What Wi-Fi?

Wireless networking sounds like a great idea, but what equipment do you need and which standard will be the best for you? Allow Scott Colvey to be your guide

Have you missed the clamour about cordless connectivity? It seems unlikely. In all areas of modern life, the will for wiring is withering. Consumers decided long ago that they didn't want to be tethered when on the telephone, opting first for cordless handsets in the home and later for mobile models when out and about.

More pertinently the cordless craze has caught on in computing circles. If you want to connect PC equipment in the form of a network or simply to stay in touch with the wider world on the web, wireless is the way to go. With wireless technology, the promise goes, you can add computers to an existing network without faffing about with cables. And you can use a cordlessly connected laptop to roam freely around your workplace. At least, those are the words on Hype Street.

But does the real-world wireless networking experience live up to the puff? The trouble is, a variety of wireless computer networking technologies exist and not all are interoperable. In other words, one piece of wireless networking equipment may not be able to communicate with another.

With that in mind we hope to make it clear which technology is right for your requirements. We don't intend talking about specific products or equipment categories as that's beyond the scope of this section. But by the end of this article you will be able to understand the pros and cons of the various wireless standards.

We've also conducted some simple performance tests with common Wi-Fi kit to gauge both the speed and reliability of wireless connections.

The Wi-Fi Alliance allows this label to be used on equipment tested for interoperability

Why Wi-Fi?

We'll begin with some basics. Wireless computer networking technology is often referred to as Wi-Fi, which is a contraction of 'wireless fidelity'. This is an umbrella term covering a variety of mostly complementary – but occasionally incompatible – cordless connectivity standards.

Confusingly, this assortment of specs is known by another coverall tag: 802.11. Penned and ratified by the IEEE (Institute of Electrical and Electronics Engineers) in 1997, the first 802.11 standard was designed to work in the 2.4GHz frequency of the radio spectrum and offer data transfer rates of up to 2Mbps (megabits per second). Essentially, the 802.11 specification allowed existing LANs (local area networks) to be extended cordlessly using familiar ethernet networking protocols.

A couple of years later the IEEE introduced an improvement to the 802.11 standard, tacking a 'b' on the end to distinguish it from the parent. Currently 802.11b is the most popular wireless networking standard. It offers a top transmission speed of 11Mbps with an outdoor range of around 120m.

You may come across products stating '802.11b+' performance (note the arrival of the plus symbol). This supposedly doubles the throughput of transmissions to a maximum of 22Mbps. Be aware, though, that while compatibility with 802.11b-based products isn't really a concern, 802.11b+ is not ratified by the IEEE. And in order to achieve the higher speeds, other wireless network equipment also needs to be 802.11b+.

Regardless of this, the data transfer speeds specified in all IEEE 802.11 standards and regurgitated by manufacturers on packaging are theoretical maximums. The performance of wireless networks can be mired by all manner of other devices that might be in the vicinity, from cordless telephones to – believe it or not – microwave ovens.

Devices connected to an 802.11-based network, for example, might occasionally reach the 11Mbps data transfer ceiling but most of the time the information will flow at slower speeds. As our tests demonstrate (see the table below), the rate of sustained throughput is typically well below that of the maximum potential of any given standard.

What a difference an 'a' makes

In larger environments such as an office, network connection speeds can be more of an issue and have led to further refinements of the 802.11

Wi-Fi/IEEE standard	Theoretical top speed	Maximum range (outdoors at top speed)	Maximum range (indoors at top speed)	Wireless access point used in test	PC card adapter used in test
802.11a	54Mbps	30m	12m	Netgear HE102	Netgear HA501
802.11b	11Mbps	120m	60m	Netgear ME102	Netgear MA521
802.11g	54Mbps	50m	20m	Netgear WG602	Netgear WG511

Footnote: these simple tests were designed to give a snapshot of the performance of the same-brand wireless networking equipment, using two different IEEE standards in two different

We used the Netgear ME102 wireless access point for testing the 802.11b standard

standard. The first of these, 802.11a, attempts to address the problem of the congested radio spectrum.

Unlike 802.11b and 802.11g (we'll come to these soon), which both rely on the heavily used 2.4GHz part of the spectrum, 802.11a operates at a frequency of 5GHz. This band carries fewer radio transmissions so 802.11a-based wireless networks are less likely to suffer interference from other cordless kit.

The 802.11a specification also ups the network data transfer rate to a maximum of 54Mbps, though the range devices can beam this information across the unobstructed ether is reduced to around 30m. Place a few desks, filing cabinets, partitions and walls between sending and receiving devices and the distance and sustained transfer speed could drop drastically.

And because 802.11a employs a different part of the radio spectrum to 802.11b, the two standards are forever incompatible. On the plus side, many manufacturers now offer dualband devices that can operate at either frequency, thus delivering compatibility with both 802.11a and 802.11b.

An access point, such as the Netgear WG602, is a station that transmits and receives data

	Average sustained data transfer rate (indoors, 10m)	Average sustained data transfer rate (outdoors, 30m)
	24.3Mbps	failed (connection repeatedly out of range)
	8.7Mbps	4.8Mbps
	31.4Mbps	22.3Mbps

settings. Results may differ in other settings.

The 'g' force

The latest ratified standard, 802.11g, allows for connection speeds of up to 54Mbps over distances of up to 50m. However, 802.11g-based equipment operates on the 2.4GHz frequency. Depending on your needs, this may be a good or bad thing. If congestion and interference aren't concerns then an 802.11g wireless network offers the dual benefit of faster throughput and compatibility with 802.11b equipment.

For instance, an 802.11g-based network adapter should be able to communicate with an 802.11b network, though the speed would be restricted to the latter standard's 11Mbps top whack.

The numerous standards and the permutations and combinations thereof creates enormous potential for confusion. Fortunately, a group called the Wi-Fi Alliance has eased the job of determining standard compliance and compatible equipment. The organisation tests all makes and models of Wi-Fi kit and issues manufacturers with packaging labels, making things much clearer for consumers. The Wi-Fi Alliance's badge allows buyers to glean at a glance the abilities of a particular product and its compatibility with the various 802.11 standards.

Channel hopping

Sadly, the Wi-Fi Alliance's labelling does not constitute a cast-iron guarantee of interoperability. Globetrotters need to be particularly wary of the whys and wherefores of Wi-Fi as in some parts of the world certain pieces of wireless networking equipment might be illegal to use.

If you roam regularly and want to use your wireless network kit in other countries, you'll need to explore the complex arena of radio spectrum apportionment – hardly an enticing prospect. To help out, we'll attempt to list the pertinent points here.

We stated that the 802.11b and 802.11g standards operate in the 2.4GHz band, but that's not entirely accurate. The precise frequency range spans from 2.412-2.484GHz, spread across 14 user-selectable channels. This aims to minimise the risk of the aforementioned interference, but only in Japan can the full 14 channels be legally used. In most parts of Europe use of the last channel is outlawed, meaning a wireless networker must set their equipment to work on a channels between one and 13 only.

Travel to Spain or North America, though, and you must ensure that channels 12, 13 and 14 are not used. Unless, of course, you fancy conducting your wireless networking operations from behind bars.

The correct kit

We've seen that there can be more to wireless networking than simply buying a bunch of boxes that boast 'Wi-Fi'. Indeed, for larger enterprises, ensuring that the correct equipment is bought for the job can be a research-intensive endeavour.

Similarly, worldwide travellers should consider the countries in which they intend to use their wireless equipment and investigate if aspects of the desired kit may be legally used abroad. Pay particular attention to the default settings in the software supplied by the equipment manufacturer as use of some 802.11 channels in certain countries would break the law.

But all that aside, small businesses and individuals wanting a wireless network have little to worry about. These days most equipment adhering to one 802.11 standard will happily communicate with devices based on the same specification, regardless of manufacturer. Obviously, dualband (or even triband) devices offer more flexibility but only larger outfits are likely to benefit from such kit.

If you're starting from scratch the most important thing is to ensure that the components you buy all conform to the same 802.11 specifications. Sticking to devices from one manufacturer will minimise the risk of problems.