Long Comment Regarding a Proposed Exemption
Under 17 U.S.C. 1201

For Software Freedom Conservancy
Proposed Class: 20 – Smart TVs

No multimedia evidence is being provided in connection with this comment

Item 1.   **Commenter Information**

The Petition submitter is Software Freedom Conservancy ("Conservancy"), a 501(c)(3) not-for-profit organization that helps promote, improve, develop, and defend Free, Libre, and Open Source Software ("FLOSS")—software developed by volunteer communities and licensed for the benefit of everyone. Conservancy is the nonprofit home for dozens of FLOSS projects representing well over a thousand volunteer contributors. Conservancy's communities maintain some of the most fundamental utilities in computing today, and introduce innovations that will shape how software will be created in the future.

Among the projects for which Conservancy provides logistical, administrative, and legal support are BusyBox and Samba, both of which are commonly installed on "smart" or computer-embedded consumer electronics devices. BusyBox provides a number of key system utilities that enable such devices to run applications, interact with files, access network services, and more.[1] It is also used by community projects focused on unlocking and improving Samsung-[2] and LG-manufactured Smart TVs.[3] Samba permits devices to interact with files stored on other networked devices.[4] Conservancy also represents the interests of several contributors to the Linux kernel, the core component of the operating system of most Smart TVs.

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Item 2.   **Proposed Class Addressed**

The proposed class addressed is Class 20: "Jailbreaking – smart TVs**.**"

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[1] *See* BusyBox - The Swiss Army Knife of Embedded Linux, http://www.busybox.net/downloads/BusyBox.html (last visited Feb. 5, 2015).

[2] *See* SamyGO wiki, *How to enable Advanced mode startup script*, http://wiki.samygo.tv/index.php?title=How_to_enable_Advanced_mode_startup_script (as of Nov. 11, 2011, 12:09).

[3] *See* OpenLGTV wiki, *OpenLGTV BCM*, http://openlgtv.org.ru/wiki/index.php/OpenLGTV_BCM (as of Jul. 4, 2012, 11:20).

[4] *See* Wikipedia, *Samba (software)*, https://en.wikipedia.org/wiki/Samba_(software) (as of Jan. 23, 2015, 13:39 GMT); For a Smart TV application, *see* Exhibit A, Sony package list section.

Item 3.   **Overview**

The software produced by Conservancy's member projects has, in conjunction with other FLOSS tools, served as the functional foundation for hundreds of Smart TVs—Internet-enabled TVs containing embedded computer systems[5]—produced in recent years. The overwhelming majority of Smart TVs run FLOSS operating systems based on Linux, an operating system kernel (developed in part by volunteer contributors to Conservancy member projects), system utilities such as BusyBox and Samba (produced and maintained by Conservancy member projects), and multimedia applications such as FFmpeg that support their most critical functions.[6]

Neither Conservancy nor the developers who contributed to this software received a dime in licensing revenue from the sales of these products, and they never intended to. They licensed their work freely under FLOSS licenses that gave everyone—individual enthusiasts and billion-dollar electronics companies alike—the freedom to use, modify, share, and profit from it.[7] In doing so, they sought to deliver these freedoms to all who received the software, directly or indirectly, and licensed their work under terms that guaranteed these freedoms.[8]

Not every television manufacturer who benefits from Conservancy projects' software shares their ideals, nor are they required to—many use encryption and other technological protection measures ("TPMs") to limit access to the proprietary software running on their Smart TVs. They have the right to do so, but their customers also have the right to access, modify, and share the software produced by Conservancy member projects and other FLOSS developers, and to use their TVs for whatever non-infringing purpose they wish.

Conservancy seeks an exemption permitting Smart TV owners to circumvent TPMs that control access to the software on their TVs and that prevent the installation of user-supplied software. Most importantly, this exemption will enable Smart TV owners to access the FLOSS applications pre-installed on their TVs—including those produced by Conservancy's member projects—and to exercise their corresponding rights to study, modify, and share these applications. It will also enable Smart TV owners to produce and share new applications for their TVs and thereby expand their access to copyrighted works. And it will allow users to make fair use of the manufacturers' proprietary applications, making their TVs more useful and accessible.

Item 4.   **Technological Protection Measures and Methods of Circumvention**

Smart TV manufacturers restrict access to the TVs' operating systems using two types of TPM: firmware encryption and administrative access controls.

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[5] *See* Wikipedia, *Smart TV*, https://en.wikipedia.org/wiki/Smart_TV (as of Feb. 4, 2015, 01:09 GMT).

[6] *See* Exhibit A, which lists the dozens of FLOSS applications contained in just a few Smart TV models produced by prominent manufacturers. These lists are representative of the pervasiveness of FLOSS industry-wide.

[7] *See* Exhibit B, GNU General Public License, version 2, also available at: https://www.gnu.org/licenses/gpl-2.0.html ("GPLv2") (GPLv2 is the license for BusyBox, Linux, and several other applications commonly embedded in Smart TVs).

[8] *See* Exhibit B, GPLv2, Preamble ("[T]he GNU General Public License is intended to guarantee your freedom to share and change free software—to make sure the software is free for all its users.").

Firmware Encryption

Firmware is software embedded in a device's semipermanent memory.[9] A Smart TV's firmware contains a filesystem (a directory structure containing application files and data) which in turn contains the operating system and other applications installed on the TV.[10] Users typically download firmware updates from the manufacturer's website, or receive them on a thumb drive mailed by the manufacturer.[11] Often, a firmware update will contain the complete Smart TV OS, as well as applications to be run by the OS.[12]

If a firmware update is encrypted, a Smart TV owner cannot view or modify its contents without circumventing the encryption by decrypting the update file. Different encryption schemes are used by different manufacturers (and on different TVs produced by a single manufacturer), but most involve the application of a well-known encryption algorithm such as Advanced Encryption System (AES), in conjunction with a secret key selected by the manufacturer.[13] In several cases, Smart TV modification enthusiasts have discovered the "secret key" by "brute force," i.e. by using a program to guess every possible key until the correct key is found, yielding the ability to decrypt the contents of updates.[14]

When firmware encryption is used, the only way for a TV's owner to produce a valid update file is to decrypt an update provided by the manufacturer, make any desired modifications, and then encrypt the entire update contents according to the manufacturer's chosen scheme. Using this decrypt-modify-encrypt process, a TV owner can place new or updated applications in the filesystem contained in the manufacturer-provided firmware update, so that when the update is installed, those applications are available to the TV operating system.

Administrative Access Controls

Smart TVs also limit access to the contents of their firmware using the types of administrative access controls commonly employed by computer operating systems. For example, the OS's access rules might prevent any user other than the administrator or "root" user

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[9] *See generally* IT Law Wiki, *Firmware*, http://itlaw.wikia.com/wiki/Firmware (as of Jan. 3, 2014, 16:39).

[10] *See generally* IT Law Wiki, *Filesystem*, http://itlaw.wikia.com/wiki/File_system (as of Sept. 16, 2011, 04:49).

[11] *See, e.g.* [How-to Guides] How to upgrade firmware of Samsung SMART TV through USB Drive ?, *http://skp.samsungcsportal.com/integrated/popup/HtgDetailGuide3.jsp?seq=8641&cdsite=in* (last visited Feb. 6, 2015).

[12] *See* Christian E. Legare, *How to evaluate an embedded flash-based file system*, IAR Systems, Aug. 12, 2011, http://www.iar.com/Global/Resources/Viewpoints/How%20to%20evaluate%20an%20embedded%20flash-based%20file%20system.pdf, p. 2.

[13] Some also involve more rudimentary encryption, such as "XOR" encryption, which involves performing a simple mathematic transformation on each byte of data in a file. And some manufacturers use both techniques in combination. *See, e.g.,* SamyGo Wiki, *Extracting the ES-series firmware*, http://wiki.samygo.tv/index.php5/Extracting_the_ES-series_firmware (as of Feb. 9, 2013, 15:56).

[14] *See* N. Sidiropoulos & P. Stefopoulos, *Smart TV Hacking*, University of Amsterdam, January 13, 2013, http://dare.uva.nl/cgi/arno/show.cgi?fid=495678.

from installing or executing applications. For Smart TVs on which it is impossible to install an entirely new firmware, the owner can sometimes install new or modified applications by circumventing the OS's access controls to enable root access.

To bypass administrative access controls, it is often necessary to identify and exploit a security vulnerability exposed by an application installed on the TV. This is the same type of technique used to jailbreak many smartphones, an activity for which an exemption has been granted in previous rulemakings.[15] For example, the administrative access controls employed by certain models of Sony Bravia Smart TVs can be circumvented by causing the TV to run a program that exploits a memory error to give the user administrative access, and then installs a program enabling the owner to connect to the TV from a personal computer.[16]

Item 5.   **Asserted Noninfringing Uses**

By accessing the firmware running on their Smart TVs, users can make several important non-infringing uses of applications (FLOSS and otherwise) pre-installed on the TV, other applications that the user installs on the TV, and the users' own digital media.

Licensed use and modification of FLOSS hardware-specific

Conservancy is primarily concerned with facilitating the use of FLOSS applications produced by its member projects and other FLOSS community members. These applications are licensed according to terms that permit and encourage users to copy, modify, and share them freely. As stated above, some of these applications, such as BusyBox and Samba, are commonly embedded in Smart TVs by manufacturers and subsequently distributed to every person who purchases these TVs. Conservancy also represents several individual developers who own copyright in Linux, the operating system kernel upon which the majority of Smart TV operating systems are built.

The specific FLOSS license used by the BusyBox and Linux kernel projects is the GNU General Public License version 2 (GPLv2), attached as Exhibit B. Samba uses version 3 of the same license, attached as Exhibit C. As stated in the license text, GPLv2 permits every recipient of the software to exercise the "four freedoms" common to all FLOSS: "the freedom to run, copy, distribute, study, change and improve the software."[17] When a Smart TV manufacturer distributes GPLv2-licensed software embedded in the TV's firmware, it is required to notify the purchaser of the TV of these rights.[18]

Because these rights are granted by the licenses of FLOSS applications contained in

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[15] *See* Recommendation of the Register of Copyrights in RM 2005-1, Rulemaking on Exemptions from Prohibition on Circumvention of Copyright Protection Systems for Access Control Technologies (U.S. Copyright Office Nov. 17, 2006) ("2006 Recommendations"), p. 53; Recommendation of the Register of Copyrights in RM 2008-8, Rulemaking on Exemptions from Prohibition on Circumvention of Copyright Protection Systems for Access Control Technologies (U.S. Copyright Office Jun. 11, 2010) ("2008 Recommendations"), p. 104.

[16] Brian Benchoff, *Getting root on a Sony Bravia*, Hackaday, Jun. 20, 2012, *http://hackaday.com/2012/06/20/getting-root-on-a-sony-tv/*.

[17] *See* GNU Operating System, *What is free software?*, *https://www.gnu.org/philosophy/free-sw.html* (last visited Feb. 5, 2015).

[18] A photograph of a Samsung TV's on-screen GPL compliance notice is attached as Exhibit D.

Smart TV firmwares, the owners of these TVs are explicitly permitted to access these applications, modify their functionality, and install new or modified versions of the applications onto their TVs. They should be permitted to circumvent TPMs that prevent them from exercising these rights.

Installation of new, licensed applications

Where enthusiast communities like the SamyGo project have successfully circumvented TPMs to access the software on their Smart TVs, the result has been a torrent of grassroots innovation. Users have developed new software to modify the behavior of their TVs in dozens of useful ways, including to:

1. modify subtitles to be larger, brighter, or outlined to enhance readability;
2. display extended channel information;
3. enable or expand the TV's compatibility with peripheral hardware, such as mice, keyboards, and external storage devices;
4. change the aspect ratio, resolution, or scale of the TV's display;
5. enable interaction with other devices over the owner's home network, including laptops and mobile devices, for example to display incoming SMS messages and other useful information provided by those devices or allow remote control of the TV from those devices.[19]

Some of these applications make the TVs more accessible to people with disabilities, where the manufacturer has opted not to support accessibility features.[20] Applications to make subtitles larger, brighter,[21] and more pronounced[22] improve accessibility for hearing-impaired viewers. Users have also worked to adapt FLOSS text-to-speech applications to read subtitles aloud to sight-impaired users.[23] Similarly, on-screen notifications could be used to alert hearing-

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[19] *See* SamyGO Wiki, *Content Library applications list*, http://wiki.samygo.tv/index.php5/Content_Library_applications_list (listing applications developed for unlocked Samsung Smart TVs) (as of May 30, 2013, 09:28); SamyGO Wiki, *Desktop applications list*, http://wiki.samygo.tv/index.php5/Desktop_applications_list (listing desktop-OS applications that operate with unlocked Samsung Smart Tvs) (as of Dec. 7, 2013, 13:09); SamyGO Wiki, *Android applications list*, http://wiki.samygo.tv/index.php5/Android_applications_list (listing Android-OS applications that operate with unlocked Samsung Smart Tvs) (as of Nov. 25, 2012, 11:14); SamyGO Wiki, *IOS [sic] applications list*, http://wiki.samygo.tv/index.php5/IOS_applications_list (listing iOS applications that operate with unlocked Samsung Smart TVs) (as of October 21, 2011, 14:40).
[20] *See, e.g.*, *vocal guide for visual impaired on ue40h6400aw*, SamyGo Forum, http://forum.samygo.tv/viewtopic.php?f=74&t=8206.
[21] *See, e.g. Bigger Yellow Font*, SamyGO forum thread at http://forum.samygo.tv/viewtopic.php?f=2&t=40#p182 (last accessed February 3, 2015).
[22] *See, e.g. Outliner*, SamyGO forum thread at: http://forum.samygo.tv/viewtopic.php?f=2&t=585&start=20#p15993 (last accessed February 3, 2015).
[23] *See* Posting of meinsource, *Re: Audio description*, http://forum.samygo.tv/viewtopic.php?f=6&t=1090#p9728 (December 9, 2010, 9:29 pm) (discussing the "espeak" text-to-speech program as a possible candidate).

impaired users to incoming calls and other messages. And by improving Smart TV interoperability with more external hardware, users could enable Smart TVs to work with accessibility products such as headphones, powered neckloop devices,[24] or Bluetooth signalers that would alert hearing-impaired users to incoming calls or messages.[25]

Licensed and fair use of proprietary software installed on TVs

Smart TV owners should also be permitted to circumvent their TVs' TPMs to make modifications and improvements to the non-FLOSS applications installed on them. The rightful possessor of software copies may make modifications to them "designed to improve their functionality in serving the [use] for which they were created."[26] This protection is rooted in 17 U.S.C. § 117, which creates fair use for a user's "adaptation … created as an essential step in the utilization of the computer program in conjunction with a machine."[27] Courts read this provision broadly, to permit the lawful owner of a copy of software to add features that were not included by the manufacturer and to facilitate compatibility with different hardware.[28] This protection is at the heart of previous rulings exempting device unlocking, such as the exemption for smartphones first granted in 2006.[29] Likewise, when a Smart TV owner modifies the proprietary software running on a television to better suit his or her purposes, the modification is authorized by § 117.

Item 6.   **Asserted Adverse Effects**

When someone purchases a Smart TV embedded with FLOSS applications produced by Conservancy member projects, they receive at the same time the right to copy, modify, and reinstall that software.[30] However, most will be prevented from exercising these rights by manufacturer-imposed TPMs. The DMCA's anti-circumvention provisions are intended to give copyright holders control over the use of their works; in this case, the TPMs imposed by manufacturers take that control away from FLOSS developers and users.

The TPMs also adversely affect TV owners' ability to make fair use of the manufacturer's software by enabling it (and the TV itself) to interoperate with other software, devices,[31] and

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[24] *See, e.g.* Clearsounds Quattro Amplified Bluetooth Neckloop, https://www.clearsounds.com/product/clearsounds-quattro-amplified-bluetooth-neckloop-a2dp (last visited Feb. 4, 2015).

[25] *See generally* Phone Ringers/Signallers, http://www.hearmore.com/categories/105/Phone-Ringers/Signalers.html (last visited Feb. 4, 2015).

[26] *Krause v. Titleserv*, 402 F.3d 119, 121 (2nd Cir. 2005) (finding that the owner of a copy of software was entitled to use and modify that program under 17 U.S.C. §117(a)(1)).

[27] 17 U.S.C. §117(a)(1).

[28] *Foresight Resources Corp. v. Pfortmiller*, 719 F. Supp. 1006, 1009 (D. Kan. 1989); *Krause v. Titleserv, Inc.*, 402 F.3d 119, 127 (2d Cir. 2005) (highlighting the ambiguity of the term "essential," and finding a broad reading most appropriate).

[29] *See* 2006 Recommendation at p. 50.

[30] Exhibit A demonstrates the huge number of FLOSS applications installed in modern smart TVs that carry these rights.

[31] *See, e.g.* SamyGO forum thread, *Email notifier*, to http://forum.samygo.tv/viewtopic.php?f=5&t=1876 (Jun. 1, 2011 2:28 pm) (a desktop PC application that pushes email notifications to the Smart TV); SamyGO forum thread, *TVCallNotify*, to http://forum.samygo.tv/viewtopic.php?

hardware.[32] It is fair use for a device owner to enable greater interoperability.[33] Copyright law recognizes that an owner's access to and modification of software to allow interoperability is fair use,[34] but when the owner cannot access the software because it is encrypted or accessible only to the manufacturer, they cannot make fair use of it. Limitations on the interoperability of these TVs with new software limits creativity and the production of new copyrighted works, such as those produced by the SamyGo and OpenLGTV communities.[35]

If a Smart TV's manufacturer chooses not to provide access to particular functionality, applications, or external hardware that the TV's owner needs, that person has only two choices: circumvent the TPMs and enable the functionality, or buy a new TV (with its own built-in limitations) and discard the old one. Conservancy does not regard the latter as a true alternative, since it does not enable the owner to make use of FLOSS applications, or other software they are entitled to fair use of, on the TV they already own.

Item 7.   **Statutory Factors**

The proposed exemption is supported by each of the statutory factors set forth in 17 U.S.C. 1201(a)(1)(C).

A) The availability for use of copyrighted works

Permitting circumvention of the TPMs controlling access to Smart TV firmware would increase the availability of the FLOSS applications on them, as well as the availability of new user-produced applications. It would have no effect on the availability of the proprietary software installed on the TVs.

Circumvention is necessary to make licensed use of the FLOSS application running on Smart TVs. There is no other way to access the firmware and filesystem on which they are installed. If the TPMs can be circumvented and the FLOSS tools modified to add new functionality to TVs, these modifications will themselves become available to other users—and to manufacturers—under the applicable FLOSS license, making more software available.

Circumvention will also increase the availability of third-party applications, such as those produced by the SamyGo and OpenLGTV projects, that are designed to run on Smart TVs and enhance their functionality. In turn, these applications (and existing FLOSS applications like Samba), will enable access to a wider range of digital media, by providing access to and

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f=12&t=1512 (Feb. 20, 2011, 6:33 pm) (a notification-pushing application for Android OS, to send call and SMS notifications to the Smart TV); Posting of Saad3000, *Tifi Remote first App for Iphones*, to http://forum.samygo.tv/viewtopic.php?f=5&t=2339 (Sept. 19, 2011, 9:17 am) (a Smart TV remote control application for iOS);

[32] *See, e.g.* SamyGO forum thread, *Autobright (sh)*, to http://forum.samygo.tv/viewtopic.php?f=8&t=2068 (Jul. 28, 2011, 6:34 pm) (a script to enable automatic brightness adjustment on unlocked Samsung Smart TVs through interoperability with an external light sensor)

[33] *Sega, LTD. v. Accolade, Inc.*, 977 F.2d 1510, 1528 (9th Cir. 1992) (finding fair use for Accolade's reverse engineering of the Sega's video game console to create new games.)

[34] *Lexmark Int'l, Inc. v. Static Control Components, Inc.*, 387 F.3d 522, 550-51 (6th Cir. 2004)

[35] *Id.* (Permitting circumvention to enable interoperability with new software "is consistent with 'the ultimate aim [of the Copyright Act], to stimulate artistic creativity for the general public good."')

interoperability with media formats, external storage, and networked devices the TVs were not able to access in their manufacturer-supplied configurations.[36]

The availability of Smart TV firmware does not depend on the TPMs that control firmware or filesystem access. There is no market for Smart TV firmware sold separately from the TVs themselves—such firmware must be heavily customized for each device by manufacturers, because of the rapid pace of development of new TV hardware. Moreover, the proprietary software on Smart TVs would be useless if separated from the TV it is intended to run on. It exists on the TV in compiled, object-code form, making even trivial modifications extremely difficult or impossible. And it is compiled for the specific hardware architecture and software environment of the TV it runs on. Divorced from that environment, it cannot be used.

B) The availability for use of works for nonprofit archival, preservation, and educational purposes

One of the fundamental purposes of the GPLv2 and other FLOSS licenses is to give users the freedom to study and learn from the software they use.[37] This freedom has given rise to widespread use of FLOSS in computer science education. For example, students commonly learn about the design and function of operating systems by studying the source code of the Linux kernel.[38] Permitting circumvention of the TPMs controlling access to the FLOSS operating systems on Smart TVs will enable individuals to study the design of those operating systems and learn about the development of software for embedded computing devices.

C) The impact the prohibition on circumvention of TPMs has on criticism, comment, news reporting, teaching, scholarship, or research

Permitting circumvention of these TPMs would enable researchers to find and expose security and privacy issues in Smart TVs. This will not only help TV manufacturers make their devices more secure, by fixing any issues exposed, but will also promote criticism and commentary on the privacy implications of placing Internet-enabled audio and video recording devices (which many of these TVs are) in every living room.[39] Smart TVs often have broader functionality than one traditionally expects of TVs, including the ability to be used for surveillance.

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[36] *See* Mike Szczys, *Samsung TV Firmware Hacking*, Hackaday, October 18, 2009, http://hackaday.com/2009/10/18/samsung-tv-firmware-hacking/ (describing the use of telnet, a remote access service, to enable access to networked devices)

[37] *See* GNU mission statement, http://www.gnu.org/ ("Our mission is to preserve, protect and promote the freedom to use, study, copy, modify, and redistribute computer software, and to defend the rights of Free Software users.")

[38] *See, e.g.*, Columbia University, Dept. of Computer Science—Operating Systems I, http://www.cs.columbia.edu/~nieh/teaching/w4118/ (last accessed Feb. 6, 2015).

[39] Matt Oh, *How I learned to hack my TV (and started worrying about the future)*, HP Security Research Blog, February 21, 2014, http://h30499.www3.hp.com/t5/HP-Security-Research-Blog/How-I-learned-to-hack-my-TV-and-started-worrying-about-the/ba-p/6383829 (specific example of an EX-Link hack, and general discussion of IoT security issues)

Smart TVs have been shown to contain security vulnerabilities that can be exploited by malicious hackers to access them remotely and run harmful code.[40] Some of these also make use of a Smart TVs' built-in microphone and camera.[41] In sum, research on the security of the Smart TVs on the market strongly suggests that manufacturers do not build sufficient privacy or security safeguards into their TVs.[42]

Though 17 U.S.C. § 1201(j) contains a limited exception to the anticircumvention provision for security research, its limitations could discourage researchers from exploring the concerns raised by these devices. For example, the exemption favors private disclosure, potentially giving courts discretion to withhold it from researchers who publish information about security vulnerabilities in Smart TVs.[43] These devices often have persistent Internet connections, built-in microphones, and video cameras (sometimes even with facial-recognition software), making the privacy issues they raise matters of public concern. But researchers who go public with information about vulnerabilities, even after first alerting the manufacturer, could reasonably fear that they will risk losing the 1201(j) exemption. An exemption authorizing circumvention of these TPMs would remove this specter of liability.

D) The effect of TPM circumvention on the market for or value of copyrighted works

Circumvention has already created an entirely new market for user-developed Smart TV software, and created new uses for existing FLOSS applications. Like most software, the value of these works is in large part derived from the size and support of their user communities, and explicitly allowing circumvention will expand their use. When Smart TV owners adapt and customize FLOSS software for use on these devices, they are not the only ones who benefit; manufacturers will also have the right under the applicable FLOSS licenses to use these modifications in their products.

As discussed above, the copyrighted works protected by the TPMs (the Smart TV OS and related applications) do not have an independent end-user market, or any usefulness when separated from the TV. To the extent circumvention will have any impact on the Smart TV

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[40] *See, e.g.* N. Sidiropoulos & P. Stefopoulos, *Smart TV Hacking*, University of Amsterdam, January 13, 2013, http://dare.uva.nl/cgi/arno/show.cgi?fid=495678.

[41] *See, e.g. Cameras in Your Cable Box...*, supra at 30

[42] *See, e.g.* Matt Smith, *3 Real Security Risks Threatening Your Smart TV Entertainment*, Makeuseof.com, Jul. 3, 2014, http://www.makeuseof.com/tag/3-real-security-risks-threatening-your-smart-tv-entertainment/ (outlining several security vulnerabilities in existing Smart TVs); Lisa Vaas, *Samsung Smart TV security hole allows hackers to watch you, change channels or plug in malware*, NakedSecurity.com, Dec. 12, 2012, https://nakedsecurity.sophos.com/2012/12/12/samsung-tv-vulnerability/ (outlining a root vulnerability found in a Samsung Smart TV); Y. Oren & A. Keromystis, *From the Aether to the Ethernet - Attacking the Internet using Broadcast Digital Television,* iss.oy.ne.ro, May 2014, http://iss.oy.ne.ro/Aether (showing an RF-frequency attack on Smart TVs that would allow mass hijacking within range of the RF signal); Robert Lemos, *Weaknesses in Webkit becoming problematic*, threatpost.com, Aug. 28, 2011, http://threatpost.com/weaknesses-webkit-becoming-problematic-082811/75586 (explaining core vulnerabilities in WebKit, an application that underlies the browser in Samsung Smart TVs).

[43] 17 U.S.C. § 1201(j)(3)(A).

market more broadly (and by extension the software embedded within), enabling interoperability and innovative uses of Smart TVs may increase demand for more customizable devices.

An example of this effect can be seen in the market for the Linksys WRT54G router, which consumers favored for its customizability and kept on the market longer than nearly any other consumer router.[44] This router's success and longevity was largely the result of FLOSS community firmware development, which unlocked latent capabilities that the manufacturer did not provide.[45] The success of the WRT54G has prompted Linksys and other router manufacturers to market later routers specifically for their compatibility with FLOSS operating systems. An exemption for unlocking Smart TVs could produce the same mutual benefit.

Finally, circumvention of these TPMs would neither impact the availability of copyrighted media or works displayed or played on Smart TVs nor encourage infringement of them. Access to this content is controlled by separate TPMs, and this request for exemption is unrelated to any circumvention of Digital Restrictions Management or other TPMs for that purpose.

E) Any other factor that may be appropriate for the Librarian to consider in evaluating the proposed exemption

As with any unlocking exemption, this exemption would give users a means to extend the effective lifespan of their Smart TVs. If users can add features to their TVs rather than purchase a new one, both they and the environment will benefit. Like other electronic devices, Smart TV components contain toxic chemicals such as antimony, beryllium, cadmium, copper, lead, and zinc. When discarded, these chemicals are released either when burned at an incineration facility or through ground-leaching in a landfill. While some progress is being made with fledgling e-waste recycling efforts, the vast majority of e-waste ends up in landfills, often overseas.[46] User modification can work side-by-side with manufacturers' nascent impact-reduction efforts,[47] to reduce the volume of electronic waste disposed of every year.

More fundamentally, an exemption is the only fair result for the thousands of people, many of them volunteers, who developed the FLOSS applications so widely used by Smart TV manufacturers and so fundamental to the success of these products. By adopting the GPL as the license for their software, the developers of BusyBox, Samba, and Linux allowed manufacturers to use and adapt their software freely, and save millions of dollars in development time and licensing fees. The only compensation they demanded was that the manufacturers extend those rights to their own users, and even then only with respect to the FLOSS components they use.

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[44] *See* Sebastian Anthony, *11 years on: Linksys cashes in on WRT54G popularity with overpriced WRT1900AC router*, ExtremeTech, Jan. 16, 2014, http://www.extremetech.com/computing/174875-11-years-later-linksys-cashes-in-on-wrt54gs-popularity-with-overpriced-wrt-1900ac-router

[45] *See, e.g.* Adam Pash, *Turn your $60 router into a $600 router*, Lifehacker.com, Jun. 6, 2006, http://lifehacker.com/178132/hack-attack-turn-your-60-router-into-a-600-router (outlining the installation and uses of the DD-WRT firmware with the Linksys WRT54G).

[46] *See* Michael Malakata, *West Africa turns into dumping ground for e-waste*, PC World, Jan. 30, 2015, http://www.pcworld.com/article/2878492/west-africa-turns-into-dumping-ground-for-ewaste.html.

[47] *See* Christina Caldwell, *Samsung Combats E-Waste with Smart TV Upgrade Kit*, Earth 911, http://www.earth911.com/eco-tech/samsung-evolution-kit/ (last visited Feb. 5, 2015).

The proposed exemption will give effect to those rights and duly recognize the contributions of FLOSS developers.

Item 8. **Documentary Evidence**

See attached:

Exhibit A, List of FLOSS software components used by major Smart TV manufacturers

Exhibit B, GNU General Public License Version 2

Exhibit C, GNU General Public License Version 3

Exhibit D, Samsung Smart TV GPL Compliance Notice

EXHIBIT A

List of FLOSS Software Components Used by Major Smart TV Manufacturers

This exhibit lists the FLOSS components contained in representative Smart TV models produced by several major manufacturers, as stated in the manufacturers' online compliance materials. Conservancy member projects, and projects (such as the Linux kernel) in which Conservancy members hold substantial copyrights, are **bold** for emphasis.

<u>LG</u>:

Many recent LG television models[48] are built on webOS, a Linux-based operating system originally developed by HP. As of version 3.0.5,[49] webOS contained the following FLOSS packages:

acct	gstreamer	mjson
alsa-lib	gzip	mkimage
alsa-plugins	ipkg	mtools
alsa-utils	imaccountvalidator	mupdf
baemuk-batang font	imlibpurpleservice	ncurses
base-passwd	imlibpurpletransport	oprofile
binutils	iproute2	palmadpcmdecoder
boost	iptables	parted (libparted)
bootchart	iputils	pmeloop
brctl	javascriptcore	ppp
bridge driver	jpeg	procps
busybox	libexif	psmisc
camsrc-omap36xx	libgcrypt	pulseaudio
cifs	libgdbus	qt4
cryptofs	libgpg-error	readline
cryptsetup	libgpod	screen
dhd kernel module	libnetbridge	setserial
dnsmasq	liboil	sgxddk
documentserver	libpng	sp-smaps
dosfstools	libsamplerate0	sysfsutils
e2fsprogs	libsdl	sysstat
e2fsprogs-libs	libsdl-image	sysvinit
expat	libsdl-mixer	tisgxgfx
faac	libsdl-net	u-boot

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[48]LG lists dozens of webOS-based models on its OpenSource Code Distribution site, http://opensource.lge.com (last visited Feb. 5, 2015).
[49]HP—HP webOS open source compliance, http://www.openwebosproject.org/opensource/3.0.5/index.html. LG's current distribution of source code for FLOSS components within its various models of television can be found at http://opensource.lge.com (last visited Feb. 5, 2015).

fbset	libsdl-ttf	udev
ffmpeg	libsigcpp-2.0	update-modules
foundations.xml	libsndfile1	update-rc.d
freetype	libsoup	upstart
fuse	libspeex	upstart-initscripts
gdbm	**linux kernel**	usbmon
glib-2.0-2.16.6	linux-hotplug	util-linux-ng
glibmm	LVM2	vpnc
goodfork	netbase	webcore
gst-ffmpeg	netcat	webkit
gst-plugins-bad	net-tools	wireless-tools
gst-plugins-base	OpenAL	zlib
gst-plugins-good	makedevs	

Samsung:

According to Samsung's Opensource Release Center, dozens of recent models of Samsung TV contain the following FLOSS components:[50]

linux kernel	pppd plugins	lame
busybox	rtnet5572sta	libiconv
binutils	rtutil5572sta	libintl
ath6kl_usb.ko	smack	libgcrypt
batman	snapmesh	libgpg-error
batctl	udhcpc	libmms
binder kernel driver	usb-modeswitch	libnl
BRCM bluetooth driver	uvc	libptp
bridge	v4l2	libsecret
bridge-utils	wireless_tools	libsigc++
cfg80211.ko	mali.ko	libsoup
compat.ko	glibc	libswtsm.so
dosfstools	alsa	LIBTASN1
e2fsprogs	atk	libthai
elfutils	atspi	libusb
exfat	cairo	libwbxml
ext4	enchant	libxml++

[50]Samsung—Opensource Resource Center, Model 14_DTV_X14H, Announcement, http://opensource.samsung.com/reception/receptionSub.do?method=sub&sub=T&menu_item=tv_n_video&classification1=tv&classification2=dtv&classification3=LED (last visited Feb. 5, 2015).

fuse	FFmpeg	mesa
gloox	fluidsynth	MIME
GnuPG	GAIL	nettle
gSoap	GDBus	pango
intltool	gdkpixbuf	PEAR
iptables	getopt	PHPExcel
iw	GIO	RTSP
jquery	glib	SDL
KNBD Module	glibmm	soundtouch
llc	GNUTLS	webkit
netfilter	gtk	xml2json
nfs	gtkprinter	wvdial
nfs-utils	JavaScriptCore	wvstreams
nspr		

<u>Sony</u>:

According to Sony's Opensource Release Center, dozens of recent models of Sony TV contain the following FLOSS components:[51]

DirectFB	glibc	ntfs-3g_ntfs
SaWMan	libiconv	ntfsprogs
alsa-driver	libmtp	qrencode
busybox	libusb	**samba**
e2fsprogs	libusb	squashfs
ffmpeg	**linux**	sysvinit
fuse	linux-fusion	u-boot
gcc	liveMedia	zvbi

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[51] These include KDL-32R303B, KDL-32R410B, KDL-32R413B, KDL-32R415B, KDL-32R430B, KDL-32R433B, KDL-32R435B, KDL-40R353B, KDL-40R450B, KDL-40R453B, KDL-40R455B, KDL-40R480B, KDL-40R483B, KDL-40R485B, and KDL-48R483B; Sony Global – Source Code Distribution Service, http://oss.sony.net/Products/Linux/TV/KDL-40R483B.html (last visited Feb. 6, 2015).

EXHIBIT B

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Version 2, June 1991

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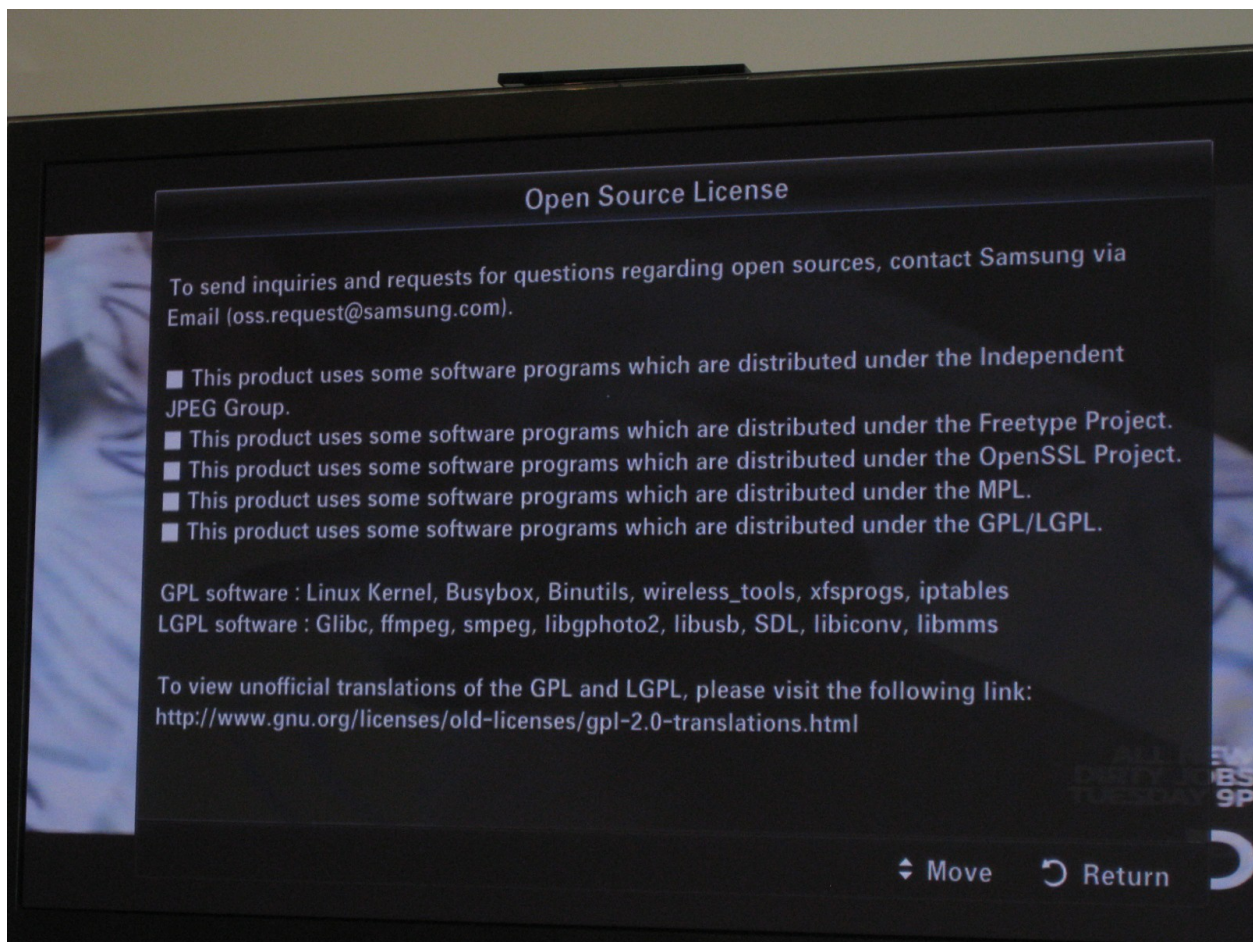
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EXHIBIT D

Samsung Smart TV GPL Compliance Notice

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[54] Photograph of the GPL notification popup on a Samsung PN58C8000 Smart TV, http://princessleia.com/images/journalpics/012011/samsung_tv_osl.jpg (last visited Feb. 6, 2015) (from: Linux kernel on my TV and Nook, earthquake, Caligula and Ubuntu-Debian meetup, PLEAI2's Blog, Jan. 18, 2011, http://princessleia.com/journal/?p=3931).