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Last January, when America Online announced its plan to absorb the Time Warner media empire, *The New York Times* quoted one marveling observer as follows: "The nerds have won. This deal really validates the Internet." The comment left me thoroughly puzzled, because my own first reaction to the merger agreement had been exactly the opposite. For me the news inspired no visions of teeshirted nerds marching triumphantly through Hollywood or liberating Madison Avenue from the tyranny of suits; the nerds I imagined were gnashing their teeth at the prospect of more commercial clutter on the Web and more "portals" to the Internet that open only at the command of proprietary software. What the merger seemed to validate was the idea of the Net as virtual movie theater and shopping mall, which is not a notably nerdish vision.

Of course it all comes down to the question of who's a nerd. The commentator quoted by the *Times* was David Readerman, a San Francisco investment banker. From his point of view, the managers of America Online may well appear to be hard-core nerds. Compared with their counterparts at Time Warner, perhaps they are. America Online represents the "new media"—meaning the Internet and all its accoutrements—whereas Time Warner is (or was) a bastion of "old media"—television, film, ink-and-paper publishing.

From another point of view, however, America Online is the very antithesis of nerdishness. Veterans of the "real" Internet reserve their most withering contempt for America Online newbies, who are assumed to be technically inept as well as ignorant of all the customs and lore of the Net. In certain forums, an aol.com address brands you a "hopeless luser." (I am doubtless guilty of such snobbery myself, although I must also state for the record that I have an AOL account.) Given the company's online reputation as the last refuge of the clueless, it seems bizarre to send America Online marching forth as the standard-bearer of the nerds. When the merger plan was reported at the Slashdot Web site (whose slogan is "News for nerds"), there was certainly no victory celebration.

The rhetoric of warfare between nerds and suits can get comically overblown, as if this were some cosmic struggle between the defenders of civilization and the barbarian hordes (it's never clear which is which). In fact, if the conflict exists at all, the outcome will surely not be conquest by either side but cultural assimilation of both. America Online and the hundreds of other glittering new dot-com companies are not decimating the nerds; they're enriching them. At the same time, the influx of grad students with stock options has got to alter corporate culture. But whether the mechanism of change is war or intermarriage, the effect on the Internet is equally profound. Hence this seems to be a good occasion for reflecting on where computer networks have come from and where they might be taking us. Does the future of the Internet lie in mass entertainment and marketing, or can it also remain a medium for scholarly and scientific exchange? Is there life beyond the com domain?

Imminent Death of the Net Predicted!

Recently I submitted the phrase "Death of the Internet as we know it" to the Web search engine called Google. The top three hits were the main welcoming pages of the Netscape Corporation (now a division of America Online), of Microsoft and of Amazon.com. I have no idea what to make of this curious result. But I do know that the Internet-as-we-know-it has long been on the edge of apocalypse. "Imminent death of the Net predicted!" was already a running joke 20 years ago.

There was always a catastrophe on the horizon. The hardware infrastructure would overload and blow a fuse. The government (which paid the bills in the early days) would lose interest and pull the plug. Or else the government would take too close an interest and strangle the Net with regulations and fees. Or malefactors would bring it down with software viruses. But the hazard cited most frequently was death by boredom and exasperation. Every generation of Net newbies—even before America got Online—was accused of driving down the signal-to-noise ratio; when it reached zero, the prediction ran, everyone would finally log off and go to bed.

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The fact that the Net has survived—and indeed now exhibits extraordinarily robust health—should give pause to doomsayers. Clearly we are dealing with a highly resilient structure. But if the Net has survived challenges, it has also been transformed by them. Nothing about it remains unchanged, save a few of the most deeply entrenched software protocols. And the changes to the social context of the Net have been just as thoroughgoing as those to its technological underpinnings.

It's worth remembering that the earliest ancestor of the Internet, called the ARPANET, was not intended as a medium of communication at all—at least not communication between people. When the first few nodes were wired together around 1970, the network's primary function was providing long-distance access to computer hardware. The first "killer app" was Telnet, which allowed a research worker in Cambridge or Salt Lake City to run programs on a machine in Los Angeles or Ann Arbor. After Telnet came the file transfer protocol (FTP), which made it easier to move data from one machine to another.

Person-to-person communication was an afterthought. The first crude facilities for electronic mail evolved out of FTP in 1972 and 1973. Mail didn't get a protocol of its own until a decade later. An early ARPANET report described e-mail as "unplanned, unanticipated, and mostly unsupported" (Frank Heart *et al.*, cited in Janet Abbate's *Inventing the Internet*, page 109). E-mail caught on nonetheless, and for a time it made up the largest single category of network traffic. Software for managing mailing lists soon made mail more than a one-to-one medium. And starting in the early 1980s the Usenet news system provided another medium for online chit-chat. Eventually it became clear that the main value of the Net was not connecting people to machines but connecting people to people.

All this happened long before Tim Berners-Lee dreamed up the World Wide Web. The Internet and its institutional predecessors had already been running for two full decades, and had become the focus of a substantial community and culture, when the first Web site went on the air. That site was at the CERN physics laboratory in Geneva, where Berners-Lee had created the Web as a mechanism for sharing documents such as software user manuals. But the name he gave the project suggests that he had grander ambitions from the outset—and those ambitions have certainly been fulfilled. The Web has become truly world wide and is arguably the fastest-spreading technology in human history. At least three-fourths of all the traffic on the Internet is now Web traffic. (For many recent recruits to Net life, the Web *is* the Internet; they have never had occasion to initiate a Telnet or FTP session.)

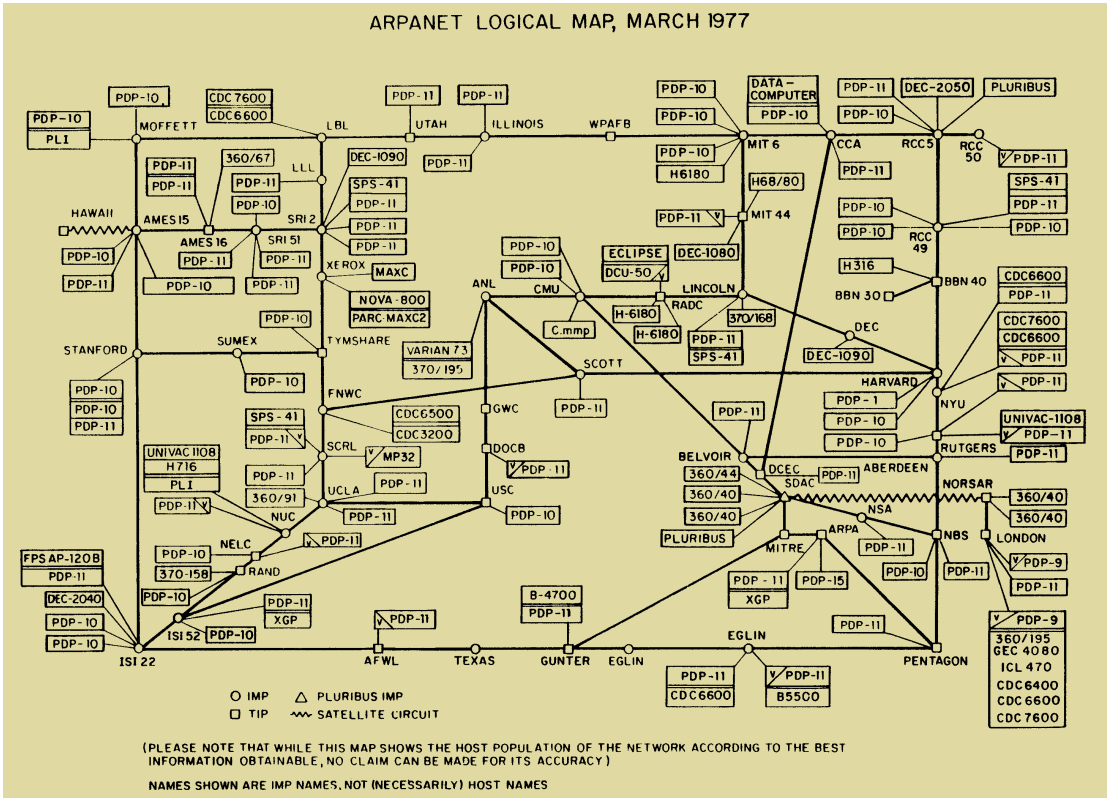

Figure 1. The ARPANET, the main predecessor of the Internet, consisted of fewer than 200 host computers at about 60 sites when this map was drawn in 1977. The topology of the entire network was still within the grasp of an individual. Most of the nodes were at universities and military bases, with just a few private-sector participants. For the modern Internet, an equivalent map would have to show 72 million hosts, most of them at commercial sites. (Illustration from Frank Heart *et al.* 1978; courtesy Larry Press, California State University, Dominguez Hills.)

At the beginning of 1970 the ARPANET was made up of just four nodes, or host machines. A decade later the number of hosts was still only about 200; a true Net weenie could know them all. But by 1990 the number of Internet hosts had grown to roughly 300,000, and in January of 2000 the host count reached 72 million. Meanwhile, in less than a decade and starting from nothing, the Web accumulated a billion documents.

Imminent Death of AOL Predicted!

If the Internet has come a long way in the past 10 years, so also has America Online. People who know the company only in its present imperial splendor may not realize just how modestly it began. AOL was launched in 1989 as a dial-up service directed exclusively to users of Apple Macintosh computers. (I was a charter subscriber.) The Macintosh community was an attractive niche at the time because other segments of the market were already occupied by better-established services such as CompuServe, The Source, Delphi, GEnie and Dialog.

America Online didn't stay in its niche for long. By carpet-bombing the country with free floppy disks (and later CD-ROMs) they signed up a million members by 1994 and added another million the next year. Their dominance of the dial-up market was unchallenged after 1998, when they acquired what was left of CompuServe, once the strongest of the rivals. The CompuServe name survives ignominiously as AOL's bargain brand.

A bigger question than how AOL overtook its competitors is how it has managed to survive—and thrive—in the era of the Web. Five years ago, if anyone had asked me to predict the fate of America Online, I would have answered with total confidence: Doom and oblivion. (So much for *my* business acumen. Look elsewhere for your stock tips.) It seemed obvious that none of the proprietary services could hold out against the momentum of the Internet, which opened up a garden of collective riches that no single organization could ever duplicate. America Online offered its subscribers an encyclopedia, but the Internet plugged you into all the world's universities and laboratories.

What I overlooked, of course, was the possibility that AOL could *become* the Internet. By simply linking its own private servers to the wider network, it offered subscribers both a familiar, protected environment and an opportunity to explore more widely—the encyclopedia *plus* the university. Nerds may sneer, but AOL has become the largest Internet service provider, with more than 20 million customers, an order of magnitude bigger than its nearest competitor. The merger with Time Warner (itself the product of several mergers) will make the new company a formidable organization by any standard. At the time of the merger announcement, AOL Time Warner was expected to become the fourth-largest corporation in the world, as measured by the total value of outstanding stock.

The idea that an upstart company such as AOL could come to overshadow all the stalwart industrial giants of a century ago—General Motors and AT&T and the remnants of Standard Oil—is disorienting. Seeing AOL become the pre-eminent Internet company gives me an even dizzier sensation of the world turned topsy turvy. I must reach for a literary analogy. In Marcel Proust's vast novel *A La Recherche du Temps Perdu*, the Verdurin family are introduced as tasteless *nouveaux riches* so ignorant of Parisian society that they don't even realize they are outcasts, snubbed by such luminaries as the Guermantes family. One of the novel's big jokes—you have to wait 3,000 pages for the punchline—is that Madame Verdurin winds up presiding over the capital's most exclusive salon; and, through the magic of remarriage, she is transformed into Princesse de Guermantes. AOL's trajectory is no less astonishing.

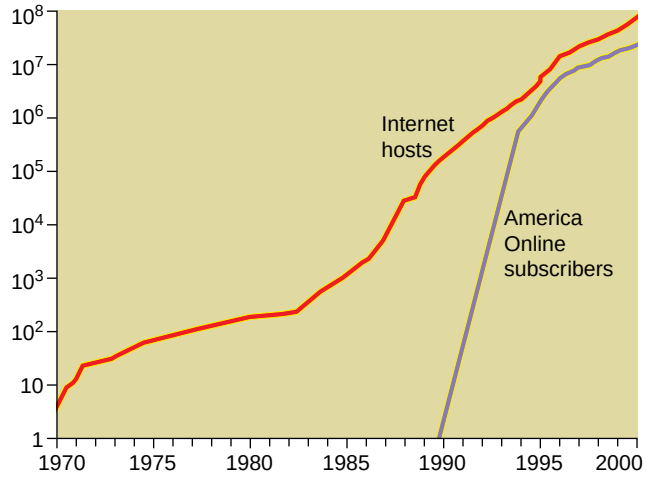

Figure 2. Growth in the number of networked computers *(red)* **accelerated in the 1980s, following adoption of the TCP/IP protocols at the heart of the modern Internet. AOL's growth** *(blue)* **has been even steeper. (The two graphs are not strictly comparable, since they measure the Internet by host numbers and AOL by subscribers.)**

Information Wants To Be Free!

Having large corporations hold the deed to a major tract of cyberspace cannot help but change the nature of the Internet. But cultural change was already under way when America Online arrived.

Histories of the early Internet and Usenet describe a community suffused by a distinctive ethos—an improbable mixture of the Wild West and the Peace Corps. On the one hand, the people who built the Net were fiercely competitive; these were gunslinger programmers who wanted to notch up a reputation for writing the best code on the planet. At the same time, the whole enterprise depended on cooperation and a spirit of volunteerism. The supreme achievement, and the way to win your colleagues' admiration, was to build something that others found useful. The community was held together by shared goals and values; for example, network bandwidth was treated as a public trust to be conserved. And even though many of the ARPANET pioneers

were subject to the Pentagon's chain of command, there was a powerful streak of antiauthoritarian sentiment. The group's governance was based on "rough consensus and working code." (It remains to be seen whether the same model of government will work for the larger, international bodies that now control parts of the Internet.)

Hacker culture is not extinct. Code-slingers still exist. No doubt some of them work for America Online. A good place to find them in large numbers is at meetings of the North American Network Operators Group, the only trade convention I know where the seats in the auditorium are wired for Ethernet, so that attendees can plug in their laptops and remain online throughout the proceedings. But this inner circle of Net intelligentsia is unknown and invisible to most of us. Far more conspicuous are the new barons of e-commerce, the dot-com billionaires.

Ironically, in the *ancien régime* of the Net, the one forbidden activity was free enterprise. Politics and sex were never much of a problem. Even though the wires belonged to the Pentagon, you could post antiwar rants and no one would murmur disapproval. Advertising a Tupperware party, on the other hand, would elicit a torrent of abuse. Ten years ago, my own Net access came with a stern warning that the network "shall not be used for commercial purposes.... Advertising of commercial offerings is forbidden." What a difference a decade makes! (The company imposing this policy was Advanced Network Systems, since acquired by America Online.)

That commerce has finally come to the Internet is no great surprise. Why should this one corner of modern life be any more fastidious than college athletics, electoral politics or public television? But the pace of the transformation has been breathtaking. As recently as 1994 the most populous domain of the Internet was still edu, the area reserved for universities and other institutions of higher education. Today com sites outnumber edu hosts by four to one. A survey of Web servers, conducted by the Inktomi Corporation and the NEC Research Center, shows an even stronger commercial presence. Almost 55 percent of all Web servers are in the com domain, with fewer than 7 percent in edu.

Yet even as business has come to dominate the Net, the Net has put its own curious twist on the practice of making money. "Information wants to be free" is a slogan that will not go away; in any case, information is something that few will pay for on the Internet. So entrepreneurs have embraced the idea of giving things away for nothing, and they've turned it into a business plan. Netscape was the leader here, when it decided not to charge for its Web-browser software. Other companies have taken the principle much further. They will give you free Internet access or free e-mail or even a free computer if you will agree to look at a stream of advertisements. Some of the ads may promote other products you can have for free if you're willing to look at still more ads. Where does it end? Where does actual money change hands? Perhaps in the stock market, where you can buy the shares of prosperous companies that have no source of revenue.

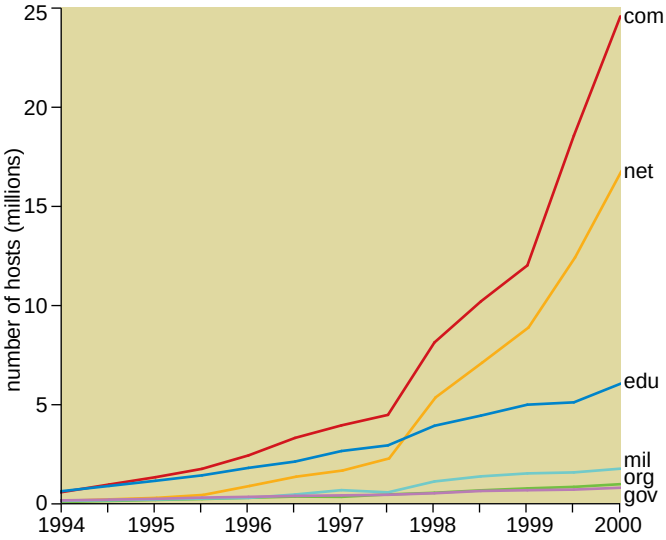

Figure 3. Commercialization of the Internet is reflected in the shifting populations of top-level domains. Sites in the edu, mil, org and gov domains, mostly owned by not-for-profit organizations, have not matched the growth of the com domain, where most companies do business. The net domain, used primarily by Internet service providers, has also expanded rapidly. (Source: Internet Software Consortium, http://www.isc.org/)

100 Million Channels and Nothing to Watch

In sentimental moments, the commercialization of the Internet is something I'm inclined to lament, but the bottom-line truth is that I would not willingly return to the age of precommercial innocence. I am too much the beneficiary of all that private investment. It's the culture of buying and selling that has brought a critical mass of people to the Net and has paid for the expansion of bandwidth and the development of new hardware and software. Even if you never order a book from Amazon.com, the infrastructure built to support Net commerce helps bring you access to library catalogues and archives of e-prints. Scholarship, research, education, art and all those other economically marginal activities get a free ride on the Doubleclick highway.

So I do not foresee the imminent death of the Internet from an overdose of marketing. But a secondary effect does worry me. The most characteristic elements of the early Net—mailing lists and news groups—were participatory entertainments, like storytelling around the campfire. Although there were "lurkers" who listened in without contributing, self-expression was encouraged. Anyone could be a producer as well as a consumer of Net content. In principle, the Web also allows such symmetrical, many-to-many interactions, but I'm not sure the tradition can be sustained. To explain my concern, I would point to the fate of another communications technology: radio.

Like computing and networking, radio began as a subject of scientific research (by Maxwell and Hertz) and then entered a phase of intensive engineering (Marconi and others). In the early years of the 20th century it became a playground for hobbyists and tinkerers. Anyone with sufficient interest and the technical know-how could get on the air, both transmitting and receiving. There was no licensing or regulation, apart from the self-imposed protocols agreed to by the community of enthusiasts. Then commercial exploitation began, first in niche markets, such as ship-to-shore communication, and later reaching a broader audience. In the 1920s, radio finally burst upon the daily lives of the general public. With commercial sponsorship and advertising, it became big business. The resulting investment of professional engineering resources produced technological leaps: Within a few years you could buy a ready-made radio receiver much better than anything the hobbyists could have assembled, and at a much lower price. But the amateurs lost control of their playground; they were exiled to a few outlying regions of the spectrum, while the best spots were reserved for commercial broadcasters. In the broadcasting era, radio became a one-way medium: Anyone could listen, but only an elite few got to speak. When television came along, it inherited the same one-to-many architecture.

I am not the first to suggest a parallel between the early history of radio and the recent evolution of computing and the Internet. (Eszter Hargittai has written at length on the subject, and it was also mentioned in the Slashdot discussion of the AOL–Time Warner merger.) A counterargument objects that the analogy is defective and misleading. Radio had to be regulated, the argument goes, only because the electromagnetic spectrum is a scarce resource; on the Internet, in contrast, bandwidth is essentially unlimited. Also, the equipment needed to produce high-quality audio and video is expensive, but anyone with a PC can make a Web page. On the Internet, therefore, we will all be free to create as well as consume.

It's a reassuring thought, but I remain uneasy. I would note that cable and satellite distribution have expanded the bandwidth available to broadcasters, yet television programming is hardly more diverse. And video equipment is now within reach of the serious amateur, but that hasn't made much difference either. You can produce your own television program, and you can probably even get someone to show it (on a "public access" cable channel); what you can seldom do is get anyone to *watch* it. The large media companies dominate broadcasting not because they have a monopoly on the spectrum or on the means of production but because they control access to the audience. What they have is marketing power.

In the early years, the Internet and the Web were a mass-media vacuum, filled with signals that would never have survived in competition with Time Warner. When I first wrote about the Web for this magazine, in 1994, there were fewer than 10,000 Web servers worldwide, and even amateurish productions attracted notice. I gleefully reported the discovery of Internet-accessible Coke machines and a Web site listing the daily contents of a certain graduate student's brown-bag lunch. Those sites are not likely to be featured selections at Yahoo or Netcenter today. The era of cheap thrills is over. From now on, if you really want the world to know what's in your lunch bag, you're going to have to promote it, preferably with halftime ads during the Superbowl.

Yet I do have hope for the survival of participatory Internet culture, not so much because of the boundless bandwidth of the Net but because a computer is not a television set. The word "programming" is used in both contexts, but with radically different meanings. A computer offers options beyond merely choosing which channel to watch. In front of the tube we may sit passively, but at the computer keyboard we are accustomed to creating, participating, making, fiddling, adjusting, changing, even deleting. If we can preserve that sense of the computer screen as a canvas everyone gets to paint on, then maybe the nerds will win one yet.

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