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presents

The story of the web

Celebrating 25 years of the World Wide Web
By Jack Schofield

The story of the web
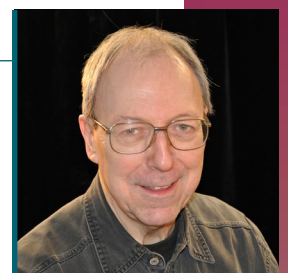
Jack Schofield

Contents:

About the author: Jack Schofield

Jack Schofield was on the internet before the web was invented, and tracked its progress for 25 years as the Guardian's Computer editor. As a freelancer, he blogs at ZDNet, and he has continued to write his weekly Ask Jack column for the Guardian, using his expertise to help readers with their computer problems. His books include The Darkroom Book, The Guardian Guide to Microcomputing, and (with Wendy Grossman and David Gould) The Hutchinson Dictionary of Computing, Multimedia and the Internet.

Jack Schofield

Introduction

The World Wide Web is so ubiquitous now that it's strange to think back to a time 25 years ago when it wasn't part of our everyday lives. But back in March 1989, the web was just an idea in the mind of Sir Tim Berners-Lee, who while working at CERN, noticed that colleagues based around the world were having problems sharing information because they all used different computers and operating systems. His initial proposal for Information Management has since changed the world in so many ways that even he may not have envisaged at the time.

We mark the web's 'silver' anniversary in 2014 – and what a 25 years it has been. From the heady days of the 1990s, when the web promised investors a brave new world of profits, to the subsequent crash; from the first seeds of social networking to today's all pervasive, connected, mobile experience – our journey with the web has truly transformed how we live, work and connect with each other.

We wanted to mark the anniversary of the web's invention with a report tracking its key moments, and looking ahead to the future. *The story of the web*, written by Jack Schofield, one of the UK's most respected technology writers, outlines the various challenges and innovations that have shaped the web that we know today, and looks ahead to the next 25 years with the help of some prominent names from the industry.

We've also developed a timeline website, which can be found at www.nominet.org.uk/storyoftheweb. Please visit and share your own stories and memories from 25 years of the web.

1989–1995: The early years

The World Wide Web has gone from "never heard of it" to "can't live without it" in 25 years. It's not quite as essential as water or electricity, but it has become our primary information utility. People use the web to watch movies and TV programmes, to listen to the radio, to read newspapers, to send and receive emails, to make phone calls, to play games, to chat to friends, to share photos, to shop, and in many cases, to do their jobs. There are few areas of life it hasn't touched.

We now take the web for granted, but it needed Sir Tim Berners-Lee's combination of existing technologies and new ideas to make it happen. Working at CERN in Switzerland, he saw that scientists had problems sharing information globally because they used lots of different computers with different operating systems and different document formats. He had already thought about hypertext (where links in a document call up other documents) for an earlier information project called Enquire. Now he implemented hypertext in HTML (HyperText Markup Language) – a simplified tagging system inspired by SGML – to make it easy for people to create and host documents. Then he added URLs (Uniform Resource Locators) to point to documents, and HTTP (HyperText Transport Protocol), to fetch them across the internet. Finally, he just needed a browser to display these HTML pages. Berners-Lee wrote one on his NeXT computer, and called it WorldWideWeb.

The browser did more than display documents: it provided a mouse-driven graphical front end to the internet. To kick-start adoption, Berners-Lee had also supported FTP (File Transfer Protocol), which made it easier for people to download files. This implanted the idea that all the other types of data you could send over the internet – emails, photos, videos etc – could also be handled through a browser.

The web took off because it was instantly appealing to those who tried it, but also because it was open and free.

Berners-Lee didn't patent or license the web to make money from it. Instead, he invited others to set up websites and develop browsers. One of the most popular was NCSA Mosaic, written at the National Center for Supercomputing Applications at the University of Illinois Urbana-Champaign. The first alpha (pre-release) version appeared in June 1993. Mosaic introduced the <img> tag to HTML, so that pictures appeared alongside text instead of loading separately. It was a game-changer. Web pages had been documents but now they could look like newspapers or magazines.

Of course, many people were already online, thanks to dial-up services such as CompuServe and America Online (AOL). But you didn't need a subscription or permission to set up a website: anyone could do it, and many did.

Soon there were so many new sites that Stanford graduate students Jerry Yang and David Filo set up a directory, Jerry's Guide to the World Wide Web. This became the first web giant: Yahoo!

Mosaic was popular with people who knew about the internet, but it was Netscape Navigator that fired the imagination of the general public. It also established the idea that the web was a way to get rich quick.

Netscape was developed after Jim Clarke, former boss of Silicon Graphics, hired some of the Mosaic programmers and founded Mosaic Communications. They quickly produced a "Mosaic killer" – Mozilla, from Mosaic and Godzilla – and launched version 0.9 in October 1994. It was a huge hit, to the point where Netscape almost became synonymous with the web. This gave it the power to innovate, and to add the features it wanted. Its developments included frames, cookies, JavaScript (originally LiveScript) and SSL secure communications, which we still use today. However, Tim Berners-Lee had already founded the World Wide Web Consortium (W3C) at MIT, also in October 1994, with the aim of steering and standardising developments, to keep the web open.

1995–2000: **From boom to bust**

The real boom started in 1995, thanks to Netscape going public on August 9 and the launch of Microsoft Windows 95 on August 24. Netscape's IPO (initial public offering) was followed avidly by the news media, and it was a spectacular success: the share price started at $28 and climbed to $75 before closing at $58. A small, unprofitable company had made lots of people rich, mainly because of excitement about the potential of the web.

Shortly afterwards, Windows 95 got the biggest launch in software history. This helped kick-start sales of affordable PCs that could surf the web. Netscape was featured at the launch, but Microsoft had developed its own browser, Internet Explorer, using code licensed from Mosaic. This marked the start of the acrimonious Browser Wars.

Together, Netscape and Windows 95 prompted a sort of land grab, with thousands of companies piling in to make their fortunes.

These included Amazon and eBay (1995), Craigslist and Hotmail (1996), Netflix and Google (1997), and PayPal (1999). Some start-ups were sold to larger companies who were trying to grow faster. Yahoo bought 18 companies before 2000, including Broadcast.com (internet radio, $5.7 billion) and GeoCities (web hosting, $3.6 billion). AOL bought 21 companies, including Netscape ($4.2 billion) and MapQuest ($1.1 billion). Microsoft bought Web TV Networks ($425 million) and Hotmail (a rumoured $400 million), among others.

New companies doing new things on the web naturally wanted new features added to HTML, which had been standardised as HTML 2 in 1994. So many new features appeared that HTML 3 was drafted less than a year later, and HTML 4 in 1997.

Netscape argued that it needed to innovate and that tags that became popular would become de facto standards. Microsoft did much the same thing but, perhaps surprisingly, allied itself more closely to the W3C and the standardisation processes of its HTML Editorial Review Board. Ultimately, the battle was about who set standards for the web. Netscape could do that when its browser had more than 80 % of the market, but W3C standards offered the best hope for the rest.

Separately, Microsoft intended to beat Netscape, mainly by producing a better browser. The 20-year-old software company iterated rapidly, sometimes with separate teams working in parallel on different versions of IE. It also allowed other companies to rebadge and redistribute IE, neither of which Netscape would allow. Microsoft was at least level with version 4 browsers in 1997 and clearly ahead when IE5 appeared in 1999. Netscape proved unable to complete its version 5 browser and its market share plunged.

In 1998, Netscape made its code open source, and the Mozilla Foundation set about re-writing it. The result, eventually, was Firefox: the only major browser dedicated to meeting users' needs, not the needs of a giant corporation such as Microsoft, Apple or Google.

Netscape had complained to the US Department of Justice that Microsoft had an unfair advantage because it was bundling IE with the Windows operating system, sparking an anti-trust battle that ran from 1997 to 2000. Although Microsoft won the browser case on appeal, it lost the larger anti-trust case, and this contributed to the dot-com crash.

The Netscape IPO in 1995 had established the idea that web-based companies didn't need to meet the traditional requirements for value such as turnover, profits and assets, they just needed eyeballs and momentum. They were – and still are – valued by the number of users they attract, and their speed of growth.

In the new Wild West, you had to stake out your territory, get big fast, and worry about monetisation later. It worked for as long as venture capitalists and investors believed in it – much like believing in the value of tulip bulbs – and it drove the stock market to its peak on March 10, 2000.

In reality, of course, most web start-ups were high-risk investments, and no conventional analysis of their earnings and profits could justify their share prices. As interest rates tightened and the US economy began to slow, concerns began to grow. Yes, some people had made fortunes on the web, but some had lost fortunes. The failure of high-profile start-ups such as Pets.com (1998-2000), Boo.com (1998-2000) and Webvan (1999-2001) fed the rout. Amazon's share price tumbled from $107 to $7. The bubble had burst, and trillions of dollars worth of market value disappeared.

2000–2004: **The people-powered web**

The ongoing dot-com crash didn't damage the web, which enjoyed a new era of creativity and growth, helped by the arrival of Wi-Fi networks and affordable broadband.

Intel's heavily-advertised Centrino Wi-Fi taught people that they could use the web wirelessly, from a laptop. The increasing take-up of always-on broadband – especially towards the end of the decade – provided faster speeds that could cope with more complex websites.

The first decade of the web had been about publishing, but the second decade saw a shift to a more personal and conversational style. In 2000, more than half of US households had internet access, according to Nielsen, and they weren't all passive consumers. They were becoming contributors, and they had a voice. There was a boom in blogging, podcasting and peer-to-peer file-sharing, and it was the start of crowdsourcing and social networking.

Ev Williams had launched Blogger in 1999, and the idea finally started to take off. Blogging software freed users from having to create web pages: they could just post their thoughts whenever they felt like it, while older blog posts scrolled away. Further, blogs allowed comments, so readers could engage with writers in ways that old-style web publishing didn't allow.

Podcasting started in 2000 with a news service called MyAudio2Go.com, targeted at new portable MP3 players. People wanted to start "audioblogging", and software developer Dave Winer enabled songs and podcasts to be included in the version of RSS (rich site syndication) software that he was developing to go with his blogging software, Radio Userland. With RSS, users didn't need to visit a website to see if there was a new blog post or audioblog. They could subscribe to the RSS feed and have it delivered.

But Napster was the most famous website of the day. It operated between June 1999 and July 2001, and popularised the MP3 music format. Napster used a peer-to-peer system that enabled users to share files without using a central file server. It was a great illustration of the power of the distributed internet, though it was soon shut down by the courts to prevent the open trading of copyright music. However, following the launch of the Apple iPod on October 23, 2001, there was no shortage of demand, and users soon found other sources of supply. These included BitTorrent (2001), KaZaA (2001), eMule (2002) and many more, culminating in a torrent site, The Pirate Bay (2003).

The two men who launched KaZaA, Niklas Zennström and Janus Friis, went on to create peer-to-peer telephony with Skype (2003).

People were also collaborating online using "wiki" software that enabled hundreds of people to contribute to a single document. The first wiki program, Ward Cunningham's WikiWikiWeb, had been launched in 1995, but the idea reached a much wider audience after Wikipedia was founded in January 2001. Wikipedia – which used open source MediaWiki software – was an ambitious attempt to create an encyclopaedia based entirely on "user generated content". Many more forums, community groups and companies saw that they could use wikis to capture and share their expertise, and make it globally available.

Widespread sharing made copyright a hot topic, and Wikipedia and others used a version of the GNU project's "copyleft" free software licence adapted for documentation. However, the Creative Commons was founded to address the problem, and released the first of its new-style licences in December 2002. Unlike ©, CC allowed users seven options according to whether they would allow their work to be re-used, and on what basis. It started with "No Rights Reserved": in other words, putting a creative work into the public domain.

This period also saw the germination of the idea of social networking. People had been socialising online on AOL and on bulletin boards, and that continued on Slashdot (1997), Digg (2004) and Reddit (2005), and in virtual worlds such as Second Life (2003) and World of Warcraft (2004). However, they were using pseudonyms: part of the net's appeal was the freedom to choose a gender, appearance (or avatar) and personality. That worked when your virtual friends were completely different from your real friends, but not when all your real friends came online.

Social networks enabled real people using their real names to interact with real friends online.

Although a few social networks were launched in the 1990s, Friendster (2002) was the first to grab mainstream attention. It was quickly followed by MySpace and LinkedIn (2003), then Google's Orkut and Mark Zuckerberg's Facebook (2004). Soon there were similar sites in other countries, such as Nexopia in Canada and VKontakte in Russia. In the long run, however, the web tends to breed only one giant in each category, and Facebook has become its social network.

2004–2007: Web 2.0

The growth of blogging and other forms of collaboration signalled a change in the nature of the web: it was no longer where you went just to read things but to do things.

In other words, the web was finally displacing the PC as the platform for applications. Tim O'Reilly of O'Reilly Media captured the zeitgeist, gave it a name, and in 2004, promoted it in a conference: Web 2.0.

Web 2.0 was based on the conversational web, but companies could now provide RIAs (rich internet applications) that encouraged user participation. Content could be dynamic rather than static, so the browser needed to support some form of programming, and the web server needed to be able to fetch information from different sites. This enabled "mash-ups" such as putting a set of Flickr photographs on top of Google maps: a service that neither website could provide on its own.

With "ajaxing" – JavaScript programming and other web technologies sharing a handy name – the browser could create an experience that was more like a desktop program. With web-oriented architectures, sites could combine data from many different resources, marking a shift from websites to web services.

Some of these technologies had been around for a while, but the Web 2.0 slogan popularised the idea, provided a framework for future developments, and – importantly – provided web start-ups with a story to tell venture capitalists who had been burned in Bubble 1.0. Google Maps, which appeared in 2005, became the movement's poster child. As usual, the majority of Web 2.0 sites failed, but the survivors include Flickr (2004), YouTube (2005), Twitter (2006), Tumblr (2007), and Soundcloud (2008).

2007–2010: **The multimedia mobile web**

There were, of course, problems. One was that web browsers weren't really designed to run applications, and there was some confusion between traditional HTML and the W3C's move towards a new XHTML. This aimed to create a "semantic web", where tags would indicate meaning rather than appearance. The browser makers weren't driving the market: Netscape was moribund, and after its experiences with US and European anti-trust lawsuits, Microsoft released IE6 (2001) and then abandoned browser development. IE6 was good for its day, but it hadn't been designed to run JavaScript at the sort of speed required by browser-based apps.

The vacuum was filled by FutureWave's FutureSplash animation program, which became Adobe Flash. If users added a Flash plug-in to their browser, websites could be as "rich" as they liked, and this included playing videos. Further, the same code would work whether the user had a Windows PC or a Mac. But Flash wasn't an open HTML standard, and some people felt browsers should handle videos the same way they handled pictures, with a simple tag.

In 2008, the W3C published the first working draft of HTML 5. This reunited the web industry around a version of HTML that could support sophisticated online programming and run across all sorts of devices without needing plug-ins.

It also kicked off a new era where the three main browser engines – Microsoft's Trident, Mozilla's Gecko, and the Apple/Google-backed WebKit – competed to implement industry standards and to run JavaScript benchmarks.

The web's first decade had been limited by the use of slow, dial-up modems and the cost of making phone calls. These meant most users were online only for short periods. With broadband and Wi-Fi – which was spreading to coffee shops and other areas – they stopped thinking about "going online" and started to worry when they were offline. What was happening to their stream of messages, tweets, Facebook updates, and so on? The answer was the smartphone…

Consumers had been using mobile phones to send and receive short text messages, but they rejected attempts to deliver a cut-down web using WAP, the Wireless Application Protocol.

Things changed in 2007 when Apple launched the iPhone with what the late Steve Jobs called "the first fully-usable browser on a cellphone". He said: "It's the internet in your pocket for the first time ever."

Now, web developers would not have to produce simplified versions of websites for mobile users: smartphones could access the same sites as PCs, often using the same fast Wi-Fi networks.

In the UK, Apple had to withdraw its advertising claim that the iPhone could access "all parts of the internet", partly because it didn't support Adobe Flash, which was in widespread use. Apple argued that it supported web standards. The iPhone's success, followed by the success of the iPad in 2010, helped turn the tide against Flash and towards HTML 5. Game over?

In reality, things turned out somewhat differently. First, in 2008, Apple released a software development kit that enabled developers to create native apps for the iPhone and iPod Touch, and sell them through Apple's online store. Developers could make more money from apps than from free websites, and Google and Microsoft followed Apple in creating app stores for Android and Windows Phone. Instead of everyone focusing on the open web, we got competition between ecosystems of closed apps.

Second, the rapid growth of mobile phone and tablet access prompted web developers to focus on mobile-friendly sites that were in many cases less good for PC users. PCs still delivered the majority of traffic, but the rapid growth in mobile made it more important, and it was easier to monetise.

2010–2014: Democracy and the web

The growth of the web during this period was marked by a huge increase in tracking to support the targeted advertising that covered the cost of "free" products. In a talk at MIT in 2013, security expert Bruce Schneier pointed out that:

"Surveillance is the business model of the internet. We have built systems that spy on people in exchange for services."

Mobile has made things even worse, because carrier networks must track phones everywhere. Even the simplest phone apps, such as flashlights, often demand access to location and other sensitive information, not because the app needs them, but because the advertising model demands it.

But the smartphone was also liberating. Users could share what they were doing via services such as Facebook, Twitter and Instagram. Most of it was trivial, but some of it was news, like a plane ditching in New York's Hudson river in 2009. Protesters used smartphones to share information of civil unrest during, for example, the Arab Spring in Egypt, Libya and Tunisia… while governments also used the same networks and services to try to track them down.

To cap all that, in 2013, whistle-blower Edward Snowden revealed that America's National Security Agency (NSA) and similar state organisations were running massive surveillance operations, partly by intercepting cables carrying internet traffic. This included a database of webcam images from Yahoo, many of which contained, as the UK's GCHQ put it, "undesirable nudity". The web that once promised anonymity and freedom had become a vehicle for the invasion of privacy beyond the dreams of Orwell's Big Brother.

Some users are taking steps to protect themselves, and some companies will move their data to companies and countries that protect their security and their privacy. However, the web has exploded from one website in 1991 to around 180 million today, and more than two billion people are online.

The web is now so deeply engrained in modern life that the issue isn't whether people will leave, but how long it will take for the next two billion to join us.

The next 25

When Sir Tim Berners-Lee floated the idea of a World Wide Web and set up the first web server in 1991, nobody dreamed it would be such a huge success. We can't think of an individual who has had such an impact since 1837 when a Birmingham schoolteacher, Rowland Hill, published a small pamphlet proposing a Uniform Penny Post. This led to an explosion in written communications where letters were delivered for the same low price regardless of distance. Berners-Lee's system has largely replaced Rowland Hill's, with the extra benefits that "regardless of distance" now applies internationally, and the penny rate has been reduced to free.

Of course, the web has changed dramatically in the past 25 years. It began as a platform for distributing scientific papers, became a platform for all types of publishing and then for ecommerce, multimedia entertainment, and applications.

This will continue as the web becomes the front end for the Internet of Things, where communications between people are dwarfed by communications between TV sets, cars, fridges, doorbells and countless other devices.

The internet addressing system has already been changed so that every lightbulb on the planet can have its own internet address, with trillions to spare.

There are, inevitably, challenges. The move from the open web to closed ecosystems of apps on smartphones and tablets has been one worry, but as the W3C's Jeff Jaffe explains below, it is being addressed. The decentralised, democratic web has become one where a handful of giants wield enormous power: Apple, Amazon, Google, Facebook, Microsoft. Some things that look like websites are more like walled gardens: are Facebook and Twitter the new CompuServe and AOL? Will the pendulum swing back?

There's the danger that the net could be segmented, with webs for China, the EU or other groups of nations. Not every nation shares the same cultural values, or has the same expectations of free speech and privacy.

There's also the threat posed by mass surveillance by governments and tracking by web-based corporations. Mozilla's "Chief Lizard Wrangler" Mitchell Baker says: "One key challenge is to build institutions that are trustworthy. That includes our governments, businesses and the technology that forms the foundation of modern life, ie the internet."

Finally, the sheer scale of the web is already threatening to overwhelm us, and that will only get worse as more devices join the web, along with several billion new users. How will we cope with the resulting fire-hose of information? Brad Templeton, a programmer and web activist who founded possibly the first dot.com company, ClariNet, in 1989, says: "The greatest challenge we now face on the web is not 'discovery' – there is nobody who doesn't already get sent more links and resources by their friends than they can handle. The next great trick will be to find a way to get us only the most important things, without the fear of missing out."

There's an idea for whoever wants to build a web giant to replace Google. It's possible. Berners-Lee's open web means billions of people have the chance to follow in the footsteps of Google's Larry Page and Sergey Brin, or Facebook's Mark Zuckerberg, and change the world. You don't need anyone's permission.

The web is in a continuous state of development, and organisations such as the W3C, IETF (Internet Engineering Task Force) and ICANN try to anticipate future needs. We spoke with several leading web thinkers to get their views on the web's biggest achievements so far, and find out their predictions for the next 25 years of the World Wide Web, and this is what they said:

Lesley Cowley OBE
CEO, Nominet

"Nominet looks after UK domain names, and when I joined in 1999, a grand total of about 235,000 names had been registered. Today, there are about 10.6 million UK names out of a world total of 265 million. That's an indicator of the growth of e-commerce. There's a lot of online business going on, and a lot of social good that's not as recognised as it should be.

"From this year onwards, there will be another fundamental change to the domain name part of the internet, with over a thousand new top-level suffixes coming online. These include .cymru and .wales, which will be the place for Wales on the internet, and people will be able to register under .uk this summer. Some names are for trades or professions so businesses will have to think very carefully about where they want customers to find them.

So far, much of the net has been in English, and what we are seeing now is domain name suffixes being in other languages and other scripts. That could mean that the internet will be increasingly local, for some users. Something that wasn't accessible to them because they couldn't read English will suddenly become accessible.

"If you put that together with the rise in mobile as a means of getting online, then some incredibly exciting things will happen.

"Making sure that people have trust and confidence in doing business online, and educating people to keep themselves safe online, are both very important. Law enforcement agencies are getting much more savvy about crime online, but there are clearly some international challenges around cybersecurity: it's all very well improving that in one locality but the crooks all merrily relocate to another one. That's an on-going challenge and there's more to be done, but we're up for it."

Lesley Cowley OBE
CEO, Nominet (1999 - 2014)

Dr Bernie Hogan Research fellow at the Oxford Internet Institute and University of Oxford

"The web is a pretty remarkable and relatively decentralised system. That said, there's still too much consolidation and concentration in the hands of big players. If we could find a way to create better secure peer-to-peer protocols for things such as search, social network sites, identity management and email, it might be possible to have a web that is not so easily surveilled or commercialised, while also being more robust. Imagine when every phone is not merely a consumer device but also an always-on personal cloud server. It may never be practical, but for many uses it seems like we have swung too far into cloud and the pendulum will eventually swing back.

Dr Bernie Hogan, research fellow at the Oxford Internet Institute and University of Oxford

"One thing that does worry me is that the shift from PCs to tablets means that typing is now a little more difficult and that coding is likely to remain an arcane process even if we can do more without coding.

"Cory Doctorow has mentioned the four horsemen of the internet: organized crime, child pornography, terrorism and piracy. These are the web's greatest threats, not merely because of the damage they do, but because they appear to be the most resilient excuses for increasing state control. However, going forward, one of the biggest challenges might be dealing with digital trash. It's easy to horde information, but terribly difficult to manage.

The web is going to get smarter, more intimate and more local. Yet, we shouldn't necessarily expect people in general to get more sophisticated in their use of the web, only that they will have more tools to manage their digital life.

"In 25 years, we will probably still be dealing with poorly formatted email, a hodgepodge of network services and pop-up ads."

Richard Holway MBE, Chairman of TechMarketView, former director of Ovum and a founding member of the Prince's Trust Technology Leadership Group

"The internet is essential but is still not available or used by about 10% of the UK population and much more in developing countries. It is such a shame that some old people have not embraced it, as it would make a great difference to their lives. So I'd make ICT skills as essential as the 3Rs at school and I'd make sure that every person, however young or old, had internet access and the means to use it their homes. Of course we can all argue about the bad things – like pornography available to young kids and cyber bullying – but in general, our lives are better. The world's knowledge at our fingertips is helping in every way.

"The biggest challenges are around privacy and cybercrime. I fear that we do not take the threats seriously enough. In the hands of a corrupt regime, or company, our freely given data could be used against us.

"In 25 years' time, fast access will be possible from every spot on the planet… and possibly beyond! Every living thing of value – like chickens, cats … and children – will be internet connected, as will everything from cars to curtain tracks.

I see the biggest advances coming in internet-enabled healthcare. It will enable old people to stay in their homes longer and enjoy a higher quality of life.

I also see healthcare being the major use of wearable computing. A single device will monitor your state of health constantly."

Indeed, the doctor will call YOU saying "You are about to have a heart attack. The ambulance will be there in four minutes".

Richard Holway MBE, Chairman of TechMarketView, former director of Ovum and a founding member of the Prince's Trust Technology Leadership Group

Dr Jeff Jaffe CEO, World Wide Web Consortium (W3C)

"HTML 5 is the next generation of mark-up for the web, and there is unanimity in the industry that that's the right direction. We refer to the current generation of technologies as the "open web platform", and we use the word platform to emphasize the fact that people are no longer using it just for static browsing of information in web pages. It's a platform for building distributed applications, and it's the most interoperable platform in history because everyone is implementing web technology. Being a platform opens up all sorts of imaginable and unimaginable opportunities.

"There are certainly challenges along the way. The web is moving to all sorts of different devices – e-book readers, tablets, set-top boxes, in-car infotainment systems – and it's a challenge to maintain the "write once, read everywhere, implement everywhere" capability with such a wide range of devices. It's true that a lot of companies are building apps for particular smartphones, but we have a project called Closing the Gap with Native. In many cases, those apps use a lot of web technologies underneath, but there may be a particular function, such as a payment infrastructure, that's not available on the open web. There's been unprecedented rapid innovation on native smartphone platforms in the past few years, and for certain capabilities, we're behind. That's not a surprise – in general, standardisation cannot be done as fast as innovation – but perhaps we're further behind than we would usually be. That's a temporary situation, and with our Closing the Gap project, we're putting in the capabilities that are needed for the open web platform.

"As part of that, we're going to have a Web Payments Workshop to work out a sensible way to have a standard payments infrastructure for the web. It has to handle payments and royalty programmes and things like that. Three or four years ago, there wasn't the motivation to create a web payments ecosystem because apps were just getting started, so that's one of the areas where we are behind. It will not be fixed overnight, but when it is, people will say "well, wouldn't it be preferable to do it once, do it openly, and have your stuff available everywhere?"

"In industry after industry, people are moving to the web, and I have four examples. The first is the whole mobile app ecosystem. Another area where we've made tremendous progress is the movement of entertainment to the web, where we have a project on TV that covers streaming, captioning [subtitles], the integration of devices in your home, and so on. A third example is digital publishing, which the web provided 25 years ago, but it gave you very low quality typography! We're now at the point where we know how to do most of the things needed for the most sophisticated high-end publishing, so we see huge opportunities there. The fourth is the automotive infotainment system, where we're getting more bandwidth to the automobile and more things that people want to do – such as entertain their children in the back seat. There are other things, too. "

We see the platform for the web becoming a platform for industry, so there are enormous opportunities for further growth.

Simon McCalla **CTO, Nominet**

Simon McCalla, CTO, Nominet

"When HTML was first envisaged, using the web was about sitting in front of a PC screen. Now, our usage has changed, and we expect our data to be much more mobile, and work on different devices. We might be watching web content on a TV while using a tablet or a mobile, and we want the experience to be tailored for the device we're using. The challenge for the web is to stay relevant as we move to more devices with different usage patterns. There's a tension between wanting to write applications that are native to a specific device, and the desire to write applications that can run across multiple devices, because in order to do that, you've got to use open standards, which is where browser-based HTML 5 apps come in.

"I think there's a parallel between this and desktops. For a long, long while we developed native programs for desktop PCs, for specific platforms, but nowadays it's rare to develop them without using the web and browser-based technologies. I think we'll see the same thing happening on mobiles.

In the next 25 years, I think we'll see the web expanding beyond the screen-based experience to other devices, appliances, our cars and so on. That will dramatically change the way we publish content on the web as we find ways to consume information that's accessible to human beings by more than just their eyes and their fingertips.

Professor Sir Nigel Shadbolt **Head of the Web and Internet Science Group at the University of Southampton, and Chairman of the Open Data Institute**

Professor Sir Nigel Shadbolt, head of the Web and Internet Science Group at the University of Southampton, and Chairman of the Open Data Institute

"The biggest reason to celebrate the web is that it's an open and universal platform for the democratisation of knowledge. Something like Wikipedia could really only exist with an infrastructure like the web. It's a great example of collective intelligence. However, I often think the web is more hierarchical than perhaps people imagine. A little bit more peer-to-peer would be interesting. Can we refactor parts of the web to make it more decentralised?

"The web has overcome some challenges in the past, like the move to Web 2.0, the writable web, and the danger of people disappearing into the mobile world, off the web. With HTML 5, we've seen a real comeback, and now the web can run on mobiles, but it was looking a bit dodgy a few years ago.

If we can keep the web open and accessible, I think we're going to see a new kind of AI [artificial intelligence] that is "augmented intelligence". People and machines connected via the web can achieve solutions that individuals and small groups just can't do.

"It's what Tim Berners-Lee refers to as "social machines" and is a main focus of my own research: the integration of people, data and algorithms. We'll also see more human augmentation, and in 25 years I think it's quite possible we'll see people routinely connected into the web, and these won't just be external peripherals. Wearables are the beginning of that. The "internet of things" will make a whole new set of elements in the environment available to us directly to view and interact with. I can also imagine Babelfish implants that will give us decent real-time translation of languages we're listening to. We're more or less permanently connected now, through our devices, and if those devices become that bit more attached… With developments like smart contact lenses and retinal projection, I think we're starting to see the future."

Dave Winer Software developer and editor of the Scripting News weblog

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"Is the web too centralised? I think we're still in a process of transition. The way media works today is already quite a bit different from the way it worked at the beginning of the web. Technology is very cyclic, and there's a period in the cycle where technology is hard, and not many people understand how it works. Individual companies rise and become large companies, so you end up with centralised technology. Over time, the technology becomes more familiar and commoditised, and then it opens up explosively. If you put a cap on people's creativity, that only stays in place for so long before it blows up.

"We've seen this any number of times. For example, networking was very difficult, so we got services like CompuServe and AOL. They were replaced with the open internet where anybody could operate a server. That was very liberating. Today, Twitter and Facebook are very limiting, but they are providing some incredible training wheels: they're showing us what the future will look like, but I don't believe they actually are the future. I think we're on the verge of an explosion with people trying lots of different ways of doing things.

"The way change happens is by people shipping complete software that works. It's not enough to put a standard up there and say "hey, you all figure it out". When people say that my contribution was RSS, I would beg to differ: my contribution was software that uses RSS. And it wasn't enough just to write the software, you had to commercialise it, to get the content providers on board, and to get people to use it. These are all much bigger problems than just inventing something new.

Right now there's a fad that every kid should learn how to code. Only a small number will want to do it, but they will have started doing it much, much earlier in life, their tools will be a lot better than the tools when I was growing up, and the costs will be very, very low.

"I think that's a formula for some amazing things to happen, and it certainly adds up to decentralisation."

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