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The Technical Code of the Internet/World Wide Web

Andrew J. Flanagin, Wendy Jo Maynard Farinola, and Miriam J. Metzger

□–*Using Feenberg's (1995a, 1995b) concept of the technical code of technological artifacts, this essay examines the evolution and current status of the Internet/World Wide Web. The idea of technical code—the cultural and social values and choices that become manifest in a technology's physical and structural forms—helps to isolate and uncover issues of design, usage, and policy that guide the Internet. In turn, the Internet/WWW can be seen in terms of the values, priorities, and assumptions that have literally become built into it. Based on this analysis, implications of the Internet's technical code and alternative outcomes are discussed.*

THE designs of technological artifacts are the result of a complex interaction between technical capabilities and the interests of many individuals, groups, and organizations. Technologies are recognized to result from felt social needs and current technical capabilities (MacKenzie & Wajcman, 1985) and are viewed as both the result of and impetus for social behaviors. Theoretical perspectives such as social constructivism (Bijker, Hughes, & Pinch, 1987; Bijker & Law, 1992; MacKenzie & Wajcman, 1985) and the ecology of games (Dutton, 1992; Dutton & Guthrie, 1991; Dutton & Makinen, 1987) confront this complexity head-on in their attempts to explain technological design, acknowledging that social, cultural, technical, and economic factors are interrelated and combine to form technologies.

Social constructivist views sort out the wide-ranging interests and interest groups that affect technological design by tracing the evolution of technologies over time in an effort to unmask why technologies have come to look as they are recognized today. In this manner, constructivist studies have undertaken social-historical examinations of such diverse technologies as refrigerators (Cowan, 1985), missile guidance systems (MacKenzie, 1987), the electric light (Hughes, 1985), and the bicycle (Pinch & Bijker, 1987). Similarly, the ecology of games perspective offers a "grammar for describing the system of action shaping public policy" (Dutton, 1995, p. 379) that sheds light on the dynamics of decision-making processes by identifying the multiple agendas and actions of interrelated actors (e.g., individuals or organizations). With

Andrew Flanagin and Miriam Metzger are Assistant Professors and Wendy Jo Farinola is a Doctoral Student in the Department of Communication at the University of California, Santa Barbara 93106-4020. *The authors would like to thank Andrew Feenberg for his helpful comments.*

both social constructivism and the ecology of games, the emphasis has been on uncovering the interest groups acting to construct a given technology and on making sense of the competing factors that contribute to form material technological artifacts as they have come to exist. Via historical-political analyses, such perspectives provide fruitful means by which to explore interest groups' construction of technologies.

Although sensitizing us to the notion of competing interest groups and illustrating the complex set of relations surrounding technologies, these perspectives tend not to be chiefly concerned with the *assumptions* or *values* underlying technologies or what these may reveal. A constructivist view of the automobile, for instance, might identify the groups advocating design changes and modifications in an effort to describe why cars are designed the way they are as opposed to other possibilities. However, the social and cultural values leading to these choices would not be a primary focus of the analysis. For example, while looking at the requirement of seat belts in cars, a constructivist analysis might highlight the dynamics between consumer advocacy groups, automobile manufacturers, governmental agencies, and the public. However, such a view would not explain the underlying *reasons* why consumer safety has come to be a value (over other values) worthy of consideration when designing cars, nor would it examine the implications of this. By contrast, a "technical code" perspective (Feenberg, 1995a, 1995b) serves to illuminate the values and choices that become manifest in technologies and to explore what these may imply.

Thus, by invoking a technical code perspective, this essay undertakes the task of "reverse engineering" the Internet in its current form in order to make explicit the assumptions, values, and norms that have literally been built into it. The Internet is a relatively new communication and information technology that is currently undergoing enormous growth. It appears to be at a crossroads in its development; scrutinized closely and used in a variety of ways by several different groups. The outcome of this attention will likely impact its long-term development and usage. In view of this, a critical examination of the Internet/WWW at this juncture can serve to illuminate important social and cultural choices and implications of the technology to date and can sensitize us to those ahead.

In order to establish a framework through which to view technologies such as the Internet, this essay begins by explicating the technical code perspective and examining its value as an analytical and descriptive tool. Examples are provided demonstrating the utility of the perspective. Next, an in-depth analysis of the Internet's technical code is undertaken by emphasizing facets of the technology that shed light on the social and cultural environment in which it exists. In this pursuit, a United States-centered perspective is adopted because the Internet was first conceived and developed in the U.S., as a communication system for the Department of Defense (Campbell, 1998), and because a majority of Internet users are currently located in the United States (NUA, 1999a).[1] Finally, conclusions are drawn based on this inquiry and lessons from the application of the technical code perspective are examined.

Technical Code and the Construction of Technologies

Feenberg's notion of the technical code (1995a, 1995b) can be applied to examine technological artifacts as a means of exploring the underlying assumptions literally built into them. The *technical code* describes the assumptions or social and cultural values that become manifest in technological design. Formed by economic, social, and cultural factors, technical codes thus indicate the bases on which technologies are built. According to Feenberg (1995a), economic and social interests "form a background of unexamined cultural assumptions literally designed into the technology itself. I call these assumptions the 'technical code' " (p. 87).

To illustrate, aspects of automobile design can be used to indicate its technical code which, in turn, serve to make cultural values, priorities, assumptions, and norms explicit. For instance, modern cars in the U.S. have mandatory safety features such as air bags, seat belts, and bumpers that meet certain crash standards. In addition, engines with relatively low emissions of pollutants are required by law and certain standards of fuel efficiency are met with many automobiles. These features of automobiles reveal the technical code of automobile transportation in the United States.

Specifically, air bags, seat belts, and bumpers testify to the belief that the safety of individuals operating what are inherently dangerous machines outweighs the added cost of equipping cars with these expensive devices. Through a process of public demand, legislation, and manufacturing, these safety features are now required on automobiles and reflect a collective value of ensuring the safety of individuals who ride in cars. Similarly, low emissions engines reveal the importance placed on environmental protection, and fuel efficient cars indicate that conservation and cost effectiveness are important to the buying public. Thus, social and cultural pressures result in physical arrangements of technologies that in turn accommodate social and cultural values. Overall, these features indicate a technical code of consumer safety, environmentalism, and economic priorities.

Importantly, this example illustrates that technical codes (a) change over time, (b) remain largely unnoticed until examined explicitly, and (c) often become reified in law or policy. Consider the automobile of 50 years ago. At that time, there were few required safety standards, emissions were not monitored or controlled, and fuel efficiency was not a major concern. Events such as increases in automobile use and attendant safety hazards, the oil crisis in the 1970s, and an increasingly polluted natural environment led to changes in the design of the automobile–these cultural, social, and normative priorities became built into the car. Thus, as values changed, the automobile adapted to suit them.

In addition, the assumptions that become manifest in technologies usually go unnoticed; this fact becomes clear when visiting other cultures where design differences in familiar technologies become more evident. For instance, cars manufactured in or for other countries may not have the same safety features, be of the same configuration, or have the same emissions standards, to name only a few possible variations. These differences can be indicative of regional or physical variations, cultural or economic priorities, or social norms. Whatever the source of differences, however, technical codes often become codified in laws or public policy (e.g., automobile emissions standards and various safety features) or, less formally, endure due to user demands (e.g., cars with higher fuel efficiency). Because of the interplay between social priorities and technical design, examining the forms, use, and policies surrounding technologies reveals the technical code of material artifacts. In turn, the technical code is a valuable analytical device to make social and cultural values and priorities explicit.

Although the technical codes of artifacts are always present, change, growth, and atypical events seem to draw special attention to them, prompting reevaluation of their appropriateness and fit. For example, Ralph Nader's (1965) book *Unsafe at Any Speed* revealed design flaws behind the Chevrolet *Corvair* and, more widely, an auto industry that marketed and sold cars despite knowing that they would cause completely preventable deaths. The publication of the book, and subsequent publicity directed at automobile safety, prompted landmark consumer safety legislation. The controversy caused attention to be directed to the auto industry at the level of technical code–prior to the controversy, the technical code included the assumption or norm that a certain casualty level was acceptable with automobile operation. Nader's work, however, prompted a reevaluation of the technical code of consumer safety and, ultimately, changed the form of the auto industry in the U.S.

In this way, the technical code is fundamentally *social* in that it is determined through cultural norms enacted by human interaction and collective priorities. Although technologies are material artifacts, their design is the result and reflection of social forces. Technical codes thus reflect social and cultural pressures that become manifest in technologies by influencing their design. Because of this, the process can be reversed: The current form of a technology can be deconstructed in order to understand the social and cultural values driving it.

The Utility of the Technical Code Perspective

Consideration of the technical code of technological artifacts is significant precisely because the forms of technologies *do* matter (Postman, 1992; Winner, 1986). According to Winner (1986), technological design is important in at least two ways. First, certain technologies demand particular social relations, such as attendant control and coordination mechanisms. For example, with the creation of the atomic bomb, a hierarchical chain of command was necessary in order to control its potential misuse. In this way, the very design of the technology requires attention and social reorganization. Second, technological design can itself be consequential. Winner cites the example of Robert Moses, public works builder in New York City until the 1970s, who designed parkway overpasses so low that they functionally prevented city buses from traveling to Long Island. In this way, Moses prohibited the typically lower-income bus riders from access to Long Island, perhaps enforcing Moses' own social class biases.

A third contribution of the technical code perspective is its utility in exposing subtle assumptions and values that become manifest in technologies. Feenberg's (1995b) observation that "design standards are controversial only while they are in flux" suggests that the form of technologies remains largely unnoticed except at times of controversy or redesign (p. 15). However, as already noted, the form and design of technologies are always important and, when examined, can reveal a great deal about the social and cultural environment in which they exist. Because of this, the technical code perspective draws attention to the typically unnoticed aspects of technologies and helps to sort out cultural and social priorities that alert us to the many choices that go into technologies. Knowledge of these choices enables a view of what has been done and perhaps also of what other possibilities exist.

Thus, the application of a technical code perspective to the study of technologies moves beyond a consideration of only the physical dimension of technologies by delving into the technical, social, and cultural underpinnings as well. By examining the form of technologies, considering their multidimensionality, and seeking out the set of assumptions that guide them, the technical code perspective serves to provide a more complete sense of modern technologies and may provide insight into their future development.

Technical Code of the Internet

The rapid rise of the Internet has prompted research on its social effects, cultural impacts, and communication implications. Researchers have examined Internet content (McLaughlin, 1996), policy (Kahin, 1997; McChesney, 1996), community and culture (Baym, 1995; Jones, 1995, 1997; McLaughlin, Osborne, & Ellison, 1997; Rheingold, 1993; Turkle, 1995; Wise, 1997), commercial development (Donnelly, 1996; Ho, 1997; Hoffman, Novak, & Chatterjee, 1996; Spar & Bussgang, 1996), communication structure (Jackson, 1997), and user interaction patterns and norms (Garton, Haythornthwaite, & Wellman, 1997; McLaughlin, Osborne, & Smith, 1995). Largely absent from this research, however, is an explicit consideration of the Internet's overall *form*–its current physical, social, and cultural configuration–and the *implications* of that form. An examination of the Internet's technical code can serve to address this need by providing lessons about social choices and highlighting dimensions of these choices that are not immediately apparent.

An examination of the Internet WWW's (a) technical design, (b) user data and usage patterns, and (c) formal and informal policy provides insight into its technical code and thus a better understanding of the social, economic, and cultural factors shaping it. Although other elements of the technology could be considered, these three characteristics contain the keys to its technical code, as explained below. Understanding them helps to situate the Internet among other communication technologies and technical systems, and to highlight the pressures and choices that have formed it to date as well as those that lie ahead. By looking at these dimensions of the Internet's technical code, understand its present state and gain insight into its future development.

The *design* of technologies is an important indicator of technical code insofar as it is the most evident aspect of technological form. As with Winner's (1986) example of the low overpasses that prohibited bus travel, a technology's form can have direct and far-reaching consequences. Technological design may include the physical form of the artifact (e.g., hardware or structure), social and operational procedures that define its use (e.g., software or rules of conduct), and specific features and capabilities. Broadly speaking, design features encompass the way a technology looks as well as how it works.

User data and usage patterns suggest an intimate part of the Internet's technical code. User patterns help to describe how individuals have actively appropriated the technology and, thus, define the choices that have gone into its construction (see Feenberg, 1992, 1995b; Poole & DeSanctis, 1990). From user demographics, behaviors, and decisions, aspects of cultural and social values as manifest in the technology itself may be glimpsed. Not surprisingly, users and their behaviors are perhaps the best indicator of social and cultural norms that become built into technologies.

Finally, *policies* regulating and guiding the Internet are an integral part of its technical code. Policy reflects the relatively explicit statement of technical code, although an understanding of policy is not sufficient alone to describe the complexity of an artifact's technical code. Policies can be formal, as in government regulatory law, or informal, as in culturally understood rules and procedures. Policies serve to establish, codify, and guide appropriate behavior, and provide clear evidence of technical code in their relatively explicit statement of boundary conditions.

Of course, design features, user characteristics and patterns, and policy guidelines are not mutually exclusive. Indeed, there is a large amount of overlap among these indicators of the Internet's technical code. For example, usage patterns clearly inform both technological design and policy. If users were unwilling to purchase products over the Internet, there would be no need for direct efforts to develop electronic commerce nor to regulate online consumer fraud. Similarly, without demand for pornographic materials on the Web, the Communications Decency Act of 1996 would likely not have been drafted. Though design, use, and policy interact in complex ways, considered separately they serve effectively to illustrate specific aspects of the technical code of the Internet.

Internet Design

Collectively, design features reflect the underlying values and assumptions manifest in the Internet. An examination of the Internet's key structural and operational features, its physical connectivity, data communality, interactivity, and ease of use, is therefore necessary for recognizing aspects of its technical code.

Physical connectivity. The Internet is a tremendously complex technology that is rapidly becoming widely accessible within the United States and around the world. The Internet currently enjoys a "critical mass" of users, or a segment of the population that makes use of the technology viable (Markus, 1990). However, in view of recent technological developments, universal access, or "the ability of any member of the community to reach all other members through the medium" (Markus, 1990, p. 194), is increasingly attainable.

Many technical developments contribute to this. Recently, the cost of computer hardware has declined sharply. Computing prices have enjoyed a radical drop recently and will continue to fall (*Business Week,* 1998). Simultaneously, Internet service providers (ISPs) are now readily available and relatively affordable. Today, individuals can receive home access for the approximate price of telephone service. In addition, public access computing is increasingly being underwritten and inexpensive hardware for basic access is readily available. An example of this is WebTV, which allows users to transform their television set into an Internet terminal cheaply and easily.

Data communality. Among the first practical applications of the Internet was its ability to share data between remote sites. With the electronic transfer of documents, individuals are able to quickly send original computer-produced documents reliably and with fidelity. Text, audio, and video information once shared only in a single analog geographic location is now easily transferred anywhere on the Internet quickly and easily (Mitchell, 1992). Databases of information provide users 24-hour access to diverse information such as airline flight schedules, personal credit card account information, and library catalogs, eliminating the need for information suppliers to predict precisely who might need specific information (Fulk, Flanagin, Kalman, Monge, & Ryan, 1996) while also reducing the time to access such information.

Interactivity. The Internet is designed to be interactive. The primary programming language used to author Web documents–hypertext mark-up language (HTML)–allows users to jump within and between sites on the Web quickly and easily. This structure was an integral part of the Web's design on both an applied and a conceptual level. On the applied level, the hypertext structure enables not only the sharing of information, but allows the creation of a flexible and evolving framework as opposed to the confines of a fixed system. Philosophically, the original creators of hypertext technology envisioned it as "removing the confines of linearity . . . [where] ideas may branch in several directions, and paths through these ideas are followed and created by the reader who also becomes author" (Jackson, 1997, p. 2). Thus, interactivity is built into the Internet through a dynamic system where users can switch roles, redefining themselves and the media they access. As a result, this multiple role relationship allows for a greater degree of two-way control of content than with other mass media.

Ease of use. Given the wide scope of the Internet and the multitude of key players in its generation-long development process, its intercompatibility (as opposed to proprietary models) is remarkable. Through the use of hypertext transfer protocol (HTTP), used to transfer HTML encoded documents from a content server to a Web browser, information is transferred easily and quickly to receiving computers. Web sites typically provide sophisticated graphical user interfaces with high detail graphics and simple navigation. Using traditional media graphics tools including color, shape, motion, and sound, these sites make their messages easily available to users of varying skill levels.

Although casually browsing the Internet is considered by many to be a charming element of the technology, it frustrates both the time-challenged user and commercially-minded Internet content provider. In a 1997 survey of web users, more than one sixth of respondents replied that navigation was the most important issue facing the Internet (Georgia Technology Research Corporation, 1997). To address this problem, sophisticated search engines (e.g., Yahoo!, Excite, AOL NetFind, Infoseek, and Lycos) were introduced that enable users to quickly access relevant content and provide a "road map" for traveling the information superhighway. Search engines and browsers thus make the selection of topics of general interest relatively easy, and further simplify web travel by featuring their own preferred sites. In addition, following the trends of other media (including newspapers, magazines, and television), narrowcasting has appeared on the Internet in the form of "push" technology (De Jesus, 1997).[2]

Design characteristics such as physical connectivity, data communality, interactivity, and ease of use inform the technical code because the form of a technology reflects decisions about its intended use. Trends in increased physical connectivity, coupled with greater data communality, demonstrate a technical code that features general inclusiveness and a free flow of information. Increases in the number of people connected, the ease with which connection is possible (both technologically and economically), and the large amount of information available on the Web suggest that the spirit of the Internet is inclusive, rather than exclusive, and that information is designed to be accessible rather than proprietary. Of course, it should be noted that this remains true only within certain domains–those of the literate and relatively wealthy. Nonetheless, the trend is toward more, not less, inclusiveness and information availability.

Similarly, ease of use and increased interactivity on the Internet also suggest a technical code reflecting inclusiveness and open information flow. Although the Internet/www functions as the largest international database ever constructed, connecting individuals and organizations in an enormous, dynamic data gathering and sharing network, it remains welcoming: computer "newbies," and even children can learn to use it quickly and easily. In addition, as a result of its interactive design, the Internet supports users who are simultaneously information providers as they are information consumers. This a characteristic that is relatively novel among communications media capable of reaching large numbers of people.

Overall, then, as these features demonstrate, the Internet is simultaneously a complex technical achievement as well as a relatively easy-to-use tool for communication and information sharing. Thus, the technical complexity of the Internet does not inhibit its user-friendliness. Indeed, the opposite is true. The Internet's technical complexity encourages inclusiveness and the free flow of information, fundamental aspects of its technical code, and fundamental aspects of the culture that created it.

Demographic Data and Usage Patterns

Demographic data and usage patterns are direct indicators of the Internet's technical code. By looking at who users are and how they have chosen to use the Internet, the social and cultural norms and values manifest in it become evident. Thus, an exploration of Internet demographics, how it is used to gather information and for entertainment, and trends toward commercialization shed light on the values embedded in it and the decisions that have resulted in its current use.

Demographics. In 1999 there were 92 million Internet users over the age of

16 in the United States and Canada, reflecting a 59% increase in Internet users since 1997 (CommerceNet, 2000). By mid-2000, there were an estimated 130 million total Internet users in the U.S. alone (Nielsen/NetRatings, 2000a). According to the Pew Research Center (1999), approximately 22 million people go online every day in the United States. Internet users average 5 hours and 28 minutes per week online, and total Internet usage in the United States and Canada is equivalent to the total playback of rented video tapes. Whereas recent estimates suggest that gender is almost perfectly balanced among Internet users in the U.S. (Nielsen/NetRatings, 2000b), overall fifty-eight percent of Inernet users are male and 42 percent female, and of these users 51 percent log on to the Internet at least once a day (NUA, 1998).

Information. The Internet was created and used for more than two decades by academics and government employees as a tool for transferring information. With the advent of the World Wide Web, the Internet was permanently changed from a limited access medium to a mass medium that is relied upon for widescale information delivery (Morris & Ogan, 1996). Compared to other media and interpersonal sources, including face-to-face communication, books and magazines, newspapers, television, and the telephone, the Internet has been found to be the most often used source for gathering information (Flanagin & Metzger, in press). Indeed, users report that an important function of the Web is gathering information by noting that it comprises 70% of their time spent online (Advertising Age, 1996; see also Pew Research Center, 1999). As Beacham (1995) notes, with the traditional governmental and corporate information filters removed, the Internet represents a new standard of information sharing.

Entertainment and Social Aspects. Although interpersonal communication mediated by computers was once believed to encourage anti-social behavior and inflammatory remarks due to its relative anonymity (Kiesler, Siegel, & McGuire, 1984; Siegel, Dubrovsky, Kiesler, & McGuire, 1986; Sproull & Kiesler, 1991), recent evidence indicates that with sufficient time, expectations of ongoing interaction, or a consideration of context and other social factors, users are able to share meaningful interaction (Lea, O'Shea, Fung, & Spears, 1992; Spears & Lea, 1994; Walther, 1992, 1994; Walther, Anderson, & Park, 1994) that is even believed to exceed that of face-to-face communication in some respects (Walther, 1996). Indeed, anecdotal evidence illustrates the existence of strong social norms (McLaughlin et al., 1995) and virtual communities in cyberspace (Baym, 1995; Rheingold, 1993). Thus, the Internet has become a social technology that contains mechanisms for the formation and cultivation of interpersonal relationships (McLaughlin et al., 1997; Pew Research Center, 1999). As Turkle (1995) states, "[Where] once the machine was perceived as putting you in a world apart . . . it can put you in the center of things and people" (p. 61) by helping to forge new relationships and social bonds.

An outgrowth of the Internet's interactivity is the advent of online entertainment. Prior to online computing, onscreen entertainment simply mimicked home entertainment systems such as Atari or Nintendo (e.g. one- or two-player games of Solitaire, Mario Brothers, or Tetris). Advanced online technology provides interconnectivity that enables entertainment to be faster, more detailed, content-driven, and highly interactive. Many Internet content providers employ entertainment to entice users to not only make an initial visit to their site, but to keep them coming back as well. In addition, users have taken advantage of the highly flexible Internet to play interactive games with multiple participants. For example, interactive, multi-player games can be played via the Internet 24 hours a day by diverse combinations of participants in various locations.

Commercialization. Although minor in comparison to its traditional sales counterparts, online sales via the Internet totaled more than 9 billion dollars as early as 1997 (CommerceNet Research Center, 1998). Led by Cisco Systems ($3.2 billion) and Dell Computer ($1 billion), more and more companies are negotiating the profitability of this new frontier. As the variety of goods and services available for purchase over the Internet expands, online sales similarly increase. Whereas in 1995 only 8% of Internet users in the U.S. had made a purchase online, in 1998 that number increased to 32% (Pew Research Center, 1999) with almost a quarter of new users in the first half of 1998 making online purchases (NUA, 1999b). By mid-2000, only about 16% of Internet users report that they have never shopped online (NUA, 2000). This evolution to electronic commerce is a resounding testament to the Internet's flexibility.

Widespread use of the Internet in a commercial capacity is, however, a relatively recent phenomenon. Other media, including newspapers, magazines, radio, and television, have been in international circulation for decades but cannot compare to the Internet in terms of *rate* of growth. This growth, coupled with the Internet's well-educated, affluent users, make it an ideal tool for marketing and selling goods and services. Because advertising, marketing, and selling are all highly targeted forms of persuasion, accomplished through expensive and precise research on markets and consumers, the Internet's capacity to gather and process user information makes it even more powerful. As Beniger (1996) points out, user preferences, habits, and data are easily captured, manipulated, and used to target users more precisely than ever before. Taken together, this helps to contextualize the Internet's significant commercial potential and development.

The Internet's demographics and usage patterns, its role as an information tool, its entertainment uses and social dimensions, and the recent trend toward commercial applications all point to technical code characteristics of diversity, flexibility, and decentralization. Clearly, information on the Internet is highly diverse–evident in the delivery of disparate entertainment, commercial, and social information. Flexibility characterizes the Internet's technical code as well. No other medium delivered to as many people can match the wide range of information, the many forms of delivery, and the range of users. Interestingly, though, while the range of information and activities is vast, the Internet is least diversified in its user base–Internet users tend to be white, educated, and wealthy, although other groups are increasingly represented on the Internet as well (NUA, 1998; Pew Research Center, 1999). In part, this homogeneity explains the current trend toward greater commercialization (due to the capability for targeted marketing) and the implication that, increasingly, capitalism is indicated in the technical code of the Internet. Finally, the Internet's technical code indicates a value of relative decentralization as opposed to more central, formalized means of control. Inasmuch as its various applications and uses represent several, often conflicting, personal, organizational, and commercial interests, there is little central or overt control of information content (exceptions are efforts to control access to pornography, for example) and only unobtrusive control over connectivity (such as the implementation of technical standards).

Internet Policy in the United States

The final element both informing and reflecting the technical code is Internet policy. Formal or informal policy stands as a relatively explicit statement of technical code in its expression of the decisions and boundary conditions collectively imposed on a technology. Although formal Internet regulation is in its infancy in the United States, questions regarding regulation of the new and unique technology fly through Congress and the popular press as fast as they can be conceived. Can government regulation be imposed upon a relatively unknown new technology without fundamentally altering its structure and future growth? Is protecting vulnerable Internet resources and users the government's responsibility? An overarching policy model question supersedes both of these questions—should the marketplace determine its own regulation or should the government invoke the trusteeship model of regulation and use mandates to control the Internet? Answers to these questions, arrived at by examining issues of Internet control, protected groups, and copyright, provide further insight into the Internet's technical code.

Control. Control of the Internet consists of codifying use or establishing rules of use and structure over the physical and virtual aspects of the technology. Control is exerted through both formal and informal methods. Formal methods include laws and policy statements, and informal methods consist of local and regional policy acts, and interpersonal and social normative pressures. Formal federal control of the Internet first occurred in the United States in 1996 with the Communications Decency Act, legislation established to eliminate pornographic content online. Much of the Act was subsequently declared unconstitutional by the United States Supreme Court in June of 1997 due to vagueness in its terms that called its limits to free speech into question and inhibited its enforceability.

In 1997, the federal government acted on another important issue of control—support of Internet commerce. In the U.S., all but two state governments enforce rules on companies that do business online by requiring them to charge state taxes as a form of revenue. Obviously, the virtual nature of the Internet challenges this geographic boundary-based model and has created some controversy. The federal government first spoke out in support of online global trade in June 1997 saying "we want to encourage all nations to refrain from imposing discriminatory taxes, tariffs, unnecessary regulations (and) cumbersome bureaucracies on electronic commerce" (Houston Chronicle, 1997). Indeed, in October 1998 Congress signed into law the Internet Tax Freedom Act, declaring a 3-year moratorium on Internet taxes and calling for the creation of an "advisory commission" to make recommendations to Congress regarding Internet and e-commerce tax policy (ZDNet, 1999a).

Web privacy has also been a focus of potential formal regulation. The U.S. Congress is currently considering measures designed to regulate online privacy by requiring organizations to alert web site visitors to the data being collected on them and the uses to which it is being put. A recent study, however, found that 66% of web sites currently supply privacy notices, up from only 14% in 1998 (Clausing, 1999; ZDNet, 1999b). This finding is being cited to argue that new laws in this regard are not necessary because of voluntary compliance. However, evidence also indicates that of five key privacy alert elements, only 10% of web sites currently employ all of them (ZDNet, 1999b).

Finally, an informal policy act that sparked national attention was the placement of blocking software on public library Internet access sites. Blocking software serves as an Internet content "nanny" by restricting access to sites containing pornography or other objectionable material. Although this software was originally designed for home use, public libraries have utilized it to restrict their users. A movement started by a Loudoun County, Virginia library board sparked immense controversy about the constitutionality of restricting public access under the First Amendment. Whether or not communities have the legal right to control local access has yet to be decided.

Protected groups. Not only does policy define and limit the use of media, but in specific cases policy also addresses content. Advertising is one area of traditional media content that has been regulated in two forms: rules established in the interest of children (as a protected audience) and regulation against certain types of deceptive product advertising. This regulation exists mostly for television and radio, although similar restrictions have been discussed for the Internet. Specifically, library regulation of pornography and other objectionable material is justified as a means by which to protect children. President Clinton referenced this in a 1997 statement saying "A hands-off approach to electronic commerce must not mean indifference when it comes to raising and protecting children" (Houston Chronicle, 1997). Accordingly, Clinton suggested a V-chip-like device that would be electronically implanted in computers and then used alongside a rating system such as the one currently in place for American television. More recently, the U.S. Congress passed the Children's Online Privacy Act that requires parental consent in order to collect data online from children (Center for Media Education, 1999).

Copyright. Copyright law, developed in response to questions of ownership brought on by the creation of the printing press, was developed to stop others from making copies of a given work without the author's permission. The aim of copyright law is to put a given work's marketplace value back to the author (Goldstein, 1994). The concept of "virtual property," however, has blurred the lines of authorship (and therefore copyright) because a computer creates information using digital code which can be combined and recombined in many different ways and by many different individuals. This undetectable "electrobricollage" makes the location, if not the idea, of the "original," protected work largely without basis (Mitchell, 1992). Recently, federal legislation has grappled to balance the spirit of copyright protection with the liabilities potentially incurred by ISPs and others who transfer information digitally. The Digital Millennium Copyright Act (DMCA) (S. 2037; HR 2281) was recently passed by the U. S. Congress. It provides for copyright protection while simultaneously limiting the liability of third parties who transmit electronic data. In this way, the Act fosters continued commercial growth of the Internet while also protecting rightful owners of source materials.

The delicate balance of the DMCA illustrates aspects of the Internet's technical code, as evidenced in its formal and informal policies. The Internet is formally regulated only by a voluntary membership organization (the Internet Society, or ISOC), whose purpose is to promote global information exchange through Internet technology, and a group of invited volunteers called the Internet Architecture Board (IAB) that meets to review standards and allocate resources.

Issues of the control of information, the protection of children, and copyright on the Internet have emerged as problematic. Community-based online watchdog systems, Internet "nanny" site blocking programs and local policy initiatives for the protection of children, and the introduction of legislation for the maintenance of copyright have emerged in response to these issues. All in all, these mechanisms largely preserve the Internet's freedom of information and decentralized mechanisms of control. Thus, the technical code of the Internet, as reflected in its policy, indicates that self-regulation and market-driven control are built into its form. Furthermore, existing trends indicate that attempts to regulate the Internet through heavy-handed federal mandates will likely meet with serious resistance, at least in the United States.

Lessons from a Technical Code Analysis of the Internet/WWW

Two assumptions underlie the technical code perspective. First, technologies result from complex but subtle choices made by designers, users, and others that accumulate over time. Second, because of this, by examining technologies we stand to learn about the reasons for the decisions made in constructing them, the values reflected in these choices, and their alternative forms. In the case of the Internet, what is learned from this application?

By examining design features, demographic data and usage patterns, and existing policy, we see that the technical code of the Internet reflects values and norms of inclusiveness, access to and relatively open sharing of diverse information, flexible capabilities that accommodate a variety of uses, and formal and informal policies that support decentralized control, free market economics, and freedom of speech as opposed to more strict, mandated usage rules. One conclusion to be drawn from this is that the technical code of the Internet openly reveals its predominantly *American* influence.

The fact that the Internet was developed in a democratic country is reflected in its very design, which emphasizes such democratic ideals as freedom and equality. The Internet's decentralized structure, initially built to withstand the ravages of a nuclear attack, guarantees a redundant network where information has multiple paths from point to point. It is unimaginable, for example, that the Internet could have been developed in countries such as China, where strict governmental control is exercised over communication technologies in order to control the flow of information. Designed, subsidized, and created via a joint venture between academics and the military, the Internet instead offers a technical form that encourages open communication, decentralized control, and capitalist economic arrangements. Although by no means a guarantee for them, such parameters encourage free speech and a certain free flow of information and ideas.

Tempering these freedoms, however, are a number of constraints built into the Internet, largely due to the interrelated issues of cost, physical access, and requisite skills and training. Although these access obstacles do constrain use of the Internet, for the most part they limit the range of users rather than inhibiting the scope of use by those who do enjoy access. Additional constraints, though, come from users themselves. For example, information security concerns and the increasing exploitation of the Internet for direct marketing and sales are threatening both the flexibility and decentralization of the Internet (Beniger, 1996; Hoffman et al., 1996). Commercialism may make information less available by increasing its cost and security, and privacy concerns may make information less readily or easily shared due to questionable security or a lack of trust.

Internet policy further illustrates an intriguing crossroads in ideology and regulation–although freedom of speech and information are ideals that have thus far been largely upheld in Internet communication, a trend toward increased regulation is apparent. For example, social pressures dictate policy protection of special groups that cannot protect themselves. However, the Internet's unique physical structure creates a policy obstacle of sorts making broad-based enforcement of formal policy difficult if not impossible. Where formal policy has proven ineffective (e.g., the Communications Decency Act of 1996), informal policy has been instituted, as evidenced by tools to regulate children's Internet use, for example. This tension and subsequent accommodation reveal central questions of freedom versus control.

Another key to understanding the technical code is to recognize that, as Bijker and Law (1992), put it, all technologies "*might have been otherwise*" (p. 3, emphasis in original)–that is, the current form of the Internet is but one among many possibilities. For instance, norms of inclusiveness would be constrained without the development of HTTP and intuitive graphical user interfaces because greater technical skills would be required of the typical user (as was the case, for example, with pre-Windows computer operating systems). In addition, through the coordinated efforts of developers, the Internet developed under norms of intercompatibility instead of migrating toward conflicting proprietary models. Competing proprietary models would no doubt inhibit inclusiveness and information access by establishing obstacles to the free flow of information (as was true of the competing Beta and VHS videotape formats). In addition, policy might look quite different had competing Internet models been developed because regulatory agencies would be required to establish and enforce standards and rules (e.g., agencies such as the National Association of

Broadcasters in the U.S. television industry).

A technical code analysis thus highlights core issues in American culture that are complex and often contradictory: freedom of information versus censorship, public versus private control of the technological infrastructure, and open access to information versus its commodification or protection illustrate such core struggles. Although the Internet's technical code reveals these current struggles, they are relatively recent, arising only with widespread diffusion of the technology. In its earliest form, the Internet was both less tightly controlled (i.e., there were few attempts to regulate content or other aspects of it) but also more exclusive (i.e., access was more limited, requiring higher skill, and resources). By bringing to light the contemporary social decisions embedded in the Internet, the technical code perspective exposes such dilemmas and also focuses attention on the choices and values at play in resolving them.

Conclusion and Future Implications

The goal of this essay was to examine rapidly growing Internet technologies by an application of Feenberg's (1995a, 1995b) technical code perspective. The technical code–the set of assumptions that become manifest in technologies–offers a novel view of technological development in general and of the Internet in particular. By conceptualizing the Internet as a collection of choices by designers, users, policy makers, and others, several dimensions of it become more evident: (a) the Internet's potential alternative forms and functions, (b) the reasons for its current form, and (c) the underlying values and norms that gave rise to that form. Thus, the dissection of the Internet via a technical code analysis offers a fresh understanding of the technology and of those affected by it.

Overall, the technical code of the Internet reveals values and choices that appear to foster equality and freedom of information, and a certain empowerment achieved through the ability to associate easily with others from a diversity of backgrounds and locations. Even potential threats to these freedoms such as access constraints, increasing commercial pressures, and complex regulation issues suggest that by and large the Internet is being left to develop through free market forces dictated by the demands placed on it and uses to which it is being put. Because of this, Feenberg's (1995b) call might be true that via "subversive rationalization" users can, with sufficient initiative and participation, to a large degree *choose* the values that come to reside in technologies. Indeed, as Pool (1983) claims, the potential of electronic media is monumental:

> They allow for more knowledge, easier access, and freer speech than were ever enjoyed before. They fit the practices of print. The characteristics of media shape what is done with them, so one might anticipate that these technologies of freedom will overwhelm all attempts to control them. (p. 251)

However, if the study of technologies teaches us anything, it is that technologies condition more than they determine. As Pool goes on to observe:

> Technology . . . shapes the structure of the battle, but not every outcome. While the printing press was without doubt the foundation of modern democracy, the response to the flood of publishing that it brought forth has been censorship as often as press freedom . . . the easy access, low cost, and distributed intelligence of modern means

of communication are a prime reason for hope. The democratic impulse to regulate evils, as Tocqueville warned, is ironically a reason for worry. (p. 251)

Thus, while the potential for such lofty ideals as teledemocracy exists, no outcomes are certain. Such is precisely the tension surrounding current popular debates about the existence and nature of so-called "virtual communities," for example, that might be facilitated by the Internet (see Rheingold, 1993; Stoll, 1995). Therefore, although the technical code of the Internet indicates that currently the potential for inclusive, egalitarian outcomes exists, the Internet is simultaneously a tool for mass persuasion and control (Beniger, 1996), and its future is by no means certain or predictable.

The technical code perspective provides a valuable, unique, and penetrating method of inquiry into the Internet's current form and usage. According to Jones (1999), this type of description is a worthy pursuit because, with the newness of the medium, "there is great interest in discovery and exploration of its contours" (p. 21). By examining the Internet's form, considering it as a multidimensional technology, and seeking out the set of assumptions that guide it, the technical code perspective serves to provide a more complete sense of these contours.

However, although a technical code perspective provides a means by which to make visible the choices, typically hidden, that have combined to form the Internet, the philosophical blueprint should be re-evaluated periodically in order to again make explicit the subtle yet important choices that go into its construction. Because the Internet is in its infancy, reexamination of the technical code is necessary to reveal the robustness of its current libertarian-egalitarian potential and the degree to which this potential is realized. □

Endnotes

[1]This is not to deemphasize the importance of the Internet as a *global* information and communication system. This perspective is taken in order to highlight the utility of the technical code for reflecting the assumptions and values of those who develop new technologies–in this case, largely those from the United States (and more generally from industrialized, Western European countries). In fact, a technology's country of origin itself has implications, as discussed later in this essay. Indeed, as more people from countries outside the United States use the Internet, the technical code is likely to change to reflect the wider cultural milieu in which it exists.

[2]"Push" media are contrasted to current "pull" technologies, whereby users must "pull" desired information from the World Wide Web and view it using technologies such as Internet browsers and search engines. Push technologies consist of software that automatically selects and displays Internet material based on predetermined user specifications.

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