Preliminary Research on Licensing of Audio/Video Codec Standard Essential Patents

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Introduction

With the development of the streaming media industry, audio/video codec technologies have significantly reduced data storage space and content dissemination costs, and have been deeply involved in the entertainment life of the public. On the global scope, audio/video codec technology standards represented by H. 264 and H. 265 have been widely used in the streaming media industry. On 18 October 2023, Avanci, the US patent pool administrator, announced the launch of a new video Internet streaming media service patent pool called Avanci Video, which primarily provides services for streaming media platforms. Great controversy has been aroused in the industry over the model in which standard essential patent (SEP) holders charge royalties to both audio/video terminal manufacturers and streaming media platforms. The streaming media platforms mainly use audio/video codec technologies on the terminal side and the cloud side. In the audio/video transportation system which takes the cloud side as an intermediary, the video production end on the terminal side, the cloud side, and the video consumption end on the terminal side jointly constitute a complete audio/video transportation process.

There is a view that charging royalties to streaming media platforms is not an efficient or rational option. [3] However, in the current judicial practice, SEP holders have already targeted their charging strategy at streaming media platforms. At present, there is little research on audio/video codec SEPs around the world: on the one hand, due to various factors such as the complexity of audio/video codec technologies, licensing strategies of patent holders and market acceptance, disputes over the licensing of audio/video codec SEPs have only gradually emerged in recent years, and the legislative and judicial authorities have not made specific response to this issue; on the other hand, in theoretical discussions, scholars and experts tend to pay more atten-

[5] 參見朱秀昌、劉峰、胡棟:《H.265/HEVC——視頻編碼新標準及其擴展》,電子工業出版社,2016年第1版,第313-314頁。

[6] 若無特別説明,本文所述芯片均爲專門用於音視頻編解碼的專用芯片。

[7] 同註5,第314頁。

[8] 早期中國《專利法》規定專利權用盡原則僅適用於産品專利,後來將專利權用盡原則的對象擴展爲專利産品與依照專利方法直接獲得的産品兩類。在西電捷通訴索尼移動案中,法院認爲,《專利法》第69條第一項規定的專利權用盡原則只能使涉及合法售出的産品本身的專利權被權利用盡,而不能認爲合法售出的實施專利方法或製造專利産品的專用設備或者專用元件、部件能够當然導致方法專利權也被權利用盡。參見(2017)京民終454號民事判決書。

[9] 參見 *Quanta Computer, Inc. v. LG Electronics, Inc.*, 553 U.S. 617 (2008)。

[10] 同註3。

[11] 建議在平臺與用户的協議中,加入相關授權委託條款。

[12] 參見(2019)最高法知民終147號民事判決書。

[13] *United States v. Univis Lens Co.*, 316 U.S. 241 (1942).

[14] 參見國家知識産權局《專利侵權行爲認定指南(試行)》第2.1.2.1條。

[15] 參見黄武雙、譚宇航:"物聯網背景下標準必要專利許可層級的選擇",載《知識産權》,2022年第9期,第45頁。

tion to the licensing of SEPs in a general sense, such as the application of the FRAND rule, the determination of licensing level and royalty rate, royalty stacking, the application of injunction and other macro issues, but pay less attention to the differentiations between specific technical details. Therefore, there has not been a systematic research conducted in the academic circle on the disputes over the royalties of audio/video codec SEPs.

This article concentrates on the licensing of audio/video codec SEPs, and aims to delve into the rationality of the streaming media platforms' liability to pay royalties, that is, whether the streaming media platforms should be obliged to pay royalties for audio/video codec SEPs. This article first analyzes the characteristics of the licensing of SEPs in the audio/video industry, in pursuit of finding out the key difficulty and breakthrough of the issue; second, it analyzes the terminal-side streaming media platforms' liability for royalty payment at the technical, legal and market levels, in order to clarify the specific scenarios where the terminal-side streaming media platforms should pay royalties; finally, this article probes into the cloud-side streaming media platforms' liability to pay royalties from three aspects: the relationship between the terminal side and the cloud side, the realization of technical value, and transaction costs, thereby clarifying the issues in relation to the royalties for audio/video codec SEPs, and boosting the promotion and application of audio/video codec technology standards and the healthy development of the streaming media industry.

I. Characteristics of SEP licensing in the audio/video codec industry

Where newly emerging and traditional SEP licensing models conflict, the industry, the judiciary, and even the legislature should consider and respect the characteristics of each industry when figuring out solutions. This article explains the characteristics of the SEPs licensing in the audio/video industry as compared to those in the communications or automotive industry from three aspects: value distribution, licensing level, and determination of royalty base.

1. Value distribution

The patent value in the communications industry mainly refers to the market value of the end-products, supplemented by the technical value embodied in chips. In the early stage, mobile phones mainly functioned as communication tools, so the entire mobile phone value was commonly taken as the royalty base when licensing SEPs in the cellular mobile communications industry. The emergence of the smallest salable patent-practicing unit rule (hereinafter referred to as the SSPPU rule) provided a new solution to the calculation of the patent value. Seeking a reasonable royalty base for an SEP license between the end-product market value and the SSPPU value may reflect the patent value more accurately. In the intelligent connected vehicle industry, the SEP value is locked in the chip end. Although intelligent networking is a vital development trend, it is a technology ecosystem jointly made of multiple technical fields such as intelligent driving, cockpit, chassis, map and communication technologies, and various innovative entities. The contribution of communications technology to the product value of intelligent vehicles is relatively limited and can hardly be commensurate with the product value of safe driving.

In the audio/video industry, the mainstream licensing practice still mainly focuses on the value of the SEPs at the terminal device level, but there is a tendency towards the preference for content-based codec licensing. The shift in the royalty charging target for the audio/video codec technologies from terminal manufacturers to software manufacturers essentially reflects a shift in the value of SEPs in the audio/video industry, and the streaming media platforms are facing the challenges of SEP licensing. Moreover, the terminal side and the cloud side are in a close relationship in terms of video codec technologies, and they coordinate to guarantee the efficient transmission and high-quality playback of audios and videos. Scholars and practitioners are usually unable to answer whether the value of the audio/video codec technologies is embodied on the terminal side or the cloud side, which also brings a challenge to the value distribution of the audio/video industry.

2. Licensing level

It is currently a prevailing practice in the communications industry to grant a license at the terminal level. The right holder's selection of only granting license at the terminal level is conducive to its management of SEP licensing and royalty calculation. Different from the communications industry, the automotive industry which possesses mature basic technologies usually has its patent licensing issues solved by component manufacturers. If the entire vehicle manufacturer is responsible for obtaining an SEP license, the cost of the entire vehicle manufacturer will be significantly lifted, which will in turn have an impact on the development of the automotive industry.

In the audio/video industry, there are multiple licensees, including terminal manufacturers and streaming media platforms. The practice of SEP holders in the audio/video field also demonstrates that licensing either terminals or upstream components is acceptable. For instance, for audio/video codec technology standards, MPEG LA patent pools grant licenses for consumers' terminal products; whereas for other products containing decoders, licenses are granted directly for decoders. [4] With the advent of the traffic era, SEP holders have gradually changed their targets from terminal manufacturers to streaming media platforms when charging royalties. Avanci Patent Pool announced the launch of its patent pool for video internet streaming services, which will provide packaging licenses for several encoding formats like H.265 and H.266. This patent pool mainly charges royalties from the streaming media platforms, rather than the terminal manufacturers.

3. Determination of royalty base

The entire value of the terminal device is mostly used as the royalty base in the communications industry, which has the advantage that the terminal device covers all the SEPs, and the right holders have easier access to the sales volume and price of the terminal devices from the terminal manufacturers. In addition to the mainstream practice of using the value of the terminal device as the royalty base, the communications field adopts the SSPPU rule which uses the smallest salable unit containing all the SEPs as the royalty base. Modules containing SEPs, that is, the SSPPU, can reflect the value of the standard technologies more directly and prevent SEP holders from gaining premiums or added value that is irrelevant to patents themselves and results from standardization. In the automotive industry, patent holders charge patent royalties from the component suppliers of entire vehicle manufacturers, that is to say, the product unit of the SEP technology that actually contributes to the automotive product is used as the base for calculating the royalties.

Regarding royalties for hardware, MPEG LA, as the major patent pool for licensing SEPs in relation to the HEVC/H.265 standard, has followed its licensing rule in the H.264 standard era that manufacturers that sell more than 100,000 terminal devices shall be charged royalties (US $0.2 per product) with an upper limit of US$25 million per year. Regarding software royalties, there is currently no software royalty-based standard that has been recognized in the audio/video industry.

II. Payment obligation of terminal-side streaming media platforms

Because of many differences in SEP licensing models between the audio/video industry and the communications industry, as well as the automotive industry, the licensing model in the audio/video industry should not be a simple copy of that in the communications and automotive industries. In particular, the streaming media platforms, as an indispensable part of the audio/video industry, utilize audio/video codec SEPs on both the terminal side and the cloud side. We are going to analyze the payment obligation of the terminal-side streaming media platforms from technical, legal, and market perspectives.

1. From the technical perspective

The technical methods for implementing audio/video codecs can be divided into two categories: software codecs, and hardware codecs. Both types have their respective advantages and disadvantages, and we can decide which method to adopt according to different application requirements.

Software codec generally refers to a process of encoding and decoding audio/video sequences by software programs on ordinary terminal devices so as to form compressed video bitstream data or files that conform to the HEVC standard or other standards. Although the subsequent improvement and upgrade of the software codec are relatively convenient, and audio/video codec programs encounter little resistance to their promotion and application with the help of general-purpose computer platforms and can be easily compatible with other apps, software codec methods are still difficult to satisfy the high real-time requirements of such apps as video conferencing and TV live broadcast. What's more, software codec is energy-consuming for mobile devices such as smartphones and leads to a poor user experience. [5]

Hardware codec is guided by the ideology of "resolving specific problems by dedicated tools", that is, to complete the task of audio/video codec by using chips [6] dedicated to audio/video codec. [7] However, in contrast with software codec, hardware codec has the following shortcomings. First, hardware codecs require higher development costs and longer development periods, and are usually difficult to modify and upgrade after the completion of development. Therefore, in practice, the following situations may oc-

cur: first, manufacturers of the chips in the terminal devices have not yet finished the research and development of hardware under the H.266 standard, whereas the software codec programs have been upgraded to the H.266 standard; second, some old mobile phones do not support hardware codecs under more mature technical standards, but can only use software codecs built into apps. It is estimated that a majority of terminal devices conduct hardware codecs through chips, and a small number of terminal devices utilize software codecs built into the apps. As such, to guarantee the user experience, the audio/video codec technologies using software generally need to be retained in the apps to coordinate with those of hardware codecs.

To sum up, hardware codecs and software codecs are both indispensable to audio/video production and consumption and are often used concertedly. Terminal device manufacturers use codec technologies through hardware chips, whereas streaming media platforms utilize audio/video codec SEPs through software programs. Accordingly, both terminal manufacturers and streaming media platforms should be obliged to pay royalties. However, according to the software codec use rate, the streaming media platforms should not bear the obligation to pay excessive royalties.

2. From the legal perspective

From the legal perspective, the royalty payment obligation borne by the streaming media platform is in close association with the infringement defenses that streaming media platforms can utilize when facing lawsuits brought by SEP holders. The following passage will analyze the feasibility of four types of infringement defenses and explain the applicable situations: non-infringement defense, right exhaustion defense, non-commercial use defense and implied license defense.

(1) Non-infringement defense

The basic legal rule for paying patent royalties is that only when a specific subject completely implements all the technical features of the patent claims can the patent implementation in the legal sense be found, and the payment obligation occurs accordingly. To put it simply, whoever implements the SEP is required to pay royalties. If the streaming media platform does not use the audio/video codec SEPs, there is definitely no need to pay. Where the chip has already been installed and the hardware codec is the final decoding manner, the software of the streaming media platform is not used for encoding and decoding audio or video files and it is the chip that utilizes the codec SEPs. Thus, under such circumstances, the streaming media platform can make a non-infringement defense and need not bear the royalty payment obligation.

(2) Right exhaustion defense

Most audio/video codec SEPs used by streaming media platforms are related to process patents that do not involve products. In China there are some controversies over the issue of exhaustion of rights in process patents.[8] However, in the United States, with the expansion of the applicable scope of the patent exhaustion doctrine, non-production method patents such as process patents will be exhausted due to the sale of related products. In *Quanta Computer, Inc. v. LG Electronics*[9], the Supreme Court of the United States held that the patent exhaustion doctrine can apply to method patents. Where a license fully authorizes the right to sell the computer components that substantially embody the patents in suit, therefore, the exhaustion of patent rights was triggered by the sale of computer components. Although process patents cannot be exhausted in the same manner as product patents, they can be specifically incorporated into related products. Thus, process patents can be exhausted by the sale of products embodying the process, and excluding the application of the patent exhaustion doctrine to process patents will severely violate the connotation of the exhaustion doctrine.

In the audio/video encoding and decoding process, the video production terminal is the most direct usage scenario. The patent holder authorizes the terminal manufacturer to use its patent, which actually provides a basis for the exhaustion doctrine, and the terminal user further continues the exhaustion doctrine through the network service contract while creating an audio or video.[10] Where the terminal device is equipped with a chip and has obtained a license, the streaming media platform can use the software codec to solve the problem that some audios and videos cannot be played. To be specific, take mobile phones for example. Terminal users are mobile phone users. They purchase mobile phones and install apps for the purpose of watching videos or listening to audios. However, chips in mobile phones have their own setbacks, so only about 90% of the audios and videos can be successfully encoded or decoded. Thus, software in the apps functions to repair chips. Where the user cannot repair the chip by himself, the streaming media platform will repair it by invoking software. The act of invoking software can be understood as the re-

pair of the chip in the terminal device.

Therefore, in the case of a licensed chip that has been equipped and ultimately relies on software codec, the invocation of software by the streaming media platform can be understood as the repair of the chip's defects. The exhaustion doctrine defense is an optional route, but is also at risk in China, which specifically depends on whether the courts in China recognize that the exhaustion doctrine also applies to process patents.

(3) Non-commercial use defense

Consumers' use of hardware and software for audio/video encoding and decoding is not for production and business purposes. If only hardware is adopted for encoding and decoding, users may encounter situations where some audios or videos cannot be played normally. Therefore, consumers have to add software codecs to the terminal devices in order to use the apps on their mobile phones normally. However, terminal users are not capable of doing so, and the streaming media platforms, under the users' authorization, add software codecs so as to optimize the experience of terminal mobile phone users who use the streaming media platform apps. [11] Therefore, from the perspective of consumers, the software is not invoked for production and business purposes, and the non-commercial use defense can be adopted.

In *Shenzhen Jixiang Tengda Technology Co., Ltd. v. Shenzhen Dunjun Technology Co., Ltd.*, [12] a case involving invention patent infringement, the Supreme People's Court held that the exploitation of the process of the patent in suit through the accused product by terminal network users does not constitute infringement in a legal sense, and the terminal network users are not liable for infringement. Although the terminal users utilize the accused product to carry out the process of the patent in suit, their exploitation is not for production and business purposes and does not constitute infringement. The Patent Law aims to regulate manufacturing, offering for sale, sale, and import for production and business purposes. An act conducted not for production and business purposes shall not be regarded as patent exploitation and therefore does not constitute patent infringement. For similar reasons, when terminal users are watching videos through the streaming media platform apps, they have no purpose for production or business, and their act of invoking software codec does not constitute infringement in the sense of patent law. Where the terminal device is equipped with a chip and ultimately performs encoding and decoding by software, the streaming media platform can make the non-commercial use defense.

(4) Implied license defense

According to the U.S. judicial precedents, implicit licensing serves as the theoretical foundation underlying the patent exhaustion doctrine. This explains why the courts often apply both the patent exhaustion doctrine and the implied license doctrine to deal with patent infringement disputes after the sale of patented products. [13] Can the use of software for audio/video encoding and decoding by the streaming media platforms be regarded as the patentee's implied license?

In China, if the devices or products sold by the patentee or its licensee can only be exclusively used for implementing the process of a process patent, and the patentee or its licensee does not explicitly impose any restrictive condition when selling these patented devices or products, it shall be deemed that the purchasers have obtained an implied license to exploit the patented process. [14] The determination of the implied patent license based on the sale of components, dedicated devices or products shall satisfy two conditions: first, the components, dedicated devices or products sold by the patentee or its licensee cannot be used for any purpose unless implementing the patented technology; second, the patentee or its licensee does not definitely impose any restrictive conditions when selling the components, dedicated devices or products.

If the process patents in relation to the audio/video codec technology satisfy the above two conditions, the patentee's implied license defense shall apply. First, the chip embodying the audio/video codec technology is the one dedicated to implementing the audio/video codec technology, rather than a general-purpose chip in the terminal device, and cannot be used in another manner, which satisfies the requirement for the dedicated device. Second, the patentee did not explicitly impose restrictive conditions when selling its audio/video standard technology. Therefore, with the licensed chip equipped, the software is invoked for encoding and decoding audios or videos under the patentee's implied license, and the streaming media platform does not need to be obliged to pay royalties.

Scenario	Is the chip equipped	Whether the chip has been licensed	Ultimate decoding manner	Defense of the streaming media platform	Is the streaming media platform obliged to pay royalties
1	Yes	Yes	Hardware	Non-infringement	No
2			Software	1. Exhaustion doctrine; 2. Non-commercial use; 3. Implied license	No
3		No	Hardware	Non-infringement	No
4			Software	Non-commercial use	No
5	No	/	Software	None	Yes

Table 1 Specific scenarios where the grounds of defense of the streaming media platform are applicable

As shown in Table 1, where the chip has been equipped and the audios or videos are ultimately encoded and decoded by the chip (scenarios 1 and 3), the streaming media platform can make a non-infringement defense regardless of whether the chip is licensed. Where the chip has been equipped and the audios or videos are ultimately encoded and decoded by software, if the chip is licensed (scenario 2), the streaming media platform can make a defense against infringement based on the exhaustion doctrine, the non-commercial use, and the patentee's implied license. However, since the audio/video codec technologies used by the streaming media platform app are mostly patented processes, and there is controversy over the application of the patent exhaustion doctrine to process patents in China, the exhaustion doctrine defense is at risk; if the exploitation of the chip is not licensed (scenario 4), the exhaustion doctrine defense and the patentee's implied license defense are not justified, and the streaming media platform can make a non-commercial use defense. Where the chip has not been equipped and the audios or videos are ultimately encoded and decoded by software (scenario 5), the streaming media platform has no ground of defense and therefore is obliged to pay royalties.

3. From the market perspective

The streaming media market is an enormous incremental market. China's streaming media platforms are also undergoing development at a rapid rate. Thus, the following is going to elaborate on the obligation of the terminal-side streaming media platforms for royalty payment at the market level primarily from the perspectives of the streaming media platforms, consumers, and patentees.

As far as the streaming media platforms are concerned, in the SEP technology promotion ecosystem, the streaming media platforms, as the technology implementers, are the crucial subjects for the implementation and market popularization of technologies and play a key role in the transformation of patented technologies to practical products and the promotion of the large-scale application of standards. Through constant technology integration, product iteration, and market development, the streaming media platforms have not only lowered the threshold for the use of standard technologies but also expanded the scope of standards through the scale effect, which creates fundamental conditions for the coordinated development of upstream and downstream industries. Royalty charge from the streaming media platforms seems to be a simple and direct business model adjustment, but essentially contains complex economic logic and has a far-reaching impact on industries. Undoubtedly, the development of streaming media platforms will be profoundly affected from various aspects. First of all, royalty charge from the streaming media platforms has a direct impact on their user base and activity level. A majority of streaming media platforms adopt the strategy of providing video streaming services for free or at a low price. Charging royalties from the streaming media platforms means that the streaming media platforms have to pass on the costs to consumers. There is no free service any longer, which will be replaced by paid service. Once the streaming media platforms decide to charge for their services, some price-sensitive users may leave. Second, charging royalties from the streaming media platforms influences the content ecosystem thereof. High costs of content may compel the platforms to take more stringent measures for cost control, such as reducing the investment in unpopular content, which may restrict the diversity and innovation of content. Finally, charging royalties from the streaming media platforms will also have an impact on their technological innovation and service upgrade. Particularly in the context of competing standards for audio/video codec SEPs, more advanced audio/video codec technologies cost more than early, less mature audio/video codec technologies. If over-high royalties are charged from the streaming media platforms, they may be unable to afford the royalties for ad-

vanced audio/video codec technologies, but are prone to choose some lower-priced and cost-effective audio/video codec technologies.

As far as consumers are concerned, the increase in service price, which directly results from cost shifting, will badly affect consumers' purchasing decisions and power. In a price-sensitive market environment, consumers tend to make a prompt response to price changes. Where the service price of the streaming media platform rises, some consumers may select to reduce the number of subscriptions or switch to more affordable competing platforms. Although users who have long relied on specific free streaming services may be willing to pay certain fees for high-quality content and services, the continued increase in price will render their doubt about the cost-effectiveness of the services, which will in turn affect their loyalty. More importantly, consumers may pay higher price for the same service grade. For instance, some platforms may change the previous basic services, such as high-definition image quality, simultaneous login with multiple devices, or ad-free viewing, to value-added services that require additional fees. The streaming media platforms will also abandon advanced audio/video codec technologies on account of high price and start to use cheap and relatively old audio/video codec technologies. Such changes not only will decrease consumer satisfaction but also may result in user dissatisfaction and complaints, which will end up with harm to consumer welfare.

As far as patentees are concerned, when the patentee grants a license to multiple licensees at different licensing stages to allow them to use one or more patents, all the factors such as the differences in licensing terms, geographical restrictions, and time limits among various licenses are intertwined to form a complicated network. To avoid duplicate charges, the patentees have to put in a huge amount of resources to supervise and manage licensing activities. These management costs, in terms of both human and financial resources, are an extra burden placed on the patentees that run enterprises. More importantly, these resources which could have been utilized to support innovative research and development will be willy-nilly when used for defensive management activities. Reduced investment in research and development will undoubtedly weaken an enterprise's innovation capabilities and slow down the progress and application of new audio/video codec technologies. In the long run, the enterprise's market competitiveness will be undermined and the innovation ecosystem of the entire industry will be affected as well.

From the market perspective, many problems may occur if the streaming media platforms are liable for royalty payment. Charging patent royalties from the streaming media platforms may increase the operation and management costs, inhibit consumer welfare, restrict the development of the streaming media platforms, and even reduce the technological innovation activities of patentees, which makes it impossible to achieve win-win cooperation among multiple parties. Noteworthily, it is usually during the promotion period of a new standard technology that the terminal is not equipped with hardware codec and uses software codec for encoding and decoding, which usually does not last long. If fees are charged for software codecs used in a short period of time, it will have a significant impact on the ecosystem of the streaming media market.

In summary, from a technical perspective, streaming media platforms utilize audio/video codec technologies, and their software invoking cannot be ignored, so they are obliged to pay royalties. From a legal perspective, streaming media platforms only need to pay when chips have not been equipped and software codec is used for encoding and decoding. From a market perspective, charging fees from streaming media platforms may affect the development of the streaming media industry, consumer welfare, and the technological innovation activities of patentees. Different conclusions are drawn from different perspectives of technology, law, and market. Hence, it is necessary to comprehensively consider the obligation of the terminal-side streaming media platforms for royalty payment from the above three perspectives.

III. Payment obligation of cloud-side streaming media platforms

The streaming media platforms coordinate to provide streaming media services on the terminal and cloud sides: the terminal-side platforms are responsible for collecting and receiving audios and videos, and the cloud-side platforms are responsible for storing, re-encoding, and distributing audios and videos. We are going to discuss whether the cloud-side streaming media platforms are obliged to pay royalties mainly from the aspects of the relationship between the terminal side and the cloud side, the realization of technical value, and transaction costs.

1. The relationship between the terminal side and the

cloud side

Based on the association between the terminal side and the cloud side, the use of the video encoding technology by multiple terminal-side and cloud-side subjects shall be charged once, rather than multiple times.

First, charging fees separately will lead to repeated charges. The cloud side is the intermediate link between the video production end and the video consumption end: on the one hand, the could side receives and decodes data from the video production end; and on the other hand, the cloud side utilizes the video encoding technology for re-encoding, and the re-encoded video is transmitted to the video consumption end when the video consumption end invokes the video. Therefore, any video viewing or use intervention by the cloud side requires the joint participation of the video production end, the cloud side and the video consumption end. If fees are charged at each step of the audio/video codec process, there occur repeated charges for the same audio/video codec technology at different licensing steps, which is in violation of the basic principle of prohibiting repeated charges by patentees.

Second, it is not feasible to charge fees separately. The audio/video codec technology, as a core step for transmitting and storing videos in the streaming media industry, has technical details and intricate industrial model, which directly pose a challenge to value distribution. Such a challenge is attributable to highly specialized patented designs and frequent patent iteration, as well as a plurality of patent implementers in the streaming media industry, including but not limited to the streaming media platforms and cloud service providers. Each implementer plays an indispensable role in the application of the audio/video codec technology, but it is hard to find a unified, accurate measurement standard in the process of transformation from technical contribution to market value. As such, in view of the differentiations among different implementers in technical implementation, application scenarios and business models, the value distribution of the audio/video codec technologies is extremely complex and it is difficult to derive a universally applicable, fair and reasonable royalty distribution scheme.

Finally, charging fees separately may provide patentees with excess profits. In the streaming media industry, the number of optional licensing steps increases with the continuous growth of the technology industry chain. The cloud side, chip manufacturers, video production end, video consumption end, etc. can all be payers in theory. Although laws like the Anti-Monopoly Law in China do not require "license to all", patentees generally charge royalties once for their SEPs from the implementers at a certain licensing level in a supply chain according to the basic principles of the patent law and the conventional practices of SEPs. [15] One type, not multiple types, of subjects should be charged for the royalties of audio/video codec SEPs. If patentees are allowed to earn high or even excess profits, they may obtain improper profits in the industrial chain and harm the economic interests of the patent implementers, and the harmed interests will finally be passed on to consumers. Over-high patent royalties and unstandardized fee-charging models may inhibit enterprises from investing sufficient funds in the research and development of new audio/video codec technologies, thereby restricting technological innovations and hindering the healthy and sustainable development of the streaming media industry.

2. Technical value of patented technologies

In comparison with the terminal side, the cloud side primarily serves the functions of storage, transcoding and content distribution in the streaming media industry chain, which are in essence technical supports and do not directly create the market value of the patented technology. Thus, the cloud side cannot effectively reflect the market value of the audio/video codec technology, and it is unreasonable to impose patent royalties on the cloud side.

First, the application of the codec technology on the cloud side plays a very limited role in the value increment of audios and videos. In the streaming media industry chain, the core value of audios and videos stems from content creation, instead of dissemination and storage. Content quality is the main factor that affects the user's choice of videos. Different from the terminal side whose application of the patented technology is directly associated with user experience, the cloud side merely functions to provide technical support, and does not directly create user experience value, let alone constitute the core of the audio/video value source.

Second, the transcoding service provided by the cloud side can hardly demonstrate the patent value in a sufficient manner. Audio or video content is usually uploaded to the cloud side by the streaming media platform, and transcoded by the cloud server. This is a one-time procedure because the transcoded video will be stored in a fixed manner and need not be re-transcoded every time it is played. It means that cloud transcoding is only an intermediate pro-

cessing step in the overall audio/video playback procedure and has extremely limited technical value. However, the audio or video needs to be encoded and decoded at the terminal side every time the audio or video is played, and the market value of the codec technologies is mainly reflected through the terminal device.

Finally, the technical value of the cloud side is mainly embodied in video enhancement and repair aspects. The cloud side technologies are applicable in a scope much larger than audio/video codec, with its key functions in video enhancement/repair such as audio noise reduction, panoramic sound, dark light enhancement, video stabilization and deinterlacing, rather than direct audio or video playback. For instance, the core technologies on the cloud side relate to CDN (content distribution network), load balancing, cache optimization, recommendation algorithms, and the like. These technologies can be applied to improve data transmission efficiency, reduce network latency, and provide better technical support in a bid to foster the efficiency of distribution and dissemination of audios or videos. Therefore, even if the codec technologies are applied on the cloud side, such an application is only a part of cloud technologies and does not constitute the core value of cloud services.

3. Transaction costs

In comparison with the terminal side, the cloud side has a more complicated market structure and involves more entities, thereby resulting in higher licensing management and calculation costs. Therefore, imposing patent royalties on the cloud side will not only increase the transaction costs, but also affect the market stabilization and innovation incentives.

First, the cloud side has a more complicated market entity structure and requires higher management costs. The market structure of the terminal side is clear and transparent as it is mainly composed of terminal manufacturers and streaming media platforms. Both licensors and licensees are definite and the royalty charging process is relatively efficient. The cloud side involves multiple entities such as streaming media platforms, terminal manufacturers, cloud service providers and chip manufacturers. In such a complicated market structure, the right holder needs to define the contribution made by different entities to the market value of the patented technology, and negotiate with them separately according to their respective business models. In doing so, the licensing management costs are increased and the royalty charging efficiency is decreased.

Second, the licensing negotiation costs are higher on the cloud side. The more fragmented market structure of the cloud side will increase the licensing negotiation costs. For instance, where the streaming media platform does not have its self-developed server, there must be a third-party cloud service provider. Under such circumstances, the patentee needs to conduct licensing negotiations with the streaming media platform, and possibly cloud computing companies or infrastructure providers as well, so as to determine the royalty payers and payment obligation. The right holder has to make a choice among the cloud side and different licensees to decide who will be charged royalties, and it is not a mature practice in this industry to charge royalties from the cloud side, which will further increase the negotiation costs and result in lower licensing efficiency.

Third, the cloud side is faced with extremely high royalty calculation costs. Although the cloud side provides certain technical support to the application of audio/video codec technologies, it does not make much contribution to the market value of the patented technologies and said contribution is hard to quantify, which poses many challenges to the calculation of patent royalties. Different entities such as streaming media platforms, cloud service providers and chip manufacturers play different roles on the cloud side. It costs extremely high to calculate the contribution ratio of each party to the market value of the audio/video codec technologies. At the same time, the cloud side has a relatively complicated business model. For instance, the streaming media platform can charge fees according to data such as video processing time, data storage, bandwidth usage. There is no authoritative economic model or case applicable to the calculation of royalties in the industry. The complicated business model and technology application situations elevate the costs of royalty calculation under this charging model.

To sum up, judging from the relationship between the terminal side and the cloud side, the terminal side and the cloud side should not be charged separately due to their high correlation. In terms of technical value realization, the cloud side mainly provides technical support, such as transcoding, and makes a limited contribution to the increment of the market value of streaming media technology. The cloud side alone cannot embody the core value of the codec technologies, and is ultimately aimed to serve audio/video playback on the terminal side. In terms of transaction costs, the

terminal side and the cloud side both belong to the streaming media industry chain and jointly provide audio / video playback services. However, charging royalties from the terminal side obviously incurs less transaction costs and ensures more efficient licensing management.

IV. Conclusion

Issues about audio/video codec SEPs are cutting-edge issues in the field of patent law, covering intricate technical issues and tricky legal issues. Since the audio/video industry is significantly different from the communications industry and automotive industry in terms of value allocation, licensing levels and royalty base, the model for charging SEP royalties in the audio-video industry cannot completely imitate the model in the communications industry and automotive industry. Royalties for audio / video codec SEPs should be paid by terminal manufacturers or chip manufacturers, which should not be shifted to the streaming media platforms on a large scale. In most cases, terminal - side streaming media platforms do not have to pay royalties, except when the terminal device isn't equipped with a chip and ultimately uses software codec, and cloud-side streaming media platforms generally do not need to pay royalties. This article delves into the critical issues such as who should pay royalties for audio/video codec SEPs, which is merely a preliminary exploration and aims to start further discussion on these issues. ■

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[3] A speech of Associate Professor Zhou Wei in the article entitled "How can the exhaustion of rights be applied to streaming media SEPs and who should be charged? Hear what experts say". WeChat Account: Antimonopoly frontier, posted on 20 November 2024.

[4] Group of Experts on Licensing and Valuation of Standard Essential Patents 'SEPs Expert Group', Contribution to the Debate on SEPs, January 2021, p. 77.

[5] Zhu Xiuchang, Liu Feng and Hu Dong (2016). *H.265/HEVC—New Video Encoding Standards and Expansion Thereof* (1st edition, pp. 313-314). Publishing House of Electronics Industry.

[6] All the chips herein are special chips dedicated to audio/video encoding and decoding, unless otherwise specified.

[7] See supra note 5, p. 315.

[8] In the early days of China's Patent Law, the patent exhaustion doctrine was only applied to product patents. Later, the patent exhaustion doctrine was applied to patented products and products directly obtained according to patented process. In *IWNCOMM v. Sony Mobile*, the court held that the patent exhaustion doctrine stipulated in Article 69.1 of the Patent Law can only exhaust the patent rights of the legally sold products themselves, and it cannot be considered that the legally sold special equipment or special components and parts dedicated to implementing the patented process or manufacturing the patented product can surely lead to the exhaustion of the method patent rights. See the Civil Judgment No. Jingminzhong 454/2017.

[9] *Quanta Computer, Inc. v. LG Electronics, Inc.*, 553 U.S. 617 (2008).

[10] See supra note 3.

[11] It is recommended to incorporate relevant authorization and entrustment clauses to the agreement executed between the platform and users.

[12] See the Civil Judgment No. Zuigaofazhiminzhong 147/2019.

[13] *United States v. Univis Lens Co.*, 316 U.S. 241 (1942).

[14] Article 2.1.2.1 of the CNIPA's Guidelines for Patent Infringement Determination (Trial).

[15] Huang Wushuang and Tan Yuhang (2022). Choice of SEP licensing level in the context of IoT. *Intellectual Property, 9, 45*.