Judicial Determination of Standard Essential Patent Licensing Fees: Dilemmas and Optimization Strategies

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Abstract: In judicial practice, there is currently no unified calculation standard for the licensing fees of standard essential patents (SEPs). The main reasons for the difficulties in determining licensing fees are the ambiguity of the FRAND (Fair, Reasonable, and Non-Discriminatory) principle, the lack of universally applicable allocation rules, the complexity of influencing factors, and inconsistent calculation methods. To calculate SEP licensing fees, it is necessary to clarify the different applicable values of allocation rules and overall market value rules, specify the SEP holder's FRAND licensing obligations, the SEP holder's information disclosure obligations, and the standard-setting organization's obligation to review necessity. A comprehensive approach to considering the specific circumstances of each case can improve the accuracy of SEP licensing fee calculations.
Keywords: Standard Essential Patent, Licensing Fee, FRAND, Allocation Rules

1. INTRODUCTION

A "Standard Essential Patent (SEP)" refers to a patent that is essential for implementing a particular technical standard. The integration of technical standards with patents has become increasingly frequent and is now an irreversible trend. However, the combination of standards and patents can easily lead to patent hold-up and royalty stacking issues, making it difficult for standard implementers to freely produce products that comply with standards, and hindering the public value of the standard. SEP holders, by virtue of owning monopolistic patents, naturally have a dominant position as the "first party," and they gain a "unique advantage" when their patents are incorporated into a standard (Hytönen et al., 2012). When SEP holders and standard implementers fail to reach an agreement on the licensing fees for SEPs, litigation is often triggered (Lerner & Tirole, 2015). The licensing fee rate is a direct reflection of the core interests in SEP licensing. The licensing fee equals the calculation base multiplied by the royalty rate, with both the calculation base and royalty rate jointly influencing the final fee amount. The calculation base determines which part of the patented product is subject to the royalty, while the royalty rate, expressed as a percentage, determines the proportion of the base value to be paid as a licensing fee. To maximize or minimize the royalty rate, SEP

holders may use their monopoly position for patent hold-up, while standard implementers may engage in reverse hold-up by invoking the FRAND principle. Injunctions often become bargaining chips in negotiations, and disputes over the royalty rate continue to escalate (Dratler, 2024). With the global expansion of domestic companies, represented by Huawei, SEP disputes have become increasingly prevalent. For instance, in 2013, the Guangdong High Court ruled in a case where Huawei sued U.S.-based Digital Interactive Company for SEP-related antitrust violations. In 2017, Conversant filed a lawsuit in the UK against Huawei and ZTE to determine the licensing fee for the involved SEPs. In 2018, Huawei sued Conversant in a case in which the Nanjing Intermediate People's Court set the SEP licensing fee for China. In 2020, OPPO sued Sharp, Xiaomi sued IDC, and Samsung sued Ericsson, all requesting courts to exercise judicial authority to determine the global licensing fee for SEPs. In 2022, the Chongqing First Intermediate People's Court made a ruling in the OPPO vs. Nokia SEP licensing fee dispute, establishing the global royalty rate for the involved SEPs. As technological products become more complex and patents more densely accumulated, the difficulty in calculating licensing fees increases (Knight, 2012). The licensing fee should be the result of mutual agreement reached between the SEP holder and the standard implementer. In theory, the licensing fee agreed upon through negotiation takes into account the interests of both parties, balancing the private rights of the patent holder with the public attributes of the standard. However, when negotiations fail, the licensing fee must be determined by antitrust enforcement agencies or courts. If a more complete methodology for calculating licensing fees could be established, many of the issues arising from the integration of patents and standards would be effectively resolved, thereby facilitating the promotion of standards and the implementation of technological innovation (Parr, 2018). Various countries have made positive attempts in judicial determination of licensing fees and have achieved certain results. However, the judicial determination of licensing fees still faces numerous practical dilemmas that need to be addressed urgently.

2. THEORETICAL ASPECTS OF STANDARD ESSENTIAL PATENT LICENSING FEE CALCULATION UNDER THE FRAND PRINCIPLE

2.1. The Connotation of the FRAND Principle

Currently, most patent or intellectual property policies of standard-

setting organizations (SSOs) require their members to commit to licensing standard-essential patents (SEPs) under the FRAND (Fair, Reasonable, and Non-Discriminatory) principle. The FRAND principle balances the interests of the SEP holder and the standard implementer by ensuring that the patent holder receives fair compensation and that implementers can use the standard without risk of infringement, lock-in, or significant investment losses (Murphy et al., 2012). On one hand, the FRAND royalty rate should be high enough to incentivize inventors to continue developing new technologies. On the other hand, the patent holder has the obligation to fulfill its FRAND commitment so that implementers can lawfully use the SEP without the risks of infringement or excessive costs associated with implementing the standard. Why do standard-setting organizations introduce the FRAND principle, and what role does it play in the integration of patents and standards? When a SEP holder has committed to licensing its patents under FRAND terms to ensure implementers can use the SEPs, how do implementers respond? Before addressing these questions, it is essential to clarify the meaning of FRAND licensing commitments. FRAND stands for Fair, Reasonable, and Non-Discriminatory, and is also known as RAND (Reasonable and Non-Discriminatory). It was first proposed by the International Organization for Standardization (ISO) and has since been adopted by more and more SSOs, requiring patent holders to commit to licensing their patents on FRAND terms (Hietanen, 2008; Lemley, 2002). The primary goal of the FRAND principle is to strike a balance between the interests of the patent holder and the standard implementer, avoiding unreasonable patent royalties due to imbalanced bargaining power. When a patent holder participates in the formulation of a technical standard, whether licensing patents through a patent pool or individually, it must adhere to the FRAND principle as a minimum standard. The FRAND principle mainly involves two aspects: reasonable royalties and non-discriminatory terms. When a technology becomes a technical standard, the fairness and non-discriminatory nature of the licensing terms directly affect the competitive environment of downstream markets producing goods based on that standard. A reasonable royalty should align with market mechanisms, staying within certain cost limits, and should not excessively burden the licensee, as this could lead to anti-competitive consequences. The non-discriminatory principle applies to all implementers using the same standard under equivalent conditions, meaning that all competing products must be treated equally when licensing from the same patent pool (Tsai & Wright, 2015). However, it is permissible to charge different licensing fees

to different types of licensees, provided they are not competitors.

2.2. The Basis for Licensing Fee Calculation: The Apportionment Rule

The SEP licensing fee is determined by multiplying the licensing fee base by the royalty rate. In the case of complex products with multiple components and patents, courts in various countries generally use the apportionment rule as the foundation for calculating licensing fees. The apportionment rule is essential for evaluating the value added by the patented technology to the final product. As technological products become more complex and patent rights become more concentrated, calculating licensing fees becomes increasingly difficult, and the role of the apportionment rule in fee calculations becomes more prominent (Contreras, 2013). The Garretson v. Clark case in 1884 established the "general rule" for apportionment. In this case, the plaintiff's patent related to an improved mop head. The plaintiff sought compensation for both his entire loss and the defendant's entire profit. The lower court dismissed the plaintiff's claim, reasoning that the plaintiff failed to prove that the entire value of the mop could be attributed to the patent. The Supreme Court upheld the lower court's ruling, citing that the patent holder must provide evidence that distinguishes patented features from non-patented features, and such evidence must be reliable and tangible, not speculative. Alternatively, the patent holder could prove that the profit and damage compensation were based on the whole machine, as the overall value of the machine could be attributed to its patented features. The court ruled that if the patent only covered part of the product, the licensing fee should be calculated based on the profit derived from that part, not the total price of the entire machine. The apportionment rule is concerned with technology apportionment, which refers to the proportion and contribution of the SEP in the final product. If we view patent licensing as an upstream market, the demand in the upstream market originates from the downstream market, where consumers' demand for products drives the need for technology. The connection between the upstream and downstream markets is through the functionalities enabled by the technology. From a theoretical perspective, technology apportionment involves two levels: the first level concerns the downstream product market, where the overall value of a product must be apportioned among its various functionalities, with consumers willing to pay for the value associated with each functionality. The second level concerns the upstream technology market, where the value of each functionality must be apportioned among the specific technologies that support it (Grindley &

Teece, 1997). As the calculation of SEP licensing fees becomes more complex with the increasing number of patents and functionalities involved, these apportionment principles become even more crucial for ensuring fair and accurate compensation for innovation.

3. CAUSES OF THE DILEMMA IN SETTING LICENSING FEES

3.1. Ambiguity of the FRAND Principle

The FRAND (Fair, Reasonable, and Non-Discriminatory) principle plays a crucial role in balancing the interests of patent holders and standard implementers. When a patent holder joins a standard-setting organization (SSO) or declares a Standard Essential Patent (SEP), they commit to licensing their patents under FRAND terms. At first glance, it appears that all patent holders agree to follow the intellectual property (IP) policies of the SSO. However, after a standard has been successfully commercialized over the years, some plaintiffs and defendants in SEP disputes interpret and understand the same IP policies differently, leading to conflicts (Burstein, 2010). The value of the FRAND principle lies not in directly determining specific licensing fees, but in providing a framework for balancing the interests of SSOs, patent holders, and standard implementers. FRAND, with its vague language, allows parties to make reasonable agreements while leaving flexibility in the application. In the event of a dispute, FRAND can provide general guidance, but courts cannot directly rely on it to determine the licensing fee. The specific licensing fee must be derived from a comprehensive consideration of various factors, applying the abstract principles of FRAND in a case-specific context. This discrepancy between abstract principles and specific fee calculations is one of the main challenges in SEP-related disputes. Patent holders commit to FRAND terms to ensure their technology is included in standards. Many SSOs can prevent implementers from obtaining unfair licenses and block potential anti-competitive behavior. However, despite the widespread encouragement or requirement for patent holders to adhere to FRAND principles, SSOs have not clearly defined how FRAND licensing should be executed, leading to numerous disputes between patent holders and implementers (Lévêque & Ménière, 2004).

3.2. Lack of Universality in the Apportionment Rule

The development of the apportionment rule was driven by the need to

calculate licensing fees accurately. The primary goals of technology apportionment rules are: (1) to avoid the issue of multiple patent payments, meaning that in cases where a product contains multiple patents, the infringer should not be forced to pay for the same infringement multiple times, and (2) to prevent patent holders from receiving compensation for features of a product that are not attributable to the relevant patent, thus avoiding infringing on the legitimate rights of the infringer (Bekkers et al., 2011). Over the years, courts in various countries have developed two main principles for selecting compensation calculation bases: the Entire Market Value Rule (EMVR) and the Smallest Saleable Patent Practicing Unit Rule (SSPPU). When calculating the FRAND licensing fee, the base for calculation can either be the smallest saleable patent-practicing unit or the profit of the final product. Since the price of the final product is much higher than the price of individual components, patent holders tend to use the final product price as the base for calculating licensing fees. In the context of disputes involving companies like Qualcomm and Huawei, Chinese courts tend to favor the final product price as the base for fee calculation. The EMVR can effectively compensate patent holders for the value their SEPs add to downstream products, making it closer to real-world licensing agreements. In such agreements, voluntary licensors and licensees generally use the value of the downstream product as the basis for calculating fees. However, using the entire market value rule to analyze the market value of the SEP may result in the patent holder benefiting from technologies not covered by the SEP, potentially leading to royalty stacking and resulting in unreasonable fees. Using the smallest saleable patent-practicing unit rule as the calculation base has its advantages. It minimizes the calculation base, making the process easier and reducing errors, and it can be more objective in determining the appropriate licensing fee. This approach also lowers the licensing fees paid by standard implementers, reducing the financial burden on businesses and supporting their development (Abramowicz, 2003). However, there are three main drawbacks to the smallest saleable unit rule: Lack of clear criteria: Almost all components include increasingly smaller subcomponents, and these may contain both patented and non-patented features, making it difficult to determine the smallest saleable patent-practicing unit. Failure to recognize the complementarity and network effects of patents: When evaluating patents in multi-component products, this rule might underestimate the incremental value that the patented technology brings to the product, leading to insufficient compensation for patent holders and potentially reducing their incentive to invest in R&D. Contradiction with reality: In

practice, many licensing agreements use the final product price as the basis for calculating licensing fees, even when no evidence shows that the patented features drive demand for the downstream products. Strictly applying the smallest saleable unit principle may lead to difficulties in applying or enforcing existing licensing agreements.

3.3. Complexity of Contributing Factors

In the Rite-Hite Corp. v. Kelley Co. case, the court observed that the Georgia-Pacific (G-P) factors offer a wide range of considerations for determining a reasonable licensing fee. The G-P factors provide a useful framework by considering 15 different factors that help link reasonable licensing fee calculations with hypothetical negotiations. These factors are commonly used in U.S. courts when determining patent infringement damages and reasonable royalties (Sidak, 2009). However, in practice, there are many issues with applying the G-P framework. Lack of coherence: The G-P framework does not provide clear guidance on how to apply or balance these factors or determine their relative weight. In the Georgia-Pacific case, the court itself acknowledged the difficulty in applying these factors, recognizing that there is no formula for precisely evaluating the importance of each factor or converting them into monetary values. This lack of guidance makes it challenging for courts to assess the appropriate royalty rate in a way that is both consistent and predictable. Risk of overcompensation: The G-P framework may lead to systemic overcompensation for patent holders, particularly because it encourages the consideration of post-hoc compensation. Factors such as comparable licenses might lead to inflated licensing fees, as the commercial outlook for a patented product may be secure once patent protection is obtained. If a party evaluates the technology in advance, they are less certain about its potential success, which would affect the agreed-upon licensing fee (Guellec & de La Potterie, 2007). Lack of clarity and predictability: The excessive length and redundancy of the 15 G-P factors make it difficult to predict the outcome of a case. Some of the factors are seen as unnecessary or repetitive, and this makes it hard to predict the reasonable licensing fee with any certainty. Comparing the 15 G-P factors to the calculation process in the Huawei v. IDC case, the court did not take into account most of these factors in determining the licensing fee. While using a comparable licensing approach is simple and effective, courts must ensure that they consider as many relevant factors as possible when drawing comparisons between the cases, to ensure that the "transactional conditions are roughly the same."

3.4. Uncertainty in Calculation Methods

Various methods are used in judicial practice for calculating licensing fees, such as the Hypothetical Negotiation Method, Top-Down Method, Bottom-Up Method, 25% Rule, and Comparable License Method. The most commonly adopted methods are the Top-Down Method and the Comparable License Method.

3.4.1. Top-Down Method

The top-down method is a calculation method that considers the total license fee. This method first examines the overall level of license fees related to the standard, and then allocates a portion of the total to each patent holder. The top-down method contains the following meaning: when multiple patents cover the same standard, the rate charged by one patent holder will inevitably affect the rate charged by other patent holders to individual manufacturers. It emphasizes the value of a single standard essential patent in the standard, and the patent holder can only obtain benefits based on the value created by its own patent technology. The top-down method mainly calculates the license fee based on the interests of the infringer (Bartlett & Contreras, 2017).

3.4.1.1 The Connotation of the Top-Down Approach

The essence of the top-down approach is that patent holders are only entitled to receive a portion of the profit margin contributed by their SEP share, which is consistent with the essence of FRAND. So far, this approach has been adopted by courts in the United States, Japan, the European Union and my country, and has also been incorporated into the latest SEP guidelines by courts and administrative agencies around the world. The calculation of the top-down approach mainly includes two steps: first, determine the fair and reasonable total licensing fee (rate) burden of all patents for a standard; then, allocate the patent fee rate to patent holders based on the relative value of their patent portfolio and the value of all patents required for the standard (Gallini, 2002). The top-down approach mainly determines patent infringement compensation based on the "technology allocation rule". The technology allocation rule is one of the 13 factors in the G-P factor, which refers to the technology share and technology contribution of the patent in the terminal product when determining the standard essential patent license fee. That is, the compensation received by the patent holder should be limited to the contribution of the infringed patent invention to the infringing product.

When analyzing the market value of the standard essential patent involved in the case, it is necessary to determine its ratio to all relevant standard essential patents and the license fees of all relevant standard essential patents (Lerner & Tirole, 2004). The top-down approach provides a simple framework for calculating the FRAND royalty for a portfolio of standard essential patents. As Mr. Justice Birss explained, the approach "starts with a number that represents the appropriate total royalty burden", which should be the license of all relevant standard essential patents for a given standard (this variable is defined as T). Once T is determined, "the royalty can then be apportioned among all licensors based on the value of each licensor's portfolio (called S) as a share of the total portfolio of essential patents for the standard." The FRAND royalty for a portfolio of standard essential patents is then calculated as T x S according to the top-down approach (Timmermans, 2003). There are two obvious advantages to adopting a "top-down" model. First, it completely alleviates the royalty stacking problem that occurs when the sum of the SEP owners' royalties exceeds the total royalty burden. Second, as long as the total royalty burden is FRAND-compliant, it can prevent patent hold-up and ensure that each patent holder only receives the royalties it deserves, rather than the value of other SEPs or non-SEPs (Sidak, 2013).

3.4.1.2. Top-Down Method Application Conditions

The top-down method is based on the total license fee charged for a particular standard. The total license fee for all patent holders in a standard is calculated first, and then this amount is divided by the number of licensees. The specific calculation steps for three typical cases are shown in Table 1.

Table 1(a): Top-Down Method Calculation Steps

Case Name	**Determine Total Patent License Fee (T)**	**Calculate Patent Contribution Ratio (S)**	**License Fee Calculation Formula**
In re Innovatio	Price-profit method	Based on relevant literature, the top 10% of standard-essential patents (SEPs)	Chip average price * chip average profit margin * (number of patents owned by patent holder / (total number of SEPs * important patent percentage)) * contribution ratio of important patents to the standard

Table 1(b): Top-Down Method Calculation Steps

Case Name	**Determine Total Patent License Fee (T)**	**Calculate Patent Contribution Ratio (S)**	**License Fee Calculation Formula**
TCL v. Ericsson Case	Publicly available information	Based on relevant literature, 10% of patents contribute 65% of total patent value, the next 10% contribute 14.6%, and the last 50% of patents contribute 4.8%	Total license fee rate * (number of Ericsson's unexpired SEPs / total number of SEPs) * regional strength ratio
Unwired Planet v. Huawei Case	Comparable license agreements	Each patent is valued equally	Ericsson's license fee rate * (number of Unwired Planet's effective SEPs / number of Ericsson's SEPs * (effective SEPs / total SEPs))

For the top-down method to result in a reliable FRAND rate, courts must carefully determine the "total license fee (rate) burden" that sets the upper limit for FRAND and ensure that the "value share" of SEPs accurately reflects the contribution of patent holders. The contribution ratio of related patent holders can only be determined using a patent counting method. The basic approach involves counting the number of SEPs owned by a specific patent holder (numerator) and dividing it by the total number of SEPs in a given standard (denominator). This process involves evaluating the necessity and validity of the patents, excluding infrastructure and expired patents, assigning individual SEPs to different standards, and making final adjustments. Patent counting should also consider the strength and value of each patent to better reflect the value contribution of the SEP. Generally speaking, the top-down method has a significant advantage: it relies on all the patents required to implement the standard. It is unrealistic to evaluate the FRAND rate in isolation because the FRAND commitment relates to the entire standard, not just a single patent. Moreover, the FRAND commitment avoids the emergence of "patent thickets," in which patent holders are constantly ready to "shake down" new market entrants. Therefore, using the top-down method primarily helps prevent license fee stacking and patent hold-up. Furthermore, the top-down approach is generally accomplished through simple patent counting, independent of the individual patent's value.

3.4.2. Comparable License Method

The Comparable License Method, also known as the Established Royalty Method or Comparable Transactions Method, refers to the process of identifying market transactions that can be used as a benchmark to determine the royalty rate for the licensing of standard essential patents (SEPs) involved in a dispute. This method focuses on the factors of G-P 1 and G-P 2, and was widely applied in early U.S. patent infringement cases. As early as the 1915 case Dowagiac Manufacturing Co. v. Minnesota Moline Plow Co., the U.S. Supreme Court clearly stated that "if there is an established royalty, that royalty may serve as a standard for determining damages." The idea is to find agreements or transactions from existing licenses that are similar to the disputed licensing situation, and use them to determine the royalty rate for the contested patent.

3.4.2.1 The Essence of the Comparable License Method

Patent licensing refers to the act of a patent holder granting a license to implement their patent to a standard implementer within a specific time frame and scope, in exchange for a royalty fee. For patent holders, licensing is one of the most common methods of realizing the commercial value of their patent technologies. Compared to the transfer of patent rights, licensing offers more flexibility in patent transactions. Chinese patent law stipulates that any unit or individual who wishes to implement another's patent must sign a licensing contract with the patent holder. Through this contract, the patent holder and the standard implementer reach an agreement and exchange benefits. Patent licenses can be categorized into different types based on their nature, scope, and authority, including ordinary licenses, exclusive licenses, non-exclusive licenses, sublicenses, cross-licenses, compulsory licenses, and patent pools. Ordinary licenses are the most common type of patent license. Under an ordinary license, the patent holder can grant implementation rights for the same patent technology to multiple licensees, either simultaneously or over time, while retaining the right to continue using the patented technology. The Comparable License Method often uses contracts based on this type of license for comparative analysis. The Comparable License Method is widely used globally and cannot be replaced by the "top-down" approach. The theory behind this method is that these licenses reflect agreements reached by the parties in real negotiations, and therefore, the resulting FRAND rate can serve as the hypothetical terms that would be reached in a negotiation, representing the market value of the relevant SEP.

3.4.2.2 Conditions for Applying the Comparable License Method

The key step in applying the Comparable License Method to determine the FRAND royalty rate is to find the correct comparable agreements. Usually, comparisons start with licenses granted by the same licensor (or at least by a licensor who previously owned the same patent portfolio) to a "similarly situated" licensee. The royalty rate derived through the Comparable License Method can only reflect the market value of the patent if there is no patent hold-up in the comparable licensing agreement. Courts have excluded licenses reached during settlement discussions or litigation because they may involve patent hold-up. Another type of license typically excluded is one reached through arbitration, as the confidentiality of arbitration procedures prevents the court from obtaining the reasoning and rationale behind the decision. In contrast, court judgments are generally accessible in full, and their reasoning can offer more valuable references. For example, the High Court of England referred to the royalty rates in the Huawei v. IDC case, noting that the rates in China were significantly lower than those in other courts. However, in the Huawei v. Samsung case, a similar judgment was rejected, as IDC was a non-practicing entity (NPE), with serious over-declaration issues. A landmark case in China, Huawei v. IDC, was the first major ruling globally to apply the Comparable License Method to determine the FRAND royalty rate for standard essential patents. This judgment provided new approaches and calculation methods for resolving legal disputes regarding SEP licensing fees in other jurisdictions. In the influential Huawei v. IDC case in China, when determining whether the patent licensing price offered by IDC to Huawei was consistent with the FRAND principle, the court mainly referred to licensing agreements between IDC and companies such as Apple, Samsung, RIM, and HTC. IDC had signed a seven-year, non-transferable, non-exclusive, fixed-fee global licensing agreement with Apple for $56 million; a four-year fixed-fee patent license with Samsung for $400 million for 2G/3G patents; a global, non-exclusive license agreement with RIM for $42.9 million for GSM/GPRS/EDGE patents; and a similar agreement with HTC for $33.8 million. Based on an analysis of global mobile phone market data from Strategy Analytics, it was found that Huawei's mobile phone sales were much lower than those of Apple and Samsung at the time. IDC not only demanded that Huawei pay a high licensing fee but also forced Huawei to grant a free license for all of IDC's patents, thus gaining additional benefits. Based on this, the Guangdong High People's Court determined that the FRAND royalty rate for IDC's patent portfolio was 0.019%, derived by comparing the royalty rates in the IDC-Samsung and

InterDigital-Samsung licenses. The "Comparable License Method" balances the FRAND principle's non-discrimination requirement and more closely reflects the expected royalty rates of both parties. This judgment has been widely recognized internationally, and the application of the Comparable License Method to calculate SEP licensing fees has gained strong practical application in China's judicial practice.

4. JUDICIAL STRATEGIES FOR DETERMINING ROYALTY FEES

4.1. Choosing an Appropriate Allocation Method

The determination of a royalty fee is essentially a process of profit allocation between the two parties to a license agreement. From a legal perspective, profit allocation does not aim for absolute mathematical precision, but rather seeks a reasonable estimation of the result. Moreover, absolute precision is practically impossible in real-world scenarios. The choice of the basis for calculating the royalty fee should avoid issues such as royalty stacking and patent hold-up, in order to maximize adherence to the principles of "fair, reasonable, and non-discriminatory" (FRAND). When valuing patents based on comparable licensing agreements, the overall market value of a product is typically used to determine the royalty fee, in accordance with the overall market value rule. When assessing the value of a product or service, the entire market value is considered, not just the value of individual components or features. The overall market value rule emphasizes the comprehensive impact and importance of a product or service as a complete system in the market, rather than focusing solely on its individual components. This is particularly important when evaluating the value of complex systems like telecommunications standards, as the value of these systems often lies not just in the individual parts but in how they collectively meet market demands and create value. In the CSIRO case, the U.S. Federal Circuit Court ruled that the minimum saleable patent practicing unit is not necessarily the starting point for all damage calculations. In other words, when calculating damages for patent infringement, it is not always required to use the smallest saleable unit that includes the infringed patent as the basis for the calculation. Typically, in patent infringement cases, the calculation of damages takes into account the contribution of the infringed patent to the overall product or service. The minimum saleable patent practicing unit rule is designed to avoid attributing the entire market value of complex products (e.g., smartphones

or computers) to a single patent, which could lead to excessively high damages. However, the CSIRO ruling suggests that in certain cases, using a larger unit than the smallest saleable patent practicing unit may be appropriate for damage calculations. This means that courts, when calculating damages, may flexibly apply different principles based on the specifics of the case. If the characteristics of the infringed patent have a significant impact on the overall product's market value, or if the patent is tightly integrated with other parts of the product, making the smallest saleable patent practicing unit rule unreasonable, the court may choose a larger unit as the basis for the calculation. In such cases, the court will seek a fairer and more reasonable method of determining damages to ensure they align with the actual value and impact of the infringed patent. The "top-down" method is based on a technology allocation rule, which focuses more on determining the technical contribution value of the specific patent involved in the case. The key to applying the technology allocation rule is, first, being able to determine the total amount of royalties that should be collected for all standard essential patents (SEPs). If direct evidence is lacking, the profits from the patented product need to be allocated based on the significance of the patent's function, and the total value of all SEPs supporting that function must be calculated. Second, the contribution of the specific SEP in question to the entire set of SEPs must be calculated, and its value allocated accordingly. In an ideal situation, if sufficient evidence is available to distinguish the contribution strength of different SEPs from a technical perspective, the value allocation would be more accurate. However, this process is time-consuming and inefficient, so a more common approach is to use a simple allocation based on the proportion of the number of patents. In summary, the allocation rules, the overall market value rule, and the minimum saleable patent practicing unit are three different methods used in patent infringement damage calculations. Their common goal is to ensure that the compensation amount corresponds to the actual value of the infringed patent. The allocation rule emphasizes only the direct contribution of the infringed patent to the product's value; the overall market value rule is a special case of the allocation rule, applicable when the product's value is primarily determined by the infringed patent; while the minimum saleable patent practicing unit method focuses on determining the smallest independently saleable unit containing the infringed patent, in order to more accurately estimate the patent’s value contribution. These three methods are used in parallel in patent law practice, with the most appropriate calculation method chosen depending on the specific circumstances of each case.

4.2. Adjusting Reference Factors for Royalty Fee Calculation

There is no complete uniformity in the factors used for patent infringement fee assessments in judicial and legal interpretations, and these factors are not entirely the same as the G-P factors. In China, hypothetical negotiation methods are not yet used to determine royalty fees; instead, a combination of key factors is applied to jointly assess the reasonable fee that the defendant should pay. Therefore, the reference factors in China are appropriately adjusted in light of the U.S. G-P factors, and summarizing important reference factors is of significant importance for judicial practice when determining the royalty fees for SEP licenses. Several important cases in China have pointed out the factors considered in their judgments. In the Huawei v. IDC case, four main factors were considered: The relationship between the royalty fee and the profits from implementing the patent: The fee should consider the profit derived from implementing the patent or a similar patent, as well as the proportion of that profit within the sales profit or revenue of the relevant product. This is similar to G-P factor 13, which focuses on the share of profits that should be attributed to the invention. A product's profit is not solely derived from the patented technology; non-patent technologies, capital, important technical features or improvements added by the licensee, and other managerial efforts contribute to the final product's profit. Therefore, the royalty fee should only represent a portion of the product's profit that corresponds to the contribution of the patent technology, and it cannot account for the entire profit, as the patent holder did not provide all the technology for the product. Contribution of the patent holder's innovation: The patent holder can only claim fees for their innovation, not for the standard as a whole. This factor is emphasized in the G-P factors, which distinguish between the value of the SEP and the value of the standard. The patent's value should not be inflated simply because it is included in a standard. The royalty fee should reflect the patent's specific contribution to technological progress and innovation. The number of valid patents held by the patent holder in the standard: The royalty fee should be based on the number of effective SEPs held by the patent holder. It is unreasonable to require the standard implementer to pay fees for non-SEPs. Some patent holders may engage in "patent tying," incorporating non-SEPs into standards, or certain SEPs may have expired and no longer be valid. In practice, the number of truly essential patents included in the standard is often smaller than assumed. Therefore, when determining the royalty fee, it is necessary to exclude such cases and only consider the value of valid SEPs. The royalty fee should not exceed a certain percentage of the product's profit: The royalty fee must consider

the reasonable distribution of fees among patent holders. A product may use more than one SEP, and if the royalty fees for each patent are too high, it may lead to royalty stacking, resulting in an unreasonable distribution of royalties among patent holders. In such cases, the overall profit of the product could be compromised, severely affecting the development of the relevant industry and conflicting with the public interest of the standard. In the case of Huawei v. Conversant Wireless Licensing Co., Ltd. (hereinafter referred to as Conversant), the court comprehensively considered all the evidence involved in the case, the current state of technology and industry prospects, the field to which the standard belongs, the role of SEPs, the scope of implementation of the standard and relevant licensing conditions. In the case of Hu Xiaoquan and Zhu Jiangrong v. Huinuo Pharmaceutical, the annual sales profit of the drugs involved in the case produced by Huinuo Pharmaceutical, the contribution rate of the invention patent involved to the sales profit of the drugs involved, and the duration of infringement were comprehensively considered. In the case of Hubei Tangshi Jianhua Building Materials Co., Ltd. (hereinafter referred to as Jianhua Company) v. Hubei Sanhe Pipe Pile Co., Ltd. (hereinafter referred to as Sanhe Company), the main factors considered included: 1. The type of patent involved, which was an invention patent; 2. Sanhe Company's main business scope; 3. The market demand for the allegedly infringing products; 4. Other reasonable expenses. In the dispute over infringement of utility model patent rights between Shenzhen Laidian Technology Co., Ltd. (hereinafter referred to as Laidian Company) and Shenzhen Jiedian Technology Co., Ltd. (hereinafter referred to as Jiedian Company), the economic compensation was determined based on factors such as the promotion degree of the defendant's products, the type of patent involved and its proportion in the defendant Jiedian Company's operating profit. In the case of infringement of invention patent rights between Sony Mobile Communications Products (China) Co., Ltd. (hereinafter referred to as Sony Corporation) and Xi'an Xidian Jietong Wireless Network Communications Co., Ltd. (hereinafter referred to as Xidian Jietong), the court of first instance considered the type of patent involved, the nature and circumstances of the infringement, the nature, scope and time of the patent license, and determined the amount of compensation as a reasonable multiple of the license fee. In the case of infringement of invention patent rights between Beijing Sihuan Pharmaceutical Co., Ltd. (hereinafter referred to as Sihuan Company) and Qilu Pharmaceutical Co., Ltd. (hereinafter referred to as Qilu Company), the court comprehensively considered the type of patent involved, the

nature and circumstances of Qilu Company's infringement, and determined the amount of compensation at its discretion at 500,000 yuan.Xidian Jietong v. Sony Corporation, Jianhua Company v. Sanhe Company, Laidian Company v. Jiedian Company, Sihuan Company v. Qilu Company cases all considered the type of patent, that is, whether the patent is an invention patent or a utility model patent (rarely a design patent). This factor involves various internal factors such as the time, scope of protection, and protection method of the patent. Therefore, it is a relatively important factor and the first consideration. In addition, the nature and circumstances of the infringement are also one of the important factors considered in Chinese cases. In the case of Xidian Jietong v. Sony, situations such as joint infringement and contributory infringement were discussed to determine the nature of the infringement. In addition, the promotion and popularity of the patent and the nature, scope, and time of the patent license were considered in the two cases. The promotion and popularity of the patent are closely related to the standard. This factor is basically equivalent to the meaning of the scope of implementation of the standard. In my country, 98.4% of patent cases use "statutory compensation" to determine the amount of compensation, while the application rate of other compensation standards is still very low. Similarly, in cases related to standard essential patents, statutory compensation is also often used to determine the amount of compensation, so these considerations are mostly put forward as factors for judging statutory compensation. In the "Interpretation of the Supreme People's Court on Several Issues Concerning the Application of Laws in the Trial of Patent Infringement Disputes (II)", Article 24, paragraph 3, provides a complex framework for determining the fairness, rationality and non-discrimination of patent licensing fees. This framework covers six key dimensions and aims to comprehensively evaluate the value of patents and their corresponding licensing fees. First, the degree of innovation of patents is regarded as the core evaluation indicator. This dimension considers the improvement and innovation level of patented technology relative to existing technologies. High innovation not only reflects the intellectual labor and investment of the inventor, but also implies the potential economic value of the technology. Therefore, the licensing fee is proportional to the degree of innovation of the patent. The second evaluation criterion is the role of the patent in the standard. Since standards usually contain multiple essential patents, the role and importance of each patent in the standard vary. The greater the contribution of a patent to the standard, the higher its licensing fee should be. Third, the impact of the

technical field to which the standard belongs on the value of the patent is taken into account. According to the International Patent Classification (IPC), the technical field to which the patent belongs is subdivided. Although the value of standards in different technical fields varies, the licensing fee of a patent should be based on its role in the standard rather than simply on the overall value of the technical field. Next, the nature of the standard is also an important consideration. According to the different application areas of the standards, standards are divided into recommended national standards, industry standards and local standards. Standards of different natures have different requirements for patent technologies, which will affect the assessment of license fees accordingly. The fifth dimension is the scope of implementation of the standards. This includes international standards, national standards and local standards. Different scopes of application of standards mean different technical values and requirements, which will also affect the license fees. Finally, the relevant licensing conditions are a supplementary consideration factor, including the scope, method, duration, etc. of the license. In summary, the adjustment of the reference factors for calculating license fees can be achieved in the following ways to improve the accuracy and adaptability of the assessment. (1) Simplify factors: From the many evaluation factors mentioned above, select the most critical ones and remove duplicate or less influential factors. For example, focus on core factors such as the degree of technological innovation and market influence of the patent. (2) Establish a grading system: Distinguish which factors have a greater impact on the calculation of license fees, take them as the main consideration points, and use other factors as auxiliary references. This helps to simplify the decision-making process in complex situations. (3) Quantitative methods: Set quantitative standards for each factor as much as possible, for example, evaluate the value of patents through specific market share, technological contribution rate, etc. Such quantitative standards help improve the objectivity and consistency of the evaluation. (4) Reference to industry standards: Consider the common practices and standards in the industry to ensure that the evaluation results are consistent with market reality. Industry standards can be used as a reference point to ensure that the evaluation results are not divorced from the actual market environment. (5) Dynamic update: As the market and technology change, update the evaluation factors regularly to ensure that they reflect the current market and technological status. This helps to maintain the relevance and accuracy of the evaluation method. (6) Compliance with laws and cases: Make adjustments based on the latest laws and regulations and

relevant case judgments to ensure that the evaluation process complies with legal provisions and judicial practice. (7) Expert opinions: In complex or controversial situations, introduce expert opinions, especially experts in technology or market analysis. Expert insights can provide in-depth insights into specific situations. Through the above measures, the calculation of patent licensing fees can be made more adaptable to market and technological changes, while ensuring the fairness and rationality of the evaluation process. This approach not only improves the accuracy and transparency of the evaluation, but also helps to improve the acceptability and enforceability of the evaluation results.

4.3. Clarification of Obligations for All Parties

Over the past two decades, most interoperability standards have been coordinated, published, and revised by Standard Setting Organizations (SSOs) with the aim of meeting the technical needs of a wide range of implementers and consumers (Chuffart-Finsterwald, 2014). These organizations play a crucial role in reconciling the diverse demands of developers and manufacturers. The overall goal of SSOs is to benefit the public by creating widely adopted industry standards (Bradner, 1996).

The importance of SSOs varies across industries, but their role has become increasingly significant, especially in fields such as telecommunications. Typically, SSOs are composed of private companies, individuals, and non-profit interest groups that come together to adopt new industry-wide standards. The Intellectual Property Rights (IPR) policies of these organizations mainly address the principles of FRAND (Fair, Reasonable, and Non-Discriminatory) licensing and the obligation to disclose patent information.

4.3.1. Clarifying the FRAND Licensing Obligation for Patent Holders

The management and licensing of Standard Essential Patents (SEPs) are critical issues in the domain of technology standards. SEPs possess three key characteristics: indispensability, complementarity, and inevitability of infringement. These characteristics shape the unique position of SEPs and lead to specific requirements for patent holders' FRAND obligations. Indispensability and Patent Hold-up Risks: The indispensability of an SEP means that no viable alternative technology exists for the specific standard. This provides patent holders with leverage in negotiations but also creates the risk of patent hold-up, where patent holders may refuse to license or demand excessive fees, thus hindering the implementation of the standard.

Complementarity and Standard Complexity: In complex standards like 5G, hundreds or even thousands of SEPs are interdependent, forming a comprehensive system. The complementarity of these patents requires SSOs to carefully consider the relevance and importance of each SEP during the standard-setting process. Inevitability of Infringement and Legal Remedies: SEPs are often infringed upon because manufacturers' products must comply with the standard, which inevitably involves using SEPs. Legal remedies typically include injunctions or reasonable licensing fees (Lim, 2014). The FRAND obligation provides a balanced solution. It requires patent holders to license their SEPs on terms that are fair, reasonable, and non-discriminatory. The goal of this principle is to prevent patent holders from abusing their market position, ensure broad adoption of standards, and protect the legitimate interests of standard implementers. The irrevocability of the FRAND commitment ensures that once a patent is included in a standard, the patent holder must adhere to the previously made licensing promises. Even if the patent holder's position changes, such as no longer being a member of the standard-setting organization or transferring the patent rights, their FRAND commitment remains valid. Thus, in SEP management and licensing, ensuring compliance with the FRAND obligation is essential. This not only helps prevent patent hold-up and market monopolization but also promotes the healthy development of technology standards and continuous innovation in the industry. The effective implementation of FRAND principles is key, and SSOs, patent holders, and standard implementers must work together to ensure their proper enforcement.

4.3.2. Clarifying the Patent Holder's Disclosure Obligations

In the process of developing technology standards, patent holders' responsibility to disclose information about their SEPs is crucial for ensuring the fairness and transparency of the standard-setting process. However, existing intellectual property policies often lack clarity about the timing, method, and circumstances under which patent holders must make such disclosures. This ambiguity presents challenges in monitoring and enforcing disclosure requirements. For example, major SSOs like the International Telecommunication Union (ITU) and the European Telecommunications Standards Institute (ETSI) emphasize that once a patent holder recognizes that their patent is essential to a particular standard, they must disclose relevant information to the organization promptly. This requirement ensures that potential patent issues that may affect the implementation of the standard are identified early, allowing

standard setters and implementers to better assess the applicability and cost of the relevant technologies. The disclosure of patents involves considering their different legal statuses, such as granted patents, published but not yet granted applications, and unpublished applications. Each stage of the patent's lifecycle requires disclosure within specific timeframes to be properly considered during the standard-setting process. Patent holders who fail to meet these disclosure obligations may face consequences, such as losing their ability to exercise patent rights or being at a disadvantage in licensing negotiations. These measures aim to protect the integrity and fairness of the standard-setting process, ensuring that all relevant stakeholders can negotiate and make decisions on an equal footing. To address the current issues with SEP disclosures, it is recommended that SSOs clarify their disclosure policies and provide patent holders with clear guidance. Additionally, relevant legal frameworks and guidelines, such as the Patent Infringement Determination Guidelines, should strengthen the regulations around disclosure, clearly defining the timing and legal consequences for failure to disclose. Such practices will not only reduce legal disputes but also contribute to a healthy and fair technology standard ecosystem. These improvements will make the standard-setting process more transparent and efficient, safeguarding the interests of all parties involved.

4.3.3. Determining the SSO's Obligation to Review Necessity

Charging licensing fees for non-essential or "junk" patents violates the principles of fairness and reasonableness. Therefore, ensuring that only patents that are indispensable to the standard are included is crucial for accurately determining FRAND licensing fees. Determining which patents are truly necessary for a standard involves legal interpretation, but more importantly, it requires technical understanding. Many scholars argue that SSOs include experts in specific fields who possess in-depth knowledge of the technology and its future prospects. These experts have a natural advantage in determining whether a technology is indispensable for the standard at the time of its formulation. Therefore, it is suggested that legal experts be incorporated into the standard-setting process within SSOs. This would allow SSOs to effectively review the necessity of the patents included in the standard, ensuring both accurate FRAND licensing fee determination and greater efficiency in judicial dispute resolution. By integrating these improvements into the standard-setting process, SSOs would not only ensure the accuracy of FRAND licensing fees but also enhance the efficiency of courts in resolving disputes. This approach would

lead to both fairer licensing arrangements and smoother legal processes, benefiting the broader technology ecosystem.

4.4. Methodology for Calculating Cumulative Royalties

In recent years, courts in the European Union, the United States, and China have made significant progress in achieving international consensus on how to calculate global FRAND licensing fees. This progress has been made through a combination of the top-down and comparable license methods. By combining these methods and analyzing the accumulated patent value and licensing terms, courts and industry professionals can reliably calculate patent fees based on each SEP holder's contribution to the same standard. This provides a certain level of clarity and certainty for SEP holders, helping to avoid inflated fee demands that could trigger antitrust concerns. Recently, courts have primarily relied on a combination of the top-down and comparable license methods to cross-check and ensure that the final royalty rates are as close as possible to the market value of the relevant portfolio. Ideally, the licensing rate derived from a comparable licensing agreement negotiated in good faith should be aligned with the patent holder's share of the total licensing burden. However, market conditions may raise individual patent holders' licensing rates, leading to an overall licensing burden that exceeds the actual value of the licensed technology. The top-down method sets an overall licensing burden to prevent the issue of royalty stacking, where multiple patents lead to excessive cumulative fees. On the other hand, the top-down approach may overlook market-recognized rates, which can be addressed through the comparable license method. Therefore, these two methods provide an excellent opportunity for mutual comparison and adjustment. Guidelines released by courts in Guangdong, the European Union, and the Japan Patent Office all consider these two methods to be reliable ways of determining FRAND royalty rates. By combining these two approaches, courts are increasingly inclined to provide a global rate rather than a country-specific rate. Since patents are governed by the laws of individual countries, courts would not initially decide licensing fees beyond their jurisdiction. However, in the Unwired Planet v. Huawei case, the UK High Court held that Huawei’s insistence on licensing based on individual countries was not in compliance with the FRAND principles. Similarly, the Guangdong High Court has granted itself the discretion to determine global licensing fees in its guidelines for handling SEP disputes. In October 2020, the Shenzhen Intermediate People's Court confirmed jurisdiction over global SEP licensing rate disputes in its ruling on a jurisdictional

objection in the OPPO v. Sharp case. While it is reasonable and legal for a national court to rule on a global FRAND royalty rate, such decisions still present significant difficulties and challenges. The global convergence of patent royalties significantly simplifies workflow and enhances the certainty and predictability of fee calculations. This convergence is particularly beneficial in industries like telecommunications, where SEP disputes are frequent, allowing courts to avoid the need for repetitive calculations and breakdowns of identical comparable license agreements submitted in different cases. These calculations are based on economic principles, unaffected by different legal systems. Unless compelling new evidence or reasons emerge to overturn previous conclusions, courts can base new rulings on existing judgments. When necessary, courts can refine or supplement previous results through more complex and thorough calculations. In determining the overall licensing fees, both parties can conduct a portfolio strength analysis to predict the FRAND rate. Based on this analysis, the parties can either quickly reach a consensus or initiate litigation or arbitration based on their respective analyses. This predictability can significantly shorten negotiation time. For example, in 2015, China's National Development and Reform Commission (NDRC) imposed a fine of approximately $1 billion on Qualcomm, which was initially expected to severely impact the company. However, in the following years, Qualcomm quickly signed over 100 licensing agreements with Chinese mobile device manufacturers, based on the patent licensing fees disclosed in the NDRC's corrective action plan. Therefore, while the determination of FRAND licensing fees may never be absolutely precise, a predictable FRAND rate provides an ideal rapid solution for resolving disputes in the SEP environment.

5. CONCLUSION

Over the past decade, the issue of licensing fees for Standard Essential Patents (SEPs) has become a focal point in international intellectual property law. Courts around the world have sought to resolve disputes between patent holders and standard implementers by providing consistent legal guidance in line with Fair, Reasonable, and Non-Discriminatory (FRAND) principles. This process involves the use of multiple methods for calculating licensing fees, each with its unique characteristics and applicable contexts. While a universally uniform calculation model has yet to be established, the approaches adopted thus far offer significant

reference value. Experts emphasize that pursuing a single unified method of calculation is neither practical nor necessary. Instead, the focus should be on the role of Standard Setting Organizations (SSOs) in addressing potential disputes at an early stage to minimize litigation. Prior agreements between parties also play an influential role in determining licensing fees in subsequent cases. In judicial practice, the lack of a unified standard for calculating SEP licensing fees remains a significant challenge. The difficulties stem from the ambiguity of the FRAND principles and the complexity of various influencing factors. Enhancing the accuracy of these calculations requires a clear delineation of applicable cost-sharing rules, the explicit definition of SEP holders' obligations, and a comprehensive consideration of different calculation methods in light of specific case circumstances. The ultimate goal is to strike a balance between the interests of patent holders and standard implementers, fostering global technological innovation while promoting consumer welfare.

6. FUNDING:

Research on the Modernization of Intellectual Property Risk Governance in Industries under the Overall National Security Outlook, Major Project of the National Social Science Fund of China.

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