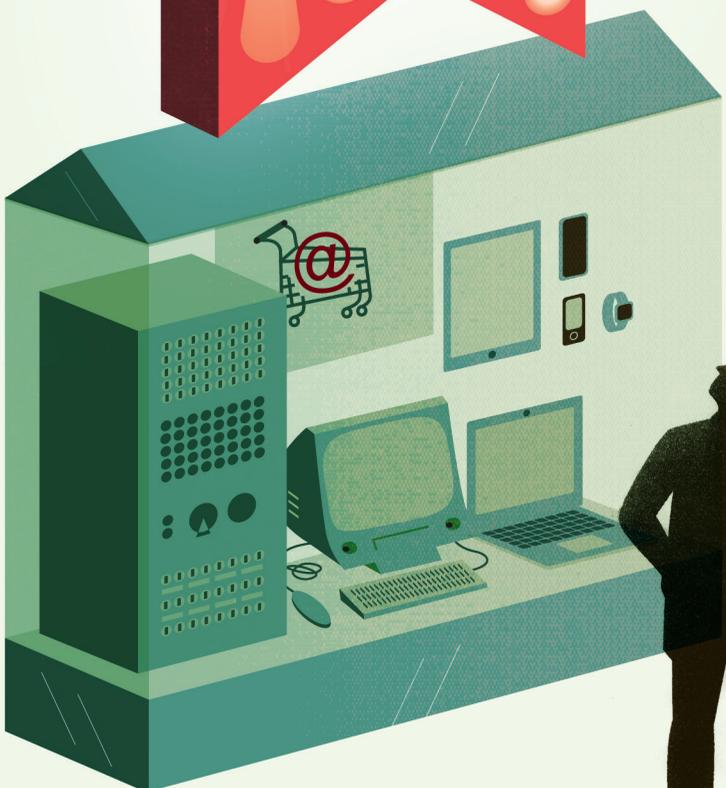


THE WEB: THE NEXT 25 YEARS



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The disruption is not over—the Web’s transformation of the world as we know it has only just begun.

In its first 25 years, the Web exhibited an impressive evolution from a niche information management system¹ to a platform so ubiquitous and universal that it drives and empowers our digital lives.² Redefining the way we live, communicate, socialize, and transact, Web tools and services enable us to gain and share knowledge and information in new ways. And Web-enabled applications continue to transform businesses, education, healthcare, banking, government, and many other key sectors. So what about the Web’s next 25 years? As George Burns once said, “I look to the future because that’s where I’m going to spend the rest of my life.” Of course, as we examine what the new Web landscape will look like, we recognize that the Web is a means to an end rather than the end itself.

In this special issue of *Computer*, we explore a variety of perspectives on the Web’s evolution and advancement in the coming quarter-century. By exploring important issues including privacy, security, equal access, Net neutrality, and Web regulation, this issue’s three feature articles and an expert roundtable give us insight into the anticipated advances and features that the future Web will bring, as well as the influence it will have on our society.

A VISION FOR THE FUTURE

The Web is poised for significant further development, and it will become an even more dominant and exciting platform than it is today. This is in no small part due to the Web’s potential for reaching billions of people at the bottom of the socioeconomic pyramid who have not yet had the opportunity to embrace it and benefit from it. The new era

of the Web is being driven by growth in a multitude of areas:

- › advances such as Web 3.0, the Semantic Web, the 3D Web, and the Real-Time Web;
- › open standards, open data, and open source software;
- › the Internet of Things (IoT);
- › multimodal access and multilingual presentation;
- › the growing use of Internet-enabled smartphones, gadgets, and consumer electronics;
- › smarter search engines and question-answering systems;
- › integrated, context-aware, collaborative apps;
- › cloud computing and cloudlets; and
- › the demand for an open, neutral, equal-access Internet, and for it to be declared a public utility.

Although the Web’s future seems bright and promising, realizing its full potential remains a bit uncertain. What do we want the Web to be? To answer this with any clarity, we must address a range of technical, developmental, operational, organizational, political, and societal issues and challenges. They include:

- › interoperability of Web applications—integration of data, knowledge, and apps to make the Web a more meaningful and collaborative platform;
- › cybersecurity—securing data on the Web and in Web applications remains a major



YOUR THOUGHTS?

Share your thoughts on the future of the Web and how it might influence us, as well as what we as computing professionals could do to help shape the future Web to be more exciting and serve society still better.
Join the discussion at <http://linkd.in/1GISWFh>.

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challenge due to increasing and sophisticated attacks;

- › a smarter Web—realization of a fully Semantic Web in which programs can analyze and synthesize Web-based information;
- › information overload—better context awareness, easier navigation, and smarter search engines for all kinds of data and information on the Web;
- › an open Web—fostering open data, open standards, and an open/neutral Internet; and
- › societal and social issues—addressing the Web's dark side, such as insufficient privacy controls and incorrect or poor information quality.

To better understand the Web's ecosystem from technical, societal, and other perspectives, we need coherent and comprehensive interdisciplinary studies. A new discipline, known as Web science, focuses on the Web's evolution and impact on society, business, and government. As Tim O'Reilly and John Battelle wrote in their white paper *Web Squared: Web 2.0 Five Years On*:

The Web is no longer an industry unto itself—the Web is now the world. And the world needs our help. If we are going to solve the world's most pressing problems, we must put the power of the Web to work—its technologies, its business models, and

*perhaps most importantly, its philosophies of openness, collective intelligence, and transparency. And to do that, we must take the Web to another level.*³

Bringing this about will require coordination among the Web's different stakeholders.

IN THIS ISSUE

In the first article, "The Web That Extends beyond the World," Vishnu S. Pendyala, Simon S.Y. Shim, and Christoph Bussler describe the Web's evolution from an interconnection of static information to a dynamic communication infrastructure for people, communities, things, and, eventually, planets. The authors anticipate an explosion of applications based on the Web of Things that includes machine-to-machine interactions and advanced machine learning that would bring growth in applications, humanitarian activities, interplanetary Web projects, politics, and augmented reality.

In "The Web of Things: Challenges and Opportunities," Dave Raggett postulates that there will be a range of really simple things to really smart things connected on the Web. These "things" are proxies for physical or abstract realities, and the "Web" infers that these things are accessible via Web technologies. As Web services become smarter, we can expect that the things will have a near-human-level understanding—so such things can better relate to and serve the people who use them. Achieving this will require interdisciplinary efforts—including cognitive psychology, linguistics, and facial recognition, among others—but will lead to the realization of many new ideas and applications in an immersive 3D Web. Raggett concludes by inviting



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readers to think about the societal ramifications of the envisaged Web.

In the next article, "Toward the Web of Things: Applying Web Technologies to the Physical World," Jörg Heuer, Johannes Hund, and Oliver Pfaff describe a future based on the interaction among devices, systems, users, and applications. In this vision of the Web, new applications and access patterns are based on applying Web technologies to physical devices enabled with multiple processors and communication interfaces. The authors predict that the Web will reach into the physical world, allowing for the creation of new applications that will harness physical devices and cause fundamental changes to the physical world and our interaction with the cyber-physical world.

Finally, in *Computer's* roundtable with panelists David Alan Grier from George Washington University, Jeff Jaffe from the World Wide Web Consortium, and Lee Rainie from the Pew

Research Center, we explore the Web's potential evolution and where it might lead us over the next 25 years. The panelists discuss key issues such as Net neutrality, accessibility, and government regulations, as well as what we as computer professionals can do to shape the future of the Web, ensuring that future developments make the world a better place.

The Web will continue its evolution, offer new capabilities, and extend its reach and utility. As it becomes even more ubiquitous and embedded in our lives and goods, the Web's influence will be even more significant and widespread in the years to come. The opportunities it presents will continue to outweigh associated risks and limitations. It certainly has not reached its zenith, so we must recognize and harness its full potential.

As a community, we must build a better, safer, more open Web that

addresses the needs of all segments of society. With the help of the Web and our coordinated efforts, we can address the coming technical, operational, organizational, political, and societal issues and challenges. We hope the articles in this issue will inspire you to think about what the Web could and should be, and that you will join us in working toward realizing the Web that we want. **□**

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