

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

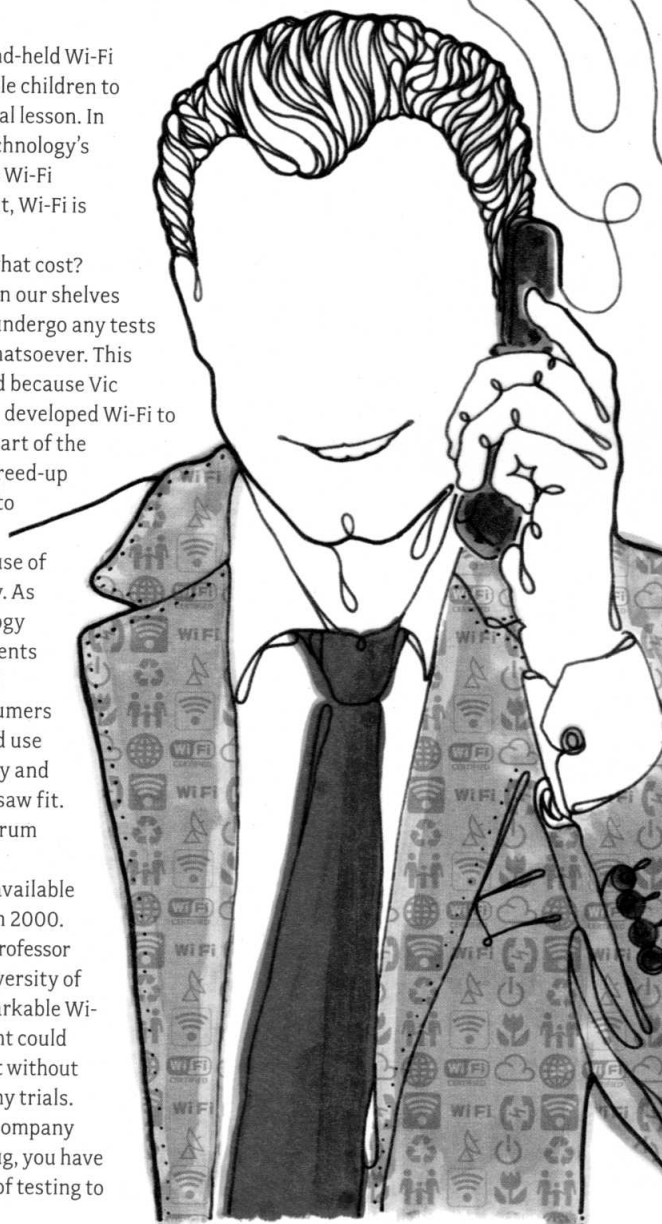
the near future hand-held Wi-Fi terminals will enable children to 'interact' with digital lesson. In the words of the technology's industry group, the Wi-Fi Alliance: 'Simply put, Wi-Fi is freedom.'

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'.

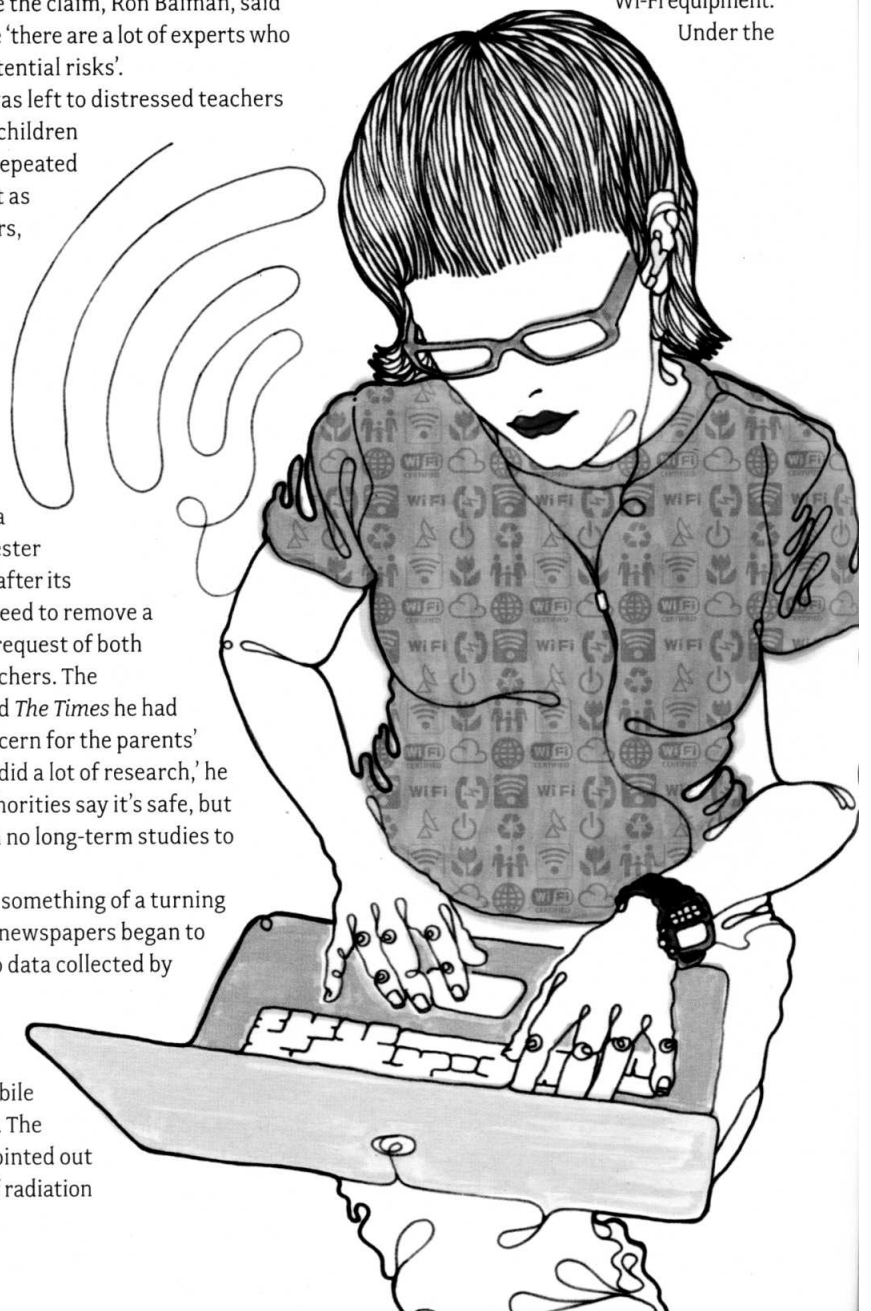
For years, it was left to distressed teachers or parents with children suffering from repeated headaches to act as unpaid regulators, gathering together scientific papers and lobbying schools to have Wi-Fi systems taken down. In 2006, a school in Chichester made headlines after its headteacher agreed 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



guidance of mobile phone concern group PowerWatch, the programme measured the intensity of microwaves 150 metres away from a mobile phone transmitter mast, and half a metre away from a laptop computer – realistic distances at which everyday exposure might occur. They found that the radiation from the Wi-Fi-enabled laptop was at least as high, if not higher, than that measured in the main beam of the mast (see box, page 47).

The programme was fiercely criticised by the telecommunications industry, partly because it feared the logical conclusion – that the battery of research built up over the past decade demonstrating very clear health risks from exposure to mobile phone masts could now be translated almost exactly into the risks faced by exposure to Wi-Fi equipment (see ‘Weight of evidence’ box, below).

Concern was further raised by comments made on the programme by the chairman of the Health Protection Agency (HPA), Sir William Stewart. Stewart, former Government Chief Scientist under Margaret Thatcher, had compiled a seminal report on mobile phones in 2000, in which he recommended that the main beam from a mobile phone mast should never be allowed to fall on school premises. He told *Panorama* unequivocally that both phones and masts could be responsible for triggering cancer,

changes in mental function and damaging effects to the body’s cells. He also said that the approach adopted by the World Health Organisation, which directly influences UK health policy, was not ‘an accurate reflection’ of the current science.

The HPA scrambled to calm the storm caused by its maverick chairman. Having first tried to deny Stewart had in fact made any claims against Wi-Fi, the Agency went on to

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change one of its online press releases; now, instead of asserting there was ‘no evidence’ that Wi-Fi could have an effect on health, it stated there was ‘no consistent evidence’. The current HPA guidelines on Wi-Fi, to which all other UK Government departments refer, state: ‘There is no consistent evidence to date that Wi-Fi and WLANs [wireless networks] adversely affect the health of the general population. The signals are very low power, typically 0.1 watt (100 milliwatts) in both the computer and the router (access point) and the results so far show exposures are well within internationally accepted (ICNIRP) guidelines.’

So what exactly is ICNIRP, the institution

that determines the maximum safe radio wave dosage for all UK citizens? The International Commission on Non-Ionising Radiation Protection was formed in 1992, but has its roots in an earlier body founded in 1970s.

Alasdair Philips, founder of PowerWatch, describes it as ‘an incredibly conservative organisation’: ‘ICNIRP grew out of the International Radiation Protection Association (IRPA), which was founded in

1950s and primarily staffed by the nuclear industry. Even when it became separate, ICNIRP retained a strong industry bias. It is highly secretive and access to the Commission is by invitation only.’

In 1998, ICNIRP published the document by which all countries with a seat on the Commission – which includes most of Europe and the US – still set their non-ionising radiation guidelines today. In the section that examines the relationship between cancer and exposure to microwaves, the ICNIRP authors cite seven studies to support their conclusion that radio waves do not increase tumour rates. None of these was conducted

Weight of evidence

All studies listed below have found adverse health effects from microwaves at levels similar to those emitted by Wi-Fi equipment:

Santini et al, 2002: 530 people living near mobile phone masts reported more symptoms of headache, sleep disturbance, discomfort, irritability, depression, memory loss and concentration problems the closer they lived to the mast.

Oberfeld et al, 2004: 97 people living near mobile phone masts reported more symptoms of fatigue, irritability, headaches, nausea, loss of memory, visual disorder, dizziness and cardiovascular problems the higher their level of microwave exposure.

Eger et al, 2004: A three-fold increase in the incidence of malignant tumours was found after five years’ exposure in people living 400 metres from a mobile phone mast.

Wolf & Wolf, 2004: A four-fold increase in the incidence of cancer among residents living near a mobile phone mast for between

three and seven years was detected.

REFLEX, 2004: A four-year study on human cells found that, after exposure to low-power microwaves, they showed signs of DNA damage and mutations that were passed on to the next generation.

Abdel-Rassoul, 2007: Residents living beneath and opposite a long-established mobile phone mast in Egypt reported significantly higher occurrences of headaches, memory changes, dizziness, tremors, depressive symptoms and sleep disturbance than a control group.

Bortkiewicz et al, 2004: Residents close to mobile phone masts reported more incidences of circulatory problems, sleep disturbances, irritability, depression, blurred vision and concentration difficulties the nearer they lived to the mast.

Hutter et al, 2006: 365 people living near mobile phone masts reported higher incidences of headaches the closer they lived to the masts.

Stewart report, 2000: Research conducted by HPA chief William Stewart advised the main beam of a mobile phone mast should not be allowed to fall on any part of a school’s grounds.

Hecht & Balzer, 1997: A huge review of studies concluded a vast array of health effects, including insomnia, brainwave changes, cardiovascular problems and increased susceptibility to infections.

Carpenter & Sage, 2007: Concluded that an maximum outdoor exposure limit of 0.6 V/m should be set, and that Wi-Fi systems should be replaced with wired alternatives.

ECOLOG-Institut, 2000: Found evidence for increases in immune and central nervous system damage, and reduced cognitive function. Recommended an exposure limit 1,000 times lower than current guidelines.

Kolodynski & Kolodynska, 1999: School children living near a radio location station in Latvia suffered reduced motor function, memory and attention spans.

