Shane Greenstein, **How the Internet Became Commercial: Innovation, Privatization, and the Birth of a New Network**, Princeton, NJ: Princeton University Press, 2015, 474 pp., $35.00 (hardcover).

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Shane Greenstein is a chaired professor at Harvard Business School and the cochair of its Digital Initiative. His goal in the ambitious new volume *How the Internet Became Commercial: Innovation, Privatization, and the Birth of a New Network* is to "explain how and why the Internet deployed" (p. 4) and was transformed from its origins within DARPA and then the NSF into a private commercial network that continues to touch and transform billions of lives. Greenstein supplies the best single account of the commercial development of the Internet up until 2003. To tackle the process of "innovation from the edges," Greenstein "identifies the economic archetypes, government policies, and influential institutions that shaped the growth and evolution of the commercial Internet" (p. 10). He raises—and goes a long way toward answering—a fundamental question: "How and why did the operations of economic archetypes, the adoption of government policies, and the influence of institutions encourage or discourage innovation from the edges?" (p. 442).
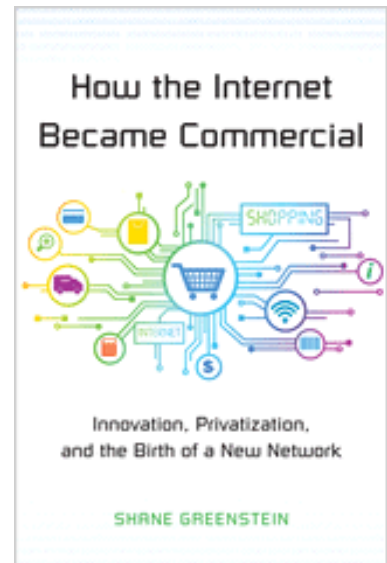
The process of commercialization was inadvertently accelerated by the divestiture of AT&T and by IBM's failure to dominate the emerging PC and wireless markets. As the NSF prepared to privatize the Internet around 1990, in the absence of a dominant U.S. telecom or computer player, the opportunity for smaller emerging firms to innovate and succeed flourished. Policy wonks and techno-nerds were delegated exceptional latitude and exercised incredible influence because they had the expertise to get things done that was often absent in government or stymied within corporate bureaucracies. Startups abounded and many of them thrived, even as others fell to the wayside.

At one level, Greenstein provides a detailed chronological history comprising a prologue (the origins) and three overlapping acts. Act I: The Transition (1990–1996) explains the transition to privatization. Act II: The Blossoming (1992–2003) explores how competing, disparate players managed to work together to foster a booming, robust takeoff of the Internet—a veritable gold rush. Act III: Exploration and Renewal (1994–2003) seeks to understand why and how some participants sustained Internet growth by eagerly jumping into the tumult surrounding the exploration, creation, and development of new commercial Internet-related services while other players stood on the sidelines.

Within this unfolding drama, Greenstein highlights the role of key individuals and institutions and the ways in which they shaped the outcome of a myriad of issues that had to be addressed for the Internet to evolve and thrive. Individuals receiving special attention include Al Gore and Representative

Rick Boucher from government, wonks like Tim Berners-Lee and David Clark, leaders and innovators such as Bill Gates, Netscape's Marc Andreessen, and Jim Clark, IBM's Lou Gerstner and Irving Wladawsky-Berger, and venture capitalists such as Tim Draper and Steve Jurvetson of DFJ. Key institutional players that receive Greenstein's scrutiny include AT&T, Microsoft, IBM, Netscape, AOL, and the National Center for Supercomputing Applications at the University of Illinois, as well as Google. But Steve Jobs and Apple are mentioned only in passing, and Facebook does not come into this story because it was founded later and will have to wait for the sequel. Among the issues assessed and discussed by the author are domain name assignment, network interconnection efforts, and the "last mile" hurdles. Also discussed are Internet architecture, computer platforms, standard protocol issues, advertising-supported commerce, and the rise of wireless access and spectrum needs.

In short, at the first level, Greenstein provides a blow-by-blow exposition on the rise and robustness that made the Internet indispensible and offers significant insight as to why the Internet evolved in the manner that it did. The spirit of business historian Arthur Chandler is smiling somewhere. This important volume admirably complements earlier exemplary works such as Janet Abbate's *Inventing the Internet* (1999) and provides a much-needed parallel to works such as James Cortada's *Before the Computer: IBM, NCR, Burroughs and Remington Rand & the Industry They Created 1865–195*6 (2000) and Steven Weber's *The Success of Open Source* (2005). But, although extremely well written, *How the Internet Became Commercial* is not beach reading material. It is much more detailed and requires more concentration than Tim Wu's *The Master Switch: The Rise and Fall of Information Empires* (2010) or Tim Berners-Lee's *Weaving the Web* (1999).

For those not riveted by the cavalcade of individuals, institutions, and issues that unfolded more than a decade ago, there is a second, more profound level of discourse in *How the Internet Became Commercial*. Greenstein is not simply telling a colorful and important story. His analysis systematically explores *why* innovation and commercialization of the Internet emerged and evolved as it did and why innovation from the edges thrived and was so important. This allows him to address the processes at work in a broad, comparative context and to escape from the trap of Internet exceptionalism.

Finally, it is worth saying that some of the greatest insights in this volume are found in the epilogue: "Enabling Innovation for the Edges." For those who tire of the detailed accounts of events before 2003, it is well worth jumping to the end to absorb the 23 pages (pp. 419–442). Indeed, journalists may well complain that he buried his lead. At its heart, the epilogue asks and then answers a critical question "Why did the privatization of the Internet . . . unleash a wide and profound set of economic outcomes as it grew into a widely used commercial network?" (p. 419). His answer, which he lays out, "involves innovation from the edges" and has important implications for future efforts to boost innovation, foster growth, and create jobs in the United States and elsewhere.

Innovation and commercialization of the Internet were shaped because a diversity of viewpoints originating in different places came together in the absence of concentrated decision-making power. There is nothing inevitable about "innovation from the edges" but various "economic archetypes" collided to generate positive outcomes. The waning of AT&T's and IBM's monopoly power and the rise of complementary, competitive markets was encouraged by a competitive core. Killer apps sometimes were

a magnet for investments and catalysts promoting adoption. Co-invention, network effects, efforts at platform governance, and creative destruction all moved the process of innovation and commercialization forward.

Greenstein notes "the symbiosis between several coordinated efforts—in particular the design of standards—and the emergence of innovation from the edges" (p. 429). He was surprised to observe "the lack of coordination behind creative destruction . . . no invisible hand guaranteed that market events would result in creative or destructive outcomes (p. 430). A third surprise the author noted was low frictions encouraged innovation because it enabled learning when the direction of development was unclear. More specifically, the nonmonetary costs of designing and setting up procedures and of executing the processes needed to deliver services to users were less onerous than predicted.

The author also points out that the important role government played in shaping the evolution of the Internet is often ignored or mischaracterized. He concludes that "innovation from the edges emerged under the encouragement of several institutions embedded in U.S. commercial markets and government policy conversations" (p. 439).

Finally, Greenstein also credits the important role a number of influential institutions played in the Internet's growth and expansion, including the democratization of standards development fostered by TCP/IP that was incubated in DARPA and the insistence on transparency of processes and independent decision making emanating from bodies such as the Internet Engineering Task Force (IETF), the World Wide Web Consortium, and others. Everything came together to make impatient entrepreneurship and innovation the new normal.

References

Abbate, J. (1999). *Inventing the Internet.* Cambridge, MA: MIT Press.

Berners-Lee, T. (1999). *Weaving the Web: The original design and ultimate destiny of the World Wide Web.* New York, NY: HarperBusiness.

Cortada, J. (2000). *Before the computer: IBM, NCR, Burroughs and Remington Rand & the industry they created 1865–195*6. Princeton, NJ: Princeton University Press.

Weber, S. (2005). *The success of open source.* Cambridge, MA: Harvard University Press.

Wu, T. (2010). *The master switch: The rise and fall of information empires.* New York, NY: Knopf.