THE BIOLOGY OF THE BROADCAST FLAG

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I. SUMMARY

During the early months of 2003, a rumor began moving around Washington that Billy Tauzin, famed Louisiana legislator, was slated to replace the legendary (but probably ultimately mortal) Jack Valenti as the chief lobbyist for the Motion Picture Association of America. Tauzin had been knocking industry heads for some time over digital copyright issues, and was said to be planning to drop a bill that would grant jurisdiction to the Federal Communications Commission to mandate copy protection technologies in machines that manipulate television signals. Tauzin was also (so the betting ran) planning to introduce a bill that would say something about mandating copy protection in all devices that converted analog signals to digital content. The bills were said to be coming in February. Or perhaps June. But although the cold winter and unbelievably damp spring of 2003 came and went, no Tauzin bills appeared. The rumors of Tauzin's connection to the MPAA had apparently made the MPAA think twice about using Tauzin as their sponsor.

If true, this reasoning on the part of the MPAA has prompted a rare moment of hesitation -- or perhaps is a signal that they are planning to move the digital copyright fight to the international stage. There is talk of a World Intellectual Property Organization (WIPO) initiative on mandated copy protection for digital media devices, to be directed and driven by Fox. The US has already entered into bilateral trade agreements that mandate DMCA-like protections (without DMCA-like exceptions). The MPAA is clearly deeply concerned about any "Napsterization" of its constitutents' content, and is willing to spend a great deal to defend its interests.

The MPAA and its content affiliates (broadly referred to as the U.S. "content industry") would like all consumer electronics and

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information technology companies to innovate "according to the rules" -- ensuring that Hollywood's movies are specially protected from unauthorized redistribution through adherence to a "broadcast flag" scheme (proposed to be implemented by the FCC) and through anticipated legislation (if the MPAA can find another sponsor) that will require U.S. manufacturers to follow policies designed to close the "analog hole." While it is beyond question that the digital world poses special threats to businesses that live or die on the controlled distribution of digital content, the arguments made by the MPAA and its content colleagues for national (or global) control over the functionality of the devices that manipulate bits are fundamentally troubling.

First, it is easy enough to think of innovation as a kind of mechanical evolution. And we know that preserving rich evolution of any system necessarily involves a willingness to allow the system to mutate or be random at various points, in order for there to be choices that can be selected. So if choices, or new machines, are otherwise lawful (capable of substantial noninfringing uses), they should be allowed. The content industry should not be allowed to prevent new creatures from coming into being through technical mandates.

Representatives of the content industry have used the language of evolution, claiming that the existence of machines that do not follow their proposed rules is unnatural -- because use of these machines will slow the natural evolution towards a well-controlled, successful digital future. This kind of social Darwinism has a long history in the U.S., and has been used as justification for any number of ultimately undesirable end-goals.

Second, to the extent some representatives of the content industry are seeking to create global flag/hole standards through international agreements, bilateral treaties, and state and federal law, we should pay attention to the evolutionary consequences of their actions. The content industry is trying to protect their particular past business model -- one that depends importantly on control over carefully-segregated distribution windows. This industry is, in effect, asking for global agreement that their creature, their business model, be immortal. But extinction is the ultimate fate of all maladapted species. The environment in which the content industry

operates has changed, and if it fails to adapt (as it so far is threatening to do), its business model should become extinct.

Finally, the broadcast flag/analog hole plans of the MPAA are unnerving on the plane on which we talk about law itself. Law is supposed to be a social conversation about collective values. To the extent that the broadcast flag and analog hole proposals attempt to instantiate the content industry's vision of copyright law in code, that conversation will be irrevocably poisoned: the evolutionary "tree" of law will be able to evolve in only the direction that a particular regime -- the regime of Fox and Disney -- favors.

The answer to the content industry's concerns is private digital rights management. And lots of it. If this industry is so concerned about losing control of their content, they should act to protect it in ways that vary from movie to movie and from moment to moment. Consumers will vote with their feet, more and more slivers of choices about content will be marketed, interoperable machines will continue to flourish, and new ways of doing business will emerge. The problem with mandating a particular code-law and form of "approved" machine, across the globe, is that it will narrow choices and frustrate many desirable evolutionary processes. That's not a tradeoff even Jack Valenti himself should be willing to endorse -- much less his rumored successor.

II. BACKGROUND

More than three years ago, Napster focused global attention on the challenges facing copyright owners in the digital age. Since then, downloading, sharing, ripping and burning of online music files have become widespread practices. While many of these uses are reasonable and legal, the RIAA and many in the recording industry believe that illegal online file sharing has caused a significant decrease in CD sales. The video content industry is anxious to avoid the 30-40% loss in revenue that it believes has been experienced by the music industry, and is searching for legislative and other solutions that stave off similar losses.

The threat of digital redistribution is particularly acute for movie studios and other video content producers because their business

models are today highly dependent on repurposing programming. The current movie studio business model is based on studios' ability to exploit multiple distribution streams for each work they produce. Licensing and distribution agreements for these windows -- domestic and international box office, airline performances, pay-per-view, rental, home sale, satellite, premium and basic cable, over-the-air broadcast, etc. -- result in payment to the studios. Control over these windows is a key element of the current studio business model.

In 2002, at the urging of the video content industry, Sen. Hollings introduced his Consumer Broadband and Digital Television Promotion Act. The Hollings bill, S. 2048, would have allowed the FCC to mandate a security standard protective of digital content for *all* "digital media devices"; the government was to develop a standard if the private sector was unable to agree to one on its own. Under the bill, it would have been illegal to make or provide a digital media device that did not contain such standard security measures (or to remove such measures).

Proponents of the Hollings bill argued that the growth and development of digital content (and broadband deployment generally) was being stalled by the absence of protection systems, and suggested that digital content would not be secure -- and would not be made available for distribution -- until some form of digital rights management system (DRM) was installed in all devices capable of displaying digital content -- from TV sets to personal digital assistants to wristwatch cellphones to general purpose computers. They insisted that the consumer electronics and information technology industries would not voluntarily accede to DRM usage, because it would add costs to the devices without providing consumers with what they would perceive to be added value, and that therefore the government must mandate the inclusion of DRMs. When public outcry forced the abandonment of the Hollings bill, the content industry went back to the drawing board. They found a convenient place for a precedent-setting "mini-Hollings" approach in the context of the country's move towards digital television.

B. *Broadcast Background*

Analog television broadcast signals (called "NTSC" signals)

received through an antenna are radio signals. These signals direct an electron beam to paint each line of the television screen with particular intensities of color and instruct the beam when to move back to the left of the line and when to start painting from the top. Because the lines are spaced very closely together, we see them as a single image. A TV screen normally has about 480 lines visible from top to bottom, and the usual analog television format is called "480i" (for "interlaced," in which alternate lines of the screen are painted 30 times a second).

Each kind of broadcast that uses radio waves (and there are many -- TV, radio, cell phones) uses a different continuous sine wave frequency. A sine wave by itself does not convey information (because it is always the same), so the particular frequency wave is "modulated" by having the message (such as the sound of someone's voice, or a picture) "encoded" onto the wave. For example, the sound part of a television signal uses "amplitude modulation," in which the peak-to-peak "size" of the wave changes. In effect, the pattern produced by the voice's sound is overlaid onto the continuous frequency sine wave to vary its amplitude.

An antenna is just a piece of metal that helps the television receiver pick the signal out of the air. In turn, the television receiver has a "tuner" that separates out the particular modulated sine wave that is desired -- it resonates only to that sine wave, and then amplifies it. The television receiver then "demodulates" the signal by extracting the video signal and the sound signal from the radio waves. This demodulated signal can work with the electronic components inside the television to paint the desired picture.

Digital television is different from analog because it involves digital cameras working at a much higher level of resolution (information per unit of space) than analog cameras do, and a similarly detailed display. Digital transmissions can be constantly error-corrected, so the resulting picture is crisp and stable (as well as incredibly detailed, with ten times more pixels on the screens of good digital televisions than analog televisions).

Digital television is broadcast just like analog television. But the composite signal is made up of ones and zeros rather than sine waves. Television broadcasters have a new frequency to use for their digital broadcasts, and each broadcaster now has an analog TV

channel *and* a digital TV channel. The digital channel carries a 19.39-megabit-per-second stream of digital data that a digital television can receive and decode.

Each digital channel can be subdivided into multiple subchannels, for two reasons. First, the public "ATSC" standard for digital television (which is different from the "NTSC" standard for analog television) allows for different formats, and in the digital world these formats do not interfere with each other. Analog transmissions are much more susceptible to interference. Second, digital transmissions are compressed by MPEG-2 compression, so broadcasters can choose the bit rate for each subchannel. Shows that are not as informationally rich (do not, for example, involve a great deal of detailed movement) can be in lower resolution formats without the viewer noticing -- and lower resolution formats require lower bit rates.

The standards for digital broadcasting are public, and at the moment any machine or software program that is capable of demodulating the broadcast signal using standard, public techniques can display digital television.

B. Broadcast Flag Overview

The triggering event for the broadcast flag discussion is the digital television ("DTV") transition, an event that is supposed to occur by 2006. Moving to DTV will release a good deal of radio spectrum for new uses (because the broadcasters will use only their digital spectrum and will give back their analog spectrum), and the FCC will auction licenses for this spectrum -- with the proceeds going to the federal government. Congress has been assuming in its budgeting process that revenues from the resulting spectrum will be more than $6 billion. Thus, there is tremendous pressure to complete the DTV transition.

DTV will be broadcast "in the clear" (in unencrypted form). Movie studios and other video producers are concerned that homes and individuals with Internet access will soon be able to share movie-length digital broadcast files that they receive with the same ease that they now share unencrypted music files, and that widespread online piracy will be the result. In the absence of a copy protection scheme, some content providers have asserted that they

will not permit high quality programming to be broadcast digitally. Without such programming, the fear is that consumers will not buy DTV transmitters -- which will delay the DTV transition.[1]

In order to provide some measure of protection for DTV content, the Motion Picture Association of America ("MPAA") and the Digital Transmission Licensing Administrator, LLC ("DTLA") have proposed a "broadcast flag" scheme to the FCC (the "MPAA/5C proposal").[2] In essence, the studios have proposed that any future device capable of modulating or demodulating DTV content be designed to:

- check for the presence of a flag,
- encrypt any flagged content using approved technologies,
- allow creation of digital recordings of flagged content using only authorized copy protection technologies, and
- allow digital transmission of flagged content only via secured digital outputs to other "compliant" devices (authorized devices that are appropriately secure and themselves ensure that protected content cannot be digitally retransmitted in an insecure fashion to noncompliant devices or over the Internet).

The MPAA/5C rule proposes that all newly-manufactured equipment -- starting in 2006 -- capable of demodulating or modulating a DTV signal have approved copy protection technologies built in. These devices would include future digital televisions and set-top boxes, but could also include computers or other future hardware or software capable of demodulating a DTV broadcast. Approved technologies will use encryption-based digital content protection to ensure that the standards for use and distribution are obeyed. Only approved content protection technologies would be permitted to handle marked programs. The list

[1] Thus, from the content owners' perspective, public policy makers are asking them to urgently do something to promote the digital transition; content makers won't put high quality programming out unless it is protected; so the broadcast flag rules need to be put in place right away to protect the fall lineup.

[2] The "5C" consortium is made up of Hitachi Ltd., Intel Corporation, Matushita Electric Industrial Co. Ltd., Sony Corporation, and Toshiba Corporation. 5C has developed the Digital Transmission Content Protection System, or DTCP, which offers secure electrical transmission of compressed content over particular interconnections. DTLA is the licensing authority joint venture founded by the 5C companies, which administers the licensing of DTCP.

of approved technologies will be part of a proposed "Table A."

Because all devices touching DTV content would have to, under the MPAA/5C proposal, incorporate approved technologies found on Table A, the process for addition to this table is both critical and controversial. The proposal contemplates that technologies could be added to Table A when they are used or approved by three major studios or ten major device manufacturers -- or when the technology is found to be "at least as effective" as other Table A technologies. The FCC is supposed to rule on all applications under any of these criteria for addition to Table A, and to revoke Table A authorization if the technology has been "substantially compromised."

As part of the process that led up to the MPAA/5C proposal, Fox suggested that a particular suite of copy protection technologies -- the 5C suite, which includes DTCP, HDCP, D-VHS, and CPRM -- be added to Table A immediately.[3] None of these technologies allows transmission over the Internet (even secure transmission) of any flagged content. And none of these technologies currently allows transmission of flagged content over wireless networks. DTCP, for example, is designed to operate over IEEE 1394 ("firewire") and USB networks, but not over WiFi.[4]

Additionally, the licensing rules accompanying Table A technologies will be critical and controversial. Significantly, the DTLA license for DTCP does not allow digital outputs of content save to devices that use one of the other three technologies.[5] This

[3] describe BPDG process. DTCP offers secure transmission of compressed content over electrical interconnections (USB, IEEE 1394, and MOST); CPRM offers secure storage of compressed content; HDCP offers secure transmission of uncompressed protected content over an electrical interconnection (DVI); and D-VHS offers secure storage of uncompressed protected content. The DTLA, the licensing authority joint venture founded by the 5C companies that administers the licensing of DTCP, has approved only three technologies to protect DTCP-protected content: CPRM, D-VHS, and HDCP.

[4] The MPAA/5C proposed regulation also states that regulated products may not include switches or buttons or functions that allow the Compliance Requirements to be defeated, and may not allow defeat of these requirements by widely available tools or inexpensive software.

[5] The DTCP license does permit "constrained" (down-resolutioned) digital output over a DVI interface to computer products manufactured before 2005, but data traveling over a DVI interface is uncompressed, and therefore extremely large and unwieldy, and restrictions on image quality are likely to diminish consumers' enjoyment and use of lawfully-acquired content. The license also permits the use

means that once a consumer builds a home network based on DTCP, the network will form a closed circle -- no devices can be added to that network unless they also are part of the 5C world. And no 5C devices will interoperate with non-5C devices, according to the current terms of the 5C license.

In order to ensure that it is not too easy to circumvent the protections offered by an approved technology, a set of "Robustness Requirements" for the flag have also been proposed. These require that products meet a specified level of secure design and construction -- by employing encryption techniques and being tamper resistant. The standard proposed by the MPAA in Section X.17 of their proposed broadcast flag rule is that content protection systems should be implemented so that they cannot be defeated by using general purpose tools widely available at a reasonable price. Robustness rules generally exclude open source software products from consideration, because users can modify these products.

C. Analog Hole Overview

At a Cato Policy conference on February 5, 2003, Andy Setos of Fox made clear that the even if the broadcast flag scheme was implemented as proposed it would not be adequately effective to stop the digital copying of copyrighted DTV works.[6] The reason? The broadcast flag proceeding concerns locking down digital outputs of devices only, and does not constrain analog outputs. This means that "flagged" digital material could be captured from an analog output such as one contained in an analog video display device (e.g., a VCR), transformed into high-quality analog form, and then redigitized -- in the process, the "flag" being considered by the FCC would be lost, and the result of this digital-analog-digital conversion would be a high-quality file that was available for perfect and

of technologies other than CPRM or D-VHS for the making of up to two first-generation copies, provided that the copy cannot be played on any device other than the device making the copy.

[6] Battle over the Broadcast Flag: The IP Wars and the HDTV Transition, Cato Policy Forum, Wednesday, February 5, 2003, featuring Fritz Attaway, Motion Picture Association of America; Jim Burger, Dow, Lohnes & Albertson; Mike Godwin, Public Knowledge; and Andy Setos, Fox Entertainment Group.

unlimited digital copying and transmission with no "flag" attached. The content industry is concerned that control needs to be extended to any outlet through which digital material could "leak" into analog form without the flag and then be redigitized -- in popular parlance, they believe that they have to plug the "analog hole."[7]

In an April 2002 "Content Protection Status Report" provided to the Senate Judiciary Committee by the Motion Picture Association of America, the MPAA said that analog-to-digital converters needed to be regulated to ensure that they responded to a "watermarking" technology that would survive digital to analog conversion. This is a very broad goal, because analog-to-digital converters are present in any number of machines -- including digital scanners, samplers, thermometers, seismographs, computer pointing devices, camcorders, cameras, microscopes, telescopes, modems, radios, televisions, cellular phones, walkie-talkies, light-meters, and many other devices.

For the process of plugging the analog hole to proceed, a watermarking or other technology will need to be chosen that survives digital-analog-digital conversion. Led by the MPAA, the information technology, consumer electronics, and entertainment industries formed a discussion group in February 2003 (the Analog Reconversion Discussion Group, ARDG or "are-dog") to work on this issue. ARDG's charter states that it will "identify[] technological tools that may be relevant to addressing security issues arising from the conversion of protected, copyrighted commercial audiovisual content from digital to analog format and reconversion to digital format." So far, the ARDG is discussing various technologies that might (or might not) carry rights signaling information from protected digital sources across analog interfaces. This rights signaling information will then need to be detected by devices that reconvert the content to digital form. The overall goal is to find some way of preserving "states" of content protection through digital-analog-digital conversions.

[7] Interestingly, the MPAA has frequently referred to the existence of the analog hole in defending against attacks on digital rights management (DRM) systems. Both in the Library of Congress DMCA rulemaking hearings, and in the 2600 litigation, content industry representatives suggested that people wanting to make fair uses of DVDs which were prevented by content scrambling technology (CSS) could use analog outputs to make those uses. cites.

In a slide presentation during an early meeting, the Chief Technology Officer of MPAA framed the issue confronting the ARDG in terms of evolution:

- For legacy analog devices, protected digital video content must be converted to analog video signals.
- Analog video signals can be easily converted to digital without any obligations to preserve the content's usage rights information.
- Since the usage rights are not managed equivalently, *the natural transition from analog to an all-digital world is impeded*.[8]

Chris Cookson, an AOLTW representative, put the issue even more strongly during the same meeting, saying in effect that the absence of rules in the analog world was preventing natural evolution towards digital, even though digital was clearly a superior technology.[9]

Thus, the challenge presented to the ARDG world is to guarantee "equivalence" between digital outputs subject to the broadcast flag scheme and analog converters. Assuming that digital outputs will be controlled by approved content protection technology under the broadcast flag scheme, the content industry's goal is to ensure that any analog output is as least as controlled as the digital. This will mean that analog converters and devices will have to be sufficiently robust (non-tamperable by users) and compliant (ensuring encryption of all flagged content) to meet the broadcast flag standards.

As of the date of this paper, the ARDG still has several scheduled meetings ahead. The group is drafting a set of questions against which available technologies can be measured. Observers predict that the resulting document will be sent to Congress with a demand for a bill that would require development of (and adherence to) technologies meeting the stated requirements.

[8] Analog Reconversion Reference Architecture Proposal, presented to the Analog Reconversion Discussion Group, March 5, 2003, by Brad Hunt, Chief Technology Officer, Motion Picture Association of America (emphasis added).

[9] No press was allowed to be present at this or any other ARDG meeting. I was present and took notes.

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III. EVOLUTION AND INNOVATION

Evolution is a simple process: Genes fluctuate or mutate. Individuals are selected. Populations change. Without fluctuation in the genes (or whatever other unit of inheritance is of interest), evolution cannot occur.

Evolution is not necessarily progress, although many people think of man as the final, triumphant link in an ever-improving chain of being. Organisms do not evolve so that they will be more efficient or useful later. Instead, populations adapt to their current surroundings through aggregated selection events, when chance fluctuations result in an increase in the reproductive success of their carriers. So in order for this adaptation to take place -- for natural selection to operate -- there must be mechanisms to increase or create genetic fluctuations which are themselves the result of chance.

Biological systems are part of a larger category of complex adaptive systems[10] -- including the environment, insect populations, the economy, the human brain, and many others[11] -- that are characterized by nonlinearity,[12] irreversability,[13] stability,[14]

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[10] Generally, a *complex* system is understood as a set of interacting elements in which the interactions are nonlinear. A *complex adaptive system* (or CAS) is a complex system that has the capacity to modify its own state (through, e.g., evolutionary change). In CAS, patterns at higher levels emerge from local processes and selection operating at lower levels. Complexity as a field is associated with the Santa Fe Institute (cite Waldrop 1992, Lewin 1993). Many books that are accessible to laypeople have been published on the subject (cite Gell-Mann 1994, Holland 1998, Kauffman 1995, Goodwin 1994, Cohen and Stewart 1994, Prigogine 1980, Prigogine and Stengers 1984, Coveney and Highfield 1995, Kelly 1994, Gleick 1988). See http://www.sbaer.uca.edu/Research/1999/ICSB/99ics052.htm The study of CAS is focused on how complicated structures and patterns of interaction can arise from random actions. The essential elements of any CAS are: different and diverse parts (sustained diversity and individuality of components); localized interactions among those components; and an autonomous process that selects from among those components, based on the results of local interactions, a subset for replication or enhancement. (Simon A. Levin, Ecosystems and the Biosphere as Complex Adaptive Systems (1998))

[11] JB Ruhl, Thinking of Environmental Law as a Complex Adaptive System: How to Clean Up the Environment by Making a Mess of Environmental Law, 34 HOUS. L. REV. 933 (1997).

[12] See Ruhl n.46: A system is described as linear when the relationship of the agents' interactions can be described in strictly proportional terms (e.g., y = 2x +

bifurcation[15] and symmetry breaking.[16] From complexity theory we know that adaptation is the key to innovation, resilience, and sustainability in any complex system, and no discipline teaches us more about adaptation than biology.

Complex adaptive systems are nonlinear, and thus unpredictable. While this nonlinearity may be an annoyance for those who would like to predict where a particular system may end up, it is the system's adeptness at avoiding being locked into linear behavior that allows it to adapt to changing circumstances. Researchers have found that the most resilient systems are those that manage to stay balanced between extreme order and extreme chaos.[17] In a sense, these systems are drawing as much as possible from the adaptive qualities of nonlinearity without falling all the way into nothingness/randomness. They are being held back from the edge of this cliff by the presence of ordered, linear behavioral qualities in the

3z). A system is nonlinear, therefore, if the relationships of the agents represents a function in which the output of an element is not proportional to its input. See also P.G. Drazin, Nonlinear Systems 1 (1992) (stating that a nonlinear system represents a feedback loop in which an element's output is not proportionate to its input).

[13] Complex adaptive systems do not have the same outcomes when they are run from the same initial conditions; so they are not deterministic. Random processes like these (non-deterministic) are subject to the irreversible consequences for future behavior of the system; they are subject to the "legacy of history." http://sevilleta.unm.edu/~ehdecker/complexity/96fall/complexity.html

[14] CAS tend to settle into stable organizational patterns -- but different stable organizations in different environments.

[15] Prigogine: "The most exciting aspect of nonequilibrium phenomena is that the same physical system can show a great variety of behaviors, each corresponding to a different attractor. The mechanism which is at the origin of this diversification is the instability of a reference state and the subsequent bifurcation of new branches of states as the parameters built in the system are varied."

[16] An imaginary person inside a system at equilibrium (a cube of water, for example) would have no perception of time or space; everything would seem the same. If the system is pushed far from equilibrium (by heating, for example), a notion of space will emerge in this minute observer, because collective, complex actions inside the system will occur. Prigogine: "We call this emergence of a notion of space in a system in which, until then, this notion could not be perceived in an intrinsic manner symmetry breaking. In a way, symmetry breaking brings us from a static, geometrical view of space to a view whereby the space is shaped by the functions going on in the system."

[17] Cites.

system -- such as, in the case of biology, natural selection.

A. Survival of the Fittest

It is very strange to say that the natural order of things requires that rules be imposed to allow progress to result -- that only regulation will allow the "survival of the fittest" dictated by Charles Darwin's theories. But that is, in fact, what certain elements of the content industry are asserting: that one form of technology (uncontrolled digital and uncontrolled analog) has to be held back and controlled in order for another (controlled digital) to flourish.[18] Let's take this assertion apart.

First, the makers of this statement are saying that digital technologies are "better" than analog, and that for that reason the content industry should be protected by rules that make it more likely that the digital transition will take place. This is an argument for imposition of the broadcast flag.

Second, this statement asserts that once the broadcast flag is in place locking down digital outputs and digital machines, analog outputs and analog machines should not be subject to different, looser rules -- because, again, digital is the better technology and the natural transition to that technology will be held back if people continue to use analog devices. This is an argument for closing the analog hole.

More generally, the content industry is using selectively the oft-repeated notion of "survival of the fittest" to support its claim that a controlled digital future would be better for us all and thus nothing should be left to chance; in their minds, control over both digital and analog outputs, and adequately secure machines, are both essential steps for the digital transition to occur -- both in the television world and in the broader content community.[19] They are saying, in effect, that the consumer electronics and information technology companies should innovate "according to the rules."[20]

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[18] MPAA ARDG slides; Cookson remarks.

[19] Of course, this position may be at risk of ignoring the fact that the digital transition has already occurred. Facts re use of internet for news etc.

[20] This is a strongly-held view of some elements of the content industry. In a public copyright debate held at the New York Bar Association on May 5, 2003, Chuck Sims of Proskauer Rose (someone who has represented a wide variety of

By making these arguments, the movie studios are aligning themselves with a view of evolution as forwarding "progress." The notion that progress results from evolution was discarded by biologists thirty years ago, because traits or strategies that are successful for a given population at one time may not work at all at another time.

This non-progress of evolution has been demonstrated through experiments:

> [Scientists] founded a yeast culture and maintained it for many generations. Occasionally, a mutation would arise that allowed its bearer to reproduce better than its contemporaries. These mutant strains would crowd out the formerly dominant strains. Samples of the most successful strains from the culture were taken at a variety of times. In later competition experiments, each strain would outcompete the immediately previously dominant type in a culture. However, some earlier isolates could outcompete strains that arose late in the experiment. Competitive ability of a strain was always better than its previous type, but competitiveness in a general sense was not increasing.[21]

Evolution is contingent, contextual, and filled with chance. Any organism's success depends on the behavior of its contemporaries. It is not necessarily progress.

The same "progress" worldview advanced by the MPAA in favor of a controlled, regulated digital future has been used selectively by many policymakers over time. For example, Bill Moyers has pointed out that turn-of-the 20th century policymakers used Darwin's theory of evolution in order to make "the plunder of America [by corporations for their own financial advantage] sound

content owners) made the following statement (paraphrased): "All creativity has to live within certain boundaries; the fact that sonneteers live within parameters doesn't mean that their First Amendment rights have been violated."

[21] Biology faq.

like divine right, " by promoting as "the natural order of things, the notion that progress resulted from the elimination of the weak." Any who opposed the oligarchy were smeared as disturbers of the peace, socialists, anarchists, or worse, and government was used only to forward money-making ends.[22]

Similarly, Sarah Cleveland has noted that "pseudo-scientific theories of racial superiority have been used to justify the exclusion of other peoples from democratic governance," using Charles Darwin's The Descent of Man and Herbert Spencer's Social Statics (in which Darwin's work was transformed into a doctrine of "survival of the fittest") to justify WASP superiority.[23] Andrew Carnegie called on Darwinian evolutionary theories to justify industrial inequities,[24] while eugenicists like Francis Galton used evolutionary science to support the view that governmental regulation was necessary to prevent the genetic spread of inferior races.[25] As Fred Bosselman puts it, "The survival of the fittest has historically been used by those who have survived to suggest that they should have survived because they and their ancestors were the fittest."[26]

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[22] Moyers speech.

[23] Sarah H. Cleveland, Powers Inherent in Sovereignty: Indians, Aliens, Territories, and the Nineteenth Century Origins of Plenary Power over Foreign Affairs, 81 TEX. L. REV. 1 (2002). Charles Darwin, The Descent of Man (1871); Herbert Spencer, Social Statics (1892); 1 Herbert Spencer, The Principles of Biology, in Synthetic Philosophy 444 (1866).

[24] Cleveland cites Andrew Carnegie, Wealth, 148 N. Am. Rev. 653 (1889), reprinted in A Documentary History of the United States 172-79 (Richard D. Heffner ed., 12th ed. 1965) (arguing that competition insures survival of the fittest, even in the industrial context).

[25] See Daniel Kevles, Annals of Eugenics: A Secular Faith, The New Yorker, Oct. 8, 1984, at 5, cited in Cleveland. Cleveland notes that the term "eugenics" was coined in 1883 by Charles Darwin's cousin, Francis Galton, who sought to use Darwinian science to improve human stock "by giving the more suitable races or strains of blood a better chance of prevailing speedily over the less suitable." Id. at 51. Galton's positive eugenics, which encouraged reproduction of the elite, quickly devolved into negative eugenics, which suggested that undesirables' reproduction be limited; ultimately, genocide was the result. Jane Rutherford, Juvenile Justice: Caught between The Exorcist and a Clockwork Orange, 51 DePaul L. Rev. 715 (2002). After a long silence prompted by revulsion against Nazi eugenics, "Social Darwinism" surfaced again in Richard J. Herrnstein & Charles Murray, The Bell Curve: Intelligence and Class Structure in American Life (1994).

[26] Fred P. Bosselman, Limitations Inherent in the Title to Wetlands at Common law, 15 STAN. ENVTL. L.J. 247, 312 (1996).

Thus, the MPAA's focus on the "survival of the fittest" as a justification for the flag and hole proposals is troubling. "Natural selection" does not necessarily promote "progress," and "survival of the fittest" should not require governmental assistance -- particularly assistance directed at keeping unapproved consumer electronics equipment from reaching the marketplace.

B. The Role of Chance

In addition to assuming that "progress" stems from natural selection, the survival of the fittest argument of the content industry proceeds from the assumption that static elements of systems are chosen for success -- plucked from a list in order to dominate the environment. But this assumption misses the key role of chance in evolution.

We know that mutation is necessary for evolution to occur. But what is mutation when the system under discussion is, say, innovation or law? The work of complex adaptive theorists may shed some light on this question. Any interesting system that is far from equilibrium[27] (like innovation, or the economy, or the host of machines that might touch digital content) can adjust to its environment in several different ways at the same moment. We know that at a certain critical constraint level (when enough real or metaphorical heat has been applied to the system) a given system will become organized, and characterized by correlations across great distance -- this is analogous to natural selection. But, in contrast to the determinism of this phase change (we know that organization will happen), we do not know which particular choice will be selected. Simultaneously stable stationary states can coexist under exactly the same experimental conditions. Only chance, in the

[27] Systems at equilibrium will all have the same temperature (like a body of water) and an observer inside the system will not be able to tell where he is -- he will have no way to measure space or time. If there are perturbations in this system, they will die out quickly, and the behavior will eventually be as simple as at equilibrium. By removing the system from equilibrium further and further, through an increase in some constraint (like density or heat), experimenters see at some critical level of the constraint that matter in the system begins to perform a bulk movement. Innovation is a complex adaptive system.

form of the particular ripple in the system that was present at the time the selection took place, will decide whether a given element within the system has characteristic A or B.

The mechanism by which this choice is made is called "bifurcation." At the crucial moment of transition between one state and another, the system performs this bifurcation, and no one knows beforehand what the outcome will be. Chance will decide, through the effect of fluctuations and the presence of multiple attractors.[28]

Indeed, all systems (chemical and physical -- and perhaps even political) are characterized by an amazing interaction between chance and constraint. Fluctuations arising from random motions are analogous to mutations, and for any bifurcation event to occur most interestingly choices (obviously) need to be present.

But not all possible choices. The complexity of natural objects (or, I would argue, of innovation) is somewhere between "perfectly predictable" and "completely random." If a new sequence can be perfectly predicted on the basis of some initial state ("since I know X, I know that Y will happen"), the information required to describe the new sequence will be zero -- because it can be perfectly described on the basis of X. If a new sequence will be realized out of innumerable random sequences, for random reasons, it will take a maximum amount of information to describe this system -- because you will have to describe each bit in order to describe what has happened. What we look for in the evolution of languages and art and music and innovation is a "process capable of producing with high probability a complex, information-rich, ... sequence of states." Such a process will be neither completely random nor completely predictable.

Indeed, having completely predictable evolution may well put any population at great risk.[29] Consider the ant. Ants as individuals have highly chancy behavior patters, even though as colonies they act quite coherently. And some randomness is an adaptive value in the organization of ant society.

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[28] Explain multiple attractors.

[29] "The extent to which an organism can evolve is relative to the ability of its genes or combinations of genes to adapt to environmental change (referred to as "evolutionary plasticity"). As a result, the natural selective preference of the evolutionary process should, over the long term, lead an organism to retain those genes with greater, rather than lesser, plasticity." Bosselman at 313.

For example, if two food sources are presented to an ant colony, and that colony as a whole is not very good at assembling ants around a food source, a large number of ants will fail to be "recruited" around the first source that is found and will wander off. Those wandering ants -- who have lost the trail because of "errors" -- will quickly find the second source of food. And then the colony as a whole will act: if the two food sources are the same quality, they'll focus all of their attention on the first source first until it is gone, and then they'll eat the second -- without a break in their rate of food-collection. If the second food source is better (because of its concentration of glucose), they'll eat the second source, but will not completely ignore the first one. This is analogous to bifurcation, in which two simultaneously stable states are possible. And some level of randomness allows the colony to switch between these two modes of behavior, by increasing the possibility of finding the second source of food. The colony can then focus its efforts on the most rewarding resource, while promoting the work to find and use resources which will be fully exploited later. Indeed, experiments show that, where there is more than one source of food, there is an "optimal" value of error that defines this level of randomness. Had the colony been perfectly good at gathering the ants around the first source of food (perfectly deterministic and predictable), they never would have found the second.[30]

Human society is subject to the individual desires of individual human beings -- something that we don't think ants have. The constraints that animate human behavior are extremely rich. Not just temperature or pressure shapes the dynamics of human society, but also the tension between desired and actual human behavior. Under these circumstances, it seems as if each human, and each human system, is a unique realization of a complex process whose rules cannot be designed in advance. We are necessarily even further from complete predictability than the ants are -- and we know that some randomness will be needed to help us adapt.

Notwithstanding what Hollywood has been telling Congress and the World Intellectual Property Organization, the key threat to innovation posed by the digital age may not be piracy of copyrighted

[30] This story comes from Prigogine/Nicolson introductory article on CAS (cites).

works. A more serious threat to this complex adaptive system may be the actual or attempted control over chance (or mutation, or fluctuation, or randomness, all of which are names for the same thing). Complete randomness is meaningless, but some randomness is necessary. Without retaining some helpful level of chance, we run the risk of failing to find new sources of food or create new, as-yet-unimagined machines that assist us in understanding and displaying digital content. The Hollings-like approaches taken in the broadcast flag and analog hole contexts, if successful, may have the unintended (or intended) consequences of (1) keeping new creatures (or new machines) from appearing and (2) keeping a particular creature (the studios' business model) from becoming extinct. Before taking the steps proposed by the MPAA, global policymakers should think hard about these consequences.

IV. KEEPING NEW CREATURES FROM APPEARING

Both the broadcast flag and analog hole proposals are (or will be) focused on ensuring that no device (or software) capable of displaying or storing or converting digital content that is not "subject to the rules" will be sold to consumers in the U.S. This means that every device will have to adhere to the broadcast flag rules: incorporate approved copy protection technology; encrypt flagged content; allow transmission of flagged content only over wired connections to other broadcast-flag-compliant devices; be sufficiently untamperable so that no hobbyist can change the device's settings; and comply with whatever additional license requirements are created by the proprietors of approved copy protection technologies (including requirements that licensees' machines not interoperate with any unapproved devices).

This a breathtakingly broad goal, and it is important to understand what its implications are. First, the proposed broadcast flag/analog hole efforts are not limited to preventing massive online redistribution of works. The MPAA/5C flag proposal, for example, states that the goal of the regulation is:

Protection against unauthorized redistribution, including Internet redistribution, of protected content.

This means that *any* redistribution, to any machine (including machines within consumers' homes) will have to be authorized. Any machine not in compliance with the flag system -- built to recognize and adhere to the flag rules -- will not be an authorized machine. Machines designed for use within consumers' homes that are not authorized will be unable to store, manipulate, display, or transmit flagged materials. So consumers will have to pay for the hardware, software and license fees needed to protect content when the flag is present, and will be subject to the inevitable frustrations of not being able to use products they purchase legally when the technology does not work properly. For example, a cable system recently turned on a content control bit (similar to the rc_descriptor), and consumers with new D-VHS recorders suddenly found that they could not record any programs from the cable system. In the broadcast flag world, once a consumer receives a television program on a flag-compliant device, he or she will not be able to store that program on any non-compliant legacy device.[31]

Second, consumer electronic/information technology product development will become subject to a variety of "gatekeeping" mechanisms. All technology touching digital television content will have to use Table A copy protection technologies approved by the video content industry. As discussed above, certain proprietary technologies (known collectively as the "5C suite") have been pre-selected as "approved technologies" that every "compliant" device will have to include. Once the 5C suite is on Table A, there will be very few incentives for manufacturers of other content protection technologies to have their products added to Table A. The 5C suite (which covers both storage and transmission) will interoperate only with other 5C technologies, and once locked in to the 5C circle consumers will not want to purchase non-interoperable equipment.

Even those manufacturers who feel they have enough monetary incentives to try for Table A admission will have a hard time getting there. Under the current MPAA/5C proposal, a technology could be added to Table A only (i) by being used or approved by three major

[31] Similarly, analog ports are used to drive almost every television product currently in consumers' homes -- such as TV sets, VCRs, digital video recorders, DVD players, game consoles, and other devices.

studios; (ii) by being used or approved by three major television broadcast groups (of which at least two must be major studios); (iii) by being licensed by ten major device manufacturers and used or approved by two major studios; or (iv) by being found "at least as effective at protecting [content] against unauthorized redistribution (including unauthorized Internet redistribution) as is any one of the technologies then listed on Table A."

The first three of these routes to Table A listing clearly would allow self-interested industry members to make decisions about new proposed technologies. And even the "as effective as" proposal creates a risk that future innovators will not diverge from approaches that are similar to those taken by the 5C suite of technologies.[32]

For example, if someone develops a method (Technology 6Y) for securely emailing content to a member of a pre-existing home network (and erasing the original copy), how will the FCC decide if 6Y method is "as effective as" the 5C suite of technologies? The 5C suite would not allow such emailing to take place. Similarly, what if someone develops Technology 6Z, which allows 15-second clips of content to be taken and emailed to friends? Again, how would anyone decide whether such a technology was "as effective as" the 5C suite, which does not allow such uses. By requiring new technologies to compare themselves to already-approved technologies (by certifying that their new technology is "as effective as" an existing technology), relative criteria tether future innovators to the technologies and techniques of the past. Any technology that doesn't do what the 5C suite of technologies does, or does less, or does what it does differently, will look like an apple to an FCC that will be used to oranges.

Had the VCR been invented after the flag rules went into effect, it would not have been allowed to be marketed. VCRs neither protect against the unauthorized copying of content nor secure content from onward transmission, including transmission over the internet. They do the opposite: VCRs allow consumers to copy broadcasts and share them with family and friends. Indeed, at the time the current VCR entered the consumer market, Motion Picture Association of America (MPAA) president Jack Valenti told the

[32] Additionally, the FCC will be in the role of deciding what technologies are "effective" -- a part for which this agency has no special competence.

House Judiciary committee that "the growing and dangerous intrusion of this new technology" threatened his entire industry's "economic vitality and future security."[33]

Implementation of the flag scheme would clearly have deleterious effects on innovation, and the chilling effect of the flag discussions has already changed the course of product development in the U.S.[34] Similarly, "closing the analog hole" will have enormous effects on innovation, as every device accomplishing an analog-digital conversion will need to incorporate approved technology and be sufficiently non-tamperable to be considered "robust."

The special case of the general purpose computer provides a clear example of the effect on innovation and the course of product development that the flag/hole schemes may have.

The personal computer is a symbol of American innovation. Part of the reason for the success of digital computing has been the freedom to develop new products and services that take advantage of the extraordinary progress made in processing, storage, and transmission of digital information in connection with this open platform, standard device. One can see the startling results of such freedom in the growth of the Internet. Anyone can design and implement a new product or service at the edge of the Internet without seeking the approval of a central authority. Moreover, the design principle now enshrined at the center of the Internet is that Internet standards should not be optimized for any particular application, in order to prevent today's design constraints from preventing the emergence of tomorrow's big idea. Yet the current proposals for mandating particular technological protection mechanisms involve setting constraints on the design of all digital devices. Mammoth legal battles have been fought to prevent the exercise of private control over innovation in the personal computer software market through a monopoly over the operating system market; mandating particular design constraints to protect digital content seems to be moving in the opposite direction.

[33] As it turns out, VCR rental income has been an enormous boon to the movie industry. Facts re change in source of revenues for studios.
[34] Phillips story re machine with tracer that was cut.

Moreover, compliance with the broadcast flag (as currently proposed) would require the general purpose computer -- still an open-platform device -- to become "secure" and "untamperable." Would this mean that future generations of garage tinkerers would be unable to open their devices, poke, push, or prod in order to bring us the steady stream of innovation we have come to expect?

If the MPAA is successful in achieving its broadcast flag and analog hole goals, it will have ensured that the variability and fluctuations necessary for evolution to occur in innovation in consumer electronics and information technology products (as in any other complex system) do not exist.[35] This effort will keep new creatures -- new machines, new innovations, and new communications methods -- from coming into being.

V. KEEPING YOUR OWN CREATURE FROM BECOMING EXTINCT

The oft-repeated statement of the MPAA is that if the flag and hole schemes are not implemented, broadcast television "as we know it" will cease to exist.[36] By this they mean, presumably, that shows that are beloved by Americans (or would be, if Americans only watched them) will cease to be available for free.[37] But why should broadcast television be singled out for special protection against its environment?

It is true that many living Americans have a special fondness for the television programs of their youth. It is also true that the movie industry has a strong growth rate and a positive trade balance, and so deserves attention as a producer of jobs for Americans. But, despite the recent slump, computer and electronic product manufacturers

[35] The analog hole scheme, for example, dictates that all future innovation in this area will strike a "ceiling" of whatever rules are required in the broadcast flag scheme. The role for analog outputs will be to support legacy equipment, in the eyes of the MPAA. This is a major change from the status quo that has given us innovations like the VCR, where analog outputs not only supported legacy devices, but were generally available to support innovative products not yet imagined.

[36] This is not the first time the broadcast industry has made this claim. Brinkley book, Defining Vision, lists ten other occasions.

[37] Note that broadcast television is not really "free' because consumers buy the products advertised on the shows.

shipped $429.5 billion worth of goods in 2001.[38] These numbers far overshadow the $69.4 billion revenues of the movie and video industry over the same period.[39] Even the $93.2 billion of consumer electronic products shipped in 2001 seems large in comparison.[40] While it is important to ensure the proper functioning of the copyright system, it is fair to ask whether shifting costs to the IT industry makes sense.

Attempts to lock down information and force the production of lower capability devices -- in the face of technology trends that continue to improve the ability of these devices to record, store, manipulate, and transmit digital information -- also ignores the significant economic activity entailed by consumers' participation in digital content. Much consumer activity in this arena is, obviously, legal. Billions of dollars are spent annually by consumers for internet access, and this number is increasing daily as broadband penetration continues to grow. And the growth in the number of devices (particularly portable devices) that allow users access to content has been dramatic. Six million portable digital media players were shipped in 2001, up 50% from the year 2000.[41]

Natural selection involves removing unsuccessful gene combinations (combinations that have not adapted successfully to a particular environment) from a population.[42] Vacuum tubes are no longer being manufactured, because their place has been taken by transistors.[43] Similarly, broadcast television's role in American culture and the American economy may have been overtaken by other forms of digital information.[44] More people are spending more time in front of screens, but the screens are not showing them broadcast television. Instead, people are watching internet

[38] U.S. Bureau of the Census, "Annual Survey of Manufacturers: Statistics for Industry Groups and Industries 2001" Table 2, p. 37, January 2003 (http://www.census.gov/mcd/asm-as1.html).
[39] U.S. Bureau of the Census, 2001 Service Annual Survey: Information Sector Services, Table 3.0.1. (http://www.census.gov/svsd/www/sas51.html).
[40] Consumer Electronics Association, Digital America: Industry Outlook http://www.ce.org/publications/ books_references/digital_america/default.asp.
[41] Need current figures. Raymond James report at 48.
[42] notes re removal of gene combinations.
[43] need more facts.
[44] facts about time in front of television screens vs. other devices.

programming of various kinds, as well as cable and satellite programming for which they pay subscription fees. The idea of protecting "free," unencrypted, over the air broadcasting by crippling devices that receive it (and devices that are traditionally thought of as open platforms, such as the general purpose computer) does not make much sense.[45]

The MPAA is seeking not only to protect broadcast television "as we know it," but also to protect the studios' particular business model -- which depends on controlled re-release of content through various windows in carefully-delineated regions of the world. This business model is based on control over distribution of hard copies of works. In an era of physical distribution of content "objects" (such as books, software, movies, and music saved on physical media), creators (or other rights holders) could divide the bundle of intellectual property rights both geographically and temporally with some assurance that the divisions would be meaningful. Thus, release of a book in England would not necessarily dictate that copies would "leak" into the U.S. in great numbers. The physical difficulty and cost involved in copying, crating and shipping books militated against easy or widespread piracy. And the economic costs of the leakage were sufficiently limited that distributors did not feel directly threatened.

Now, in the digital era, the friction and cost involved in copying physical content-goods has radically diminished. All a person has to do now is save a file to a publicly accessible folder on his or her hard drive, where it can be redistributed to other users via peer-to-peer file sharing services. Or that person can email the file as an attachment to a message sent to many people. Or that person can upload the file to a personal web page and make it visible to the world. The capability of the internet to allow worldwide, instantaneous, cost-free distribution of perfect, non-degradeable copies makes the digital world frightening to owners of high-investment content. The video content world has responded to this fear by asserting that they need legal protection that will allow them to replicate in the digital world the "friction" found in the analog world that makes unauthorized

[45] Theoretically, DTV movies and shows could be protected from piracy by encrypting the digital broadcast before transmission ("encryption at the source"). There are political issues embedded here, however. The historic availability of "free" over-the-air television is almost an article of faith at the FCC.

distribution difficult or impossible. Indeed, the MPAA even speaks of the broadcast flag and analog hole proposals as creating "speed bumps" that slow down the ease of reproduction and transmission of their content in the online world. The studios, as far as anyone can tell, are not aggressively pursuing online content business models.[46] Instead, they are working at many levels (international agreements, treaties, federal and state law) to make the online world adapt to them.[47]

By contrast to the video content approach to the world, the music industry is beginning to adapt to the digital environment -- creating new business models that fit this world. Apple's iTunes Music Store, providing music downloads from a large library of songs, processed as many downloads on its opening day in May 2003 as had been collectively requested from the other competing download services over a six-month period -- more than 200,000. The reasons for the Music Store's popularity are many. Rather than streaming music, it offers all the songs available for download from the big-five record labels for $.99 each -- and is very easy to use. Users can save downloaded tracks on multiple devices, and can copy music onto their own CDs -- allowing time- and space-shifting.[48] Further experimentation will undoubtedly explore different forms of private DRM that will be successful in the marketplace.

The video content industry should be left to adapt to the changed conditions of the online digital world, just as the audio content industry has had to do. Private DRM systems will provide the variability, choice, and fluctuations that are needed -- while, in the meantime, protecting content.[49] The video content industry's approach has been, instead, to act as if their particular creature should be globally protected from extinction -- a very unnatural

[46] They did try MovieLink, but it hasn't worked. Why? Explain bandwidth issues.
[47] Details re WIPO, FTAA agreements, state DMCA laws, other.
[48] The iTunes Music Store uses the Advanced Audio Coding (AAC) format -- a form of DRM. Downloaded files can be played on up to three computers and can be copied onto CDs. An album can be copied no more than ten times.
[49] DRM can always be hacked. But private systems will provide the "speed bump" that MPAA says it is looking for, without needing a global, uniform solution. As long as there is adequate choice in DRM systems (something with which global competition law should be concerned), evolution of devices and uses (and copyright law, as discussed below) can continue to flourish.

request.

VI. THE ROLE OF LAW

The first part of this paper has been descriptive, pointing out how the content industry's references to evolution do not make sense -- and how their pleas for legal protection fly in the face of evolutionary theory. But the most troubling aspect of the broadcast flag/hole discussion is its theoretical discontinuity with our shared American beliefs about law.

Whatever we understand "law" to be -- social patterns that are labeled "law," per Robert Cover,[50] or a complex social institution, per H.L.A. Hart[51] -- we do not think of law as a regime of its own. Law is not something that exists in the abstract, in a fixed state, and is handed down to citizens from above. Law cannot be, we believe, separated from the constituencies that are affected by law's statutes, court decisions, and other expressions.

Many scholars have asserted that law is a complex adaptive system, characterized by unpredictability and sensitivity to initial conditions.[52] David Post and Michael Eisen have described law as a

[50] Robert M. Cover, The Folktales of Justice: Tales of Jurisdiction, 14 Cap. U. L. Rev. 179, 179 (1985).

[51] H.L.A. Hart, The Concept of Law 1 (1st ed. 1961).

[52] E.g., .B. Ruhl, Thinking of Environmental Law as a Complex Adaptive System: How To Clean Up the Environment by Making a Mess of Environmental Law, 34 Hous. L. Rev. 933 (1997); J.B. Ruhl, Is The Endangered Species Act Eco-Pragmatic? 87 MNLR 885 (2003); see also, e.g., Hope M. Babcock, Democracy's Discontent in a Complex World: Can Avalanches, Sandpiles, and Finches Optimize Michael Sandel's Civic Republican Community?, 85 Geo. L. J. 2085 (1997) (critiquing civic republican political theory using complex systems principles); Vincent Di Lorenzo, Complexity and Legislative Signatures: Lending Discrimination Laws as a Test Case, 12 J.L. & Pol. 637 (1996) (using chaos theory to evaluate the legislative response to alleged lending discrimination); Thomas Earl Geu, Chaos, Complexity, and Coevolution: The Web of Law, Management Theory, and Law Related Services at the Millennium, 65 Tenn. L. Rev. 925 (1998) (discussing complexity theory in the context of corporate structure, management, and law); J. B. Ruhl, Complexity Theory as a Paradigm for the Dynamical Law-and-Society System: A Wake-Up Call for Legal Reductionism and the Modern Administrative State, 45 Duke L. J. 849 (1996) (using complexity theory to develop a general behavioral model of legal system).

fractal "tree" that involves choices at ever-lower levels.[53] The creation of this fractal, complex system involves a social conversation about collective values. We have town meetings; we elect legislators; we appoint judges; we negotiate and arbitrate -- all of this activity, involving many people, is "law making." No one regime controls this activity, notwithstanding the positive or negative views of any particular administration at any particular moment in history.[54]

The content industry's suggestion in the broadcast flag/analog hole contexts is that copyright law be instantiated in code -- in content protection software systems that all U.S. manufacturers will have to include in any new device that touches particular digital content. As Larry Lessig has argued, software copyright protection programs that make software difficult to steal are a form of regulation created by programmers instead of legislators.[55] And Tim Wu has reminded us, "The prominent effects of computer code have made it difficult to ignore the fact that code can be used to produce regulatory effects similar to laws."[56]

But, unlike choices made by programmers, here the choice of what "code" to put in place will be made by the sovereign at the request of a single industry, and refusal to use particular software will be a violation of law. Code really will be law, and law will be indistinguishable from code. What relationship will the broadcast flag code have to copyright law?

For their part, the supporters of the broadcast flag and analog hole proposals assert that implementation of their plans would do no more than ensure that copyright law is followed by users. They say, for example, that if the broadcast flag scheme is passed into law

[53] David G. Post and Michael B. Eisen, How Long is the Coastline of the Law? Thoughts on the Fractal Nature of Legal Systems, 29 JLEGST 545 (2000) ("We believe, more specifically, that legal arguments have a kind of fractal structure--recursively generated and possessed of a branching, self-similar, treelike structure at all levels of the argumentation hierarchy"). Fractals are jagged curves or surfaces that retain the same level of jaggedness when looked at at any level of minuteness. Coastlines, for example, are fractal; the big bays and inlets will have little bays and inlets of the same general pattern.

[54] Ashcroft cites.

[55] Lawrence Lessig, Code and Other Laws of Cyberspace 89 (1999).

[56] Cite.

consumers will be allowed to make as many copies of DTV content as they want within their home networks, and that only a very generous reading of copyright law would allow this.[57]

But this statement is misleading. In the 5C world, once flagged content is recognized by a 5C compliant device, it cannot be transmitted to (or played on, or copied by) any noncompliant legacy device. So, if 5C is a approved technology listed on Table A, consumers will be able to copy content only on (or transmit content only to) compliant devices. For many consumers, this may mean substantial (and perhaps surprising) required upgrading of their home networks, and it is not clear that copyright law would require this.

More generally, the broadcast flag proposal will require users to operate machines that automatically prevent all "unauthorized" uses -- even uses that are not necessarily infringements of copyright.

By contrast, copyright law is based on the grant of specifically-defined rights to prevent (or remedy damage caused by) particular actions of other people. The copyright holder can choose to enforce her rights and obtain money damages or an injunction. The owner may also choose not to enforce her rights, because a particular abuse is not worth the investment. Many small infringements that have no particular economic consequences (or may even be good for the copyright holder, by increasing awareness of the work) get ignored. And many individuals choose to use content in ways they believe to be reasonable.

For example, the flag scheme leaves no place for so-called "first sale" rights. In the old world of copyright, it is perfectly legal to sell or give away your copy of a book. But in the new world of technologically-enforced permissioning through the flag, which entails only licenses, not sales, that use might not be authorized. In the analog world, resale of objects that have been distributed is generally legal. In the world of the flag, "everything not permitted by the copyright holder is prohibited."[58]

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[57] Need MPAA cites to this.

[58] The so-called "first sale" doctrine embodied in Section 109(a) of the Copyright Act of 1976 provides that the copyright owner's right to control distribution of copies only extends to the "first sale." In other words, the Copyright Act grants to authors the exclusive right to distribute copies of their work, but limits that right by distinguishing between ownership of a copyright (the bundle of exclusive rights) and ownership of a copy (the tangible material in which a work is fixed), and by

Similarly, neither the flag scheme nor any hole proposal takes account of fair use rights. This may be an unfair criticism, because it would be impossible to "code" something as context-dependent as fair use, which requires an after-the-fact review of the circumstances under which a particular infringement took place. Fair use does not lend itself to clear and precise rules; for example, it is not clear whether sending an entire copy of a film or song to a friend over the internet is a fair use or not. Any coded description of what a "reasonable" use of particular content is would be very likely to bar future uses that might (in the context of a different time) be considered fair. But the answer of the content industry to the effect that "home copying is allowed," so no fair use concerns could possibly exist -- and no online transmission of their content could possibly be fair -- is insufficient.[59] Fixing the MPAA's vision of copyright law in code will produce a body of code-law that does not map to current copyright law, because it will not acknowledge first sale or fair use rights (or the duration of copyright or the idea/expression dichotomy).[60]

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extinguishing the copyright owner's distribution right after the first sale of each copy. This right is the basis for standard practices such as used book markets, library lending, and exchanges of copyrighted works between friends and family. This first sale doctrine has allowed the creation of libraries that provide access to copyrighted works to people who might not otherwise have such access. A library can buy a single copy of a work and then loan it to dozens or hundreds of people, one at a time, and, because of the first sale doctrine, such loans are not considered infringements of copyright. Although these loans might be seen as making it impossible for the publisher to make additional sales, as all potential purchasers are potential library patrons, we know that the creation of libraries did not kill the publishing industry in this country. Both authors and publishers have benefited from a broadly educated public.

[59] In the recent Eldred decision, the Supreme Court recognized that copyrights were not necessarily "categorically immune from challenges under the First Amendment," but held that as long as Congress did not "alter[] the traditional contours of copyright protection, further First Amendment scrutiny is unnecessary." Thus, any Congressional action that has the effect of substantially narrowing the public domain and/or eliminating fair use (perhaps by mandating particular DRM measures that made no allowance for fair use) might be subject to First Amendment scrutiny.

[60] Flagged material will include ideas that, once flagged, will not be free to spread. in unapproved ways. They will be free to be received inside a closed, approved

More broadly, once we understand that law is now code, and an "approved" version of code created by the content industry is in place, there will be no need for (or incentive for) further lawmaking. Adoption of the MPAA proposals will poison the fractal tree of copyright law by ensuring that evolution unapproved by the MPAA will not occur.[61]

This cannot be a desirable outcome. Law is, again, not a "regime" of its own, enforcing a particular worldview. In its most enlightened form, it is a platform that does not favor particular regimes or rulesets.[62] It should not cut across the protocol stack, making certain applications (or rulesets) more difficult to use.[63] Law should, and often does, facilitate the emergence of regimes with their own rulesets -- like religions and private groups -- and keep the effects of each of these groups from slopping over into the realm of other groups in ways that would cause harm. Law is supposed to tolerate the existence of multiple regimes, and should not allow one sphere to mandate rules in another. Indeed, arguably the only thing law can do wrong is to turn itself over to one regime.

Thus, the question of the broadcast flag and the analog hole is at bottom a question of jurisdiction -- the relationship of law to subsidiary rulesets.[64] There is nothing wrong with the content industry building gates around its own content -- private DRM systems are exactly that. But there *is* something wrong with the content industry using code-law to force groups that do not want gates (and are otherwise acting in a law-abiding fashion) to build them -- when the social conversation that is now copyright law has not chosen to outlaw these otherwise legal devices.[65]

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circle within the home network, but will not be available for transmission online. Information is not (usually) conserved; in the flag context, it will be.

[61] Post, supra; Ruhl Arizona article.

[62] Cf. US rules re gay marriage v. Kennedy remarks.

[63] Explain protocol stack. Religious freedom cites.

[64] Paul Schiff Berman, The Globalization of Jurisdiction, 151 U. PA. L. REV. 311 (2002).

[65] Like the Betamax case: The MPAA and its member companies were worried enough to use litigation to attempt to shut down the VCR industry. In the 1970s, Universal City Studios and Disney sued Sony for contributory copyright infringement for making (and selling) Betamax VCRs. The studios argued that Sony's machines materially contributed to unauthorized copying of protected works -- in this case, television programs. They maintained that such copying was

Some manufacturers will not want their devices to be crippled. Some manufacturers will believe that PCs should remain open platforms. Using code to mandate a particular vision of copyright law is, arguably, an abuse of the law-making function -- because it creates path dependencies that will be very difficult to change, cuts off all social conversation about the course of the law, and allows one regime to set rules for another without a social agreement that such rules are necessary.

Maybe it was inevitable that when our cultural technology turned digital we would begin to hope for law to be instantiated in zeros and ones -- adopting hard-edged software-enforced rules rather than fuzzy "fair use" concepts. Human beings are not as perfectly regulable as bits are, and technology-based rules governing the behavior of bits are more predictable than the current legal framework. We now have a situation where technology can trump existing legal rights: the proposed broadcast flag and analog hole systems theoretically allow control over access to works notwithstanding what the non-code-law says about fair use or first sale (or even the duration of copyright or the idea/expression dichotomy). But we should be careful not to poison the non-code-law's fractal tree.

VII. CONCLUSION

The "best" complex adaptive systems are very good at coping with changing conditions -- and do not fix on one regime at the expense of all others.[66] These systems range from the behavior of

not "fair use" because it was "nontransformative" -- no new works were being created by users, who were merely copying the works wholesale for their own purposes. The studios also pointed out that the entire work was copied by the user. (The amount of the work copied is a key factor in fair use analysis.) Because Sony knew or should have known that these private infringements were taking place, it was (so the studios said) a contributory infringer. In 1984, the Supreme Court heard the case and ruled that Sony's actions did not constitute contributory infringement because the VCRs were capable of substantial non-infringing uses. Here, similarly, most of the devices that will be required to adhere to the flag/hole schemes will be capable of substantial non-infringing uses.

[66] Many authors have described how complex processes and systems operate, survive and evolve surrounded by ever-changing conditions. See Murray Gell-

organisms in ecological systems, learning in human beings, to the evolution of human societies. "The common feature of all these processes is that in each one a complex adaptive system acquires information about its environment and its own interaction with that environment, identifying regularities in that information, condensing those regularities into a kind of "schema" or model, and acting in the real world on the basis of that schema."[67] The more complex the system (and law is a very complex system), the more numerous are the types of fluctuations that threaten its stability.

So how do such systems survive? The answer is likely "communication": "[T]he faster the communication takes place within a system, ... the more stable the system ...."[68] "Communication" may be another way of thinking about the non-code-law way of rulemaking -- a human role that we should not abandon.

The broadcast flag/analog hole issues are complicated and often ill-defined, even by the authors of the proposals now under consideration. We need to construct hypotheses to work with to confront these proposals. Biology provides a useful (if simple) way to understand how these proposals interact with the worlds of machines and law.

We need to become more comfortable with uncertainty in law. We should have confidence in our own social conversation about copyright law, even as the digital world suggests to us that protection of valuable copyrighted works could be made more globally certain. Loss of resiliency and adaptability, both in innovation and in law-creation, may not be worth trading away.

Mann, The Quark and the Jaguar (1994); Ilya Prigogine & Isabelle Stengers, Order Out of Chaos: Man's New Dialogue with Nature (1984); W. Brian Arthur, Complexity in Economic Theory: Inductive Reasoning and Bounded Rationality, 84 AEA Papers & Proceedings 406 (1994).

[67] Murray Gell-Mann, The Quark and The Jaguar, 17 (1994).

[68] "The stabilizing effect of communication, of diffusion processes, could be a partial answer to theses questions. In complex systems, where species and individuals interact in many different ways, diffusion and communication among various parts of the system are likely to be efficient. There is competition between stabilization through communication and instability through fluctuations. The outcome of that competition determines the threshold of stability." Ilya Prigogine & Isabelle Stengers, Order Out of Chaos: Man's New Dialogue with Nature 187-89 (1984).