June 29, 2015

Ms. Jacqueline C. Charlesworth
General Counsel and Associate Register of Copyrights
United States Copyright Office
101 Independence Ave. S.E.
Washington, D.C. 20559-6000

Re: Docket No. 2014-7
Exemptions to Prohibition Against Circumvention of Technological Measures Protecting Copyrighted Works
June 3, 2015 Questions Posed to Class 1 Witnesses

Dear Ms. Charlesworth,

Thank you for this opportunity to say more about screen capture software and its limitations as an alternative to circumvention for lawful educational uses. We hope our response will be helpful to you, and we welcome any further questions you may have. ¹

Screen capture is not a viable alternative to circumvention for educational uses.

As the extensive record in this proceeding demonstrates, all of the screen capture technologies mentioned in the hearings and in the comments of parties opposed to the proposed Class 1 exemption produce low quality clips that do not meet the needs of teachers and students. Footage obtained with screen capture technologies is ridden with imperfections, including interlacing, dropped frames, frame rate issues, insufficient resolution, and artifacting. ² Some of these problems were demonstrated in opponents’ own exhibits. ³ At the May 27, 2015 hearing, a

¹ Since several witnesses who testified on these issues received the same question as part of their post-hearing inquiries, we collaborated on our responses. In particular, this response includes substantial contributions from Jack Lerner, Aaron Johnson, and R.J. Szuba from the UCI Intellectual Property, Arts, and Technology Clinic and Blake Reid and Molly McClurg from the CU Boulder Samuelson-Glushko Technology Law and Policy Clinic.


representative of DVD CCA admitted that screen capture software produces footage of visibly diminished quality. These quality problems wholly preclude using screen capture software to extract clips from DVDs. Moreover, no one contends that screen capture is even capable of capturing clips of any quality from Blu-ray discs or other high definition sources.

Even if screen capture software worked reliably, it remains unclear whether it is actually an alternative to circumvention. Users of screen capture software cannot be certain how it works, and in particular, whether it involves circumvention that may violate the DMCA. With the exception of WM Capture, none of the screen capture programs identified by opponents of the proposed exemptions make the representation required by the current exemption—that the software “enable[s] the reproduction of motion picture content after such content has been lawfully decrypted.” TechSmith, the makers of Jing, Camtasia, and Snagit, even urges its customers to circumvent TPMs on DVDs to enable screen capture technology to function.

In short, even absent the compatibility issues raised in the hearings and addressed in more detail below, screen capture software is not a viable alternative to circumvention.

Most screen capture software is not fully capable of recording from DVD and other protected formats on the latest versions of Mac OS X.

We have reviewed the specifications and websites of the manufacturers of the software in question, as well as comments by users, to determine operating system compatibility, and detail our results in the appendix to this letter.

Of the eight screen capture programs mentioned in the proceedings so far, three—WM Capture, EzVid, and Cam Studio—are not compatible with Mac OS X. Two other programs—Jing and Screencast-O-Matic—are compatible with OS X, but are not sufficient to capture high quality video. By their manufacturers’ own descriptions, these programs only support basic forms of screen capture and are designed only to enable users to create short tutorial videos that track a cursor’s movement on the screen.

The remaining three programs—Movavi Screen Capture for Mac, Camtasia and Snagit—are not capable of capturing clips from DVDs or iTunes purchased videos on OS X. Beginning with OS X 10.7, Apple implemented its own measures to prevent capture of video content played from iTunes or the built-in DVD player that comes with the system software. Techsmith, the maker of Camtasia, Jing, and Snagit, suggests in a recent support document that

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5 AACS admitted that it is not aware of any screen capture technology capable of Blu-ray level quality. Id. at 45:1.
6 See id. at 11.
7 Id.; see 37 C.F.R. § 201.40 (emphasis added).
8 See discussion infra, at 3.
users employ potentially circumventing software such as Handbrake or VLC in order to defeat Apple’s video protection. Because the makers of these programs suggest that their utilization requires a separate circumvention that might itself violate Section 1201, neither program is likely to serve as an alternative to circumvention.

**Dual booting and emulation have numerous flaws that render them unsuitable solutions to the problem of limited screen capture functionality on Mac OS X.**

Screen capture programs that are only available on PCs are not a viable option for teachers and students who seek to operate in a Mac environment, notwithstanding the existence of programs like Boot Camp and Parallels Desktop. To use Boot Camp, a user must undertake a time-consuming and lengthy process that can include each of the following steps: purchasing a new Mac, moving data from an old Mac to another drive, or partitioning an existing Mac’s hard drive; purchasing and installing a copy of Microsoft Windows; installing Boot Camp and Windows; and devising a mechanism to move large video files back and forth from one operating system to the other, which may require purchasing an external hard drive.

In addition, creating a partition suitable for creating large video files substantially reduces the storage space available to the main Mac OS portion of the machine—a critical consideration when managing the large files involved in the creation of multimedia presentations. Further, some University IT offices have warned students about security risks associated with using dual-OS machines.

In short, a requirement that Mac users seeking to make fair use must utilize Boot Camp would be unduly burdensome. A student who uses Apple hardware because of its ease of use and its well-developed ecosystem of media creation and editing tools would suddenly find herself the reluctant owner of a possibly insecure machine with significantly reduced storage space on the

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13 See 37 C.F.R. § 201.40.


15 See [Windows on a Mac](http://uits.arizona.edu/services/win_mac/macosx) (last visited June 18, 2015); [Windows on a Mac](http://itservices.stanford.edu/service/helpdesk/osxresources/windowsonmac) (last modified Jan. 25, 2010); [Computer Use Policies](http://www.csc.ncsu.edu/it/policies.html) (stating that Dual OS boot setups are not allowed on departmental owned computers because of a “huge” likelihood that one of the operating systems may be offline for a long period of time, miss critical system updates, and thus face significant risks of being compromised); [Dual Booting & Virtualization](http://cats.lsa.umich.edu/Policy-Help/virtual-machines-dual-booting) (discouraging “highly” the use of dual booting for, in addition to other reasons, security compromises); [Basic Installation Notes](http://www.liv.ac.uk/csl/mws/install/basic.htm) (noting that there are “a number of drawbacks” to dual booting, including risks that virus infections in one operating system could infect files in the other operating system, resulting in both systems being compromised); [Encryption: How to protect your computer and University Data](http://helpdesk.princeton.edu/kb/display.plx?id=9944) (noting that Dual boot computers do not support encryption) [last updated Mar. 4, 2015].
OS X side, and will be forced to do most of her media work in the Windows environment. To require a Mac user to partition her hard drive and dual boot Windows is not much better than requiring her to purchase a PC.

Emulation software is an even less viable alternative. A machine running Windows OS using emulation software such as Parallels or VMware Fusion suffers severe constraints in operability. Emulators tax system resources, reducing the computing power available for playing and capturing video. Reduced computing power naturally means more dropped frames, lower resolution, and visibly lower-quality output. Opponents have acknowledged that screen capture simply cannot handle the HD video output from Blu-ray discs without serious visual defects. Indeed, our research indicates that a Blu-ray disc cannot even be played from within an emulator, much less captured. Once the CPU is taxed by emulation software, DVD capture will naturally suffer as well.

Reverting to earlier versions of Mac OS X is not a viable option for Mac users.

Because Apple has configured OS X 10.7 and later to block screen capture programs from capturing DVD clips, the only remaining option is to configure a Mac with OS X 10.6 or earlier. However, this alternative presents numerous disadvantages and is impossible in many circumstances, and thereby would not make screen capture viable for purposes of making lawful educational uses.

The install base of OS X 10.6 and earlier is extremely small; the vast majority of Mac users run the latest version of the operating system. The lifespan of most laptops is around three to five years, so the majority of Apple laptops now in use will have been purchased with OS X 10.7 or later pre-installed. Apple has been releasing its OS updates as free downloads since the release of Mac OS X 10.9 in 2013, so even older laptops will most likely have upgraded to recent OS versions. Once a recent OS is installed, downgrading to an older version is challenging, even for experienced Mac users. Additionally, Apple support explicitly discourages installing an OS earlier than that which was originally installed on that Mac. Even if an educator or a student were to ignore this warning and go through the trouble of

16 For many accounts of users running Parallels and experiencing extreme slowing of computer speed and operability see Slowing Down Computer, Parallels Forums, https://forum.parallels.com/threads/slowing-down-computer.90728/.
17 May 27 Hearing, supra note 4, at 45:1.
19 See Why Can’t I Capture from a DVD?, supra note 11.
23 See Lou Hattersley, How to Downgrade Mavericks to Mountain Lion. How to roll back Mac OS X 10.9 to 10.8 (and earlier), Macworld (Dec. 20, 2013), http://www.macworld.co.uk/how-to/mac-software/downgrade-mavericks-mountain-lion-3494785/ (stating that it is “by no means easy to roll back to an earlier operating system” because the process involves, among other things, creating a recovery install disk, cloning a hard drive, securely erasing the drive, and restoring and installing the older operating system).
downgrading her OS, she would then need to install older versions of screen capture programs because the latest versions of these programs are only compatible with Mac OS X 10.9 and later. However, older versions of screen capture programs will likely result in even lower quality footage.

**Problems with screen capture software on OS X affect DVD, streaming, and Blu-ray.**

We reiterate that screen capture is not a viable alternative to circumvention with respect to any format. OS X prevents screen capture recording of DVD and iTunes content. OS X also frustrates efforts to capture streaming video. Further, screen capture technology is particularly unsuitable for procuring HD content because it introduces severe visual artifacts such as dropped frames and precludes obtaining full 1080p resolution. To ensure that lawful educational uses are not adversely affected by the law’s bar on circumvention, the Register should recommend, and the Librarian should grant, an exemption for proposed Class 1.

Best regards,

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25 *See infra* Appendix, Figure 1.


APPENDIX

Screen capture operating system capabilities as represented by software makers’ websites and specifications

<table>
<thead>
<tr>
<th>Screen Capture Software (vendor)</th>
<th>Compatible with?</th>
<th>Notes</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Mac OS X 10.10</td>
<td></td>
</tr>
<tr>
<td>Camtasia (Techsmith)</td>
<td>Yes*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mac OS X 10.9</td>
<td>Yes*</td>
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<tr>
<td></td>
<td>Mac OS X 10.8</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Mac OS X 10.7</td>
<td>No</td>
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<tr>
<td></td>
<td>Windows 7, 8, 8.1</td>
<td>Yes</td>
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<td></td>
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<tr>
<td><strong>According to Techsmith support, though Camtasia says that it is compatible with 10.9 or higher, Apple DVD software 10.7 and beyond prevents it from working.</strong> 28 Workarounds suggested by Techsmith require using VLC or Handbrake, which may involve circumventing TPMs. 29</td>
<td></td>
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<tr>
<td>Movavi</td>
<td>Yes*</td>
<td></td>
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<tr>
<td></td>
<td>Mac OS X 10.9</td>
<td>Yes*</td>
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<td></td>
<td>Mac OS X 10.8</td>
<td>Yes*</td>
</tr>
<tr>
<td></td>
<td>Mac OS X 10.7</td>
<td>No</td>
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<tr>
<td></td>
<td>Windows 7, 8, 8.1</td>
<td>Yes*</td>
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<tr>
<td><strong>Movavi’s website indicates that none of its screen capture software, on any platform, allows capture of protected formats.</strong> 30 This is also true for Movavi Video Converter. 30</td>
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<tr>
<td>Snagit (Techsmith)</td>
<td>Yes**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mac OS X 10.9</td>
<td>Yes*</td>
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<td></td>
<td>Mac OS X 10.8</td>
<td>No</td>
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<td></td>
<td>Mac OS X 10.7</td>
<td>No</td>
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<tr>
<td></td>
<td>Windows 7, 8, 8.1</td>
<td>Yes</td>
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<tr>
<td><strong>Though Snagit’s system requirements asserts compatibility with Mac OS 10.9 or higher, Apple DVD software 10.7 and beyond prevents it from working, and workarounds suggested by Techsmith require using VLC or handbrake which may also constitute circumventing of TPMs.</strong> 32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WM Capture</td>
<td>No</td>
<td></td>
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<tr>
<td></td>
<td>Mac OS X 10.9</td>
<td>No</td>
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<td></td>
<td>Mac OS X 10.8</td>
<td>No</td>
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<td></td>
<td>Mac OS X 10.7</td>
<td>No</td>
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<tr>
<td></td>
<td>Windows 7, 8, 8.1</td>
<td>Yes</td>
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<tr>
<td>WM Capture's requirements list includes only Windows 8, 7, Vista, XP, or Macs with Parallels or Bootcamp and Windows installed. 33</td>
<td></td>
<td></td>
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<tr>
<td>EzVid</td>
<td>No</td>
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<tr>
<td></td>
<td>Mac OS X 10.9</td>
<td>No</td>
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<tr>
<td></td>
<td>Mac OS X 10.8</td>
<td>No</td>
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<td></td>
<td>Mac OS X 10.7</td>
<td>No</td>
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<td></td>
<td>Windows 7, 8, 8.1</td>
<td>Yes</td>
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<tr>
<td>EzVidWiki &amp; Screen Recorder is compatible with Windows XP SP3, Vista, Windows 7, Windows 8, and Windows 8.1. 35 EzVid has obtained poor reviews by users and is known for having very low frame rates and poor sound quality. 36</td>
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</table>

29 See Spink, Camtasia, supra note 12.
30 Movavi Screen Capture For Mac, Movavi, http://www.movavi.com/mac-video-recorder/ (“Movavi Screen Capture for Mac does not allow to capture copy protected videos and audios.”).
33 See Spink, Snagit, supra note 12.
<table>
<thead>
<tr>
<th>Screen Capture Software (vendor)</th>
<th>Mac OS X 10.10</th>
<th>Mac OS X 10.9</th>
<th>Mac OS X 10.8</th>
<th>Mac OS X 10.7</th>
<th>Windows 7, 8, 8.1</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CamStudio</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>CamStudio asserts compatibility only with Windows operating systems. CamStudio is a well-known purveyor of malware and is not sufficiently trustworthy for use by authors.</td>
</tr>
<tr>
<td>Jing (TechSmith)</td>
<td>Yes*</td>
<td>Yes*</td>
<td>Yes*</td>
<td>Yes*</td>
<td>Yes</td>
<td>Jing is basic screen capture software intended for short, fast communication. *TechSmith support also claims that Jing is blocked from recording DVD or iTunes purchased content.</td>
</tr>
<tr>
<td>Screencast-O-Matic</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Screencast-O-Matic, like Jing, is clearly advertised as a basic capture tool not capable of capturing high quality video.</td>
</tr>
</tbody>
</table>

39 See Spink, Jing, supra note 12; see also Jing: 5 Minute Recording Limit, TechSmith (Mar. 13, 2013 2:15 PM), https://support.techsmith.com/hc/en-us/articles/203733698-Jing-5-minute-recording-limit (stating that Jing “is intended for short, fast communication; not so much for long tutorials or presentations”).
40 See Spink, Jing, supra note 12
41 See Screencast-O-Matic, supra note 11 (advertising the program as a tool for teachers, students, “how to-ers,” and “YouTubers;” note that all examples provided are basic computer tutorial-type videos).