



The Future of Web Apps

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The Web's evolution has been phenomenal, and its growth continues unabated. The Web has changed how people gather information, perform their work, buy goods and services, connect with friends and family, spend their leisure time, and find partners and lost friends. It has also forced companies to rethink how they conduct business, interact with customers and suppliers, foster innovation, and collaborate with others. It has changed the face of politics, governance, religion, and spirituality. Furthermore, it's now mobile and more versatile, serving billions of people. The state of the Web is constantly in flux, and the future of the Web is up for grabs.

Reviewing the Web's evolution, it began with Web 1.0, which focused on connecting information (see Figure 1). Web 2.0 was more concerned with connecting people, while the emergent Web 3.0 is about integrating data, knowledge, and apps to make the Web a more meaningful and collaborative platform. Web 4.0 will harness the power of human and machine intelligence on a ubiquitous Web in which both people and computers not only interact but also reason and assist each other in smart ways.¹

The Changing Web Landscape

We're entering a new era of the Web, driven by Internet-enabled smartphones, gadgets, and consumer electronics; the promise of cloud computing; and advances such as Web 3.0, RFID, the Internet of Things (IoT), and multimodal access and presentation. In the coming years, billions of devices will be connected to the Internet, and they'll access and share information through the Web. New kinds of Web apps are on the horizon that will be more ubiquitous and smarter than current apps and will be accessible anytime, anywhere, and from any device.

For example, we might embrace augmented reality in mobile Web apps. Rudimentary apps such as Layar (<http://layar.com>) are already available, and other apps will likely follow. We might access the Web through new interfaces activated by voice or gestures. In a distant future, there might even be a Web interface activated through brain waves. More users will access the Web as mobile phones penetrate developing and underdeveloped economies in a big way. Multilingual and multimodal presentations will cater to all users' needs.

Several trends are shaping the current and future Web and its apps, and the emerging

landscape is exciting. However, we'll need to address numerous technical, developmental, operational, organizational, and societal challenges. The new discipline of Web science refers to the study of the Web's evolution and its impact on society, business, and government. This special issue presents a glimpse of the future of Web apps and their development.

In this Issue

In looking at future Web apps and the opportunities and challenges they present, the first three articles in this special issue focus on Web app development. In "A Service-Oriented Web Application Framework," Haluk Demirkan, Robert R. Harmon, and Michael Goul emphasize the unprecedented opportunities for organizations presented by the convergence of Web apps, Web 2.0 and 3.0, cloud computing, smartphones, and other technological advancements. The authors outline key requirements for a new Web app framework for conceptualizing the development of service-based apps that are easy to use, understand, and deploy. They argue that using component-based approaches instead of monolithic solutions minimizes risks and enables deployment of context-rich Web apps.

The second article explores mashups, which combine information and services from different sites to present new apps that add value—in a user-customizable manner. "Next in Mashup Development: User-Created Apps on the Web," by Florian Daniel, Maristella Matera, and Michael Weiss, discusses mashup-app development processes, methods, and architectures from the viewpoint of end-user development. The authors point out that mashups let end users be prominent actors in the creation of customized Web apps in the emerging Web landscape.

Developing Web apps is becoming a complex process involving various programming languages, frameworks, and paradigms—so it's unlikely that any single person will have the required skills to manage the entire process. In "Toward Unified Web Application Development," Markku Laine, Denis Shestakov, Evgenia Litvinova, and Petri Vuorimaa focus our attention on the problem of the traditional three-tier Web app architecture. They advocate tier-expanding Web-development frameworks that simplify the difficulties arising in multiple tiers. They evaluate three such

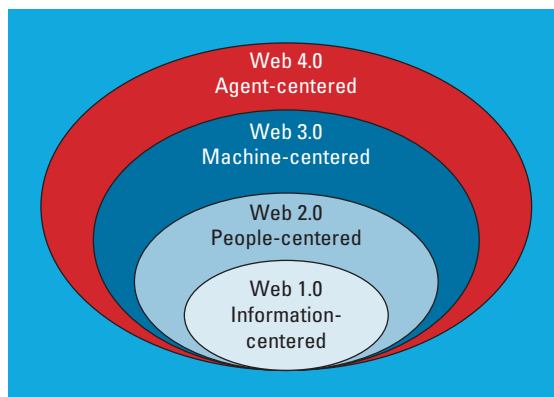


Figure 1. The Web's evolution.¹ Web 1.0 was static and information-centered, but Web 4.0 will be smarter and more collaborative.

frameworks, one for each tier, and recommend them as an alternative to traditional three-tier Web development.

The fourth article explores a new app scenario. With more people using Internet-connected smartphones and sensor networks, new kinds of Web-based digital diaries that record everyday activities will gain wider adoption. In "All-About Digital Diaries: Opportunities and Challenges," Laura Ferrari, Marco Mamei, and Franco Zambonelli present their vision of these diaries, which can automatically collect, process, and share relevant information. They also outline the opportunities such diaries present and discuss key challenges in building them.

Cloud computing is another promising trend. It enables users to access smart and complex apps with a simple device such as a mobile phone or netbook computer using a Web browser. In "The Next Web Apps Architecture: Challenges for SaaS Vendors," Stéphane Gagnon, Véronique Nabelsi, Katia Passerini, and Kemal Cakici examine cloud computing software-as-a-service (SaaS) business models and the cloud industry ecosystem, outlining vendor, user, marketplace, and infrastructure issues.

The last article focuses on the mobile-Web convergence. In "Mobile Applications and Their Delivery Platforms," Marcelo Nogueira Cortimiglia, Antonio Ghezzi, and Filippo Renga argue that the boundary between Web and mobile apps is shrinking. They then present a brief survey of mobile apps and their stores.

We—and the generations to follow—can't afford to live without the Web. The Web will become the dominant

The Web Turns 20

In 1989, Sir Tim Berners-Lee wrote a proposal for information management, showing how you could easily transfer information over the Internet using hypertext. When approving the project, Lee's boss wrote on the proposal, "vague, but exciting" (see <http://info.cern.ch/Proposal.html>). Two years later, on 6 August 1991, the first Web page went online (at <http://info.cern.ch/hypertext/WWW/TheProject.html>).

It had no fancy graphics, animations, or sophisticated interactive features, and there was no fanfare in the global press. It was marked only by a short post by its creator on the alt.hypertext newsgroup. Only later did the Web become known to the general public through an article by Steven J. Vaughan-Nichols in *Computer Shopper* ("WAIS and WEB: The Future of Internet Data Searching," Apr. 1993). The establishment

of the Commercial Internet Exchange in 1991 complemented the launch of the Web by opening the Internet—previously reserved for military, research, and academic use—to businesses and the public.

Within a mere 20 years, the Web has transformed the world irrevocably and has become indispensable. The Web's evolution will continue and its influence will be even more significant and widespread in the years to come. We've not yet discovered and embraced its full potential. What we can expect in the next 10 years and thereafter is anybody's guess. So, in commemoration of the 20th anniversary of the Web, we acknowledge the insights and contributions of Berners-Lee and his colleagues at CERN for setting the foundation for the still unknown promise of this sensational tool.

platform for most of our activities, including communication, collaboration, work, entertainment, learning, and all forms of transaction processing. It will continue to be a fertile area for research and development, as the Web will continue to offer vast opportunities and pose new technical, business, and social problems. How we embrace the opportunities and address the challenges will shape the future of the Web. As Alan Kay has said, "The best way to predict the future is to invent it."²

The Web will be critical not only to the ongoing information and communication revolution but also to our prosperity and well being, especially for the billions people who have yet to benefit from Web apps. (For a related discussion, see this issue's IT in Emerging Markets department, "Social Life Networks.") US First Lady Eleanor Roosevelt once said, "The future belongs to those who believe in the beauty of their dreams." So let's dream big as we harness the power of the Web to benefit both current and future generations around the globe. ■

References

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