

On the periphery

The cloud's communications with its clients will become evermore-intelligent and interactive

Ir WILL take something with a lot more bang to replace a medium that is thousands of years old. That was the prevailing reaction when Amazon last November announced the launch of Kindle, an electronic book reader the size of a paperback that can store more than 200 volumes. Yet by the end of this year Amazon will have sold nearly 380,000 Kindles, says Mark Mahaney, an analyst with Citigroup, a bank. "Turns out the Kindle is becoming the iPod of the book world," he recently wrote in a note to clients, in a reference to Apple's iconic music player.

It is certainly not the Kindle's looks that explain its success. Compared with the iPod, its design looks very last century. Software and battery life, too, leave a lot to be desired. The chief attraction of the device is the ease with which it can be used to buy books and other content. Equipped with a mobile-phone modem, the Kindle can simply pull new reading material out of the air. Users do not even have to have a wireless service contract. "Our vision is to have every book that has ever been in print available in less than 60 seconds," explains Jeff Bezos, Amazon's boss.

It remains to be seen whether the Kindle will become a cultural phenomenon like the iPod, of which around 160m have been sold so far. Amazon, for its part, is downplaying the Kindle's success and will not confirm any sales estimates. But it is safe to say that, once the next generation of wireless networks is up and running, hundreds of millions of devices will come, like the Kindle, with built-in radio connectivity (see chart 5). Digital cameras will automatically upload pictures. Smart meters will send readings of how much electricity a house consumes. All kinds of sensors will be able to send messages, even things like dipsticks when tanks of liquid are low.

The relationship of these devices to cloud computing may not be obvious. But if huge data centres and applications make up the cloud itself, then all the hardware and software through which it connects and communicates with the real world are its periphery. In IT speak, this is known as the "front end" or "client side".

As the Kindle and other examples show, this layer does not have much to do

with the user interface or client device of old. It will do a lot of computing itself. It will come in all shapes and sizes, depending on what the user wants to do. And it will not just distribute information, as the web does, but collect it as well. The analogy that springs to mind here is a theatre performance with audience participation: the electronic cloud will adapt to whatever it engulfs.

As you like it

Just like computing itself, the dominant user interface has evolved continually. In the days of the mainframe, when computers and their peripherals filled entire rooms, people communicated with these machines first via punch cards and then via green-glowing monitors, which were simply dumb terminals. Only with the rise of personal computers did the user interface become more intelligent, responsive and graphical.

The first version of the web was thus a brief step backward. To be sure, browsers brought colour and graphics to the hitherto text-based internet, but they were as dumb as the mainframe terminal. This has changed only in recent years. A bundle of web-development techniques dubbed AJAX and multimedia software such as Adobe's Flash and Microsoft's Silverlight now allow programmers to write what are called "rich internet applications" (RIA).

Whatever the buzzword, the principle is much the same. Servers no longer dish up simple hypertext markup language (HTML), the web's early lingua franca. Increasingly, web pages are bona fide pieces of software that are executed in the browser. Users of Web 2.0 sites who venture into menu items such as "view source" in their browsers can sometimes see thousands of lines of code.

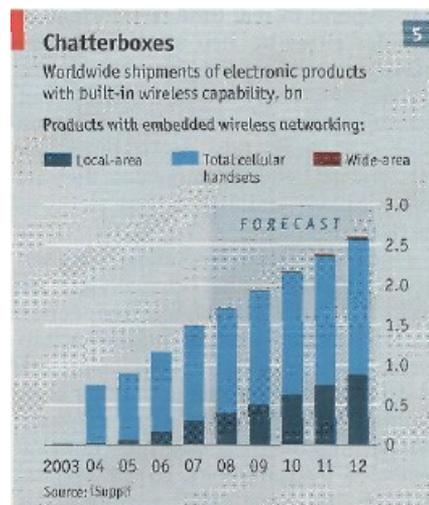
In recent months the browser has become even more of a platform for other programs, akin to an operating system such as Windows. The main driver of this trend is Google, with its huge strength in distribution that can only gain from more and more software being offered as a service. In May 2007 the Silicon Valley firm launched Gears, a program that allows web applications to be used offline, and in September this year it released a new browser called Chrome. Its most important feature is that it can execute several sophisticated web applications at once.

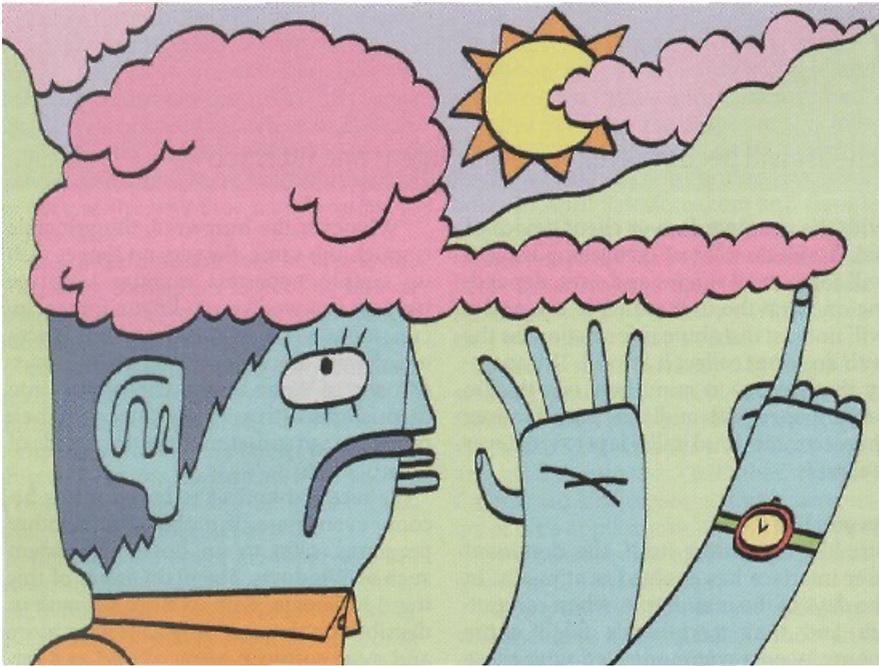
Although for now the internet browser will remain the main vehicle for people to interact with the cloud, other forms are coming to the fore. One is the "widget", a snippet of code that often lives on a PC's desktop and allows the user to get a quick personalised view of a set of data. The idea is that a salesperson, for instance, should not have to fire up an entire application for customer-relationship management to find out which leads to follow up.

More importantly, there is now a greater variety of hardware through which to access the cloud. Already, desktop and laptop computers are starting to lose their monopoly for surfing the web as smaller devices such as smart mobile phones and various forms of portable computers start to compete with them.

ASUS, a Taiwanese computer-maker, started the trend when it launched a small, cheap laptop called "Eee" a year ago. Now there are dozens of these devices. Gartner reckons that 5.2m of these "mini-notebooks" will be sold this year, 8m next and as many as 50m in 2012.

Perhaps the best indicator of things to come is Intel, a huge chipmaker. It made a fortune selling processors for servers, personal computers and laptops. In June the





long since been scrapped. But Google's approach is still the same: mining information provided by web users, such as their search histories, to provide more relevant search results and more effective and targeted advertising.

The direct link to users also allows firms such as Google continuously to improve their interface, something traditional software-makers were not able to do. At any given time Google is running dozens of tests to optimise the look and feel of its offerings. This makes web applications far less technology-driven and much more user-oriented, says IBM'S Mr Wladawsky-Berger. "They are much more inspired by what goes on in the real world."

A raft of start-ups is also trying to build a business by observing its users, in effect turning them into human sensors. One is Wesabe (in which Mr O'Reilly has invested). At first sight it looks much like any personal-finance site that allows users to see their bank account and credit-card information in one place. But behind the scenes the service is also sifting through its members' anonymised data to find patterns and to offer recommendations for future transactions based, for instance, on how much a particular customer regularly spends in a supermarket. Wireless devices, too, will increasingly become sensors that feed into the cloud and adapt to new information.

Nokia, for its part, is planning to build all kinds of sensors into mobile phones to monitor things like movement, barometric pressure or even the owner's health, which many experts expect to become a big new trend. Sensors could also be used to record people's activities, creating what some already term a "lifelog"-raising all kinds of privacy concerns.

As wireless technology gets better and cheaper, more and more different kinds of objects will connect directly to the cloud. SAP, the German software-maker, has launched a research project called "The Internet of Things" to see what can be done with the resulting information. As part of that project, an initiative called the "Future Factory" is now under way to investigate how intelligent tags can make manufacturing more adaptive and efficient.

More and more data get you only so far, however. In the end, Google's search results and its text-based online advertisements are relevant to users only because the firm has devised clever ways to sift through them, says Hal Varian, the firm's chief economist. The big challenge of the cloud will be to connect the myriad data in it and make them profitable. •

firm launched a new line of chips called Atom, designed to power what it calls "netbooks" and "mobile internet devices" (MIDS), mainly intended for surfing the web. Intel is also the driving force behind WIMAX, a technology for wireless broadband access to the internet. It wants to put a WJMAX radio chip into as many devices as possible, from portable computers to specialised gadgets such as the Kindle.

Apple's iPhone and its App Store, which allows iPhone and iPod owners to download applications, also provide a foretaste of how important wireless devices will be for the cloud. Apple launched App Store only in July. Two months later it had already tallied loom downloads, meaning that it took off much faster than Apple's highly successful iTunes music store. Many of the programs on offer connect to the cloud, including news feeds, multi-player games and a service that keeps track of the latest polls for America's presidential election.

You can take it with you

The plethora of devices wirelessly connected to the internet will speed up a shift that is already under way: from a "device-centric" to an "information-centric" world, in the words of VMware's Paul Maritz. Up in the cloud there will be a body of data for each individual that will accompany them through life, he explains, and it will not be tied to any particular device, as it is today.

Again, what will make this possible is

virtualisation-this time of client devices, not servers. With the help of software from VMware and others, some firms have already virtualised their employees' desktop computers, which allows them to be managed centrally. Operating systems and applications will no longer run only on the employee's pc but on a virtual machine in a data centre that can be accessed remotely, theoretically from any PC in the world. Sooner or later mobile devices will also become virtualised. Users will be able to use their applications and data on whichever gadget they have at hand.

Yet the cloud's interface is designed not merely to provide information but to gather it as well. The future belongs to services that respond in real time to information provided either by their users or by non-human sensors, predicts Tim O'Reilly, the founder of O'Reilly Media, a publisher of technology books who coined the term "Web 2.0". Such "live applications", he says, will get better the more data they are able to collect-and there will be plenty as the cloud expands.

One of the first examples of such a service was Google. What originally put the search service ahead of the competition when it was launched a decade ago was its way of harvesting the information provided by web users in linking to other sites: the more links point to a page, the more useful it must be. These days most links are generated by computers, so the original form of this "page rank" algorithm has