

# Demography and Decentralization: Measuring the Bulletin Board Systems of North America

[BBS](#) [Bulletin Board Systems](#) [community](#) [demography](#) [history](#) [internet](#)

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*For many home computer enthusiasts of the 1980s and 1990s, a local dial-up bulletin board system, or BBS, provided the first opportunity to get online, chat with strangers, share files, and play games. But how many is “many”? Was BBSing limited to a few elite geeks, or did it reach broader populations? Lacking any central record-keeping authority, the demography of dial-up BBSs is difficult to ascertain. To estimate the number of systems and the size of the user population, this study draws on a mix of incomplete sources. Regional lists of bulletin board systems indicate the geographic growth of the decentralized BBS network; a questionnaire circulated by the U.S. Census reveals a partial snapshot of the user population; and market statistics published in the trade press reflect its commercial expansion. In spite of their limitations, a statistical analysis of these data provides a first-order approximation of North American BBS demographics, suggesting a scale comparable to better-known contemporary systems such as ARPANET or CompuServe. Further development of this methodology will enable the production of historical demography across networks, regions, platforms, and language groups.*

Scale is both a conceptual and methodological challenge for historians of computer networks. Networks with human users are dynamic assemblages of social and technological relationships; uncertain systems living at particular historical conjunctures. We name them and write them into the singular—The WELL, FidoNet, IRC—but these networks are, by definition, multiple. Each network is composed of nodes and subnetworks, communities, clusters, channels and cliques. In order to compare the size, spread, and influence of various networks over time and space, we need common techniques of measurement. But networks of the past were diverse and their platform characteristics resist easy quantification. So, if we want to know how many people were online in the past, where do we begin to count?

For many users today, the experience of getting online is seamless and ubiquitous. Yet, the historical diffusion of networked personal computing was anything but seamless. In the US, adoption of data communications spread inconsistently across social groups and geographic regions. By early 2000, the “information superhighway” had been a matter of public concern—discussed by state leaders and featured on the covers of popular magazines—for nearly seven years but fewer than half of all American adults reported ever accessing the Internet for any reason.<sup>[1]</sup> Paradoxically, a majority of the active users (61.3%) had been online for two years or longer, reflecting the unequal distribution of access across society. Furthermore, the technical apparatus connecting personal computing devices to one another changed dramatically with the transition from dial-up to broadband networking.

This paper focuses on a period of computer networking history from roughly 1978 to 1998 (Driscoll and Paloque-Berges 2017). Archival sources refer to this period by several different names. In the late 1980s, some bulletin-board system (BBS) enthusiasts used “modem world” to describe the distributed social computing networks they had created atop the publicly switched telephone network (PSTN).<sup>[2]</sup> In the 1990s, industry researchers, policy makers, and Internet Service Providers (ISPs) began to use the term “dial-up” to distinguish PSTN access from other network media including DSL, cable, and satellite (Delfino 1994). Finally, early representations of the Internet in popular culture used vernacular terms such as “Grid,” “Matrix,” “Metaverse,” and “Net” to evoke a sense of the global information infrastructure as an uncertain assemblage of new and old media technologies.<sup>[3]</sup>

To home computer owners of this period, the Net was an archipelago; a metanetwork of diverse systems joined by improvised gateways of uncertain reliability.<sup>[4]</sup> Depending on a user’s social and geographic position relative to institutions of power, densely settled metropolises, and material resources, the Net appeared quite differently. To some users, the Net was a dial-up BBS, perhaps hosted by an acquaintance, hobby shop, or user group (Delwiche 2018; Driscoll 2016). To others, the Net was a commercial information service such as CompuServe, providing access to a rotating menu of databases, games, and communication channels. To still others, the Net was a State-run platform like Minitel, providing access to a variety of third-party services from the familiar to the mysterious (Schafer and Thierry 2012; Mailland and Driscoll 2017). Taken in aggregate, the Net was a decentralized socio-technical phenomenon, unfolding along the diverse telecom infrastructures linking cities and towns across the globe.

Decentralized networks present peculiar challenges for historical demography. Without a single point of entry, nor clear boundaries, nor overarching authority, there were no official record-keeping apparatuses for the Net. Today, there are no institutional archives to explore the vernacular Net, no single set of server logs to parse. Instead, measuring the Net is an ecological problem. Like a naturalist tagging a small number of birds to measure the migration of a flock, we must extrapolate outward from the few lingering slices and snapshots.

The purpose of this paper is to provide a partial solution to the demography challenge posed by decentralized computer networks. In particular, I propose to answer a deceptively simple question: *Approximately how many people in the United States accessed a dial-up BBS between 1978 and 1998?* This central research question invites a number of compelling and related questions. How were users and BBSs distributed geographically during this period? How did the population of dial-up BBSs reflect the larger population of the US in terms of age, gender, race, class, and education? Finally, this work provides a foundation for a demography of the modem world extending beyond the hobbyist communities of North America, enabling us to trace more precisely the influence of these early communities on the mass-scale systems of the broadband era.

## **Sources of demographic data from the early Net**

There is no comprehensive source of historical information about modem owners or BBS users. Whereas commercial online services such as CompuServe kept a single database of all of their users, every dial-up BBS maintained its own database, resulting in redundant records spread across the network. In spite of this fragmentation, the overall size and character of the BBS user population is evident in a handful of surveys published by government researchers, trade organizations, and the BBS community itself. In aggregate, these sources portray BBSing as a widespread form of networking, reaching millions of personal computer owners throughout the United States.

## The U.S. Census Bureau, 1984–1997

For the first ten years of the BBS phenomenon, from the late 1970s until the late 1980s, there appear to have been no nationwide surveys taken of bulletin board system users or operators in the United States. Beginning in 1984, the Bureau of the Census began to administer “sporadically” a supplemental questionnaire about personal computing sponsored by the National Telecommunications and Information Administration. Initially, the questionnaire did not ask about going online, but was revised in 1989 to include a set of questions about networking at home and in the workplace. In 1989 and 1993, the Census specifically asked respondents about their use of “bulletin boards,” but in 1997, the Bureau removed the question about bulletin boards and replaced it with a question about “internet” access.

The results of the Census questionnaire illustrate the relatively small scale of the early Net. In 1989, fewer than one-in-ten adults reported using a computer at home (9.3%), and among those home computer users, going online was quite uncommon (U.S. Bureau of the Census 1991: Table 5). Of the 16.8 million American adults who reported using a computer at home, approximately 5.7% reported accessing a bulletin board and 5.3% reported using electronic mail. The only specific activity to rank lower than BBSing and e-mail was “Telemarketing” (1.5%). The proportion of BBS users was relatively stable across age groups, with little variance among respondents aged 22-54 years old (5.7-6.6%) and income groups (respondents with family incomes ranging from \$10,000 to \$75,000 reported between 5.7-6.3%). Counter to a common sense assumption, perhaps, BBS use fell off among the highest income earners. Of those households earning \$75,000 per year or more, 4.8% reported accessing bulletin boards.

Sharper demographic differences in the 1989 Census data emerge, however, when we examine BBS use by race and gender. Relatively few Black home computer owners reported using bulletin boards (3.5%) or electronic mail (3.1%). Black users were, however, somewhat more likely than their White counterparts to use their computers for home businesses (12%), programming (22.4%), and video games (46.7%). Similarly, male users of all racial categories reported using bulletin boards at nearly twice the rate of female users (7.1% and 3.9%, respectively). Across the survey, the respondents reporting the greatest use of bulletin boards were single men living alone (9.2%).

Experience may have been a key factor in the reported use of bulletin boards by American adults in 1989. Between the 1984 and 1989 reports, the overall proportion of households that reported owning a PC jumped from 8.2% to 15%. Similarly, about one in five respondents indicated that they were still “learning to use” their machines, a proportion that grew inversely with the rate of bulletin board system use. It may be the case that modeming was practiced primarily among long-time PC owners. Indeed, a much greater number of respondents reported owning a modem (23%) than reported ever accessing an online service. Most modems, it seems, remained quiet.

By 1993, the prevalence of home computers and the visibility of the “information superhighway” seemed to have drawn a greater number of American adults into the online world. The number of households with a computer had grown to 16.1% and many had owned a home computer for five years or longer.<sup>[5]</sup> Additionally, the proportion of home computer owners who reported going online rose dramatically. While bulletin boards grew slightly from 5.7% to 8.7%, electronic mail grew sixfold from 5.3% to 32.2%. These trends were consistent across race and gender groups as well. Black and white computer owners now reported similar rates of bulletin board use (approximately 8.7-8.8%) and a higher than average number of Black users reported using their computers for electronic mail (35.21%). This parity was not evident across gender groups, however. Female-identified users were still nearly half as likely to report using a bulletin board (6.07%) as their male-identified peers (10.93%), a disparity reflected in the first-hand accounts of women from the period (see Horn 1998).

Table 1. Hardware Components of Home Computers (in thousands). 1989. Source: U.S. Bureau of the Census 1991: 2.

<b>Component</b>	<b>Number</b>	<b>Percent</b>
<b>All computers</b>	13,683	100.0
<b>Floppy disk drive</b>	10,137	74.1
<b>Dot matrix printer</b>	7,812	57.1
<b>Color monitor</b>	6,962	50.9
<b>Joystick/mouse control</b>	6,681	48.8
<b>Hard disk drive</b>	5,613	41.0
<b>Telephone modem</b>	3,149	23.0
<b>Laser printer</b>	1,571	11.5
<b>Plotter</b>	719	5.3
<i>Don't know</i>	<i>1,127</i>	<i>8.2</i>

### **Optimistic statistics and the trade press**

Toward the end of the 1980s, as online services attracted growing visibility and attention from home computer owners, publishers of technical books began to commission how-to guides for BBS users and administrators. The typical how-to book began with a wide-eyed overview of the modem world, highlighting the many joys and curiosities to be found in the electronic realm. A standard feature of this genre was to offer rough estimates of the number of bulletin boards in operation and the population of users one might meet online. As one author put it, “No one knows quite how many bulletin boards exist. The number involved is elusive.” (Dewey 1998) Elusive, maybe, but it did not stop him from throwing out a few numbers of his own (See: Table 2).

Table 2. Anecdotal estimates from how-to books and technical manuals.

Users	BBSs	Year	Source
—	1,500–2,000	1987	<i>The Essential Guide to Bulletin Board Systems (Dewey 1987)</i>
500,000	—	1990	<i>Using Computer Bulletin Boards (Hedtke 1990)</i>
20,000,000	60,000	1994	<i>Running a Perfect BBS (Chambers 1994)</i>
15,000,000	150,000	1994	<i>Creating Successful Bulletin Board Systems (Bryant 1994)</i>
“Several million”	60,000–200,000	1998	<i>The Essential Guide to Bulletin Board Systems, 2<sup>nd</sup> ed. (Dewey 1998)</i>

Although the authors of these books rarely cited a source for their statistics, their crude estimates are nonetheless valuable. As cheerleaders for the BBS community, these authors were motivated to exaggerate its size but their estimates needed to fall within a plausible range in order to maintain good faith with their readers. As a result, though the numbers themselves are hardly reliable as precise measures of the burgeoning BBS scene, we should assume that they reflect an upper bound of plausibility for the time of their publication. The numbers are surely inflated but not outrageously so.

In their discussions of BBS statistics, the authors of how-to books often reveal intriguing details about their perception of growth. In 1990, author John Hedtke suggested that BBSing was a particularly urban phenomenon, musing that the user population was expanding “particularly in metropolitan areas.” (Hedtke 1990, 3) Later, in 1994, Alan Bryant, author of multiple BBS books, positioned BBSs within the broader economy of online services: “one of the fastest-growing segments of the computer industry.” (Bryant 1994, xiii) Bryant also portrayed the BBS as a point of entry into a kind of secret society, “[a] huge audience of computer-smart, modem-using individuals.” (ibid.)

Consistent with the global imaginary that accompanied popular articulations of the early Net, many authors gestured at a transnational diffusion of dial-up BBSs by using ambiguous geospatial phrases like “around the world.” The authors of a characteristically giant tome

from tech publisher Que suggested that going online was “one of the primary uses for the PC [practiced by] over 20 million BBS users worldwide.” (Chambers 1994: 3) Similarly, Bryant implied that the use of BBSs in the US represented just a fraction of the overall growth, “It is estimated that more than 15 million people call BBSs each day *in the United States alone*” (Bryant 1994, xiii, emphasis mine).[\[6\]](#)

In the December 1995 issue of *Boardwatch* magazine, editor Jack Rickard set out to correct these overly-optimistic estimates with his own numbers (Rickard 1995). By this point in his career, Rickard had long promoted an integrated view of the modem world, casually slipping between “Internet” and “the Net” in his editorials, and sub-titling his magazine: “Guide to the Internet, World Wide Web and BBS.” He prefaced his quantification effort with an admonition of his industry peers: “The online community in general, and most wantonly the Internet portion of it, has a history of inflating virtually all measures of usage sufficiently to qualify as a case of ‘liar, liar, pants on fire.’” (Rickard 1995, 8) As a booster for the entrepreneurial BBS sysop, Rickard argued that accurate statistics were essential to establishing sustainable business plans and reasonable expectations among investors.

Rickard’s editorial included a useful round-up of market research statistics in circulation during the mid-1990s. First, Rickard detailed the “host count” approach to measuring internet use, highlighting a recent estimate from Mark Lottor of Network Wizards.[\[7\]](#) Lottor estimated that 6.64 million unique computers were connected to the Internet in July 1995, of which 4.25 million (64%) were located in the United States (Rickard 1995, 8-9). Rickard rejected any effort to extrapolate a human user population from Lottor’s host count on the basis that there was no reliable way to determine the number of humans per host computer. To illustrate this problem, he suggested that some estimates were based on an assumption that a single host computer might represent any number of users from 1 to 250,000.[\[8\]](#) Beyond this statistical assumption, however, the “host count” approach also failed to represent the practices of microcomputer enthusiasts who might own two or more active machines. Rickard noted, for example, that the *Boardwatch* offices were populated by 14 employees and 25 computers, a human-per-computer factor of 0.56.

Instead of host count, Rickard preferred an estimate based on a nationwide telephone survey commissioned by O’Reilly and Associates and conducted by Trish Information Systems (O’Reilly et al. 1995). The O’Reilly/Trish survey determined that 5.8 million adults in the US accessed the Internet “directly” from home, work, or school.[\[9\]](#) Of the internet users in their *WiderScreen 2-3/2020: Home Computer Cultures and Society Before the Internet Age (vol.23 no.2-3)*

sample, approximately one-half were aged 18-44 years old, one-half earned between \$35,000-\$75,000 per year, and two-thirds identified as male. By dividing the O'Reilly/Trish user population by Lottor's count of hosts in the US, Rickard argued that a reliable human-per-computer factor was likely closer to 1.37174. This line of reasoning lead him to conclude that the internet of 1995 was populated by 9,111,096 individual human beings (Rickard 1995, 64-65).

Despite the title of his magazine, Rickard did not attempt to break out the number of BBS users from the overall estimate of Internet users. [\[10\]](#) Instead, he turned his attention to the equally tricky category of commercial online services (Table 3). By comparing the marketing materials from various services to the survey results from O'Reilly/Trish, Rickard argues that the subscribership claims made by commercial online services were inflated. These numbers are additionally difficult to interpret because of how different platforms defined an "account." On Prodigy, for example, a single account might have been shared by multiple users. Conversely, highly-engaged users might have been counted more than once because of the likelihood that they subscribed to more than one service.

Table 3. Commercial service populations (in thousands).

Source: Adapted from Rickard 1995: 65.

<b>American Online</b>	3800.0	38.65%
<b>CompuServe</b>	3540.0	36.00%
<b>Prodigy</b>	1720.0	17.49%
<b>Microsoft Network</b>	200.0	2.03%
<b>Delphi</b>	125.0	1.27%
<b>eWorld</b>	115.0	1.17%
<b>Genie</b>	75.0	0.76%
<b>Mnemonics Videotex</b>	65.0	0.66%
<b>ImagiNation Network</b>	62.0	0.63%
<b>Reuters Money Net</b>	33.0	0.34%
<b>AT&amp;T Interchange</b>	25.0	0.25%
<b>Interactive Visual</b>	25.0	0.25%
<b>Digital Nation</b>	15.0	0.15%
<b>The Well</b>	12.0	0.12%
<b>Computer Sports World</b>	10.2	0.10%
<b>Multiplayer Games Network</b>	10.0	0.10%
<b>TOTAL</b>	9832.2	

Neither the nationwide surveys conducted by the Census, nor the BBS trade press provided a clear sense of the size of the BBS user population in the US during the 1980s and 1990s. Yet, each source offers some clues as to how we might proceed. While Rickard was correct to critique the “host count” method used by over-eager readers of Lottor, the BBS network represents a unique case. Nodes in the BBS network were functionally different from hosts on the Internet. Whereas internet users might jump from host to host via remote logins or Gopher, BBS users tended to stick to a few nearby systems. Therefore, the statistical relationship between BBS users and hosts should have been closer than on the internet at large.

## Modeling the BBS user population

To estimate the population of BBS users, we will analyze a database of BBS hosts. The best source of data for the population of dial-up BBSs is *The TEXTFILES.COM Historical BBS List*, an archive of BBS dial-in numbers compiled and maintained by Jason Scott since 2001. Scott originally drew these data from hundreds of BBS lists compiled by BBS enthusiasts during the 1980s and 1990s (see: <http://bbslist.textfiles.com/usbbs.html>). In the absence of central directories or search engines, BBS lists were a primary means of discovering new systems for BBS enthusiasts. Circulated in both print and electronic forms, BBS lists could be found at computer shops and swap meets, as well as online in both nationwide online services like CompuServe and on BBSs themselves. Many lists, such as Clark Gilbo's "Westcoast 813 BBS Directory," Gerry George's "Caribbean BBS List," and Charles R. Grosvener Jr.'s "Worcester Area BBS List," were organized by geographic region, reflecting the structuring force of long-distance dialing fees on North American BBS culture (George 1994; Grosvener Jr. 1995; Ziegler 1993). Other list-makers took a thematic approach, such as Tom Brown's "Ham Radio Phone BBS List" or the collectively-authored "Gay and Lesbian BBS List" (Brown 1988; Miller 1992). While BBS lists cannot provide a comprehensive account of every BBS in a region, the decentralized manner of their production reflects the decentralized structure of the BBS phenomenon, a similarity that suggests greater reliability than the centralized directories sold in bookstores (e.g. Cane 1983; Cane 1986).

According to my independent analysis,<sup>[11]</sup> the *Textfiles* archive includes 106,438 distinct BBSs grouped into 264 area codes.<sup>[12]</sup> This quantity represents BBSs that operated anywhere in North America for any length of time between 1978 and 2001. Informally, this number conforms to the anecdotal estimates published in journalistic accounts of the period. In a trade book published in 1994, for example, technical writer Markus W. Pope wrote evocatively of "tens of thousands of creative souls—BBS operators—who act as hubs, succumbing to the supply and demand of an information-hungry culture." (Pope 1994, 1) Similarly, in 1995, Gary Wolf and Michael Stein published *Aether Madness*, an irreverent "travel guide" featuring a curated sample of the "more than 50,000 BBS" dotting in the modem world (Wolf and Stein 1995, 4). And, also in 1995, San Jose *Mercury News* writer Mark Shapiro suggested that there were "over 100,000" BBSs active in the US (as quoted in Dewey 1998).

Each BBS in the archive represents an unknown number of individual users. To model this decentralized network, we need to set upper and lower bounds on the possible size of each node. At lower end of the scale, each BBS had, at minimum, one user—its sysop. It is difficult to imagine such a system staying online long enough to be added to a BBS list, however, so we might reasonably set our minimum somewhat higher than one. A plausible minimum number of users might be in the range of five to ten users—imagine a group of friends sharing software on local BBS.

For an upper bound, however, we need to return to our historical sources. Arguably the most well-documented and widely-publicized BBS in North America was The WELL in Sausalito, CA.[\[13\]](#) In Katie Hafner’s popular biography of the system, she reports a peak user population in the range of 10,000 subscribers (Hafner 2001, 164). *Boardwatch*, meanwhile, published a somewhat greater estimate of 12,000 “WELLians” (Rickard 1995, 65). For our purposes, we might take the mean of these two ballpark figures and set our maximum subscriber number at 11,000.

For the present exercise, I assume a highly-skewed distribution of users among BBS.[\[14\]](#) This assumption is supported by the first-hand accounts of former users as well as the anecdotal evidence of many other social computing systems. The limitation of Rickard’s approach to estimation was that he assumed a normal distribution of users among host computers. By seeking a single human-per-computer factor, he ignored the “rich-get-richer” phenomenon that often characterizes the distribution of resources and attention in information systems.[\[15\]](#) Instead, we should assume that a small number of BBSs attracted a massive number of users while the vast majority of systems got by with just a few regular callers.

Based on these assumptions, I estimate that approximately 2.5 million users accessed the dial-up BBSs listed in the *Textfiles* archive. I arrived at this number by modeling the entire network using a power-law distribution with a lower bound of 5 and an upper bound of 11,000. I then used a computer program to take a random sample of 106,438 values from this distribution; the simulated population of each BBS. Next, I ranked these simulated BBSs and summed their values. Finally, I repeated this simulation, resulting in a sampling distribution with a mean of 2,505,694 ( $SD=43,417.86$ ). This mean represents the estimated population of North American BBS users.

## The challenges of Net demography

The statistical model detailed above is admittedly incomplete. In the absence of ground truth, I present the estimated population of 2.5 million BBS users as a methodological provocation, an oblique strategy for thinking creatively about network demography. If we are to write persuasively about the history of personal computer networking, we need techniques that allow us to assess the scope and scale of the phenomenon. A richer, more nuanced census of the modem world would address the limitations of this first-order approximation, taking into account additional information about the social and technical characteristics of dial-up BBSing.

First, the geographic locations of each bulletin board system should play a role in any population estimate. It may be possible to use government census data about the surrounding population to estimate the number of likely callers to nearby systems. Second, in many cases, we know which BBSs were multi-line or featured high-speed modems. These platform features would have accommodated a greater number of users in a given time period, suggesting a greater overall base of subscribers. Third, we must contend with the obvious redundancies in the BBS user population. From numerous memoirs and first-hand accounts of the period, we know that only a very few BBS users dialed into just one system. Indeed, in densely populated regions, users might be active on a dozen or more systems simultaneously. How should we measure these overlapping accounts? Is it necessary to collapse them into one? Or, might an argument be made for counting each account individually?

Finally, the pursuit of precision and scale may simply be a quixotic exercise, a pleasurable diversion from the hard, messy work of oral history and archival research. The decentralized structure of the modem world may prove sufficiently resistant to population statistics that we must abandon the epistemology of macro-scale quantification altogether. Indeed, although there is a utility in knowing how many thousands or millions of people accessed BBSs at a given time and place, these statistics should support and provide context to detailed case studies of specific users and systems.

The critical outcome of this demographic work is that many—perhaps most—of the systems that populate the “long tail” of the modem world were operated and populated exclusively by white, middle-class, American men. Like the previous generation of ham radio operators, they built their systems for the intrinsic pleasure of technical mastery and a fraternal intimacy sustained by technologically-mediated communication.<sup>[16]</sup> But, as FidoNet creator Tom

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Jennings cried out 1985, “Enough tech boards already!” (Jennings 1985) The overwhelming homogeneity of the majority of BBS culture should push us to pursue the stories of systems that represent alternative glimpses of futures from the past: queer, women-only, and Black-owned board; boards aimed at connecting rural communities together; boards founded by religious sects; boards for the elderly; and boards on which people wrote in languages other than English.[\[17\]](#)

With over 100,000 bulletin board systems in the *Textfiles* archive alone, the work of net histories is only just beginning. As we explore the islands of this network archipelago, we will need to develop new techniques for shifting between micro- and macro-scale perspectives. In doing so, however, we should endeavor to represent the period with fairness and justice, acknowledging the overwhelming homogeneity while at the same time celebrating the pockets of difference, resistance, creativity, and utopian possibility.

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All links verified 16.6.2020

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## Notes

[1] The statistical claims in this section are based on data published by the Pew Research Center, specifically the "Internet/Broadband Fact Sheet," "Mobile Technology Fact Sheet," and the March 2000 survey, available for download here:

<http://www.pewinternet.org/datasets/march-2000-survey-data/>

[2] Across a number of sources, I found the term "modem" being adapted to serve new discursive purposes: as a verb ("modeming"), an adjective ("modem scene"), and a noun ("modemer"). This symbolic use of the modem reflected a growing orientation toward computer-mediated communication that Annette Markham described as a "way of being." See: Chris 1991; Driscoll 2014; Hobbs 2000; Markham 1998.

[3] Cyberpunk author John Shirley’s articulation of “the Grid” offers one of the clearest examples of the popular understanding of the internet as a collection of multiple co-joined systems rather than a single, coherent platform. Shirley’s Grid is a massive infrastructure, always changing and frequently breaking down, that includes every sort of data transmission from financial transactions and television news, to military operations and corporate espionage. See also: Shirley 2012; Stephenson 1992; Sterling 1988.

[4] For examples of cyberspace as an archipelago, see: Held 1994; Quarterman 1990.

[5] The statistics in this paragraph are based on an independent analysis of data published as “Computer Use in the United States October 1993” and available from the US Census FTP site.

[6] Bryant, *Creating Successful Bulletin Board Systems*, xiii.

[7] Lottor repeated the host count for nearly two decades. See: “ISC Domain Survey,” archived at <http://web.archive.org/web/20150524091949/http://www.isc.org:80/services/survey/>

[8] According to Rickard, the number 250,000 was based on a possibly apocryphal story about a server at IBM with one IP address and 250,000 active user accounts. See Rickard 1995: 9.

[9] The discrepancy between this figure and the results of the Center for the People and the Press survey seems to lie in the definition of “Internet.” Without access to the original report, it is difficult to discern from Rickard’s summary alone.

[10] Indeed, to do so would undermine Rickard’s assertion that the popularized/privatized Internet was the result of a widespread BBS metamorphosis.

[11] Shared with and verified by Scott.

[12] Area codes are three-digit dialing prefixes defined by the North American Numbering Plan (NANP). The Numbering Plan went into effect in 1947 and has been continuously updated by the North American Numbering Plan Administration (NANPA). Initially, area codes referred to specific geographic regions. Following the break-up of AT&T, the deregulation of telephony in the 1980s, and the growth of telematics devices such as fax machines and modems, demand for telephone numbers rose dramatically. To meet the demand, area code “splits” and “overlays” were introduced to densely-settled areas such as Houston, Los Angeles, and New York. With the emergence of mobile telephony and “number portability,” the geographic meaning of area codes is largely symbolic. See: “NANPA : North American Numbering Plan Administration – About Us,” accessed May 2, 2016, [https://www.nationalnanpa.com/about\\_us/index.html](https://www.nationalnanpa.com/about_us/index.html).

[13] One might argue that the WELL is more accurately compared to nationwide services like CompuServe but it serves our immediate purposes to place it in the BBS category.

[14] The analysis in this section uses the powerlaw Python module. See: Alstott et al. 2014.

[15] For a more detailed discussion of these phenomena from a computer science perspective, see: Easley and Kleinberg 2010.

[16] For this point, I am indebted to the histories of radio written by Susan Douglas and Kristen Haring, specifically: Douglas 1987; Haring 2003; Haring 2008.

[17] For exemplary work in this area, see: Dame-Griff 2018; Evans 2018; McKinney 2018; Rankin 2018.