

The gathering brainstorm

It is unregulated, untested, more dangerous than its proponents would have you believe — and soon to become even more powerful. **Mark Anslow** reports on the inexorable march of Wi-Fi

In early summer of 1997, computer scientist and former Dutch military radar engineer Vic Hayes joined the end of a long line of scientists and smiled at the camera. The shutter clicked, celebrating the official launch of the first international Wi-Fi standard.

Known officially as IEEE 801.11, what Hayes had created was a universally accepted way of linking up computers by using high-frequency microwave radio waves. Once connected, the machines could then share information, including internet access and email.

Originally designed to connect together cash-registers at checkouts, the ambitious scientist made no secret of his desires for the new technology. 'I see Wi-Fi being used for everything eventually,' he was quoted as saying, but not even he could have predicted how widespread his invention would become.

By 2008, experts predict that there will be 53 million Wi-Fi enabled devices in Europe alone. One in every five UK adults already owns a Wi-Fi enabled laptop, and 80 per cent of secondary schools in the UK have installed the technology throughout their buildings. McDonald's recently announced that free Wi-Fi facilities would be available in all its restaurants, and the growing 'Mu-Fi' initiative — where entire municipalities receive Wi-Fi coverage — has already made Norwich the UK's first 'Wi-Fi town'.

The technology is sold to the public as the ultimate convenience tool: it allows you to grab a coffee and check your email on the go, to print photos without using a wire or listen to music on speakers not even attached to a computer. In schools, teachers can already give lessons using Wi-Fi white-boards, and in

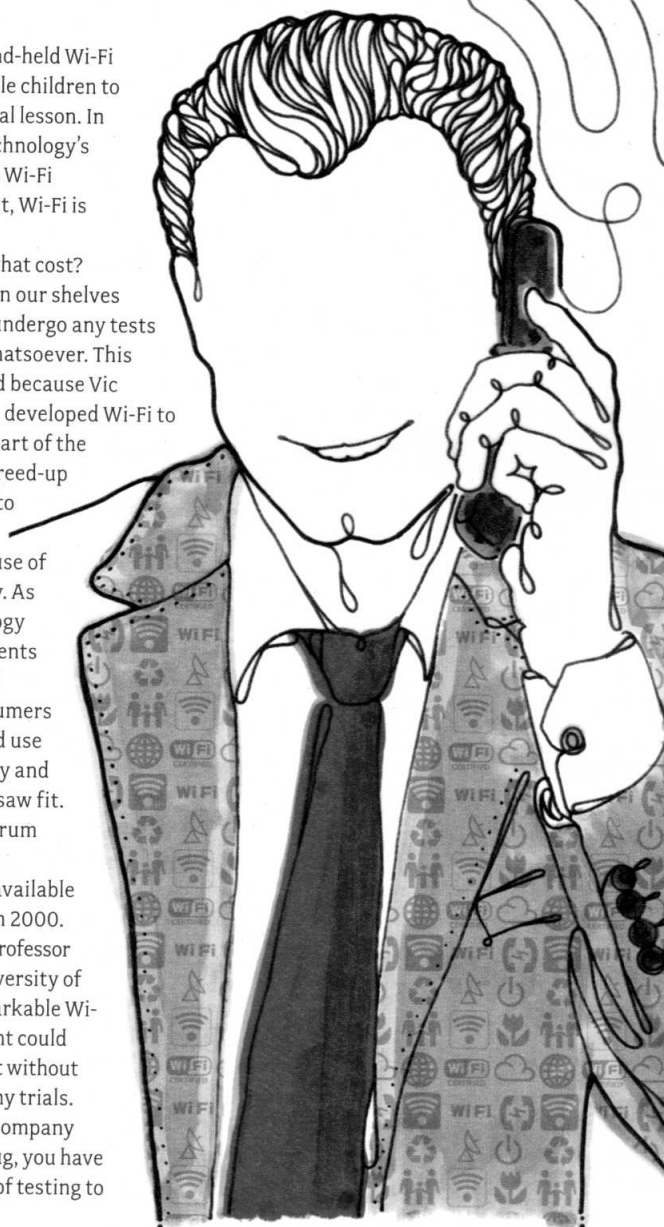
the near future hand-held Wi-Fi terminals will enable children to 'interact' with digital lesson. In the words of the technology's industry group, the Wi-Fi Alliance: 'Simply put, Wi-Fi is freedom.'

But freedom at what cost?

Wi-Fi appeared on our shelves without having to undergo any tests or safety checks whatsoever. This was partly achieved because Vic Hayes and his team developed Wi-Fi to use an unlicensed part of the radio spectrum — freed-up airwaves designed to encourage more widespread public use of wireless technology. As long as the technology met basic requirements on interference and compatibility, consumers were free to buy and use Wi-Fi devices as they and the manufacturers saw fit. In the UK, the spectrum used by Wi-Fi (2.4 gigahertz) became available for unlicensed use in 2000.

Denis Henshaw, professor of physics at the University of Bristol, finds it remarkable Wi-Fi-enabled equipment could have come to market without having to undergo any trials.

'If you are a drug company marketing a new drug, you have to go through years of testing to



How microwaves affect us

There are many different theories on how electromagnetic radiation interacts with our bodies, but pulsed microwave radiation, such as that used by Wi-Fi and mobile phones, is thought to affect the body's cells in a unique way.

Although microwaves oscillate (change direction) many thousands of times each second, the carrier pulses which convey your voice or emails along the signal actually oscillate at a much slower rate, only hundreds of times a second. This slower rate allows the pulses to interact with protein vibrational receptors, like microscopic hairs, on the membranes of our cells. The cells interpret this unusual stimulation as a foreign invader and react as any organism would – by closing down the cell membrane. This impairs the flow of nutrients into the cell or waste products on their way out. It also disrupts inter-cellular communication, meaning that clusters of cells that form tissues can no longer work as effectively together.

The increase of trapped waste products can lead to an increase in the number of cancer-causing 'free radicals'. Worse still, a chemical known as 'messenger RNA' inside the cell passes on this 'learned response' to daughter cells, meaning that the cell's offspring also learn to interpret microwaves as an external threat and react in the same way.

This disruption in the cellular processes is thought to lead to the many and various symptoms of electrosensitivity, and the build-up of free radicals released when the cell dies could be connected with the increase in tumours seen in those exposed to frequent doses of microwave radiation.

Special circumstances can enhance the process even further. The effects are likely to be worse in people with damaged or developing immune systems, particularly children, and certain drugs can dramatically increase the risk of negative microwave effects.

prove your product is safe,' he says. 'If you're a Wi-Fi developer using the 2.4 GHz spectrum, however, you don't need to prove anything.'

Concerns were first raised about the health effects of Wi-Fi as early as 2000. A report by the British Educational Communications and Technology Agency (BECTA), the body responsible for the use of IT in schools, noted that engineers installing some of the first classroom-based systems complained of headaches at the end of the day. The report was never published, but was eventually leaked to *The Times Educational Supplement* seven years later.

In 2003, concerned parents of children in suburban Chicago filed a lawsuit against the Oak Park Elementary School on the basis of concerns over the possible adverse health effects of the school's Wi-Fi network. The father who made the claim, Ron Baiman, said he acted because 'there are a lot of experts who say there are potential risks'.

For years, it was left to distressed teachers or parents with children suffering from repeated headaches to act as unpaid regulators, gathering together scientific papers and lobbying schools to have Wi-Fi systems taken down. In 2006, a school in Chichester made headlines after its headteacher agreed to remove a network at the request of both parents and teachers. The headteacher told *The Times* he had acted out of concern for the parents' views. 'We also did a lot of research,' he added. 'The authorities say it's safe, but there have been no long-term studies to prove this.'

The case was something of a turning point. National newspapers began to pay attention to data collected by campaign groups that had long been fighting the mobile phone industry. The campaigners pointed out that the type of radiation

emitted from Wi-Fi devices, although on a slightly different wavelength, was essentially the same as that used by mobile phones and their transmitter masts. Both systems use high-frequency microwaves that are 'pulsed' rapidly on and off to transmit data.

This pulsed aspect of data transmission is important, because it means that, although a signal might appear to be low-powered when measured over a period of time, it could reach 'spikes' of much higher levels when data is actually being transmitted. Campaigners were also at pains to show that Wi-Fi was just a part of a whole host of technologies using the same microwave system, including baby monitors, DECT cordless phones, and Bluetooth computer devices (see box, page 47).

In May 2007, the BBC's *Panorama* programme investigated the signal strengths used by Wi-Fi equipment. Under the

