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Fenwick McKelvey, **Internet Daemons: Digital Communications Possessed**, Minneapolis, MN: University of Minnesota Press, 2018, 336 pp., $112.00 (hardcover), $28.00 (paperback).

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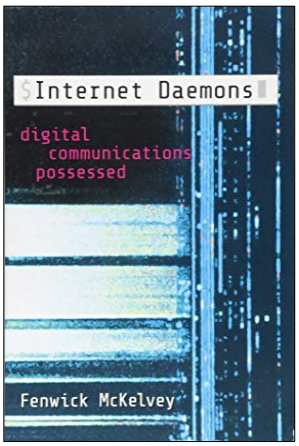

Who rules the Internet? Popular wisdom claims it is the big tech firms. For author Fenwick McKelvey, it is Internet daemons: computer programs that run in the background and thus are not "visible" or in the direct control of the user, but which are essential for the performance of various functions. McKelvey provides a well-researched and authoritative account of the history and theory of Internet daemons, and related policy responses. ***Internet Daemons: Digital Communications Possessed*** is a fascinating read, though it assumes that the reader possesses a certain technical knowledge about the Internet.

The book concentrates on daemons responsible for data flows, those that ensure that every packet and every message reach their recipients. The question that McKelvey sets out to answer is this: "How these daemons control the Internet" (p. 4).

The book starts with the eMule story, a peer-to-peer (P2P) file-sharing application popular in the 2000s, where users were trying to find out why downloads and uploads were slow. User-generated investigations revealed that Comcast was throttling eMule and that it was not the only ISP doing so nor was eMule the only P2P network affected. McKelvey's book examines such typically "unannounced" changes in bandwidth management, changes that are "obscured by technical layers and buried deep within the infrastructures of these ISPs" (p. 3). This is the work of daemons.

The book is organized into seven main chapters. Chapter 1 delves into the history of the concept: Maxwell's demon (an imaginary mechanism working in the background sorting out gas molecules) and its centrality in cyborg sciences. This thought experiment inspired the infrastructures of early computing. Computer scientists working at MIT evolved demons from concept to reality, and the spelling changed from "demons" to "daemons" to indicate this. Working constantly in the background, daemons perform system choices and assume control functions. McKelvey explains that mechanisms of control "are more suggestive than deterministic"; they create "conditions of possibility rather than constrictions" (p. 40). The outcome of control is not a fixed state but a volatile "optimal" state.

Chapter 2 examines the history of packet switching and the work of daemons. In these early computer network days, at issue was the interconnection of different computer systems and daemons were to manage precisely that, thus paving the way for what we now call a network of networks. Researchers built the first daemons, the Interface Message Processors, an integral component of the architecture of ARPANET in the late 1960s. They decided against central control and advanced distributed solutions. Daemons were left to figure out the optimal (best) way to transmit traffic and for different networks to share

a common infrastructure, the crux of the network neutrality debate. As the size and complexity of the Internet have grown ever since, so have the intelligence and significance of daemons. Daemons are now ubiquitous, running on interfaces, switches, hubs, routers, gateways, and so on. For McKelvey, "The Internet is now an infrastructure possessed" (p. 67).

Chapter 3 examines the evolution and growing complexity of packet switching and computer networking, highlighting the new and more demanding roles that daemons have been called upon to fulfill. The Internet brings together many diverse computer networks, but despite running on a common infrastructure, these networks have different values, cultures, and priorities. As a result, the work of daemons has become more challenging. Not only do they have to accommodate these diverse networks, but, in addition, they have to find an optimal way to manage them.

Daemons are now omnipresent—what McKelvey, borrowing from computer science, calls in chapter 4 "pandemonium." The term encapsulates how daemons make the Internet function, handling tasks such as packet switching, queuing, routing, and policy management. Daemons, enjoying a certain degree of autonomy, "orchestrate" flow control. They manage bandwidth capacity and prioritize traffic. McKelvey examines two kinds of optimization: *nonsynchronous* (unmanaged) and *polychronous* (managed). Nonsynchronous optimization draws on the end-to-end principle. Daemons working at the edges, not the core, of the network take the key decisions about transmission. While this optimization tries to accommodate all kinds of networks, there is no obligation to treat all the different networks well. This arrangement results in unpredictability, as it is not clear how different networks share infrastructural resources.

In contrast, the second type of optimization replaces "best effort" by "reasonable management" of infrastructural resources (p. 115). Polychronous optimization uses more daemons at the core of the network and tends to target (home) users who consume "more than their 'fair share' of bandwidth" (p. 126). McKelvey explains that:

> A polychronous optimization does not remove or block problematic [bandwidth hungry] networks. This optimization does not stop the innovation of new networks, at least not deterministically, but it incorporates them into an economy of bandwidth in which they have lower value and priority. Discrimination might not be intentional, but rather an externality of accelerating and prioritizing other users and applications. (p. 116).

With this in mind, McKelvey's subsequent discussion of Comcast's interference with P2P traffic (an example of polychromous optimization) offers a fascinating technical explanation of network neutrality, quite different from the large body of analyses of the policy and legal aspects of the issue. In doing so, the author calls for further critical political economy study of, in particular, the Internet infrastructure industry that develops daemons and, more broadly, the equipment of the Internet. Such analyses not only need to unpack financial and power relations but also hidden values and politics.

In chapter 5, McKelvey turns to the affective influence of flow control, which is managed by Internet daemons. He examines five commercials to assess how ISPs define an optimal Internet and in doing so assign to network performance (daemons) feelings, such as frustration when experiencing a slow

connection. McKelvey points out that daemons become more intelligent in the emergent future of cloud computing; IoT and AI and will continue to demand critical attention.

Chapter 6 covers the infrastructural tactics of The Pirate Bay. McKelvey explains how TPB's strategy to resist daemonic optimization moved from accelerationism to escalationism. Under the former, TPB encourages the growth and expansion of P2P networking through decentralization. Under the latter, TPB uses VPN technology that encrypts and obscures communication and thus protects privacy by allowing users to anonymously connect to the Internet and, relatedly, escapes detention and control by daemons. Accelerationism ("rapid networking") and escalationism ("dark" networks) endure online (p. 180). The author ponders whether such strategies that attempt to confuse and circumvent existing controls will result in more intelligent daemons that can provide better flow control.

Chapter 7 grapples with how the work of Internet daemons might be rendered public and how they might be governed. Using the case of the problems of traffic management (polychronous optimization) by Rogers Internet posed to the Canadian World of Warcraft gamers, the chapter documents how the public was convened bringing together those affected (the gamers) and, in turn, how this commonality turned them participants in the policy process. Given the central role of daemons, McKelvey claims that regulators "can no longer avoid studying the deep materiality of infrastructure" and that public participation—through complaints, information, and advocacy—might help the work of regulators (p. 204).

In the Conclusion, McKelvey looks forward to the future of daemons in large and complex networked operating systems and, embracing the infrastructural turn in Internet studies (e.g., Musiani et al., 2015; Sandvig, 2013), to daemons as an analytical tool to study digital media. His main contribution is to draw attention to the role that daemons play by focusing on their materiality through code and algorithms. He calls for more "daemonic media studies" research to look into and question not only the work of individual daemons but also their complex configurations and effects, and for more interdisciplinarity, computer science, and economics and also crucially other social sciences and the humanities.

McKelvey rightly argues that daemons (and infrastructural matters in general) though seemingly technical are fundamentally political and social. "The stakes of flow control are more than sending and receiving, more than faster or slower" (p. 210). Daemons matter because they affect how we communicate and participate in culture, the economy, society, and politics.

McKelvey has laid the foundations for daemonic media studies. His book establishes the centrality of daemons in Internet research and offers new ways for examining the Internet and aspects of online communication.

The book gives examples from P2P networks and gaming, but daemons can be used to combat disinformation as well as offensive, harmful, and hateful content. Indeed, Persily's (2019) study, without using the term, argues in effect for the use of daemons to deal with such content through flow control tactics such as demotion, delay, and diversion. The future of daemonic media studies is bright!

References

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