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Technical code and the social construction of the internet

Andrew J. Flanagin
University of California, Santa Barbara, USA

Craig Flanagin
New York, New York, USA

Jon Flanagin
University of South Dakota, USA

Abstract

This article employs and extends the concept of technical code (Feenberg, 1992, 1995a, 1995b) to examine the current state of the internet. The notion of technical code – the cultural and social assumptions and values that become manifest in a technology's physical and structural forms – is invoked to examine design characteristics of the internet that, in turn, reflect and provide opportunities for important social outcomes. Overall, the internet's technical design supports interoperability and open access, while suggesting an enormous capacity for personalization and innovation. In turn, these technical features support the emergence of myriad collective social activities, resulting in a sense of individual empowerment achieved through enhanced agency. Significant countervailing forces, however, inhibit this potential. By examining the values, priorities, and assumptions that have become built into the internet, both technically and socially, the present analysis clarifies this tension and serves to frame the internet's potential at this critical time in its evolution.

Key words

internet, social construction of technology, social values, technical code

The *technical code* (Feenberg, 1992, 1995a, 1995b) describes the values or assumptions that become manifest in technological design. According to Feenberg (1995a), economic and social interests constitute 'a background of unexamined cultural assumptions

Corresponding author:
Andrew J. Flanagin, Department of Communication, University of California, Santa Barbara, CA 93106, USA.
Email: flanagin@comm.ucsb.edu

literally designed into the technology itself. I call these assumptions the "technical code'" (p. 87). A technical code analysis, therefore, reveals the underlying assumptions and choices that become built into technologies, which would otherwise remain largely obscure.

By invoking a technical code perspective, this article undertakes the task of 'reverse engineering' the internet in order to make explicit the assumptions, values, and norms that have to date been built into it. In light of its remarkably rapid development in the last decade or so, coupled with its tremendous social, cultural, and economic significance, it is particularly important to understand the internet's evolution, current form, and future potential. A technical code perspective is valuable in this pursuit (Flanagin et al., 2000) and is best re-applied periodically, particularly to technologies with dramatic impact during periods of brisk change.

The utility of the technical code perspective and the social construction of technologies

It is well understood that technical design and social values are interrelated (Abbate, 1999; Bowker et al., 1997; Friedman, 1997; Suchman, 1994). Social constructivist perspectives (Bijker et al., 1987; Bijker and Law, 1992; MacKenzie and Wajcman, 1985), for example, argue that technological design is a function of interconnected social, cultural, technical, and economic factors. Technological artifacts thus result from a complex interaction between technical capabilities and the interests and values of many individuals, groups, and organizations. In this manner, technologies reflect felt social needs and current technical capabilities (MacKenzie and Wajcman, 1985) and are both the result of and impetus for social behaviors.

Given their focus on the complex interactions among diverse interest groups and technical capabilities, such perspectives are useful in making sense of the origin and evolution of a wide range of technological artifacts. Indeed, constructivist studies address such diverse technologies as refrigerators (Cowan, 1985), missile guidance systems (MacKenzie, 1987), the electric light (Hughes, 1985), and the bicycle (Pinch and Bijker, 1987). Social-historical constructivist examinations therefore provide fruitful means by which to explore the competing factors that contribute to form material artifacts.

Nonetheless, the relation between technical properties, values, and social outcomes is often obscure. As Feenberg (1995b) notes, 'design standards are controversial only while they are in flux', suggesting that the form of technologies remains largely unnoticed except during rare times of controversy or redesign (p. 15). A technical code perspective is a powerful analytic tool because it exposes this relation by correlating technical properties with the social values leading to them or facilitated by them. In this manner it extends social constructivism by exploring the assumptions that are designed into technologies as a way to illuminate the values and choices that become manifest in them. Even if the values themselves change over time, a technical code analysis remains relevant, since values are always interpreted within a specific social and cultural context. Thus, one contribution of the technical code perspective is its utility in exposing the social and design consequences and priorities of technologies that might otherwise go unnoticed.[1]

A second contribution is the technical code perspective's emphasis on change. Because a technical code analysis accentuates the coevolution of technical and social change, it is particularly well-suited to highlight shifts in social values and priorities during periods of rapid technical change, as with the internet's swift evolution. Changing patterns of technical code elements are thus indicative of the changing priorities and values in a group or society, and as such warrant special attention.

Related to this, a third contribution of the technical code perspective is that it draws attention to possibilities that have been foreclosed. By helping to articulate the values manifest in current technologies, attention is simultaneously directed at values or assumptions that are *not* realized, via the technical possibilities that do not come to fruition. In the same way that obsolete technical artifacts and outdated social practices instruct contemporary life, technical foreclosure highlights collective priorities and decisions, past and present. As Bijker and Law (1992) note, the technologies we recognize today 'might have been otherwise' (p. 3), suggesting that current and alternative forms are both consequential in their designs and in what they imply (Postman, 1992; Winner, 1986).

Nonetheless, different, and even highly contradictory, technical forms can coexist in the same time and place. For instance, given sufficient demand and tolerance, Hummers and hybrid cars may not only coexist but both thrive in the same consumer market, in spite of their vastly different environmental and economic implications. Whatever the source or nature of differences, however, technical codes often become codified in laws or public policy (e.g. manufacturing safety standards for children's toys) or, less formally, endure due to user demands (e.g. recycled and recyclable consumer products).

Change, growth, and atypical events draw special attention to the technical codes of artifacts, prompting re-evaluation of their appropriateness and fit. For example, Ralph Nader's (1965) notorious 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 ensuing 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 largely unspoken assumption or norm that a certain casualty level was acceptable with automobile operation. Nader's work, however, can be viewed as a *technical code document* that prompted a re-evaluation of consumer safety and, ultimately, changed the form of the auto industry in the US.

Although the technical code perspective as articulated by Feenberg focuses on material technological artifacts, it can also be extended to consider social arrangements such as the structures, processes, and practices that facilitate human interaction. Doing so explicitly recognizes that technologies are physical objects as well as social practices. Working from this view of technology as both tool (e.g. artifacts such as hardware and software) and technique (e.g. procedures, practices, and social/organizational arrangements) enables a more complete view of the values and assumptions embedded in technologies. Thus, not only can underlying values and norms be extracted from material artifacts but, in the same manner, the social arrangements that constitute technologies (e.g. bureaucracy; see Beniger, 1990) also indicate particular assumptions and values.

In fact, the material and social are often inseparable. For example, the open source software movement reflects as much of a social arrangement as a technical structure: absent strong norms of reciprocity and cooperation, the tools that enable rapid, distributed information sharing could not result in viable software that is freely available, continually improved, and openly shared. Similarly, absent the means of rapid and efficient communication and information sharing, the most altruistic intentions would be unlikely to result in massively co-authored and widely available software programs. Indeed, it is the interaction between the material and social that constitutes complex technologies such as the internet.

The technical code of the Internet

A technical code analysis of the internet[2] necessarily implicates its design features, both through an explicit consideration of values solidified in the internet's structure and through reflection on the implicit values suggested by this structure. Moreover, design decisions support particular social features. In the case of the internet, for example, enhanced individual agency and a renegotiated sense of individual and collective authority are privileged. These social features, in turn, support certain types of outcomes, which would not otherwise be possible. Many of these are novel, or at least unprecedented in scope and form, and are created by the affordances stemming from the internet. In the end, however, such affordances are not unchecked: genuine social, political, and technical limits curb their potential. Overall, a technical code analysis of the internet reveals these and other related possibilities, each of which will be discussed in the following sections.

Technical code by design

Technological design is an important indicator of technical code since design features directly reflect the underlying values and assumptions manifest in a technology. Design features may include the physical form of the artifact (e.g. hardware or physical structure), social and operational procedures that define its use (e.g. software or rules of conduct), and the intersection of these. Broadly speaking, design features encompass the way a technology looks as well as how it works, both technically and socially.

Explicit values by design Design elements of the internet indicate assumptions and values that have been built into it. For example, given its military roots, values of survivability and performance, as opposed to more commercial concerns such as simplicity and consumer appeal, were initially designed into the internet's structure (Abbate, 1999). Perhaps the most important decision in designing the internet was to follow a set of network principles now called the end-to-end arguments or end-to-end structure (Saltzer et al., 1984). Many later decisions, and many of the internet's novel features, follow naturally from this early choice. The defining characteristic of an end-to-end system is that network 'intelligence' (discrimination and processing functions) exists primarily at the periphery of the network, while the network pathways remain neutral, handling all data traffic identically.

The code that implements the internet's end-to-end design at the most basic level is TCP/IP (Transmission Control Protocol/Internet Protocol), which defines the protocol for data transfer. TCP/IP provides a reliable and efficient means of transmitting information over the internet by breaking up data into manageable information 'packets', addressing them correctly, and then reassembling them upon arrival at their destination (for an account of potential internetworking alternatives to TCP/IP see Abbate, 1999; Felczak, 2007). The TCP/IP internet protocol suite is responsible for ensuring that data are delivered via the internet with fidelity and, importantly, that different physical networks share a common method of data transfer that enables their global interconnectivity. Unlike previous communication systems, the internet protocol suite is designed to be independent of the physical conduit, with the result that any network that can carry two-way data can also accommodate internet data traffic.

Other design features also inform the internet's technical code. For instance, HTML (HyperText Markup Language, the predominant programming language for the creation of web pages) and HTTP (hypertext transfer protocol, the main method used to transfer web-based information over the internet) were integral parts 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: 2). Thus, interactivity was from the start built into the internet through a dynamic system where users can switch roles and redefine themselves and the media they access (Abbate, 1999). As a result, this multiple role relationship allows for a greater degree of two-way control of content than with traditional mass media.

Given the wide scope of the internet and the multitude of key players in its generation-long development process, its interoperability (as opposed to proprietary models) is remarkable. Other technologies are by contrast developed as proprietary and have an economic incentive built into them, which increases the chances that one form will succeed at the expense of another. This stands in marked contrast to the way in which the internet has developed, with standards set industry-wide that are for the most part agreed to and followed by all.

The technical code of interconnectivity that results from these design elements is sometimes an emergent feature of users but is at other times a direct result of what Feenberg (1999) calls 'reflexive design', where designers themselves incorporate values into the technical code self-consciously (see also Srinivasan, 2007). Indeed, formal standards-making bodies such as the W3C (World Wide Web Consortium), an international consortium whose mission is to develop web standards, aim explicitly to ensure 'web interoperability' by promoting compatible web technologies that allow seamless interaction between the hardware and software used to access the web (About the W3C, 2007).

Implicit values by extension Extension of the basic data processing principle of end-to-end design has resulted in the evolution from centralized, data processing-intensive networks to the largely distributed, decentralized structure of the internet (see Abbate, 1999). With transition of information processing over time from batch processes to time-sharing devices to personal computers linked by networks, there has been a steady migration of processing power to computers that are under individuals' personal control. So-called 'peer-to-peer' technologies have leveraged this fact to provide wide-scale distributed information sharing among individuals who manage their own storage/processing devices residing at the periphery of the network. Centralized computers merely coordinate information sharing on these peripheral devices, suggesting that control and power have shifted outward, away from central control, toward individuals.

These design features privilege certain things over others, providing additional information about the internet's technical code. For example, providing information online is simpler than verifying it. Everything from personal websites to social networking sites to product ratings on Amazon constitutes a trail of one's preferences, habits, tastes, and personal information. Among other outcomes, this has resulted in new and complex difficulties in assessing the credibility of web-based information (see Metzger et al., 2003). Indeed, information provision is so simple that it has prompted novel privacy issues as well. Whereas historically the chief problem to overcome in information-sharing was how to publicize information effectively, individuals must now take affirmative steps to maintain privacy and control of their personal information. Chat rooms, bulletin boards, online groups and the like routinely archive and make available transcripts of conversational communication that until recently would have dissolved over time or not been easily locatable. Even information that was once largely geographically localized and therefore functionally unattainable by most people, such as address information residing in telephone books, is now readily available online for anyone to access.

The shift from authority to authorities: new agency for internet users

The internet's end-to-end structure has another important characteristic: It is especially well suited to *innovation* on the scale of the individual user. For example, the internet was intentionally designed in a manner that allows those with the requisite skills to program new features directly into it (Abbate, 1999). Because the network is largely indifferent to specific data content, and the information processing functions reside at the periphery of the network in the hands of interconnected users, its design suggests an enormous capacity for personalization, through customized information seeking and specific information provision facilitated by the sheer scale of users online.

Indeed, in its brief history the internet has undergone a dramatic shift in the level and nature of individual involvement. There has been a steady appreciation of the hallmark of digital media: the ability to connect to others and share information easily, quickly, and across distance. Importantly, this appreciation has bloomed in parallel to significant technical developments in both access devices (e.g. computer technologies becoming simultaneously more powerful and less expensive) and infrastructure improvements (e.g. the wide availability of broadband connections). Moreover, extensibility (i.e. software and infrastructure design that anticipates growth) suggests that innovative features and uses have been anticipated from the internet's inception. The end result has been the recognition of the power of the internet to take full advantage of its enormous scale in ways that capitalize on the diversity and knowledge of its users (see, for example, Jenkins, 2006).

Among other things, this shift toward greater individual interconnectivity, personalization, and innovation has upset traditional one-to-many models of mass communication. For example, medium-sized to mass audiences were until quite recently accessible exclusively to those who controlled the substantial centralized media apparatus necessary to reach them. Now, however, large-scale audiences up to the size of social movements as well as highly targeted, specialized audiences have been brought into range for meaningful group participation. Indeed, some argue that we may be witnessing the end of mass communication as traditionally conceived, given the substantial opportunities for targeted communication between individuals and groups of widely diverging sizes, across a variety of topics (Chaffee and Metzger, 2001).

Functionally, the emergence of viable alternatives to centrally controlled media outlets and communication venues, coupled with an appreciation and incorporation of the resources of users, signals a broader shift from an information environment in which there existed few, central, relatively inaccessible, well-known, trusted authorities to multiple, decentralized, widely accessible, emergent, competing voices. Ultimately, this shift from single authority to multiple authorities implies an enhanced perception of individual *agency*, or the capacity for individuals to act or exert power.

Internet tools, social practices, and the outcomes of enhanced agency

Related to this increased sense of agency are changes in the structure, form, and instances of collective activity that invoke internet tools in substantial ways. An enhanced sense of agency has expanded possibilities for realizing collective goals by undercutting several of the major obstacles to successful cooperative behavior. In fact, theorists have recently proposed that collective action theory itself fails to sufficiently account for current collective efforts being facilitated through the use of internet technologies (Bimber et al., 2005; Flanagin et al., 2006; Lupia and Sin, 2003).

Specifically, theories of collective action traditionally posit that individuals face a distinct decision to either 'free-ride' on the efforts of others' contributions toward some 'public good', or to contribute to the good themselves (Bimber et al., 2005). However, with public goods consisting of web-based information (e.g. databases, information repositories, and archives that become viable when information is provided by many), individuals may in fact contribute their information unintentionally, unwittingly, or even unknowingly. As mentioned earlier, internet and web technologies actually require users in many cases to take proactive steps to withhold information from public view (including everything from discussions on electronic bulletin boards to feedback offered as part of online rating activities to the identities of friends and common interests in social-networking environments). In such cases, the free-riding construct – premised on conscious and explicit decisions by users as to whether to contribute to a public good or not – is not useful in explaining the initiation and sustenance of many forms of contemporary collective behavior.

In addition, formal organizations have typically been viewed as necessary for coordinating people's collective action efforts by motivating them to make private resources publicly available and persuading them to remain involved in collective efforts despite substantial risks and potential setbacks (Bimber et al., 2005). Indeed, in many instances, formal organizations are indispensable for overcoming communicative and administrative challenges in the orchestration of efficient collective effort. Yet, instances of coordinated collective action without formal organization are increasingly common when efforts rely in various ways on internet technologies. From political advocacy efforts such as the US presidential campaign of Howard Dean in 2003 and the political action organization MoveOn.org, to self-organizing networks of 'smart mobs' that mobilize people to gather at a particular moment for a common goal on short notice (Rheingold, 2003), to the open source software development movement, the internet has enabled a diversity of collective efforts that do not fit well into traditional collective action theory.

Thus, collective action theories as traditionally formulated are most useful under conditions where information sharing boundaries are firm and comparatively impermeable, and individuals' efforts to cross them are characterized by discrete free-riding calculations in the context of high costs (Bimber et al., 2005; Flanagin et al., 2006). Formal organizations are required for collective action in circumstances where costs of information, communication, and coordination are high. Although such conditions remain important, they are no longer universal given the substantial affordances provided by the internet. When boundaries between private and public domains are permeable and easily crossed, people's negotiation of the boundary typically involves less intentionality and calculation and the formal structures designed to broker the private-to-public transition become less crucial. Indeed, such a transition may even be inadvertent, or it may involve a more fluid movement back and forth between public and private domains of interest and action. This further emphasizes individuals' reinvigorated sense of agency, given the expanded possibilities they now have for realizing their collective goals, and suggests that the technical code of the internet exhibits an enhanced sense of *empowerment*, inasmuch as internet users feel their collective efforts result in desired outcomes.

The notion of enhanced agency is also evident in current rhetoric about so-called 'web 2.0' functionality and philosophy, which is itself highly indicative of the internet's current technical code. Although there is some disagreement on its definition (O'Reilly, 2005), web 2.0 typically denotes an internet environment in which tools are used to leverage the potential contributions of a wide variety of users, each of whom is believed to contribute value in some manner to collective endeavors. Rather than seen primarily as a static information delivery platform, this view conceives of the internet as a dynamic collaborative environment in which diverse opinions, experiences, and skills can be aggregated to provide substantial resources. The essential premise is that given efficient means of information sharing and participation, collective benefits will emerge from individual contributions.

Examples of this type of wide-scale collaboration abound: For instance, 'credentialing' activity relies on peer rating of some dimension of an individual, organization, transaction, opinion, or product that is subsequently tallied to provide an omnibus rating score. A simple example is the online auction site eBay.com, which relies on its members to rate others with whom they have engaged in a transaction, in order to mitigate the considerable risk involved in financial transactions with unknown others. Credentialing thus resolves the problem of the lack of reliable, firsthand knowledge by enhancing the distribution of existing information. Other tools similarly recognize and exploit the aggregated experiences of individuals. In order to predict a range of phenomena – from movies, books, or news stories a person is likely to enjoy or find relevant to the degree to which an email message is likely to be spam – 'collaborative filtering' invokes a similarity metric, calculated from the preferences of a subgroup of like others, that is used to make recommendations to a target individual. Collaborative filtering thus serves to automate 'word-of-mouth' recommendations, tailored to a person based on his or her individual characteristics by simultaneously radically expanding and making manageable the potential pool of known others.

Further exemplifying the emergence of individual experiences and preferences are tools that promote user self-provision and self-organization of web content. For instance, the English-language version of the online encyclopedia Wikipedia currently boasts nearly 3 million user-created articles that have been judged to be nearly as accurate as well-regarded print encyclopedias, where the content is supplied solely by established experts (Giles, 2005). This collaborative resource suggests the enormous knowledge assets that reside in collectives, which until recently remained largely untapped due to insurmountable coordination costs.

What is called the 'self-organization' of web content has also burgeoned in recent years. For instance, recent online tools have begun to support a shift from taxonomies of web information, where information is organized according to a centrally-imposed relational or organizational structure, to more emergent classifications based on users' own categorization (so-called 'folksonomies', indicating their emergence from individual users). The use of 'tags', for example, where individuals select key words of their own choosing that are in turn used to organize content ranging from websites to more specific pieces of information (e.g. photos, news stories, or ideas) are increasingly heralded as a means of bottom-up organization of web content. Tags can be presented in a way that provides a visually intuitive means of organizing web content (i.e. as 'tag clouds'), leading to hyperlinked associations among items based on the popularity of associations. Importantly, collaborative categorizations based on tags can represent multiple associations that may overlap, rather than mutually exclusive identifiers. Tags also appear to provide a relatively low cost means of user input, thereby overcoming the potential obstacle to collaborative filtering tools, which opens them up to a wide range of applications, from photograph sorting and sharing (e.g. http://flickr.com/) to 'social bookmarking' of a wide variety of web content (e.g. http://del.icio.us/).

Collectively, the reformulation of traditional collective action theory and the various means of individual participation and collaboration suggest the power of the 'long tail' distribution of internet user preferences. Due to reductions in the costs of production and distribution stemming from contemporary technologies, Anderson (2006) argues that substantial opportunities exist to tap into that portion of the demand curve represented by products that may be low in popularity overall, but that collectively represent a large proportion of the market (i.e. those that reside in the 'long tail' of the distribution curve). This idea of the long tail extends beyond consumer product demand. As evidenced by new forms of formalized collective action efforts, as well as the less formal collective behaviors of credentialing, collaborative filtering, and the self-provision and self-categorization of information through tools such as wikis and tags, the potential of the long tail of internet users is enormous. As communication and information sharing costs are reduced, new opportunities that take advantage of the resources of collectivities – in the form of everything from the provision of consumer information to political protests – arise (Benkler, 2006). Moreover, it appears that the current generation of information sharing tools mark only the early stages of effectively tapping into the specific skills and knowledge of the internet's existing user pool.

From a technical code standpoint, the emergence of collective action enhanced by internet connectivity and so-called web 2.0 affordances, behaviors, and philosophy signal increased agency, as noted earlier, as well as the values of democratic participation, empowerment, collaboration, and social engagement. Indeed, the acknowledgment (and labeling) of web 2.0 itself signals a wider recognition of the internet's evolving technical code, inasmuch as the articulation of web 2.0 characteristics and philosophies indicates an underlying recognition and appreciation of the values and assumptions that are increasingly manifest in the internet's current usage and potential.

Limits to Internet openness

Elements of the internet's technical code articulated so far – decentralized technical interoperability that increases the potential for innovation, coupled with a sense of empowerment achieved through enhanced agency and collaboration – imply that the internet is resistant to centralized control and is not adversely affected by impediments to these outcomes. Nonetheless, although these technical code features legitimately emerge from an analysis of the internet in its current form, there also exist countervailing forces, which are also indicative of the internet's technical code. Indeed, as noted earlier, technical codes can co-exist in oppositional ways, and the very technical features that currently appear to engender relative freedom can also be employed to exert strict control. In the end, conclusions about the internet's technical code must account for both forces.

Many internet-specific laws in the US illustrate this opposition. Given the open access architecture and inclusive reach of the internet, several laws have been enacted specifically to inhibit the internet's openness, particularly in cases where this openness implicates protected audiences such as children. For instance, the Communications Decency Act (CDA, 1996) and the Child Online Protection Act (COPA, 1998) were enacted in order to shield children from pornographic material on the web. Similarly, the Child Pornography Prevention Act (CPPA, 1996) attempted to expand the definition of child pornography to include images that appear to depict children but actually do not, including images of youthful-looking adults or images that are computer-generated. The Deleting Online Predators Act (DOPA, 2006) would require schools and libraries to restrict minors' access to online 'commercial networking sites' and chat rooms, in order to retain subsidized funding for their internet access. Finally, the Children's Internet Protection Act (CIPA, 2000) requires libraries and schools to install filters on their internet computers designed to block obscene or pornographic material, or material deemed 'harmful to minors'. These laws are complex and have been the target of considerable legal challenge, with results ranging from being largely overruled (e.g. CDA, CPPA, and COPA), to being upheld (e.g. CIPA), to battles that are ongoing (e.g. DOPA). Nonetheless, these acts and laws collectively illustrate specific efforts to counteract the internet's information sharing capabilities, at least with regard to a specific 'vulnerable' audience. Notably, each serves as a technical code document, inasmuch as they all articulate specific social values.

Legal efforts to thwart the open access inherent in the internet's design extend beyond protected audiences like children. For example, as noted earlier, one outcome of the internet's end-to-end design is the potential of peer-to-peer communication and information sharing. The heart of peer-to-peer architecture is the ability to efficiently connect end-users directly with one another, in order that people might share information among members of widely distributed groups. In the late 1990s peer-to-peer file sharing became popular among individuals with access to the internet. Perhaps the most highly-publicized instance of wide scale file sharing at the time was the peer-to-peer service Napster, which facilitated individuals' exchange of MP3 format music files, among other things. In 1999 Napster was charged with contributing to copyright infringement by its users, and was forced to cease operations as a free file-sharing peer-to-peer system. More recently, in the case of MGM versus the peer-to-peer software company Grokster (545 U.S. 913), the US Supreme Court ruled that internet file-sharing services will be held responsible if they *intend* for their customers to use software primarily to swap songs and movies illegally. In addition, the Digital Millenium Copyright Act (DMCA) makes it illegal to circumvent technological copyright protection mechanisms that can be used on CDs or DVDs or to distribute tools that enable such circumvention. In these ways, the widespread and simplified exchange of copyrighted information, at least as it once existed in the US and elsewhere during Napster's heyday, is one potential technical and social feature or value that has been legally – if not functionally – foreclosed.

In essence, the conflict between peer-to-peer file sharing services and the recording industry represents a conflict at the level of the technical code: although peer-to-peer file sharing was, and remains, a key capability (value) of the internet, it is at odds with the goal of some copyright holders to enforce their exclusive rights to intellectual property (a conflicting value). Specific enforcement of copyright law in this instance, and in the manner executed to date, can thus be seen as a countervailing force designed to reign in the inherent openness of the architecture and design of the internet. For example, the new 'inducement' doctrine of copyright infringement liability arising from the *MGM v. Grokster* case can only serve to inhibit innovativeness. Ultimately, this conflict draws attention to the internet's technical code by highlighting the tension surrounding the innovativeness designed into the internet and which values and assumptions are being realized. Interestingly, efforts to resolve or mitigate this conflict have arisen through the internet itself. For example, 'creative commons' licensing, designed to enable copyright holders to stipulate and publicize specific legal uses of their intellectual property, relies on the internet's information sharing capacity to enact a system of more flexible copyright than has existed before.

These conflicts begin to illustrate the complexity of assessing technical codes, particularly when artifacts are intricate, various interests are involved, and boundaries between groups are fluid or widely inclusive. Although well-matched within particular social environments, technical codes that clash with widely-held principles, ideologies, or beliefs are likely to result in conflict, as is often the case when technologies cross group boundaries. Indeed, this type of conflict may be more pronounced with some technologies than others. Given the internet's global reach, it seems more likely than many technologies to prompt meaningful and instructive technical code conflicts.

For example, as a global technology, the dominant technical code of the internet is bound to violate political, ideological, and cultural norms and expectations across countries. One prominent instance is the attempt by the Chinese government to control the information accessed by its citizens via the internet. In essence, the internet's technical code conflicts with priorities and controls that the Chinese government wishes to impose. Thus, the Chinese government is faced with the task of re-aligning the internet to conform to its view of how communication and information sharing tools should be used. However, given the internet's inherent ability to circumvent information loss or single points of control, close monitoring of the 135 million people currently using the internet in China is a daunting task (Fowler, 2007). Nonetheless, the Chinese government has employed sophisticated filtering mechanisms that prohibit all but the most ambitious users in China from accessing a wide range of content, including pornographic, religious, and political information (Internet Filtering in China, 2005).

However, the internet address and domain name registration system can greatly facilitate this type of centralized control. Unlike the distributed end-to-end architecture of the internet generally, the technology and administrative control of internet and Web addresses and names is highly centralized and hierarchical. This address or naming system, in fact, ties internet activities to particular jurisdictions, agencies, and even individuals. It therefore presents significant potential for centralized control over its more distributed and heterogeneous aspects. For example, nations like Germany can block content promoting Nazi ideology or denying the holocaust within its own borders – even though the servers providing this content might be located in other nations and jurisdictions. Similarly, this naming system allows the Chinese government to block international news content from the BBC's website, while allowing content from CNN, for example. This system also makes it possible for internet service providers to contravene internet neutrality principles by enabling them to identify the source of a given packet of information, and to expedite or delay its delivery in subsequent switching and transmission procedures. This part of the internet's architecture thus illustrates the ambivalence of values articulated in its technical code, and in the values and priorities that can be articulated through it.

There thus exist several forces working against the internet's decentralized, innovative, collaborative, and empowering structures. Many of these are represented by laws, which constitute a relatively explicit statement of technical code in their expression of the decisions and boundary conditions collectively imposed on a technology. Other countervailing forces are social, such as political and social pressures to enact laws in the first place, and normative uses that dictate acceptable and unacceptable behaviors online. As the economic, legal, and social influences on the internet converge, innovative solutions that balance freedom with control are also emerging (e.g., creative commons copyright licensing), many of which in fact take fundamental advantage of the internet's distinctive features.

The role of (technical) code in realizing the internet's potential

Overall, a technical code analysis of the internet reveals a decentralized interoperable architecture that is constrained by certain countervailing forces. Technical characteristics that enhance individuals' agency, and increase the likelihood of collaboration and innovation, also present the potential for centralized control. As Castells (2001) argues, the internet represents a complex 'double game,' where the very tools used to promote democratic participation can also be used to restrict it. This ambivalence in the internet's technical code illustrates both its enormous potential to realize innovation and freedom as well as its facility for constraining these.

There is evidence that the positive potential promised by the internet is being realized. Successful political advocacy efforts are enabled by online organization and mobilization (Earl, 2006); bottom-up, participatory culture relying in large part on the internet can increase collaboration and enhance the communal practice of cultural production and consumption (Jenkins, 2006); and group 'intelligence,' collated and tallied with the aid of web-based tools, can in many cases lead to superior solutions to a wide range of problems (Surowiecki, 2004). Moreover, many of these efforts result from a tacit awareness of technical code principles: instances of reflexive design offer hope that communities can create information systems tailored to their own particular cultural contexts in order to satisfy their own priorities (Srinivasan, 2007). In the extreme, even 'direct democracy' has been proposed, where agency and empowerment coincide through citizens' direct expression in law, trials, and decrees or motions by all those who wish to participate in their own governance. Such efforts take reflexive design one step further with a transparent convergence of design and values, which is rarely the case.

The current technical code of the internet suggests the partial realization and continued potential for these various types of relatively unrestrained participation and collaboration. Indeed, it is precisely this potential the Chinese government is vigorously attempting to restrain among its citizens. As Pool (1983) observed relatively early in the development of networked technologies, 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)

Yet this potential for freedom and the internet's ability to resist control are more fragile than the overall evidence from a technical code analysis might at first suggest. Structural features facilitating individual agency and freedom also present a 'relatively easy target for political and commercial exploitation' (Beniger, 1996: 59; see also Castells, 2001). As Lessig (1999, 2006) notes, the 'code' of the internet, or the software and hardware that regulate and thus govern cyberspace, is malleable and therefore open to control by various forces. In fact, the same technical features supporting open access can be applied to exert various forms of control. For example, digital networked technologies provide remarkably efficient and accurate surveillance mechanisms that can seriously violate individuals' privacy, particularly if coupled with reliable digital identification, which some argue is on the near horizon (Lessig, 2006).

Thus, the same tools that enable increased individual agency can also be used to diminish it through deceptive and carefully crafted ploys that exploit individuals' security, privacy, or freedom of expression. Managing the balance between these forces will be one of the critical challenges over the next several years and, depending on what forces are privileged, future technical code analyses of the internet might suggest radically different values and assumptions than are now evident. To assess this, periodic reexamination of the technical code is required.

To frame the internet's possible futures, Lessig (2006) describes a tension between so-called 'east coast' code (suggesting the Washington, DC origin of much US law) embedded in laws that dictate what can and cannot be done with the internet, and the 'west coast' computer code (suggesting the Silicon Valley/Microsoft influence), or 'the instructions imbedded in the software and hardware that make cyberspace work' (p. 72). Lessig argues that the power of east over west is increasing: Code is increasingly the product of commercial entities (as opposed to nonprofits or individuals), which by their nature are subject to many levels of control. As some argue, cyberspace will ultimately be controlled by those controlling society at large, namely large corporations with interests that are often at odds with those ascribed, perhaps idealistically, to the early denizens of the internet (Beniger, 1996).

Lessig therefore advocates actively using laws to control the basic architecture of the internet because, left unchecked, the internet is likely to experience 'the opposite of its architecture at its birth. This invisible hand, pushed by government and by commerce, is constructing an architecture that will perfect control and make highly efficient regulation possible' (Lessig, 2006: 4). According to him, 'code' is thus crucial to consider under any future scenario because

> it will present the greatest threat to both liberal and libertarian ideals, as well as their greatest promise. We can build, or architect, or *code* cyberspace to protect values that we believe are fundamental. Or we can build, or architect, or code cyberspace to allow those values to disappear. (Lessig, 2006, p. 6, emphasis in original)

Conclusion

The technical code perspective provides a penetrating view of technologies by increasing awareness of the choices that form them, and by suggesting the consequences of those choices. When attention is drawn to the technical code, public interest and involvement in related policies and practices tend to be lively and robust. For instance, recent debate and action surrounding battles over 'net neutrality,' or the continuation of the internet's nondiscriminatory approach to data traffic, has sparked intense citizen involvement, governmental action, and wide scale media attention. In effect, this debate has taken place at the level of the technical code: The question of net neutrality has fundamentally been framed as 'what values should be built into the internet?' In spite of its importance, attention is seldom focused at the level of the technical code. People rarely look beyond current technological forms to consider alternative versions, past or future, and public attention is rarely directed at the underlying values that are implicit in technical choices.

Yet, many suggest that this is precisely the level of public involvement and discourse that is required, particularly during times of rapid technological change. To ensure that the internet accurately reflects individual users' values and preferences, 'there are choices to be made about how this network evolves. These choices will affect fundamentally what values are built into the network.' (Lessig, 2006: 311). Put another way, what is required is directed and conscious influence over technical design and decision-making, rather than passive acceptance of current (or continuing) forms and tacit endorsement of the forces increasingly serving to control them. With sufficient initiative and participation, users of technologies have at least the potential to *choose* the values that come to reside in technologies through active engagement in their use and (re)design (Feenberg, 1995b). Such choices are not trivial. In the end, they are likely to determine the degree to which the potential of the internet as a 'technology of freedom' will continue to be realized, or will be foreclosed.

Notes

1 It is important to note that design decisions originate from technology users at least as much as they do from the original 'designers' of technology (e.g., engineers, programmers, and the like). Technologies are constantly modified, reinvented, and appropriated in their use (Abbate, 1999; McPherson, 2008; Jenkins, 2006; Poole and DeSanctis, 1990), often resulting in novel forms and unintended consequences. In the process of user appropriation, just as in the process of initial design execution, values become embedded in technologies. A technical code analysis can help to reveal which among these values have been privileged, at least for the time being.

2 Although the 'internet' refers to the physical infrastructure of interconnected computers, cables, and other devices that serves as the infrastructure for global communication, it is often conflated with a host of other services communicated via the internet, such as the web. From a technical code perspective, 'the internet' is best conceived of as the internet (i.e. an infrastructure) and its associated applications (e.g. the web), as well as a series of design and user decisions. This more inclusive definition best highlights the internet's sociotechnical nature.

References

Abbate, J. (1999) *Inventing the Internet*. Cambridge, MA: MIT Press.

About the W3C (2007) URL (consulted 3 January 2007): http://www.w3.org/Consortium/

Anderson, C. (2006) *The Long Tail: Why the Future of Business Is Selling Less of More.* New York: Hyperion.

Beniger, J.R. (1990) 'Conceptualizing Information Technology as Organization, and Vice Versa', in J. Fulk and C. Steinfield (eds) *Organizations and Communication Technology,* pp. 29–45. Newbury Park, CA: Sage.

Beniger, J.R. (1996) 'Who Shall Control Cyberspace?', in L. Strate, R. Jacobson and S.B. Gibson (eds) *Communication and Cyberspace: Social Interaction in an Electronic Environment*, pp. 49–58. Cresskill, NJ: Hampton Press.

Benkler, Y. (2006) *The Wealth of Networks: How Social Production Transforms Markets and Freedom*. New Haven, CT: Yale University Press.

Bijker, W. and J. Law (eds) (1992) *Shaping Technology/Building Society*. Cambridge, MA: MIT Press.

Bijker, T., T. Hughes and T. Pinch (eds) (1987) *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*. Cambridge, MA: MIT Press.

Bimber, B., A.J. Flanagin and C. Stohl (2005) 'Reconceptualizing Collective Action in the Contemporary Media Environment', *Communication Theory 15*: 365–88.

Bowker, G.C., W. Turner, S.L. Star, W. Turner and L. Gasser (1997) *Social Science, Technical Systems, and Cooperative Work: Beyond the Great Divide*. Mahwah, NJ: Erlbaum.

Castells, M. (2001) *The Internet Galaxy: Reflections on the Internet, Business, and Society*. New York: Oxford University Press.

Chaffee, S.H. and M.J. Metzger (2001) 'The End of Mass Communication?', *Mass Communication and Society* 4(4): 365–79.

Cowan, R.S. (1985) 'How the Refrigerator Got Its Hum', in D. MacKenzie and J. Wajcman (eds) *The Social Shaping of Technology*, pp. 202–18. Philadelphia, PA: Open University Press.

Earl, J. (2006) 'Pursuing Social Change Online: The Use of Four Protest Tactics on the Internet', *Social Science Computer Review* 24(3): 362–77.

Feenberg, A. (1992) 'From Information to Communication: The French Experience with Videotext', in M. Lea (ed.) *Contexts of Computer-mediated Communication*, pp. 168–87. London: Harvester Wheatsheaf.

Feenberg, A. (1995a) *Alternative Modernity: The Technical Turn in Philosophy and Social Theory*. Berkeley, CA: University of California Press.

Feenberg, A. (1995b) 'Subversive Rationalization: Technology, Power, and Democracy', in A. Feenberg and A. Hannay (eds) *Technology and the Politics of Knowledge*, pp. 3–22. Bloomington, IN: Indiana University Press.

Feenberg, A. (1999) *Questioning Technology*. New York: Routledge.

Felczak, M. (2007) 'The Ghosts of Internet Past? X.25, IPv6, and Control in Cyberspace', in A. Feenberg and N. Friesen (eds) *(Re)Inventing the internet: Critical case studies*. Publisher?

Flanagin, A.J., W.J.M. Farinola and M.J. Metzger (2000) 'The Technical Code of the Internet/World Wide Web', *Critical Studies in Media Communication* 17: 409–28.

Flanagin, A.J., C. Stohl and B. Bimber (2006) 'Modeling the Structure of Collective Action', *Communication Monographs* 73: 29–54.

Fowler, G.A. (2007) 'It's Called the Forbidden City for a Reason', *Wall Street Journal*, 19 January, B1.

Friedman, B. (ed.) (1997) *Human Values and the Design of Computer Technology*. Cambridge: Cambridge University Press.

Giles, J. (2005) 'Special Report: Internet Encyclopaedias Go Head to Head', *Nature* 438: 900–1.

Hughes, T.P. (1985) 'Edison and Electric light', in D. MacKenzie and J. Wajcman (eds) *The Social Shaping of Technology: How the Refrigerator Got Its Hum*, pp. 39–52. Philadelphia, PA: Open University Press.

Internet Filtering in China in 2004–2005: A Country Study. URL (consulted 8 January 2007): http://www.opennetinitiative.net/studies/china/ONI_China_Country_Study.pdf

Jackson, M. (1997) 'Assessing the Structure of Communication on the World Wide Web', *Journal of Computer-mediated Communication* 3(1). URL (consulted 28 February 2007): http://jcmc.indiana.edu/vol3/issue1/jackson.html

Jenkins, H. (2006) *Convergence Culture: Where Old and New Media Collide*. New York: New York University Press.

Lessig, L. (1999) *Code and Other Laws of Cyberspace*. New York: Basic Books.

Lessig, L. (2006) *Code: Version 2.0*. New York: Basic Books.

Lupia, A. and G. Sin (2003) 'Which Public Goods Are Endangered?: How Evolving Communication Technologies Affect the Logic of Collective Action', *Public Choice* 117: 315–31.

MacKenzie, D. (1987) 'Missile Accuracy: A Case Study in the Social Processes of Technological Change', in T. Bijker, T. Hughes, and T. Pinch (eds) *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, pp. 195–222. Cambridge, MA: MIT Press.

MacKenzie, D. and J. Wajcman (1985) *The Social Shaping of Technology: How the Refrigerator Got Its Hum*. Philadelphia, PA: Open University Press.

McPherson, T. (ed.) (2008) *Digital Youth, Innovation, and the Unexpected.* Cambridge, MA: MIT Press.

Metzger, M.J., A.J. Flanagin, K. Eyal, D.R. Lemus and R. McCann (2003) 'Credibility in the 21st Century: Integrating Perspectives on Source, Message, and Media Credibility in the Contemporary Media Environment', in P. Kalbfleisch (ed.) *Communication Yearbook* 27, pp. 293–335. Mahwah, NJ: Lawrence Erlbaum.

Nader, R. (1965) *Unsafe at Any Speed*. New York: Grossman.

O'Reilly, T. (2005) 'What Is Web 2.0?: Design Patterns and Business Models for the Next Generation of Software', URL (consulted 22 January 2007): http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html

Pinch, T.J. and W.E. Bijker (1987) 'The Social Construction of Facts and Artifacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other', in T. Bijker, T. Hughes and T. Pinch (eds) *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, pp. 17–50. Cambridge, MA: MIT Press.

Pool, I. (1983) *Technologies of Freedom*. Cambridge, MA: The Belknap Press of Harvard University Press.

Poole, M.S. and G. DeSanctis (1990) 'Understanding the Use of Group Decision Support Systems: The Theory of Adaptive Structuration', in J. Fulk and C.W. Steinfield (eds) *Organizations and Communication Technology*, pp. 173–93. Newbury Park, CA: Sage.

Postman, N. (1992) *Technopoly: The Surrender of Culture to Technology*. New York: Vintage Books.

Rheingold, H. (2003) *Smart Mobs*. New York: Basic Books.

Saltzer, J.H., D.P. Reed and D.D. Clark (1984) 'End-to-end Arguments in System Design', *ACM Transactions on Computer Systems* 2: 277–88.

Srinivasan, R. (2007) 'Ethnomethodological Architectures: Information Systems Driven by Cultural and Community Visions', *Journal of the American Society for Information Science and Technology* 58: 723–33.

Suchman, L. (1994) 'Do Categories Have Politics? The Language/Action Perspective Reconsidered', *Computer Supported Cooperative Work* 2: 177–90.

Surowiecki, J. (2004) *The Wisdom of Crowds*. New York: Random House.

Winner, L. (1986) *The Whale and the Reactor: A Search for Limits in an Age of High Technology*. Chicago: University of Chicago Press.

Andrew J. Flanagin is a Professor in the Department of Communication at the University of California, Santa Barbara, where he is also Director of the Center for Information Technology and Society. His research focuses on the ways in which communication and information technologies structure and extend human interaction, with particular emphases on processes of organizing and information evaluation and sharing.

Craig Flanagin (BA, Yale University; JD, Fordham University) is interested in international intellectual property, anti-trust law, and civil liberties. Recent technical interests include robotics and free and open source software. He lives in New York City where he

has been a professional musician for over 20 years and where he founded the band God is My Co-Pilot.
Address: PO Box 490, Cooper Station, New York, NY 10276, USA.

Jon Flanagin is a Professor Emeritus in the Department of Sociology at the University of South Dakota, where he has taught since 1969. His primary research and teaching interests are in sociological theory, social change, and media.
Address: Department of Anthropology and Sociology, 301 East Hall, University of South Dakota, Vermillion, SD 57069, USA.