

THE PAST, PRESENT, AND FUTURE OF COMPUTING  
AND ITS IMPACT ON DIGITAL RIGHTS  
MANAGEMENT

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INTRODUCTION

*What If?*

What If? The question invites the Symposium participants to fill in the answer by posing a counterfactual and then describing the implications for intellectual property. A counterfactual<sup>1</sup> usually takes the form of an “if-then” statement in which the antecedent following the “if” and preceding the “then” is known to be false.<sup>2</sup> It is frequently used to support arguments

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1. See generally DAVID LEWIS, COUNTERFACTUALS 1 (Blackwell Publishers 2001) (1973) (“*If kangaroos had no tails, they would topple over*” seems to me to mean something like this: in any possible state of affairs in which kangaroos have no tails, and which resembles our actual state of affairs as much as kangaroos having no tails permits it to, the kangaroos topple over.”).

2. The first explicit definition of causation in counterfactual terms is often credited to David Hume, when he wrote, “We may define a cause to be an object followed by another,

for causation; for example, the truth of the statement “X caused Y” can be supported by demonstrating that “if X had not occurred, Y would not have occurred.”<sup>3</sup> Examining counterfactuals can also give us a fresh perspective and a broader view of familiar “truths” by forcing us away from assumptions and toward a potentially deeper look at causation. The Symposium asks participants to take this approach in an effort to provide insight in the area of intellectual property. I will be using this method to examine the relationship between computing infrastructure and digital rights management.

Here is my counterfactual: what if the proliferation of personal computing had followed the mainframe and terminal model instead of a personal computer model?<sup>4</sup> Such a different infrastructure for personal computing would likely have a number of significant consequences. I will address one area, the impact such a difference might have had on digital rights management technologies.<sup>5</sup> So, more specifically, the counterfactual would be as follows: if the spread of personal use of computing ability had been accomplished by an infrastructure of mainframe-connected terminals, then what would the impact have been on digital rights management technologies? I will argue that if personal computing had been implemented with a mainframe and terminal infrastructure, then digital rights management technologies would be much more effective than those technologies are within an infrastructure of irregularly interconnected personal computers.

After using the counterfactual to elucidate the relationship between computing infrastructure and the efficacy of digital rights management

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and where all the objects, similar to the first, are followed by objects similar to the second. Or, in other words, where, if the first object had not been, the second never had existed.” Peter Menzies, *Counterfactual Theories of Causation*, in *STANFORD ENCYCLOPEDIA OF PHILOSOPHY* (2001) (emphasis omitted) (quoting DAVID HUME, *AN ENQUIRY CONCERNING HUMAN UNDERSTANDING* (1748)), available at <http://plato.stanford.edu/entries/causation-counterfactual/>.

3. *Id.*; see also *Mental Causation*, in *THE INTERNET ENCYCLOPEDIA OF PHILOSOPHY* (James Fieser & Bradley Dowden eds., 2007), <http://www.iep.utm.edu/m/mental-c.htm>.

4. A terminal is a hardware device for inputting and viewing data from an attached computer that is often both remote and shared. There appears to be no universal definition for what constitutes a mainframe; they are typically thought of as large, often room-sized, machines that provided time-shared computing that was accessed via dumb terminals. For our purposes, the critical difference between the mainframe and terminal model and the personal computer model is the relative location of, and control over, the computing ability. In the personal computer model, computing ability is located where use takes place and is typically within the control of that local user. In the mainframe and terminal model, only the terminal is close to and under the control of the user; the computing ability is contained in the mainframe, which is typically remote to the user.

5. See generally Stefan Bechtold, *Digital Rights Management in the United States and Europe*, 52 AM. J. COMP. L. 323, 331 (2004) (“DRM is a general term for a set of intertwining technologies that may be used to establish a secure distribution chain for digital content.”).

technologies, I will seek to apply that insight to the present and future of digital rights management and in doing so argue that potential future infrastructures of computing may have similarities to our counterfactual infrastructure and thereby provide for more effective digital rights management. Following this Introduction, Part I, “The Alternate Past,” will describe the basis of the counterfactual and its theoretical impact on the efficacy of digital rights management technologies. Next, Part II, “The Transient Present,” will assess the current state of both our computing infrastructure and digital rights management with an eye to viewing them with a broader historical perspective. Then Part III, “The Potential Future,” will speculate about possible futures of our computing infrastructure and how such possible futures might provide more efficacious digital rights management technologies.

## I. THE ALTERNATE PAST

### A. A World Without Personal Computers

“The [microprocessor and personal computer] revolution would not have happened under other circumstances. Scientific and technical progress only appears inevitable because discoveries accumulate sequentially . . . .”<sup>6</sup>

The development of the 4004, 8008, and 8080 microprocessors was the necessary ingredient that allowed computer hobbyists to spark the personal computer revolution.<sup>7</sup> The Altair 8800, introduced in kit form in 1975, is often credited with being the first personal computer.<sup>8</sup> Featured on the cover of the January 1975 issue of *Popular Mechanics*, the Altair 8800 was created by Ed Roberts and based around the 8080 processor.<sup>9</sup> It could run BASIC after the addition of a memory module.<sup>10</sup> While the Altair 8800 received more attention and sold more units, it was actually preceded by

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6. JEFFREY ZYGMONT, MICROCHIP: AN IDEA, ITS GENESIS, AND THE REVOLUTION IT CREATED xix (2003).

7. STEPHEN SEGALLER, NERDS 2.0.1: A BRIEF HISTORY OF THE INTERNET 138 (1999) (“Nerds wanted their own computers, but it took a technological breakthrough to make that possible.” The personal computer was not practical “[u]ntil the invention of the microprocessor. . . . [W]hat enables us to have a mainframe computer on the desk is the chip.”); *see also* MARTIN CAMPBELL-KELLY & WILLIAM ASPRAY, COMPUTER: A HISTORY OF THE INFORMATION MACHINE 235-36 (1996).

8. SEGALLER, *supra* note 7, at 140-42.

9. MARK RICHARDS & JOHN ALDERMAN, CORE MEMORY: A VISUAL SURVEY OF VINTAGE COMPUTERS FEATURING MACHINES FROM THE COMPUTER HISTORY MUSEUM 113 (2007). The computer was reportedly named after a destination in the original Star Trek television series. *Id.*

10. The BASIC programming language was written by Bill Gates and Paul Allen. *Id.* at 114.

both the Kenbak-1<sup>11</sup> and the Mark-8.<sup>12</sup> The Kenbak-1 was designed by John Blankenbaker in 1971, but only forty or so were ever sold;<sup>13</sup> the Mark-8 was introduced in July of 1974, six months before the Altair 8800.<sup>14</sup> These personal computers created much interest among hobbyists, but it was the introduction of the Apple I in 1976 and the Apple II in 1977 that saw the personal computer revolution truly take off.<sup>15</sup> Only around 200 Apple I computers were produced;<sup>16</sup> however, between the original release in 1977 and the discontinuation of the Apple II series in 1993, Apple produced over six million personal computers within the Apple II model series.<sup>17</sup> In 2008, just over thirty years after the initial release of the Apple II, the number of personal computers worldwide is projected to reach one billion.<sup>18</sup>

But our story does not begin with the microprocessor and the rise of the personal computer; our counterfactual starts before the development of the microprocessor and personal computer and then omits their development entirely. To answer our counterfactual, we need to ask and answer a more specific question: what would have happened if the microprocessor had not been developed?

The use of computing power was very different prior to the development of the microprocessor and the personal computer. The first true computer<sup>19</sup> is most often identified as the ENIAC, built by Presper Eckert and John Mauchly and based on the design of John von Neumann.<sup>20</sup> It was created in 1946 to aid the military in calculating ballistic trajectories of artillery guns. The ENIAC consisted of 40 eight-foot racks and more than 18,000 vacuum tubes, and it cost over \$500,000 to build.<sup>21</sup> This began the era of mainframe computing in which computers took up entire floors of buildings

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11. *Id.* at 105.

12. PAUL E. CERUZZI, A HISTORY OF MODERN COMPUTING 225 (2d ed. 2003).

13. RICHARDS & ALDERMAN, *supra* note 9, at 105.

14. CERUZZI, *supra* note 12, at 225.

15. RICHARDS & ALDERMAN, *supra* note 9, at 126-29, 131. The Commodore PET and the TRS-80 were also released in 1977.

16. *Id.* at 126-29.

17. Tony Long, *June 5, 1977: From a Little Apple a Mighty Industry Grows*, WIRED, June 5, 2007 [http://www.wired.com/science/discoveries/news/2007/06/dayintech\\_0605](http://www.wired.com/science/discoveries/news/2007/06/dayintech_0605).

18. In 2008 the Number of Personal Computers in the World Will Reach Billion, Sci. Portal, <http://www.science-portal.org/in/71> (June 20, 2007).

19. The term "computer" originally referred not to a machine but rather to a person who solved equations. It was not until around the time of the creation of the first true computers, such as ENIAC, that the term "computer" came to refer to computing machines. CERUZZI, *supra* note 12, at 1. In popular press, ENIAC was actually often called the "Giant Brain." SCOTT MCCARTNEY, ENIAC: THE TRIUMPHS AND TRAGEDIES OF THE WORLD'S FIRST COMPUTER 4 (1999).

20. MCCARTNEY, *supra* note 19, at 5.

21. RICHARDS & ALDERMAN, *supra* note 9, at 17.

and in which computing was limited to experts.<sup>22</sup> A quarter of a century later, Intel's 4004 microprocessor,<sup>23</sup> measuring in at only a half inch long, packed as much computing power as the ENIAC.<sup>24</sup> Within a decade, microprocessor performance was surpassing that of even contemporaneous minicomputers and mainframes.<sup>25</sup> The invention of the microprocessor enabled the development of what we think of as the personal computer and thus brought the use of computing ability to ordinary people.<sup>26</sup> The development of the microprocessor, therefore, presents us with a possible point of departure for our counterfactual. The demand for personal use of computing ability pre-existed the microprocessor and presumably would have continued had the microprocessor not been invented. Our alternate past could have been triggered either by the failure to develop the microprocessor or by a significant delay in its development. In the absence of the microprocessor, networking connectivity could have arisen as the enabling technology that allowed widespread household computer use. In our alternate story, personal use of computers occurs not through the use of self-contained personal computers but rather through the use of mainframe connected terminals.

Clues of the potential for this alternate past can be found. Certainly, the desire for the personal use of computing ability pre-existed the microprocessor, and attempts to create such personal use also preceded the microprocessor and the accompanying rise of the personal computer. Minicomputers, which were "mini" only in reference to room-sized mainframe computers, served as transitions to personal computers by introducing the idea of a computer as a personal interactive device.<sup>27</sup> For example, the PDP-10, a timesharing minicomputer built by DEC, produced a very personal feel for the users of each terminal when they ran the TOPS-10 software.<sup>28</sup> The manual of the TOPS-10 software stated that, "Our goal has

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22. SEGALLER, *supra* note 7, at 163 ("Until the mid-1970s, the world of networked or distributed computing was confined technologically to the 'big iron' of mainframes, and sociologically to academic/government ranks.").

23. Intel's 4004 microprocessor was actually first created for a Japanese calculator company that wanted a custom chip. Instead of designing a custom chip with very specific and restricted functioning, Intel engineers decided to create a single microprocessor design that could then be used in many different applications. CAMPBELL-KELLY & ASPRAY, *supra* note 7, at 236.

24. ZYGMONT, *supra* note 6, at 128-29.

25. CERUZZI, *supra* note 12, at 289.

26. SEGALLER, *supra* note 7, at 138; *see also* CAMPBELL-KELLY & ASPRAY, *supra* note 7, at 235-56.

27. CERUZZI, *supra* note 12, at 124-25 ("Minicomputers, in particular those operated by a Teletype, introduced the notion of the computer as a personal interactive device. Ultimately that notion would change our culture and dominate our expectations, as the minicomputer yielded to its offspring, the personal computer.").

28. *Id.* at 208-10.

always been that in a properly configured system, each user has the feeling that he owns his portion of the machine for the time he needs to use it.”<sup>29</sup> Users of the PDP-10 time-sharing system saw it as a basis for public access to computing.<sup>30</sup> Thus, both the possibility of and desire for the personal use of computing can be seen in time-sharing minicomputer/terminal systems that preceded the personal computers.<sup>31</sup>

Another example of personal computing accomplished without personal computers was in wide use in France slightly after the heyday of the PDP-10, but around the same time as the emergence of the personal computer in the late 1970s. Provided by France Telecom/Alcatel, the Minitel network and X25 terminal allowed individual users access to networked computing, particularly uses associated with information communication. “French networks of millions of users of Minitel . . . combined terminals with a closed network [to] let users do many of the tasks for which we now use the [Internet].”<sup>32</sup> With the X25 terminal and the Minitel network, “[b]uying rail tickets, checking show times, posting personal ads, chatting, and searching for phone numbers were all made remarkably easy.”<sup>33</sup> While the Minitel network was not used for all types of personal computing, it provided the infrastructure for the use of computing ability by individuals.

Equally as important for our counterfactual is the potential for the rise of networking. It is essential to remember that today’s networking technology preceded the personal computer.<sup>34</sup> We often think of the rise of the personal computer and the Internet as two sequential events, with the latter following the former.<sup>35</sup> However, the basic networked packet-switching

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29. *Id.* at 209.

30. *Id.* at 221. As one writer put it after observing use of the PDP-10, “Ready or not, computers are coming to the people. That’s good news, maybe the best since psychedelics.” Stewart Brand, *Spacewar: Fanatic Life and Symbolic Death Among the Computer Bums*, ROLLING STONE, Dec. 7, 1972, at 50.

31. Around this time, a Nieman-Marcus Christmas catalog even included a sleek minicomputer marketed for use in the kitchen. It was roughly the size of a small piece of furniture.

32. RICHARDS & ALDERMAN, *supra* note 9, at 137.

33. *Id.* The Minitel network was even used to distribute and share the most ubiquitous of Internet content, pornography. JANET ABBATE, *INVENTING THE INTERNET* 209-10 (1999) (describing pornography on the Minitel network as “a popular attraction that received much public comment and that the US-government-run Internet could not have openly supported”).

34. The IMP, one of the first packet routers, debuted in 1969, two years before the Kenbak-1, five years before the Mark-1, and six years before the Altair 8800. RICHARDS & ALDERMAN, *supra* note 9, at 101.

35. SEGALLER, *supra* note 7, at 136 (“Since most Internet use today occurs through personal computers, it seems ironic that the PC was actually invented and developed long after networking.”).

technology of the Internet was in use prior to the emergence of the personal computer.<sup>36</sup>

While it is true that the dramatic rise of networking and the Internet was largely driven by both the desire to network business applications on personal computers and the usefulness created by massive parallel applications on widely accessible personal computers,<sup>37</sup> both of these drivers could have arisen within our counterfactual. This is particularly true of the former. The use of computers in business was certainly well within the purview of mainframe computing. The crucial difference was that only a few experts actually directly interacted with the computer; there was little, if any, personal computing.<sup>38</sup> This, however, was a feature of how the technology was used, not a feature of the technology itself.<sup>39</sup> In our counterfactual story, more personal use of mainframe computing ability could certainly have evolved without the emergence of the personal computer. As the software and interfaces of mainframes became easier for lay people to use, that is, more personal, terminals could be used less by computer experts and more by business professionals. Terminals could have moved beyond the mainframe rooms occupied by experts and spread into the offices of and onto the desks of business professionals. Such a change in the use of mainframe computing technology was well within the capabilities of the technology; it would have been only a matter of changing the practice of how the technology was used.<sup>40</sup> Thus, in our counterfactual, we have personal use of computing ability evolving within a mainframe and terminal model rather than having arisen from the emergence of the personal computer.

Another part of our counterfactual story that we need to consider is how personal computing would have spread into the homes of individuals

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36. *Id.* at 19-20. In fact, any of the most common attributes of computer and Internet use today were envisaged and sketched out prior to the emergence of the personal computer. In a presentation on December 9, 1968, Doug Engelbart laid out a vision for using computing systems to edit text, to link documents through hypertext links, to mix text and graphics, and to present video and graphics. The presentation also provided a sketch of ARPAnet, the precursor to the Internet. JOHN MARKOFF, WHAT THE DORMOUSE SAID: HOW THE SIXTIES COUNTERCULTURE SHAPED THE PERSONAL COMPUTER INDUSTRY 148 (2005).

37. SEGALLER, *supra* note 7, at 19-20, 136 (“PC’s gave networking the massive parallel application it needed to be both widely accessible and thoroughly useful.”).

38. CERUZZI, *supra* note 12, at 251.

39. SEGALLER, *supra* note 7, at 136-37 (“Mainframe computers were far from ‘personal.’ They were remote in both a practical and a political sense, sitting in big air-conditioned rooms at insurance companies, phone companies, and banks, the institutions that generally controlled the lives and communications of ordinary citizens. But computer terminals had filtered down from university departments and had begun to appear in schools.”).

40. This capability can be seen by comparing the use of “Big Iron” mainframes by the government and large corporate entities with more personal uses, such as the TOPS-10 software running on DEC’s PDP-10, *see supra* text accompanying notes 27-31, and the Minitel x25, *see supra* text accompanying notes 32-33.

within the mainframe and terminal model of computing. The first primary impediment would have been the economics of initially deploying mainframe computing on a scale to be able to create a market for home computing, where little or no such market previously existed. The second primary impediment would have been providing the proper infrastructure for such widespread massive connectivity between remote mainframes and in-home terminals. This would have provided both an economic challenge and a technical challenge.

With respect to the first impediment, the economics of the situation would have likely slowed the spread of computing into the personal realm. Prior to the emergence of the microprocessor in the 1970s, the economics did not favor the spread of computing to more personal uses.<sup>41</sup> However, if computing did spread to personal use, the mainframe and terminal model probably would have been the most likely candidate as opposed to the spread of individual minicomputers, at least from an economic point of view.<sup>42</sup> In our alternate history in which the microprocessor was not developed, the economics would have clearly favored the sharing of computing power instead of each user owning computing power that was rarely fully utilized. ARPAnet itself was developed because the military wanted to use mainframe computing power in more places without purchasing additional mainframes.<sup>43</sup> Clearly, the sharing of computing power among many users, where each user pays only a small portion of the total cost associated with the mainframe, would be the most likely way for computing to spread to more individuals, at least from an economic perspective. Perhaps the biggest economic problem with this approach would have been a free rider problem in which each individual withholds committing his own resources in the hope that others will provide enough to cover him as well. However, the likely top-down approach to the spread of personal use of computing would have ameliorated much of the impediment created by the free rider problem. In other words, in our counterfactual history, large companies would have provided the initial investment in acquiring and making available the computing power and then would have recovered the costs from large numbers of individuals. Because the provider could have withheld the use of computing ability from those that did not contribute their portion, free riding would not have presented a problem.

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41. CERUZZI, *supra* note 12, at 211 (“Economics prevented the spread of computing to the public from the top down—from large mainframes through time-shared terminals.”).

42. One might argue that the relative success of the Minitel x25 terminal in France when compared to the Neiman Marcus Kitchen Computer demonstrates the greater likelihood of computing spreading to personal uses through a mainframe and terminal model instead of through individually-owned minicomputers.

43. SEGALLER, *supra* note 7, at 18.

But what entities would invest initially in the hardware to create the capability for large numbers of private individuals to use computing ability in their own homes within a mainframe and terminal model? One potential answer lies in the solution to our second primary impediment, the need for a massive infrastructure to provide connectivity between terminals and mainframes. In our counterfactual, the answer to both concerns is the cable industry.<sup>44</sup>

In actual history, the cable television industry expanded more or less concurrently with the rise of the personal computer.<sup>45</sup> Within our alternate history, this massive expansion of the cable television infrastructure could have provided the necessary connectivity to allow widespread distribution of mainframe-connected terminals into private homes. These terminals would probably have evolved initially from cable boxes. First, functionality would have been added to increase the types and methods of experiencing media. Then, with the addition of increased mainframe computing power and with the addition of means to input information to cable boxes, these advanced cable boxes-cum-terminals would have provided the capability for many of the forms of communication associated today with Internet-connected personal computers, from chat to email to multiplayer games.<sup>46</sup> Eventually, these terminals might have provided the ability for sharing user-generated content over the cable network.

Other personal uses of computing, such as word processing and data processing, could have emerged in two parallel paths. First, our counterfactual cable and computing providers could have sought to exploit their computing and connectivity resources by providing computing use to small and mid-sized businesses that did not have the resources to own their own mainframe computers. Second, the expansion of these types of computing uses could have evolved from educational programming. Personal programming seems to be the main use that would have been left undeveloped in our counterfactual.

In many ways, this cable-computing version of the mainframe and terminal model of computing would have more closely resembled the walled gardens of the early Internet years, the early versions of Prodigy and America Online.<sup>47</sup> It would also have had similarities to the Minitel net-

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44. See *infra* notes 45-46 and accompanying text.

45. InfoTech at K-State: Cable TV and Internet, <http://www.kstate.edu/info-tech/cable/history.html> (last visited May 4, 2008).

46. The ability of current cable companies to act as Internet service providers demonstrates many of the technological possibilities of cable networks. Our alternate history merely shifts the location of the computing ability from a user's desktop to the network provider.

47. Walled garden,

[r]efers to a network or service that restricts its users to its own content. Cable TV and satellite TV are walled gardens, offering a finite number of channels and pro-

work in France.<sup>48</sup> In fact, taken together, the actual historic emergence of the early walled gardens such as CompuServe and of the widespread Minitel network adds support for the plausibility of the emergence of a cable-based personal computing network in our counterfactual.

So, having described how computing could have spread towards more personal use in both the business and the home environment in the absence of the microprocessor and personal computer, the primary environment left to explore is the academic environment. Here, the emergence of a mainframe and terminal model of personal computing is the easiest to envision because such a model was beginning to emerge at the time the personal computer actually emerged.<sup>49</sup> Because academic institutions are accustomed to coordinating resources and infrastructures within what are generally tightly clustered campus environments, expanding the use of university computing resources to more and more individuals on that campus fits very well with a mainframe and terminal model of computing.

In all of these environments, particularly the business and home environments, the spread of personal computing within the mainframe and terminal model would likely have been delayed in our counterfactual, compared to the same degree of spread in the personal computer revolution, because of the unfavorable economics and still largely nascent cable network infrastructure. The emergence of the microprocessor and the personal computer made personal computing economically feasible and even attractive.<sup>50</sup> The spread of access and use of computing ability to individuals would therefore have very likely been delayed in the absence of the microprocessor and the personal computer. Many of the drivers of personal computing would still have been present, but their spread would have had to wait for the cost associated with computing in a mainframe and terminal model to drop.<sup>51</sup>

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grams to its subscribers. When AOL was king of ISPs, it did an excellent job of keeping users on AOL-affiliated sites more than other sites.

TechWeb Network, TechEncyclopedia, Walled Garden, <http://www.techweb.com/encyclopedia/defineterm.jhtml?term=walled+garden> (last visited May 4, 2008).

48. See *supra* text accompanying notes 31-32.

49. SEGALLER, *supra* note 7, at 136-37 (“But computer terminals had filtered down from university departments and had begun to appear in schools.”).

50. CERUZZI, *supra* note 12, at 211 (“Economics prevented the spread of computing to the public from the top down—from large mainframes through time-shared terminals.”); see also CAMPBELL-KELLY & ASPRAY, *supra* note 7, at 235-36.

51. For example, developers of the software for the PDP-10 saw its timesharing model as a basis for public access to computing. CERUZZI, *supra* note 12, at 221.

## B. The Impact on Digital Rights Management

Our counterfactual world in which the personal use of computing ability is accomplished not through personal computers, but rather through a mainframe and terminal model, would have made digital rights management much more efficacious.

The mainframe and terminal model of computing places much more control in the hands of the administrator of the mainframe and reduces the amount of control exercised by the individual user.<sup>52</sup> The degree of control and power a self-standing personal computer gives an individual, especially a skilled individual,<sup>53</sup> should not be underestimated. The personal computer has become so embedded in our technological landscape that it can be difficult to remain cognizant of the power it gives to individuals. If one looks carefully, those claiming that digital rights management systems will always be broken easily will either explicitly or implicitly base such statements on the availability of personal computers.<sup>54</sup> Without personal computers, individuals in our counterfactual world would have less autonomy and control with respect to their use of personal computing power.

This shift in power from individuals to mainframe administrators means that more control is shifted into the hands of fewer gatekeepers. Having fewer gatekeepers makes it easier for rights holders to enforce their rights, either directly through copyright rights, or indirectly by adding legal teeth to digital rights management technologies with the anti-circumvention provisions of the Digital Millennium Copyright Act.<sup>55</sup> Additionally, in our counterfactual story, one of the primary gatekeepers, the cable-computing industry, has an established working relationship and interdependence with media producers, the primary rights holders. In the actual personal computer and Internet revolution, both the makers of personal computers and Internet service providers had little or no incentive to protect copyright rights. In fact, their products and services probably had more value to individuals because those individuals could use their products and services to

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52. See Jonathan Weinberg, *Hardware-Based ID, Rights Management, and Trusted Systems*, 52 STAN. L. REV. 1251, 1256 (2000) (“In the old days, when mainframe computers ruled the world, system administrators had little difficulty associating the individuals using their systems with unique usernames, and thus using permissions or similar file access rights to enforce that aspect of system security.”).

53. Such as a hacker trying to crack a digital rights management system.

54. See, e.g., Jonathan L. Zittrain, *The Generative Internet*, 119 HARV. L. REV. 1975, 2000 (2006) (“The fact remains that so long as code can be freely written by anyone and easily distributed to run on PC platforms, trusted systems can serve as no more than speed bumps or velvet ropes—barriers that the public circumvents should they become more than inconvenience.” (emphasis added)).

55. Pub. L. No. 105-304, 112 Stat. 2860 (1998) (codified in scattered sections of 17 U.S.C.).

infringe copyright rights. The opposite is true for our counterfactual cable-computing industry. This putative cable-computing industry bases its business model primarily on the delivery of media content; actions by users of its computing resources to infringe copyright rights through the unauthorized copying and distribution of copyright-protected content therefore directly impact the industry's own profits. It therefore has a much higher incentive to work with the copyright holders.<sup>56</sup>

Remember that in talking about the efficacy of digital rights management, we are speaking primarily of network-distributed media, and network distribution of media does not require personal computers as we now have them. While digital reproduction, with its ability to produce perfect copies, is a potential concern towards which digital rights management technologies have been addressed, it was digital distribution, first through bulletin boards and then later through peer-to-peer networks, that provided the impetus for and then later the challenge to digital rights management technologies.<sup>57</sup>

The delay in the spread of access and use of computing ability to individuals might have had another, less obvious impact in the area of digital rights management. The development of both the personal computer and the Internet were influenced by the counterculture, anti-establishment movement of the 1960s. As Stewart Brand said, "[T]he counterculture's scorn for centralized authority provided the philosophical foundations of not only the leaderless Internet but also the entire personal-computer revolution."<sup>58</sup> Some historians have described a sub-group of these individuals as "computer liberationists" who wanted, for philosophical and political reasons, to bring computing to the ordinary person.<sup>59</sup>

Although it is difficult to assess the influence the counterculture had on the personal computer and Internet revolution or would have had on our counterfactual mainframe and terminal model of personal computing, any

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56. In our counterfactual story, the transition to new distribution models of copyright-protected media would likely have been much, much smoother. Where the changes would have likely been less smooth is the potential competition between the cable-computing industry and the telephone industry, particularly as the cable-computing industry moved more and more into communication technologies. Another potential area for unrest might have resulted from consumer interest in greater competition for computing services.

57. See generally Bechtold, *supra* note 5.

58. MARKOFF, *supra* note 36, at xii (quoting Stewart Brand, *We Owe It All to the Hippies*, TIME, Mar. 1, 1995, at 54). Markoff also describes the attitudes in terms of West Coast versus East Coast, with the counterculture ex-hippies of the West Coast represented by researchers at Xerox PARC and researchers at California academic institutions, and with the hierarchical and ordered old world of the East Coast represented by researchers at MIT. *Id.* at xiv-xv. See also SEGALLER, *supra* note 7, at 19 ("[n]etworking was funky in the 1970s," a mix of military and counterculture hippies).

59. CAMPBELL-KELLY & ASPRAY, *supra* note 7, at 238 (describing the "computer liberationists" as a post-Beatles, post-Vietnam, strong anti-establishment group that was distinct from the computer hobbyists).

influence the counterculture did or would have had would have been lessened with the passage of time. Any delay in the development of the structure of personal computing would have resulted in fewer members of the counterculture being involved in its development. The lack of that influence would likely have led to a less open structure for personal computing.<sup>60</sup>

Thus, we see two reasons why our counterfactual in which the micro-processor was not developed and personal use of computing spread through a mainframe and terminal model would have resulted in more effective digital rights management technologies. First, control of computing power would have been centralized in the hands of fewer gatekeepers who would themselves be much more protective of copyright rights. Second, the delay in spread of computing to ordinary people would have lessened the influence of the counterculture on our model of personal computing.

## II. THE TRANSIENT PRESENT

### A. The Present of Computing

The history of technology is littered with assessments of then-present technologies and the future of those technologies that have been so far off that these assessments have survived and gained fame solely because of how completely wrong they were. The field of computing is no different.

*I think there is a world market for about five computers.*<sup>61</sup>

*Computers in the future may weigh no more than 1.5 tons.*<sup>62</sup>

*There is no reason for any individual to have a computer in their home.*<sup>63</sup>

These statements, the complete wrongness of which has given them fame, probably did not seem necessarily inaccurate at the time they were made. In fact, one of the reasons for their fame is that each was made either by indi-

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60. Think of it in terms of the sitcom *Family Ties*. Consider the likely difference between a structure for personal computing designed by the conservative, pro-establishment Alex P. Keaton and one designed by his ex-hippie father Steven Keaton.

61. This quote has been widely attributed to Thomas Watson, who was then chairman of IBM when he supposedly made this statement in 1943. Although it has been widely attributed to Watson, *see, e.g.*, CHRISTOPHER CERF & VICTOR NAVASKY, *THE EXPERTS SPEAK: THE DEFINITIVE COMPENDIUM OF AUTHORITATIVE MISINFORMATION* 208 (1984), some have disputed the attribution, and there appears to be no primary source available to verify that Watson did, in fact, make the statement.

62. Steve Ditlea, *A Century of Technology*, *POPULAR MECHANICS*, Jan. 2000, at 50 (quoting a 1949 issue of *Popular Mechanics*).

63. Kenn Olson, President, Chairman, and Founder of Digital Equipment Corporation, made this statement at the 1977 meeting of the World Future Society. CERF & NAVASKY, *supra* note 61, at 209.

viduals highly placed in the field of computing or by entities that were considered authoritative within the field of technology. I repeat them here to emphasize how difficult it can sometimes be to see beyond present circumstances and present realities.

The present of computing is dominated by the microprocessor and the personal computer. This model of computing places computing power in billions of separate independent boxes.<sup>64</sup> Each personal computer is an autonomous, functionally unrestricted processing device that dwarfs early mainframe computers in power. The autonomous power of the personal computer is further augmented by the ability of personal computer users to elect to connect to the Internet.

Power and control are extremely decentralized in the current model of personal computing. With respect to media, the present nature of personal computing allows any one personal computer user to defeat digital rights management technologies, to make an unlimited number of copies of media, and to then distribute those copies to an unlimited number of other users by connecting to the Internet. The capabilities of the personal computer, particularly when connected to the Internet, has thus lead to a concern from some corners over the ability of media producers to protect their copyright rights.<sup>65</sup> This concern has led to the continuing development of digital rights management technologies, which seek to shift some of the power and control away from the users of personal computers. The success and potential impact are the subject of much current debate surrounding digital rights management.

## B. The Present of Digital Rights Management

Currently, the debate surrounding digital rights management can be characterized by two sides that maintain nearly opposite views on the state of digital rights management. One side, the side occupied by most producers of copyright-protected content, argues that it cannot continue to produce content in the face of massive, widespread online piracy, without a drastic improvement in digital rights management technologies, which in their current form are too easily defeated.<sup>66</sup> The other side argues that current digital

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64. Michael Kanellos, *PCs: More Than 1 Billion Served*, CNET NEWS, June 30, 2002, <http://www.news.com/2100-1040-940713.html>; *The Number of PCs to Reach 2 Billion by 2015*, INTERNET MARKETING NEWSWATCH, June 15, 2007, [http://www.imnewswatch.com/archives/2007/06/the\\_number\\_of\\_p.html](http://www.imnewswatch.com/archives/2007/06/the_number_of_p.html).

65. The empirical data on the infringement of copyright rights on a massive scale in peer-to-peer networks has no doubt provided fuel for concern as well.

66. See, e.g., Recording Industry Association of America, *Piracy: Online and On the Street*, <http://www.riaa.com/physicalpiracy.php> (last visited May 4, 2008) ("It's commonly known as piracy, but it's a too benign term that doesn't even begin to adequately describe the toll that music theft takes on the many artists, songwriters, musicians, record label employees

rights management technologies are too strong in that their restrictions are over-inclusive and prevent legitimate, desirable benefits/advantages.<sup>67</sup> Those include both uses of public domain material that are contained within the technological enclosures and uses of copyright-protected material permitted by fair use.<sup>68</sup>

### C. Taking a Long View by Placing the Present in Context

As the quotes at the beginning of this Part demonstrate, we have to take care not to mistake present realities for permanent realities. We can do this by viewing the present in the context of history and seeing how computing realities have evolved over time. Hopefully, the exercise of posing and analyzing this counterfactual has helped us to understand the impact those changes have had.

I think too often we look back at recent history with the emergence of the personal computer, and then later the Internet and World Wide Web, and think that we have reached some technological endpoint. We think that how we use computing technology today is the only way it can be used and is the only way we will always use that technology. This thinking could almost be described as an “End of History” for computing. And perhaps that line of thinking is true. Perhaps the personal computer will continue to be the dominant model for the use of computing power. But perhaps not. We may benefit from taking a longer view of our current location in history. We may in fact still be in the early developmental stages of the information age and the computing revolution.

## III. THE POSSIBLE FUTURE

By examining the relationship between the past and how it crafted the present, and by examining how a different past could have lead to a differ-

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and others whose hard work and great talent make music possible. . . . Our goal with these anti-piracy efforts is to protect the ability of the recording industry to invest in new bands and new music and, in the digital space, to give legal online services a chance to flourish.”); *see generally* Peter K. Yu, *Anticircumvention and Anti-anticircumvention*, 84 DENV. U. L. REV. 13 (2006).

67. *See, e.g.*, Fred von Lohmann, *Fair Use and Digital Rights Management: Preliminary Thoughts on the (Irreconcilable?) Tension between Them 1* (2002), [http://w2.eff.org/IP/DRM/cfp\\_fair\\_use\\_and\\_drm.pdf](http://w2.eff.org/IP/DRM/cfp_fair_use_and_drm.pdf) (“In essence, copyright owners now have the ability to write their own intellectual property regime in computer code, secure in the knowledge that the DMCA will back the regime with the force of law. It’s not surprising that in light of these developments many have expressed alarm that DRM technologies may be used by copyright owners to erode capabilities that had previously been permitted to the public by copyright law under the “fair use” doctrine (or its cousins, such as first sale or limited term).”); *see generally* Yu, *supra* note 66.

68. *See generally* Yu, *supra* note 66.

ent present, we are hopefully made more aware of the possibilities for the future of computing. Just as computing's past differs from its present, so too could computing's future differ from its present. Importantly, I will discuss future possibilities, not predictions. As renowned futurist Jim Dator once wrote, "[a]ny useful idea about the future should appear to be ridiculous."<sup>69</sup> In other words, discussing a future that is little different than the present, that contains so few changes from the present as to not appear ridiculous, is of little value as an exercise in future study. If there is going to be little change, then there is little need to study beyond the present. In contrast, possibilities for the future that are perhaps radically different from the present and that might therefore appear to be "ridiculous" merit greater consideration. The differences between the present and the possible "ridiculous" future invite analysis on the changes' overall desirability and consideration of whether that future should be actively avoided or promoted.<sup>70</sup>

Mainframes and minicomputers dominated the use of computing from the late 1940s to the late 1970s and even into the early 1980s. Since then, for the last thirty years, personal computers have defined how we used computing ability. While the personal computing paradigm still appears to be strong, we need to consider that our use of computing may be different in the future. Rather than try to discuss all the possible futures for computing, I will focus on the possibilities that may arise out of two currently visible trends: omnipresent connectivity<sup>71</sup> and hardware-embedded control.<sup>72</sup>

Because these trends bear directly on the use of computing to experience media, they are particularly relevant to the effect of the future of computing on digital rights management.<sup>73</sup> Additionally, I will relate how both trends have similarities to our counterfactual story in which the efficacy of digital rights management was increased in an alternate past where personal use of computing spread through a mainframe and terminal model. These two trends, omnipresent connectivity and hardware-embedded control technologies, act, at least in part, to shift control of computing activities away from the individual user and toward a more centralized model. Thus, these

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69. Futurology, Wikipedia, The Free Encyclopedia, [http://en.wikipedia.org/wiki/Future\\_studies](http://en.wikipedia.org/wiki/Future_studies) (last visited May 4, 2008).

70. I also think this approach, by focusing on a future set of potential facts, fits very nicely with the counterfactual approach of the Symposium and this Article.

71. Omnipresent connectivity essentially refers to always-on, always-present broadband Internet connectivity that is for practical purposes universally present within a particular market. *See infra* notes 74-89 and accompanying text.

72. Hardware-embedded control refers to technologies that restrict use and are either built into a device's hardware or are built into software that is both required for use of the device and is inaccessible to the user. *See infra* notes 90-96 and accompanying text.

73. My focus is on the impact on digital rights management, so I will not address many of the trends associated with ubiquitous computing, which is one of the more common scenarios presented as the next paradigm of computing.

two trends envision a future in which computing is quite different than the present.

#### A. Omnipresent Connectivity

The first trend, omnipresent connectivity, is created by the increasing availability of network connectivity.<sup>74</sup> While networking technology preceded the microprocessor, the personal computer emerged in an environment where network connectivity was largely absent. The personal computer and the software designed to run on it have therefore always had to function as a stand-alone device without connection to any outside source. The design has had to assume that connection to a network is not always possible. This design requirement prevents any aspect of control from being withheld from the user if such withholding would negatively affect the functioning of the personal computer in the absence of a network connection. If a designer of computer hardware and software can assume that connectivity is always available, then the hardware and software system can be designed such that someone other than the user can retain control of the computer. If the system can be designed to require some form of input or permission arising from someone other than the user, then that person can exercise a degree of control over the computer.

The trend toward such omnipresent connectivity and the use of it can be seen in a variety of computing devices and software, such as gaming systems, mobile phones, virtual worlds, and cloud computing. For example, with the release of a new popular game, Halo-2, Microsoft used the online portion of the game to block the game's use on user-modified Xbox game consoles. Full use of the game could not be accessed without connecting to a site controlled by Microsoft, and when that connection revealed a modified game console, that functionality was denied to those users.<sup>75</sup> Thus, by being able to require a connection for full game function, Microsoft was able to leverage more control over the use and modification of the Xbox game consoles.

Another example of the trend toward omnipresent connectivity involves the increasing use of mobile devices as a substitute for the use of computers. The iPod Touch incorporates WiFi connectivity that allows a user to download music and videos from the iTunes store without the use of

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74. The network connectivity we are talking about here concerns primarily connections accomplished through the Internet.

75. David Becker, *Is Microsoft Using 'Halo-2' to Thwart Xbox Hackers?*, CNET NEWS, Nov. 12, 2004, [http://www.news.com/Is-Microsoft-using-Halo-2-to-thwart-Xbox-hackers/2100-1043\\_3-5449160.html](http://www.news.com/Is-Microsoft-using-Halo-2-to-thwart-Xbox-hackers/2100-1043_3-5449160.html).

a personal computer.<sup>76</sup> Amazon's new e-reader Kindle allows users to purchase and download books and other texts directly to their Kindles without the use of a computer.<sup>77</sup> Younger generations are substituting text messaging on mobile phones for emailing on computers.<sup>78</sup> More and more functionality that used to rely on personal computers is being shifted to mobile devices. In Japan, the sale of personal computers has for the first time leveled off, while the sale and use of mobile phones continues to increase. This Japanese trend is partially attributed to young consumers shifting activities previously carried out on computers to mobile phones.<sup>79</sup> These examples have at least this in common: connectivity allows them to shift computing uses away from personal computers that are more open to user control and modification and onto mobile devices that are less open to users.<sup>80</sup>

A third present phenomenon that illustrates this trend is that of virtual worlds. From fantasy role-playing worlds such as Ultima Online, Everquest, Linneage, and World of Warcraft, to social worlds such as Habbo Hotel, There, and Second Life, millions of people worldwide are spending enormous amounts of time in virtual worlds.<sup>81</sup> First, virtual worlds demonstrate that large numbers of people will invest time and energy in something that only works when connected to remote servers. Thus, software that requires connectivity is viable on a large scale. Second, virtual worlds demonstrate the high amount of control that can be exercised by system administrators when functionality is linked to connectivity. Because ultimate control of access to a virtual world rests with the network connection to the virtual world servers, and since information and code on those servers have the ability to control everything within the virtual world, the system admin-

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76. See Apple—iPod touch, <http://www.apple.com/ipodtouch/> (last visited May 4, 2008).

77. See Amazon.com, <http://www.amazon.com> (last visited May 4, 2008).

78. See, e.g., Chad Lorenz, *The Death of E-mail: Teenagers Are Abandoning Their Yahoo! and Hotmail Accounts. Do the Rest of Us Have To?*, SLATE, Nov. 14, 2007, <http://www.slate.com/id/2177969/pagenum/all/>.

79. Frederick Lane, *NPD Report: Age of Electronics Literacy Drops*, TOP TECH NEWS, June 6, 2007, [http://www.toptechnews.com/story.xhtml?story\\_id=112003LRI080](http://www.toptechnews.com/story.xhtml?story_id=112003LRI080) (attributing this projected decline to other consumer electronics and youth use of cell phones instead of personal computers); see also Press Release, ComScore, *Mobile Phone Web Users Nearly Equal PC Based Internet Users in Japan* (Sept. 20, 2007), <http://www.comscore.com/press/release.asp?press=1742> (reporting that the number of users accessing the Internet through mobile devices in Japan nearly equaled those accessing the Internet through personal computers and that young persons were largely responsible for these new usage patterns).

80. The second trend toward hardware-embedded controls can also be seen in these examples.

81. See generally Joshua A.T. Fairfield, *Virtual Property*, 85 B.U. L. REV. 1047 (2005); see also MMOGChart.com: *Total MMOG Active Subscriptions*, <http://www.mmogchart.com/Chart4.html> (last visited May 4, 2008) (showing greater than twelve million active subscriptions to virtual worlds as late as June 2006).

istrators who control those servers have a high degree of control. They have been likened to gods within the virtual worlds.<sup>82</sup>

The fourth phenomenon is cloud computing. Cloud computing is the term used to describe “the idea of relying on Web-based applications and storing data in the ‘cloud’ of the Internet.”<sup>83</sup> So instead of storing software applications and data locally on a personal computer, the software applications and data are stored on remote servers and are accessed through a connection to the Internet. It is ever-increasing connectivity that makes cloud computing both technologically possible<sup>84</sup> and attractive to users.<sup>85</sup> Although there are many interesting aspects that a move to cloud computing presents, for us the interesting aspect is that cloud computing is a “newly recentralized computing architecture.”<sup>86</sup> That is, cloud computing returns us to architecture with a great deal of similarity to the mainframe and terminal model of computing.<sup>87</sup> With that return, some amount of control shifts away from the user and back to the administrator of the “newly recentralized” computing infrastructure.

When taken together, these phenomena point towards the possibility of a return to a model of computing eerily similar to the mainframe and terminal model of computing.<sup>88</sup> Non-personal computer, Internet-accessing

82. See, e.g., Aleks Krotoski, *Government Intrusion is Nothing on Game Gods*, THE GUARDIAN, Aug. 30, 2007, <http://www.guardian.co.uk/technology/2007/aug/30/guardian-weeklytechnologysection.secondlife>; *Ten Reasons We Need Micropayments in Virtual Worlds*, SECOND THOUGHTS, Nov. 7, 2007, [http://secondthoughts.typepad.com/second\\_thoughts/2007/11/ten-reasons-we-.html](http://secondthoughts.typepad.com/second_thoughts/2007/11/ten-reasons-we-.html). See also THE STATE OF PLAY: LAW, GAMES, AND VIRTUAL WORLDS (Jack M. Balkin & Beth Simone Noveck eds., 2006).

83. Erica Naone, *Computer in the Cloud: Online Desktop Systems could Bridge the Digital Divide*, MIT TECH. REV., Sept. 18, 2007, <http://www.technologyreview.com/Infotech/19397/>.

84. George Gilder, *The Information Factories*, WIRED, Oct., 14, 2007, at 181, available at <http://www.wired.com/wired/archive/14.10/cloudware.html> (“Back in 1993, in a midnight email to me from his office at Sun Microsystems, CTO Eric Schmidt envisioned the future: ‘When the network becomes as fast as the processor, the computer hollows out and spreads across the network.’”).

85. Naone, *supra* note 83, at 3 (“Michels says that he expects the younger generation to be more willing to adopt the computer-in-the-cloud idea than people were 10 years ago because young people’s familiarity and comfort with Web-mail systems and other forms of cloud computing currently in use. ‘That generation grew up with the notion that desktops don’t matter.’”).

86. Gilder, *supra* note 84, at 181. The article’s introductory text announces, “The desktop is dead. Welcome to the Internet cloud.” *Id.* at 178.

87. *Id.* at 194 (“Cloud computing, he confirmed, has indeed succeeded the old high performance staples: mainframes and client-server . . .”).

88. *Id.* at 181. Gilder drops allusions to the mainframe and terminal model throughout his article. For example, at one point, he remarks with a bit of tongue in cheek irony, “Just last century—you remember it well, across the chasm of the crash—the PC was king. The mainframe was deposed and deceased.” *Id.* at 180. Later, he writes, “In the PC era, the

devices combined with the transfer of software operating systems and applications into the cloud could bring about the disappearance of the personal computer as we understand it today.<sup>89</sup>

## B. Hardware-embedded Control

The second trend in computing that could impact the efficacy of digital rights management is hardware-embedded control technologies. While embedding control into the hardware, rather than relying on software controls, does not prevent a user from overriding that control, it does make the task significantly more difficult.<sup>90</sup> In addition to making the initial cracking of controls more difficult, it also makes the distribution of such cracks to large numbers of other users more difficult. If overriding the hardware-embedded controls involves modification of the user's hardware, then that override cannot be distributed as easily as software overrides can.<sup>91</sup>

The primary examples of hardware-embedded control technology fall within the area known as trusted computing or trusted systems.<sup>92</sup> Two early attempts at trusted computing systems were Intel's Processor Serial Number and the Broadcast Flag. The primary impact of trusted computing is to give someone else besides the owner of the computer control over that computer.<sup>93</sup> Essentially, "[t]rusted systems are systems that can be trusted by outsiders against the people who use them."<sup>94</sup> Although many reasons have been proffered in support of trusted computing, the primary driving force seems to be more effective digital rights management. Although there is doubt that trusted computing could be fully efficacious within an environment of uncontrolled personal computers,<sup>95</sup> trusted computing would have an impact. All in all, it "would probably lead users to lose control over their

winner were companies that dominated the microcosm of the silicon chip. The new age of petacomputing will be ruled by the masters of the remote data center." *Id.* at 181.

89. *Id.* at 180 ("According to Bell's law, every decade a new class of computer emerges from a hundredfold drop in the price of processing power. As we approach a billionth of a cent per byte of storage, and pennies per gigabit per second of bandwidth, what kind of machine labors to be born?").

90. Julie E. Cohen, *Pervasively Distributed Copyright Enforcement*, 95 GEO. L.J. 1, 11 (2006) ("Such 'trusted systems' efforts are, and are designed to be, far more impervious to hacker workarounds.").

91. *Id.* ("[Trusted systems] are also far more inhospitable to unauthorized technologies that an independent third party might seek to market.").

92. See generally JONATHAN L. ZITTRAIN, TECHNOLOGICAL COMPLEMENTS TO COPYRIGHT (2005); MARK STEFIK, THE INTERNET EDGE: SOCIAL, TECHNICAL, AND LEGAL CHALLENGES FOR A NETWORKED WORLD 55-78 (1999).

93. LAWRENCE LESSIG, CODE AND OTHER LAWS OF CYBERSPACE 135 (1999).

94. Zittrain, *supra* note 54, at 1998 (stating that in the context of digital rights management, trusted systems allow the architects of the trusted system to determine the uses a person can make of the computing system, rather than the user making that decision).

95. *Id.* at 2000.

machines, but it would also make copying more easily controlled by verifying that users are trustworthy.”<sup>96</sup>

Together, the trend toward omnipresent connectivity and the trend toward hardware-embedded controls could evolve into a very different computing infrastructure in the future than the personal computer model that dominates the present. And that potential future infrastructure would, like our counterfactual mainframe and terminal model of personal computing, shift control away from the user and thus make digital rights management more effective.

#### CONCLUSION

By exploring computing’s past, both the factual and counterfactual past, we can hopefully better appreciate the impact our current model of personal computing has on digital rights management. Perhaps more importantly, we can also be a little more conscious of our assumptions about the possibilities for computing technologies and digital rights management; and we can be more aware of the potential for change to the current model that is so dominated by the personal computer and the potential impact of such a change on digital rights management.

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96. Nicola Lucchi, *Intellectual Property Rights in Digital Media: A Comparative Analysis of Legal Protection, Technological Measures, and New Business Models Under EU and U.S. Law*, 53 *BUFF. L. REV.* 1111, 1165 (2005).