critical position to provide a path around the obstruction.

– OR a repeater may simply amplify the received signal and re-transmit it un-altered at either the same frequency or a different frequency.

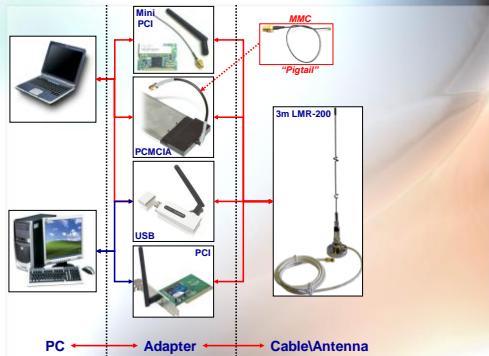**Repeater**
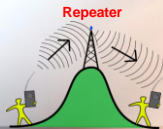
Solution Examples

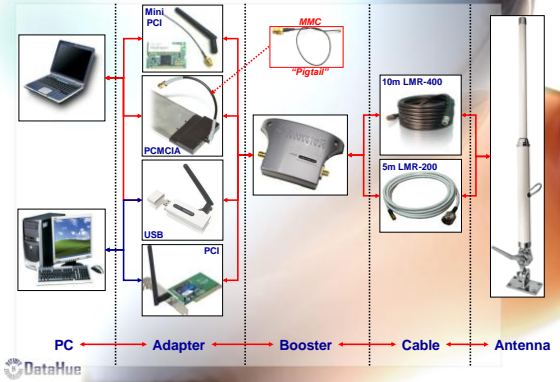**A Couple Pre-configured Examples!**

USB Extension Solution *(easy)*

USB

USB

PC ← → **USB Cable** ← → **USB Adapter** ← → **Pole\Mount (*optional*)**
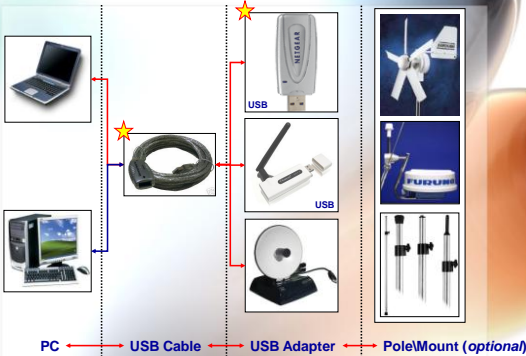
Weatherproof these items!

External Antenna Solution *(Easy)*

Mini PCI

MMC

"Pigtail"

3m LMR-200

PCMCIA

USB

PCI

PC ← → **Adapter** ← → **Cable\Antenna**
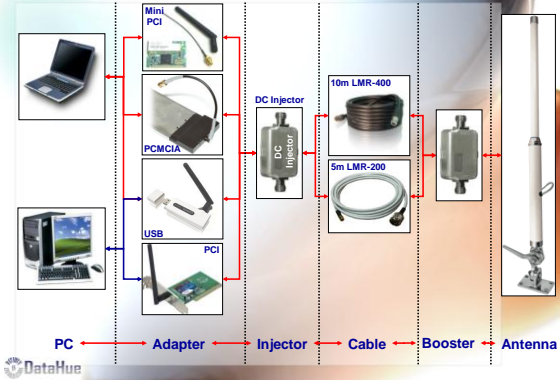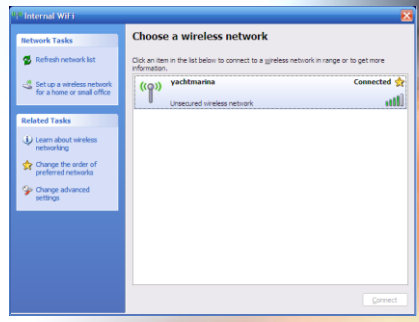
External Antenna & Booster

Hub & Ext. Antenna Solution
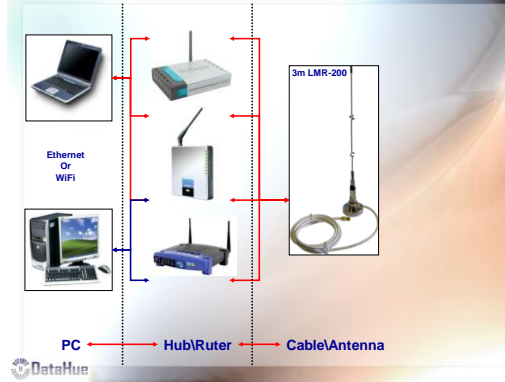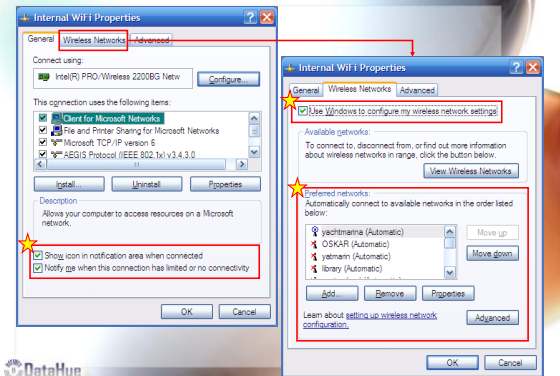

External Antenna *(Enhanced)*

Configuring & Connecting

How to configure your PC for WiFi

WiFi Properties...

Wireless Network Properties...
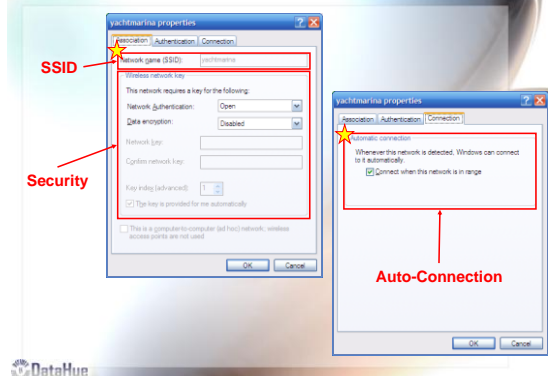
Changing Your Configuration...

Questions?