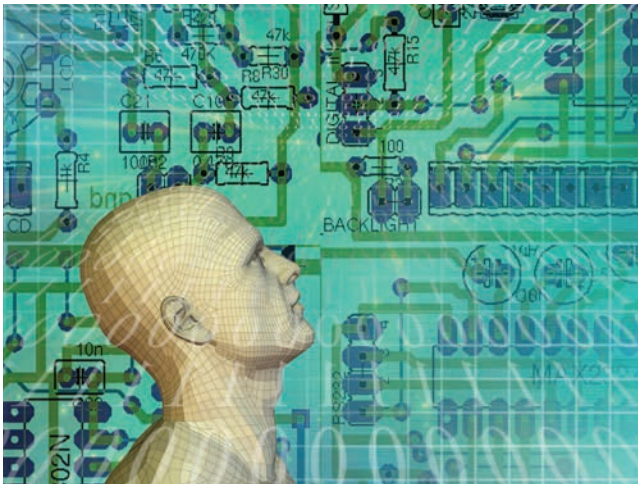


# Larry Smarr: Building Mosaic

Charles Severance

**Larry Smarr describes Mosaic's birth and evolution at the National Center for Supercomputing Applications.**

Over the next two years, we'll celebrate 20-year anniversaries marking the release of the various versions of NCSA Mosaic—or as it became more simply known, Mosaic—the first Web browser that worked across the Unix, Macintosh, and Windows environments and led to the Internet's rapid expansion beyond the academic world.

Mosaic's roots are in the National Center for Supercomputing Applications (NCSA) at the University of Illinois. In an interview taped back in 1997, four years after the first Mosaic release, I talked with Larry Smarr, who was then the NCSA director, and asked him why Mosaic happened at NCSA and not somewhere else. You can view the entire interview at www.computer.org/computingconversations.

## SUPERCOMPUTING

The first supercomputer centers essentially focused on installing and maintaining supercomputer equipment and making it available to customers. NCSA went a step further and built a client-server model using personal computers as the clients and supercomputers as the servers. Long before Mosaic was imagined, NCSA worked on software that could make Macintosh and Microsoft DOS computers capable of connecting to and working with supercomputers:

> We knew from the beginning that the personal computer was the real computer and that it was going to change the world. We started the supercomputer centers program two years after the IBM PC came out. The Mac was light years ahead of DOS, so we did a lot of work on the Mac and some on DOS. The first thing that was clear is that Unix wizards knew how to do Telnet and remote login to bring remote computers up on your screen, but ordinary folks with Macs and DOS didn't have a clue, so we developed NCSA Telnet, which was software that allowed you to have multiple remote computers open on your screen and do remote sessions in them, which is how you had to behave if you were going to be in a networked world. We would make these pictures of the Macintosh screen with a little Cray icon on the Mac and the title would be "Hide the Cray." This was totally radical because we were taking the supercomputer and the mass storage systems out of Livermore and Los Alamos and literally cloning them. There was no notion of client-server, there was just time sharing.

Because NCSA wanted to allow anyone to access its supercomputers, it decided to give the software away at no charge and make the releases available using anonymous FTP servers:

> We could have taken Telnet and tried to keep the intellectual property, but instead we said if this is going to go anywhere, let's just give it to everybody. Again, this was kind of radical. Later on, the authors of NCSA Telnet were part of a company called InterCon, which later became a successful private-sector company. But we didn't let that interfere with our primary mission, which was to get software out to enable people to use high-performance computing.
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> We adopted the notion of putting the software up on anonymous FTP servers and letting people download it; this

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allowed the rapid prototyping that the world now thinks is the way to go. This was being done in 1985 with NCSA Telnet. Every time we would come up with a new revision, we just put it up on the server. If NCSA decided, "Let's build a distribution system and a warehouse, and let's hire lots of secretaries to take people's names and numbers, and let's charge for it," the Internet would have been much slower in coming because many people got their first impression of the Internet using NCSA Telnet.

Having NCSA Telnet available throughout the late 1980s meant that as the NSFNet was gaining popularity, users of both Microsoft DOS and Macintosh computers could participate in the new and increasingly networked world.

## IMAGES AND BEYOND

Another trend throughout the late 1980s was a move from purely text-based interaction with computers to the increasing use of images to visualize and communicate data. But managing large image files was challenging in a world of 720-Kbyte floppy disks, 5-Mbyte hard drives, 640 × 480 displays, and 2,400-baud modems. Initially, managing images required costly and specialized hardware and software. NCSA tackled this by building software to improve the PC's image-handling capabilities:

> With NCSA Image, we said, "We want to build a world of infrastructure in which it is as easy to move an image around as it is to move a word." That was our design point and that was the way we talked about it back then. It meant we had to scale the network, the disk drives, and the compute power, and go to full color. When the Mac-II first came out, it had 256 color levels. Apple gave us 50 Mac-IIs, which was stunning. We could take things on $100,000 computer graphics workstations dedicated to image processing and put them into software in NCSA Image on the Mac. You could use the mouse on your Mac and do what otherwise would have cost $100,000 to do if you were an elite specialist.

Just as before, NCSA Image was also available for download at no charge through anonymous FTP servers. The next logical step was to build NCSA Collage, a synchronous collaboration environment.

**We adopted the notion of putting the software on anonymous FTP servers and letting people download it; this allowed the rapid prototyping that the world now thinks is the way to go.**

Developed in 1990 and 1991, Collage allowed multiple users at different locations to interact, working on data together using a shared whiteboard and shared applications. NCSA Collage was one of the world's earliest network-based virtual meeting rooms:

> We had a meeting in San Diego with a lot of top government people, and we did a live demo that most of them will never forget. We had people at Cornell, Pittsburg, NCSA, and in San Diego all on a Collage synchronous linkup from their workstations. Then we had a teleconference call so they could all talk simultaneously. One person would bring up a whiteboard or open up a color image, someone else would draw a line across it, and up would come a contour map across that line of the image. They were all in this conversation, and from where you were sitting in the room, it was all coming from this one speaker and this one screen because everything was melded together. All of a sudden, everybody got it—in cyberspace, distance does not exist; everybody is in one point.

Because NCSA wanted to add shared document viewing to Collage, it set out to build a way for people to simultaneously view and annotate documents:

> We set up a team to go after document retrieval, and Dave Thompson, who was another one of our computer science undergraduate guys, found this thing called the World Wide Web and that seemed pretty cool because it wasn't just documents but hyperdocuments. So we put a team together to develop a module that would work with Collage, which became the Unix version of Mosaic. In the early versions of Mosaic for X-Windows, there was a "Collaborate" button that allowed the users to use Mosaic to find and display documents and images in a Collage session. Marc Andreessen and Eric Bina were the two Unix developers, and then we gradually developed Mac and Windows because by then, DOS had gone to Windows. The Mosaic browser module was dislodged from Collage and just became its own separate product.

In a sense, Collage was too far ahead of its time for broad adoption. While users at supercomputer centers, research labs, and leading universities had enough bandwidth and desktop computing power to handle multiuser screen-sharing sessions, the average person was lucky to have the latest "high-speed" 14,400-bps modem. The average user didn't have enough power or bandwidth to do real-time two-way synchronous collaboration, but it was possible to download and view simple webpages with a few embedded images and hyperlinks to other interesting pages.

## THE RISE OF THE WEB

NCSA Mosaic quickly became a popular stand-alone product and was ported to the Macintosh and Windows systems—again, released as freely downloadable software for noncommercial use. Robert McCool and others at NCSA also developed the NCSA webserver (httpd) and released it as freely downloadable, public domain software. The NCSA httpd software would later become the basis of the Apache 1.x webserver.

The combination of an easy-to-install-and-use browser and webserver, as well as the increasing speed of the NSFNet backbone and home Internet connections, set off a viral storm of people finding Mosaic and using the Web:

> Once you had an easy-to-use point-and-click interface to the Web, people started looking at the servers. Until then, it had been geeks looking at geeks. But when people saw how cool stuff looked when it was put on the Web, they said, "I have cooler stuff than that! I want people to see me!" So they got their copy of the NCSA webserver (httpd) and started putting their own stuff up. But then there was more stuff to look at, so there was more reason to download the viewer, which put it into this bootstrapping loop. In the end, it was all driven by narcissism—people wanted to put up their own stuff so that others could see who they were—a very strange effect.

Almost as quickly as Mosaic created a viral storm of Web adoption, the attention quickly shifted from software produced by academics to commercial Web browsers. The University of Illinois licensed various aspects of Mosaic in early 1994, and in August, the earlier NCSA spinout Spyglass negotiated the exclusive right to relicense Mosaic for commercial use:

> Soon, a lot of the Mosaic programmers went off and joined Marc Andreessen and Jim Clarke and formed Netscape. Microsoft obtained a license for Mosaic from Spyglass as did 100 other companies. Increasing commercial investment led to Internet Explorer and Netscape as the two dominant browsers in the business [in 1997].

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The University of Illinois has a long tradition of developing software within the university and allowing it to move outside the university as it becomes a commercial product. From the outset, NCSA and the University of Illinois were very clear that their mission was to innovate and advance the state of the art of computing and networking technology. They fully understood that building a commercial product adds many layers of complexity, and if they got bogged down commercializing any one product, it would consume valuable resources and shift the focus away from efforts to develop the next innovation.

The introduction of NCSA Mosaic on Unix, Macintosh, and Microsoft Windows in 1993 and 1994 seemed like an "overnight success." However, in reality, Mosaic was the result of nearly a decade of continuous investment to build software that ran across three platforms with a goal of involving as many end users in the network as possible without requiring the purchase of special high-end equipment. While NCSA provided the space and framework for the building of Mosaic, it was the drive and vision of the creative people working at NCSA, including Marc Andreessen, Eric Bina, Rob McCool, and others, that ultimately produced the Mosaic phenomenon.

In a sense, once NCSA developed Telnet, Image, and Collage, building Mosaic was the next logical step for NCSA—but the overall effort was a giant leap for mankind that has forever changed our world.

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