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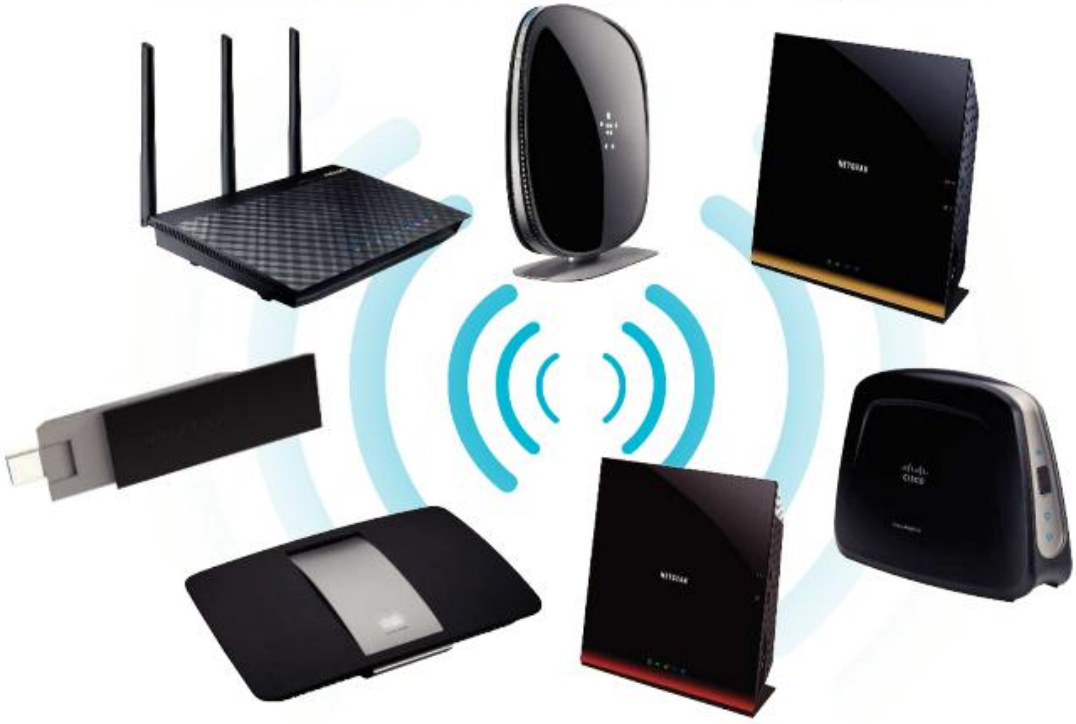
CRANK UP THE AC!

The next iteration of Wi-Fi has arrived. Nathan Taylor tests seven 802.11ac devices to see which ones are worth your dosh.



Wi-Fi is about to get a shot in the arm. Over the course of 2013, you'll be seeing more and more networking devices using the new 802.11ac wireless standard. This new iteration of Wi-Fi, which will eventually replace 802.11n as the dominant standard, more than doubles the speed. In some circumstances, it might even be faster than a wired Gigabit Ethernet connection.

FIVE THINGS TO KNOW ABOUT 802.11AC

01 It's fast. The initial products released for 802.11ac come in two speeds: 867Mbps and 1300Mbps. That's compared to the 450Mbps that 802.11n currently supports. As we found in our tests, 1300Mbps at relatively close range can actually be roughly as good as a wired Gigabit Ethernet link.

In the future, 802.11ac can theoretically go up to speeds of 6.93Gbps and beyond, but that's not likely to happen for a few years yet.

02 It's only for the 5GHz band. That's right, 802.11ac *only* works in the 5GHz frequency band. There's no 2.4GHz version of it. Historically, most wireless devices have operated in the 2.4GHz band.

That being said, all the routers and access points released so far include support for 802.11n in the 2.4GHz band, so your legacy devices (and by 'legacy' we mean the vast majority of existing Wi-Fi devices) can still use them. As a result, expect to see routers and access point with wireless speeds advertised something like this: 300/1,300Mbps. That means they support 300Mbps 802.11n in the 2.4GHz band for older devices and full 1,300Mbps 802.11ac in the 5GHz band.

03 It's backwards compatible. An 802.11n device can absolutely talk to an 802.11ac access point – on the proviso that the device supports the 5GHz band, though see the point above, as most 802.11ac routers also support dual-band, but can only operate at 802.11n speeds in the 2.4GHz band.

Of course, an 802.11n wireless device can only talk to a router at wireless n speeds, so there will be no special benefit to using these devices with an 802.11ac router. But they'll be compatible.

04 Mobile devices will have lower speeds. That's actually true today with 802.11n and it will continue to be true with 802.11ac. Like 802.11n, 802.11ac achieves high speeds using multiple antennas, multiple radio

bands and complex encoding. To save power, mobile devices tend to have a stripped-down implementation: typically, a single antenna and a single band.

As a result, when they appear, mobile 802.11ac devices may be limited in speed. We don't yet know what the typical speed will be. For example, today mobile 802.11n implementations are often limited to 72Mbps or 150Mbps. 802.11ac mobiles may have a top speed of 200Mbps or less, though 433Mbps is theoretically possible with a single antenna.

It's still a draft standard (but don't let that stop you). Technically, 802.11ac is still a draft standard and full ratification won't happen until later in the new year. The gears of the IEEE grind slowly. However, the implementation is more or less settled, and any minor changes that might come up can be fixed with a software patch. In short, there's almost no danger of a router you buy today being made obsolete when the standard is ratified.

That being said, the products we looked at here did give us some concern. While the Netgear and Linksys devices all interoperated beautifully, the Belkin and ASUS routers didn't want to play nice with their counterparts, with problems detecting the networks and sub-par performance when they did connect. As a result, we'd be wary of mixing and matching vendors until the final standard is ratified.

TALKIN' TECH

To understand what's changed with 802.11ac, you really have to go back to the innovations that appeared in 802.11n. The big advancements we saw in 802.11n were multi-channel usage, improved encoding and MIMO (Multiple Input Multiple Output).

The first one is easy to understand. The radio spectrum available for Wi-Fi communication is divided into 20MHz channels. Prior to 802.11n, a single device was only permitted to use a single channel; with 802.11n, a device could use two channels at once, doubling the throughput.

MIMO is more complex. It allows a wireless transmitter to use multiple physically separated antennas to send multiple streams in the same frequency band, using spatial division to keep the streams separate.

The number of antennas determines the number of spatial streams available, and different encoding methods also support different data rates. As a result, we ended up with a number of permutations of 802.11n single spatial stream on a 20MHz channel (72Mbps, commonly seen in mobiles), single spatial stream on a 40MHz channel (150Mbps), dual spatial streams on a 40MHz channel (300Mbps), and triple spatial streams on a 40MHz channel (450Mbps).

Simply put, 802.11ac is 802.11n cranked up to the next level. Where 802.11n supported up to four spatial streams, though we never saw more than three implemented, 802.11ac supports up to eight. Where 802.11n was limited to 40MHz channels, 802.11ac allows 80 and even 160MHz channels. Modulation encoding has also been upgraded, from 64-QAM to 256-QAM, to use the technical terms.

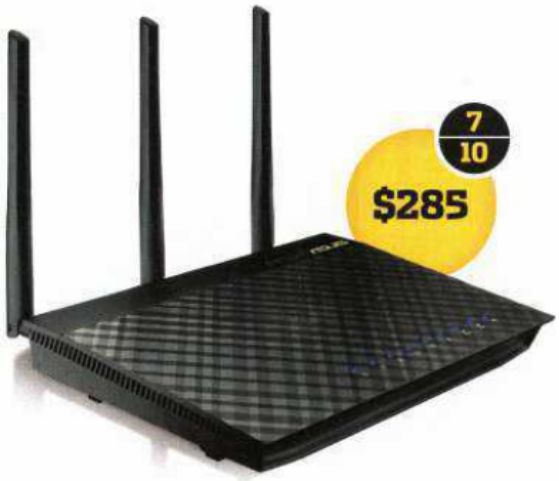
As with 802.11n, we're going to see multiple permutations, depending on the capabilities of the access point or router. Indeed, we already have: 867 and 1,300Mbps devices are available right now. The 867Mbps devices use two spatial streams and 80MHz channels, while the 1,300Mbps devices use three. In the future, we'll likely see devices that support four spatial streams (1,733Mbps) and possibly 160MHz channels for a total of 3,466Mbps. Technically, the specification goes even further – with eight spatial streams, we could hit 6.93Gbps.

IN PRACTICE

There's no question from our test results: 802.11ac is the real deal. We tested each of the devices here at three different ranges and at the shortest range (5m), we actually wondered whether the limiting factor was the wireless link or the Gigabit Ethernet bridge between the router and server. That's to say, it transferred data fast enough to saturate a Gigabit Ethernet link in practice. Our top test speed was over 507Mbps (63.4MB/s), which is as fast as you're likely to see Gigabit Ethernet go.

So how does this compare to 802.11n? To find out, we retested the Linksys EA6500 in the same setup as for 802.11ac, but this time the wireless network was set to 802.11n only. Everything else, including the use of the Linksys WUMC710 as a client, was identical. With 802.11n, data transferred at 28.6MB/s at 5m, 23.3MB/s at 10m and 15.2MB/s at 15m. Respectively, that's 45.1%, 53.9% and 48.5% of the 802.11ac speeds.

ROUTERS We managed to get hold of five early-release routers and all but one are standard broadband routers, lacking a modem of any kind. All are NBN-ready.



ASUS RT-AC66U

Great features, but disappointing performance.

@ www.asus.com.au

✓ Lots of features, including advanced options like VPNs.

✗ Significant performance issues in our tests.

On paper, the RT-AC66U looks close to being the ideal router. Supporting full 1,300Mbps 802.11ac wireless as well as 450Mbps 802.11n in the 2.4GHz band, its wireless performance is theoretically as fast as they come. On top of that, it comes with a host of great features: twin USB ports for file and printer sharing, Gigabit Ethernet ports, cloud storage tools and excellent Quality of Service (QoS) management.

Unfortunately, when it came to performance, it didn't live up to the promise. It made us actually wonder if there were indeed compatibility issues to be resolved with these draft products. The Linksys WUMC710 station we were using for our testing couldn't even see the SSID of the RT-AC66U unless all security was switched off, and when we did manage to connect it, the performance was dismal relative to its competitors. We even had to check that it was connecting at 802.11ac rates (it was).

Worrying that there might be a compatibility issue between the Linksys client and the ASUS access point, we then tried connecting with the Netgear A6200 USB adapter. The results were worse, at 21.2MB/s at 10m. Finally, we tried bridging two ASUS RT-AC66U routers (making one router the access point and one the client station) and testing the performance – the result was better, but not by much. Two ASUS routers bridged produced a speed of 30.9MB/s at 10m. Clearly, ASUS has some work to do to get its implementation up to scratch.

It's a shame, too, because the interface is excellent. It's a little more hardcore than we saw with the Linksys and Netgear routers, but if you're a tinkerer it's got the goods. It even lets you set advanced elements like transmit power, VPNs and traffic management. Quite simply, it has more tools built in than any of its competitors. It seems ASUS just has to get the performance right.

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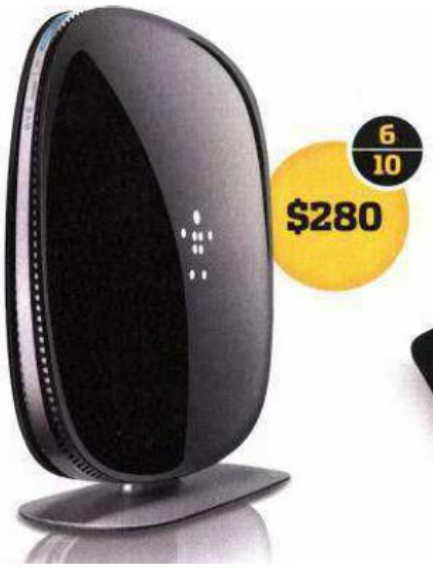


Belkin AC 1200 DB

An attractive router, but has it got the goods inside?

@ www.belkin.com/au
✔ Looks great.
✖ Poor performance, even for a device limited to 867Mbps.

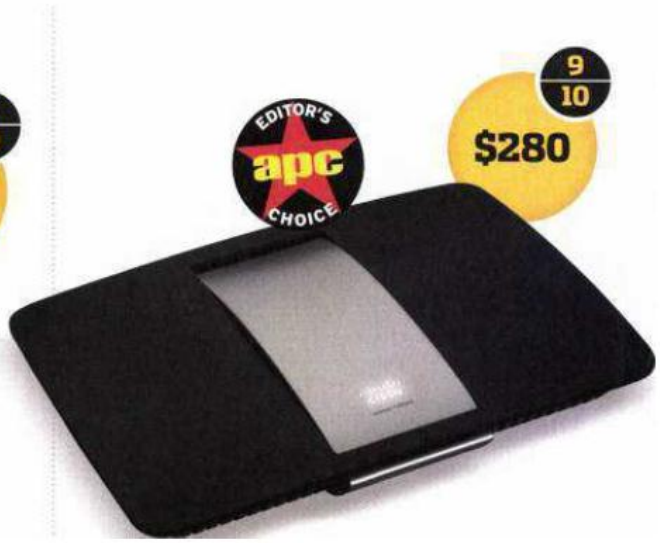
Belkin was one of the first companies out the gate with an 802.11ac product, releasing the AC 1200 DB back in August. It's a router with dual-band wireless networking, but unlike the other routers here, all of which support 1,300Mbps 802.11ac, it only supports 867Mbps.

Predictably, that resulted in test speeds that were considerably lower than the competition, even the poorly performing ASUS. It also had similar compatibility issues as the ASUS: the Linksys station we used for testing initially didn't even want to acknowledge its existence. While the Netgear wireless adapter connected fine, its transfer rates were still significantly lower than they should have been, barely hitting 16MB/s at 10m.

We were also a little disappointed with the management interface. Where other router vendors have continually improved their management interface to make them more accessible to consumers, Belkin seems to have gone the other way. Its management interface is more technical than we've previously seen in Belkin devices, with a wall of technical options and specs greeting anybody who logs onto the router's web interface. Thankfully, most people can avoid these by using the setup wizard.

There are a lot of great features buried here, however, including some fine traffic management and QoS features, as well as DNS-based parental controls – an increasingly common feature in consumer routers. These parental controls use a third-party DNS server (in this case, Symantec's) that won't resolve the addresses of sites with unwelcome content. This means it'll filter out sites with objectionable content.

The router also boasts two USB ports with excellent file-sharing features (including full support for DLNA) along with the now-familiar Belkin art deco styling that sure looks better than the monotone blobs that are most routers.



Linksys EA6500

Crazy fast and highly capable.

@ www.linksys.com.au
✔ Crazy fast, sleek but friendly management interface.
✖ It ain't cheap.

Maybe it was because of a vendor advantage, with the client station we used for testing also from Linksys, but the EA6500 blew through our tests faster than any other router we looked at. At its top speeds it was rivalling Gigabit Ethernet for data rates and that's something we never really thought might happen.

But pure speed isn't the only thing the Linksys has going for it. Like Netgear, Linksys has made considerable strides with respect to making the router easier for non-technical people to manage. Setup is managed by a plain English wizard and even highly technical elements like QoS have been simplified enough to be accessible to everyone. We particularly like the guest access system, which creates a virtual wireless network that guests can use; it gives them access to the internet, but not to your private computers and servers. To please parents who want to limit the amount of time their kids spend surfing the net, there are also parental controls which specify at which certain times a given computer can access the internet.

As has become common, the router boasts two USB ports, capable of sharing files using Windows File Sharing (Server Message Block), FTP or DLNA. We tested the DLNA service with an Xbox 360 and PlayStation 3, and both worked flawlessly. It even worked with a notoriously fickle Samsung television.

Like all current 802.11ac routers, however, the speed of the router comes at a fairly steep price. With a street price of around $300, the Linksys isn't quite as expensive as the Netgear routers (the Netgear D6300 reviewed on the next page is closer to $350), but it's still going to set you back much more than most equivalent 802.11n routers. No doubt this will change throughout the course of the year, but as always, being an early adopter is expensive.

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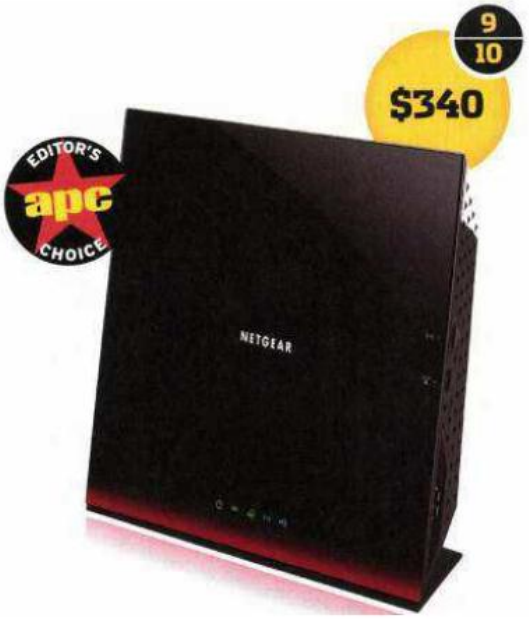


Netgear D6300

Superfast, and ADSL and NBN-ready. What more do you need?

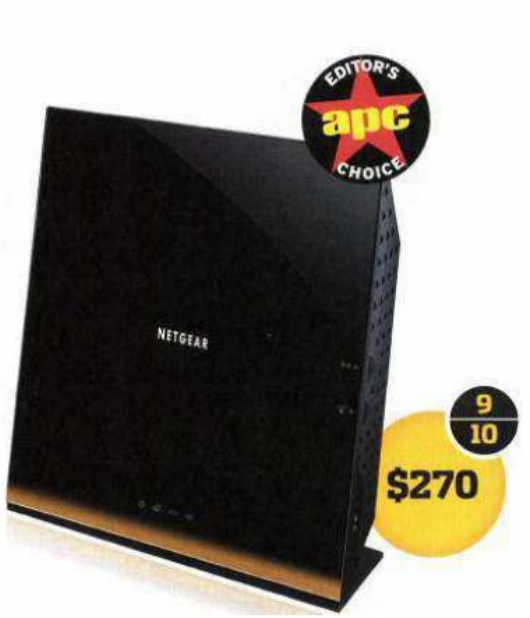
@ www.netgear.com.au
✓ ADSL is built in, great firmware and associated apps.
✗ That price tag.

The sole ADSL router we were able to acquire for this feature, the D6300 is perfect for those who have ADSL2+, but want to be ready when the National Broadband Network (NBN) fibre comes along. As has become the trend in new ADSL routers, it includes both an ADSL2+ port and a Gigabit WAN port, ready to be switched over to the NBN when it finally comes your way.

The D6300 supports full 1,300Mbps 802.11ac and 300Mbps 802.11n in both the 2.4GHz and 5GHz bands. We tested the former performance and it was very impressive – not quite as quick as the Linksys EA6500, but not far off the pace, either. As expected, its results were extremely similar to the R6300, which isn't surprising given the many similarities between the routers.

As an added bonus with the D6300, you get two USB ports for sharing files and printers, and one of the best-designed router interfaces we've encountered. It supports full DLNA sharing, and very solid parental controls and bandwidth management. We tested the DLNA function with both an Xbox 360 and PlayStation 3, and both worked flawlessly. We also tried out the Netgear Genie app for Android (also available for iOS), which lets you manage your router from a mobile phone. Although it didn't provide quite the level of control we'd have liked, it still gave us easy access to the most important features of the router, which is a plus.

As an added bonus, the D6300 also comes with ReadySHARE Cloud, a web service from Netgear that lets you access the contents of attached files over the internet. It's not a true cloud service – you're not uploading to an online hard drive, you are just getting remote access to your own drives – but it's a useful, free and easy way to get access to your files from anywhere. And we'd all agree that this is a very handy thing to be able to do.



Netgear R6300

A speedy broadband router with excellent firmware.

@ www.netgear.com.au
✓ Great firmware and features, fast.
✗ Yet another 802.11ac router that's just too expensive.

At first glance, it's hard to tell the difference between the Netgear D6300 and R6300. They both have the same oversized chassis with glowy Netgear logo, very similar firmware, twin USB ports, wired Gigabit Ethernet ports and support for 1,300Mbps 802.11ac. But there are differences; most notably, the R6300 doesn't have an ADSL port and is therefore only really useful for fibre and cable users.

But there are other subtle differences as well. For example, the R6300 supports 450Mbps 802.11n in both the 2.4GHz and 5GHz bands, whereas the D6300 supports only 300Mbps 802.11n. That's a significant factor for now, since it will be some time before 802.11ac becomes ubiquitous.

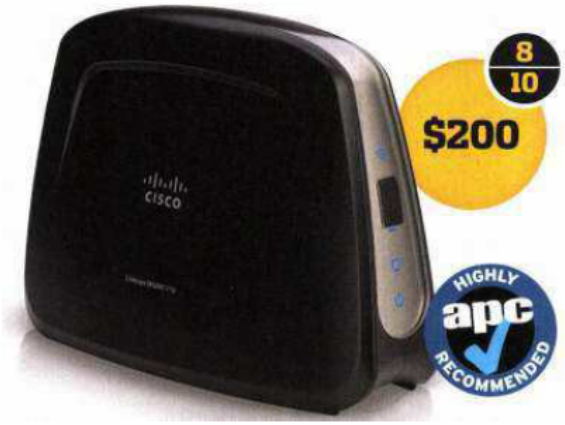
As we noted with the D6300, Netgear has the best firmware going in our view. It has stripped away much of the technical jargon that plagued earlier router models and has made something that's not terrifying for the layman to manage. There are some things it still could do better – like explaining what the different wireless security options are – but it's a step up from many of its competitors. Like the D6300, the R6300 can be fully managed through the Netgear Genie app for Windows, Mac, iOS and Android. It provides a simple touchscreen interface to major router features, including traffic management and parental controls.

It also has great consumer features built in, like DLNA and SMB file sharing from attached hard drives, as well as easy printer sharing. There are honest to goodness categorised parental controls (not just user time limits, but actual site filters), great mobile apps for router management and even cloud services for secure remote access to shared files.

It didn't quite have the performance of the Linksys in our tests, but we give this Netgear the edge when it comes to features.

ADAPTERS & BRIDGES

While we've reviewed mostly routers here, 802.11ac networking is so new that you'll likely need an adapter or wireless bridge to use it. Here are a couple of options.



Linksys WUMC710

A media connector and bridge from wired to 802.11ac wireless.

@ www.linksys.com.au

✓ Extremely fast, four Gigabit ports.

✗ Requires mains power, doesn't work with 2.4GHz.

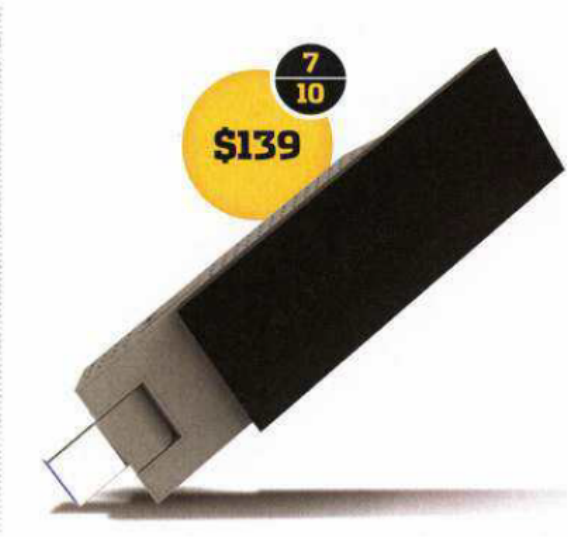
Releasing a simple bridge for 802.11ac was a very clever move by Linksys. The WUMC710 is a box approximately the size of a small router, with four Gigabit Ethernet ports on the back. Its sole function is to take data from an 802.11ac router and put it on to the Gigabit Ethernet links, and vice versa. It allows you to effectively connect wired devices (like gaming consoles, TV sets and other AV equipment) to an 802.11ac network.

With its four ports, up to four wired devices can be hooked up to the wireless network. It's even useful for devices that already have wireless built in; after all, very few devices have 802.11ac support right now, seeing as it's such a new standard.

It's very fast, too, even for networks that are only 802.11n. In addition to substantially outperforming the Netgear A6200 adapter (see our next review) in terms of 802.11ac performance, it absolutely lapped our laptop's integrated Intel Centrino Wireless-N 1030 adapter. At 10m, the Intel adapter was transmitting data at 8.1MB/s on an 802.11n network, while at the same range on the same network the WUMC710 achieved 23.3MB/s, which impressed us.

It's not without its downsides, of course. Notably, it only supports 5GHz operation – it can't even see networks in the 2.4GHz spectrum. It can also be a pain to set up. Once it got an IP address from the router using DHCP, we had to go through hoops to find and log into the web administration console again. The manual was of very little help and there's no simple software management tool to help out like Linksys has for its routers.

Still, it's extremely fast and a very easy way to get up to four devices connected to your new 802.11ac network. It's perhaps not as convenient as a USB adapter and requires mains power, but if you've got fixed devices that you want to give top speed to, it's a great deal.



Netgear A6200

Easily adds 802.11ac support to your laptop or desktop.

@ www.netgear.com.au

✓ It's actually available, simple setup.

✗ Only supports the slower 802.11ac standard, USB 2.0 not USB 3.0.

As is typical when a new wireless networking standard comes out, finding an adapter that supports it is like finding a unicorn. It took forever, for example, for 450Mbps adapters to become widely available.

Fortunately, there's at least one USB 802.11ac adapter on the market: the Netgear A6200. A chunky grey USB stick, it can plug either directly into the side of a laptop or, if better antenna positioning is needed, it can slot into a small stand attached to a flexible cable. The stand is an added boon for those with computers that have tightly packed USB ports – the A6200 is so fat that it will likely crowd out nearby USB ports if plugged directly into a PC.

Like the Belkin router, the A6200 only supports the slower of the initial 802.11ac standards, peaking at a speed of 867Mbps. It's actually less than that in reality, since the device is unaccountably USB 2.0 and the peak throughput of USB 2.0 is 480Mbps.

Of course, wireless performance rarely even approaches peak speeds and in practice, it's the wireless networking that will be the limiting factor. So it was in our testing, where speeds were insufficient to push the limits of USB 2.0. At 10m it transferred data at 16.6MB/s to the Linksys EA6500 on an 802.11ac network. At 5m that increased to 22MB/s and at 15m, dropped to 9.1MB/s. When we switched the network over to 802.11n, it hit 9.2MB/s at 10m in the 2.4GHz band.

These test results were substantially slower than the Linksys WUMC710, but that's not entirely unexpected, given that the Linksys supports full 1,300Mbps and contains considerably more internal space for an antenna.

Thankfully, Netgear isn't trying to squeeze early adopters too much when it comes to pricing. Sure, it's considerably more expensive than an 802.11n adapter, but it's not so expensive that you'll go broke trying to equip your home computers with 802.11ac.

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HOW WE TESTED

We always dread wireless testing. There are a million variables that come into play with wireless and any one of them can produce performance spikes or drag overall performance down. For this roundup we finally decided to set aside things like signal strength and signal-to-noise ratios and settled on a 'proof is in the pudding' test: file copy speeds.

For each router we performed file copy tests from a RAM drive on a high-speed server. A 2GB file was copied three times at a range of 5m from the router and the transfer rate averaged. We then moved back to 10m (with one intervening wall) and repeated the test, and again at 15m through two intervening walls. The test results show the average transfer rates at those three ranges in megabytes per second (MB/s); in all cases, the higher the better.

All the test results were achieved using the Linksys WUMC710 as the client station device. It was the only device we could acquire that supported full 1,300Mbps speeds. We also performed backup tests with the Netgear A6200 USB adapter in case of specific incompatibilities with the Linksys – its results were lower than that of the Linksys, but consistent on a relative basis.