

## Toward Open Source Software: A Study of the U.S. DMCA Copyright Licensing Investigation System Postprint

**Authors:** Lü Chen, Jiang Linjun

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### Abstract

[Purpose/Significance] The development of open source software and its institutional framework in China has progressed relatively slowly compared to that in the United States. Nevertheless, given the current development status and demands, it is imperative to establish and improve institutional mechanisms that provide viable solutions for the development and protection of open source software while reserving necessary space for addressing potential risks.

[Method/Process] An examination of the U.S. copyright licensing investigation system reveals that this mechanism aims to investigate potential infringements of open source software, endeavoring to balance the development and protection of open source software. By contrast, China has yet to establish the legal status of open source software under copyright law, much less specific institutional provisions.

[Result/Conclusion] It is necessary to draw upon the U.S. copyright licensing investigation system, integrate it with China's actual conditions, and reference the German protection model. Through clarifying the legal validity of open source software, incorporating it within copyright protection, permitting infringement actions, and stipulating the right holder's right to request information provision, the legal status of copyright protection for such software can be established. The implementing body for copyright licensing investigation authority may be provisionally designated as copyright administrative departments at the prefecture level or above. The design of its authority should be completed from four dimensions: prerequisites for initiating investigations, types of investigative equipment, boundaries of investigation subjects, and legitimacy of investigative conduct, thereby achieving the localized construction of this system.

## Full Text

# Toward Open Source Software: An Investigation of the U.S. DMCA Copyright Licensing Investigation System

Lü Chen, Jiang Linjun

(Department of Law, Hunan University of Technology and Business, Changsha 410205)

### Abstract:

[Purpose/Significance] The development of open-source software and its institutional framework in China lags behind that of the United States. However, given current development status and needs, it is imperative to establish sound institutional mechanisms that provide feasible solutions for the development and protection of open-source software while leaving sufficient room to address potential risks. [Method/Process] By examining the U.S. copyright licensing investigation system, this study reveals that the system aims to investigate potential infringement of open-source software while striving to balance development and protection. In contrast, China has not yet established the copyright legal status of open-source software, let alone specific institutional provisions regarding implementation subjects and authority design. [Results/Conclusions] It is necessary to draw upon the U.S. copyright licensing investigation system. Combining Chinese realities and referencing German protection models, we can establish the legal status of copyright protection for such software by clarifying its legal validity, incorporating it into copyright protection, permitting infringement litigation, and stipulating rights holders' right to request information provision. The implementation subject of copyright licensing investigation authority can be temporarily designated as copyright administrative departments at or above the prefecture level. The authority design should be completed across four dimensions: prerequisites for initiating investigations, types of investigable equipment, boundaries of investigation objects, and legitimacy of investigation conduct, thereby achieving localized construction of this system.

**Keywords:** Digital Millennium Copyright Act; open source software; copyright licensing investigation; technical protection measures; intellectual property

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## 1 Introduction

In 1998, the United States pioneered the establishment of anti-circumvention provisions for Technical Protection Measures (TPMs) in the Digital Millennium Copyright Act (DMCA), which stipulated that temporary exceptions be revised every three years by the Library of Congress based on public proposals and practical needs [1]. On October 28, 2021, the U.S. Library of Congress completed the eighth revision of DMCA temporary exceptions, adopting for the first time explicit provisions for copyright licensing investigation temporary exceptions for open-source software. It should be noted that today's free and open-source

software movement is often abbreviated within and outside the industry, and free and open-source software is similarly referred to as such [3]. Therefore, this paper uniformly uses these appellations.

## **2 Reasons for the Emergence of the Copyright Licensing Investigation System**

### **2.1 Open-Source Software is Indispensable for Economic and Technological Development**

Open-source software constitutes a component of the modern economy and serves as fundamental infrastructure for smart devices, the Internet of Things, and other modern technologies. Its widespread application stems from low licensing thresholds—anyone can use it without payment or royalty obligations, provided they comply with its license terms. This characteristic has enabled open-source software to occupy a crucial position in modern economic and technological development. By 2016, open-source software had captured over 70% of the web services market and 80% of the smartphone market [6]. As of 2020, open-source software had become mainstream across multiple dimensions [5], with the average number of open-source components per codebase rising to 595 by 2023 [9]. Open-source software is now ubiquitous, embedded in everything from websites and thermostats to critical infrastructure, making it a powerful technological innovation model and a vital driver of global scientific progress [4].

### **2.2 Infringement of Open-Source Software Copyright is Increasing**

With the widespread application of open-source software, violations of open-source licenses and resulting copyright infringements have gradually increased. The drawbacks of relying solely on licenses to protect copyright have become increasingly apparent. For instance, the formalistic nature of license terms eliminates communication or negotiation between parties, while licensees exploit the complexity and variability of open-source code [10]. Reports from the Software Freedom Conservancy (SFC) and Free Software Foundation (FSF) further demonstrate this escalating infringement trend, with FSF receiving an average of 186 reports annually [12]. The 2020 Open Source Security and Risk Analysis Report indicated that 99% of audited codebases contained open-source software, with each codebase averaging 445 open-source components [7]. The 2022 report showed that all industries contained high proportions of open-source code, with some sectors reaching 100% [8]. The 2023 report revealed that the average number of open-source components had risen to 595, reflecting both the deep integration of open-source software into modern software development and the practical difficulties in copyright protection [9].

### 2.3 Investigation Faces Dual Obstacles from Technology and Legislation

Among all copyrighted works, computer software possesses unique characteristics that hinder infringement investigations. Unlike other works, software cannot be perceived through observation—one cannot see what programs or systems exist in a computer or device through simple inspection. Determining whether copyright infringement has occurred requires cracking the code within computer programs, which demands considerable technical expertise and resources, significantly impeding investigation activities [12]. Moreover, TPMs and anti-circumvention prohibitions create additional barriers. Investigative actions may be deemed circumvention, causing investigators to face adverse consequences under DMCA Section 1201. Infringers also employ anti-circumvention measures to conceal their actions, further obstructing investigations by organizations like SFC [12]. Currently, no exceptions permit circumvention of TPMs for investigation purposes, leaving investigators unable to fulfill their duties effectively and often forcing them to abandon valuable investigations [11].

## 3 Controversies in Formulating the Copyright Licensing Investigation System

Based on these challenges, SFC and FSF, as proponents of establishing copyright licensing investigation temporary exceptions in the DMCA, submitted proposed exemptions to allow: (1) investigation of potential copyright infringement in computer programs, and (2) legitimate use of computer programs, including redistribution and updating of open-source software [13]. Opponents, including the DVD Copy Control Association (DVD CCA), Advanced Access Content System Licensing Administrator (AACSLA), Equipment Dealers Association (EDA), and Associated Equipment Distributors (AED), submitted opposition comments citing concerns about potential harms from circumvention, including damage to markets, breach of licensee expectations, and compromised security measures for other software components [15, 18]. The controversies focused on four main aspects:

### 3.1 Controversy Over Whether Investigation Equipment Exceeds Statutory Scope

Proponents argued that when consumers report suspected license violations in devices containing open-source software, they investigate such devices. The proposed exemption's scope was limited to computer programs, with circumvention performed on legally obtained devices running those programs—already an approved category for security research—thus not exceeding statutory limits [16]. Opponents contended the scope was overly broad, exceeding the narrow subset permitted under Section 1201(a)(1) exemptions and the Librarian of Congress's authorization [15]. The U.S. Copyright Office ultimately sided with proponents, recognizing that computer programs, as a literary works subcategory, qualified

as the specific class of works contemplated by law, and that the updated proposal appropriately described a narrow subset for infringement investigation purposes [17].

### **3.2 Controversy Over Whether Investigation Conduct Constitutes Fair Use**

Proponents argued that copyright licensing investigations and open-source software reuse under licenses constitute fair use. The U.S. Copyright Office evaluated this against the four fair use factors in Section 107: (1) Purpose and character favored fair use as investigations were non-infringing and transformative; (2) Nature of copyrighted works favored fair use given software's functional rather than expressive character; (3) Amount and substantiality were reasonable for determining open-source software location; and (4) Market effect was minimal as investigations did not create publicly accessible copies or negatively impact software value [17]. The Office concluded that the proposed exemption likely qualified as fair use, with all factors weighing in favor [17].

### **3.3 Controversy Over Whether Investigation Capability Faces Adverse Effects**

Proponents argued that copyright owners, particularly those qualified to bring license violation claims, face adverse effects because TPMs prevent source code review necessary to detect infringement, and circumvention would not create genuine litigation threats given open-source software's nature [12]. Opponents countered that adverse effects were merely speculative, with reasonable alternatives available—such as pre-litigation demand letters or filing lawsuits—and that the exemption lacked necessity [19]. They proposed restrictions: (1) prohibiting investigation-enabled access to unauthorized content, and (2) requiring re-encryption after investigation [18]. Proponents responded that alternatives were inadequate and re-encryption was inapplicable for devices requiring disassembly [16]. The Copyright Office found proponents demonstrated sufficient adverse effects from TPMs and defects in alternative proposals, while the restrictions were reasonable and could mitigate potential harm [17].

### **3.4 Controversy Over Whether Copyrighted Works Meet Statutory Factors**

Under Section 1201(a)(1)(C), temporary exceptions must consider: (1) availability of copyrighted works, (2) non-profit archival, preservation, and educational uses, (3) impact on criticism and research, (4) market impact, and (5) other appropriate factors [1]. Regarding availability, proponents argued anti-circumvention prohibitions impeded infringement investigations, while opponents claimed TPMs did not affect availability [11, 17]. For educational and research impacts, proponents demonstrated significant negative effects from TPMs, while opponents could not prove open-source software presence in certain devices like set-top boxes or video game consoles [17]. Regarding market

impact, opponents argued circumvention would harm device markets and digital ecosystems, while proponents noted investigations would not affect creators' investments or software value [15, 16]. The Copyright Office ultimately favored proponents, finding the factors supported the exemption and that opponents' arguments concerned market impact rather than availability [17]. Video game consoles were excluded from the exemption to avoid potential risks like piracy and market harm [17].

## 4 Content Analysis of the Copyright Licensing Investigation System

Under the 2021 final rule, the copyright licensing investigation provision permits circumvention of TPMs solely to investigate potential open-source software copyright infringement. The system comprises behavioral conditions and commands.

### 4.1 Behavioral Conditions

The provision requires: (1) circumvention on legally obtained devices running computer programs (excluding video game consoles); (2) implementation by good-faith parties with reasonable belief in investigation necessity and qualification to bring license violation or copyright infringement claims, or those acting under their direction; (3) compliance with law; and (4) use or maintenance of computer program copies or devices in a manner not facilitating copyright infringement. These conditions ensure investigation legitimacy and prevent abuse.

### 4.2 Behavioral Commands

The behavioral command permits circumvention of TPMs to investigate potential infringement under the above conditions. This authorization aims to prevent the original anti-circumvention prohibition from hindering non-infringing investigations and their beneficial effects. The command includes three models with four elements: actor qualification, behavioral scenario, behavioral composition, and legal consequences [20]. The restriction that investigation must not facilitate infringement mitigates potential market harm and ensures the investigated devices cannot be abused during or after investigation.

## 5 Local Considerations for China

### 5.1 Necessity of Borrowing from the U.S. Copyright Licensing Investigation System

While the U.S. leads in open-source software development and protection with balanced institutional design, China's progress has been relatively slow. However, this does not diminish the field's importance to China. As of April 17, 2023, China's open-source developer population exceeded 8 million, ranking

second globally [22]. The 14th Five-Year Plan (2021) supports developing digital technology open-source communities, outlining a blueprint for open-source software development and legal protection. Yet China's open-source ecosystem faces risks from insufficient standardization, frequent conflicts among stakeholders, and inadequate legal safeguards [24]. The lack of autonomous products creates strategic risks of U.S. judicial control and dependency [21]. Therefore, it is urgent to clarify open-source software's copyright legal status, establish localized copyright licensing investigation systems, and provide robust protection to address internal and external challenges.

## 5.2 Establishing Legal Status for Open-Source Software Copyright Protection

Current Chinese copyright laws, including the Copyright Law and Computer Software Protection Regulations, do not explicitly address open-source software protection. Given its unique characteristics and investigative complexities, open-source software forms a distinct category from traditionally protected software. Establishing its legal status is key to enabling legal protection and constructing copyright licensing investigation systems. Drawing on German precedents (*Welte v. D-Link* and *Harald Welter v. SiteCom*), which established consistent infringement litigation remedies [25], China can clarify open-source software's legal validity, incorporate it into copyright protection, permit infringement lawsuits, and stipulate rights holders' information provision request rights. Additionally, public interest litigation mechanisms could be introduced to provide further safeguards.

## 5.3 Implementation Subject and Authority Design

After establishing legal status, institutional design must address the investigation subject and its authority. Differences in national conditions, legal systems, and culture necessitate adaptations. The U.S. DMCA defines investigation subjects as parties with reasonable belief and qualification to bring claims, or those acting under their direction—a definition overly broad for China's context. Individual investigators may lack expected impartiality, while unrestricted organizational investigations could cause chaos.

Given China's context, temporarily assigning copyright licensing investigation authority to copyright administrative departments at or above the prefecture (city) level is more feasible. These departments offer: (1) neutrality as administrative organs, (2) professional and technical capacity superior to county-level departments, (3) reduced regional influence compared to higher-level authorities, and (4) stable salaries and benefits attracting qualified personnel. Once open-source foundations and related public welfare organizations mature, some or all powers could be delegated to third-party public welfare organizations.

The authority design should specify: (1) prerequisites—reasonable and legitimate belief with qualified sponsor applications to prevent abuse; (2) equipment types

—legally obtained devices running computer programs (excluding video game consoles); (3) investigation boundaries—limited to potential open-source software copyright infringement due to its complexity and hidden nature; and (4) legitimacy requirements—proper handling and protection of investigated devices to avoid direct or indirect copyright harm.

### Differences and Similarities Between the DMCA System in the United States and the System Concept in China

| Aspect                      | U.S. DMCA System                                                                                            | Chinese System Design                                                                                                                                                                                 |
|-----------------------------|-------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Investigation Subject       | Party qualified to bring license violation or copyright infringement claims, or those under their direction | Temporarily assigned to copyright administrative departments at or above prefecture (city) level; based on Chinese realities, administrative implementation is more feasible                          |
| Investigation Prerequisites | Good faith, reasonable belief in investigation necessity                                                    | Reasonable and legitimate basis, with application by qualified sponsor; adds legitimacy standard and application-based model                                                                          |
| Equipment Types             | Legally obtained devices running computer programs (excluding video game consoles)                          | Legally obtained devices running computer programs (excluding video game consoles)                                                                                                                    |
| Investigation Boundaries    | Potential infringement of open-source software                                                              | Potential infringement of open-source software                                                                                                                                                        |
| Investigation Legitimacy    | Use or maintain investigated devices in manner not facilitating infringement                                | Properly handle and protect investigated devices to avoid direct or indirect harm to open-source software copyright; 基本相同 (basically same), both aim to prevent investigation from harming copyrights |

## 6 Conclusion

Litigation serves as a traditional rights remedy and important means to combat copyright infringement. Copyright licensing investigation can supplement litigation by discovering and stopping potential open-source software infringement, preventing damage escalation, and providing useful evidence to improve litigation efficiency. Although China's open-source software development lags behind the U.S., the country now prioritizes this field's development and intellectual property protection. Given risks and challenges from insufficient autonomous products, China must accelerate legal construction adapted to its realities while advancing technical development. By drawing on the U.S. DMCA copyright licensing investigation system and establishing the legal status of open-source



software copyright protection, China can build a localized system that promotes healthy open-source software development and provides robust legal safeguards.

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