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Chapter 10

The Structural Problems of the Internet for Cultural Policy

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When we are concerned about cultural production, we think chiefly of content. We search for more money for our artists; we seek the preservation of artifacts; we organize exhibits, outreach, and public education programs; and we encourage treatises that explain whichever fading heritage or tradition worries us. This essay argues that at the present moment, the Internet sorely needs the attention of established advocates for culture and expression. But not their concern for content.

At first blush, the Internet seems a boon to culture—it doesn't need our help; it is a great gift. From the outset the network appeared to realize Stewart Brand's (1987) mantra that "information wants to be free." Anyone with an Internet connection can both send and receive: the depressing trend that each new form of communication from antiquity to the present has allowed a smaller number of people to speak to a greater number is now finally reversed.[1] We are free from the awkward prefix "mass" that has plagued "communication" since the introduction of broadcasting (Peters 1996). In some respects, the costs of cultural production have fallen and the hoped-for diversity of voices has materialized. Any Internet user can start a blog, make a Web page, share unpublished writing, or distribute music that would not otherwise be heard. We even have before us the tantalizing prospect of digitizing the public domain and offering it in an instant, for free.[2] The Internet seems, at first glance, to deliver the whole of human creativity to us and to open avenues of expression that were formerly closed.

Yet the same structures of the Internet that grant these new ways to speak also ensure that no one will ever hear you. This new medium is not

the participatory turn in the production of culture that it seems to be. It is true that most of the Internet's users prefer a few familiar sources of information—that is, the most popular .01 percent of the Web accounts for about 50 percent of all traffic.[3] But even more important is that we can't write a ratio that is very different from .01:50 without a very different Internet. We will never hear those prophesied new voices, exercising their digital freedoms with new contributions to culture, because the Internet is designed to keep them silent. People who are concerned about cultural production are powerless because by and large they cannot see inside the Internet's design. We must address this problem, as this essay will explain by example.

A Problem: The Slashdot Effect

Let us consider a specific new voice. In a corner of the Web, nerds and geeks banded together to create what they thought might be a new form of journalism: the self-reported electronic newspaper (Baoill 2000). The newspaper existed before the professional reporter, they might have reasoned, and when reporting "news for nerds" (their motto) only the real nerds can be trusted to get the details just right.[4] They started *Slashdot* to report "news for nerds, stuff that matters"—a news service about technology, but a news service run like a bulletin board, where the reporters were readers and the readers were editors. Contributors to *Slashdot* received "points" from other readers for having interesting things to say. First-hand accounts and diverse sources were encouraged. *Slashdot*'s users trawled the Web seeking news for nerds, but as the site increased in popularity, they encountered an unexpected problem.

When *Slashdot* readers/contributors stumble upon a juicy photo, story, or comment tucked away on a personal Web server (a bona fide unconventional news source) and then share their prize on *Slashdot,* the clicks of *Slashdot* readers overwhelm the bandwidth available to the target site. That is, the act of promoting unusual content to even *Slashdot*'s modest audience causes that content to become instantly inaccessible. This phenomenon is common enough that they named it "the Slashdot effect."[5] The Web's eye, in the act of looking, destroys the object of its gaze. But this doesn't happen for the more traditional Web destinations that we visit every day.

Two Solutions to "Delivering a Better Internet"

The *New York Times* never suffers from the Slashdot effect, partly because when you click on a link to nytimes.com, your bits don't really come from New York, as will be explained. The Slashdot effect cripples Web servers because of the way that communication from one to many—broadcasting—is implemented on the Internet (or, rather, the way that it isn't). The Internet's original architecture was built so that when five computers in the same house request the home page of the *New York Times,* five identical copies of the page are sent all the way from the Web server, wherever in the world that may be, to each machine. Since we are dealing with electrons and not broadsheet, it would make more sense to send just one copy. Copying the electrons is cheap, but the bandwidth across the world is expensive. So instead of sending five duplicates around the world, a single copy could be quickly duplicated as close to the house as possible. Sending all five copies the whole distance only congests long Internet pipelines with five times more traffic than necessary.

With the *New York Times* homepage this effect might be trivial, but with the large files required by streaming multimedia the consequences are profound—today's Internet sends two (or ten or a hundred) copies when one will do because the way it delivers traffic is typically not sophisticated enough to realize that the identical requests are related. This is the reason why multimedia streaming on the Internet does not work very well, and it also explains the Slashdot effect: the network near a source of very popular content becomes overwhelmed as duplicate requests proliferate.

So far, this sounds like an arcane technical problem, at best a tangent to cultural production. But for this problem there are solutions, and then there are *solutions.* One approach proposes modifying the Internet's basic protocols to reduce the duplicate transmission of multiple streams. This solution is called "multicasting," and it is being advanced and refined in an open, deliberative process in the standards bodies of the Internet world. These proposed changes to the Internet's protocols have not yet succeeded, and the multicast backbone, or "MBONE," remains experimental (Eriksson 1994).[6] A second approach is called "content caching."[7] Like a guarded cache of pirate treasure, this approach involves employing a third party to store and copy your traffic at some intermediate point between source and destination, but as close as possible to the people that want it. The private company Akamai is the overwhelming leader in the obscure

content-caching market.[8] Content-caching systems are both proprietary and expensive.

When you request a Web page from the *New York Times,* Akamai (the *Times*'s content-caching supplier) intercepts your request. Your rough geographical location is traced—this is called geolocation. The page is then dispatched to you from a high-capacity Akamai data center as close to your computer as possible. The technology involved is a trade secret, and this service is available only to Akamai subscribers (the Akamai motto: "Delivering a better Internet"). As a result, when *Slashdot* readers repost links to mainstream news from the *New York Times,* these links never suffer from the Slashdot effect.

The Capital Requirements for Cultural Products to Be Popular

In the example above, the most important difference between the proprietary, private solution to our arcane technical problem and an open, deliberative solution is simple: who pays? Multicasting is a collective solution deep in the guts of the infrastructure—it requires each Internet user to pay for the cost of delivering content from anywhere to anywhere, though with flat-fee Internet pricing the user will never know it. Streaming and broadcasting from anywhere would simply *work.* Content caching—the solution we have today—requires the provider of content to pay for an expensive add-on service, costs that they must recoup through advertising, subscription, or some other source of revenue. Streaming and broadcasting simply work, but only from the *New York Times.*

Therefore, although the fact is unknown to most users, the present Internet requires those who produce popular content to be well capitalized. Companies pay for their own Web hosting, and at anything other than small rates of traffic they pay for the bandwidth their visitors generate. The infrastructure for popularity is available, but it is expensive. The difference between the solutions of content caching and multicasting is nothing less than the decision between an Internet where only capitalized producers of culture can be popular versus one where anyone can.

Even leaving diversity of expression aside, there are other benefits to the multicasting approach. Changing the Internet's fundamental protocols is now accomplished through a public process negotiated in international standards bodies, and the resulting solutions are published and available for free to anyone, as is the specification for the Internet's protocols.[9] This

means simply that challenging "technical" problems for the production of culture, or any human value, can be unearthed in these public documents and addressed. In contrast, proprietary solutions like content caching may function in ways that raise privacy concerns (as geolocation might), but we must guess at how these systems function by snooping: peeking at traffic, interpreting sales brochures, and reading annual reports of the companies involved.[10]

This does not mean that we should value open processes in and of themselves. There is no reason to assume that an open solution to a knotty problem of Internet architecture will be more likely to lead to freedom (or any positive normative value) in the long run than a secret solution. In fact, the present dilemma of multicasting versus content caching presents us with a case in which an open process that has produced a flawed solution. That is, our Internet architecture debates are currently open, but multicasting has not (yet) been incorporated into the Internet protocols.

Why Not the MBONE? General Problems for the Public Interest

The preceding summary may suggest a conspiracy to the conspiracy-minded. If one solution (multicasting) is so clearly beneficial, why isn't it yet the standard? One set of answers is clearly related to *process*: even if we prefer open deliberation and public results, open deliberation about complicated issues is hard work. As each new group of interested parties joins the debate about the future of the Internet, consensus becomes even more elusive. In addition, the solution becomes ever more complex to accommodate each new set of interests. Worse, even the long and contentious debates we have today may involve the wrong people. No group of advocates has stepped forward to agitate that multicasting deployment is crucial for freedom of expression; such a group of advocates does not exist because people who concern themselves with freedom of expression typically don't participate in Internet standards debates.

The second set of answers is clearly related to *incentives*: Some multicast functionality has been available in the off-the-shelf equipment used by your Internet Service Provider (ISP) for the past few years, but your provider likely has no interest in using these features. Simply put, "Receivers do not care whether they receive their . . . streams from unicast or multicast" (Diot et al. 2000, p. 81). It doesn't matter to you how the *New*

York Times arrives on your screen. It *does* matter to the sender who wishes to provide multimedia content and has no access to the *New York Times*'s expensive private content-caching supplier, and it does matter to society that successful Internet speech carries a requirement that the speaker be well capitalized. But these concerns are not immediately felt by the users that click on Web links to the *Times*. So to implement a collective solution to broadcasting on the Internet that would let anyone be a sender, we would need to secure the cooperation of the ISPs, who gain their revenue from receivers: the people that click on these links. Implementing multicasting is an additional cost for providers, but there will be no demand from users.[11]

If we had the answers to these normative problems of Internet architecture in our pocket, it would still be unclear what exactly we should do with them. These problems of process and incentive arise in a context where the Internet is thought to be free of anyone's control. In reality, the Internet is at most an uneven anarchy—aside from pockets of ungovernability, the inability of governments to regulate cyberspace has been greatly exaggerated. For instance, the Domain Name System is effectively under centralized control, and this control is a direct delegation of authority from the U.S. government, although the U.S. government hopes that this situation is perceived as a product of international cooperation (see Froomkin 2000).[12] Yet no such governmental relationship exists with Internet architecture, where a jumble of overlapping standards bodies mostly continue to operate under David Clark's credo that "We don't believe in kings, presidents, or voting. We believe in rough consensus and running code."[13]

Although this essay has focused on this problem of broadcasting on the Internet in order to illustrate the structural problems of the Internet for cultural policy, it is important to note that this problem for freedom of expression is only one problem from an infinite series. Even in the realm of the distribution of content there are many more: widespread deployment of filters and caches in firewalls by ISPs have other worrying structural effects on content.[14] Problematic biases also exist in search and directory services (Introna and Nissenbaum 2000; Rogers 2000). The phenomenal success of Google's revolutionary PageRank algorithm makes it much easier to locate the most popular Web content and much harder to locate unpopular content that uses the same words as popular content. Preferred-placement services on search engines and portals also reward capitalized content providers. Concern about the Internet's structure must

also encompass complicated overlaps between the legal and the technical.[15] The lack of any legal nondiscrimination requirement for ISPs (unlike, say, telephone companies) means that they can turn away content they disagree with. The Internet's vulnerability to some very specific forms of hacking combine with the nondiscrimination problem to make unpopular content a pariah: Aljazeera, the controversial media network of the Arab world, initially could not find a hosting provider for its English-language Internet site, in part because the site would attract hackers to any provider that hosted it.[16] The legal and technical conspire to make unpopular views a "poisoned chalice" for skittish ISPs.[17] This essay, then, is not meant to highlight the specific problem of broadcasting on the Internet but to raise the problem of a continuing series of technical decisions that need attention from people concerned about the public interest and the role of communication systems in society.

Pragmatic Steps toward the Techno-Socio-Legal

After outlining a number of obstacles that presently exist between us and the Internet we hope for, we must turn to strategy. Yes, the situation is difficult, but it is not hopeless. If we can articulate our normative goals for the Internet's development, a course of action suggests itself. Our situation is far from unprecedented and, indeed, not a surprise. As the scholarly literature on technology predicts, "technical" questions about how a particular function should be realized in technology mask assumptions, interests, and political bargains.[18] The egalitarian potential of new communication technologies like the Internet, then, is lost or gained in a series of early implementation decisions that are debated solely in technical terms, despite their political character and cultural import.

It is true that we are presently faced with a messy, semianarchic Internet that we want to change (but we aren't sure how). But the birth of the Internet was just as messy, and the early stages of other communication technologies may have been even be messier.[19] Even those who pine for the clearer jurisdictional frame of other media are remembering an imagined past.

First, the easy answer: to advance normative goals such as freedom of expression, a straightforward strategy is to continue the successful government policy of funding applied networking research projects. The projects that produced the Internet provided a development environment that

(although not neutral) at least developed standards and software under pressures that were orthogonal to the insistent and competing factions of commerce. The keystone of this policy was public ownership of the results. Investment in these protocols should be a priority for technology policy in the United States and elsewhere.

Second, and most important, the situation argues for an infrastructural cultural policy, one in which structural, technical decisions about the development of society's communication system require direct involvement by public-interest advocates charged to give voice to the voiceless. To succeed, this requires an awkward combination of technical, social, and legal expertise. It requires skilled engineers whose technical acumen is matched by an understanding of the place of technology in society and of the normative issues raised by engineering work. It requires scholars who study the political economy of communication systems but who change their research agendas to better embrace the minefield of the technical. The best current researchers have recognized this need and are moving toward a techno-socio-legal convergence, from both inside and outside of engineering (e.g., Clark et al. 2002; Shah and Kesan 2003).

Institutional structures still need to change course to encourage the fusion of this necessary triad. Foundation programs that deliver more money for our artists, the preservation of cultural artifacts, and public-education programs need to be reconsidered to include the structural problems of the Internet. A successful program of philanthropic investment to change these Internet fundamentals will provide a ten- or hundredfold return when compared to more traditional, narrowly defined giving for the purpose of cultural diversity. Similarly, rethinking educational programs as fusions of what is now found in communication, science and technology studies, law, and computer science will directly prepare a new generation of students with the skills to navigate the entangled current landscape of communication technology. Finally, academic institutions and national research councils need to encourage and recognize inter- and multidisciplinary work—not as a general good but as a collaboration across this specific gulf to face these problems.

Toward an Infrastructural Cultural Policy

The future of broadcasting on the Internet may yet be resolved in favor of diversity in cultural production: we can hope for the smooth introduc-

tion and adoption of multicasting in the Internet's core. This will render Akamai's private pay-to-speak services unnecessary, and Internet popularity will become affordable. Still, the resolution of this one problem is no answer for the larger problem for cultural policy: a communication system's "plumbing" presently seems irrelevant to people concerned about cultural production, and this must change.

It is true that attention to these problems requires an unusual combination of expertise: this situation begs people who care about culture, society, and the law to care about technology at a level of detail where few outside computer labs are comfortable. But if the history of other media is any guide, the structural decisions made in the early decades of the Internet—these decisions, made these days—have the potential to endure for years to come. After these decisions are made, it will be very costly to change our minds when we realize we are unhappy with the Internet we have built. To care usefully about the freedom of expression and the production of culture on the Internet, we must care about the "plumbing." An attention to infrastructural cultural policy may be a lot to ask, but it is the least that is required. The unsettled character of today's advanced communication systems is not our burden; it is our chance to act.

NOTES

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1. This compelling though debatable trend was expressed by Innis (1964).

2. This possibility is similar to the promise now offered by Project Gutenberg after the concept of charging for content was dropped. See http://gutenberg.net/.

3. Statistics on the concentration of Web use among a few sites are notoriously unstable. This estimate is based on data from 2001, combined from market research and academic data (Information Technology Association of America 2001; Online Computer Library Center 2001). Although the numbers given in other estimates vary, the general trend of concentrated attention is clear across a wide variety of studies and methods (e.g., Barabási, Albert, and Jeong 2002; Hindman, Tsioutsiouliklis, and Johnson 2003).

4. For the history of newspapers, objectivity, and reporters, see Schudson 1981.

5. An excellent overview of the Slashdot effect can be found in the Wikipedia. See http://www.wikipedia.org/wiki/Slashdot_effect.

6. For a history and overview of multicasting, see Almeroth 2000.

7. The content-caching market was worth about $430 million in 2001; see Vichare 2002. Participants included the private companies Akamai, Inktomi, and Cable & Wireless.

8. See http://www.akamai.com/.

9. This openness at the basic level of architecture is an often-overlooked benefit that came from the Internet's origins as a government project. The original contractor, BBN, was ordered by DARPA to make its technical specifications freely available, and the home of the early Internet in the academic culture of computer science departments promoted an openness that led to the present public "Request for Comments" system that explains the core of the Internet. For more, see Abbate 1999.

10. Closed systems also raise technical concerns. For example, how do engineers design and plan the future Internet if they cannot determine how applications and protocols will behave? In this section, however, I mean to highlight the problems for human values.

11. This is not to say that multicasting carries a fee to providers but only that the configuration and support for a new feature like multicasting entails some effort. For a discussion of this infrastructure-migration problem in the context of innovation, see David 2001 or, more generally, the economic literature on network externalities.

12. This comment does not mean to endorse the governance of the Domain Name System but simply to point out that control is centralized and effectively under the control of one government.

13. David Clark is now a Senior Research Scientist at the MIT Computer Science and Artificial Intelligence Laboratory, and he is an undisputed leader of the development of the Internet's architecture. Several versions of this comment have been attributed to him at various times, most famously in an address to the Internet Engineering Task Force.

14. This argument has been framed by others in terms of the end-to-end argument in Internet system design, but the end-to-end argument is a technical gloss further obscuring the familiar debates about mediation that occur in all communication systems, as I argue elsewhere (Sandvig, forthcoming).

15. To be fair, though, *every* example in this essay can be conceptualized as a complicated overlap between the legal and the technical. The legal components of a problem are, however, less obvious for some of the more arcane examples.

16. For instance, the provider would be vulnerable to the distributed denial of service (DDoS) attack.

17. The phrase "poisoned chalice" has been used in exactly this way in trade publications catering to ISPs (Lettice 2003).

18. See, e.g., Bijker, Hughes, and Pinch 1987; Winner 1980.

19. See, e.g., McChesney 1993.

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