# Shipboard WiFi

**Originated from: Brennan Phillips on May 23, 2011**

## Originated From: Brennan Phillips (IFE) on Mon, 23 May 2011

Hello RVTEC,

We're interested in broadcasting WiFi onboard the E/V Nautilus and I wanted to get some input from the community in terms of hardware. Securing our network, controlling access, etc. is something we're on top of... I'm more interested in discussing the in's and out's of broadcasting signal inside a steel hull.

We own a LinkSys router that is hooked up to a 1-watt amplifier board and an omnidirectional antenna. I'd like to place this outdoors with hopes that TX/RX will work within at least the upper two decks, but that might be ambitious.

If anyone has experience installing wifi on their vessel I'd be interested to hear your advice. In then end we'll just try it out and see what works, but the more information we know beforehand the better. Thanks!

-Brennan Phillips

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## From: Toby Martin (OSU)

Hi Brennan,

When evaluating placement of access points it is often better to have more low power units versus one high power unit. With one unit there will always be blind spots; with multiple units you can shift one to cover the blind spots of others.

Regarding deck penetration:
- Solid steel decks are difficult to penetrate. Holes (portholes, stairways, ventilation) will allow a signal to leak in nearby.
- Metal passageways act as wave guides, but can also cause multipath interference.

As you say, "In then end ... just try it out and see what works".

Good luck!
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Toby

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## Reply From: Thomas Wilson (SUNYSB) on Tue, 24 May 2011

I agree with Toby, lots of a little access points beat one big AP hands down. Not exactly the same application, but when I installed WiFi in our Flax Pond Running Seawater Laboratory, I just bought a bunch of standard Linksys wireless routers (cheaper than buying "access points") and deployed thusly:

1) Set the router WiFi frequencies as far apart as possible: channel 1, 6, and 11 or 2, 5, 8, 11. Adjacent channels typically are too close and interfere with each other. Set all SSIDs, security, and passkeys identical (this worked for me), this way you only have one passkey and a portable device should automatically lock onto the best signal and jump from one access point to the other when carried around.

2) Determined the optimum locations by putting routers in different places and walking around with a laptop looking at the signal strength until you get a good wireless signal everywhere in the building. If you have more than one router sharing a WiFi channel, place them as far apart as possible so the signals don't overlap.

3) IMPORTANT: disable DHCP on all but one "master" router. Plug the WAN port of the master into the cable modem or other Internet connection, then using cables and switches/hubs as needed, connect all the routers together using their LAN ports. The one "master" router will now provide DHCP for all wired and wireless clients, and all the clients will be on the same subnet (handy if you want to connect to printers or shared
storage).

4) Enjoy! This system has provided wired and wireless access for a couple of years with almost no trouble or downtime. All the routers are the same so if one dies you just drop in a suitably configured spare.

5) This should work for almost any wireless router so please feel free to use your favorite brand, for example D-Link for the detachable antennas.

6) For even more possibilities Google "DDWRT". Trevor Young introduced me to this free open-source Linux-based router firmware that installs on many commercial routers and gives them additional functionality. I use a DDWRT supercharged router as a WiFi bridge to transport Internet service between the tide gauge on the north tower of a drawbridge and the weather station on the south tower.

6) Several years ago I remember someone talking about "leaky coax" that they ran through all the compartments of their ship and connected to a cellphone repeater to heat up belowdecks for cellphone service. Wonder if a similar method could be used for WiFi. Anyone want to 'fess up and give us an evaluation of how it worked for cellphones and a source for the coax?

Hope this helps!
Tom

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## Reply From: Brennan Phillips (IFE) on Tue, 24 May 2011

Thanks Tom-

A couple years ago I experimented with 3rd-party firmware for a Linksys WRT54G and had success in amplifying the router's output. The WRT54G has two antennas and the firmware allowed you to choose to use one antenna or the other (so you don't waste power on two antennas when you have a special one hooked up to one), and it also allowed you to boost up the default output power of the amplifier. I think what I used was called Tarifa, but there's a list on Wikipedia:

http://en.wikipedia.org/wiki/List_of_wireless_router_firmware_projects

This is fun stuff to mess with!

-Brennan

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## Reply From: Thomas Wilson (SUNYSB) on Tue, 24 May 2011

Addendum: all the routers need different static IP addresses. I set the master to that old standby 192.168.1.1, then the others to 192.168.1.2, 1.3, 1.4, etc.

Tom

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## Reply From: Andrew Girard (WHOI)

Hey Brennan,

Reed and I have been playing with DD-WRT with pretty good success. http://lifehacker.com/178132/hack-attack-turn-your-60-router-into-a-600-router

An interesting one I've looked at but haven't gotten to play with was http://www.open-mesh.com/ They would allow you to just keep adding stations as you need them on the boat. You set up a bunch and keep them in a closet. As scientist request wifi in a certain area of the ship, you install one.

Good luck with it, keep us in the loop on what you find.
Andy

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## Reply From: David O'Gorman on Tue, 24 May 2011

A quick by-the-by, for older wireless access points (pre 802.11n) a feature of those units (and the reason that they had multiple antennas) is that they would figure out which antenna had the best signal and switch to it automatically. There's a good article on multipath radio signal reflection and diversity antennas here:
http://www.cisco.com/en/US/tech/tk722/tk809/technologies_tech_note09186a008019f646.shtml
The short of the long is the case study about the golf course at the end, which boils down to not using each antenna port to cover a different area of the golf course (or ship), as the access point will constantly switch back and fourth and it won't work for either area. The multipath sections of the article are interesting as well.

Also of interest is that the N standard includes a provision for using spatial multiplexing (read: having multiple antennas working on the same frequency at the same time) to increase the overall information transfer rate. The wikipedia page on it is ok (the MIMO page is better than the spatial multiplexing one):
http://en.wikipedia.org/wiki/MIMO
And the short of the long is that you don't *have* to use multiple antennas, but that if you do, you can effect higher data rates.
There is a table of the data rates vs number of antennas on the 802.11n wikipedia page.

The discussion of 'leaky co-ax' reminded me of passive repeaters. I couldn't find a good article on them in 30s of google searching and the wikipedia page wasn't that great, but all they mount to is two antennas connected by a chunk of co-ax. With the price of access points you'd probably be further ahead to just install an access point (as you'd have to run a cable in either event) but there are occasions where a passive repeater may come in handy, so I thought I'd pass it on.

Dave

David O'Gorman
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## Reply From: Trevor Young (SUNYSB) on Tue, 24 May 2011

The leaky coax would probably work well in a ship, especially with a 1watt amp. Here on the KM we have several wireless access points (Belkin) and the signal has a very hard time going through bulkheads unless there is some large opening.

You can use the calculator here to find cable http://www.timesmicrowave.com/cgi-bin/calculate.pl
The LMR-900 looks to have pretty low attenuation at 2.4ghz. Make sure you use a 50 ohm termination

on each end, and if the cable is running along a wall, try to space it a couple inches away or the wall will tend to soak up signal.

As Tom said, we had pretty good success with custom firmware on commercial routers. DD-WRT and Tomato are very good. They both give you far more features than what comes on the commercial software. Interestingly, they let you increase the transmit power (from around 70 to 250mw). If you decide to go this route make sure you look up the specific model and version of your router to see what versions of software support it. Also look for installation instructions for your specific router. Installation is not always straight forward and if you install the wrong firmware version, or do it the wrong way you may end up with a brick (sorry Tom ) You can usually resurrect the router if this happens but it may not be worth the time required.

Anyone looking to try this, I would highly recommend getting a Linksys WRT-54GL. Its pretty common and has more ram and flash so it supports the best firmware versions and handles heavy loads better. There are also models with usb ports if you want to add some easy network attached storage.

Best Regards

Trevor Young

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## Reply From: Trevor Young (SUNYSB) on Tue, 24 May 2011

A correction to my previous message. The cable I recommended would act as a nice feeder line but wouldn't radiate much. See here for radiating cable
http://www.commscope.com/andrew/eng/product/trans_line_sys/coaxial/radiating/

This has made me curious. I'm gonna go walk around the KM right now and see exactly how far and through how many walls a signal will go.

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Reply From: John Haverlack (UAF) on Tue, 24 May 2011

I'm looking for a solution that meets the following:

* Provides multiple centrally managed SSID's with and/or without encryption. Different SSID's would have access to different ship networks.
* Span multiple access points such that users can transparently move between access points without loosing wireless connectivity. Multiple access points are to achieve full ship coverage.
* Web Authentication integration that can integrate with a single sign on (SSO) ship account. Similar to a "hotel" web authentication, but that uses a ship based SSO authentication system.
* The ability to control what level of network accessess and routing is available on a per user basis. I would like the ability to give users internet access on a per user basis (for a window of time and/or rate

limited access) from the wifi network, while other users are restricted to ship only access on the same wifi network.
* The ability to authenticate devices by MAC address on secure wifi SSID's for persistent wireless devices (ie: webcam).
* The same network access controls could also be implemented for wired network ports too.

We are doing most of this already at the University here in Fairbanks. Â I have not had a chance to look into the details but I believe we are using Cisco Access points. Â I can share details as I find them if anyone is interested.

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