Buffalo Intellectual Property Law Journal

Volume 10 | Number 1 Article 5

10-1-2014

Curing *Cablevision*: Prescribing a Functional Solution to a Technical Astigmatism

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NOTE

CURING *CABLEVISION*: PRESCRIBING A FUNCTIONAL SOLUTION TO A TECHNICAL ASTIGMATISM

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ABSTRACT

In a string of recent copyright cases, judges have increasingly adopted a technical approach to copyright law. Rather than evaluating contested technologies based on how the technologies are used, courts have focused their analysis on technical details of implementation. As a consequence, courts have constructed rules that limit technologies not in what they do, but how they do it. In this Article, I argue that courts should evaluate technologies based on functional considerations. I argue that this functional approach is constitutionally, statutorily, and practically preferable to a technical approach. Finally, I show that a functional approach would lead to decisions that are clearer, easier to understand, and better-reasoned.

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* Yale Law School, J.D., 2015; Stanford University, B.S. 2012. I would like to thank Rachel Rudinger, Victoria Cundiff, Firas Abuzaid, Molly and Stuart Adler, Philipp Kotlaba, Matt Kemp, and Alex Kasner for their many insightful thoughts and comments.

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INTRODUCTION

Judges do not make good engineers. In a string of recent copyright cases, judges across the country have increasingly adopted a technical approach to copyright law. Rather than evaluating contested technologies based on how the technologies are used, courts have focused their analysis on technical details of implementation. As a consequence, courts have constructed rules that focus on form rather than function—rules that limit technologies not in *what* they do, but how they do it. These decisions have encouraged inventions that engineers and commentators have described as "inefficient and convoluted," [1] "Rube Goldbergian," [2] "idiotic," [3] and "monstrously unscalable."[4] From a legal standpoint, they have led to paradoxical and inconsistent judicial holdings. For example, under some courts' interpretation of the Copyright Act, it would be legal to create and store one million identical copies of a television show for general distribution, but illegal to create and store one copy.[5]

In this Article, I argue that courts should evaluate technologies based on how they are used rather than on their underlying implementations. In advancing my argument, I will introduce and evaluate three approaches to copyright law: a pure-technical approach, which evaluates technology based on implementation details, a pure-functional approach, which evaluates technology based on how the technologies are used, and a hybrid approach, which looks to both implementation and usage. Ultimately, I will show that the pure-functional approach is statutorily, constitutionally, and practically preferable.

This paper builds on the current literature in three ways. First,

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[1] Jerry Brito, *How Government Regulations Distort the Television Airwaves*, REASON (Apr. 25, 2013), http://reason.com/archives/2013/04/25/how-government-regulations-distort-the-t [http://perma.cc/9NN2-VZ5B].

[2] Mike Masnick, *How Copyright Has Driven Online Streaming Innovators Insane*, INNOVATION (Aug. 31, 2012), http://www.techdirt.com/blog/innovation/articles/20120830/13260820222/how-copyright-has-driven-online-streaming-innovators-insane.shtml [http://perma.cc/F3VL-EWSV].

[3] Farhad Manjoo, *Don't Root for Aereo, the World's Most Ridiculous Start-up*, PANDODAILY (July 14, 2012), http://pandodaily.com/2012/07/14/dont-root-for-aereo-the-worlds-most-ridiculous-start-up [http://perma.cc/AV45-ZD32]; *see also* James Grimmelmann, *Why Johnny Can't Stream: How Video Copyright Went Insane*, ARSTECHNICA (Aug. 30, 2012), http://arstechnica.com/tech-policy/2012/08/why-johnny-cant-stream-how-video-copyright-went-insane [http://perma.cc/UPE3-RC8Y] (referring to a court-approved technology as "ridiculous").

[4] Manjoo, *supra* note 3.

[5] *See infra* Part I.A, discussing the decision in Cartoon Network LP v. CSC Holdings, Inc., 536 F.3d 121, 138 (2d Cir. 2008), *cert. denied*, 557 U.S. 946 (2009).

while numerous scholars have criticized technical decisions,[6] few have synthesized holdings across cases to identify a consistent judicial approach. Even fewer have proposed an alternate framework for courts to apply in future cases.[7] Second, this paper draws significantly from engineering principles and concepts. While courts often have difficulty comparing technologies and determining the extent to which new and old technologies differ, engineers and computer scientists have developed robust methods and techniques for evaluating, testing, and comparing different technical problems and solutions. As far as I can tell, this paper is the first to incorporate these methods when considering how courts should approach technical cases.[8] The final aspect of this paper that distinguishes it from similar works is its timeliness. Over the past two or three years, courts have issued a several technology-based copyright decisions. The Supreme Court even considered the issue recently in *American Broadcasting Cos., Inc. v. Aereo, Inc.*[9] This paper is the first to evaluate these recent decisions and to consider where courts currently stand on this issue.

This paper has four parts. In Part I, I will review a variety of copyright cases to highlight a split that exists in different courts' approach to technology. I will show how some courts have adopted a pure-technical approach while others have implemented a more balanced system of statutory interpretation. In Part II, I will define the pure-functional approach to copyright law, as well as the efficient-technical approach, a hybrid between the pure-technical and pure-functional approaches. In Part III, I will show how a pure-functional approach to copyright is constitutionally, jurisprudentially, and technically preferable to a technical approach. Finally, in Part IV, I will review the relative advantages and disadvantages of the efficient-technical approach.

I. RECOGNIZING THE TECHNICAL APPROACH

Courts across the country have splintered. On one side, a number

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[6] *See, e.g.*, Dennis S. Karjala, *"Copying" and "Piracy" in the Digital Age*, 52 WASHBURN L.J. 245, 249 (2013) (noting that "copying," as defined in the Copyright Act, does not take into account modern technologies).

[7] The article that comes closest to proposing a decisional framework proposes an approach that is drastically different from the one at the center of this paper. *See* Deborah Tussey, *Technology Matters: The Courts, Media Neutrality, and New Technologies*, 12 J. INTELL. PROP. L. 427 (2005) (describing a "media neutral" approach to copyright law).

[8] Specifically, this Article introduces the legal analogues of "black-box testing" and "reductability," concepts which are explained in greater detail later in this paper. *See* discussion *infra* in Part II.

[9] 134 S. Ct. 2498 (2014).

of courts, led largely by the Second Circuit Court of Appeals, have decided to interpret the Copyright Act in a manner that emphasizes implementation details and technical minutia. On the other side, courts led by the Ninth Circuit Court of Appeals have focused more on the use, function, and application of technology. In this Part, I will discuss a variety of copyright cases from around the country. As I describe the facts and holdings of the cases, I will show how courts differ from one another and will identify patterns and trends that have become prevalent in ongoing disputes.

This Part has three Sections. First, I will explain how courts have arrived at different interpretations of the § 106(4) right of public performance and will discuss the Supreme Court's decision in *Aereo*. Second, I will discuss how courts have arrived at different interpretations of the § 106(1) right of reproduction. Third, I will synthesize examples to show how many courts have adopted what largely amounts to a pure-technical approach to copyright law.

A. The Public Performance Right

The Copyright Act provides the owner of a copyright with the exclusive right to "perform the copyrighted work publicly."[10] Despite several amendments to the Act, the meaning and scope of "public performance" has been hotly contested for decades.[11] Section 101 of the Act states:

> to perform or display a work "publicly" means—(1) to perform or display it at a place open to the public or at any place where a substantial number of persons outside of a normal circle of a family and its social acquaintances is gathered; or (2) to transmit or otherwise communicate a performance or display of the work to a place specified by clause (1) or to the public, by means of any device or process, whether the members of the public capable of receiving the performance or display receive it in the same place or in separate places and at the same time or at different times.[12]

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[10] 17 U.S.C. § 106 (6) (2012).

[11] *See, e.g.*, *Aereo*, 134 S. Ct. 2498; Twentieth Century Music Corp. v. Aiken, 422 U.S. 151, 157 (1975) (deciding whether a restaurant owner can play the radio for his customers); Fortnightly Corp. v. United Artists Television, Inc., 392 U.S. 390, 395 (1968) (deciding whether the retransmission of a television broadcast via coaxial cables constitutes a public performance), *superseded by statute*, Copyright Revision Act of 1976, Pub. L. No. 94-553, 90 Stat. 2541; Buck v. Jewell-LaSalle Realty Co., 283 U.S. 191, 196 (1931) (determining whether a hotel proprietor violated the right of public performance when he used a radio to allow customers to hear musical compositions).

[12] 17 U.S.C. § 101 (2012).

The meaning of this definition has been the subject of intense litigation. In this Section, I will show how courts have interpreted § 101 in drastically different ways.

1. Redd Horne & On Command

In *Columbia Pictures Industries, Inc. v. Redd Horne, Inc.*,[13] the owner of a video rental store created a service that allowed customers to watch videos in private viewing booths located in the back of the store.[14] At a customer's request, the clerk would insert a video cassette into a VCR located at the front of the store and would transmit the video signal to the customer's viewing booth.[15] Columbia Pictures sued the video store, claiming the store violated the § 101(4) right of public performance. The Third Circuit Court of Appeals agreed. In reaching its decision, the court relied on the commercial nature of the service.[16] Because the service was "open to the public," the court found that it implicated the "transmit" clause of the § 101 public performance definition.[17]

The court, however, did not stop its analysis after making this determination. Instead, it decided the case again on alternate grounds. The court stated that the viewing service constituted a public performance because, "although Maxwell's has only one copy of each film, it shows each copy repeatedly to different members of the public."[18] This alternate justification differs significantly from the court's primary holding. Whereas the primary holding focuses broadly on the relationship between the challenged service and the general public, the second justification rests on a *technical* distinction that required the court to determine whether a copy is "unique." While this distinction did not alter the outcome in *Redd Horne,* it caused substantial trouble in future cases.[19]

While *Redd Horne* was decided by the Third Circuit, courts in other areas of the country were soon forced to grapple with the same problems. For example, in *On Command Video Corp. v. Columbia*

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[13] 749 F.2d 154 (3d Cir. 1984).

[14] *Id.* at 156-57.

[15] *Id.*

[16] *Id.* at 159.

[17] *Id.*

[18] *Id.*

[19] It is interesting to note that the introduction of this inquiry was both unnecessary and, relative to the court's primary reason for decision, unjustified. In this sense, the alternative justification amounts to dicta. "A holding consists of those propositions . . . that (1) are actually decided, (2) are based upon the facts of the case, and (3) lead to the judgment. If not a holding, a proposition stated in the case counts as dicta." Michael Abramowicz & Maxwell Stearns, *Defining Dicta*, 57 STAN. L. REV. 953, 1065 (2005).

Pictures Industries,[20] a court in the Ninth Circuit considered the validity of an early pay-per-view system. On Command developed a system for the electronic delivery of video tapes in hotels. Participating hotels would store a collection of video tapes in a central storage room.[21] Using a wired transmission system, the hotel would allow patrons to play videos remotely from their rooms.[22] As in *Redd Horne,* the court found that the transmission of videos constituted a public performance as defined by § 101.[23] Specifically, the court found that "hotel guests . . . [are] members of 'the public' . . . because the relationship between the transmitter . . . and the audience . . . is a commercial, 'public' one."[24]

While a number of courts have relied on the relationship between sender and receiver when assessing whether a transmission or performance is "to the public," this distinction has recently been called into question. Specifically, in *Cartoon Network v. CSC Holdings, Inc.* ("*Cablevision*"), the Second Circuit abandoned the functional "nature-of-the-relationship" test in favor of *Redd Horne*'s "unique-copy" test.[25]

2. Cablevision

Cablevision is a cable company that provides television programming to its subscribers. Like other companies, Cablevision obtained license agreements with content providers to obtain permission to transmit television programs to its subscribers. [26] Following in the steps of TiVo, Cablevision planned to offer a Digital Video Recording (DVR) system.[27] DVR systems function like a digital VCR. They allow users to record television programs and to store those programs on local hard drives.[28] Unlike standard DVRs, however, Cablevision intended to create a *Remote* Storage DVR (RS-DVR). Cablevision's RS-DVR system would store recordings of programs at a remote location, rather than on a device located in subscribers' homes.[29] The technical details of the RS-DVR system are complex and are outlined in detail in Figure 1. What matters most, however, is that, to facilitate the system, Cablevision routed all television programs, 0.1

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[20] 777 F. Supp. 787 (N.D. Cal. 1991).

[21] *Id.* at 788.

[22] *Id.*

[23] *Id.* at 790.

[24] *Id.*

[25] Cartoon Network LP v. CSC Holdings, Inc., 536 F.3d 121, 138 (2d Cir. 2008), *cert. denied*, 557 U.S. 946 (2009).

[26] *See id.* at 124-25.

[27] *Id.* at 124.

[28] *See Roamio Product Page*, TiVo, https://www.tivo.com/shop/roamio [http://perma.cc/6Q8J-VSPY].

[29] *Cartoon Network LP*, 536 F.3d at 124.

seconds a time, through an ingest buffer.[30] When a customer requested access to a program, the RS-DVR system would route the program, 1.2 seconds a time, through a secondary buffer before finally copying the program to the subscriber's designated hard drive.[31] A subscriber would only be able to access his or her designated hard drive.[32] As a result, if 1,000 subscribers requested a program, Cablevision would create and store 1,000 copies of that program.[33]

Content providers filed suit, claiming the RS-DVR system infringed their public performance right.[34] In interpreting the statutory definition of public performance, the Second Circuit deviated from the approach used in *On Command.* The court engaged in a great deal of definitional and interpretational gymnastics and arrived at the conclusion that "the transmission of a performance is itself a performance."[35] Based on this interpretation, the court confusingly decided that the relevant audience for § 101 was not the audience of the *underlying* performance—all subscribers who could view the television program—but was instead the audience of the *performance of the performance*—the audience of a specific transmission.[36] Because each user would receive a "unique" transmission, the court found that all performances were necessarily private.[37]

In explaining its rationale, the court discussed the significance of having a "unique copy." Citing *Redd Horne*, the court held that "the use of a unique copy may limit the potential audience of a transmission and is therefore relevant to whether that transmission is made 'to the public.'"[38] In advancing this argument, however, the court walked into the woods without a map and in the wrong direction—the court adopted a *technical* criterion to evaluate a *functional* implication. That is, the court was interested in limiting the size of a potential audience. But instead of considering the audience of a transmission *directly*, the court decided to use a nonsensical proxy. What is most bizarre is that the court seemed to ignore the fact that in the very case it decided, the creation and transmission of multiple unique copies[39] allowed an

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[30] *Id.* at 124-25.

[31] *Id.*

[32] *Id.* at 125.

[33] *See id.* at 124-25.

[34] *Id.* at 126.

[35] *Id.* at 134.

[36] *Id.* at 135 ("It is evident that the transmit clause directs us to examine who precisely is "capable of receiving" a particular transmission of a performance.").

[37] *See id.* at 134-36.

[38] *Id.* at 138.

[39] That the phrase "multiple unique copies" is an oxymoron is the point. The fact that identical copies are stored in multiple locations does not change the reality that

audience of *millions* to receive and view performances of copyrighted works. Regardless of what one thinks about the outcome of *Cablevision*,[40] what is clear is that, when deciding the case, the Second Circuit departed from the precedents set by the Third and Ninth circuits by focusing on form rather than function.

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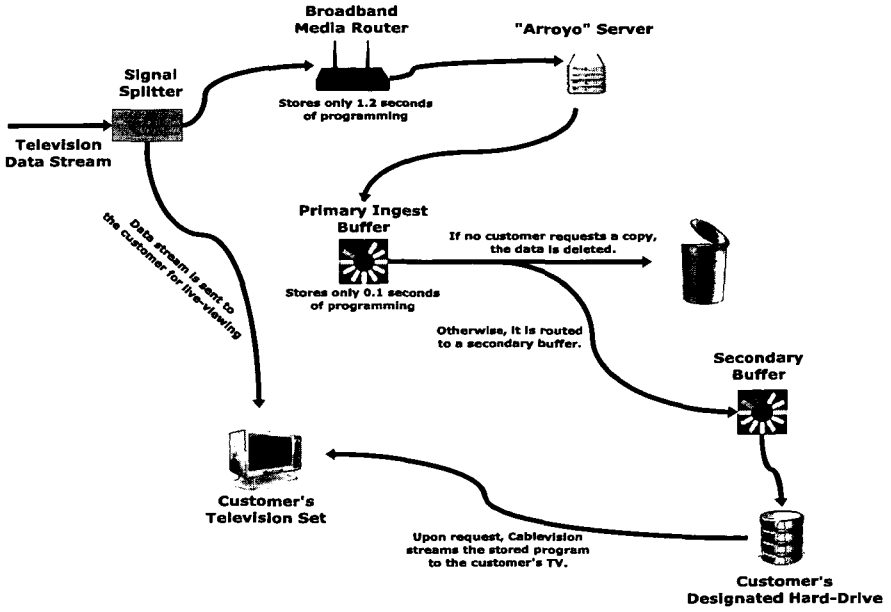
they are, in fact, not "unique."

[40] For reasons stated *infra*, in Part II, I believe the court reached the correct conclusion, but for the reason. I acknowledge, however, that even under a functional approach, the case could have been decided in favor of either party. What matters most is not the outcome, but the reasoning used to arrive at that outcome.

FIGURE 1: CABLEVISION'S RS-DVR SYSTEM



This figure illustrates each of the component steps of Cablevision's RS-DVR system. As Judge Walker explained:

> Under the new RS–DVR, [a] single stream of data is split into two streams. The first is routed immediately to customers . . . . The second stream flows into a device called the Broadband Media Router ("BMR"), which buffers the data stream, reformats it, and sends it to the "Arroyo Server," which consists, in relevant part, of two data buffers and a number of high-capacity hard disks. The entire stream of data moves to the first buffer (the "primary ingest buffer"), at which point the server automatically inquires as to whether any customers want to record any of that programming. If a customer has requested a particular program, the data for that program move from the primary buffer into a secondary buffer, and then onto a portion of one of the hard disks allocated to that customer. As new data flow into the primary buffer, they overwrite a corresponding quantity of data already on the buffer. The primary ingest buffer holds no more than 0.1 seconds of each channel's programming at any moment. Thus, every tenth of a second, the data residing on this buffer are automatically erased and replaced. The data buffer in the BMR holds no more than 1.2 seconds of programming at any time. While buffering occurs at other points in the operation of the RS–DVR, only the BMR buffer and the primary ingest buffer are utilized absent any request from an individual subscriber.[41]

[41] *Cartoon Network LP*, 536 F.3d at 124-25.

3. Aereo

Cablevision turned out to be an influential case. It inspired new technologies that were designed to take advantage of the court's technical reasoning. The most notable technology to follow *Cablevision* was Aereo. Aereo allowed its subscribers to receive broadcast television over the internet. But unlike prior services that courts have found illegal,[42] Aereo did not broadcast television signals directly. Instead, it assigned each of its subscribers a mini-antenna.[43] Each antenna received a broadcast signal and used a remote hard drive (also assigned to an individual subscriber) to store the transmission.[44] Upon request, Aereo would stream the program from the customer's designated hard drive to the customer's computer or mobile device.[45] Aereo's antenna system was similar to Cablevision's RS-DVR in that it went to great lengths to collect, create, and store independent, "unique" files for each of its subscribers.

In response to the Aereo service, numerous content providers filed suit, alleging that Aereo's service constituted an infringing public performance.[46] In a straightforward application of its decision in *Cablevision*, the Second Circuit Court of Appeals held that Aereo's system did not constitute a public performance.[47] The court recognized that Aereo was similar to Cablevision in two essential respects: first, each transmission could only be received by one subscriber rather than by the public at large. Second, each subscriber received a unique copy of the underlying work.[48]

In response to the Second Circuit decision, the Plaintiffs appealed to the Supreme Court. In a 6-3 decision, a fractured Supreme Court reversed the court of appeals.[49] Notably, the Court disagreed about the correct way to approach the case. Writing for the majority, Justice Breyer argued that implementation details were irrelevant and that the most important consideration was the way consumers interacted with the technology. Specifically, Justice Breyer found that technological differences should not matter[50] and that "the many [functional]

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[42] *See generally* WPIX, Inc. v. Ivi, Inc. 691 F.3d 275 (2d Cir. 2012) (holding that a service that streamed copyrighted television live over the internet did not qualify as a "cable system" under the Copyright Act), *cert. denied*, 133 S. Ct. 1585 (2013).

[43] WNET, Thirteen v. Aereo, Inc. 712 F.3d 676, 683 (2d Cir. 2013).

[44] *Id.*

[45] *Id.*

[46] *Id.* at 680.

[47] *Id.* at 684-95.

[48] *Id.* at 689-90.

[49] Am. Broadcasting Cos., Inc. v. Aereo, Inc., 134 S. Ct. 2498 (2014).

[50] *See id.* at 2508.

similarities between Aereo and . . . cable companies" provides sufficient reason to regulate Aereo as if it were a cable company—meaning that Aereo should not be able to retransmit (or facilitate the retransmission) of television signals.[51] In contrast, Justice Scalia, writing in dissent, placed more emphasis on implementation details. Scalia argued that it would be improper to treat Aereo like a cable company for the simple reason that it is *not* a cable company.[52] Scalia went on to argue that a strict reliance on functional equivalence (which he called "guilt-by-resemblance") [53] without considering prior precedents or the text of a statute risks creating a "two-tier[ed] version of the Copyright Act," where one part "applies to 'cable companies and their equivalents' while the other governs everyone else."[54]

The cases described in this Section constitute only a sample[55] of the cases attempting to interpret and understand the meaning of § 101's public performance clause. The cases adequately show how courts at all levels have not been able to reach a consensus on the proper framework for evaluation. I will revisit *Cablevision* and *Aereo* in Part II.

B. The Reproduction Right

The use of a technical perspective when interpreting the Copyright Act is not unique to courts' interpretation of "public performance." In this Section I will show how courts have also adopted a technical approach when interpreting and defining the § 106(1) reproduction right.

1. ReDigi

The first case I will discuss is *Capitol Records v. ReDigi*.[56] ReDigi operated a service that allowed consumers to resell digital music files over the internet.[57] The district court from the Southern District of New York explained how ReDigi operates:

> To sell music on ReDigi's website, a user must first download ReDigi's "Media Manager. . .Once installed, Media Manager analyzes the user's computer to build a list of digital music files eligible for sale. A file is eligible only if it was purchased

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[51] *Id.* at 2507. Notably, the majority did not overturn the Second Circuit's decision in *Cablevision*. *See id.* at 2510-11; *id.* at 2517 (Scalia, J., dissenting).

[52] *Id.* at 2515 (Scalia, J., dissenting) (noting that "there are material differences between" Aereo and the cable systems considered by the Court in previous cases).

[53] *Id.* at 2517 (Scalia, J., dissenting).

[54] *Id.* at 2516 (Scalia, J., dissenting) (quoting *id.* at 2506-07).

[55] For more cases, see *infra* note 71.

[56] 934 F.Supp 2d 640 (S.D.N.Y. 2013).

[57] *Id.* at 645-46.

> on iTunes or from another ReDigi user .... After this validation process, Media Manager continually runs on the user's computer and attached devices to ensure that the user has not retained music that has been sold or uploaded for sale.... If a copy is detected, Media Manager prompts the user to delete the file.[58]

The result of ReDigi's service was that after a customer sold a music file, the file could not exist on the seller's computer.[59] Moreover, the seller was no longer able to access the music file unless he made an external copy.[60]

Shortly after ReDigi introduced its service, Capitol Records filed suit in the Southern District of New York, alleging that ReDigi infringed on its reproduction right.[61] In deciding against ReDigi, the court found that the end-state of the file (*i.e.*, that only one copy of the file existed at the end of an exchange) was irrelevant and that the only consideration for the court was the technical question of whether the music file had, in a strict sense, been copied or reproduced over the course of the transaction.[62]

2. Cablevision

Cablevision implicated not just the public performance right, but also the reproduction right. As described above, Cablevision implemented its RS-DVR system by copying television programs, 1.2 seconds at a time, into a buffer.[63] The buffer, however, was limited in size, such that no data remained in the buffer for more than a few seconds—information was constantly transferred and overwritten.[64] However, when a subscriber subsequently transmitted a request to see the recorded program, he would be able to view the program in its entirety as originally broadcast.[65]

Section 101 of the Copyright Act states that a work is only copied if its embodiment in a medium is "sufficiently permanent or stable to permit it to be perceived, reproduced, or otherwise communicated for a period of more than transitory duration." When the Second Circuit

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[58] *Id.* at 645.

[59] *See id.*

[60] *See id.*

[61] *Id.* at 647.

[62] *Id.* at 650 (holding that ReDigi violated the reproduction right "regardless of whether one or multiple copies of the file exist" at the end of the transaction).

[63] *Supra* fig.1.

[64] *Id.*

[65] *See id.*

considered Cablevision's system in the context of the reproduction right, there was no question that the system reproduced copyrighted works without permission.[66] The only question for the Second Circuit was whether the reproductions were sufficiently "fixed" to constitute a "copy" under the Copyright Act.[67] In deciding this question, the Second Circuit focused most of its attention on the "transitory duration" requirement of § 101. Its analysis once again privileged a technical approach over an interpretation that would take into account the broader policy goals of the Copyright Act.

Ultimately, the court provided a blanket justification for any technical system that stores copies for only a brief period of time, regardless of what is later done to or with the copy.[68] In essence, the court applied a human-perception standard of "transitory" rather than the more apt computer-centric standard. In doing so, the court ignored the fact that a computer can, in 1.2 seconds, thoroughly copy, analyze, and process *billions* of bytes.[69] So while the fixation may be fleeting in time, it is substantial in volume. As a result, the court did not consider the broad legal and functional implications of its decision. Rather than focusing on the purpose of the Copyright Act, the court authorized a particular technical approach which, as discussed below, if carried to its logical conclusion would swallow § 106 of the Copyright Act whole.

C. Constructing the Pure-Technical Approach

In the previous two Sections, I described a number of cases dealing with the reproduction right and the public performance right. Collectively, the cases highlight the fact that some courts, especially those in the Second Circuit, interpret the Copyright Act in a manner that creates implementation-based rules, standards and guidelines. That is, rather than focusing on the *service* provided by a technology or on the ways in which consumers interact with the technology, these courts focus on the details of implementation: whether a copy is

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[66] *See* Cartoon Network LP v. CSC Holdings, Inc., 536 F.3d 121, 129-30 (2d Cir. 2008), *cert. denied*, 557 U.S. 946 (2009).

[67] *See id.*

[68] Perhaps realizing this, the court attempted to limit the scope of its holding, stating that its conclusion was limited only to the RS-DVR technology involved in the case. *Id.* at 139 ("This holding . . . does not generally permit content delivery networks to avoid liability by making copies of each item of content and associating one unique copy with each subscriber to the network . . . ."). But as demonstrated by *Aereo*, without a limiting condition or principle, the court's attempt to issue a narrow ruling was hardly successful.

[69] *E.g.*, Jeff Tyson, *How Computer Memory Works*, HOW STUFF WORKS, http://computer.howstuffworks.com/computer-memory2.htm [http://perma.cc/T5A8-RFG2] (indicating that modern CPUs can analyze "potentially billions of bytes per second").

"unique," whether a reproduction exists for less than 1.2 seconds, whether a transmission can be received by one person or many people. This approach, which I refer to as the pure-technical approach to statutory interpretation, is characterized by a tendency to evaluate the legitimacy of technology according to its implementation details. Under the pure-technical approach, a service will be judicially acceptable if the court finds its specific technical implementation compliant with court-made technical guidelines. [70]

While some courts have adopted a pure (or close to pure) technical approach, others (as in *Redd Horne*, *On Command,* and *Aereo*) have focused more on the *functional* implications of technology. The *Aereo* court found Aereo infringed the public performance right because it transmitted, en masse, broadcast transmissions to the general public over the internet; the *Redd Horne* and *On Command* relied primarily on the functional relationship between facility-owner and guest. It is worth noting that the cases discussed above are by no means exhaustive. They represent only a small sampling of the functional-technical interpretation debate.[71] For the remainder of this paper, I will use the cases described in this Part to define, describe, and defend several alternatives to the pure-technical approach.

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[70] I do not mean to suggest that judges adhering to a technical approach are "activist" or arbitrary. When I say the guidelines are "court-made," I simply mean that the guidelines are not written explicitly into the Copyright Act.

[71] For more cases that deal with these or similar issues, see generally, for example, United States v. Am. Soc. of Composers, Authors, Publishers, 627 F.3d 64 (2d Cir. 2010) (deciding whether downloading a music file over the internet constitutes a public performance), *cert. denied*, 132 S. Ct. 366 (2011); National Football League v. PrimeTime 24 Joint Venture, 211 F.3d 10 (2d Cir. 2000) (deciding whether transmitting a broadcast signal to a satellite which in turn publically broadcasts the signal to a location outside the jurisdiction of the Copyright Act constitutes a public performance), *cert. denied*, 532 U.S. 941 (2001); and Sega Enterprises Ltd. v. Accolade, Inc., 977 F.2d 1510 (9th Cir. 1992) (deciding whether reverse-engineering computer code violates the exclusive reproduction right); Warner Bros. Entm't Inc. v. WTV Sys., Inc., 824 F. Supp. 2d 1003 (C.D. Cal. 2011) (considering whether an automated DVD rental system, which broadcasted movies over the internet, infringed on a movie studio's public performance right). For criticisms of *Cablevision*, see, for example, Jeffrey Malkan, *The Public Performance Problem in* Cartoon Network LP v. CSC Holdings, Inc., 89 OR. L. REV. 505 (2010); Joshua C. Liederman, Note & Comment, *Changing the Channel: The Copyright Fixation Debate*, 36 RUTGERS COMPUTER & TECH. L.J. 289 (2010); Marc Miller, Comment, Cartoon Network LP v. CSC Holdings, Inc., 54 N.Y.L. SCH. L. REV. 585 (2010); and Christopher Vidiksis, Note, *How to Buffer Your Way Out of A Scrape: Potential Abuse of the* Cartoon Network v. Cablevision *Decision*, 4 BROOK. J. CORP. FIN. & COM. L. 139 (2009). But for praise of *Cablevision*, see, for example, Jesse Harman, Case Note & Comment, *Drawing A Line Between Direct and Contributory Copyright Infringement: The Second Circuit's Take on A Copying Service Provider's Direct Liability in* Cartoon Network v. CSC Holdings, 19 DEPAUL J. ART, TECH. & INTELL. PROP. L. 397 (2009).

II. DEFINING THE FUNCTIONAL APPROACH

While some courts have rejected the technical approach, few, if any, have adopted a consistent alternative framework. In this section, I will introduce such a framework, the pure-functional approach. Under the pure-functional approach, courts would evaluate technologies based on the technologies' functional capabilities.

This Part will have four Sections. First, I will introduce the concept of functional equivalence—an essential element of the pure-functional approach. Second, I will introduce and define the pure-functional approach. Third, I will introduce the concept of functional reducibility and will show how courts can use reducibility analysis to evaluate new technologies. Finally, I will introduce the efficient-technical approach, which represents a compromise between the pure-functional and pure-technical approaches.

A. Functional Equivalence

The principle underlying the pure-functional approach is that the legal legitimacy of a technology should depend completely (or almost completely) on what the technology allows an end-user to accomplish. In other words, the implementation details of a given technology should not significantly impact the technology's legitimacy in the copyright context. A natural corollary of this principle is that, absent an extrinsic harm,[72] two technologies that perform the same function should be equally legitimate (or illegitimate) in the eyes of the law, regardless of their underlying implementation. This principle, known to engineers as a "black-box" approach,[73] requires some parsing.

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[72] By extrinsic harm I mean a legally cognizable harm articulated and defined without reference to the copyright claim implicated by the technology. Consider a *VCRX* which allows users to time-shift incoming television programs but that, in the process, releases poisonous radiation. In *Sony Corp. of America v. Universal City Studios, Inc.*, 464 U.S. 417 (1984), the Supreme Court held that time-shifting qualifies as fair use. Nevertheless, environmental regulations prohibit the emission of poisonous radiation. Even though the *VCRX* is functionally equivalent to a standard VCR, we still have good cause to prohibit the device because of its implementation. Not because it runs afoul of copyright law, but because it harms the environment. The requirement that the harm be defined outside the scope of the copyright claim is essential. Because the purpose of a legal functional framework is to determine, based on end-user functionality, whether a given technology violates an exclusive copyright privilege, any reference to an implementation-based copyright harm would assume an answer to the problem we are trying to solve. Such an argument would constitute circular reasoning—suggesting that a given technical implementation runs afoul of copyright law by running afoul of copyright law.

[73] The term "black-box" refers to a system whose implementation is hidden from the end-user. *See* Boaz Barak, NON-BLACK-BOX TECHNIQUES IN CRYPTOGRAPHY vii (Jan. 6, 2004) (unpublished Ph.D. thesis, Feinberg Graduate School of the Weizmann Institute of Science), http://www.boazbarak.org/Papers/thesis.pdf

We can say an instance of technology (*X*) is functionally equivalent to another instance of technology (*Y*) if, from the perspective of all potential end-users (and affected parties), *X* performs the same function as *Y*. In this definition, end-users are individuals for whom the technology was designed.[74]

Functional equivalence applies to some of the technologies discussed in the cases above. In *Cablevision,* for example, the court found that, with respect to video recording and video playback,[75] Cablevision's RS-DVR system was functionally equivalent to standard DVR systems—systems the Plaintiffs never challenged.[76] Likewise, in *Aereo*, the Second Circuit recognized that, with respect to video recording and playback capabilities, *Aereo* is functionally equivalent to a DVR and Slingbox.[77] When *Aereo* reached the Supreme Court, functional equivalence was arguably the most important part of the Court's decision—with the majority and dissent disagreeing about whether *Aereo*'s service was functionally equivalent to services provided by cable companies.[78]

[http://perma.cc/JJQ6-PXXY]. Interestingly enough, there is an ongoing debate in computer science about how technology should be tested. *See* Tyner Blain, *Foundation Series: Black Box and White Box Software Testing*, TYNER BLAIN (Jan. 12, 2006), http://tynerblain.com/blog/2006/01/12/foundation-series-black-box-and-white-box-software-testing [http://perma.cc/2M66-XXDU]. Some advocate for black-box testing, which ignores implementation details, others for white-box testing, which uses implementation details to construct tricky edge-cases, and still others for grey-box testing, which combines white and black box testing. *Id.* While the considerations involved for computer scientists are radically different from the considerations required for the Copyright Act, a review of the relevant computer science literature adds some informative texture to the legal debate.

[74] In almost all cases, the end-users will be consumers. This analysis is limited to technologies which, once distributed, do not require any action by individuals other than the end-user.

[75] On an absolute level, standard DVR systems and Cablevision's RS-DVR system are not functionally equivalent. Some customers might place greater value on cloud storage or want to access their hard drive if Cablevision's systems are offline. The lack of absolute equivalence demonstrates why a discussion of relative functional equivalence is necessary. With respect to video recording and playback, the two systems are functionally equivalent.

[76] Cartoon Network LP v. CSC Holdings, Inc., 536 F.3d 121, 125 (2d Cir. 2008), *cert. denied*, 557 U.S. 946 (2009).

[77] A Slingbox is a device that connects a user's cable box, satellite dish, or DVR to the internet so that signals can be streamed and observed in any location and on a variety of computers and mobile devices. WNET, Thirteen v. Aereo, Inc. 712 F.3d 676, 680 & n.2 (2d Cir. 2013). *But see infra* notes 85-86 and accompanying text, explaining how this functional equivalent might not apply to all of Aereo's subscribers. It is also worth noting that the legality of a combination Slingbox/DVR is also the subject of ongoing litigation. *See* Fox Broad. Co. Inc. v. Dish Network, L.C.C., 905 F. Supp. 2d 1088 (C.D. Cal. 2012).

[78] *Compare* Am. Broadcasting Cos., Inc. v. Aereo, Inc., 134 S. Ct. 2498, 2508-09 (2014) (observing that the "viewing experience of Aereo's subscribers" is no different

B. The Pure-Functional Approach

Under a pure-functional approach, the legitimacy of a technology would depend solely on the technology's functional capabilities. The approach considers implementation details only to the extent necessary to understand what functions the technology performs and to ensure that Congress has not explicitly prohibited the implementing technology. Of course, because this approach provides a framework of statutory interpretation, any explicit technical prohibition or requirement provided by Congress must be considered.[79] However, under this approach, courts would interpret all statutory language, as much as possible, to speak to permitted functionality.

To determine whether a given function is permitted under the Copyright Act, courts should use standard tools of statutory interpretation: they should consider the plain language of the statute, the intent of Congress (both the current Congress and the enacting Congress),[80] and the motivating goal of copyright law to balance authors' exclusive rights against the public's right to take advantage of creative works. Courts should also consider whether the technology in question is functionally equivalent to another statutorily or judicially approved technology. Functional equivalence to an approved technology should create a large presumption that the technology is legitimate.

Of course, while the decision to adopt a functional approach would likely simplify cases, it would not necessarily determine the outcome of any given case. Courts would still have to determine what functionality is implicated by a contested technology, and courts would still have to decide whether that functionality runs afoul of the Copyright Act. A few examples will be helpful.

Under a pure-functional approach, one could argue that the transfer of digital files as construed in *ReDigi* should be permitted under the first-sale doctrine. The basis for the court's decision in

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than the viewing experience of cable company subscribers) *with* Am. Broadcasting Cos., 134 S. Ct. at 2515 (Scalia, J., dissenting) (finding that "there are material differences between . . . cable systems . . . and Aereo").

[79] In practice, very few portions of the Copyright Act contain direct technical prohibitions. While the Act contains a few technical definitions, e.g., "semiconductor chip product" and "mask work," most prohibitions and limitations on activities are made with reference to function. In fact, many definitions are made with reference to any device or process "now known or later developed," indicating that the specific technology does not matter as much as what the technology is doing. *See generally* 17 U.S.C. § 101 (2012). Insofar as judges believe technical prohibitions are unavoidable, my criticism does not apply.

[80] *See* EINER ELHAUGE, STATUTORY DEFAULT RULES 9-14 (2008).

ReDigi relied on a technical assessment of the technology.[81] The court found that the *ReDigi* service violated the reproduction right because the transfer of a file necessarily requires copying the file.[82] From a functional perspective, however, one could argue this intermediate copying is insignificant. If we were to ignore the implementation details of the transaction, we would simply compare the state of the file before the transaction with the state of the file after the transaction. Before the transaction, the file resides on the seller's computer, and after the transaction, the file resides on the buyer's computer.[83] Because the *functional* output does not multiply files or permit use by multiple users, no exclusive copyright privilege is implicated in the sale. Alternatively, one could argue that ReDigi's transfer of files should be prohibited because it would allow users to resell goods faster than ever before. One could argue that increased speed and lower transaction costs would undermine the incentive authors have to develop and share creative works.[84] For the purposes of this paper, the outcome of any given case is not as important as the reasoning used to arrive at the outcome. While the ReDigi court based its arguments on the technical act of "copying," the arguments above show how it could have reached the same conclusion under a functional approach.

A similar argument can be made in the context of the *Aereo* case. That is, one could argue that a pure-functional approach would likely *prohibit* the Aereo system. Aereo allowed some users to receive broadcast signals they would not have been able to receive without the service.[85] As such, from a functional perspective, Aereo rebroadcast television signals to its subscribers—a function the Transmit Clause was explicitly designed to prohibit.[86] Alternatively, one could argue, as

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[81] *See* discussion *supra*, in Part I.

[82] *Id.*

[83] That the seller might be able to make a copy of the file to elude ReDigi's file scanning system might be significant in an overall review of the service, particularly if the services' promoters encouraged or induced the creation and retention of such copies. *See generally Metro-Goldwyn-Mayer Studios Inc. v. Grokster, Ltd.*, 549 U.S. 913 (2005). However, the evidence presented in *ReDigi* did not indicate such inducement, and because maintained/withheld copies are no less a problem for the permitted sale of digital files in tangible media (for example if a buyer sells a CD, there is no mechanism to prevent him from keeping a backup copy of the CD), this problem is not unique to *ReDigi*'s service and should not impact the analysis in any meaningful way.

[84] This argument is discussed in more detail *infra*, in Part IV.B.2.

[85] This is because not all subscribers to *Aereo* lived in a location that enabled them to receive normal broadcast signals.

[86] American Broadcasting Cos., Inc. v. Aereo, Inc., 134 S. Ct. 2498, 2506 (2014). Note that Aereo would be impermissible for users who live outside the broadcast zone not because it allows them to access broadcasts on demand over the internet, but rather because it allows them to access broadcasts *at all*. With respect to

Justice Scalia did, that because each transmission was initiated by Aereo's users (rather than by Aereo itself), Aereo could not be held liable for creating *any* performance, let alone a public one.[87]

C. Functional Reducibility: Testing the Technical Approach

It is easy to think that the functional and technical approaches might be two roads to the same place—that the courts' technical guidelines might match up with the qualitative, functional goals of the Copyright Act. To determine whether this is true, we need a way to translate technical guidelines into functional implications. This is where functional reducibility comes into play.

This Part will have two Sections. First, I will introduce the concept of functional reducibility. Second, I will use functional reducibility to show that the functional and technical approaches are qualitatively different and lead to substantially different results.

1. Functional Reducibility Defined

Ironically, the concept of reducibility lies at the core of theoretical computer science and is itself quite technical. Computer scientists say a problem X is reducible to another problem Y if the solution to Y can be used to solve X.[88] As a simple example, we can say that multiplication is reducible to addition since one can use repeated applications of addition to achieve the effect of multiplication. Computer scientists use reducibility analysis to compare the difficulty of two computational problems. But because we want to compare technologies rather than theoretical problems, we need to develop a new understanding of reducibility. This form of reducibility, which I call *functional* reducibility, compares two instances of technology based on the end-user experiences that can be crafted from their underlying implementations.

We can say an instance of technology X is functionally reducible

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users who can receive the original broadcast transmissions. Aereo would be permissible. For these users, Aereo is functionally equivalent to a DVR and Slingbox. Because Aereo extended the reach of the original broadcast zone, one could argue that Aereo moved beyond functional equivalence, in violation of the Copyright Act. Aereo tried to limit this problem by requiring its subscribers to agree not to "use or attempt to use [Aereo's service] to access signals that are not available in [their] Home Market." *Aereo Terms of Use*, AEREO, https://www.aereo.com/terms [http://perma.cc/JUA4-7AG7].

[87] The majority found this functional difference irrelevant. *Id.* at 2514.

[88] THOMAS H. CORMEN ET AL., INTRODUCTION TO ALGORITHMS 1067 (3d ed. 2009) ("Intuitively, a problem Q can be reduced to another problem Q' if any instance of Q can be 'easily rephrased as an instance of Q', the solution to which provides a solution to the instance of Q.").

to an instance of technology Y if one can use the underlying implementation of Y to achieve functionality that is identical to X without relying on any significant innovative technological advancements. For example, we can say a pair of eyeglasses is functionally reducible to a monocle. Once you have the ability to make a monocle, it is possible to make a pair of eyeglasses without any significant technological advancements.[89] Conversely, a DVD player is not functionally reducible to a VCR. Because the two technologies work in fundamentally different ways, the technology underlying a VCR does not provide any insight into the workings of a DVD player.[90]

It is important to recognize that functional reducibility analysis does not take into account the efficiency, expense, or difficulty of the steps needed to arrive at functional equivalence.[91] For example, with respect to power generating abilities (energy output), a nuclear reactor is functionally reducible to a windmill. The relevant consideration is whether a windmill can, without any technological advancements, generate power in the same form and amounts as a nuclear reactor. The fact that nuclear reactors generate power eight times faster[92] than windmills does not impact the reducibility analysis.[93]

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[89] Interestingly enough, in the context of simple devices, it is possible for two technologies to be functionally reducible to each other without being functionally equivalent. Eyeglasses and monocles are one such example. Given the ability to make eyeglasses, it is a fairly trivial task to produce monocles. Similarly, if one has the ability to make monocles, one can, without much difficulty, make a pair of eyeglasses.

[90] Likewise, a VCR is not functionally reducible to a DVD player. In this sense, functional reducibility analysis is unbiased with respect to the *quality* of a technology. A DVD player certainly provides technology that *improves* upon the VCR. But because a VCR and DVD player are not functionally equivalent (with respect to playing videos), and because the technology of a DVD player cannot be used to create a VCR, the two technologies are not functionally reducible in either direction.

Note also that if two technologies are functionally equivalent, each technology is functionally reducible to the other. This follows immediately from the definitions of equivalence and reducibility. If two technologies are functionally equivalent, then it is of course possible to achieve identical functionality without any significant technological advancements—indeed, it is possible to achieve identical functionality without *any* advancements.

[91] Multiplication is reducible to addition because one can use repeated additions to achieve the effect of multiplication. It is of no import that, in some instances (1000000*504,000, for example), the multiplication would require millions of additions. The analysis focuses only on whether, given one solution, another solution is *possible*.

[92] A series of small wind turbines can generate 1.5 terawatt hours per year, *Small-scale Wind Energy*, CARBON TRUST (Aug. 2008), http://www.carbontrust.com/resources/reports/technology/small-scale-wind-energy [http://perma.cc/N4GD-QB4Z], while an average nuclear reactor can generate 12.2 terawatt hours per year, Frequently Asked Questions, UNITED STATES ENERGY INFO. ADMIN. (July 27, 2012), http://www.eia.gov/tools/faqs/faq.cfm?id=104&t=3 [http://perma.cc/T5QG-7KGP].

[93] Of course, if we wanted to make reducibility analysis *more* complex, we could

2. *Functional Reducibility as a Measurement: Bridging the Gap Qualitatively*

Functional reducibility is helpful in the current context because it allows us to understand the extent to which the courts' technical focus deviates from the functional approach. The premise behind the technical-approach cases discussed above is that some implementations infringe on copyright while others do not: streaming technology that uses a central data source (such as a DVD) violates the public performance right, while a technology that creates thousands of "unique" copies does not; a digital "transfer" of files violates the reproduction right, while a 1.2 second buffer-copy does not, etc. Because these determinations are based on implementation rather than function, they fit nicely into a model of functional reducibility.

Specifically, we can say that if a court approves some technology X, the functions theoretically allowed by that approval would consist of the set of functions corresponding to the technologies that reduce to X. This is because any technology (and thus any functionality) that reduces to X could, by definition, be constructed using only court-approved implementations, and would thus necessarily adhere to the court's technical guidelines.[94]

Reducibility is significant because it shows that the functional and technical approaches are *not* two roads to the same place—relative to the functional approach, the pure-technical approach is *over-inclusive* because it allows technologies that are a.) functionally reducible to a judicially approved technology and b.) unable to withstand judicial scrutiny under a functional approach. Likewise, we can say that the pure-technical approach is *under-inclusive* because it prohibits technologies that would be allowed under a functional approach . The articulation of the gap in terms of over- and under-inclusiveness implicates important value judgments that lend themselves to the formation of an additional approach.

D. The Efficient-Technical Approach

The efficient-technical approach is something of a compromise between the functional approach and the pure-technical approach. Under the pure-technical approach, technologies must comport to court guidelines. Under the efficient-technical approach, however, technologies need only *reduce* to a technology that comports with court

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add an efficiency factor. Such a factor is, however, beyond the scope of this paper.

[94] The converse, however, is not true. If a court *condemns* some technology X, no functions are disallowed, provided they can be made without using X. I discuss this in some detail *infra*, in Part III.

guidelines. Evaluation under an efficient-technical approach would thus involve a two-step system of analysis. First, courts would consider what technologies, if any, the contested technology reduces to. Second, courts would consider whether any of the reduced-to technologies would be permissible according to a pure-technical approach.[95]

The efficient-technical approach does not change the courts' current approach as much as it *modifies* the approach to avoid technical "gimmicks" and inefficiencies. Rather than forcing companies to work around technical restrictions, the efficient-technical approach allows them to achieve identical results using sustainable, sensical, and efficient engineering techniques. For example, under an efficient-technical approach, if one accepts the holding of *Cablevision*, it would be feasible to implement the *Cablevision* remote DVR system using one centralized hard drive (rather than creating a unique copy for each user). This is because one could achieve functionality identical to Cablevision's RS-DVR system by storing one master copy of each program and monitoring which programs a customer wanted to record. All customers who chose to "record" a show prior to the show's original broadcast would then have access to the master copy of the program.

Because this modified system is functionally equivalent to the court-approved system and because it does not require any significant technological advancements or innovation, we can say the modified system reduces to the court-approved implementation. As such, the modified system would be permissible under the efficient-technical approach. A similar argument could be made for implementing Aereo's technology with one master antenna for each channel.

The efficient-technical approach is notable because it captures many of the advantages of a pure-technical approach while avoiding many of the disadvantages. This will be discussed in greater detail below.

The relationship between the different approaches is explained in Figure 2. Figure 2 also shows how the various approaches would view the cases discussed above.

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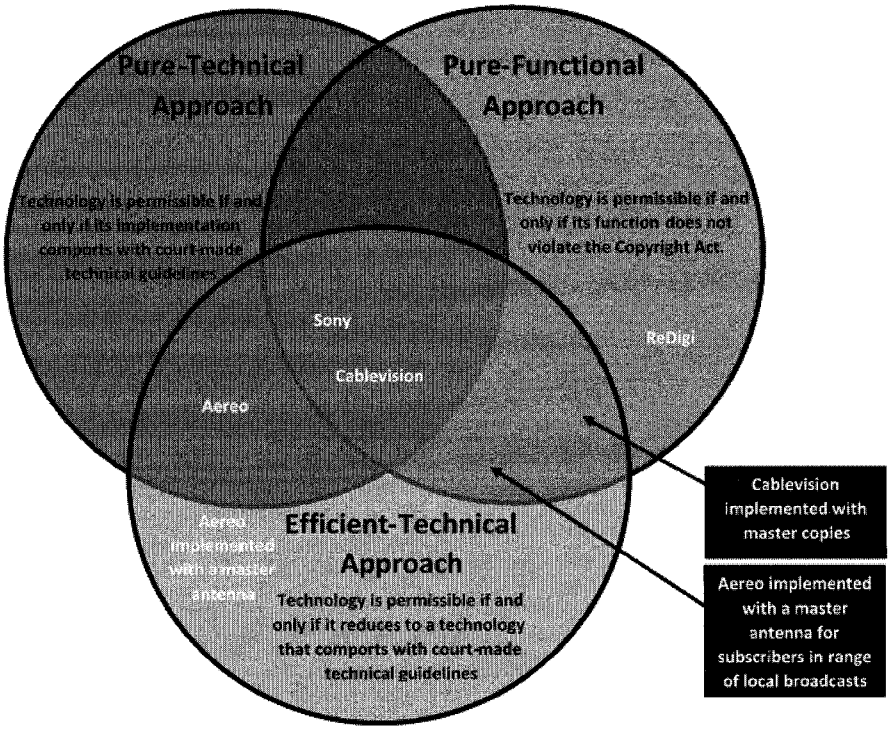
[95] Note that if a technology is legitimate according to the courts' current technical approach, it will also be permissible under the efficient-technical approach. Because all technologies reduce to themselves, it follows immediately that a technology that comports with the courts' current guidelines reduces to a technology that comports with the courts' guidelines. This means that, relative to the pure-functional approach, the efficient-technical approach is at least as over-inclusive as the pure-technical approach.

FIGURE 2: UNDERSTANDING THE FUNCTIONAL AND TECHNICAL APPROACHES TO PERMISSIBILITY



Note that two of the seven zones indicated in the diagram will contain no technologies. Because all technology reduces to itself, any technology that would be permissible under the pure-technical approach would also be permissible under the efficient-technical approach. As such, the zones constituting the pure-technical approach and the intersection between the pure-technical and pure-functional approaches are included only for conceptually demonstrative purposes. Any technology that falls in either of the two zones would actually lie in the intersection between the pure-technical approach and the efficient-technical approach or in the intersection of all three circles, respectively.

This figure can also be used to visualize the extent to which the pure-technical approach and efficient-technical approach are over-inclusive and under-inclusive with respect to the pure-functional approach. An approach is over-inclusive insofar as it would allow a technology that would not be allowed under the pure-functional approach. Likewise, an approach is under-inclusive insofar as it would not allow a technology that would be allowed under the pure-functional approach. Given these understandings, we can see that both technical approaches are over-inclusive, but that the pure-technical approach is less over-inclusive and more under-inclusive than the efficient-technical approach. Note that, as described supra in Part II.B, the functional approach does not necessarily lead to a clear answer or outcome in any given case. Accordingly, my categorization of different technologies is by no means absolute. For example, while I think ReDigi should be allowed under a functional approach, reasonable minds could disagree. See discussion supra, in Part II.B.

III. THE ADVANTAGES OF A FUNCTIONAL-APPROACH

In this Part, I will defend the pure-functional approach from a variety of perspectives. My goal is to show that a functional approach is constitutionally, statutorily, and practically preferable to a technical approach. I also hope to show that a pure-functional approach would lead to decisions that are clearer, easier to understand, and better-reasoned.

A. Innovation and Creativity

In this Section, I will show how the technical approach harms innovation, technological growth, and business confidence.

A technical approach stands to harm innovation in two ways. First, by prohibiting certain implementations, the technical approach short-circuits innovation by reducing the incentive engineers have to improve the efficiency or efficacy of the technology underlying the prohibited implementations. An engineer will be less likely to build, improve, or innovate on technology if the resultant improvement cannot easily be used. Consider ReDigi's used marketplace for digital files.[96] Because of the decision in *Capital Records v. ReDigi*, ReDigi no longer has a reason to develop more efficient file transfer protocols. Similarly, the decisions in *Cablevision* and *Aereo* have reduced the incentive for companies to develop new solutions to concurrent-access problems[97] or to create new mechanisms for mass file distribution.[98]

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[96] *See* discussion *infra* in Part I.

[97] Because of the decisions in *Cablevision* and *Aereo*, each user is assigned a unique copy of a file. Absent these decisions, basic engineering principles would allow companies to distribute data to consumers from one centralized copy. Because multiple users would necessarily access the same copy at the same time, system engineers would have to develop extra precautions to preserve system integrity. While the technical details of this problem (and potential solutions) are beyond the scope of this paper, it is worth noting that this is a relatively common problem that can be solved in a number of ways. For an example of one approach to this problem, see *The Secret to 10 Million Concurrent Connections—The Kernel Is the Problem, Not the Solution*, HIGH SCALABILITY (May 13, 2013), http://highscalability.com/blog/2013/5/13/the-secret-to-10-million-concurrent-connections-the-kernel-i.html [http://perma.cc/S4F3-D7GS]; *See also Concepts: Concurrency*, UNIV. OF HOUSTON, http://sce.uhcl.edu/helm/rationalunifiedprocess/process/workflow/ana_desi/co_cncry.htm [http://perma.cc/UPD7-6X43].

[98] It is worth noting that "less" incentive does not mean "no incentive." Many licensed services rely on these types of technologies and are constantly working on solutions to these problems. Netflix, for example, licenses television programs from content producers and, as a result, is not required to create a unique copy for each subscriber. *See* Greg Kumparak, *Netflix Spends $2B Per Year On Content, Primarily On Licensing Movies And TV Shows*, TECHCRUNCH (Apr. 24, 2013), http://techcrunch.com/2013/04/24/netflix-spends-2b-per-year-on-content-primarily-on-licensing-movies-and-tv-shows [http://perma.cc/5Y5G-EZMH]. The impact of courts'

But the technical approach does not just prevent innovation with respect to restricted technologies—it limits innovation in general. Because the technical approach is indifferent towards function, companies affected by technical restrictions will use their resources to find alternate ways to achieve their desired functional goals.[99] Because the straightforward implementation is precluded, companies and engineers must spend time, effort, and money designing around the courts' limitations. In this sense, engineers *are* developing new technologies, but these technologies are not driven by sound engineering principles. Instead, they are guided almost exclusively by the technical rules established by courts—rules that, as discussed below, lead to inefficient designs. Thus, the technical approach's impact on innovation is two-fold. First, engineers have less incentive to optimize or advance the technologies prohibited by the courts, and second, engineers are discouraged from developing technologies *unrelated* to the courts' technical restrictions.

Notably, the functional approach avoids both of the disadvantages discussed above. First, because the functional approach does not address the legal legitimacy of implementations, it does not sizably impact the incentive engineers have to further develop or improve upon existing technologies. Second, because there is no way to "engineer around" a prohibited function, the functional approach does not create any incentive for engineers to find loopholes in judicial decisions.

So what, then, is the impact of a functional prohibition? Interestingly, most technical innovations or advances can be used to solve problems in a variety of contexts. Consider again the technical problems referenced above: concurrent-access problems, file transfer efficiency, and mass file distribution. These problems would persist[100]

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prohibitions is that fewer companies (and thus fewer engineers) are working on new solutions to these problems, decreasing the likelihood that a new approach to the problem will be found. Additionally, as described *infra*, the technical approach also prevents engineers from developing new technologies unrelated to the courts' prohibitions. Accordingly, the technical approach also makes it less likely that engineers will work on projects that present new and novel engineering problems.

[99] *E.g.*, Vivian I. Kim, *The Public Performance Right in the Digital Age: Cartoon Network v. CSC Holdings*, 24 BERKELEY TECH. L.J. 263, 291 (2009) ("This gives cable providers incentive to design systems solely for purposes of avoiding liability.").

[100] For a discussion of the wide application of the above problems, see Dominique Lebrun, *The Problem of Concurrent Access to Data*, PLATYPUS (Apr. 7, 2013) (discussing applications of the concurrent access problem), http://platypus.belighted.com/blog/2013/04/07/concurrent-access-to-data [http://perma.cc/W7HY-HTVH], and Brian Tierney et. al., *Efficient Data Transfer Protocols for Big Data*, (discussing applications of the file transfer and distribution problems), http://www.es.net/assets/pubs_presos/eScience-networks.pdf [http://perma.cc/84P8-7SYP].

and be worth solving even if the functions or services were prohibited. The result is that the functional approach is much less likely to create barriers to technological advances.

B. Constitutional Consistency

The authority for the Copyright Act resides in Article I, § 8 of the Constitution: "To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries." Scholars and commentators have long recognized that the Progress Clause was included for utilitarian purposes—to encourage innovation and incentivize the creation and distribution of creative and scholarly works.[101] As the Supreme Court recognized in *Twentieth Century Music Corp v. Aiken*,

> [t]he immediate effect of our copyright law is to secure a fair return for an 'author's' creative labor. But the ultimate aim is, by this incentive, to stimulate artistic creativity for the general public good. 'The sole interest of the United States and the primary object in conferring the monopoly,' this Court has said, 'lie in the general benefits derived by the public from the labors of authors.'[102]

In this Section, I will show how the Progress Clause supports a functional approach to copyright law and how the Progress Clause should lead courts to interpret the Copyright Act using a functional approach.

1. The Progress Clause Supports a Functional Approach to Copyright Law

In this Section I will show how the functional approach to copyright law advances the aims of the Progress Clause better than the technical approach. Because the Progress Clause was designed to encourage individuals to create and distribute creative and scholarly

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[101] *E.g.*, LYDIA PALLAS LOREN & JOSEPH SCOTT MILLER, INTELLECTUAL PROPERTY LAW: CASES & MATERIALS 342 ("Thus copyright law is meant to provide an incentive not just for creation but for dissemination as well."); Jeanne C. Fromer, *The Intellectual Property Clause's External Limitations*, 61 DUKE L.J. 1329, 1366 (2012); Mark A. Lemley, *The Economics of Improvement in Intellectual Property Law*, 75 TEX. L. REV. 989, 997 (1997).

[102] Twentieth Century Music Corp, 422 U.S. 151, 156 (1975) (quoting Fox Film Corp. v. Doyal, 286 U.S. 123, 127 (1932)).

works, the Clause suggests a utilitarian analysis.[103] Accordingly, when evaluating the constitutional consistency of the two competing approaches, we should compare the extent to which the two approaches encourage the creation and dissemination of new works.[104] There are two reasons why these criteria, and thus the Progress Clause, support a functional approach to copyright law.

First, assuming there is desirable content, authors, creators, and the general public make decisions based on functional implications rather than production considerations. When deciding whether to buy a book, consumers seem to be indifferent to the technology used to publish the book or the software used to write the book. Instead, consumers seem to care about how they will interact with the book—will they enjoy the story, will the text fade overnight, will the binding withstand a lot of pressure, etc. Likewise, when deciding whether to subscribe to *Aereo*, consumers have no reason to consider the implementation—assuming constant price and functional equivalence, consumers have no reason to prefer a system with millions of antennas over a system with one central antenna—and every reason to consider functionality—how much will the service cost, what television programs does it cover, how difficult is it to record a show, etc.

These incentives are not limited to consumers. Authors and content-creators also seem to be driven by functional considerations. And this makes sense—the financial success of a creative work depends on how the work is perceived by the general public, meaning authors have a financial incentive to internalize the functional preferences of their consumers. In the rare instances where implementation *is* a consideration (either for consumers or authors), it is only a consideration because the implementation itself is functionally beneficial in some way—whether that function is eco-friendliness,[105] increased prestige,[106] cost, or perceived efficacy.

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[103] *See supra* note 101.

[104] In this Section, the analysis is constitutional, not statutory. That is, I am concerned with the question of what *types* of rules we should have—whether our rules should be based on functional guidelines or technical guidelines. Accordingly, this analysis is conducted on a theoretical level, apart from the Copyright Act and the decisions discussed above.

[105] Andrea Divirgilio, *Most Expensive Electric Cars for the Eco-Friendly Billionaires*, BORNRICH (June 13, 2012), http://www.bornrich.com/expensive-electric-cars-eco-friendly-billionaires.html [http://perma.cc/4TQ9-R7KH] (explaining demand for expensive electric cars).

[106] Mark Milian, *Apple Removes $1,000 Featureless iPhone Application*, L.A. TIMES (Aug. 7, 2008), http://latimesblogs.latimes.com/technology/2008/08/iphone-i-am-ric.html [http://perma.cc/9WV2-H82Z] (describing a $1,000 app, "I am Rich," which was purchased eight times by buyers who wanted to "alert people that [they] have money in the bank").

The second reason why the Progress Clause supports a functional approach to the Copyright Act is that the technical approach decreases innovation and hinders the development of technologies. As demonstrated by television, the internet, and even the ReDigi service, new technologies allow people to communicate in new ways,[107] on new terms,[108] and in medium-dependent[109] forms. Accordingly, incentives that promote the creation of communicative-technologies are at least as important as incentives that promote communication itself. Likewise, rules that discourage the creation of communicative-technologies are at least as harmful as rules that discourage communication.

In sum, because the goal of the Progress Clause is to create incentives that promote the creation and dissemination of creative works,[110] and because incentives are determined by function, we can conclude that the aims of the Progress Clause are best advanced by a functional approach.

2. *The Progress Clause Suggests that Courts Should Interpret the Copyright Act According to a Functional Approach*

While the Constitution seems to favor a functional approach to copyright law, the question of constitutional interpretation is distinct from the question of statutory interpretation. In this Section, I will argue that the Progress Clause, as construed above, provides courts with a good reason to interpret the Copyright Act in a manner consistent with a functional approach.

It is a common canon of statutory interpretation that, given two possible interpretations of a statute, courts should choose the interpretation that avoids constitutional conflict.[111] As argued above, a

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[107] *See* Andrew Lasane, *MoMA Defends Inclusion of Video Games in Applied Design Exhibition*, COMPLEX (June 3, 2013), http://www.complex.com/art-design/2013/06/ted-talk-moma-defends-video-games-in-applied-design-exhibition [http://perma.cc/J3HE-64L2] (recognizing video games as a new method of communication).

[108] *See* Andrea Chang, *Photo App Snapchat's Allure is Images' Fleeting Nature*, JOURNAL SENTINEL ONLINE (June 9, 2013), m.jsonline.com/business/photo-app-snapchats-allure-is-images-fleeting-nature-b9927947z1-210763431.html [http://perma.cc/DP8Y-AYTY] (discussing a new app that allows users to send self-deleting messages).

[109] For example, consider *Zombies, Run!*, a phone app that uses GPS and other mobile technology to tell users a dynamic story generated from the user's local surroundings. ZOMBIES, RUN!, https://www.zombiesrungame.com [http://perma.cc/KUW4-YPPC].

[110] *See supra* notes 98-99 and accompanying text.

[111] United States v. Jin Fuey Moy, 241 U.S. 394, 401 (1916) ("A statute must be construed, if fairly possible, so as to avoid not only the conclusion that it is

technical approach to copyright law *does* run contrary to the aims of the Progress Clause; and while the Supreme Court has interpreted the Clause to give Congress considerable latitude and discretion,[112] it is not clear that the latitude extends far enough to justify an interpretation that inhibits the creation and dissemination of creative works. Because the technical approach would lead to sizable constitutional concerns, courts should, in the face of ambiguity, interpret the Act according to a functional approach.

In response to this argument, supporters of the technical approach could argue that the latitude given to Congress *would* extend far enough to save a technical interpretation of the Copyright Act. While this argument might be correct, it does not change the outcome of my analysis—the fact that a constitutionally suspect construction of a statute would not actually be considered a constitutional violation does not preclude the application of the avoidance canon.[113] Moreover, even if the technical approach would fall *clearly* on the side of constitutionality, a court should, in the face of statutory ambiguity, construe statutes in the manner most consistent with the aims of the Constitution. [114] As argued above, those aims clearly support a functional interpretation. The Supreme Court came to the same conclusion. As the Court explained, "[w]hen technological change has rendered its literal terms ambiguous, the Copyright Act must be construed in light of [its] basic purpose."[115]

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unconstitutional, but also grave doubts upon that score."); ELHAUGE, *supra* note 52, at 237-239; *see* Nat'l Fed'n of Indep. Bus. v. Sebelius, 132 S. Ct. 2566, 2573 (2012) ("Every reasonable construction must be resorted to, in order to save a statute from unconstitutionality." (quoting Hooper v. California, 155 U.S. 648, 657 (1895))).

[112] *See* Eldred v. Ashcroft, 537 U.S. 186, 205 (2003) (applying rational basis review to Congress' durational extension of the copyright term).

[113] Clark v. Martinez, 543 U.S. 371, 381 (2005) ("providing examples where the Court construed a statute narrowly to avoid a constitutional question ultimately resolved in favor of the broader reading"(citing Adrian Vermeule, *Saving Constructions*, 85 GEO. L.J. 1945, 1960-61 (1997))); William N. Eskridge, Jr., *Public Values in Statutory Interpretation*, 137 U. PA. L. REV. 1007, 1021 (1989) ("The Court can also update statutes by construing them to reflect . . . values as they relate to the Constitution. . . . The Court interprets a statute to avoid constitutional problems even though the broader interpretation would not necessarily be invalid.").

[114] This view is consistent with at least two of the common justifications for constitutional avoidance. The first justification is that avoidance is a means of determining Congressional intent—that, unless the text of a statute suggests otherwise, courts should presume that Congress intends legislation to be consistent with the values and spirit of the Constitution. The second justification is that courts should interpret statutes to advance constitutional norms and that, in doing so, courts will encourage Congress to discuss, consider, and incorporate those norms into their discussions surrounding statutes. *Clark*, 543 U.S. at 382.

[115] Twentieth Century Music Corp. v. Aiken, 422 U.S. 151, 156 (1975).

C. Better Adjudication

The third reason why courts should adopt a functional approach is that it allows for better adjudication. This is true for two reasons. First, because judges do not generally have the expertise needed to consider and evaluate intricate technical details, and second, because judges are especially good at evaluating qualitative functionality. As we will see, the end result is that a functional approach, if adopted, would lead to decisions that are at once more consistent, better-reasoned, and easier to understand.

1. Judges Are Not Good at Evaluating Technical Details

In this Section, I will show how, in practice, relying on judges with little or no technical expertise significantly exacerbates some of the problems discussed in the previous two Sections.

Unfortunately, judges are generally ill-equipped to evaluate technology. Judges do not receive technical training, do not generally hold degrees in mathematics, computer science, or engineering, and do not deal with technical issues on a regular basis.[116] Numerous cases show how this lack of technical expertise negatively impacts the way judges decide technology-based cases. In one case, a judge ordered a defendant to "retrieve . . . code" that had been widely disseminated over the internet.[117] In another, a judge attempted to resolve a claim under the Electronic Communications Privacy Act by insisting that "data transmitted over WiFi is not radio communication."[118] At least one judge admitted that he "[did not] really understand what a Web site is."[119] These are not isolated examples. When it comes to technology, judicial ignorance exists even at the Supreme Court.[120] In

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[116] I exclude from this analysis judges on the Federal Circuit Court of Appeals. While my criticism would assuredly apply to many of these judges, copyright disputes are not generally in the Federal Circuit's jurisdiction. Accordingly, the merit of the Federal Circuit and its judges is not relevant to this discussion.

[117] Mike Masnick, *The PS3 Hack Injunction Shows the Problems of Judges Who Don't Understand Technology*, TECHDIRT (Feb. 1, 2011), http://www.techdirt.com/articles/20110201/00580112903/ps3-hack-injunction-shows-problems-judges-who-dont-understand-technology.shtml [http://perma.cc/XV5K-SBAE].

[118] Mike Masnick, *Judge Who Doesn't Understand Technology Says WiFi Is Not a Radio Communication*, TECHDIRT (July 1, 2011), http://www.techdirt.com/blog/wireless/articles/20110701/12225114934/judge-who-doesnt-understand-technology-says-wifi-is-not-radio-communication.shtml [http://perma.cc/V2K8-XAYF].

[119] Jon Skillings, *U.K. Judge Stumped by Web Lingo*, CNET (May 17, 2007, 10:06 AM), http://www.cnet.com/news/u-k-judge-stumped-by-web-lingo/ [http://perma.cc/RH6S-SMCK].

[120] *See* Kimberly Atkins, *Technical Difficulties at the Supreme Court*,

sum, it is no stretch to say that judges do not generally understand how technology works.[121]

In the context of a technical approach to copyright law, this is problematic for two reasons: it leads to poorly written opinions and it creates bad law. I will explore each of these in turn.

i. Poorly Written Opinions

There are three reasons why judges' generally poor understanding of technology leads to poorly written opinions. First, judges' lack of technical expertise may make it difficult for them to understand the implementations and technologies at issue in their cases. Because cases often revolve around these type of details, judges' lack of expertise would likely make it more difficult for them to reach a clear conclusion or holding. While this would almost certainly lead to bad law (discussed below), it would also make it more difficult for judges to craft opinions that are clear and understandable. Indeed, as author William Zinsser observed, clear writing cannot exist without clear thinking.[122]

Second, judges' lack of technical expertise can make it difficult for them to cleanly and clearly *communicate* their intended holding for the case (regardless of whether the holding itself is clear). Under a technical approach, a decision on the merits would almost always be made on technical grounds. This means judges would, at a minimum need to explain the technology at issue in their cases and explain their implementation-based rule or holding. The problem is that writing about technical details and implementations is difficult, even for experts in the field.[123] For those with little technical experience, describing the technology cleanly and clearly would be at best extremely challenging and at worst impossible.

Finally, the impact of the two communicative shortcomings is magnified by judges' necessary reliance on precedent. The

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LAWYERSUSA (Apr. 19, 2010), http://lawyersusaonline.com/dcdicta/2010/04/19/technical-difficulties-at-the-supreme-court-2 [http://perma.cc/22FT-MC8E]; *see also* Ass'n for Molecular Pathology v. Myriad Genetics, Inc., 133 S. Ct. 2107, 2120 (2013) (Scalia, J., concurring) (noting that he does not have expertise in the "fine details of molecular biology").

[121] *See* Ameet Sachdev, *Federal Judge Richard Posner Takes on Science and Law*, CHICAGO TRIBUNE, May 11, 2012, http://articles.chicagotribune.com/2012-05-11/business/ct-biz-0511-chicago-law-20120511_1_judges-law-clerks-7th-circuit-bar-association [http://perma.cc/74PM-WBX2].

[122] WILLIAM ZINSSER, ON WRITING WELL 8 (2006) ("It's impossible for a muddy thinker to write good English.").

[123] Roy Tennant, *Talking Tech: Explaining Technical Topics to a Non-Technical Audience*, *in* TECHNOLOGY IN LIBRARIES: ESSAYS IN HONOR OF ANNE GRODZINS LIPOW 93 (Roy Tennant ed., 2008), http://techinlibraries.com/tennant.pdf [http://perma.cc/8HX5-JUSU].

communication problems are bad enough when limited to one case, but when judges are called upon to consider, explain, and apply technical reasoning from previous cases, the opinion-writing process seems to become an extended game of "telephone," as previous decisions themselves must be parsed and analyzed so that a judge's intent can properly be ascertained.

The net effect is that understanding a technical decision is like understanding a message written in German and translated first to French, then to Chinese, and finally to Klingon. Each step along the way—engineer to lawyer, lawyer to judge, judge to opinion, and past opinion to future opinion, is likely to result in miscommunication, confusion, or a skewing of the technical analysis. For examples of this effect, one can consider the decisions discussed in Part I. *Cablevision*'s discussion involving "the performance of a performance," *Redd Horne*'s and *Cablevision*'s discussion of "unique copy," and even *ReDigi*'s discussion of what it means to transfer a file, each involve stilted, confusing, and somewhat counter-intuitive explanations and analysis of technology.

Judges write opinions to bring clarity to law and to establish the constitutional and statutory boundaries of legislation and executive action. The more muddled an opinion, the less clarity and insight it brings to the dispute at hand, and the more confusion it causes when considered in future cases.

Confusing cases are especially problematic in the technology sphere because companies have good reason to consider the legal landscape when considering which services and technologies to develop. If the relevant decisions are confusing, muddled, or difficult to understand, then it will be difficult for companies to know whether their proposed technology is compliant with the decisions. This means there is a higher risk, and thus a higher expected cost, associated with developing new services and technologies. Thus, the impact of unclear opinions and of a technically uninformed judiciary magnifies the innovational claims presented above and runs contrary to the purpose of the Copyright Act and the Progress Clause.[124]

ii. Bad Decisions

The second problem associated with the technical approach is that a judge's lack of technical sophistication may lead to decisions that are at once over-inclusive and under-inclusive. Judges who do not understand how technology works cannot easily understand the practical implications of their technical decisions—they cannot

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[124] *See* discussion *supra* in Part II.A and Part II.B.

understand the extent to which their decisions will stifle innovation and cannot envision the functionality their decisions would preclude. Consequently, it is difficult for judges to write opinions in a way that would *minimize* the functional or innovative impact.[125] As a result, whatever harm might be associated with a technical approach on a *theoretical* level would likely be magnified on the practical level, making the technical approach more restrictive than it needs to be.

At the same time, because engineers have an advanced understanding of technical details, it is difficult for judges to craft decisions with enough precision to avoid legal loopholes. Enterprising engineers have the expertise to design technologies that violate the spirit and intent of the Copyright Act while still complying with the technical holdings of previous cases. For a real world example of a legal loophole, consider Aereo, which used the technical imprimatur from *Cablevision* to short-circuit Congress' explicit intent to prevent the rebroadcast of television signals.[126] For another example, consider the Second Circuit's holding that 1.2 seconds is only transitory and thus that data held for that brief period of time cannot qualify as "fixed" for the purpose of finding a violation of the § 106(1) reproduction right.[127] Using this technical holding, a creative engineer could create an end-run around copyright as follows:

a. Take a 90 minute movie. 90 minutes*60 seconds=5,400 seconds.
b. Take 5,400 micro-hard drives, each of which can store 1 second of video. Number the hard-drives from 1 to 5,400 and load the movie onto the drives, such that the *x*th second of the movie is located on hard drive x (the 1st second is on hard drive 1, the 2nd second is on hard drive 2, etc.).
c. Create a cycle, whereby each hard drive continuously transfers its one second of video to the previously-numbered hard drive (e.g., 5 transfers to 4, 4 transfers to 3, etc.), except for hard drive 1, which transfers data to hard drive 5,400. Note that each copy is constantly overwritten with each transfer and thus technically does not persist for longer than 1.2 seconds. Hard drive 1 is used a buffer drive to play the video.
d. Use an indexing system to keep track of which micro hard-drive will have which second of the movie at each point in

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[125] *Cf.* Am. Broadcasting Cos., Inc. v. Aereo, Inc., 134 S. Ct. 2498, 2517 (2014) (Scalia, J., dissenting) (arguing that the majority's attempt to limit its holding would likely fail).

[126] *See supra* note 86 and accompanying text.

[127] *See supra* Part I.

> time. Use the indexing system to keep the drives synchronized so that a user can play the movie in full.

This system continuously reads a movie, yet does not make a persistent copy. And unlike Cablevision's RS-DVR, this system does not require any access to the internet or any other external source. Thus, even though there is permanent access to the copyrighted material, and even though the copyrighted material is continuously copied, this system can claim to be justified by the holding in *Cablevision*.[128] Similarly, one could "break" the transmit clause simply by using a 1.2 second buffer (similar or identical to the one used by Cablevision) to create a separate transmission stream for any number of subscribers. Because no copy lasts for more than 1.2 seconds, and because each subscriber would receive a "different copy," *Cablevision*'s unwarranted fascination with and ultimate emphasis on technical implementation would appear to justify such a system from a technical standpoint, even though the resulting device would almost certainly contravene most judges' understanding of the Copyright Act.

The harms associated with such slavish replication of judicially approved technologies are two-fold. First, as demonstrated clearly by the micro-hard drive example, they allow companies and engineers to effectively circumvent the intent of copyright law. Second, and perhaps less obvious, these workaround systems are atrociously inefficient. The system at issue in *Cablevision*, for example, would, if implemented, use *millions* of hard drives to store information that could just as easily be stored on *one* hard drive.[129] Likewise, the systems at issue in *Aereo* used millions of antennas to capture incoming broadcasts when it could accomplish identical functionality using just one antenna. Courts and scholars have long recognized the value and need for judicially-prompted efficiency.[130] Technical workarounds, and thus the approach

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[128] This is perhaps the most obvious example of why we should use a functional approach. After reviewing the purposes and overall legislative scheme of the Copyright Act, we want to say this sort of system should not be allowed—yet we cannot do so without an appeal to function. That this system *could* be justified by a technical approach (even if, ultimately, a court might find some technical-based justification to prohibit it) is reason enough to reject the technical approach. No similar analogue exists for the functional approach.

[129] As stated above, to avoid qualifying as a "public performance," Cablevision planned to store as many copies of a program as were requested rather than storing one central copy. "If 1000 customers want to record a specific episode of HBO's 'The Wire,' 1000 separate copies of that episode are made, each copy uniquely associated by identifiers with the set-top box of the requesting customer." Brief for Plaintiffs-Counter-Defendants-Appellees at 19, Cartoon Network LP v. CSC Holdings, Inc., 536 F.3d 121, 125 (2d Cir. 2008), *cert. denied*, 129 S. Ct. 2890 (2009) (No. 07-7511).

[130] *See, e.g.*, Marnie H. Pulver, *Electronic Media Discovery: The Economic Benefit*

that spurs these workarounds, directly contradict and hinder the goals of judicially crafted efficiency.

In response to these arguments, a supporter of the technical approach could claim that my argument employs circular reasoning—that it attempts to impugn a technical approach using criteria from a functional approach, and thus assumes the result it attempts to prove. The supporter could further argue that, by definition, the decisions that emerge from a technical approach are no more over-inclusive or under-inclusive than decisions issued in other areas of law—that judges evaluate implementations according to the language of the Copyright Act and issue their decisions accordingly. Proponents of the technical approach could argue that, insofar as future technologies are consistent with a technical decision, they are not loopholes as much as they are legitimately legally permissible. Finally, a supporter could argue that the impact on future innovation and functionality are irrelevant—that a judge's primary concern should be whether a technology violates the Copyright Act and that questions of innovation and functionality should be left to Congress.

I have several answers to these arguments. First, in response to the claim that my arguments employ circular reasoning, I would point to the fact that the question of how to evaluate technology is distinct from the question of how to evaluate the *impact* of technology. The technical and functional approaches differ in how they evaluate technology—but judges under both approaches would consider the impact of their decisions. My position is first, that judges are (for a variety of reasons) better able to consider that impact when considering end-user functionality than they are when considering internal implementation, and second, that the functional approach is more closely connected to utility considerations than the technical approach.

Second, the argument that the technical approach is neither over- nor under- inclusive assumes the conclusion it is trying to show—that is, it assumes that decisions made under a technical approach would be made properly and correctly. The analysis presented above provides several reasons and examples illustrating why this is not the case. Without technical expertise, judges will not be able to pair the language of the statute with the technologies under consideration.

Finally, the argument that judges should not consider the impact their decisions would have on incentives, innovation, or future technologies advances a legal fiction. Judges can and do make policy-based determinations on a regular basis. As one scholar observed,

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of Pay-Per-View, 21 CARDOZO L. REV. 1379, 1394-95 nn. 85-86 (2000) (citing a series of decisions and papers that discuss the importance of and need for efficient lawmaking).

"[a]sking whether judges have a policy-making role in the American system of government is like asking whether gravity has a role in the solar system."[131] Judicial policymaking *is* part of the American judicial system—and the worse the policy implications of a decision, the less likely it is that a judge will make that decision. Because judges necessarily engage in consequential decision making, it is important that they do so with an accurate understanding of the consequences. As argued above, this is not generally possible under the technical approach.

2. Judges Are Good at Evaluating Function

When it comes to evaluating functionality, judges are able to make full use of their analytical skill sets and are fully capable of making decisions that are consistent, well-reasoned, and easy to apply. In fact, judges employ functional analysis on a regular basis in the copyright arena: judges use a functional approach when evaluating fair use claims,[132] when considering whether a creation qualifies as "an original work of authorship"[133] or as a "work for hire"[134] and when deciding whether an assistant should qualify as a co-author for the purposes of joint copyright ownership.[135] Each of these potentially complex issues requires judges to consider the goals of the Copyright Act, to think about how the case before them relates to those goals, and to develop (or apply) a decisional framework that faithfully and effectively implements those goals. Notably, the judicial resolution of each of the above issues resulted in a clear framework that is reasonably easy to apply and evaluate in all but the closest of cases.

I introduce these examples not to suggest that the use of a functional approach in these areas justifies the use of the approach when evaluating technology, but rather to show how judges are well-equipped to analyze issues under a functional framework and to show how judges have a great deal of experience with functional analysis. When resolving each of the above issues, judges focused on relationships—the relationship between the creative work and the infringer, between the author and the creative work, and the relationship between the author and the collaborator, respectively. In sum, there is no reason why courts would be able to apply sensible

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[131] *See, e.g.*, Linoa A. Graglia, *Do Judges Have a Policy-Making Role in the American System of Government?*, 17 HARV. J.L. & PUB. POL'Y 119, 120 (1994).

[132] *See* Sony Corp. of Am. v. Universal City Studios, Inc., 464 U.S. 417 (1984); *see also* Metro-Goldwyn-Mayer Studios Inc. v. Grokster, Ltd., 545 U.S. 913 (2005).

[133] Feist Publ'n, Inc. v. Rural Tel. Serv. Co., Inc., 499 U.S. 340 (1991).

[134] Cmty. for Creative Non-Violence v. Reid, 490 U.S. 730 (1989).

[135] Thomson v. Larson, 147 F.3d 195, 200 (2d Cir. 1998).

functional analysis in *Grokster* and *Sony* but not in *Cablevision* or *Aereo*. As Judge Deny Chin recognized in his dissent from the denial of rehearing en banc in *Aereo*, "[c]ourts should follow Congress's lead and resist the urge to look 'under the hood' . . . . [O]ur inquiry should be a functional one, as set forth in the statute."[136]

IV. THE ADVANTAGES (AND DISADVANTAGES) OF THE EFFICIENT-TECHNICAL APPROACH

In a certain sense, my arguments in Part III advance a false dichotomy. My analysis was predicated on a strict choice between two alternatives—a pure-functional approach and a pure-technical approach. As explained in Part I, however, there is at least one more approach to consider—the efficient-technical approach. As stated above, under an efficient-technical approach, a technology is non-infringing if it reduces to a court approved technology. Recall that instance of technology X reduces to instance of technology Y if one can use technology Y to obtain functional equivalence with technology X. In this Part, I will consider the advantages and disadvantages associated with the efficient-technical approach.

A. Advantages of the Efficient-Technical Approach

In this Section, I will discuss some of the advantages of the efficient-technical approach. First, I will argue that, relative to a pure-functional approach, the efficient-technical approach is more conservative and palatable to advocates of a technical approach. Second, I will argue that, like a functional approach, the efficient-technical approach is more efficient and will lead to less economic and technological waste. Ultimately, I will conclude that while the efficient-technical approach is in many ways an improvement on the pure-technical approach, the pure-functional approach is still preferable.

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[136] WNET, Thirteen v. Aereo, Inc., 712 F.3d 500, 512 (2d Cir. July 16, 2013) (Chin, J., dissenting from denial of rehearing en banc).

1. *The Efficient-Technical Approach Is Less Radical and More Conservative than a Functional Approach*

One of the possible objections to the adoption of a functional approach is that it tries to do too much too fast—that, if courts were to adopt a functional approach, they would have to do so in a slow, step-by-step process, adopting intermediate approaches along the way. This objection holds significantly less weight when applied to the efficient-technical approach. As mentioned in Part I, the only difference between a pure-technical approach and an efficient-technical approach is how services are implemented. Because the mapping of permissible services from the pure-technical approach to the efficient-functional approach is one-to-one, it would be relatively easy for a court to justify the efficient-technical approach without departing significantly from current precedents or technical rules. In this sense, the efficient-technical approach is more practical and realistic than a functional approach.

2. *The Efficient-Technical Approach Avoids Inefficiencies and Waste*

One of the largest disadvantages of a technical approach is that it causes companies and engineers to "design around" implementation rules. In Part III of this paper, I argued that these workaround implementations are problematic because they directly conflict with the aims of the Copyright Act and because they are monstrously inefficient. The efficient-technical approach avoids both of these problems. As stated above, the efficient-technical approach looks to technical details only to determine whether a given service reduces to a court approved implementation. Once such a reduction is established, the court would not limit or restrict the manner in which a service is implemented. Accordingly, under the efficient-technical approach, there is no need to "design around" technical constraints. This means that, in comparison to a pure-technical approach, the efficient-technical approach promotes innovation and avoids inefficient, wasteful implementations.

B. The Disadvantages of the Efficient-Technical Approach

In this Section, I will discuss some of the relative disadvantages of the efficient-technical approach. First, I will argue that the approach requires more technical analysis and judicial expertise than a pure-technical approach, exacerbating the adjudication related difficulties discussed in Part III. Second, I will address concerns that this approach might be *too* efficient.

1. *The Efficient-Technical Approach Requires Advanced Technical Analysis*

One of the largest criticisms of a pure-technical approach is that it requires judges to make decisions based on technical details they do not and cannot readily understand. As argued above, this results in poorly constructed decisions, confusing holdings, and judicial inconsistency. Unfortunately, these problems apply with even more force to an efficient-technical approach. In Part II, I explained that cases invoking an efficient-technical approach would involve a two-step analysis. First, courts would consider what technologies, if any, the contested technology reduces to, and second, courts would consider whether any of the reduced-to technologies would be permissible according to a technical approach.

Each step of this analysis could easily require more technical discussion and expertise than the whole amount of analysis involved in the pure-technical approach. In the pure-technical approach, courts are required to analyze the legitimacy of *one* technology to determine whether the implementation of that technology should be permitted under the Copyright Act. Under the efficient-technical approach, however, courts might have to consider *multiple* technologies not just to determine whether they conform to the Copyright Act, but also to determine whether they qualify as reduced forms of the contested technology. While dueling technical experts could assist in the effort, the ultimate decision likely would be particularly challenging from both legal and technical perspectives.

The first step of analysis under the efficient-technical approach requires courts to consider which technologies qualify as reduced versions of the contested technology. It is worth noting that any assessment of reducibility requires more technical expertise than is involved under a pure-technical approach. In determining whether technology X reduces to technology Y, one must understand how both X and Y function and how one would be able to use the implementation of Y to obtain functional equivalence with X. This type of analysis can be incredibly involved and, in the context of technologies like video streaming or file transfers, would be almost impossible for non-technical judges to perform. These difficulties are exacerbated by the fact, acknowledged above, that in any given case, judges would likely have to invoke reducibility analysis multiple times (defendants would likely point to several technologies to which their invention reduces, requiring courts to consider each one).

The second step of analysis under an efficient-technical approach requires courts to evaluate the reduced-to technology using a pure-technical approach. However, in the context of the efficient-technical

approach, the analysis is made more difficult for two reasons. First, as with the starting step of analysis under this approach, courts will likely have to evaluate multiple reduced-to technologies (and to consider potential future technologies not currently before the court), meaning that relative to the pure-technical approach this step likely would involve several times the amount of technical analysis. Second, and perhaps more problematic, is that the efficient-technical approach requires only that it is conceptually *possible* to reduce the contested technology to a court-approved technology—it does not require that a company actually engineer, design, or produce the reduction.[137] This means that, under the efficient-technical approach, judges would likely have to evaluate the permissibility of abstract, *theoretical* technologies—a task that is much more difficult than evaluating concrete, implemented, and real technologies.

In sum, the efficient-technical approach represents something of a compromise between the pure-functional and pure-technical approaches. It avoids some of the inefficiencies of the pure-technical approach, but it requires more technical analysis and expertise. The end result is that, while the efficient-technical approach is interesting to think about, it is less workable and more problematic than both the pure technical and pure functional approaches.

2. The Problems with Efficiency

As stated above, one of the largest benefits of the efficient-technical approach is efficiency. Through reducibility analysis, the approach allows companies and engineers to implement court-approved services without resorting to unwieldy and inefficient workarounds. But efficiency is not a silver bullet. In fact, some would argue that inefficiencies are essential—that a system without inefficiency is like a ski slope without friction—too fast and out of control.[138] In *ReDigi*, the District Court hinted that efficient technology is not necessarily legally or even socially beneficial. Quoting the United States Copyright Office, the court noted that

> time, space, effort, and cost no longer act as barriers to the movement of copies, since digital copies can be transmitted nearly instantaneously anywhere in the world with minimal effort and negligible cost. The need to transport physical

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[137] Indeed, if the approach did have such a requirement, then the efficiency arguments presented earlier in this Part would not apply.

[138] *E.g.*, Samuel R. Gross, *The American Advantage: The Value of Inefficient Litigation*, 85 MICH. L. REV. 734, 752-56 (1987) (describing how inefficiencies result in greater justice).

> copies of works, which acts as a natural brake on the effect of resales on the copyright owner's market, no longer exists in the realm of digital transmissions. The ability of such "used" copies to compete for market share with new copies is thus far greater in the digital world.[139]

By referring to the impact of digital files on the copyright owner's market, the court (and the Copyright Office) was advancing the argument that technical efficiency—instantaneous communication, ease of transport, and permanence of goods—may fundamentally change the relationship between authors and consumers. Under this view, the more efficient a technology, the more protective courts may need to be of authors' rights and incentives. This implicates the efficient-technical approach. Because the approach allows technologies to use *any* implementation, one could argue that the approach directly circumvents the spirit and intent of the courts' technical constraints.

As an example, consider the micro-hard drive apparatus described above. As stated above, the micro-hard drive system adheres to all court-issued technical guidelines. Moreover, because the apparatus only involves hard drives and file transfers, we can say that a simple hard-drive containing a copyrighted movie reduces to the apparatus,[140] and thus would be permissible under the efficient-technical approach. Now suppose *arguendo* that we do not yet have the technical capabilities to sustain 5,400 micro-transfers, without error, for any substantial period of time. If that were the case, then the fact that the pure-technical approach would allow the hard-drive apparatus would be of no import—there is no need to prohibit a technology that, because of technical constraints, cannot be implemented. Under the efficient-technical approach, however, the infeasibility of the micro-hard drive system is irrelevant. The fact that a pure-technical approach would allow the apparatus would justify the use of the functionally equivalent single hard-drive implementation—an implementation that is more efficient, and thus more effective at contravening the intent of the Copyright Act.

In Part I, when describing functional reducibility, I stated that, with respect to energy output, a windmill is functionally equivalent to a

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[139] Capitol Records, LLC v. ReDigi, No. 12 Civ. 95 (RJS), 11 (S.D.N.Y. 2013). It is worth noting that this was not the court's justification for its decision. As stated in Part I, the court adopted a technical approach and decided the case based on technical details.

[140] While the specific details are not relevant to this argument, the hard drive would also have to delete all of its data each time it is powered up to have functional equivalence to the 5,401 micro hard-drive apparatus (which, to avoid violating the fixation requirement, would lose the copyrighted file upon losing power).

nuclear power plant. While both can generate the same amount of power, the fact remains that there are many who prefer the safety, control, and moderation associated with wind power. Likewise, as the Copyright Office and the *ReDigi* court indicate, there are some who, when considering the author-consumer exchange at the core of copyright, would prefer to limit technological advancement and leave things as they are.

Note that this criticism does not apply to the pure-functional approach. While the functional approach does not invoke technical limitations, it *does* consider the impact a technology will have on the market and on the incentives authors have to share their work. Accordingly, if a given implementation is "too efficient," then the implementation would be rejected. However, this rejection would not be predicated on the implementation itself, but would instead be based on the functional impact of the implementation.

As a final thought, it is worth considering possible modifications to the efficient-technical approach that would avoid the efficiency problem. Specifically, one can imagine an alternate model that is identical to the efficient-technical approach *except* that engineers whose implementations deviate from the pure-technical approach would be required to pay a fee to the relevant copyright owners. This fee would be determined by the difference in implementation costs between the efficient and inefficient constructions, but would be set so as to discourage economic and technological waste. This approach would compensate copyright owners, grant credence to the courts' current technical guidelines, and incorporate a corrective factor that would help preserve the appropriate incentives for authors to create and share their creative works. While it is not as ideal as a pure-functional approach, it is a step in the right direction.[141]

V. CONCLUSION

In 1975, famous computer scientist Gordon Moore observed what has come to be known as "Moore's Law."[142] According to Moore's Law, "the number of transistors on a given chip can be doubled every two years." [143] The increased number of transistors means that

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[141] This modified license approach likely strays too far from the current Copyright Act. Accordingly, it is not likely an approach that can be adopted by the judiciary unless Congress amends the Act. Even so, it is an interesting alternative to think about.

[142] *"Moore's Law" Predicts the Future of Integrated Circuits*, COMPUTER HISTORY MUSEUM, http://www.computerhistory.org/semiconductor/timeline/1965-Moore.html [http://perma.cc/QZU6-NZG6].

[143] Michael Kanellos, *Moore's Law to Roll on for Another Decade*, CNET NEWS (Feb. 10, 2003), http://news.cnet.com/2100-1001-984051.html [http://perma.cc/TJ27-

computing power doubles every 18 months.[144] As Moore's Law suggests, modern computer chips are approximately one million times more powerful than those of the 1970s. Unfortunately, Moore's Law does not extend to the judiciary. Judges of the 21st century are no slower or faster than those of the 1970s, and the judges of the 1970s are no slower or faster than those of the 1850s. Given the rate of technical progress, it should come as no surprise that it is difficult for individuals without a technical background to keep up. In fact—it should come as no surprise that it is difficult for individuals *with* a technical background to keep up.[145] I point out these difficulties not to impugn the judiciary. Instead, my goal is to show the sheer irrationality inherent in any judge-based technical analysis. The rate of change is too fast and the impact too significant for judicial decisions to be based on incomplete or insufficient knowledge. Rather than engaging technology on its own terms, judges should do what they do best—consider the intent of Congress and the aims of the Constitution, evaluate the ways in which people interact with technology, and deliver consistent, well-reasoned, and clearly articulated decisions.

By recognizing the largest and most significant judicial strengths, the functional approach enables the judiciary to keep up with technology and allows judges to issue decisions that are clear, reasonable, and, most importantly, consistent with the aims of the Copyright Act. Judges do not make good engineers—but they do make good judges.

6RCB].

[144] *A Deeper Law than Moore's?*, THE ECONOMIST (Oct. 10, 2011), http://www.economist.com/blogs/dailychart/2011/10/computing-power [http://perma.cc/B769-K9EF].

[145] *See, e.g.*, *How to Keep Up to Date on the Latest Computer Science?*, STACKOVERFLOW (Oct. 14, 2009), http://stackoverflow.com/questions/1567837/how-to-keep-up-to-date-on-latest-computer-science [http://perma.cc/5JBE-Y76T], (illustrating that even experienced computer scientists have to do a fair amount of work to remain aware of the newest protocols, algorithms, and methods).