CASE HISTORY

A brief history of Wi-Fi

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Wireless networking: Few people have a kind word to say about telecoms regulators. But the success of Wi-Fi shows what can be achieved when regulators and technologists work together

IT STANDS as perhaps the signal success of the computer industry in the last few years, a rare bright spot in a bubble-battered market: Wi-Fi, the short-range wireless broadband technology. Among geeks, it has inspired a mania unseen since the days of the internet boom. Tens of millions of Wi-Fi devices will be sold this year, including the majority of laptop computers. Analysts predict that 100m people will be using Wi-Fi by 2006. Homes, offices, colleges and schools around the world have installed Wi-Fi equipment to blanket their premises with wireless access to the internet. Wi-Fi access is available in a growing number of coffee-shops, airports and hotels too. Yet merely five years ago wireless networking was a niche technology. How did Wi-Fi get started, and become so successful, in the depths of a downturn?

Wi-Fi seems even more remarkable when you look at its provenance: it was, in effect, spawned by an American government agency from an area of radio spectrum widely referred to as "the garbage bands". Technology entrepreneurs generally prefer governments to stay out of their way: funding basic research, perhaps, and then buying finished products when they emerge on the market. But in the case of Wi-Fi, the government seems actively to have guided innovation. "Wi-Fi is a creature of regulation, created more by lawyers than by engineers," asserts Mitchell Lazarus, an expert in telecoms regulation at Fletcher, Heald & Hildreth, a law firm based in Arlington, Virginia. As a lawyer, Mr Lazarus might be expected to say that. But he

was also educated as an electrical engineer—and besides, the facts seem to bear him out.

In the beginning

Wi-Fi would certainly not exist without a decision taken in 1985 by the Federal Communications Commission (FCC), America's telecoms regulator, to open several bands of wireless spectrum, allowing them to be used without the need for a government licence. This was an unheard-of move at the time; other than the ham-radio channels, there was very little unlicensed spectrum. But the FCC, prompted by a visionary engineer on its staff, Michael Marcus, took three chunks of spectrum from the industrial, scientific and medical bands and opened them up to communications entrepreneurs.

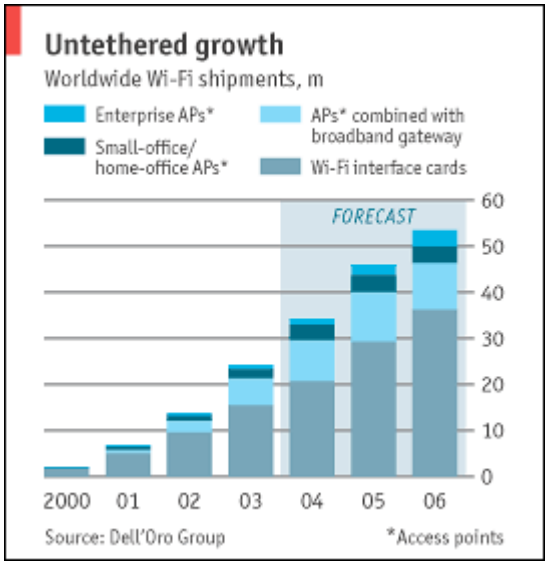
These so-called "garbage bands", at 900MHz, 2.4GHz and 5.8GHz, were already allocated to equipment that used radio-frequency energy for purposes other than communications: microwave ovens, for example, which use radio waves to heat food. The FCC made them available for communications purposes as well, on the condition that any devices using these bands would have to steer around interference from other equipment. They would do so using "spread spectrum" technology, originally developed for military use, which spreads a radio signal out over a wide range of frequencies, in contrast to the usual approach of transmitting on a single, well-defined frequency. This makes the signal both difficult to intercept and less susceptible to interference.

Though the 1985 ruling seems visionary in hindsight, nothing much happened at the time. What ultimately got Wi-Fi moving was the creation of an industry-wide standard. Initially, vendors of wireless equipment for local-area networks (LANs), such as Proxim and Symbol, developed their own kinds of proprietary equipment that operated in the unlicensed bands: equipment from one vendor could not talk to equipment from another. Inspired by the success of Ethernet, a wireline-networking standard, several vendors realised that a common wireless standard made sense too. Buyers would be more likely to adopt the technology if they were not "locked in" to a particular vendor's products.

In 1988, NCR Corporation, which wanted to use the unlicensed spectrum to hook up wireless cash registers, asked Victor Hayes, one of its engineers, to look into getting a standard started. Mr Hayes, along with Bruce Tuch of Bell Labs, approached the Institute of Electrical and Electronics Engineers (IEEE), where a committee called 802.3 had defined the Ethernet standard. A new committee called 802.11 was set up, with Mr Hayes as chairman, and the negotiations began.

The fragmented market meant it took a long time for the various vendors to agree on definitions and draw up a standard acceptable to 75% of the committee members. Finally, in 1997, the committee agreed on a basic specification. It allowed for a data-transfer rate of two megabits per second, using either of two spread-spectrum technologies, frequency hopping or direct-sequence transmission. (The first avoids interference from other signals by jumping between radio frequencies; the second spreads the signal out over a wide band of frequencies.)

The new standard was published in 1997, and engineers immediately began working on prototype equipment to comply with it. Two variants, called 802.11b (which operates in the 2.4GHz band) and 802.11a (which operates in the 5.8GHz band), were ratified in December 1999 and January 2000 respectively. 802.11b was developed primarily by Richard van Nee of Lucent and Mark Webster of Intersil (then Harris Semiconductor).



Companies began building 802.11b-compatible devices. But the specification was so long and complex—it filled 400 pages—that compatibility problems persisted. So in August 1999, six companies—Intersil, 3Com, Nokia, Aironet (since purchased by Cisco), Symbol and Lucent (which has since spun off its components division to form Agere Systems)—got together to create the Wireless Ethernet Compatibility Alliance (WECA).

A rose by any other name...

The idea was that this body would certify that products from different vendors were truly compatible with each other. But the terms "WECA compatible" or "IEEE802.11b compliant" hardly tripped off the tongue. The new technology needed a consumer-friendly name. Branding consultants suggested a number of names, including "FlankSpeed" and "DragonFly". But the clear winner was "Wi-Fi". It sounded a bit like hi-fi, and consumers were used to the idea that a CD player from one company would work with an amplifier from another. So Wi-Fi it was. (The idea that this stood for "wireless fidelity" was dreamed up later.)

The technology had been standardised; it had a name; now Wi-Fi needed a market champion, and it found one in Apple, a computer-maker renowned for innovation. The company told Lucent that, if it could make an adapter for under $100, Apple would incorporate a Wi-Fi slot into all its laptops. Lucent delivered, and in July 1999 Apple introduced Wi-Fi as an option on its new iBook computers, under the brand name AirPort. "And that completely changed the map for wireless networking," says Greg Raleigh of Airgo, a wireless start-up based in Palo Alto, California. Other computer-makers quickly followed suit. Wi-Fi caught on with consumers just as corporate technology spending dried up in 2001.

"Wi-Fi's ultimate significance may be that it provides a glimpse of what will be possible with future wireless technologies"

Wi-Fi was boosted by the growing popularity of high-speed broadband internet connections in the home; it is the easiest way to enable several computers to share a broadband link. To this day, Wi-Fi's main use is in home networking. As the technology spread, fee-based access points known as "hotspots" also began to spring up in public places such as coffee-shops, though many hotspot operators have gone bust and the commercial viability of many hotspots is unclear. Meanwhile, the FCC again tweaked its rules to allow for a new variant of Wi-Fi technology, known as 802.11g. It uses a new, more advanced form of spread-spectrum technology called orthogonal frequency-division multiplexing (OFDM) and can achieve speeds of up to 54 megabits per second in the 2.4GHz band.

Where next? Many Wi-Fi enthusiasts believe it will sweep other wireless technologies aside: that hotspots will, for example, undermine the prospects for third-generation (3G) mobile-telephone networks, which are also intended to deliver high-speed data to users on the move. But such speculation is overblown. Wi-Fi is a short-range technology that will never be able to provide the blanket coverage of a mobile network. Worse, subscribe to one network of hotspots (in coffee-shops, say) and you may not be able to use the hotspot in the airport. Ken Denman, the boss of iPass, an internet-access provider based in Redwood Shores, California, insists that things are improving. Roaming and billing agreements will, he says, be sorted out within a couple of years.

By that time, however, the first networks based on a new technology, technically known as 802.16 but named WiMax, should be up and running. As its name suggests, WiMax is positioned as a wide-area version of Wi-Fi. It has a maximum throughput of 70 megabits per second, and a maximum range of 50km, compared with 50m or so for Wi-Fi. Where Wi-Fi offers access in selected places, like phone boxes once did, WiMax could offer blanket coverage, like mobile phones do.

Wi-Fi is also under threat in the home. At the moment it is the dominant home-networking technology: Wi-Fi-capable televisions, CD players and video-recorders and other consumer-electronics devices are already starting to appear. This will make it possible to pipe music, say, around the house without laying any cables. Cordless phones based on Wi-Fi are also in the works. But Wi-Fi may not turn out to be the long-term winner in these applications. It is currently too power-hungry for handheld devices, and even 802.11g cannot reliably support more than one stream of video. And a new standard, technically known as 802.15.3 and named WiMedia,

has been specifically designed as a short-range, high-capacity home networking standard for entertainment devices.

Wi-Fi's ultimate significance, then, may be that it provides a glimpse of what will be possible with future wireless technologies. It has also changed the way regulators and technologists think about spectrum policy. The FCC has just proposed that broadcast “whitespace”—the airwaves assigned to television broadcasters but not used for technical reasons—should be opened up too. That is not to say that spectrum licensing will be junked in favour of a complete free-for-all over the airwaves. Julius Knapp, the deputy chief of the office of engineering and technology at the FCC, maintains that both the licensed and unlicensed approaches have merit.

Wi-Fi also shows that agreeing on a common standard can create a market. Its example has been taken to heart by the backers of WiMax. Long-range wireless networking gear, like short-range technology before it, has long been dominated by vendors pushing proprietary standards, none of which has been widely adopted. Inspired by Wi-Fi's success, the vendors have now thrown their weight behind WiMax, a common standard with a consumer-friendly name, which they hope will expand the market and boost all their fortunes. Whatever happens to Wi-Fi in future, it has blazed a trail for other technologies to follow.