FRAND Economics

Valuation Methods in Licensing Standard Essential Patents

WIPO

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World Intellectual Property Organization
34, chemin des Colombettes,
P.O. Box 18
CH-1211 Geneva 20
Switzerland

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The work was carried out under the general auspices of WIPO Director General Daren Tang, the Patents and Technology Sector led by Deputy Director General Lisa Jorgenson and the Innovation Ecosystems Sector led by Assistant Director General Marco Alemán.

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The project was led by the Patents and Technology Law Division headed by András Jókúti, in collaboration with the Department of Economics and Data Analytics, headed by Carsten Fink. Overall coordination and content management was carried out by Nina Belbl. Vanessa Behrens provided economic input and review. Mariam Ayvazyan and Brian Kelly Nyaga contributed research assistance and citation checks.

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Foreword

Technology standards are a cornerstone of the modern economy. They set technical requirements that allow conforming products and services to perform particular tasks in a predictable way – for example, how devices connect to a network or each other, how data is formatted and transmitted, or how signals are encoded and decoded.

The benefits that a standard conveys reflect the combined contributions of two groups: innovators of standards, who invest in developing solutions to be incorporated in these technology platforms; and implementers of standards, who invest in developing standard-compliant products, bringing value to consumers.

Each group's contribution is dependent on that of the other. A technical solution creates less value if it does not become part of the industry norm that manufacturers or service providers use; while implementers equally rely on getting access to superior technologies to make better and safer products.

Standard essential patents (SEPs) and the undertaking to license them on fair, reasonable and non-discriminatory (FRAND) terms are central to a balanced dynamic between the two groups. FRAND licensing seeks to accommodate the ability of innovators to obtain appropriate return on their R&D investments, while ensuring access to standardized technologies on sensible terms. Yet translating this high- level undertaking into concrete terms can be complex in practice.

This publication explains why economic valuation plays a central role in FRAND licensing and dispute resolution, and provides an accessible overview of the principal methodologies used in SEP valuation. Throughout, it highlights both the strengths of the methods discussed and the limitations that matter most in real-world scenarios.

Prepared under the WIPO Strategy on SEPs , the report aims to offer an objective and practically relevant resource. While recognizing that there is no single formula for determining FRAND terms across all cases, it offers an analytical review supporting predictability in a field where the stakes are high and details matter.

We trust that this publication will assist stakeholders in navigating SEP valuation with greater clarity and confidence. By fostering a more informed and constructive discussion among parties, it serves the broader objective of ensuring that standards continue to enable innovation, competition and inclusive economic growth.

Lisa Jorgenson
Deputy Director General
World Intellectual Property Organization

Marco Alemán
Assistant Director General
World Intellectual Property Organization

Introduction

This Economic Report (hereinafter, Report) explains how valuation methods are used to assess whether the terms of standard essential patent (SEP) licenses are fair, reasonable and non-discriminatory (FRAND). It sets out the principal approaches, their strengths and the limitations that matter in practice.

This issue matters beyond its impact on the parties to a single dispute, as it influences the success of standardization. The FRAND undertaking is a legal commitment, but its rationale is economic. Licensing terms shape innovators' and implementers' ability and incentive to develop the technologies included in standards and make the products that benefit from standards. When licensing terms are FRAND, standards can provide and enable substantial benefits, including large interoperable markets, improved functionality and a platform on which complementary innovation can build.

Once technologies are embedded in a widely adopted standard, however, neither SEP holders nor implementers have practical alternatives to a license agreement. This can distort the terms they agree to. Either side may be forced to acquiesce to terms that do not adequately reflect the value of the technology, thereby weakening investment incentives and constraining the development, quality and diffusion of standard-enabled products and services.

Valuation helps to translate the commitment to FRAND licensing into concrete terms in practice. It assists parties, courts and arbitrators to identify a plausible range of FRAND terms, while also helping them assess the extent to which offers and counteroffers are reasonable.

Valuation is not a single technique. The methods covered in this Report fall into two broad categories.

- The **comparable contracts approach**[1] starts from "market prices". Its strength is that it draws on real-world payment terms that parties have agreed for contracts in similar circumstances. But those payment terms are not necessarily FRAND – even for genuinely comparable contracts, in principle, they too could have been affected by litigation costs, the availability of injunctive relief or excessive delay. In such cases, the approach could *perpetuate* non-FRAND terms, rather than prevent them.
- The **bottom-up** and **top-down** approaches are "value-based" methodologies. When applied well, they are grounded in economic principles that underpin the concept of FRAND. But often, applying these principles depends on choices that may be difficult or impossible to verify. That can make these approaches risky to apply, as they might *introduce* non-FRAND payment terms.

Which of these valuation methods can be applied in a given case depends not on abstract principles, but on whether its limitations can be satisfactorily evaluated and mitigated in practice. Furthermore, market-based and value-based methods are complementary: used together, they can provide a more robust assessment than either would in isolation.

1 Also referred to as "comparables".

Purpose of the Report

This Report is written for policymakers, judges and arbitrators, competition and patent authorities, and parties involved in SEP licensing and dispute resolution.

It is intended as a practical reference, not as an academic study. SEP license negotiations and disputes are often technically complex and depend on many context-specific facts. This Report is designed to help readers navigate that complexity. It aims to identify the issues that affect the value and terms of a license from an economic perspective, to better inform and prioritize the key choices that parties and decision-makers must make.

It is not a prescriptive manual. It is neither possible nor productive to offer a "do-it-yourself" guide to SEP valuation that can be applied mechanically across all cases.

In that spirit, the Report uses hypothetical examples and refers to selected cases to illustrate the dynamics of particular issues. For clarity, these illustrations are simplified and, where drawn from real disputes, presented without their full procedural and factual context. In practice, however, issues interact with one another, and with the circumstances of the parties, in ways that materially affect both negotiation outcomes and valuation.

That complexity gives rise to two familiar risks. One is the view that the issues are too ambiguous to analyze at all. The other is that analysis becomes so qualified and caveated that it becomes difficult to follow or apply consistently.

The Report aims to avoid both these spectres. The fact that a negotiation or dispute may be complex, ambiguous and contested makes principles *more* useful, not less. First, there is more agreement on the principles that broadly apply than it may seem from the narrower (though material) points of disagreement that surface in litigation and arbitration. Second, even where they do not determine a single answer, principles help stakeholders to identify what matters, test arguments, organize evidence and understand why a familiar rule of thumb may not apply to a particular case.

Therefore, where this Report makes generalizations (or appears to do so), they should be read as tools that help to navigate complexity, not as universal rules that deny it. It does not attempt to catalogue every potential interaction or exception. That would be neither possible nor helpful. Generalization and simplification are not denials of ambiguity or edge cases; rather, they offer ways to move through them, to better identify, understand and address what is driving the disagreement.

Structure of the Report

Following this Introduction:

- Part 1 explains the economic role of standards and why SEP licensing negotiations are prone to frictions;
- Part 2 describes the FRAND undertaking, the main categories of disputes and why reliable valuation is often central to resolution;
- Part 3 examines market-based valuation, by reference to the terms agreed for **comparable contracts**;
- Parts 4 and 5 then turn to value-based approaches – the **bottom-up** and **top-down** frameworks – and explain how each can be applied and tested.[2]

Finally, an Epilogue summarizes the purpose, role and utility of economically sound valuation methods for a more predictable and less costly FRAND assessment.

2 It should be noted that the order in which the different approaches are analyzed does not reflect any preference for, or assessment of, their practical utility, but instead follows an economic logic.

1 Enabling value – the importance of innovators and implementers to markets that use technology standards

Topics covered in Part 1:

- **Technology standards: what they are and why they matter economically**
- **How technology standards emerge and why that affects the value of products and technology**
- **Standard essential patents in context**

Part 1 sets the scene by explaining what is at stake in standard essential patent (SEP) licensing negotiations. It describes how technology standards create economic value and why patents declared essential to a standard shape firms' ability and incentives to develop and commercialize valuable technologies.

It then explains why standardization can make SEP negotiations more prone to dispute than bilateral licensing of non-standard essential patents. Limited commercial alternatives, information asymmetries, uncertainty about value and the interaction between remedies and bargaining dynamics can intensify negotiation frictions. These frictions underpin parties' concerns that they may become victims of "hold-up" or "hold-out" – situations in which a party contributes to the success of a widely adopted standard, only to be exploited once it is irreversibly committed – potentially strangling incentives to invest in innovation and to adopt otherwise valuable technologies.

1.1 Technology standards: what they are and why they matter economically

Technology standards set technical requirements that allow products and services to perform particular tasks in a predictable way – for example, how devices connect to a network, how data are formatted and transmitted, or how signals are encoded and decoded.

Many widely used technologies are standardized. Universal Serial Bus (USB) enables devices to exchange data and power through common connectors and communication protocols. Hypertext Transfer Protocol (HTTP) supports the exchange of information between web browsers and servers. Near Field Communication (NFC) enables short-range wireless communication, including contactless payments. Wireless communication standards, including successive generations of cellular standards (such as 4G and 5G)[1] and Wi-Fi[2] standards, define how data are transmitted through the air, supporting services such as browsing, video calling and streaming.

1 4G and 5G refer to fourth- and fifth-generation cellular network technologies, respectively.
2 Wi-Fi is a wireless local area network (WLAN) technology based on the Institute of Electrical and Electronics Engineers (IEEE) 802.11 standards.

Markets that use standards benefit in two ways:

1. **Coordination**: any product that complies with the standard can interoperate with other compliant products because they perform the relevant task in a compatible way.
2. **Performance**: the interfaces, protocols, data formats and processes specified by the standard determine the speed, reliability, efficiency and capabilities of those functionalities in compliant products.

Standards, obviously, do not operate in a vacuum. Many devices that implement technology standards (such as smartphones and laptops) also benefit from various associated technologies and other contributing factors. So, the value of a device may be affected by a particular technology standard to some extent, but those other technologies and factors also contribute. The question, therefore, is the extent to which the technologies essential to a particular standard contribute to a device's value, and in what way.

1.1.1 How technology standards enable value

The dual roles of technology standards affect the economic value of the products that implement them. As mechanisms for coordination, they affect how easily independent firms can align with a common technical approach. As enabling technologies that shape performance, they influence what compliant products and services can do, and how well they can do it.

1.1.1.1 Standards as coordination devices

The scale of the value created when firms coordinate around a common technical approach can depend on several factors.[3]

The importance of interoperability and competition. By defining shared technical requirements, standards allow products and services from different suppliers to work together. Where lack of interoperability would constrain consumer choice or raise integration costs, compatibility can intensify competition among suppliers of standard-compliant products. That can support greater choice, lower costs and more product innovation, because firms can compete on price, quality, design and complementary features rather than on incompatible technical foundations.

The importance of network effects. Many technology markets exhibit network effects, where a product or service becomes more valuable as more users adopt compatible products, and more complementary products and services are developed around them. Standards can strengthen these effects by discouraging fragmentation and allowing broad participation. A larger compatible ecosystem can increase value to users and raise the potential commercial returns available to firms operating within it.

The importance of scale economies. Technology markets often involve significant fixed costs in research and development (R&D), product development and market entry. A common standard can enlarge the addressable market over which such costs are spread, reducing firms' per-unit costs and lowering barriers to entry. It can also reduce duplication of cost by limiting the need to develop and maintain multiple incompatible technologies, allowing firms to focus their resources on differentiation and complementary innovation.

1.1.1.2 Standards as enablers of functionality

In principle, the technologies that a particular standard incorporates can affect the value of a compliant product in several ways.

Enabling functionality and performance. Many standards define core capabilities that directly affect the functionality and performance of compliant products, and therefore their value to users. In wireless communications, for example, the speed, latency, reliability and energy efficiency supported by a standard shape the quality of services, such as browsing or streaming.

3 Katz, M.L. and C. Shapiro (1985). Network externalities, competition, and compatibility. *American Economic Review*, 75(3), 424–440.

A standard that enables gigabits per second can increase an implementing product's value to users relative to one that is restricted to only megabits per second.

Enabling complementary innovation. Standards can act as technical platforms on which others may build complementary features and develop new use-cases that users value. A step-change in technological capability may improve the performance on an existing task; it can also expand the range of tasks that are feasible. For example, higher-bandwidth cellular standards enabled new use-cases, such as mobile high-definition video streaming, that were not practicable under earlier generations which restricted the functionality of handsets to phone calls and text messages.

Supporting incremental upgrades through generations and releases. Many standards evolve through successive versions or generations, introducing new features and improved performance while seeking to maintain compatibility with existing deployments. Implemented effectively, this evolutionary pathway can sustain innovation and increase value as market needs change.

All of this relates to the "standard" generally and not necessarily to each of the *patented technologies* that underlie it. The value associated with all the functionalities enabled by the standard may be separate from the contributions of specific patented technologies.[4]

1.1.2 The nature of the economic value that depends on technology standards

The coordination and functionality provided by standards may affect the economic value of an implementing product – that is, the value of the benefits that the product provides to consumers, and the returns available to firms that develop and supply it. The impact on value has several features, detailed below.

1.1.2.1 A proportion of an implementing product's value may relate to the standard

A standard can affect a product's economic value in various ways: by changing the amount that consumers are willing to pay for the product, increasing or decreasing its production costs, and affecting the prices that implementers can charge and the quantities they sell. Either of a standard's two roles may have this effect.

First, technical functionality can affect demand for a product. For example, if mobile devices were limited to data speeds measured in megabits per second rather than gigabits per second, the performance of devices would be reduced, some of their current features would not be available, consumers would not be willing to pay as much for devices, and the returns available to both implementers and innovators of the standard would be lower. The difference between these outcomes reflects the total economic value of the benefits that depend on the standardized technology.

Importantly, this effect – where it occurs – would typically affect only *a proportion* of the implementing product's economic value. The value of the entire product depends on all its features, many of which may not be related to the functionality enabled by the standard.

Second, how widely adopted the standard is affects both consumer demand and production costs. If mobile devices had cellular technology that offered the same technical performance as 5G, but each device required its own incompatible version of that technology, then the market would probably be smaller and less competitive. Fragmentation would raise switching costs, weaken network effects and reduce scale economies, leaving consumers and firms worse off than in a coordinated ecosystem.

4 Note that a patented technology could contribute to the economic value functionality that the standard enables but not contribute *incremental value* if another technology could have contributed to its value equally well. We discuss the significance of incentivizing technologies that provide *incremental value* to a standard in Part 4.

1.1.2.2 Economic value depends jointly on innovators and implementers

The economic value that a standard contributes does not *solely* depend on the standardized technology. The value is *complementary*: it reflects the combined contributions of two groups of firms:

- **innovators** of standards, who invest in developing technologies that may be incorporated into a standard and made available for others to implement; and
- **implementers** of standards, who invest in developing standard-compliant products that use the standard's functionalities in ways that users value.[5]

The value of each group's contribution is enhanced by the other's contribution. A technical solution creates less value if it is not implemented in ways that consumers value or not implemented at scale. Equally, implementers' products are constrained if they cannot access compatible capabilities that enhance performance.

1.1.2.3 The scale of value depends on incentives, in both the short term and the long term

The economic value associated with a standard is dynamic rather than fixed. It varies with the quality of the technical solutions selected, the degree of coordination achieved, and the pace and direction of upgrades over time.

Outcomes depend on whether firms have adequate incentives to participate – innovators of standards to continue improving the technical functionalities and standard implementers to bring compliant products to market and compete within the standard.

The benefits of coordination and better functionality can reinforce each other: better functionality can encourage adoption, and wider adoption can strengthen incentives to invest in developing and implementing better functionality.

They can also come into tension. Where the benefits of interoperability, network effects and scale economies are strong, markets may "tip" toward a single technological approach, whether or not it is formally designated as an industry standard. In the short term, the prospect of tipping may be positive as a "race to market" intensifies efforts to develop and back a winning approach, hoping to capture the benefits of network effects. The impact can also be negative, deterring or delaying investment if firms fear ending up on the wrong side of the divide after the market tips.

In the long term, however, once a market has tipped, the benefits of coordination work against the incentive to develop new technologies that would otherwise improve functionality. To compete against an incumbent, rivals do not simply have to offer superior technical alternatives, those alternatives must be sufficiently superior that users are prepared to incur switching costs and the loss of established network effects. That additional hurdle may reduce the ability and incentive for rivals to compete in the market, which in turn reduces an incumbent's incentive to improve its own technical functionality. In those circumstances, the pace of improving technical functionality will be slower than it would be in a market with more direct technological rivalry.

For these reasons, the processes by which standards are adopted, governed and updated can materially shape the value they deliver. Arrangements that sustain participation by both innovators and implementers of standards tend to support more frequent capability upgrades and larger product markets. Arrangements that weaken incentives for either group can reduce the value that standards would otherwise create, which is why the way in which new and updated standards emerge matters.

5 The Report uses the wording "innovator" and "implementer" of standards. However, it should be noted that implementers of standards may also be innovative companies, and standard innovators (SEP holders) may assume dual roles, as they simultaneously implement standards in their products.

1.2 How technology standards emerge, and why that affects the value of products and technology

The technology standards we discuss in this Report are typically developed through collaborative processes in **standards development organizations (SDOs)**. In doing so, SDOs aim to incentivize participation from both innovators and implementers of the standard, in the long-term interests of both innovators and implementers – and, ultimately, the consumers of compliant products.

Standards developed by an SDO (also referred to as **de jure standards**) can be usefully contrasted with technology standards developed by a single company (or small group of companies), often referred to as **de facto standards**. Box 1.1 compares an example of each. Either type can emerge from a "standards war": 4G LTE[6] competed with rival 4G standard WiMAX,[7] both developed by SDOs; and VHS,[8] developed by JVC,[9] competed against Sony's Betamax to become the de facto standard for video cassette technology. However, once the market tipped and each became widely adopted, the different processes for updating their technical functionality affected the pace of innovation.

Box 1.1 An illustrative comparison of an SDO-developed (de jure) technology standard and a de facto technology standard

Category	An SDO-developed standard	A de facto standard
Example	Mobile cellular standard: 4G LTE	VHS video cassette format
Developed and governed by	Various parties through 3GPP, a partnership that brings together regional standard development organizations (for example, ETSI).	The company JVC, and then supported by a wider group of manufacturers.
Adopted by	Numerous manufacturers of consumer devices (such as smartphones, automobiles and Internet of Things (IoT) products), network infrastructure vendors and mobile network operators.	Numerous manufacturers of video cassette players and recorders, and producers of compatible camcorders and related consumer electronics.
Emerged	4G LTE faced market competition from a rival incompatible standard, WiMAX, tipping as the market increasingly chose LTE.	Emerged from market competition between companies with rival incompatible formats (notably Sony's Betamax), tipping as the ecosystem of compatible content and devices grew.
Replaced	Replaced by competitive and managed development of 5G NR, which 3GPP coordinated explicitly to succeed LTE as the global cellular standard.	Replaced by market competition, when DVDs rendered video cassettes obsolete, taking over as the dominant technological format.
Adoption and functionality affects a wider ecosystem of	Complementary markets, including network services, device components, app developers and digital content and distribution channels.	Complementary markets, including content production and distribution, retail and rental channels and compatible consumer electronics.

Note: ETSI = European Telecommunications Standards Institute. The 3rd Generation Partnership Project (3GPP) unites seven telecommunications standards development organizations (ARIB, ATIS, CCSA, ETSI, TSDI, TTA and TTC). For a general discussion of de facto standards, see the section on "proprietary standards" in Padilla, J., J. Davies and A. Boutin (2017). *Economic Impact of Technology Standards: The Past and the Road Ahead*, paras 3.76–3.95, and specifically discussion of: (i) Ohashi, H. (2003). The role of network effects in the US VCR Market, 1978–1986. *Journal of Economics & Management Strategy*, 12(4), 447–494; (ii) Katz, M.L. and C. Shapiro (1985). Network externalities, competition, and compatibility. *The American Economic Review*, 75(3): 424–440; and (iii) Farrell, J. and G. Saloner (1985). Standardization, compatibility, and innovation. *The RAND Journal of Economics*, 16(1), 70–83.

6 4G Long Term Evolution.
7 Worldwide Interoperability for Microwave Access.
8 Video Home System.
9 Japan Victor Company.

1.2.1 How the standardization process works in an SDO

SDOs develop standards through collaborative processes, where rival innovators compete to contribute to the standard that implementers will later adopt. These processes provide a structured forum in which participants identify technical needs, propose solutions, evaluate trade-offs and converge on shared specifications that can be implemented by many firms. Standardization is commonly iterative: standards are developed, tested, released and then improved through successive updates.

The main features of three technology standards developed through SDOs are set out in Box 1.2

Box 1.2 Examples of standards coordinated through SDOs

Standard	Cellular communication	Wi-Fi	Video codec
SDO/standards body	3GPP develops the specifications through Technical Specification Groups (TSGs).	IEEE develops the specifications through the 802.11 Working Group.	Developed through ISO/IEC and ITU-T working groups (notably Study Group 16).
Functionality	Radio interface and core network protocols for mobile connectivity (including signalling, mobility and handover, authentication, security and roaming).	Radio and medium-access protocols for wireless local area connectivity (including association, channel access, link management and security).	Compression and decompression methods for digital video (encoding and decoding).
Performance features include:	Data throughput and capacity, latency, coverage and reliability, and energy efficiency.	Data throughput and capacity, latency, interference management and energy efficiency.	Compression efficiency, visual quality, latency and power usage.
Latest generations (release year)	5G NR (2018) 4G LTE (2008)	Wi-Fi 6 (2021) Wi-Fi 5 (2013) Wi-Fi 4 (2009)	VVC H.266 (2020) HEVC H.265 (2013) AVC H.264 (2003)
Implementing product markets	Consumer devices, including phones, and connected devices (such as automotive, industrial IoT and consumer IoT); mobile network infrastructure (base stations, core networks); test equipment and network services.	Consumer devices, including phones, tablets, laptops and consumer devices (TVs, smart speakers, consoles); Wi-Fi access points and routers; enterprise networking equipment; and public and private Wi-Fi networks.	Smartphones and tablets; TVs and set-top boxes; streaming devices and services; video conferencing platforms; cameras and editing tools; network equipment that transports video traffic.

Notes: See 3GPP, "About 3GPP "; IEEE Standards Association, "IEEE 802.11 Working Group "; Wi-Fi Alliance, "Certification "; and ISO/IEC JTC 1/SC 29 and ITU-T Study Group 16 .

Although the exact procedures differ across SDOs, broadly they all provide institutional infrastructure that allows requirements and proposals to be scrutinized and agreed on. They typically convene participants, establish working groups and set procedures for submitting proposals, discussing alternatives, testing and revising drafts, and approving releases. They also manage documentation and decision-making processes (such as consensus or voting mechanisms) and maintain procedures for updating standards over time.

Innovators of standards propose and refine technical solutions to meet the agreed requirements. They may contribute engineering approaches, data, prototypes and

research results, and they often engage in iterative development in response to feasibility concerns, interoperability needs and comparative evaluation against alternatives. Standardization therefore involves aligning technical possibilities with implementation constraints to produce a shared framework within which different firms can develop compatible products and services.

Implementers of standards contribute requirements and develop products based on users' needs. This can include defining use cases, performance requirements (such as throughput, latency, reliability and energy consumption) and practical constraints (including cost, complexity, manufacturability and backward compatibility).

1.2.2 Incentives to participate in standardization

The value enabled by standards depends on the willingness of both innovators and implementers to participate in standardization. Participation is not costless: it requires firms to commit time, information and resources, and to accept that key technical choices will be shared across the industry. In this sense, it can generate significant ecosystem benefits, but only if enough parties find it worthwhile to contribute and adopt the result.

Innovators of standards face substantial upfront costs, including R&D, prototyping, testing and sustained participation in technical meetings and development cycles. Their incentives depend on a credible prospect of earning returns that justify risky investment and support ongoing improvement.[10] Those returns are typically greater when a standard is widely adopted, because diffusion increases the commercial opportunity associated with successful technologies. Where markets fragment across incompatible approaches, diffusion and expected returns may fall, weakening incentives to invest and participate.

Implementers of standards also incur substantial upfront costs, including product design, integration of compliant components, alignment of manufacturing and supply chains, and the development of services and features that rely on the standard. Their incentives depend on expected returns from adoption, including the opportunity created by a large interoperable market and access costs of licensing.

A consolidated market aligned around a single standard can therefore increase the potential rewards for successful standard innovators and implementers. At the same time, it can increase the costs of being on the losing side of the standardization process and reduce practical alternatives once the market has coordinated around the chosen approach.

1.3 Standard essential patents in context

In many technology standards, some of the technologies incorporated into the specifications are protected by patents. In principle, licensing these patents should allow both innovators and implementers of standards to contribute and share the value created by standardization. In practice, however, SEP licensing negotiations may involve structural and informational frictions that can make it difficult for parties to identify and agree terms that reflect their respective contributions and preserve incentives to participate.

1.3.1 Understanding SEPs

A SEP is a patent that protects an invention that is essential to the implementation of a particular technology standard. The patent is considered "essential" if its claims correspond to the technical features of the technology standard, meaning that implementing the standard necessarily infringes the patent.[11]

10 Arrow, K.J. (1962). Economic welfare and the allocation of resources for invention. In National Bureau of Economic Research (NBER) chapters, *The Rate and Direction of Inventive Activity*. Princeton, NJ: Princeton University Press, 609–626. Some caution should be applied here. This discussion relates to incentives generally but does not address the exact trade-off between R&D, risk and reward, and the trade-off with public welfare. The goal of standard setting is not to encourage participation, per se, but to encourage the contribution of valuable technologies to a standard.

11 This is a simplified explanation and it should be noted that the proof of infringement is often not as clear-cut since some parts of standards may also rely on voluntary features that not every implementing product of the standards may enable.

In general, SDOs' intellectual property rights (IPR) policies include rules that require participants to disclose at an early stage whether they may hold patents that could become essential to the standard.

For example, ETSI IPR Policy, Article 4 Disclosure of IPRs, provides:

4.1 Subject to Clause 4.2 below, each MEMBER shall use its reasonable endeavours, in particular during the development of a STANDARD or TECHNICAL SPECIFICATION where it participates, to inform ETSI of ESSENTIAL IPRs in a timely fashion. In particular, a MEMBER submitting a technical proposal for a STANDARD or TECHNICAL SPECIFICATION shall, on a bona fide basis, draw the attention of ETSI to any of that MEMBER's IPR which might be ESSENTIAL if that proposal is adopted.

4.2 The obligations pursuant to Clause 4.1 above do however not imply any obligation on MEMBERS to conduct IPR searches.

4.3 The obligations pursuant to Clause 4.1 above are deemed to be fulfilled in respect of all existing and future members of a PATENT FAMILY if ETSI has been informed of a member of this PATENT FAMILY in a timely fashion. Information on other members of this PATENT FAMILY, if any, may be voluntarily provided.

Source: ETSI Directives, Version 52, 5 December 2025 , Rules of Procedure, 4 September 2025, Annex 6, ETSI Intellectual Property Rights Policy (ETSI IPR Policy).

An essentiality declaration, however, does not by itself establish that a patent is in fact essential. Essentiality declarations are often made at an early stage in the standardization process and are generally not updated once the standard is adopted. Furthermore, where the SDO's IPR policy allows it, some standard innovators only provide general (blanket) declarations that they will license any potential SEP on FRAND terms. Moreover, declared patents may turn out to be invalid in some jurisdictions, or may not be infringed by particular implementations. The actual number of SEPs per standard (or product implementation) is therefore not readily determined.

Where essentiality is contested, it can be assessed using evidence such as claim charts mapping patent claims to the relevant provisions of the standard (and version). Assessments may be detailed for individual patents or may be conducted on a sample basis for larger portfolios, depending on the purpose and context of the exercise.

1.3.2 Balancing incentives in standardization

Standardization relies on contributions from innovators on the one hand and on widespread adoption by implementers on the other. Ensuring that both groups can participate on viable terms is therefore essential for the effectiveness and sustainability of standardization systems. This balance of incentives is central to standardization. The frameworks governing how technologies are contributed, accessed and implemented shape the incentives and ability of different stakeholders to participate. This, in turn, determines the extent to which standards enable innovation, interoperability and value creation across products and markets.

Standardization is generally recognized as capable of producing significant procompetitive effects – by improving interoperability, reducing costs, increasing efficiency, supporting innovation and enhancing consumer choice – while, depending on the design of the standard-developing process and access conditions, it may also give rise to competition concerns, including foreclosure, reduced innovation or exclusionary access to the standard.[12] SDOs' IPR policies address competition law[13] concerns that can arise from the inclusion of patented technologies in standards. Provisions that aim to prevent standardization leading to foreclosure,

12 See, for example, European Commission,Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements (2023), section 7.3. ; U.S. DOJ/FTC, Antitrust Enforcement and Intellectual Property Rights: Promoting Innovation and Competition 2007 , Chapter 2; Nyman, S. andBegazo, T., Standards and Competition, World Bank background paper, pp. 2-6.

13 For consistency, this Report uses the term "competition law" throughout. In certain jurisdictions, in particular the United States of America, broadly equivalent rules are more commonly referred to as "antitrust law." References in this Report to "competition law" should be understood, where appropriate, to include such equivalent concepts.

or other anti-competitive effects, contribute to placing standardization agreements under a lenient competition law treatment. In particular, transparency obligations, procedures for the disclosure of potentially essential patents[14] and commitments to license on FRAND terms are intended to mitigate the risk that collective and individual market power derived from standardization is exercised in a manner that restricts competition.[15] At the same time, disclosure obligations[16] and FRAND undertakings under the SDO policies that require participants to declare whether they are willing to license any potential SEP on FRAND terms, contribute to maintaining a broader economic and societal function of standardization by supporting a balance of incentives between innovators and implementers.

For example, Article 6 of the ETSI IPR Policy, Availability of Licences, provides:

6.1 When an ESSENTIAL IPR relating to a particular STANDARD or TECHNICAL SPECIFICATION is brought to the attention of ETSI, the Director-General of ETSI shall immediately request the owner to give within three months an irrevocable undertaking in writing that it is prepared to grant irrevocable licences on fair, reasonable and non-discriminatory ("FRAND") terms and conditions under such IPR to at least the following extent:

- MANUFACTURE, including the right to make or have made customized components and subsystems to the licensee's own design for use in MANUFACTURE;
- sell, lease, or otherwise dispose of EQUIPMENT so MANUFACTURED;
- repair, use, or operate EQUIPMENT; and
- use METHODS.

The above undertaking may be made subject to the condition that those who seek licences agree to reciprocate.

6.1 *bis* Transfer of ownership of ESSENTIAL IPR. FRAND licensing undertakings made pursuant to Clause 6 shall be interpreted as encumbrances that bind all successors-in-interest. Recognizing that this interpretation may not apply in all legal jurisdictions, any Declarant who has submitted a FRAND undertaking according to the POLICY who transfers ownership of ESSENTIAL IPR that is subject to such undertaking shall include appropriate provisions in the relevant transfer documents to ensure that the undertaking is binding on the transferee and that the transferee will similarly include appropriate provisions in the event of future transfers with the goal of binding all successors-in-interest. The undertaking shall be interpreted as binding on successors-in-interest regardless of whether such provisions are included in the relevant transfer documents.

6.2 An undertaking pursuant to Clause 6.1 with regard to a specified member of a PATENT FAMILY shall apply to all existing and future ESSENTIAL IPRs of that PATENT FAMILY unless there is an explicit written exclusion of specified IPRs at the time the undertaking is made. The extent of any such exclusion shall be limited to those explicitly specified IPRs.

6.3 As long as the requested undertaking of the IPR owner is not granted, the COMMITTEE Chairs should, if appropriate, in consultation with the ETSI Secretariat use their judgment as to whether or not the COMMITTEE should suspend work on the relevant parts of the STANDARD or TECHNICAL SPECIFICATION until the matter has been resolved and/or submit for approval any relevant STANDARD or TECHNICAL SPECIFICATION.

6.4 At the request of the European Commission and/or EFTA, initially for a specific STANDARD or TECHNICAL SPECIFICATION or a class of STANDARDS/TECHNICAL SPECIFICATIONS, ETSI shall arrange to have carried out in a competent and timely manner an investigation including an IPR search, with the objective of ascertaining whether IPRs exist or are likely to exist which may be or may become ESSENTIAL to a proposed STANDARD or TECHNICAL SPECIFICATIONS

14 See Section 1.3.1 above, Article 4, ETSI IPR Policy.
15 For example, European Commission, Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements (2023), section 7, Standardisation agreements, in particular section 7.3.3.1 Agreements which generally do not restrict competition, which include *inter alia* transparent procedures and commitments to license SEPs on FRAND terms.
16 See Section 1.3.1 above, Article 4, ETSI IPR Policy.

and the possible terms and conditions of licences for such IPRs. This shall be subject to the European Commission and/or EFTA meeting all reasonable expenses of such an investigation, in accordance with detailed arrangements to be worked out with the European Commission and/or EFTA prior to the investigation being undertaken.

Source: ETSI Directives, Version 52, 5 December 2025 , Rules of Procedure, 4 September 2025, Annex 6, ETSI Intellectual Property Rights Policy.

In this way, FRAND undertakings and the respective applicable competition laws[17] help to ensure that implementers can access the technologies necessary to comply with a standard, while preserving the ability of innovators to obtain a return on their investments. Where licenses are unavailable, SDOs may provide procedural rules governing how to proceed before and after the publication of a standard, further contributing to the stability and credibility of the standardization process.[18]

1.3.2.1 Incentives for innovators of standards

SEPs, like patents in general, are intended to support innovation by allowing inventors to earn returns on risky, upfront investments. In broad terms, the patent grants an exclusionary right for a limited period of time in exchange for public disclosure of the invention, after which it enters the public domain. This framework reflects a key feature of knowledge-based assets: once disclosed, inventions may be relatively easy to use or imitate, even where their development required significant time, expertise and risk. The prospect that others could benefit without contributing to an invention's development may affect innovators' incentives to invest in new technologies. Patents and their enforcement therefore provide innovators with a mechanism to prevent unauthorized use and to secure appropriate returns from their inventions. At the same time, patent rights, while conferring exclusivity, are subject to statutory exceptions and limitations on their exercise that balance innovation incentives with access.

In the context of standardization, innovators commit to license essential technologies on FRAND terms in accordance with SDO IPR policies and applicable competition laws.[19] This framework enables innovators to participate in standardization while retaining the prospect of remuneration. Conversely, where FRAND conditions are perceived as insufficiently protective of returns, incentives to contribute technology to standards may be reduced.

1.3.2.2 Incentives for implementers of standards

The incentives for implementers in standard-based markets include the ability to offer interoperable products, access widely adopted technologies and compete within established ecosystems. By building on a common technical foundation, implementers can focus on product differentiation and complementary innovation rather than duplicating core technologies.

Once a market has coordinated around a particular standard, a non-compliant product may not be viable, particularly where compatibility and network effects are important. Implementers therefore require access to the technologies that a standard specifies.

In this context, access to licenses on predictable terms enables implementers to develop and commercialize standard-compliant products. The conditions under which such access is provided can influence investment decisions, product development and market entry. Where licensing conditions are perceived as uncertain or difficult to assess, implementers may adjust the timing or scope of their participation in standard-based markets. Any imbalance in licensing conditions can affect implementers' incentives to invest and compete in the development of standard-compliant products.

17 This publication concentrates on the economic matters surrounding SEPs. The legal discussions on the nature of the FRAND undertaking are outside the scope of the Report.
18 See, for example, ETSI Directives, Version 52, 5 December 2025 , Rules of Procedure, 4 September 2025, Annex 6, ETSI Intellectual Property Rights Policy, Article 8 Non-availability of Licences.
19 This publication concentrates on the economic matters surrounding SEPs. Legal discussions on the nature of the FRAND undertaking are outside the scope of the Report.

1.3.3 Particularities of SEP licensing negotiations

Licensing negotiations typically depend on the parties' ability to compare the terms of a potential agreement with competitive alternatives. In non-SEP settings, a licensor may decide not to license and instead pursue other routes to market, while a licensee may choose a different technology, supplier or product design. These "outside options" constrain what each side is willing to accept and help the parties to converge on a range of mutually beneficial terms – or simply walk away without a deal.

SEP licensing can be different. The two features detailed below are especially important.

1.3.3.1 Limited outside options prevent competitive "price discovery"

In many non-SEP licensing settings, competitive alternatives help the parties to identify a range of mutually beneficial terms. In simplified form, that range lies between (i) the maximum amount that the implementer would pay before its next-best alternative offers better value – considering both the cost of a license and the benefits that the licensed technology enables and (ii) the minimum that the patent holder would accept before preferring its own next-best alternative. These competitive constraints help parties to converge on terms without needing perfect information about value.[20]

However, where compliance with a standard is commercially necessary, implementers may have little practical ability to avoid the technologies specified by the standard. SEP holders may also have limited ability to pursue an alternative route to market for the same standardized use once the market has coordinated around the standard. So, it is possible that neither party has effective outside options.

Limited or no commercially viable alternatives for implementers. In many patent-licensing settings outside standards, an implementer can compare the net value of taking a license with the net value of using the next-best alternative technology, taking into account both the benefits that the technology provides and the cost of licensing. That alternative places competitive pressure on the maximum royalty that the implementer is willing to pay and, in turn, on what the patent holder can reasonably demand. Once a standard is widely adopted, however, implementers may be effectively locked into the technologies specified by the standard. Even if alternatives could offer similar functionality in principle, they may not be commercially viable if adopting them would require abandoning compatibility with the standard or incurring prohibitively high switching and redesign costs.

Limited or no commercially viable alternatives for innovators. A patent holder's willingness to accept a given royalty is often influenced by its own alternatives – for example, implementing the technology itself, licensing it for other uses or licensing it to others on different terms. These alternatives can create a practical "floor" below which the patent holder would not license. In a standard setting, once the market has coordinated around a single specification, compatibility and network effects can make alternative routes to market for the same standardized use less realistic. At the same time, the licensing conditions associated with standardization commonly limit selective licensing or differential pricing among similarly situated implementers. These constraints serve important objectives but they may also weaken the SEP holder's outside options in negotiations – as it is less able to use the rivalry between implementers to apply competitive pressure on royalties, for instance, through selective licensing or differential pricing.

Box 1.3 illustrates how the terms agreed in otherwise identical license negotiations may differ in a non-SEP setting and an SEP setting, simply because the parties' commercial alternatives to the agreement differ.

20 See Section 4.2 below for a fuller discussion of the dynamics of negotiations.

Box 1.3 Example demonstrating outside options in non-SEP versus SEP licensing

A negotiation for a non-SEP license

An implementer can choose between two rival technologies: A and B. Each delivers similar functionality that improves the implementer's product and makes it more attractive to consumers.

If Technology A is superior to B, the implementer will prefer to implement that technology. However, it will not pay more than the value of the incremental benefit that the technology adds to its product, compared with the benefit that Technology B would provide in its place. If the license terms for A exceed the incremental benefit it provides over B, then the implementer would be better off with the lower benefits and lower costs that B provides: the net value is higher.

The patent holders of A and B, in turn, will not accept less than each can earn by licensing elsewhere or commercializing the technology themselves.

Each party's commercial alternatives help them to converge on a range of mutually beneficial terms.

A negotiation for an SEP license

The same Technology A is incorporated into a widely adopted standard. The implementer cannot use Technology B and remain standard-compliant, and switching away from the standard would sacrifice compatibility. The implementer's practical outside option is therefore much weaker.

At the same time, the SEP holder's alternative route to market for the same standardized use may also be limited.

With weaker outside options, the negotiation is less constrained by substitution and more dependent on evidence, assumptions and the credibility of the enforcement and remedies available.

Note: This is a simplified, illustrative example highlighting how outside options are typically considered in non-SEP versus SEP licensing. It is not exhaustive and licensing negotiations can be affected by other factors.

1.3.3.2 Features that make the value of SEP licenses uncertain

Limited outside options are often compounded by features that make it difficult for parties to assess the value of a particular SEP license. These include the following.

Not all SEPs have the same value. A patent is not necessarily valuable in economic terms.[21] The contribution of a particular SEP, or portfolio of SEPs, to the economic value of a technology standard may vary considerably. If a patent is shown to be essential, valid and infringed, the magnitude of that value depends on the significance of the specific technology it protects. Conversely, if a patent is not essential, not valid or not infringed, its value in relation to that standard will be nil. Before these issues are assessed, the value of an asserted SEP (or portfolio) is therefore often probabilistic, reflecting uncertainty about essentiality, validity, scope and technical importance.[22]

Licenses may have too many SEPs to assess individually. Some standards have thousands of declared SEPs across multiple jurisdictions. A patent-by-patent and country-by-country

21 Allison, J.R. and M.A. Lemley (1998). Empirical evidence of the validity of litigated patents. *AIPLA Quarterly Journal*, 26(3).
22 Lemley, M.A. and C. Shapiro (2005). Probabilistic patents. *Journal of Economic Perspectives*, 19(2), 75–98.

assessment of essentiality, validity and infringement can be prohibitively expensive and time-consuming for all parties. Portfolio licensing is therefore common as a practical response. While portfolios can reduce transaction costs, and facilitate access to standardized technology, their size and heterogeneity can make it more difficult to determine how the proportion of essential, valid and technologically important patents translates into the incremental value delivered to implementers and users.[23]

Fragmented ownership of complementary SEPs ("Cournot complements"). Relevant SEP rights may be held by multiple SEP holders whose rights are complementary, in the sense that each license is required to make a standard-compliant product. When complementary rights are priced separately, each licensor may set its royalty without fully accounting for the effect of its pricing on demand for the final product and on the royalties charged by other licensors. The combined royalty burden may therefore be higher than it would be if the same set of complementary SEPs were priced as a single package (for example, by a single owner or through a joint license arrangement, such as a patent pool). This phenomenon is often described as royalty stacking.

Contribution to the value of multi-feature products. Many technology standards are implemented in complex products whose economic value reflects a combination of standardized technology, product-specific features, design choices and other complementary innovations. For example, in a smartphone user value may depend in part on the quality of the cellular technology implemented but it also depends on features such as the screen, camera, operating system, hardware design, processor and brand. In such circumstances, it may be difficult to assess the economic significance of the standardized technology within the overall product. This may, in turn, complicate the assessment of royalties that appropriately reflect the value of the licensed technology.

1.3.4 Negotiation dynamics and potential imbalances

The combination of limited outside options and uncertainty about the value of SEP rights increases the likelihood that licensing negotiations are influenced by factors other than purely competitive benchmarks.

Concerns raised in this context revolve around the concept of patent hold-up and patent hold-out.

In economics, **hold-up** is generally defined as a situation in which one party makes relationship-specific investments before the terms of cooperation are fully determined and is then exposed to demands that it would not have accepted before committing. The concern is not only that outcomes may be inefficient, but that parties may be deterred from participating in the first place if they expect that they could be worse off after committing.[24]

The concept affects standards because, even if several technical alternatives were available before a standard was set, once a single solution is incorporated into a standard and widely adopted, those alternatives may cease to be commercially viable. In economic terms, this gives rise to a risk of market failure: although innovators and implementers could create value by cooperating through standardization, the prospect of opportunistic behavior may deter *both sides* from making the investments needed for that cooperation to occur.

The counterpart that economic literature discusses, particularly in the context of SEPs and FRAND,[25] is the concept of **hold-out**. It can be defined as a strategy by an implementer exploiting the cost and difficulty of enforcing patent rights to knowingly use others' patented technology without consenting to pay reasonable compensation.[26]

23 Shapiro, C. (2001). Navigating the patent thicket: Cross licenses, patent pools, and standard-setting. In Jaffe, A.B., J. Lerner and S. Stern (eds), *Innovation Policy and the Economy* (Vol. 1). Cambridge, MA: MIT Press, 119–150.
24 See Williamson, O.E. (1985). The fundamental transformation. *The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting*, Chapter 2.3. New York: Free Press; London: Collier Macmillan; Klein, B., R.G. Crawford and A.A. Alchian (1978). Vertical integration, appropriable rents, and the competitive contracting process. *Journal of Law and Economics*, 21(2), 297–326.
25 See, for example, Heiden, B. and Baron, J. (2024). The economic impact of patent holdout. *Harvard Journal of Law & Technology*, 38(3), 637–669.
26 Heiden, B. and Baron, J. (2024). The economic impact of patent holdout. *Harvard Journal of Law & Technology*, 38(3), 640.

1.3.4.1 Concerns relating to hold-up and hold-out in principle

There are two opposing concerns that are debated in this regard.

SEP holder "hold-up" (as described by implementers). Implementers argue that once they have developed and deployed standard-compliant products and incurred sunk costs in development and market entry, SEP holders may seek licensing terms that differ from those that would have been agreed prior to lock-in. In this context, the availability of exclusionary remedies – such as injunctive relief – may affect the parties' positions in negotiation. Where such outcomes are considered relevant, an implementer's willingness to pay may reflect the costs of disruption or adjustment of its broader product business, rather than the value contributed by the underlying SEP technology. Even where the concern does not materialize, the perception of this risk can influence decisions regarding market entry or reduce investment in standard-compliant products, which can limit adoption and ecosystem development.[27]

Implementer hold-out concerns (as described by SEP holders). SEP holders argue that implementers can delay taking a license or prolong negotiations, relying on the cost, complexity and time involved in enforcing SEP rights – often across multiple jurisdictions – to obtain royalties below a reasonable range that the parties would agree in a competitive situation, where the licensor had outside options. In its strongest form, the concern is that an implementer may benefit from standardized technology while postponing payment, and that enforcement costs and delay can reduce the innovator's ability to obtain adequate and timely compensation.[28] If such behavior were widespread, it could weaken incentives to invest in the development of technologies intended for standardization.[29]

1.3.4.2 The impact of hold-up and hold-out in practice

There is considerable debate about the extent to which either hold-up or hold-out happen in practice.[30] Two conceptual issues arise.

Deterrence of entry and investment. One concern is that the perceived risk of hold-up or hold-out may discourage entry or investment. For implementers, the risk can be more salient for small and medium-sized enterprises (SMEs) and new market entrants that lack scale, experience or resources to manage complex cross-border licensing negotiations and disputes. For innovators, the risk may be more salient for firms that depend on licensing revenues to fund R&D rather than product sales. Courts and competition authorities have in specific cases considered that large companies on either side are comparatively able to "look after themselves" – as they have the scale and resources needed to defend their interests in court.[31] However, this generalization is subject to debate and difficult to examine empirically because it relates to the *absence* of companies that could have developed or implemented standardized technologies but never entered the market in the first place.

Licensing outcomes outside a reasonable range. A further question is whether SEP licensing outcomes tend to fall within a reasonable range in practice, or whether they diverge due to differences in the concerned parties' bargaining conditions. Courts and tribunals have identified, in specific cases, outcomes both above and below such a range. This reflects the fact that, where outside options are limited, negotiated outcomes depend on the parties' relative bargaining positions.[32] These positions are shaped by factors such as time, information, litigation costs and the availability and credibility of legal remedies, which vary across cases. As a result, outcomes may differ according to context, with different parties being comparatively better positioned in negotiations.[33]

27 See Lemley, M. and C. Shapiro (2007). Patent holdup and royalty stacking. 85 *Texas Law Review*, 1991 (2007), 1 Stanford Law and Economics Olin Working Paper No. 324, 1990-2049, available at SSRN .
28 There may be mitigating factors, such as the availability of prejudgment interest.
29 See Epstein, R.A. and K.B. Noroozi (2017) Why incentives for "patent holdout" threaten to dismantle FRAND, and why it matters. *Berkeley Technology Law Journal*, 1381, 1384 and Osenga, K. (2023). Efficient infringement in the SEP space. In Barnett, J.M. and S.M. O'Connor (eds), *5G and Beyond: Intellectual Property and Competition Policy in the Internet of Things*. Cambridge University Press, 112, 111–128.
30 For instance, see Galetovic, A., S. Haber and R. Levine (2015). An empirical examination of patent holdup. *Journal of Competition Law & Economics*, 11(3), 549–578; and Shapiro, C. and M.A. Lemley (2020). The role of antitrust in preventing patent holdup. *Stanford Law and Economics Olin Working Paper* No. 554.
31 For instance, see *InterDigital* v. *Lenovo* [2023] EWHC 539 (Pat) (link) , para. 729; [2023] EWHC 1095 (Ch), para. 245; SEPs, Antitrust, and the FTC: Remarks of Commissioner Rebecca Kelly Slaughter, as prepared for delivery (2021); *Optis* v. *Apple* [2025] EWCA Civ 552 (link) , para. 122; and Heiden, B. and Baron, J. (2024). The economic impact of patent holdout. *Harvard Journal of Law & Technology*, 38(3), 6–669.
32 Sidak, J.G. (2013). The meaning of FRAND, Part I: Royalties. *Journal of Competition Law & Economics*, 9(4), 931–1055.
33 See Heiden, B. and Baron, J. (2024). The economic impact of patent holdout. *Harvard Journal of Law & Technology*, 38(3).

1.3.4.3 Levers of hold-up and hold-out

In SEP licensing, once a standard is widely adopted, competitive alternatives to an agreement (i.e., outside options) may have limited influence on negotiations. Therefore, the parties' "inside options" – including the expected cost, duration and outcome of litigation – become more relevant. These factors typically shape the negotiation process, as parties assess the relative benefits of agreement compared to continued dispute.

Factors that change the expected cost, timing or risk of the dispute (pathway) influence the negotiation positions. Some factors may more often strengthen a licensor's position, such as the realistic prospect of injunctive relief in a relevant jurisdiction. Others may more often strengthen an implementer's position, such as low-cost delay where the licensor faces financial pressure to settle. In practice, the effect is context specific. The main considerations are detailed below.

Litigation costs

Litigation is costly for both sides, but its bargaining impact depends on how those costs compare with the expected change in royalties and on the parties' ability and willingness to sustain them over time. Where incremental litigation costs are large relative to the likely uplift (or reduction) in license terms, parties may settle on terms that reflect their risk tolerance and budget constraints as much as portfolio value.

This effect is more pronounced where expected royalty exposure is small relative to largely fixed litigation costs. The effect is less pronounced where the dispute concerns potentially large changes in expected royalty payments – due to large volumes of licensed units and/or sizeable SEP portfolios.[34]

Injunctive relief

The prospect of injunctive relief can influence negotiation dynamics because the commercial consequence of exclusion may be large relative to the value of the specific portfolio in question. Where an injunction is realistically available, and where the licensee has meaningful exposure in that jurisdiction, the relative negotiation position of the licensor may be strengthened. At the same time, limitations on injunctions, or frameworks that condition them on other factors, restrict the potential impact and, in some settings, may increase the scope for implementers to delay while litigating validity, essentiality, infringement or FRAND compliance.[35]

Patent-by-patent and jurisdiction-by-jurisdiction litigation

Because patent rights are territorial, a global business can face disputes on multiple fronts, potentially requiring separate proceedings to test validity, essentiality and infringement across jurisdictions. This can raise the cost and complexity of reaching a global portfolio license, even where both parties would prefer a single worldwide agreement. The use of anti-suit injunctions and anti-anti-suit injunctions can also concentrate the dispute in a forum perceived as favorable to one party, reducing predictability and affecting the conduct of dispute resolution.[36]

Recovery of past sales

Licenses frequently address past sales, either through explicit back-royalties, lump sums that cover past and future sales, releases for past infringement, or practical limits, such as limitation periods. The treatment of past sales can affect bargaining incentives because specific courses of action can change the payoff from delay.

34 See Heiden, B. and Baron, J. (2024). The economic impact of patent holdout. *Harvard Journal of Law & Technology*, 38(3), 637–669.

35 For instance, in the United States, access to injunctions is subject to the four-factor test set out by the Supreme Court in *eBay* v. *MercExchange* L.L.C., 547 U.S. 388 (2006) (link) . In Europe, access to injunctions for SEPs is subject to the considerations on the conduct of a willing licensor and a willing licensee set out by the Court of Justice of the European Union (CJEU) in *Huawei* v. *ZTE Deutschland GmbH*, CJEU [2015] Case No. C-170/13 (link) . In the United Kingdom, injunctions for SEPs are subject to a FRAND determination by the court. In China, injunctions for SEPs are granted on a fault-based approach, where the licensee is considered by the court to have acted in bad faith, for instance, by delaying negotiations, while the licensor acted in good faith with a FRAND offer, set out by the Beijing Intellectual Property court in *Iwncomm* v. *Sony* (2017) and Shenzhen Intermediate Court in *Huawei* v. *Samsung* (2018).

36 See the discussion in Section 2.2.3 below.

Where settlements include provisions on past sales through mechanisms such as forgiveness, limitation periods or a considerable difference between the royalties on past sales and those on future sales, some courts have treated this as potentially rewarding delay and thus as indicative of hold-out.[37] At the same time, discounts may reflect legitimate compromise in the face of litigation risk, or differences between forward-looking license terms and backward-looking damages frameworks, and that the inference to hold-out is not universal across jurisdictions. Ultimately, how past sales are treated in practice depends upon both case-specific evidence and legal considerations.

1.4 Summary

Standards can generate substantial coordination benefits and stimulate innovation by providing a common technical foundation for interoperable products and services. When licensing functions effectively, it can align incentives among participants: the prospect of reasonable terms for SEP holders incentivizes innovators to develop new technologies that provide valuable functionality and contribute them to standards, while implementers can obtain access on terms that support the development and commercialization of standard-compliant products. When balanced, those incentives deliver greater value – broader adoption, better functionality and more scope for complementary innovation.

Where incentives or bargaining positions are not aligned, however, that value is constrained. Because compliance with a widely adopted standard is a commercial necessity, the parties' outside options no longer discipline bilateral license negotiations. Combined with information asymmetries, portfolio complexity and the strategic role of litigation and remedies, this situation can create scope for hold-up or hold-out, intensifying disputes over license terms. Over time, such frictions can affect incentives to invest and limit the quality and pace of new functionality and products built on the standard.

The disclosure requirement of potential SEPs and the FRAND undertaking seek to address those dynamics in the context of standardization inside SDOs. In particular, the FRAND undertaking aims to support conditions under which both innovators and implementers can benefit from standardization and obtain appropriate returns on their respective contributions.

37 See, for instance, *InterDigital* v. *Lenovo* [2024] EWCA Civ 743 (link) , paras 187–188. Cited by *Lenovo* v. *Ericsson* [2025] EWCA Civ 182 (link) , para 23, which noted: "Key reasons for this conclusion were that the implementer required a licence from day one, that the implementer should pro-actively contact the SEP owner for a licence rather than sit back and wait for a demand, that the terms of the licence should not depend on the date it was entered into and that there should be no discrimination in favour of implementers who were slow to take a licence and against implementers who were quick to take a licence: [187]-[188]. In short, implementers should not be rewarded for hold out."

2 Mutually beneficial terms – the role of the FRAND undertaking and valuation methodologies

Topics covered in Part 2:

- **The FRAND undertaking – legal basis and key principles**
- **Common types of FRAND disputes**
- **Why reliable valuation is central to resolving FRAND disputes**

Building on Part 1, which has outlined the importance of the FRAND concept in balancing incentives for innovators and implementers in the context of standardization, this part of the Report sets out the legal basis and key principles of the FRAND undertaking, identifies common types of disputes surrounding FRAND and shows why these disagreements can often be mitigated by reliable valuation.

2.1 The FRAND undertaking – legal basis and key principles

As discussed in Part 1, the inclusion of the FRAND undertaking in SDO IPR policies may contribute to balancing the interests of standard innovators and implementers and mitigating competition law[1] concerns. Although the legal foundation, interpretation and enforcement of FRAND undertakings differ across SDOs and jurisdictions, the central objective – and the economic rationale that underpins it – is broadly consistent. The FRAND undertaking seeks to safeguard incentives: with respect to innovators, to develop and contribute valuable technologies for inclusion in the standard; and with regard to implementers, to adopt the standard and develop products and complementary assets that users value. In this way, FRAND aims to align licensing terms with the value created when innovation and implementation are combined, increasing the quality and value of both the functionalities that standards enable, and the products that implement them.

In practical terms, the FRAND undertaking provides legal assurance to both sides. It gives implementers confidence that they can obtain access to the essential patented technology needed to produce standard-compliant products and services. At the same time, it preserves innovators' rights over successful technologies, supporting continued investment in R&D and participation in the development and evolution of standards. In settings where lock-in arises from standard adoption, the FRAND undertaking provides a framework that can reduce uncertainty associated with ex post opportunism and support licensing, investment and market participation.

2.1.1 Legal basis of the FRAND undertaking

The FRAND undertaking is a legal obligation. Its interpretation therefore depends on the relevant SDO policy, applicable laws and the approach taken in the specific jurisdiction. This Report focuses on valuation and the economics of FRAND, which broadly do not vary with legal interpretation. It will therefore not go into detail concerning the legal interpretation of FRAND in different jurisdictions and potential different outcomes.

1 See Section 1.3.2 above.

However, as a basis for the subsequent economic discussions, this section briefly summarizes several of the *legal* issues that may arise in FRAND cases, the interpretation of which can vary between jurisdictions.

As noted above, the inclusion of FRAND undertakings in SDO IPR policies may be motivated, in part, by competition law considerations. In some jurisdictions, consequently, the interpretation of FRAND has been approached primarily through the lens of competition law, while in others it is treated predominantly as a matter of contract law (for example, as a third-party beneficiary arrangement). In practice, both perspectives may be relevant. A detailed analysis of these approaches is beyond the scope of this Report. It is sufficient to note that these two foundations serve different functions: the contractual undertaking supports standardization by providing assurance that innovators and implementers can make relationship-specific investments before detailed licensing terms are agreed, with a reduced risk of subsequent appropriation. Competition law, by contrast, focuses on protecting the competitive process and is directed at constraining certain forms of SEP licensing conduct, particularly where companies hold a position of dominant market power.

A practical implication is that a breach of a contractual FRAND undertaking does not necessarily imply a competition law violation, and vice versa. Contract and competition law apply different tests and provide different remedies. As a result, a royalty may be considered to be outside the FRAND range under an undertaking made at an SDO if understood contractually, without meeting the separate – and often higher – threshold for an antitrust infringement, which typically requires additional elements, such as dominance and competitive harm.[2]

Naturally, differences in applicable competition laws, as well as differences in the wording and in the applicable laws governing different IPR policies, affect the outcome of what is considered to be FRAND.[3] However, some differences in terminology can be superficial. For instance, some policies use "FRAND," as is the case in ETSI's policy for the governance of cellular standards. Others use "RAND," such as the ITU's policy for video codec standards. Generally, these terms are treated as substantively the same undertaking in practice.[4]

2.1.2 Key principles of FRAND

Without going into the details and differences between jurisdictions, some general key principles in the interpretation of FRAND can be observed.

Committing to "**fair and reasonable**" terms is typically framed as the price a *willing licensor* and a *willing licensee* would agree, both acting in *good faith* and with appropriate information, taking account of the value of the patent rights.[5]Courts may use valuation to determine fair and reasonable royalty terms that are FRAND, either to directly award for terms, or to assess whether a party's offer or counter-offer is FRAND.[6]

The concept of a **willing licensor** and a **willing licensee** is often assessed against the parties' behavior during the negotiations. It permits good faith disagreement over terms but seeks to distinguish between parties that genuinely seek to reach an agreement within a reasonable

2 Specifically in the context of FRAND and SEPs, see *Optis* v. *Apple* [2025] EWCA Civ 552 (link) , para. 119: "A finding that a degree of hold-up or hold-out was involved in a given real negotiation is not a finding that either party has acted in an unlawful manner. It is simply a finding that that outcome cannot be taken as the FRAND rate. It may be close to it or far away, and if a view can be taken about the degree of hold-up or hold-out involved that might shed some light, but these are different issues."

3 For example, in the UK Supreme Court's assessment of non-discrimination, it was relevant that ETSI had previously considered and rejected the imposition of a "most-favourable licence" clause in the undertaking, which requires that the lowest rate agreed with one party is offered to all other parties. See *Unwired Planet* v. *Huawei* [2020] UKSC 37 (link) , para. 116 et seq.

4 This report uses the term FRAND.

5 See, for example, *Georgia-Pacific Corp.* v. *United States Plywood Corp.*, 318 F Supp. 1116, 6 USPQ 235 (SD NY 1970), May 28, 1970. See also *Optis* v. *Apple* [2025] EWCA Civ 552 (link) , para. 119: "The relevant context is the court's task of identifying a rate which is FRAND. As a matter of principle that is a rate which a willing licensee and willing licensor would agree. This is an idealised legal standard."; and Intellectual Property Office, Patents Act 1977, United Kingdom (amended up to 2025).

6 For example, in litigation between *Samsung* and *ZTE*, the High Court (England & Wales) and Chongqing Court both determined a royalty they considered FRAND for a global license between the parties; their valuation differed. The Munich Regional Court did not set a FRAND rate, but compared *ZTE*'s offer to its own FRAND assessment. It considered *ZTE*'s offer was FRAND. See *Samsung* v. *ZTE* [2026] EWHC 999 (Pat), *ZTE* v. *Samsung*, The People's Republic of China Chongqing First Intermediate Court Civil Judgment, Yu 01 Min Chu No. 905; *B*, Munich Regional Court, 30.04.2026, 7 O 64/25 – *Bestimmung der Angemesenheit von FRAND-Lizenzrate* (link)

range and those that strategically refuse to engage, delaying negotiations or insisting on unreasonable positions. Parties are generally expected to engage with each other in good faith, and their conduct – including the exchange of offers, the provision of information and the use of legal remedies – may influence whether outcomes are consistent with a reasonable range. The assessment of such conduct is context specific. Jurisdictions differ in how far they treat negotiation conduct as a distinct requirement. Courts and government authorities in a number of jurisdictions have developed practical guidance on negotiation steps and information exchanges that may be relevant to assessing good-faith behavior and the appropriateness of particular remedies.[7]

It is generally recognized that there may be a **range of reasonable prices** for a given portfolio and set of circumstances, rather than a single rate. Commercial negotiations do not normally converge on a single point estimate that reflects "the" FRAND rate in all cases.[8] Terms may also be structured in different ways, while providing broadly the same economic value. For example, licenses with terms that provide the same economic value may involve a lump-sum payment, a running royalty per unit or a cross-license; provided the overall value exchanged is broadly comparable once the differences in their scope, timing, risk allocation and other commercial terms are taken into account.[9]

The "**non-discriminatory**" element seeks to ensure that similarly situated implementers are not placed at a competitive disadvantage. For example, it prevents a vertically integrated licensor from using market power to impose disadvantageous terms on downstream rivals.[10] It generally does not require identical licensing terms and differences may be justified where they reflect relevant commercial factors (for example, where one license covers more licensed units, or those units are sold in countries with materially different conditions, or the license lasts longer, includes more patents or the payment structure allocates risk differently between the parties)

FRAND undertakings typically do not specify a predetermined royalty rate or a fixed set of payment terms. Neither, typically, do they specify a predetermined process for negotiating or calculating FRAND terms. Instead, they operate as a **principles-based undertaking** that licensing terms will satisfy the core concepts that underpin FRAND terms and negotiations. This allows flexibility in licensing arrangements but also leaves scope for disagreement over what constitutes FRAND in practice.

2.2 Common types of FRAND disputes

FRAND disputes arise when parties disagree, in the context of a particular negotiation, about what the FRAND undertaking requires. Such disagreements may concern different dimensions of the undertaking and may, depending on the applicable law, procedural framework and the parties' own choices, arise separately or together in the same proceedings. Against that background, four recurring categories of dispute can be identified. Each is connected, directly or indirectly, to the value of the license agreement to the parties, and each may be informed, clarified or narrowed by reliable valuation and economic analysis.

7 For instance, see discussions in *Huawei* v. *ZTE Deutschland GmbH*, CJEU [2015] Case C-170/13 (link) ; *Unwired Planet* v. *Huawei* [2020] UKSC 37 (link) ; and Federal Court of Justice, 05.05.2020, KZR 36/17 – FRAND-Einwand ; Japan Patent Office, Guide to Licensing Negotiations Involving Standard Essential Patents ; METI, Good Faith Negotiation Guidelines for Standard Essential Patent Licenses (31 March 2022); Tokyo District Court IP Divisions, Guidelines for Standard Essential Patents Judicial Mediation (SEPJM) (January 2026) .

8 This does not mean that the range is unbounded, and a "range" may take on different meanings depending on the context; e.g., a FRAND range may have a different meaning in the context of offers (where there may be limited or asymmetric information) from the range that is considered in a FRAND rate determination (which may be due to factors such as measurement issues).

9 See Section 3.2 below.

10 Swanson and Baumol offer a principle for determining non-discriminatory royalties when the licensor is vertically integrated, known as the efficient component pricing rule (ECPR). The ECPR provides a pricing rule that is competitively neutral in downstream markets. The ECPR states that the price of the bottleneck input (here, the license fee for the SEP) should equal the price that the vertically integrated firm charges for the final product using the intellectual property (IP), net of the incremental cost to that firm of all other inputs used to produce the final good. Swanson, D.G. and W.J. Baumol (2005). Reasonable and non-discriminatory (RAND) royalties, standards selection, and control of market power. *Antitrust Law Journal*, 73(1), 1–58.

2.2.1 Disputes about price and payment structure

These disputes concern whether proposed payment terms fall within a FRAND range. Parties may disagree about the royalty level, the royalty structure (for example, a running royalty per unit, a percentage of a price or a lump sum) and the treatment of cross-licenses or other forms of non-monetary consideration.

These disagreements often reflect different views about (i) the value of the SEP portfolio, (ii) the appropriate benchmarks for reasonableness and (iii) the adjustments needed to compare alternative structures on a cash-equivalent basis.

Disputes about price are often resolved through mediation and arbitration. The WIPO Arbitration and Mediation Center (WIPO AMC) regularly manages disputes concerning FRAND royalty rates. Under the WIPO Rules, parties and neutrals are free to determine applicable valuation methodologies. See also WIPO ADR for SEP/FRAND Disputes and WIPO ADR Options for FRAND Dispute Management and Resolution . Court determinations of FRAND terms are not equally common across jurisdictions, reflecting differences in legal frameworks, procedural design and the claims or remedies pursued by the parties. Box 2.1 provides examples of approaches in different jurisdictions. In some jurisdictions, most notably the United Kingdom and China, courts have, in a number of cases, determined FRAND rates. In the United States, FRAND rates have also been determined by courts, but such determinations remain relatively uncommon. In continental Europe, by contrast, courts have generally approached FRAND disputes according to the applicable legal framework, including the *Huawei* v. *ZTE* line of case law in the European Union (EU), focusing in particular on the parties' conduct and on whether proposed terms are FRAND-compliant or evidently non-FRAND, rather than themselves determining a complete FRAND rate or royalty schedule. These differences are also relevant when considering the judicial sources available on valuation methodologies.[11]

Box 2.1 Disputes about royalty level and structure (case examples)

United Kingdom: Global portfolio rates and pricing of past sales. In *Unwired Planet* v. *Huawei*, the UK Supreme Court confirmed that an English court may determine FRAND terms for a global portfolio license, backed by an injunction on UK patents if the implementer refuses that license. In *InterDigital* v. *Lenovo*, the Court of Appeal addressed historic unlicensed sales, holding that using heavy discounts and limitation periods to reduce the price for past use was not FRAND, as it risks rewarding delay and weakening negotiation incentives.

China: Increasing use of court-set rates, including global rates. In *OPPO* v. *Nokia* (Chongqing), the court set global FRAND rates for Nokia's cellular SEP portfolio. There are also domestic FRAND determinations, such as the Supreme People's Court judgment in the *Advanced Codec Technologies* v. *OPPO* dispute.

United States: Court-set FRAND rates are relatively uncommon. Most SEP disputes in the United States are resolved without court FRAND determinations. However, US courts ruled on some of the first and most cited FRAND determinations – *Microsoft* v. *Motorola*, *Innovatio* and *TCL* v. *Ericsson.*

Germany and the Unified Patent Court (UPC): In application of the *Huawei* v. *ZTE* framework, both the German national courts and the German divisions of the UPC have generally assessed FRAND as a defence in infringement proceedings, rather than as an independent rate-setting exercise. Under German *FRAND-Einwand* case law, courts focus on the parties' negotiation conduct and whether the SEP holder's offer is so clearly outside the acceptable FRAND range that it cannot be regarded as a serious FRAND offer, in which case injunctive relief may be unavailable. The UPC's early *Panasonic* case law similarly applies *Huawei* v. *ZTE* in a conduct-based manner. Although implementers have sought FRAND-rate or FRAND-terms

11 Judicial decisions from jurisdictions in which courts regularly determine FRAND terms, including global portfolio rates, may provide more detailed discussion of valuation methodologies than decisions from jurisdictions in which courts more often focus on conduct and FRAND compliance without themselves setting a complete rate or royalty schedule.

determinations by counterclaim before the UPC, the Mannheim Local Division dismissed those counterclaims and did not itself set a FRAND royalty rate.

Interaction between jurisdictions with divergent views on the global FRAND rate. An SEP licensing dispute between *Samsung* and *ZTE* was heard in several jurisdictions. Three of them opined on the FRAND rate, reaching different conclusions. In the UK, the High Court awarded a global FRAND license valued at USD 392 million for a five-year term. In China, the Chongqing Court valued a six-year global license at USD 731 million. The Munich Regional Court did not set a rate, but concluded the upper bound of a FRAND offer was USD 798.6 million for a five-year term. The reasons reflect differences in the evidence presented, how its relevance was assessed, and the interpretation of the previous license between the parties.

Sources: *Unwired Planet* v. *Huawei* [2020] UKSC 37 (link) ; *InterDigital* v. *Lenovo* [2024] EWCA Civ 743 (link) ; *OPPO* v. *Nokia* [2021] The People's Republic of China Chongqing First Intermediate Court Civil Judgment, Yu 01 Min Chu No. 1232 ; *Advanced Codec Technologies* v. *OPPO* [2022] ZGFZMZ Nos. 907, 910, 911, 916, 917 and 918, SPC (link) ; *Microsoft Corp.* v. *Motorola, Inc.* No. C10-1823JLR (W.D. Wash., 2013) (link) ; *In re Innovatio IP Ventures, LLC, Patent Litigation,* (link) 921 F. Supp. 2d 903 (N.D. Ill. 2013) ; *TCL Communication Technology Holdings Ltd.* v. *Telefonaktiebolaget LM Ericsson,* No. 8:14-cv-00341, (C.D. Cal. Dec. 21, 2017), amended and superseded (C.D. Cal. Sept. 14, 2018) (link) , rev'd in part, vacated in part 943 F.3d 1360 (Fed. Cir. 2019) CJEU, *Huawei Technologies Co. Ltd* v. *ZTE Corp.* and *ZTE Deutschland GmbH*, Case C-170/13, judgment of 16 July 2015 (link) ; Federal Court of Justice , 05.05.2020, KZR 36/17 – FRAND-Einwand ; Federal Court of Justice, 24.11.2020, KZR 35/17 – *FRAND-Einwand I*, Federal Court of Justice , 27.01.2026, KZR 10/25 – *FRAND-Einwand III*, especially headnotes and paras. 50–53, 60–63; UPC Local Division Mannheim, *Panasonic* v. *OPPO*, UPC_CFI_210/2023, decision of 22 November 2024 (link) ; the judgment states that OPPO filed a counterclaim for determination of a FRAND royalty for the EP territory. Same judgment, *Panasonic* v. *OPPO*, UPC_CFI_210/2023, decision of 22 November 2024 (link) , dismissing the FRAND counterclaim / FRAND-rate determination request. *Samsung* v. *ZTE*, [2026] EWHC 999 (Pat) (link) ; *ZTE* v. *Samsung*, The People's Republic of China Chongqing First Intermediate Court Civil Judgment, Yu 01 Min Chu No. 905; Munich Regional Court, 30.04.2026, 7 O 64/25 – *Bestimmung der Angemessenheit von FRAND-Lizenzraten* (link) .

2.2.2 Disputes about discrimination

Non-discrimination disputes concern whether similarly situated implementers are being offered sufficiently comparable terms.

As outlined in Part 1, FRAND does not necessarily require identical terms for all licensees. Differences in circumstances can justify differences in terms, particularly where licensees operate in distinct product markets or where the same technology creates different value in different uses. The dispute typically turns on (i) whether the implementers are comparable for the relevant purpose and (ii) whether differences in terms are objectively justified and consistent with lawful, non-exclusionary competition.

These disputes therefore rely on reliable valuation and economic analysis, not a simple comparison of whether the terms are "broadly similar".

Whether two firms are "similarly situated" often depends on the economic facts: whether products compete and, if so, how intensely, how the standardized functionality contributes to value in each use, and whether differences in license scope, timing or risk allocation and so forth change the cash-equivalent value of the proposed terms.

Some argue that *differential* treatment is *discriminatory* treatment if royalty rates differ substantially among similarly situated licensees after controlling for other factors. Others have argued for a higher standard, based on whether such rates would distort downstream competition – for example, by raising a rival's costs relative to a vertically integrated licensor, or by conferring a cost advantage on one implementer that cannot be explained by objective commercial differences. Economic analysis can help to assess (i) the relevant product market and competitive conditions, (ii) which differences between implementers are economically material, and (iii) whether differences in terms are likely to affect competitive outcomes rather than merely reflect normal commercial variation.

In practice, non-discrimination disputes revolve around three questions, as set out in Box 2.2.

Box 2.2 Discrimination disputes (case examples)

Are firms similarly situated? The similarity of the parties' situations should be assessed by reference to economic facts, such as product type, geographic footprint and sales scope. For instance, in *TCL* v. *Ericsson* (United States), major global smartphone manufacturers were treated as relevant comparators to TCL, whereas firms with a narrow geographic focus on China (CoolPad) and India (Karbon) were not.

Must similarly situated firms agree the same rate? In both the United Kingdom and Germany, courts have generally rejected a hard-edged approach under which any lower rate offered to another licensee automatically makes an offered rate discriminatory. The analysis instead focuses on whether differences are objectively justified and, in particular, whether they could distort competition. The jurisdictions may differ in emphasis – for example, in the weight given to competition-law framing and to information and procedural expectations – but not in requiring identical rates in all cases.

Does structure matter, or only the value of the terms? Courts often focus on whether different payment structures deliver broadly comparable cash-equivalent value, rather than requiring identical structures (for example, English FRAND decisions including *Optis* v. *Apple*). Some decisions, however, treat structure and transparency as more significant in particular contexts. The Karlsruhe Higher Regional Court in *Datenpaketverarbeitung* considered it relevant that the licensor did not adequately explain why it accepted a lump sum from one party but offered a running royalty to another In India, competition proceedings have also treated aspects of royalty structuring as potentially discriminatory, particularly where they may affect downstream competitive conditions.

Sources: *TCL Communication Technology Holdings Ltd.* v. *Telefonaktiebolaget LM Ericsson,* No. 8:14-cv-00341, (C.D. Cal. Dec. 21, 2017), amended and superseded (C.D. Cal. Sept. 14, 2018) (link) , rev'd in part, vacated in part 943 F.3d 1360 (Fed. Cir. 2019) , cert. denied 141 S.Ct. 239 (2020); *Unwired Planet* v. *Huawei* [2020] UKSC 37 (link) ; *Optis* v. *Apple* [2025] EWCA Civ 552 (link) ; Federal Court of Justice, 05.05.2020, KZR 36/17 – *FRAND-Einwand* (link) ; Higher Regional Court Karlsruhe, 30.10.2019, 6 U 183/16 – *Datenpaketverarbeitung* (link) ; Higher Regional Court Düsseldorf , (link) 22.03.2019 , (link) 2 U 31/16 – *Improving Handovers* (link) , paras 413–414 and 420. For Indian competition proceedings, see *Micromax v Ericsson,* Case No. 50/2013 , and *Intex v. Ericsson* , Case No. 76/2013 (link) .

2.2.3 Disputes about negotiation conduct

Conduct disputes focus on how the parties negotiate – for example, whether offers and counteroffers were made in a timely way, whether information was shared sufficiently to evaluate proposals or whether either side delayed unreasonably. While these disputes are formally about process, they often matter because negotiation conduct can affect bargaining leverage and therefore influence the terms ultimately agreed or imposed.

Reliable valuation and economic analysis can help to resolve these disputes, even though they are about "conduct" not "prices."

In many cases, whether a party is acting as a willing licensor or willing licensee depends in part on whether its proposals and responses were anchored to plausible FRAND terms. For example, an offer that is materially outside a reasonable valuation range may support an inference that a party is using process strategically rather than seeking agreement. Conversely, a refusal to engage, prolonged delay or insistence on terms that remain unsupported by any credible valuation may indicate unwillingness, even if the party asserts that it is "still negotiating." Such issues, however, can be addressed by valuation, which contextualizes parties' conduct, providing information on whether particular positions or remedies are proportionate in light of the value and terms at stake.

A recent development in conduct disputes is the strategic use of parallel proceedings in multiple jurisdictions. This is particularly evident where parties litigate in – or seek to avoid – courts that are prepared, in some circumstances, to determine FRAND terms for global portfolio licenses (notably the United Kingdom and China and, in more limited procedural contexts, the United States). Box 2.3 highlights disputes where courts assessed whether the parties' global litigation strategy – including seeking injunctions in parallel proceedings – was consistent with negotiating a FRAND license in good faith.

Box 2.3 Global litigation strategy and good-faith FRAND negotiations (case examples)

United Kingdom/United States; United Kingdom/UPC/Germany – cross-border interim measures in global SEP disputes (Ericsson v. Lenovo; Amazon v. InterDigital). In the United Kingdom, courts have considered interim measures in global SEP disputes. For example, in *Ericsson v. Lenovo*, the Court of Appeal granted an interim license declaration holding that, pending a final FRAND determination, a willing SEP holder would offer a temporary license so the dispute can be resolved without the prospect of an injunction distorting negotiations. In the United States, the Federal Circuit sent the case back to the district court after holding that it was wrong to refuse, at the threshold stage, to consider an anti-suit injunction that would stop enforcement of foreign SEP injunctions while the US court considered alleged FRAND-related breaches. Further, in *Amazon* v. *InterDigital*, the UK proceedings seeking interim or adjustable RAND licensing relief led to parallel applications for anti-interim license relief before the UPC Mannheim Local Devision and the Munich Regional Court. Both courts granted *ex parte* anti-interim-license injunctions restraining *Amazon* from seeking or continuing UK interim license relief, or equivalent measures, that would effectively prevent *InterDigital* from pursuing or continuing patent infringement proceedings before the UPC or German courts, or from enforcing any resulting judgments or measures. The UK High Court subsequently granted an *ex parte* anti-anti-suit injunctive relief (AASI) intended to prevent *InterDigital* from seeking further anti-suit relief before the UPC Mannheim Local Division, the Munich Regional Court, or any other court to restrain *Amazon* from carrying on its claim to substantive, final RAND relief in the UK proceedings.

China/India – anti-suit and anti-anti-suit injunctions (*InterDigital* v. *Xiaomi*). In China, the Wuhan court granted an anti-suit injunction ordering *InterDigital* to withdraw or suspend the Indian proceedings and restraining it from seeking injunctions or FRAND determinations elsewhere while the Chinese case proceeded. In India, the Delhi High Court granted relief restraining *Xiaomi* from enforcing the Wuhan anti-suit injunction against *InterDigital* in relation to the Indian proceedings (an anti-anti-suit/anti-enforcement order), so that the Indian case could continue.

Sources: *Lenovo* v. *Ericsson* [2025] EWCA Civ 182 (link) ; *Ericsson v. Lenovo., No. 24-1515 (Fed. Cir. Oct. 24, 2024)* (link) *Amazon. v InterDigital* [2025] EWHC 3170 (Pat) (link) ; *InterDigital* v *Amazon*, UPC_CFI_936/2025, Local Division Mannheim, order of 30 September 2025; Munich Regional Court, 24.09.2025, 21 O 12112/25, clarified by order of October 1, 2025 [Klarstellungsbeschluss] pursuant to sections 319, 938 (1) German Civil Procedure Code (ZPO); *Amazon v. Interdigital* [2025] EWHC 3170 (Pat) (link) ; *InterDigital* v. *Xiaomi* [2021] Delhi High Court CS(COMM) 295/2020 (link) .

2.2.4 Disputes about the appropriate licensing level

Parties may also disagree about the appropriate point in the supply chain at which SEP licenses should be taken. For example, disputes can arise over whether licensing should occur at the component level (for example, where a Wi-Fi chipset manufacturer takes a license) or at the end-product level (where a laptop manufacturer takes a Wi-Fi SEP license).

In simplified terms, two positions are often described[12]:

- "**License-to-all**" approaches emphasize the availability of licenses on FRAND terms at different levels of the supply chain, including to upstream component suppliers. Proponents often argue that this can reduce transaction costs, provide clearer pricing signals earlier in the supply chain and support downstream access.
- "**Access-to-all**" approaches emphasize access to the standard on FRAND terms for all implementers, even where licensing takes place at a particular level of the supply chain, such as the end-product level. Proponents often argue that licensing at the level where the standard is implemented and sold can be administratively simpler and more closely aligned with how value is realized in products and services.

12 On SEP valuation and the level of licensing, see, for example, Heiden, B., J. Padilla and R. Peters (2021). "The value of standard essential patents (SEPs) and the level of licensing. *American Intellectual Property Law Association Quarterly Journal*, 49(1). Llobet, G. and D. Neven (2023). Investment and patent licensing in the value chain. Journal of Competition Law & Economics, 19(4), 527–555.

These issues raise several economic questions, including the costs of negotiating licenses, as transaction costs can differ depending on the number of firms at each level in the supply chain, whether the licensing level and potentially different royalty base affects the reasonable price that parties agree to, the risk of double-dipping, and how the benefits and costs of a license are passed on to firms and consumers downstream. Box 2.4 provides examples.

Box 2.4 Disputes about licensing level across jurisdictions (case examples)

India – upstream component versus downstream device (*Micromax* v. *Ericsson*; CCI proceedings). In 2014, the Competition Commission of India (CCI) ordered an investigation into Ericsson's SEP licensing practices following complaints including *Micromax* v. *Ericsson*. Among other issues, implementers argued that royalties should be linked more closely to the SEP-practising component, rather than calculated on the selling price of the end device. In 2023, the Delhi High Court held that, in this context, the Patents Act prevailed over the Competition Act and quashed the CCI proceedings. In 2025, the Supreme Court dismissed the CCI's Special Leave Petition against that judgment, leaving the Delhi High Court's position undisturbed.

United States – no antitrust duty to license at the component level (*FTC v. Qualcomm*). In 2020, the Ninth Circuit reversed the district court's ruling and held that Qualcomm's refusal to license rival chip suppliers did not, on the facts, amount to an antitrust violation. The court further indicated that disagreements about licensing level under the FRAND undertaking were better addressed, in that case, through contract and patent law rather than under the antitrust framework.

Germany/EU – connected vehicles and tiered supply chains. In a series of connected car disputes, the vehicle manufacturer argued that licenses should be taken by upstream suppliers, while the SEP holder pursued licensing at the vehicle manufacturer level. In Germany, one first-instance court found infringement and rejected the car manufacturer's FRAND defence; another first-instance court referred questions to the CJEU concerning, among other matters, the level of licensing. The litigation and related proceedings illustrate how licensing level questions can become central in multi-tier industries, where components are supplied by specialist firms but value is realized at the end-product level. The parties settled in 2021.

Sources: *Federal Trade Commission* v. *Qualcomm Inc.*, 969 F.3d 974 (9th Cir. 2020) (link) . For German connected car disputes, see Regional Court Mannheim,18.08.2020, 2 O 34/19 – *Lizenz in der Wertschöpfungskette*, as to the preliminary stay of enforcement, see Higher Regional Court Karlsruhe,12.02.2021, 6 U 130/20 – *Wurzelsequenzordnung*, as to the CJEU referral, see Regional Court Düsseldorf, 26.11.2020, 4c O 17/19 ; for the Indian competition proceedings, see Case *Competition Commission of India v Monsanto Holdings Private Limited, Telefonaktiebolaget LM Ericsson & Micromax Informatics Limited.* (link)

2.3 Why reliable valuation is central to resolving FRAND disputes

Valuation methodologies can be used to establish both the economic value that is generated when innovators and implementers of technology standards combine their contributions and the prices that parties would negotiate in light of that value and those specific circumstances.[13]

2.3.1 The role of valuation

Ensuring that license negotiations and FRAND determination are informed by reliable valuation helps both to resolve disputes and to deter them.

13 How parties negotiate terms that divide the value created by their cooperation is underpinned by the economics literature on bargaining. In particular, on bargaining power and complementary values, see Nash, J.F. (1950). The bargaining problem. *Econometrica*, 18(2), 155–162; Shapley, L.S. (1953). A value for n-person games. In Kuhn, H.W. and A.W. Tucker (eds), *Contributions to the Theory of Games (Vol. II)*, *Annals of Mathematics Studies*, 28. Princeton University Press, 307–318.

2.3.1.1 Resolving FRAND disputes

Reliable valuation is most obviously relevant to disputes about royalty level and structure. In essence, these disputes arise because the parties have incompatible views about what constitutes a reasonable range of terms. To the extent that robust valuation methods can identify, or at least narrow, a plausible FRAND range, they can reduce disagreement and help parties reach agreement.

In practice, however, valuation evidence in SEP disputes has often been contested. Opposing parties sometimes present estimates that diverge widely, even where each party claims to have applied recognized methodologies. This divergence does not necessarily imply bad faith: even when everyone is acting honestly and using the same data, results can still differ significantly because analysts must make many legitimate choices along the way, and those choices change the answer.[14] This is exacerbated by the intrinsic features that make the value of SEP licenses uncertain:[15] complexity, incomplete information and uncertainty about the strength and relevance of particular patents, about comparability of benchmarks and about how value should be apportioned.

Divergence is exacerbated when analyses are difficult to interpret or verify. If key assumptions and modelling choices are not transparent, it becomes challenging for opposing parties – and for courts, arbitrators and mediators – to identify the source of disagreement, test sensitivity to inputs or determine which conclusions are robust. In such circumstances, decision-makers may face a practical difficulty: even if they find weaknesses in both sides' analyses, they must still determine terms. Where valuation evidence does not provide clear, verifiable anchors, outcomes can become more dependent on judgment and discretion, which can in turn increase uncertainty and the possibility of subsequent disputes. The impact of uncertainty and ambiguity is exemplified by the dispute between *Samsung* and *ZTE*. Considering broadly similar evidence, three courts – the High Court (England & Wales), Chongqing Intermediate Court, and Munich Regional Court – reached different conclusion about the FRAND terms. Those differences relate to the evidence presented, their assessment of it, and interactions with other issues regarding the scope of the license.[16]

For these reasons, reliable valuation should be understood not only as producing a plausible numerical estimate, but also as using methods that are transparent, reproducible and appropriately grounded in evidence. Valuation that meets these standards reduces the scope for incompatible expectations and supports more efficient resolution of disputes.

2.3.1.2 Deterring disputes

Valuation also has a bearing on whether disputes arise in the first place. Good valuation not only helps to resolve disputes, it also makes disputes less likely to occur.

Parties typically form their negotiating positions by considering the range of outcomes that a court or arbitrator might impose if negotiations fail. If adjudicated outcomes are reasonably consistent and predictable, parties are more likely to agree terms commercially. Conversely, if outcomes are highly uncertain, parties may be encouraged to "wait and see", to litigate strategically or to delay in the hope of obtaining more favorable terms from a particular forum.[17]

14 The uncertainty created by the variance in these choices is referred to as "**nonstandard errors**." Standard errors capture randomness from the data-generating process (sampling noise): if a new sample is drawn, the estimate would alter. Nonstandard errors capture randomness from the evidence-generating process: different analysts, working in good faith, will make different defensible choices – what to include/exclude, how to define variables, which specification to use, which adjustments are "reasonable." Those choices can change estimates substantially. Menkveld, A.J. *et al*. (2024). Nonstandard Errors. *Journal of Finance*, 79(3), 2339–2390.

15 See Section 1.3.3 above.

16 Samsung v ZTE [2026] EWHC 999 (Pat) *ZTE* v *Samsung*, The People's Republic of China Chongqing First Intermediate Court Civil Judgment, Yu 01 Min Chu No. 905; and Munich Regional Court, 30.04.2026, 7 O 64/25 – *Bestimmung der Angemessenheit von FRAND-Lizenzrate* (link) *n.*

17 Economic models of bargaining and settlement predict that, when parties have limited outside options and disagree about expected adjudicated outcomes – especially under asymmetric information – negotiations are more likely to involve delay or impasse; conversely, more predictable and transparent valuation anchors narrow the range of plausible outcomes and increase the likelihood of agreement. See Rubinstein, A. (1982). Perfect equilibrium in a bargaining model. *Econometrica*, 50(1), 97–109; Fudenberg, D. and J. Tirole (1983). Sequential bargaining with incomplete information. *The Review of Economic Studies*, 50(2), 221–247; Admati, A.R. and M. Perry (1987). Strategic delay in bargaining. *The Review of Economic Studies*, 54(3), 345–364; and Bebchuk, L.A. (1984). Litigation and settlement under imperfect information. *The RAND Journal of Economics*, 15(3), 404–415.

Uncertainty can therefore increase the incentive to dispute even where the parties privately recognize that an agreement exists within a reasonable range. More predictable valuation frameworks can reduce these incentives by narrowing the plausible range of outcomes and making the implications of key assumptions easier to test. They can also support better investment decisions by both innovators and implementers, because expected licensing costs and revenues become less uncertain.

2.3.2 An overview of valuation approaches

There are three broad approaches that are commonly discussed – two of which can be applied to SEPs. Each offers a different way to anchor the assessment of FRAND terms, and each has strengths and limitations.

2.3.2.1 Market-price-based approaches

Market-price-based approaches assess the reasonableness of proposed terms by reference to prices that arm's-length parties have agreed in comparable license agreements. The aim is to identify a "going rate" for similar rights in similar circumstances and to adjust for differences in scope, geography, timing, portfolio strength or other relevant factors.

This approach aligns with valuation practice in many markets, where the price of an asset is benchmarked against prices for similar assets. In SEP licensing, however, comparables can be difficult to apply effectively. Licenses are often confidential, may bundle multiple rights and may reflect settlement dynamics, cross-license value or litigation risk. In addition, comparable agreements are not necessarily FRAND – as the comparable contracts may also have been agreed by parties without credible outside options to apply competitive pressure on prices.

Nonetheless, valuation by reference to comparable contracts is widely used in practice and frequently features in litigation and arbitration. See Part 3 for a detailed discussion of this approach.

2.3.2.2 Value-based approaches

Value-based approaches assess the reasonableness of licensing terms by reference to the economic value of the benefits enabled by the technology. In practical terms, this means focusing on forward-looking expectations: the future benefits, revenues, cost savings or avoided losses that access to the standardized technology is expected to deliver and how that expected value should be shared between innovators and implementers.

In principle, value can be described in two related ways:

- **absolute economic value**: this is the value of the total benefits enjoyed by users and implementers (for example, improved performance or new functionality); and
- **incremental value**: this is the value of the technology relative to the next-best alternative that would have been available absent standardization, recognizing that, once adopted, standardization eliminates alternatives.

Identifying both the economic value and the incremental value that depends on licensed technology helps to clarify the stakes of negotiation. The economic value establishes the scale of the benefits to which both parties have contributed. The incremental value over alternatives is one of the factors that influences the specific terms – or price – that the parties agree, which determines how the total value will be divided between them.

Value-based approaches are particularly relevant in innovation-driven sectors because development costs and economic value are not closely linked. A technology can be expensive to develop and yet create limited value, or relatively inexpensive to develop and yet create very significant value. A valuation framework that focuses only on cost risks rewarding effort rather than impact.

At the same time, value-based approaches require evidence and assumptions that can be challenging to verify. In this Report, two value-based approaches are discussed in detail: the bottom-up method (Part 4) and the top-down framework (Part 5).

2.3.2.3 Cost-based valuation approaches

Cost-based approaches assess reasonableness by reference to costs and a margin – often described as “cost-plus". In regulated sectors with high fixed costs and stable demand, cost-based approaches can provide administrable benchmarks for ensuring cost recovery and incentivizing investment.

In SEP licensing, however, cost-based approaches are generally less informative. Research and development is inherently risky: many projects fail and returns are earned from the subset that succeeds. A benchmark that focuses on the costs of successful inventions alone can understate the level of returns required to sustain overall R&D effort. Consequently, the appropriate “plus” – the margin required to reward risk, reflect opportunity cost and incentivize ongoing improvement – often becomes the central question, and it cannot be determined from costs alone.

Cost evidence can nevertheless play a role in some settings. It may be relevant as part of a broader assessment of commercial reasonableness; for example, by offering insight into whether proposed terms are clearly inconsistent with sustainable participation or by providing a cross-check for extreme outcomes. However, cost-based methods rarely provide a sufficient standalone basis for determining FRAND terms in innovation-led standardized technology markets.

2.4 Summary

FRAND disputes have several recurring dimensions: disagreement over royalty level and payment structure; disagreement over non-discrimination and comparability; disputes about whether parties negotiated in good faith; and disputes about where, within a supply chain, licenses should be offered.

Across these categories, the same practical challenge recurs. FRAND is expressed at a high level, but settlement and adjudication turn on concrete issues: the scope and strength of the portfolio, the value contributed by standardized technology, the relevance of market benchmarks, and whether particular offers and counter-offers are consistent with that evidence.

The concept of FRAND has an important economic rationale. It is intended to preserve incentives on both sides of standardization: for innovators to contribute patented technologies for inclusion in a standard, and for implementers to invest in developing, manufacturing and bringing standard-compliant products and services to market. In practice, that objective requires an assessment of the value that standards help to create, the contributions that innovators and implementers make to that value, and how specific license terms divide it between licensor and licensee. Carrying out this assessment in a disciplined way depends on reliable valuation.

Reliable valuation helps to bridge the gap between an undertaking to the principle that licenses are FRAND and the agreement to terms that are FRAND in practice. Where parties can anchor their positions with robust methodologies and verifiable inputs, the range of plausible FRAND outcomes narrows and negotiations are less likely to be distorted by strategic delaying tactics or entrenched positions. Where clear valuation anchors are lacking, courts, tribunals and mediators are left to exercise broader evaluative judgment when settling FRAND disputes. In such circumstances, the prospect that a resolution may provide a “mechanical” middle-ground outcome would not only risk failing to serve the markets that rely on FRAND license terms, but can also encourage parties to adopt more extreme positions, rather than converging on terms that balance their interests.

The next three parts of this Report address the principal valuation methodologies put forward in SEP license negotiations, whereby the order follows an economic logic, which does not reflect any preference for, or assessment of, the practical utility of the methodologies. Part 3 examines the comparable-licenses approach in detail. Parts 4 and 5 then turn to value-based frameworks – bottom-up and top-down approaches, respectively – and explain how they can be applied, and tested, to better inform negotiations and resolve disputes more effectively.

3 Valuation from comparable contracts

Topics covered in Part 3:

- **Overview of valuation from comparable contracts**
- **Step 1: Identifying transactions with comparable characteristics**
- **Step 2: "Unpacking" the rates agreed for comparable contracts**
- **Step 3: Adjusting unpacked rates to estimate comparable prices**
- **Assessing whether comparable contracts provide prices within the FRAND range**

3.1 An overview of valuation from comparable contracts

Parties, courts and arbitrators often estimate reasonable terms for an SEP license (the **Focal Contract**) by reference to comparable contracts. In this Report, "comparable contracts" means licenses that have sufficiently similar "characteristics" – with regard to the licensed patent rights, the products implementing those rights and other circumstances that affect the commercial substance of the negotiation and, therefore, the value of the agreement.[1]

3.1.1 The rationale

Inferring the reasonable price for an asset from transactions for similar assets is a "market-based" valuation methodology. Its central premise is that independent parties facing similar circumstances will tend to agree similar prices for similar assets.

The task is therefore to (i) identify transactions that are genuinely comparable and (ii) use the terms agreed in those transactions to estimate terms that may be reasonable for the license being valued (the Focal Contract), taking account of relevant differences in structure and circumstances that affect the terms which parties agree.

This approach is widely used in valuation in general. A familiar example is property valuation. Although each property is unique, sale prices for properties with similar relevant features – such as location, floor area and condition – can indicate a plausible range for the property being valued. Comparable properties need not be identical. They may differ in ways that affect price; where that is the case, the valuation may adjust observed prices to better reflect the specific circumstances of the property being valued.

The same basic logic can be applied to SEP licensing. The terms agreed in comparable licenses may indicate a plausible range for the Focal Contract to the extent that those licenses were negotiated at arm's length, in sufficiently similar commercial circumstances, for sufficiently similar patent rights used in sufficiently similar products.

1 Generally, the outcomes of arbitrations and the valuation methodologies they use are confidential. Nonetheless, in the contributors' experience, reference to comparable contracts is common. Publicly available court judgments informed by comparables valuation are listed in Part 3.4 below.

The practical appeal of this approach is that it relies on real-world agreements in the relevant market. In some cases, it may therefore rest on fewer, and more readily verifiable, assumptions than approaches that seek to derive a royalty directly from estimates of the value contributed by the licensed patents.

However, the use of comparable contracts in SEP valuation raises two issues that require particular attention:

- **Whether contracts are genuinely comparable**. A contract is informative only to the extent that the characteristics and circumstances that materially affect price are similar to those of the Focal Contract. In general, the more similar contracts are with respect to the characteristics that determine their value, the more informative the comparison is likely to be.
- **Whether contracts have reasonable terms**. Even where contracts have similar characteristics, the terms agreed in relation to them may not be reasonable. They too were agreed by parties without competitive outside options, and may unreasonably reflect the impact of litigation risk, bargaining power, information asymmetries or strategic considerations.

Accordingly, in SEP valuation one should not assume that a license is comparable, nor that its price is necessarily reasonable. Both propositions must be examined in practice, otherwise there is a risk that not only is the valuation inaccurate but also that the methodology can proliferate non-FRAND prices through the market, resulting in them becoming entrenched.

3.1.2 The approach

At a high level, the comparable contracts approach involves three conceptually distinct steps. They are presented in Box 3.1 in a logical sequence but, in practice, an analyst may apply them iteratively – revisiting earlier steps as additional information becomes available, depending on the specific facts of the valuation.

Box 3.1 The three conceptual steps of a comparable contracts valuation

Step 1 Identifying transactions with comparable characteristics	Step 2 "Unpacking" rates agreed for comparable contracts	Step 3 Adjusting rates to estimate comparable prices
A transaction is **comparable** where the features that materially determine its price are similar to those of the asset being valued.	Comparable licenses may have **different royalty structures**, or non-monetary consideration (such as cross-licenses).	Even the **most similar transactions may differ** from the asset being valued in ways that materially affect its value and the price parties agreed.
Goal: Identify characteristics that drive value and the licenses that reflect the Focal Contract's characteristics closely.	**Goal**: Express the value of each contract's terms using a common cash-equivalent metric, such as an effective per-unit rate.	**Goal**: Adjust the unpacked rates to estimate the price parties might have agreed in circumstances that more closely reflect the Focal Contract.

In principle, the risk that hold-up or hold-out influences the terms agreed in SEP licenses can limit the extent to which comparable licenses provide a reliable indication of FRAND terms for the Focal Contract. To assess the plausibility of that risk, a comparables analysis can be complemented by an assessment of whether the rates inferred from comparable contracts are reasonable in context.

Such assessment can take several forms (which are not mutually exclusive), including the following:

- **Assessing the bargaining process for indications of hold-up and hold-out**. This assessment considers whether features of the negotiation (for example, time pressure, financial pressure or litigation) may have affected the rate ultimately agreed. As far as imbalances in bargaining power result in non-FRAND outcomes, contracts that would be susceptible to such imbalances should be given less or no weight in the assessment.
- **Assessing the breadth of the rates inferred from comparable contracts**. The rates inferred from comparable contacts typically form a range, even when differences have been adjusted for to fullest extent possible. However, that range should be narrow. Otherwise, the central premise that underpins this approach would be wrong: that similar parties in similar circumstances will agree similar prices.
- **Assessing the rates against an external benchmark of value**. Even a narrow range of agreed terms may not converge on royalties that are genuinely FRAND. Cross-checks against external indicators of value are therefore helpful for evaluating the rates that parties agreed to in practice. Courts in several jurisdictions have considered such cross-checks when assessing the royalty rates estimated from comparable contracts.

3.2 Step 1: Identifying transactions with comparable characteristics

This section sets out an analytical framework for identifying contracts whose characteristics are sufficiently similar to those of the Focal Contract to inform the assessment of FRAND terms.

3.2.1 What does it mean to have comparable characteristics in principle?

3.2.1.1 What makes a contract comparable?

A genuinely comparable contract is one where the circumstances and characteristics that materially determine its price and value are sufficiently similar to those of the Focal Contract, such that willing parties would agree similar terms for both contracts. In practical terms, the question is whether willing parties negotiating the Focal Contract would reasonably regard the other contract as informative when negotiating FRAND terms, given their similarity.

A contract will not be comparable where differences in its commercial substance are so material that its agreed terms would not be suitable for the Focal Contract. Conversely, where two transactions are truly like-for-like in their commercial substance, materially different prices may be difficult to reconcile with the idea that similarly situated parties would agree similar terms (which may raise questions regarding the non-discrimination principle in FRAND).

Because comparability depends on context, rigid checklists can be misleading. Nonetheless, in SEP licensing, factors commonly treated as relevant (or argued to be relevant) tend to fall into four broad categories: (i) the **licensed SEPs**, (ii) the **implementing products**, (iii) the **parties** and (iv) the **contract terms**. Box 3.2 provides non-exhaustive examples.

Box 3.2 Examples of characteristics that may determine the value of an SEP license

Categories of value drivers	Non-exhaustive examples
The licensed SEPs	• Scope of SEPs covered
	• Portfolio strength and relevance to the standard (e.g., share of essential patents, technical importance and geographic coverage)
The implementing products	• Extent to which products rely on the latest generation of the standard
	• The scope of implementing product categories covered
	• The volume and mix of each product category
The parties	• Size or market share (which may affect bargaining power)
	• Geographic presence (global v. regional)
	• Business model (pure implementer, vertically integrated)
	• Position in the value chain (consumer product or midstream components)
The contract terms	• Contract duration
	• Sublicensing rights
	• One-way or cross-license
	• Break clauses

Note: This table offers examples of dimensions that may be relevant when assessing comparability. However, they are neither essential to the assessment nor exhaustive. Whether or not a dimension is economically important in a given case, and how much weight each has, depends on its specific context and must be assessed on a case-by-case basis.

3.2.1.2 Exact parallels are ideal, but unnecessary

Comparable contracts rarely match the Focal Contract in all respects. That is not, by itself, a reason to discard them. In many cases, independent parties negotiating the price of the Focal Contract would find informative the price agreed for a contract that is broadly similar, even if it differs in some ways that affect its price.

What matters is the nature of the differences between contracts, and how materially and predictably they affect the prices that parties agree.

- **Crucial characteristics**. Contracts may differ in a way that makes them not comparable, even if they are similar in all other respects. Similarity with respect to these characteristics is essential for a contract to be informative. For instance, the similarity of the licensed SEPs and products typically falls within this group.
- **Material characteristics**. Contracts may differ in ways that materially affect the price that parties agree on. However, if the contract is otherwise similar and the impact that a particular difference in circumstance has on price can be taken into account, then the contract may still be informative. For instance, specific features of the product market, parties and contract terms typically fall within this group.
- **Trivial characteristics**. The fact that certain characteristics may differ will be irrelevant to whether contracts are comparable provided that the differences are immaterial to the prices that parties agree.

The contracts shown in Box 3.3 illustrate the above points.

Box 3.3 Differences across potentially comparable contracts

Parties negotiate a Focal Contract covering Wi-Fi SEPs in laptops. Five potentially comparable contracts are identified.

Assessing differences in potentially comparable contracts

	SEPs	Product	Contract duration	Effective date	Markets
Focal Contract	Wi-Fi	Laptops	10 years	2027	Global
Contract A	Cellular	Smartphones	10 years	2026	Global
Contract B	Wi-Fi	Household IoT	5 years	2025	Global
Contract C	Wi-Fi	Laptops and tablets	9 years	2026	Global
Contract D	Wi-Fi	Tablets	6 years	2024	Indonesia
Contract E	Wi-Fi	Laptops	3 years	2014	Global

Note: For illustrative purposes, this table presents a simplified example with a few dimensions that may be relevant when assessing comparability. These are neither essential nor exhaustive.

Contract A covers SEPs that are essential to a different technology standard (cellular rather than Wi-Fi) for use in different products (smartphones rather than laptops); its terms are unlikely to be informative even though it is similar in other ways.

Contracts B to E all cover the relevant Wi-Fi SEPs but the licensed products sometimes differ.

Contract B licenses the SEPs for use in IoT products, such as smart speakers, whereas the others cover laptops and tablets. Contract B's use-case differs substantially – as its requirement for superior functionality and high data speeds is lower than for products that have high-resolution screens. It is less comparable than the other contracts and probably not a comparable contract, all other things being equal.

The product coverage in Contracts C to E differs, but their use cases are sufficiently similar that it is plausible the manufacturers gain similar value from the Wi-Fi SEPs to the extent that they would agree similar prices and find the terms that each other agree to be informative. They differ in various other ways that may materially affect the consideration that parties would agree. However, each difference in isolation is unlikely to be so material that parties would conclude that the contracts are entirely uninformative. They are probably "comparable" in broad terms.

3.2.1.3 A structured approach to assessing comparability

In practice, it is often prudent to begin by identifying contracts that are **broadly comparable** (for example, licenses covering similar SEPs in similar product markets), rather than rejecting potentially informative contracts too early in the process.

Candidate contracts can then be assessed in more detail to determine:

- the extent to which the remaining differences may materially affect prices;
- whether those differences can be taken into account when valuing the Focal Contract; and
- whether some contracts constitute superior comparisons to others.

The detail of an assessment may vary depending on the facts of the negotiation and the contracts available. Nonetheless, a structured approach helps to identify areas of potential disagreement between the parties, and reduces the risk of inconsistency, selective inclusion ("cherry-picking") and error.

We address practical and specific considerations in Section 3.2.2 below. However, in many cases, their impact can be navigated or mitigated by applying the following broad principles.

- **Explicit and transparent criteria for "comparability"**. First, the characteristics and circumstances that affect the value of a license and the terms that parties agree need to be identified. They are typically determined by referring to commercial experience, economic rationale and evidence on conventional industry practice.
- **A clear rationale for their material impact on royalties**. The factors that parties identify as relevant should be grounded in an economic rationale that explains why differences in that characteristic would affect the terms that parties agree. The stronger the rationale, the more confidence can be placed on the assessment.
- **Broadly, closer comparables are more informative comparables**. Generally, all other things being equal, a contract that more closely resembles the disputed contract with respect to a given characteristic will be a better comparable than contracts that are less similar. This broad observation tends to underpin how courts and arbitrators consider what it means to be "comparable."[2]

3.2.2 Practical considerations when identifying comparable contracts

Several practical considerations must be assessed when identifying comparable contracts. The main issues and best practices for addressing them are set out below:

- assessing the risk of **unobserved characteristics**
- scrutinizing characteristics with an **ambiguous impact** on price
- assessing the risk of **changing circumstances**
- analyzing a single price for a **bundle of technologies and products**
- assessing the risk of using a **limited number of potentially relevant transactions**
- accounting for the **different nature of licensors' comparables and licensees' comparables**
- accounting for differences in the **geographic distribution of patents and products**.

3.2.2.1 Assessing the risk of unobserved characteristics

A comparability assessment necessarily relies on differences in *observed* characteristics. This creates a risk that unobserved factors affecting price are omitted from the assessment in such a way that two contracts appear comparable when their underlying commercial substance differs.

The property analogy is helpful: even with information on location and size, sale price may reflect unobserved factors (for example, disrepair or an urgent requirement to sell). Similarly, SEP license terms may reflect factors that are not apparent from the agreement alone or from market data – for example, time pressure, strategic settlement motivations or information asymmetries.

Broadly, there are two considerations when assessing the risk of unobserved factors:

- **Characteristics that commonly and materially affect contract value**. In principle, the main drivers affecting the terms that parties agree on will be observable, either directly or indirectly; if they were impossible to observe, then it is less likely that parties would have been able to take them into account when agreeing prices. Therefore, the risk of unobserved differences between contracts can often be assessed and mitigated to some extent. For instance, more granular information may be available from the contract terms and supporting materials, market data on products and volumes and, where available, evidence about the negotiation context. While not all material factors will be observable,

2 For instance, in English law, the Court of Appeal in *Optis* v. *Apple* [2025] EWCA Civ 552 (link) , par 35, quoting *Smith Kline & French Laboratories Ltd's (Cimetidine) Patents* [1990] RPC 203 (Lloyd LJ).: "The object of the comparability exercise, in this as in any other branch of the law, is to find the closest possible parallel. If there is an exact parallel, there is no point in looking any further. If there are slight differences, an allowance may be made. But once you have found your comparables, whether one or more, which enable you to arrive at the appropriate figure, it would surely be erroneous to modify that figure by reference to other cases which are not truly comparable at all, so as to bring the case into line with a predetermined range. This was, with great respect, the mistake which the hearing officer made."

systematic scrutiny reduces the likelihood that important differences have been overlooked in the analysis.
- **The number of potentially comparable contracts**. Where there is a large number of comparable contracts, the risk of unobserved factors may be lower, either because it is easier to identify gaps (where seemingly comparable contracts fail to converge to a narrow range of terms) or because the impact of unobserved factors may be cancelled out to some extent – provided that unobserved factors do not skew the terms agreed for contracts in the same direction. However, the larger the number of contracts that are used in the pool of comparables, the larger their disparity of relevance is likely to become, risking the inclusion of contracts with weaker comparability. There is a trade-off between seeking to rely on a greater number of comparable contracts and seeking to rely on more closely comparable contacts.

The risk of unobserved characteristics cannot be ruled out entirely, as it is not possible to prove a negative. However, it can be mitigated. The more systematic and thorough the assessment of each of the factors that typically and materially affect the prices that parties agree for contracts, the less likely it is that material factors have been overlooked.

3.2.2.2 Scrutinizing characteristics with an ambiguous impact on price

In some markets, identifying the main features that determine prices and value is relatively straightforward. Their relevance is an accepted feature of commercial practice and the economic rationale that explains why differences affect the prices that parties agree is easy to articulate and demonstrate.

When comparing patent licenses (including SEPs) it may not be clear whether a particular characteristic materially affects the price that parties negotiate. In particular, a comparability assessment should assess the risk of the following differences:

- **Superficial differences**. These refer to characteristics that differ formally, but the difference has little or no impact on the economic and commercial substance of the license. For instance, in Box 3.4 the Focal Contract has the same formal scope of licensed SEPs and products as Contract A, and Contracts B and C have a narrower scope. However, in practice, the commercial substance more closely reflects Contract B. Superficial differences can be included for strategic reasons – obscuring the contract's commercial substance to increase or decrease its *apparent* similarity when used as a comparable contract in subsequent negotiations.
- **Uncertain differences**. These refer to characteristics that differ, but the impact on price may be genuinely ambiguous. For instance, using the example in Box 3.4, the Focal Contract does offer an "option value"[3] that Contract B lacks. If Party B, the implementer party of the Focal Contract, launched a new product, say Product Z, during the license term, those units would be covered. Whether that option value is material is unclear. If the implementer has no intention, opportunity or capability to go to market, then it is likely to be trivial. If it has all three, it could be material.

The risk and impact of superficial or uncertain differences must be assessed. This avoids excluding relevant contracts that are meaningful comparisons and including misleading ones. The specific approach may vary with context but essentially involves scrutinizing the economic rationale. For example, in Box 3.4 the wider product scope is not valuable to the Focal Contract in abstract; it depends on the materiality of the additional licensed units.

3 In this context, the option to launch new products under the same license.

Box 3.4 Assessing superficial or uncertain differences between contracts

Parties A and B negotiate terms for a Focal Contract covering Wi-Fi SEPs in all consumer products that Party B sells. Three potentially comparable contracts are presented.

Comparison of Wi-Fi licenses with different licensed product scope and mix

			Product X	Product Y
Contract	**Licensed SEPs**	**Licensed products**	**expected volumes**	**expected volumes**
Focal Contract	Wi-Fi	All consumer products	100%	0%
Contract A	Wi-Fi	All consumer products	50%	50%
Contract B	Wi-Fi	Product X	100%	0%
Contract C	Wi-Fi	Product Y	0%	100%

Note: For illustrative purposes, this table presents a simplified example with a few dimensions that may be relevant when assessing comparability. These are neither essential nor exhaustive.

Formally, Contract A has the same scope of SEPs and products as the Focal Contract. The product scope of Contracts B and C is narrower.

However, Party B (the implementer) is expected to sell only Product X during the license term. The **commercial substance** of the transaction more closely resembles Contract B than Contract A.

3.2.2.3 Assessing the risk of changing circumstances

In principle, the impact that a given characteristic has on contract terms may change over time. A more recent transaction may therefore be a better point of comparison than an older transaction that appears otherwise similar.

The value of a licensed technology can change for several reasons. Early transactions may reflect greater uncertainty about market development, adoption or demand for the functionality that the technology enables. Standards are also frequently revised, which can alter the functionality, performance and commercial attractiveness of compliant products. In addition, the apparent strength and scope of a licensor's portfolio may strengthen or weaken over time, as patents are granted, invalidated, supplemented or expire. For these reasons, the price that willing parties would agree for the same rights, used in the same products, may reasonably move up or down over time.

However, in SEP settings, allowing for changes in the rates that parties agree on introduces a particular risk. Once a standard's network effects have removed competitive alternatives, it is particularly difficult to distinguish between changes in circumstances that *should* reasonably affect the prices that parties agree from ex post opportunism that *should not* affect prices. In practice, changes in prices may be influenced more by hold-up or hold-out tactics than by changes in relevant circumstances. So, potentially, an older license could be a better comparable than a recent license when considering all factors together.

Accordingly, it is better to identify the underlying factors that directly affect contract value and that may have changed over time. For instance, rather than assessing differences in contract age, one may be able to assess changes in the indicators of portfolio strength over time, the mix of products implementing the latest generation of the standard or product volumes and price points.

Where such assessments are not feasible, contract age may in some cases provide a pragmatic filter for contracts – for example, excluding contracts that are older than a specified period.

However, although circumstances may change *in principle*, that does not mean they can be treated as a "fudge factor" (i.e. an arbitrary adjustment) *in practice*. Any *potential* source of changing circumstances should be specifically articulated and there should be an economic rationale for it. This means that, in principle, older licenses that are more comparable along other dimensions (provided that changes in other circumstances can be controlled for) may be a better comparable than a more recent contract.

3.2.2.4 Analyzing a single price for a bundle of technologies and products

SEP licenses often cover multiple technology standards and multiple products. For instance, a contract may cover both cellular and Wi-Fi SEPs for use in several types of products, such as smartphones, tablets, household IoT and electric vehicles.

In principle, the value of each standard to each product may vary, depending on whether:

- a particular product type implements the specific standard at all, and
- how much value that product gains from the particular standard's functionality.

However, in practice, parties often agree a single price for the contract as a whole – without breaking down how that price relates to each component in its bundle of technologies and contracts. This can complicate comparability where contracts differ in scope or product mix.

Box 3.5 illustrates why it is important to understand how differences in product scope and mix may affect the terms that parties agree on for otherwise identical licenses. As we discuss below, in practice, these differences can be adjusted for – for instance using agreements with narrower scope for a single standard in a single product category.

Box 3.5 Analyzing royalties in contracts with different product mixes

Parties A and B negotiate terms for a Focal Contract covering Wi-Fi SEPs in Products X and Y. Three potentially comparable contracts are presented.

Comparison of Wi-Fi licenses with different licensed product scope and mix

Contract	Consideration	Effective unit rate	Product volumes (X + Y)	Product X: tablet	Product Y: household IoT
Focal Contract	Under negotiation	Under negotiation	400m	75%	25%
Contract A	$500m	$1.00	500m	100%	0%
Contract B	$50m	$0.50	100m	0%	100%
Contract C	$150m	$0.75	200m	50%	50%

Note: For illustrative purposes, this box offers a simplified example highlighting a few dimensions that may be relevant when comparing Wi-Fi licenses with different licensed product scope and mix. They are neither essential nor exhaustive.

Contract C has the same scope of licensed technologies and also produces both products (X and Y), just like the Focal Contract. Applying its underlying effective unit rate to the Focal Contract's volume of licensed units would imply a reasonable consideration of $300m (400m × $0.75). However, that is misleading as the two contracts have different mixes. In this idealized example, the underlying rate for each product in Contract C is $1.00 per unit of Product X and $0.50 per unit of Product Y. On a like-for-like basis, the Focal Contract would therefore be valued at $350m = (400m × 75% × $1.00) + (400m × 25% × $0.50).

Here, Contracts A and B can be identified as narrow contracts, revealing a rate that parties agreed for a component of the Focal Contract's bundle of technologies and products. Those contracts, therefore, may inform reliable adjustments.

3.2.2.5 Assessing the risk of using a limited number of potentially relevant transactions

When analyzing SEP licenses, relatively few comparable licenses may be available. For emerging technologies or in new product markets, there may be few (if any) prior agreements. Even mature product markets may be concentrated, meaning that there are only a handful of comparable manufacturers for a given product. Moreover, SEP licenses are typically confidential, so the pool of potentially comparable contracts is often limited to those disclosed by parties to the relevant license negotiation or dispute.

In principle, a limited number of transactions is not necessarily a barrier. A good comparable is a good comparable. However, the greater the number of observations that are available, the more they should corroborate one another and result in a clearer understanding of how the differences in their circumstances affect prices. As discussed above, with a small number of observations, the risk of exposure to unobserved factors is greater and the ability to reliably understand the significance of variation and adjustment for them may be limited. There may be a trade-off between relying on a greater number of comparables, and relying on better comparables.

3.2.2.6 Accounting for the different nature of licensors' comparables and licensees' comparables

Typically, each of the negotiating parties can draw on its own set of potentially comparable licenses. This can assist the valuation process by increasing the number of informative contracts available.

However, a licensor's and a licensee's potentially comparable contracts are different.

- The licensor may reference prior agreements for the same (or a similar) **SEP portfolio** licensed to various other implementers, whose products may or may not closely resemble those in the Focal Contract.
- The licensee may point to its own licenses for the same (or a similar) **product portfolio** but involving different SEP portfolios essential to the same standard.

Each set of contracts, therefore, requires different types of comparisons.

All other things being equal, the licensor's comparables would be expected to provide a better starting point than the licensee's comparables, as they refer to the same licensed portfolio as the Focal Contract[4] – although, obviously, there may be important exceptions, such as if the licensor's license or licenses are not FRAND. The challenge with the licensee's comparables, therefore, is that comparison requires an additional layer of analysis to determine how similar they are (i.e., that captures the extent to which each of the different portfolios contributes to the standard as a whole). SEP portfolios can differ in size, essentiality, validity and technical importance so these differences need to be assessed when making comparisons across licenses for different SEP portfolios. Nonetheless, where these differences can be assessed reliably, the licensee's comparables may contribute to the analysis.

3.2.2.7 Accounting for differences in the geographic distribution of patents and products

Because patents are territorial, the value of a portfolio can depend on (i) where the licensee sells products and (ii) where the licensor holds enforceable patent rights. For that reason, parties sometimes agree different effective royalty rates by region or apply region-specific adjustments within a license. In some cases, courts have also considered whether geographic variation affects the portfolio's value to the particular licensee and whether this justifies an adjustment.

4 See *Optis* v. *Apple* [2025] EWCA Civ 552 (link) , para. 95.

Three drivers of geographic variation are commonly cited:

- **Differences in patent coverage**. In principle, a royalty is due only when the implementer's products are made, imported, used or sold in a jurisdiction where the licensor holds relevant, enforceable patents. Where parties negotiate a single "global" rate, the territorial coverage of the licensed patent portfolio may therefore be a relevant consideration. Consider a stylized example: an SEP holder's portfolio only contains US patents. An implementer that sells only in the United States would, in principle, expect to pay a royalty on each unit sold there; an implementer that makes and sells otherwise identical devices entirely outside the United States would, in principle, owe nothing to that SEP holder; and a third implementer with worldwide sales would expect any global payment to reflect its exposure to the US market – for instance, a rate that is scaled (explicitly or implicitly) by the share of its units sold into the United States or by the value of those sales.
- **Differences in legal and enforcement conditions**. The practical strength of patent rights can vary across jurisdictions (for example, differences in patent examination standards, available remedies, speed of enforcement or local FRAND practice). In addition, competition law interventions may affect licensing structures in particular jurisdictions. For example, following China's 2015 National Development and Reform Commission (NDRC) investigation, *Qualcomm* committed to using a royalty base set at 35 percent below the net selling price when calculating royalties for certain devices sold in China. That precedent acts as an effective reduction in royalty-bearing revenue for sales in China.[5]
- **Differences in market conditions between regions**. Commercial realities may support effective rates that are lower in some markets than in others – for example, where consumers' willingness to pay is lower or where pricing strategies are designed to promote adoption and scale (including in emerging markets).[6]

The significance of these factors depends on the geographic scope of a license, which in practice ranges between the two extremes outlined below.

- **Licenses with global coverage**. In many product markets, parties enter global portfolio licenses covering sales across jurisdictions. Courts – notably in the United Kingdom and, in some circumstances, in China and the United States – have also determined terms on a worldwide basis, often on the premise that country-by-country licensing would be commercially inefficient. In this setting, the question is usually not whether each jurisdiction is priced independently, but whether the agreed global structure appropriately reflects material regional differences. For example, where a licensee has above-average exposure to markets with systematically lower effective rates, then the rate it pays for a global license may be lower than it would be with an average regional profile of sales.[7]
- **Licenses with narrow geographic scope**. In some circumstances, a licensee's sales may be concentrated in a particular jurisdiction or group of jurisdictions. In such cases, special emphasis is placed on whether it is unlikely that the patent will be able to yield the "full" typical rate in that jurisdiction – because it has no or limited patent coverage, enforcement is weak in practice or market conditions produce lower rates. In that case, the portfolio may provide less leverage and its licensing may offer less value to that particular licensee than it would to a licensee with global sales in jurisdictions where the portfolio is strongest.

In practical terms, the issue for parties, courts and arbitrators is how granular the consideration of these issues should be.

In principle, a strict patent-by-patent, country-by-country assessment may be accurate. However, in some circumstances, such an exercise may be sufficiently impractical – at least for negotiations relating to large global portfolios and worldwide sales – that willing parties would

5 While this discount was not codified into formal regulation, the *Qualcomm* decision acts as a de facto benchmark when determining royalty bases for Chinese sales. One of the reasons is that licensees may come to expect such discounts from other licensors based on the expectation that Chinese regulators could bring pressure to bear on such licensors if they do not follow the *Qualcomm* model. NDRC press release, February 10, 2015 .
6 For example, see *InterDigital* v. *Lenovo* [2023] EWHC 539 (Pat) (link) .
7 For instance, see *Unwired Planet* v. *Huawei* [2020] UKSC 37 (link) , para. 15, "SEP owners, which have a large portfolio of patents covering many countries, and implementers, which market their products in many countries, would as a matter of practice voluntarily negotiate worldwide licences, or at least licences from which a given territory is carved out while the rest of the world is licensed."

not pursue it. So, there can be a trade-off, which is possible to be assessed and mitigated in some cases. For instance, in order for FRAND to mirror the underlying patent rights, it may be possible to assess whether a portfolio is weaker across jurisdictions where the implementer sells or manufactures the licensed products by analyzing the relative number of patents in those jurisdictions.

Alternatively, some have categorized where the implementer sells or manufactures the licensed products in two broad groups: (a) major jurisdictions, where the SEP holder's portfolio is sufficiently deep (and expected to remain sufficiently robust after validity and essentiality challenges) that the implementer faces a credible risk of effective enforcement; and (ii) minor jurisdictions, where the portfolio is thin or less enforceable, so willing parties would agree a lower rate on sales in those regions. On this view, the practical question is not whether *every* patent is valid and important in *every* territory, but whether the licensor has enough enforceable coverage in the commercially significant territories that a willing party would treat the global rate as reasonable.[8]

3.3 Step 2: "Unpacking" the rates agreed for comparable contracts

After having identified the relevant transactions, the identified rates need to be "unpacked." Unpacking aims to express the value of what the parties actually agreed in the light of the circumstances they faced. Payment terms in SEP licenses are often complex and can vary substantially across agreements. Two licenses may provide the same present, cash-equivalent value of consideration to the licensor even where the structure of payment differs (for example, a lump sum paid up-front versus a running royalty contingent on future sales). For the purpose of valuing the Focal Contract, it is therefore the economic *value* of the consideration that matters, not the particular *form* the parties chose to express it.

Differences in payment structure can, however, obscure whether two licenses are similar in economic substance. The payment terms in the comparable contracts approach therefore need to be "unpacked" and expressed in a common metric that enables like-for-like comparison.

3.3.1 What it means to "unpack" prices in principle

3.3.1.1 Differences in payment structure

Licensors receive consideration in return for granting a license. Licenses define that consideration through one, or a combination, of the elements in Box 3.6.

8 Even here, it may be contested how many patents a licensor requires for its portfolio to be considered sufficient that willing parties regard it as sufficiently enforceable that they would simply agree to the typical "major jurisdiction" rate. For instance, in *InterDigital* v. *Lenovo* [2023] EWHC 539 (Pat) (link) , pp. 180–187 (paras 758 and 791) Justice Mellor considers that adjustments for weak patent coverage "is not an approach that translates necessarily to larger portfolios" as, for these patent holders, "the prospect of … losing all coverage [is] extremely remote."

Box 3.6 Analyzing royalties in contracts with different payment structures

Payment structure	Description
Fixed-sum (or lump-sum) payments Example: $500m paid in five equal annual instalments	Royalties are agreed in advance, specifying a schedule of payments with a fixed nominal value. The lump sum may be calculated to reflect the volume of licensed units (and possibly their prices) expected at the time of agreement. For example, a willing implementer anticipating high sales volumes may agree to a larger lump-sum payment than one expecting to sell fewer licensed units. However, these payments are not contingent on actual sales – if sales exceed or fall short of expectations, the value of the lump-sum payment agreed will not change.
Sales-contingent (or "running") royalties Example: $2.00 per unit Example: 1% of the product's average selling price (ASP)	These specify a royalty rate applied to each licensed unit sold during the contract period. There are two common forms: – unit rates: a fixed cash amount per licensed unit; and – ad valorem rates: a fixed percentage applied to a defined royalty base, usually the product's ASP. For example, a 1% royalty applied to an ASP of $200 yields $2.00/unit; if the ASP falls to $150, the royalty falls to $1.50/unit.
Non-monetary (or "in kind") payments Examples: cross-licenses	patent transfers and cooperation agreements"

Note: This table offers a simple, illustrative description of the payment structures that may be relevant when analyzing different SEP contracts.

3.3.1.2 Normalizing payment terms

Differences in payment structure can obscure the true value of the consideration that parties agree (see Box 3.7). All contracts have different payment structures. Comparing the specific payment terms does not reveal whether the prices agreed for each contract are similar or not.

Box 3.7 Comparing contracts with different payment structures

Contract	Payment structure	Payment terms
Focal Contract	Lump sum	Immediate cash payment
Contract A	Lump sum	6 annual instalments of $100m
Contract B	Running unit rate	$2.00 per licensed unit
Contract C	Running ad valorem rate	1% of licensed units' ASP
Contract D	Cross-license	License to counterparty's SEPs

Note: For illustrative purposes, this table provides simplified examples of how contracts may differ in both payment structure and payment terms.

To compare the value of the consideration agreed in each contract, the specific payment terms of the comparable licenses must be normalized – or "unpacked" – into common, cash-equivalent

terms. There are three common approaches to unpacking, detailed below, although alternative metrics may be included in cases where that would be informative.

- **Effective unit rates**. This metric expresses the value of the running unit royalty that a licensor would accept instead of the payment structure it actually agreed. It states the total cash-equivalent value of the consideration in present value terms, divided by the number of licensed units expected at the time the parties agreed on the terms (accounting for the volatility risk of future volumes).
- **Effective ad valorem rates**. This metric expresses the value of the running ad valorem royalty that a licensor would accept instead of the payment structure it actually agreed. It states the effective unit rate as a proportion of the ASP of the licensed units. In essence, it shows the total cash-equivalent value of the consideration in present value terms, as a proportion of the licensee's expected revenue from the licensed units (accounting for the volatility risk of future volumes and prices).
- **Effective lump sum**. This metric expresses the value of the single and immediately paid lump sum royalty that a licensor would accept instead of the payment structure it actually agreed. This expresses the total present value of the cash-equivalent consideration, normalized for the Focal Contract's volume and profile of licensed units.

Box 3.8 shows the value of the payment terms for the same five contracts "unpacked" into each of the three metrics. In this illustrative example, the common metrics reveal that the payment terms in all five contracts offer the same *value* to the licensor; only the *structure* of the payment terms differs. In principle, the parties should be indifferent to the differences between them.

These metrics provide a means of expressing the economic value of the terms the parties agreed; they are not necessarily the payment structure that the parties would have selected in an alternative negotiation. For example, if the parties had agreed a running royalty rather than a lump sum, this could have involved different administrative and monitoring costs, and different risk allocation, which might have affected the rate.

Box 3.8 Unpacking different payment structures into common metrics

Contract	Payment terms the parties actually agreed	Effective lump sum in net present value terms	Effective unit rate for 250m units (risk adjusted)	Effective ad valorem rate on expected ASP of $200 (risk adjusted)
Focal Contract	Immediate cash payment	$500m	$2.00 per unit	1% of ASP
Contract A	5 annual instalments of $100m	$500m	$2.00 per unit	1% of ASP
Contract B	$2.00 per licensed unit	$500m	$2.00 per unit	1% of ASP
Contract C	1% of licensed units' ASP	$500m	$2.00 per unit	1% of ASP
Contract D	Cross-license to counterparty's SEPs	$500m	$2.00 per unit	1% of ASP

Note: For illustrative purposes, this table offers a simplified example of how SEP contracts with different payment structures can be unpacked into common metrics.

3.3.2 Practical considerations when normalizing payment structures

In practice, parties and experts have often struggled to agree on unpacked royalty rates – sometimes arriving at very different results, even when analyzing the same contracts. The main sources of difference are typically (i) the valuation of non-cash consideration, (ii) discounting and risk assumptions, and (iii) assumptions about expected volumes, prices and the treatment of past sales.

However, in most cases these challenges are not so hard that they make unpacking an insurmountable barrier to a reliable and informative valuation. Generally, they can be addressed.[9] Key practical considerations include:

- converting non-monetary payments into cash-equivalent terms;
- estimating discount factors;
- accounting for expected volumes (and prices);
- accounting for past sales, subsequently covered by the license;
- sensitivity testing; and
- unpacking the aggregate rate implied for all SEPs.

3.3.2.1 Converting non-monetary payments into cash-equivalent terms

Ideally, non-cash consideration should be converted into its explicit monetary value. For example:

- **Cross-licenses**. Where two SEP portfolios are cross-licensed, the agreement may include a "net" royalty that reflects the difference in value between the two portfolios. In principle, that net payment can be used to infer the implied "gross" value of one portfolio absent the other, provided that the scope and value of the licensed rights granted by each side can be assessed. This requires careful attention to differences in portfolio strength (including validity, essentiality, infringement and technical importance), and to whether other terms are bundled into the deal.
- **Transfers of other assets or services**. Patent transfers or cooperation agreements may be easier to value where there is an observable market benchmark. Where no such market exists, other valuation approaches may be required (for example, historical acquisition costs, avoided costs or projected cash flows), acknowledging the associated uncertainty.

The materiality of non-monetary consideration should be assessed, even if the value cannot be established precisely. Where it is relatively minor, it may be preferable to retain the contract as a comparable and test the sensitivity of the analysis to reasonable valuation ranges for the non-monetary element, rather than excluding the contract altogether. This is particularly important because non-monetary terms may sometimes be used strategically to make a contract appear more or less comparable than its economic substance would suggest.

3.3.2.2 Estimating discount factors

The price agreed in a license should reflect the present value of the payments – not just their nominal value. Present value depends on:

- **timing**: money received sooner is worth more than the same nominal amount received later; and
- **risk**: uncertain or contingent payments are worth less than guaranteed payments.

Estimating the present value of future cash flow requires a discount factor. In principle, discounting should use a rate that is consistent with the risk of the expected royalty cash flows. Different payment structures allocate risk differently. For example, lump sums have fixed cash payments, so they have low volatility risk. In contrast, unit royalties (i.e., royalties with a fixed cash amount per licensed unit) are contingent on volumes, and ad valorem royalties (i.e., royalties with a fixed percentage applied to a defined royalty base, usually the product's ASP) are contingent on both volumes and prices. These differences matter when comparing the present value of cash flows with otherwise identical profiles in nominal terms.

In practice, parties may use a company's cost of capital as a benchmark, but the appropriate rate may differ depending on how closely the royalty cash flows reflect the risks of the broader business. Where inputs are uncertain, parties should test sensitivity to plausible discount-rate ranges.

9 See, for example, the considerations in *Optis* v. *Apple* [2025] EWCA Civ 552 (link) .

3.3.2.3 Accounting for expected volumes (and prices)

Unpacking often requires assumptions to be made about expected sales volumes (and, for ad valorem structures, expected prices) over the relevant period. In principle, the relevant expectations are those held at the time by the parties negotiating the contract. In practice, the parties' contemporaneous forecasts may be unavailable or contested.

In practice, two alternatives can be used as proxies:

- **Data on actual sales** may be informative, but only to the extent that they reflect the expectations that genuinely informed the agreement when it was signed. That is often difficult to verify and, where actual sales have diverged significantly from original expectations, using these data will distort the analysis.
- **Contemporary third-party commercial forecasts** are often available and reliable, particularly for large companies in mature product markets. They may be less reliable, or unavailable, when considering the expectations for small implementers, niche markets or new products.

3.3.2.4 Accounting for past sales, subsequently covered by the license

As discussed in Section 1.3.4 above, it is common for SEP licenses to consider both future and past sales. This reflects the purpose of the FRAND undertaking, which is to promote adoption and widespread use of the standard, with the understanding that royalties can be negotiated and agreed on reasonable terms after the technology has already been implemented in products. For purposes of normalization, what often matters is how the total value of consideration relates to the total number of units covered by the agreement, across past and future periods. This may be expressed as a weighted average effective rate across all covered units.

However, when a license covers both past and future sales, there can be disagreement about how to unpack the underlying effective unit rate across all units.

First, the scope of relevant units may be disputed. For instance, where a "past release" clause waives royalties on past sales, the units may be interpreted as irrelevant to the average rate – in formal terms, the royalty is waived, it is not zero. Alternatively, they could be interpreted as licensing the past sales for free (i.e., at zero royalty). The distinction is important as the first interpretation would not include a past release in the rate unpacked across all licensed units. The second interpretation would, and obviously it would determine a lower rate.

Second, the rationale for setting different rates for past and future sales requires scrutiny. One consideration is that the differential may be strategic. In theory, both parties could benefit from agreeing a certain average rate, and then disproportionately allocating the consideration to future sales. It makes no difference to the commercial substance of a lump sum agreement but may affect how the license is perceived as a comparable in subsequent negotiations. Conversely, some consider that heavy discounts on past sales, or appeals to patent limitation periods, are not FRAND. The economic value enabled by the technology does not expire with age and delay may reward or incentivize hold-out tactics. As such, the extent to which particular approaches to past sales (including releases, limitation periods or discounts) are appropriate in FRAND contexts can also raise jurisdiction-specific legal questions.[10]

10 *InterDigital* v. *Lenovo* [2023] EWHC 539 (Pat) (link) and *InterDigital* v. *Lenovo* [2024] EWCA Civ 743 (link) .

3.3.2.5 Sensitivity testing

Parties often unpack different rates from the same comparable contracts.[11] Typically, these disparities result from differences in:

- **the data used for the calculations** – for example, using different data providers for expected product sales, cost of capital or patent data;
- **assumptions and approach** – for example, whether to differentiate between different products (such as tablets and laptops) or treat them as the same for the purposes of the analysis; or whether a license covers past sales.

Disagreement and disparity can be mitigated with transparent assumptions and careful sensitivity testing – to assess the extent to which the results depend on those assumptions. This process helps to ensure that any errors or uncertainties are identified and either corrected or appropriately accounted for, so that the prices of the purported comparables can be reliably compared – both with each other and with the Focal Contract.

3.3.2.6 Unpacking the aggregate rate implied for all SEPs

The licensor's comparables often involve the same portfolio as the Focal Contract, whereas the licensee's comparables involve different SEP portfolios that are essential to the same standard. The rates unpacked for different portfolios cannot be compared directly without accounting for differences in portfolio strength and contribution to the standard.

One approach is to derive, from the unpacked royalty, an implied aggregate royalty rate for the standard: an estimate of what the implementer would pay if all SEP portfolios were licensed on a consistent basis. This requires an assessment of the licensed portfolio's relative contribution to the standard (which may depend on more than patent counts and include validity, essentiality, infringement and technical and economic importance). In principle, implied aggregate royalty rates have been used as a cross-check, but they can be sensitive to portfolio-contribution assumptions – especially in the case of small portfolios.[12] In principle, the metric should capture several factors, including the number of SEPs, the proportion that are valid, essential and infringed, and the technical importance of the functionality that the patents protect. In practice, some parties have focused on patent counting as a practical simplification. New metrics are being developed which may provide greater accuracy, although the proliferation of alternative sources can lead to disagreements between parties over which data providers should be used.

Box 3.9 illustrates a hypothetical example, where the implied aggregate royalty rate for the relevant standards is $40 per unit (or 8 percent of an implementing product with an ASP of $500).

11 For example, in the UK High Court's analysis in *InterDigital* v. *Lenovo*, the experts who were unpacking the same group of comparable licenses derived vastly different effective rates due to differences in assumptions and data. "[I]t will be seen that the experts frequently arrived at and utilised radically different figures for total consideration and total unit sales for certain PLAs [Patent Licence Agreements]. The combination of the different approaches and the use of different data sources meant that comparisons were, at best, difficult to make." *InterDigital* v. *Lenovo* [2023] EWHC 539 (Pat) (link) , para. 294.

12 For instance, if a portfolio only has a handful of SEPs then the rate it implies for *all* SEPs will be much more sensitive than extrapolating an implied rate from a portfolio that contains a substantial proportion of SEPs. Nonetheless, this comparison is merely relative. The sensitivity of a larger portfolio should still be considered and assessed in its own right.

Box 3.9 Calculating implied aggregate royalty rates from portfolio rates

Party A, the licensor, presents two contracts, which cover the same portfolio as the Focal Contract. Party B, the licensee, presents three contracts that cover *other licensors'* patent portfolios that are essential to the same technology standard as the Focal Contract.

Estimating the implied aggregate royalty rates from a licensor's and licensee's contracts

Contract	Party	Effective unit rate of portfolio	Contribution of portfolio to relevant standard	Implied aggregate royalty rate
Contract A	Licensor	$2.00 per unit	5%	$40 per unit
Contract B	Licensor	$2.00 per unit	5%	$40 per unit
Contract C	Licensee	$6.00 per unit	15%	$40 per unit
Contract D	Licensee	$10.00 per unit	25%	$40 per unit
Contract E	Licensee	$0.40 per unit	1%	$40 per unit

Note: For illustrative purposes, this table offers a simplified example with a few dimensions that may be relevant when calculating implied aggregate royalty rates from portfolio rates. They are neither essential nor exhaustive.

In this idealized case, all the licensor's contracts include the same rate for its portfolio and imply the same aggregate royalty rate, since the protected technologies contribute to the overall standard to the same extent in each case. In contrast, all the licensee's comparables have different rates as they all cover different portfolios. However, the implied aggregate royalty rates are the same as each other, and the licensor's comparables, as they control for the contribution that each portfolio makes to the standard.

3.4 Step 3: Adjusting unpacked rates to estimate comparable prices

Even the closest comparable license may differ from the Focal Contract in ways that make its unpacked rate an imprecise guide to the rate that would be reasonable for the license being valued. In such cases, adjusting the unpacked rates from comparable contracts can improve the precision of the valuation.

"Unpacking" and "adjusting" serve different purposes. As mentioned under step 2 at Section 3.3 above, unpacking aims to express the value of what the parties actually agreed, given the circumstances they actually faced. Those unpacked rates provide the empirical foundation for a comparables-based valuation, but they are only a starting point. Adjustments, by contrast, estimate the rate that might have been agreed in circumstances that more closely resemble those relevant to the Focal Contract (or, in some cases, circumstances consistent with FRAND principles).

For clarity, it is generally preferable to present unpacking and adjusting as separate steps, rather than conflating them into a single exercise of "unpacking comparable reasonable prices."

3.4.1 What it means to adjust unpacked rates in principle

Adjustments typically have one of two aims:

- improving comparability, or
- improving reasonableness.

3.4.1.1 Adjustments to improve comparability of unpacked rates

These adjustments account for material differences between the Focal Contract and an otherwise comparable license, as identified in the comparability assessment.

In principle, adjustments may be made for any difference that materially affects the value exchanged and, therefore, the price that independent parties would be likely to agree. Some examples are given below:

- **Adjusting for differences in the scope or mix of technologies and products**. As discussed above, where a comparable license covers additional standards, patent portfolios or product categories that are not present in the Focal Contract, the unpacked rate may not be directly comparable. If sufficiently reliable information is available, the analyst may "carve out" the portion of value attributable to the additional rights or products. This typically requires either (i) an independent valuation of the incremental component or (ii) another license with a narrower scope that isolates the component to be valued.
- **Adjusting for the proportion of products sold in a particular region with lower rates**. In some cases, a party may have sufficient sales in a particular region that it can agree to a rate below the typical global level. The rate in a particular region may be low for various reasons. For instance, in *Unwired Planet* v. *Huawei* sales in China were considered to be 50 percent lower than for the rest of the world, so an adjustment was made to reflect the different proportion of sales in China between the comparable and Focal Contracts.[13] Similarly, in *InterDigital* v. *Lenovo* the royalty rate unpacked from the closest comparable license was reduced by 27 percent, to reflect the fact that the Focal Contract had a higher proportion of sales in emerging markets, where rates are lower than in developed markets to promote growth.[14] Licensees whose products are predominantly sold or manufactured in regions where a licensor has few patents may also achieve lower rates than a global manufacturer would agree.
- **When using the licensee's comparables, adjusting for differences in portfolio quality**. The size, strength, essentiality and technical importance of SEP portfolios vary across licensors. Differences in these factors affect the terms that parties would agree to, so they should be assessed and, where feasible, appropriate adjustments made.[15]

Box 3.10 illustrates an example of adjusting the rate agreed for a particular contract, so that it more closely reflects the rate that parties would agree for the Focal Contract, which has a different product mix and proportion of sales in emerging markets. The partes agreed $1.250 per unit for Contract A, given its specific circumstances. Adjusting to reflect the Focal Contract's circumstances, the parties would have agreed to $1.495 per unit on a like-for-like basis.

13 *Unwired Planet* v. *Huawei* [2017] EWHC 711 (Pat) (link) , paras 582–583.
14 *InterDigital* v. *Lenovo* [2023] EWHC 539 (Pat) (link) .
15 Ensuring that the adjustments are reliable can be challenging. These issues are discussed in Section 5.3.2 below on the top-down approach.

Box 3.10 Adjusting a contract to improve its comparability to the Focal Contract

Parties A and B negotiate terms for a Focal Contract covering Wi-Fi SEPs in Products X and Y. A comparable contract is otherwise similar, but has a different product mix and proportion of sales in emerging markets, which affects the prices that parties consider reasonable.

Licenses for Wi-Fi SEPs with adjustments for product mix and emerging markets sales

Contract	Product X: tablet	Product Y: household IoT	% of sales in emerging markets	Effective unit rate
Focal contract	75%	25%	20%	Under negotiation
Contract A unpacked	50%	50%	0%	$1.250
Contract A adjusted for the product mix	75%	25%	0%	$1.625
Contract A adjusted for product mix and emerging market	75%	25%	20%	$1.495

Note: For illustrative purposes, this table offers a simplified example with a few dimensions that may be relevant when adjusting a contract to improve comparability to the Focal Contract. They are neither essential nor exhaustive.

The rate unpacked from Contract A is adjusted incrementally.

The first adjustment accounts for the product mix. It increases the rate, as Product X has a higher underlying unit rate ($2.00) than Product Y ($0.50). Hence, the effective unit rate for Contract A, adjusted for the product mix, is $1.625 = ($2.00 × 75%) + ($0.50 × 25%).

The second adjustment accounts for the proportion of sales in emerging markets. In this stylized example, it is assumed that sales in emerging markets have Wi-Fi rates 40% less for Products X and Y than in developed markets ($0.975). The blended rate over all sales is $1.495 = (80% × $1.625) + (20% × $0.975).

3.4.1.2 Adjustments to improve the reasonableness of unpacked rates

This second type of adjustment estimates the terms on which willing parties would have been likely to agree had negotiations not been conducted under conditions that distort bargaining outcomes, whether through hold-up or hold-out.

Unlike adjustments made to improve comparability, this type of adjustment necessarily involves a normative judgment to distinguish between:

- factors that *did* influence the terms agreed in practice, and
- factors that, under FRAND principles, *should not* influence the terms that define a reasonable outcome.

In principle, an adjustment may be considered where a feature of the negotiation environment affected the terms agreed in a comparable contract in a way that is not regarded as consistent with what willing, good-faith parties would take into account. As discussed in Section 1.3.4 above, examples may include:

- litigation costs that may be significant relative to the expected adjustment in royalties;
- the prospect of injunctions;

- the treatment of past sales (including substantial discounts or waivers), particularly where this could be perceived as incentivizing delay;
- the procedural complexity and costs associated with patent-by-patent and jurisdiction-by-jurisdiction dispute resolution.

In practice, such adjustments are often difficult. A reliable adjustment requires, first, a principled basis for concluding that the relevant factor should be excluded from the benchmark of reasonable terms and, second, sufficiently robust information to estimate its effect on the agreed consideration. Both propositions may be contested.

Box 3.11 provides an example drawn from a case before the Court of Appeal (England and Wales). In that case, the court treated discounts for past sales as a product of hold-out that suppressed the total consideration below the level that a willing licensee would agree in a FRAND-compliant license, and it adjusted the determination accordingly. That approach, however, is not accepted in all jurisdictions, and even where the underlying rationale is accepted, estimating the magnitude of the required adjustment may involve material uncertainty.

Box 3.11 Case example of adjusting a rate to remove the impact of unreasonable factors: InterDigital v. Lenovo

In *InterDigital* v. *Lenovo*, the royalty rate unpacked from the closest comparable license included a lower rate for past sales than for future sales (all other things being equal). The Court of Appeal (England and Wales) considered discounts on past sales to be a feature of hold-out that suppressed rates below the reasonable level that a willing licensee would agree to. It adjusted the FRAND determination upward, to estimate the reasonable amount that parties would have agreed absent hold-out. This conclusion, obviously, depended on the facts of the case. Furthermore, the interpretation of those facts by the Court of Appeal (England and Wales) does not necessarily reflect the interpretation that would apply in other jurisdictions.

Sources: *InterDigital* v. *Lenovo* [2024] EWCA Civ 743 (link) and *Lenovo* v. *Ericsson* [2025] EWCA Civ 182 (link) , paras 23–24.

3.4.2 Practical considerations when adjusting rates

Adjustments are not without risk. The central appeal of the comparable contracts approach is that it relies on the prices that the market agreed to, not estimates. Any adjustment is a departure from what the parties actually agreed, and therefore adjustments may introduce uncertainty to various degrees. So, the more materially the valuation relies on adjustments, the further the methodology risks moving away from that initial appeal.[16]

Nonetheless, adjustments can be reliable and improve accuracy where they are grounded in evidence and applied in a disciplined manner. The following principles help to mitigate the risk of error.

3.4.2.1 A clear economic and commercial rationale

An adjustment should be grounded in a sound understanding of how the market works and why a specific difference in a given characteristic would influence the price that willing, good-faith parties would agree to.

For instance, the issue of how royalties are determined in licensing negotiations over sales in emerging markets is influenced by three distinct economic factors:

16 For instance, in *Samsung* v. *ZTE*, [2026] EWHC 999 (Pat) , the judgment notes that "The experts also agreed that when considering comparable licences, the fewer adjustments needed to account for differences between the comparable licence and the licence being negotiated the better (with a caveat added by Mr Lin, which I accept, that it is important to recognise that it is not just the number of adjustments that matters; the extent of each adjustment is equally significant)."

- portfolio strengths may be lower in emerging countries, which, all other things being equal, drives royalty rates down for negotiations where the licensee predominantly sells only in emerging countries;
- incomes and the effective value of IP rights may be lower in emerging markets due to local economic and policy conditions; and
- the relevance of regional variation to the terms of the license: for instance, regional variation may have little if any impact on the terms that willing parties would agree for a global license with sufficient sales in major patent jurisdictions but it may matter a great deal to the terms that parties agree for a contract where the majority of units will be sold and manufactured in regions without patent coverage.

Where the rationale for adjustment is unclear or speculative, the adjustment is unlikely to improve accuracy and may even introduce additional error.

3.4.2.2 A clear relationship between characteristics and prices

Reliable adjustments require an understanding of how specific differences in the contractual characteristics would affect the price that parties would consider reasonable, including:

- the **direction** of the effect (whether the differences increase or decrease the price), and
- the **magnitude** of the effect (by how much).

The better the understanding of this relationship between characteristics and prices, the more reliable the adjustment is likely to be.

In many cases, simplifying assumptions may be necessary and reasonable. For instance, the precise relationship may not be known but may be reasonably approximated by a linear scale – at least over small differences. In addition, data used for adjustments may be uncertain to some extent.

However, simplification is not always appropriate. The estimated price may become increasingly unreliable as its dependence on uncertain adjustments grows. At some point, it may be better to leave the rate *unadjusted* and address any imprecision qualitatively, rather than present an adjusted but uncertain estimate.

Box 3.12 provides an example of an adjustment that was, *in those particular circumstances*, considered justified in principle but unreliable in practice.

Box 3.12 Case example of a relevant characteristic where no reliable adjustment was made: Unwired Planet v. Huawei

In *Unwired Planet* v. *Huawei*, the court accepted that financial pressure may have lowered the royalty rate agreed in one of the comparable licenses. However, the size of that effect was unclear and could not be quantified reliably. As a result, no precise adjustment was made. Instead, the issue was treated qualitatively, rather than forming the basis for a numerical correction.

Source: *Unwired Planet* v. *Huawei* [2017] EWHC 711 (Pat) (link) , paras 487, 488 and 517.

3.4.2.3 Collective and individual reliability

The reliability of adjustment should be considered collectively as well as individually. The effects of different adjustments may overlap. If two adjustments address the same underlying driver, applying both may double count the impact and reduce accuracy.

Box 3.13 provides an example of two adjustments that, in that particular circumstance, were each considered reasonable in isolation but not in combination.

Box 3.13 Case example of a correlated characteristic, whose impact on royalties overlaps: InterDigital v. Lenovo

In *InterDigital* v. *Lenovo,* Justice Mellor considered this risk when adjusting for the difference in sales mix between developed markets and emerging markets. He was also asked to consider adjusting for differences in cellular technology generation mix.

He concluded, in that particular case, that the data provided on the two issues were correlated, such that adjusting for both factors would have overstated the impact to some extent. He adjusted for the difference in the emerging market product mix but declined to adjust for technology generation mix.

Source: *InterDigital* v. *Lenovo* [2023] EWHC 539 (Pat) (link) .

3.5 Assessing whether comparable contracts provide prices within the FRAND range

The comparable contracts approach is attractive because it relies on rates that market participants have actually agreed. However, if earlier licenses were materially influenced by the parties' relative negotiating positions or strategic conduct (for example, due to hold-up or hold-out), their use as comparable contracts risks carrying forward non-FRAND rates into subsequent negotiations.

Accordingly, any application of this method should include an assessment of whether the rates inferred from comparable contracts are themselves reasonable. In practice, three complementary approaches can be applied in parallel:

- assessing the bargaining power dynamics for indications of hold-up and hold-out;
- assessing the breadth of the rates inferred from comparable contracts;
- assessing the rates against an external benchmark of value (cross-checks).

3.5.1 Assessing the bargaining power dynamics for indications of "non-FRAND factors" (hold-up and hold-out)

This approach directly assesses the negotiation process that led to the agreed rate in order to determine whether there is evidence of tactics associated with hold-up and hold-out. Greater confidence can be placed in rates unpacked from contracts where there is little or no evidence of such conduct.

In a recent decision, the High Court (England and Wales) framed this assessment as considering the impact of "non-FRAND factors", rather than hold-up and hold-out. It explained that: The terms "hold-out" and "hold-up" in this field are often used to imply wrongdoing, though, and to try to avoid this I think the more neutral term "non-FRAND" is useful. Further, it explained "I refer to these matters as "non-FRAND factors" deliberately. No conscious bad faith or deliberate delaying tactics on the part of [the parties] was alleged. It was the duty of their negotiators to get the best price they could…".[17]

The typical indicators of potential distortions include relatively high litigation costs compared with the expected change in royalties, the possibility of injunctive relief, fragmented litigation strategies or approaches to past sales that may reward delay.[18] There is a degree of subjectivity in such assessment. Different courts may reach different conclusions when assessing the potential impact of these non-FRAND factors on negotiation for the same license [19]

17 [2026] EWHC 999 (Pat), paragraphs 92 and 37 respectively.
18 See also Section 1.3.4 above.
19 For instance, the Munich Regional Court, Chongqing Court, and High Court (England and Wales) reach different conclusions about the extent to which non-FRAND factors affect the potentially comparable contracts available in *Samsung* v *ZTE*. See *Samsung* v *ZTE* [2026] EWHC 999 (Pat) (link) , *ZTE* v *Samsung*, The People's Republic of China Chongqing First Intermediate Court Civil Judgment, Yu 01 Min Chu No. 905; and Munich Regional Court, 30.04.2026, 7 O 64/25 – *Bestimmung der Angemessenheit von FRAND-Lizenzraten* (link) .

Depending on the evidence, a contract may be excluded as unreliable, adjusted – where the impact can be quantified with sufficient reliability[20] – or used only as a directional reference point (for example, as an upper or lower bound), rather than as a point estimate.

3.5.2 Assessing the breadth of the rates inferred from comparable contracts

Comparable contracts typically imply a range of rates, even after unpacking and (where appropriate) adjustments. However, the range should be reasonably narrow. If the implied rates remain widely dispersed, that may indicate that key differences have not been identified or controlled for, or that one or more licenses are not informative comparables.

One diagnostic is to compare the inferred rates across the set and assess whether they converge when expressed on a like-for-like basis. Where licensors' and licensees' comparables can be converted into an implied aggregate royalty rate – that is, an estimate of what an implementer would pay if all SEP portfolios were licensed – this can provide an additional check on their reasonableness, provided that a consistent approach is used to assess portfolio contributions and subject to the sensitivity of any assumptions regarding portfolio strength.

As discussed above, the implied aggregate royalty rate is sensitive to portfolio-contribution assumptions – especially for small portfolios. Imposing an "average value" assumption (that all SEPs, on average, are equally valuable) may often create a wide range of implied aggregate royalty rates, but this range will not in itself be informative in determining which licenses are reliable. So, in that context, the wide range may reveal *either* that rates were not similar on a like-for-like basis, or that the values of the portfolios per patent are not similar (i.e., some are genuinely more valuable than others). As a result, caution should be exercised when attempting to apply the reverse top-down approach as a "selection tool" to screen out comparables without a more detailed assessment of the transactions and portfolios in question. Box 3.14 provides a stylized example.

20 Regarding adjustments, see also Section 3.4.1 above.

Box 3.14 Calculating implied aggregate royalty rates from a range of contracts

Party A, the licensor, presents four comparable contracts **(contracts A–D),** which cover the same portfolio as the Focal Contract. Party B, the licensee, presents four contracts **(contracts E–H)** that cover *other licensors'* patent portfolios that are essential to the same technology standard as the Focal Contract.

Estimating an aggregate royalty rate from a range of comparable contracts

Estimating an aggregate royalty rate from a range of comparable contracts

Contract	Party's comparable	Effective unit rate of licensed portfolio	Contribution of licensed portfolio to standard	Implied aggregate royalty rate per unit
Contract A	Licensor	$8.00	5%	$160
Contract B	Licensor	$6.00	5%	$120
Contract C	Licensor	$2.50	5%	$50
Contract D	Licensor	$2.00	5%	$40
Contract E	Licensee	$10.00	25%	$40
Contract F	Licensee	$5.25	15%	$35
Contract G	Licensee	$1.00	5%	$20
Contract H	Licensee	$0.10	1%	$10

Notes: for illustrative purposes, this table offers a simplified example with a few dimensions that may be relevant when calculating implied aggregate royalty rates from a range of contracts. These are neither essential nor exhaustive.

A key observation is that the range of implied average royalty rates is very wide – too wide for each contract to be reasonable. This suggests that either the circumstances are not comparable, the rates have not been unpacked reliably, or some contracts do not reflect FRAND terms. The dispersion is also evident within each party's set of comparables, where the highest implied rate is approximately four times the lowest.

Note: This issue was discussed in *Optis* v. *Apple* [2025] EWCA Civ 552 (link) , paras 108–109, 122, 139 and 145, where the judgmentconcluded that a wide range of implied average royalty rates demonstrates that, where they have sufficientbargaining power to do so, parties will agree non-FRAND rates and, given a wide observed range, they cannot all bee equally good comparables.

3.5.3 Assessing the rates against an external benchmark of value (cross-checks)

Cross-checks against external benchmarks of value can help to evaluate whether the rates inferred from comparable contracts are plausible. Courts in several jurisdictions, including the United States, United Kingdom and China, have considered such cross-checks when determining FRAND terms, comparing the implications of comparable licenses with other indicators of value.[21]

21 Part 5 discusses the various benchmarks, which include the ASP of the implementing product, statements by licensors on aggregate rates, the profit margins on chipsets and the price premium attributable to the technology. The various decisions include: in the United Kingdom, *Optis* v. *Apple* [2025] EWCA Civ 552 (link) , *InterDigital* v. *Lenovo* [2023] EWHC 539 (Pat) (link) and *Unwired Planet* v. *Huawei* [2017] EWHC 711 (Pat) (link) ; in the United States, *TCL Communication Technology Holdings Ltd.* v. *Telefonaktiebolaget LM Ericsson*, No. 8:14-cv-00341, (C.D. Cal. Dec. 21, 2017) (link) , amended and superseded (C.D. Cal. Sept. 14, 2018), rev'd in part, vacated in part 943 F.3d 1360 (Fed. Cir. 2019) , cert. denied 141 S.Ct. 239 (2020) and 921 F. Supp. 2d 903 (N.D. Ill. 2013) ; and, in China, the Nanjing Intermediate People's Court in *Huawei* v. *Conversant* (2018) and the Chongqing court in *Nokia* v. *OPPO* (2021).

External benchmarks can take a variety of forms. Examples include:

- the average royalty rates that licensors announced before the standard was widely implemented;
- the price or profit margin of the implementing product; and
- the "price premium" – which indicates the proportion of a product price that is directly attributable to the licensed technology.

The merits of these benchmarks are discussed in Section 5.2 below, which covers the top-down framework.

Courts have sometimes accepted such benchmarks and at other times have rejected them where the benchmark itself was considered unreliable or insufficiently linked to the licensed technology. Nonetheless, the underlying principle is widely recognized: where a benchmark is sufficiently reliable, it can help parties, courts and arbitrators to assess whether market-observed license rates are consistent with a reasonable (including FRAND) outcome.

Benchmarks can be grouped into two broad categories.

- **Bottom-up approach**. This school of thought seeks to estimate the value attributable to a particular SEP portfolio (or to the functionalities it enables) using economic reasoning and evidence about portfolio quality and technological contribution, which may go beyond both patent counts and binary assessments of validity and essentiality. Basing the calculation on a hypothetical negotiation seeks to directly address the shortcomings of the comparables approach that stem from an ex post analysis – the Report will therefore addresses this method next (Part 4).
- **Top-down framework**. Methods belonging to this category begin with an estimate of the aggregate royalty rate for the relevant standard (the "total royalty stack") and then allocate a share of that total to the SEP portfolio being valued, based on an assessment of its relative contribution (using proxies such as portfolio share, adjusted where possible for quality and other relevant factors). This approach provides a cross check for *both* the previously discussed methodologies, by ensuring that the prices agreed in practice make sense in principle, avoiding the risk of royalty stacking. Parts 4 and 5 will discuss both value-based approaches by breaking them down into methodical steps and highlighting their respective strengths and limitations.

The reliance that courts place on a cross-check depends on their assessment of each approach based on the facts in the relevant case. In that respect, the 2026 judgments relating to Samsung and ZTE are instructive. All three courts – in the UK, China, and Germany – considered evidence from comparable contracts and a "top-down" valuation. They each assessed the strength of that evidence differently. In the UK, the comparable contracts were considered to more robust and informative than the top-down valuation, which on the facts of that case was considered too sensitive to its underlying assumptions.[22]The Chongqing Court considered both valuation approaches informative and consistent with each other – although the specific applications of those approaches differed from those in the English judgment. In contrast, the Munich Regional Court considered that none of the contracts were sufficiently comparable, and relied on a top-down assessment.[23]

3.6 Summary

The comparable contracts approach offers a structured way to estimate FRAND terms by reference to licenses concluded in sufficiently similar circumstances. It proceeds on the premise that agreements for similar patent rights, products, parties and contractual settings may provide useful evidence of the terms that willing parties would regard as reasonable for the Focal Contract.

22 [2026] EWHC 999 (Pat), para 49 .
23 *ZTE* v. *Samsung*, The People's Republic of China Chongqing First Intermediate Court Civil Judgment, Yu 01 Min Chu No. 905; and Munich Regional Court, 30.04.2026, 7 O 64/25 – *Bestimmung der Angemessenheit von FRAND-Lizenzraten* (link) .

As this part has shown, the approach is feasible in principle but depends heavily on evidence, judgment and the disciplined treatment of differences across contracts. This includes:

- identifying transactions that are sufficiently comparable in their economically relevant characteristics;
- "unpacking" the agreed terms into a common cash-equivalent metric, notwithstanding differences in payment structure, timing, risk allocation and non-monetary consideration; and
- adjusting unpacked rates where relevant differences remain between the comparable contract and the Focal Contract, whether to improve comparability or, in some cases, to address features of the negotiation environment that may have affected the agreed terms.

In practice, the method may be complicated by unobserved characteristics, changing circumstances over time, bundled technologies and products, limited numbers of observable transactions, and geographic variation in patent coverage, enforcement conditions and market conditions. It also requires an assessment of whether the rates inferred from comparable contracts plausibly fall within a FRAND range, including, where appropriate, by reference to external benchmarks of value.

Overall, the comparable contracts approach may provide useful market evidence for FRAND valuation, but its reliability depends on transparent criteria for comparability, careful treatment of contractual structure and appropriate cross-checks to assess reasonableness in context.

4 The bottom-up approach

Topics covered in Part 4:

- **An overview of the bottom-up approach**
- **Step 1: The economic principles of modeling a hypothetical negotiation**
- **Step 2: An empirical assessment of technical contributions and their economic value**

4.1 An overview of the bottom-up approach

In license negotiations, a "bottom-up" approach estimates a reasonable royalty for a specific patented contribution. It anchors the rate, or a range of rates, in the technology's incremental value. Incremental value refers to the additional benefit the technology delivers compared with the next-best alternative way of performing the same function.

In SEP licensing, practical alternatives are constrained – or eliminated – once a standard has become widely adopted. In this setting, the bottom-up approach therefore seeks to anchor a FRAND rate in the SEP's incremental value ex ante: that is, the royalty that the parties would have regarded as reasonable immediately before the standard was set, taking into account the incremental benefit that the chosen technology offers over the alternatives available at the time.

4.1.1 The rationale

The motivation for this approach to SEP valuation is to address the main concern with ex post negotiations – lock-in. Once a patented technology has become essential to a widely adopted standard, implementers' competitive alternatives narrow, and the royalty that an SEP holder seeks may reflect the benefit of complying with the standard, rather than the use of the patented technology itself. This concern is most acute where compliance is necessary for the implementer, but the patented technology contributes only limited incremental value to the product – for example, because it relates to a minor feature, or because similarly effective alternative technologies were available when the standard was being developed.

The ex ante benchmark therefore asks what price the parties would have agreed when implementers still had credible outside options, such as rival technical solutions that could have been incorporated into the standard, or the option to delay, redesign or forgo the relevant functionality. These outside options limit what an implementer would rationally be willing to pay and, correspondingly, constrain what a licensor could demand in a competitive setting.

In such a setting, license terms would fall within a bargaining range bounded by two constraints:

- **The licensor's minimum willingness to accept (WTA)**. The lower bound reflects the value of the licensor's best alternative to the agreement – its opportunity cost. A patent owner's alternatives to an agreement may include profits from using the technology itself, licensing the technology to other implementers or deploying the invention in other markets.
- **The implementer's maximum willingness to pay (WTP)**. This is determined by the incremental value of the licensed technology over the next-best alternative, taking account of any costs of adopting that alternative. If the royalty demanded exceeds that incremental

value, the implementer would rationally prefer the alternative. In the limiting case, the "next-best alternative" may be to forgo the functionality and to incur neither the costs nor the benefits associated with it.

In some settings – particularly where rivalry for selection into the standard is strong and the leading technical alternatives are close substitutes – the ex ante benchmark can imply a low royalty, in the limiting case approaching zero, even where the chosen solution will provide substantial value to implementers. This outcome occurs where two conditions coincide: (iI) the licensor's WTA is low due to the limited availability of outside options even before the standard is set,[1] and (ii) the incremental value of the patented technology over the next-best alternative is small.

Whether it is reasonable, as a matter of economic theory and commercial practice, for a valuable technology to command a zero, or near zero, royalty is contested. The debate turns on issues such as the realism of "perfect substitutes," the appropriate timing of the ex ante benchmark, the need to preserve long-term innovation incentives and how to treat alternatives that may have existed in theory but not in practice. These issues are discussed in Section 4.2 below.

In principle, focusing on the *incremental value* that a technology provides over its alternatives provides incentives to develop beneficial technologies. First, if a technology's advantage over its alternatives is small, a low royalty can be economically consistent with competitive markets. Second, innovators are incentivized to develop technologies that offer high incremental value over the value that existing alternatives can already provide.

Box 4.1 sets out the dynamics of two otherwise identical license negotiations: one conducted ex post and the other ex ante.

Box 4.1 A simple comparison of ex post and ex ante negotiations

Parties Gamma and Alpha negotiate an SEP license relating to a wireless communication standard. Gamma is an implementer that sells standard-compliant devices for $500, earning $100 profit per unit. Alpha owns an SEP covering a data-packaging technique used in the standard. The functionality added by this technique increases consumer demand for the devices, increasing Gamma's profits by $1.00 per unit (compared with not offering that functionality at all).

Ex post negotiation: after the standard is set
Alpha demands a lump sum royalty that would correspond to $100 per unit: the entire profit on each implementing device sold.

The demand is unreasonable, but Gamma is locked in: no workaround can be developed and no substitute can be adopted without abandoning the standard. Gamma could increase the price of its product, but that would reduce its quantity of sales and thus the profits it can achieve.

Ex ante negotiation: immediately before the standard is set
Gamma and Alpha have the same negotiation, *before* the standard is finalized.

Even before considering alternative technologies, Gamma can walk away if the royalty exceeds $1.00 per unit. It is not willing to pay more for a license than it expects to gain from using the patented technology. That constrains the royalty that Alpha can demand.

However, before the standard is set, Alpha faces competition from alternative technical solutions that could instead be included in the standard. Beta has developed an alternative. The alternative is inferior, but it is still useful – it would increase an implementer's profits by $0.80 per device (compared with not having the functionality at all). As a result, Gamma can compare the net value offered by the two technical solutions when negotiating with their respective patent holders. Competition between the two technical solutions applies pressure on the royalties that Alpha and Beta can offer to secure an agreement with Gamma.

1 See Section 5.2 explaining possible reasons.

In a stylised hypothetical negotiation, in which Gamma is free to negotiate with both patent holders on the basis of the net value – the technology benefit minus royalty – they can provide, the following dynamic arises (see note):

- Alpha seeks a royalty that reflects the value that its technical solution provides to the implementer: $1.00 per device. Beta can undercut Alpha with a lower royalty, so that it offers Gamma better net value than Alpha offers. Alpha can respond by lowering its offer.
- In this case, because it is assumed to have no outside option, Beta has an incentive to keep lowering its royalty, if necessary, until it reaches its minimum WTA, a royalty that has been driven down to practically $0.00. This would offer Gamma $0.80 in net value ($0.80 – $0.00). For Gamma, Beta's alternative is the outside option: Gamma is in a strong position to negotiate for an offer that provides no (or only marginally) less than $0.80 in net value.
- The outside option constrains Alpha's final offer to $0.20, which is the incremental value its solution offers over the next-best alternative ($0.20 = $1.00 – ($0.80 – $0.00)).

Gamma and Alpha then can negotiate over a bargaining range that spans between $0.20 (Gamma's maximum WTP) and practically $0.00 (Alpha's minimum WTA).

In this example, it is crucial that Gamma can freely negotiate with each patent holder. If, for instance, Beta had offered a take-it-or-leave-it offer of $0.50 and refused to revise its bid, then that offer would set Gamma's outside option and its WTP for Alpha's technology would rise to $0.70 (the incremental value it offers – $0.20 per unit – over the outside option, plus the cost of that outside option, $0.50, keeping $0.30 additional profit).

Note: This is a simplified, illustrative example, highlighting relevant factors when considering the differences between ex post and ex ante SEP license negotiations. Note that the outcome of a hypothetical negotiation depends on how it is designed.

4.1.2 The approach

Typically, a bottom-up valuation is conducted ex post, after the relevant SEPs are already essential to a successful standard. To estimate the royalty range that would have been available under competitive constraints, it therefore seeks to establish the outcome of a hypothetical negotiation.

In practice, the approach combines two linked components:

- **Step 1: An economic model of the hypothetical ex ante negotiation**. This sets out the principles and assumptions used to identify a bargaining range for the license.

- **Step 2: An empirical assessment of technical contributions and their economic value**. This provides the evidence needed to apply (or "calibrate") the model to the particular SEP(s) or portfolio at issue and its credible ex ante alternatives.

4.1.2.1 Step 1: Modeling a hypothetical negotiation

Modeling a bargaining range is a standard tool in economic analysis and is used relatively frequently when economists assess reasonable royalties in US patent-infringement cases.[2] Swanson and Baumol first formalized the approach for SEPs.[3]

2 See Meyer, C. and B. Ray (2005). A critique of noneconomic methods of reasonable royalties. In Leonard, G.K. and L.J. Stiroh (eds), *Economic Approaches to Intellectual Property.* NERA Economic Consulting.

3 The ex ante benchmark was developed in Swanson D.G. and W.J. Baumol (2005). Reasonable and non-discriminatory (RAND) royalties, standards selection, and control of market power. *Antitrust Law Journal*, 73(1), 1–58. Also see: Layne-Farrar, A., A. Jorge Padilla and R. Schmalensee (2007). Pricing patents for licensing in standard-setting organisations: Making sense of FRAND commitments. *Antitrust Law Journal*, 74(3), 671–706; and Lemley, M. and C. Shapiro (2007). Patent holdup and royalty stacking. 85 *Texas Law Review*, 1991 (2007), 1 Stanford Law and Economics Olin Working Paper No. 324, 1990-2049, available at SSRN .

The result of any hypothetical negotiation depends on the economic assumptions used to represent bargaining dynamics and competitive constraints. Therefore, a key task is to ensure that the model reflects economically plausible behavior and a realistic decision point for standard selection.

In particular, the timing of the hypothetical negotiation will affect the result. This approach typically frames the negotiation as occurring just before the standard specifies the preferred technology, when manufacturers – through the standard-setting process – could hypothetically still have chosen between rival technical solutions based on the net value they would provide, based on the benefits of their functionality minus any costs, including royalties.[4] Further considerations about selecting this timing as a reference point are addressed in Section 4.2.2.

The structure of the bargaining process will also matter. In principle, the negotiation can be characterized as either:

- **bilateral negotiation** between a patent holder and a *prospective* implementer, in which rival technologies act as outside options that constrain the royalty that the patent holder can achieve; or
- **auction for inclusion in the standard**, in which rival technologies effectively compete for selection based on the functionality they offer and the licensing terms on which they are made available.

The bilateral negotiation is typically the default structure used for the ex ante approach and produces a bargaining range, rather than a winning "bid."

4.1.2.2 Step 2: Assessing technical contributions and their value

To apply the approach to a particular SEP or SEP portfolio, the analysis then requires evidence on (i) the value of the patented solution's technical contribution to the implementing product and (ii) the value of any credible ex ante alternatives that could have been adopted instead.

In practice, this assessment can be structured in two stages:

1. a **technical assessment**, comparing the performance and trade-offs of the patented solution against contemporaneous alternatives;
2. an **economic assessment**, translating incremental technical improvements into incremental economic value, recognizing that technical improvements and economic value may not be proportional.

The main considerations for each step are set out below.

4.2 Step 1: The economic principles of modeling a hypothetical negotiation

A bottom-up valuation depends on the economic logic that underpins the hypothetical ex ante negotiation.

The central idea is that a license determines how the parties divide the **gains from trade**, i.e., the economic value created when patented technology is combined with an implementing product.

4 See the discussion on timing below, in "practical considerations." In the United States, in reasonable royalty cases, the hypothetical negotiation takes place on the "eve of infringement," which is determined by the implementer's first use. However, in the context of FRAND, in principle this would reflect the ex ante principle – i.e., the parties at the negotiating table would be focused on the FRAND obligation, which would price the value of the technology prior to standardization.

4.2.1 Understanding the economic principles that determine the bargaining range

In a hypothetical negotiation, the bargaining range is shaped by the gains from trade created when patented technology is combined with an implementing product and by the outside options available to the parties.

4.2.1.1 Gains from trade: the economic value of implementing a technology

The starting point for the hypothetical negotiation is the economic value that the licensed technology unlocks in use. Standard essential technologies are valuable because they provide technical functionality that benefits users and can reduce costs, or improve performance and reliability, for implementers. Ultimately, the amount that users are willing to pay for the resulting product improvements, together with any cost savings, determines the technology's economic value. For an implementer, the value attributable to the technology is the incremental profit it can earn when the product implements the technology, compared with the position it would have faced without it. That incremental value may be driven by higher demand – reflected in prices or volumes, or both – and by lower production or operating costs (see Part 1).

That technical value is *conceptually* distinct from the value that arises when a market coordinates around a common standard. Interoperability, **scale economies** (lower per-unit costs as production volume increases) and **network effects** (product value increases as more users adopt it) can be important sources of value, but they play a different role in ex post and ex ante negotiations.

- In an ex post negotiation, coordination benefits have already formed around the chosen technology, weakening competitive constraints and insulating it from price competition.
- In an ex ante setting, by contrast, the benefits of coordination will form around whichever technology is selected. However, the *scale* of those coordination benefits may differ depending on which technology is selected; a higher-quality solution may attract more implementers and consumers and thereby generate larger network effects and economies of scale than the inferior alternative would have done. But that difference does not distort the comparison between technologies. It simply affects the size of the gains from trade that each ex ante alternative will generate.

Finally, as discussed in Section 1.1.2 above, the economic value created by implementation is complementary: it depends on *both* the patented technology and the implementer's product. The technology generates value only when implemented in products; products capture additional value only when they can use the technology.

The resulting value is therefore a gain from trade – joint value that depends on an agreement to combine the patent holder's technology with the implementer's product.

Box 4.2 illustrates the **gains from trade** in the negotiation between Gamma and Alpha described in the hypothetical ex post and ex ante negotiations discussed above.

Box 4.2 Example where standardized technologies create mutual incentives

As in Box 4.1, parties Gamma and Alpha negotiate a license for an SEP covering a data-packaging technique used in a wireless communication standard.

Implementing Alpha's patented technique increases the implementer Gamma's expected profit by $1.00 per unit (on average), compared with the scenario in which it cannot use the functionality.

Without the technology, Gamma's device will have inferior functionality, which reduces consumer demand for the product, and reduces the profit Gamma can earn. Without the implementer, however, the patent holder Alpha will earn no licensing revenue. The technology has value in use, not in abstract. The $1.00 per unit of additional value therefore is complementary; it requires the contributions of both parties: it is a gain from trade.

The parties therefore have a mutual incentive to agree terms that allow them to share the $1.00 gain from trade between them.

Note: This box offers a simple, illustrative example highlighting relevant factors when considering the role of standardized technologies in SEP license negotiations. They are neither comprehensive nor exhaustive and license negotiations can be affected by other factors. See Section 4.2.2 below.

4.2.1.2 Negotiating a price that divides the gains from trade

The parties negotiate terms of a license agreement. They do not *negotiate a specific division of the gains from trade*; they *negotiate a price*. However, *in principle*, each party will reject terms that leave it worse off than it would be if no agreement is reached: therefore that price will be mutually beneficial.

In an ex ante negotiation, before parties are locked into implementing a particular technology, the price they agree will divide the gains of trade: the royalty is the patent holder's share, the remainder is the implementer's share – its additional profit after royalties.

The range of prices that the parties would mutually agree on depends on the net value provided by their outside options at the time of the negotiation. The implementer will choose the option that provides it with the greatest *net value*: the difference between the benefit and the cost of choosing that option.

In the typical setting for an ex ante hypothetical negotiation, for the purposes of the bottom-up approach assumed to take place immediately before the standard is agreed, the minimum royalty that innovators competing to be part of the standard are willing to accept may be low. In certain scenarios, this value may be zero. Under the assumptions typically used for this method, two reasons explain this phenomenon.

First, for the patent holder, the alternatives to an agreement may include profits from using the technology itself, licensing it to other implementers or deploying it in other markets. However, in the context of standards, these outside options may be constrained or eliminated by the *process* of developing a successful industry standard – even at the ex ante stage, immediately before the standard is set. Where a market is expected to coordinate around a single standard, a patent holder whose technology is not selected may anticipate that it has a limited prospect of competing against the eventual standard and its associated network effects. If the technology is selected, standard adoption and a FRAND undertaking commonly imply broad access on non-exclusive terms, which can limit reliance on exclusivity, or on playing implementers off against one another, as a source of bargaining pressure on royalties.

Second, whether a patent is essential to a standard or not, the patent holder's development or acquisition costs will not affect the minimum royalty it is willing to accept. At the point of negotiation at the selected point in time, those costs are sunk: they have been incurred and cannot be recovered whether an agreement is reached or not. So, it may accept little to no

royalty and incur a loss, even if its technology offers value. The prospect of that loss may have deterred it from its earlier decision to invest, but by the time the standard is being set, its sunk costs do not make a given royalty offer less attractive than the option of walking away.

The significance is that, in this situation, the patent holder of the next-best alternative will be willing to accept no royalty, even if its technology offers value to implementers. In that case, the net value offered by an implementer's outside option will be the same as the economic value of that option. This constrains the maximum amount that the implementer is willing to pay for the preferred technology to the incremental value that technology offers over the next best alternative– as illustrated in Box 4.3.

Box 4.3 Comparing the net value offered by ex ante alternatives

An implementer negotiates the terms of a license with a licensor, option A. Its alternative is option B. The implementer will choose the option that offers the highest *net* value: the difference between the benefit and the cost of choosing that option.

Net value of option A > net value of option B

Where:

Net value of option A = value of A – royalty for A

Net value of option B = value of B – royalty for B

B's WTA = 0

Then:

Value of A – royalty for A ≥ value of B – royalty of B

Value of A – value of B + royalty of B ≥ royalty for A

Value of A – value of B ≥ royalty for A, since royalty of B = 0

Note: This box offers a simple, illustrative example comparing the net value offered by ex ante alternatives. Terms can be affected by other factors. See Section 4.2.2 below.

4.2.1.3 Negotiations in three cases of ex ante competition

Here, we illustrate the dynamics of the hypothetical ex ante negotiation between an implementer and an innovator. As in Box 4.1 above, the implementer, Gamma, sells consumer devices for $500, earning $100 profit on each one. It implements a wireless communication standard, to which the innovator, Alpha, contributes. Alpha's patented technology, covering a data-packaging technique, increases Gamma's profits by $1.00 per unit (compared with not having that functionality).

The outcome of ex ante negotiation between the parties depends on the strength of Gamma's outside option. There are three possible situations:

- **No ex ante alternative**. Where no realistic alternative exists for the relevant function, the incremental value may approach the technology's full economic value, subject to the implementer's ability and incentives to adopt. Even then, an implementer would not rationally pay more than the economic value that the technology enables; beyond that point, it would prefer to forgo the functionality.
- **An imperfect alternative**. Alternatives may be inferior in quality or differentiated in ways that affect the implementer's preference. Where the next-best alternative would have delivered less value, the incremental value reflects that difference – which may be substantial or modest, and may vary across implementers.

– **A perfect (or near-perfect) alternative**. Where the next-best alternative would have delivered substantially the same value, incremental value is small. That does not imply that the total value of the functionality is small; it means that the best option and the next-best option benefit the implementer to a similar extent, which may or may not be large. In either case, the royalty is tightly constrained and may tend toward the licensor's minimum WTA.

Ex ante negotiation with no alternative

If the parties agree terms, the gain from trade is $1.00 per unit. Without an agreement, neither party benefits.

The minimum amount that the licensor, Alpha, is willing to accept is nothing. It has no outside option: its past development or acquisition costs are sunk at the time of negotiation, therefore any positive payment improves its current position. In practice, if anticipated, such an outcome would have discouraged Alpha from conducting R&D, and it may dissuade it from developing technology for inclusion in *subsequent* standards. However, it does not affect the *current* negotiation in this hypothetical scenario.

The maximum amount that the implementer, Gamma, is willing to pay is $1.00 per unit. Above that price, the cost of licensing exceeds the benefit it provides, and so Gamma would rather do without.

In a bilateral negotiation, the bargaining range lies between these two points. The parties determine the royalty based on their relative bargaining power. In an auction setting, which differs from a standard setting, the royalty may simply be the implementer's willingness to pay, if the patent holder can make take-it-or-leave-it offers. Box 4.4 illustrates the bilateral negotiation.

Box 4.4 An ex ante negotiation with no alternative

Net value of option A > net value of option B

Where:

Net value of option A = value of A – royalty for A

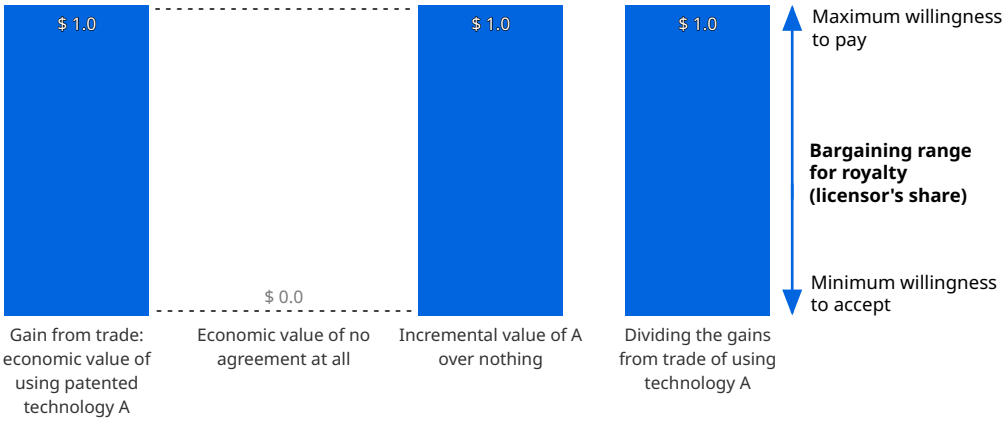
Net value of option B = value of no technology at all – royalty for no technology at all

= 0 – 0 = 0

Then:

Royalty for A ≤ value of A – value of B + royalty for B

Royalty for A ≤ value of A – 0



Note: This box offers a simple, illustrative example of an ex ante negotiation with no alternative. The factors highlighted are not exhaustive and negotiations can be affected by other factors. See Section 4.2.2 below.

Ex ante negotiation with an imperfect alternative

This section considers the same negotiation, at the ex ante stage, where the relevant part of the standard could instead have adopted a credible alternative technical solution that provides the same or similar functionality – although not as well. The next-best alternative is an imperfect substitute that offers less value.

As before, if the parties agree on terms, the gain from trade is $1.00 per unit. However, this time, the implementer, Gamma, can opt for an alternative agreement, which provides $0.80 per unit. Both licensors have no outside options, so the minimum each is willing to accept for the benefit that their respective technical solutions provide is zero. On that basis, the net value offered by Gamma's outside option is $0.80 per unit: its entire value for no royalty.

The bargaining range for Alpha's superior technology is $0.00 to $0.20 per unit – the incremental value it offers over the next-best alternative ($1.00 – $0.80). The royalty they determine depends on their relative bargaining powers; the rest of the gains of trade is Gamma's share. This is illustrated in Box 4.5.

Box 4.5 An ex ante negotiation with an imperfect competitor

Net value of option A ≥ net value of option B

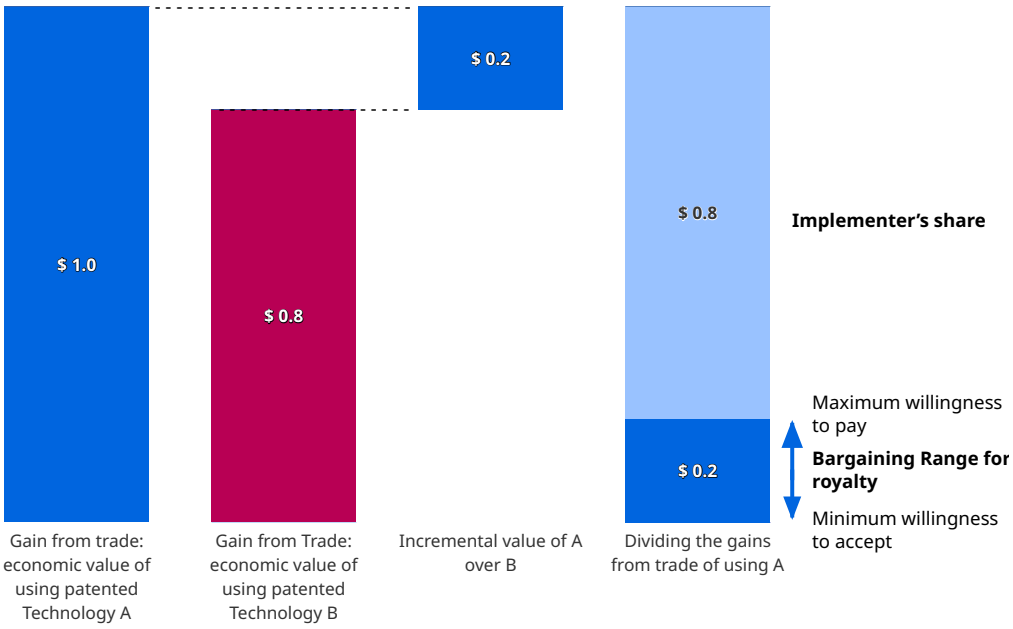
= value of A – royalty for A ≥ value of B – royalty for B

So:

Royalty for A ≤ value of A – value of B + royalty for B

Royalty for A ≤ 1.00 – 0.80 + 0.00

Royalty for A ≤ $0.20



Note: This box offers a simple, illustrative example of an ex ante negotiation with an imperfect competitor. The factors highlighted are not exhaustive and negotiations can be affected by other factors. See Section 4.2.2 below.

This section considers the same negotiation but in this instance the next-best alternative at the ex ante stage is a perfect substitute that offers the same value.

As before, if the parties agree terms, the gain from trade is $1.00 per unit. Both technical solutions offer the implementer Gamma exactly the same benefit, and both licensors are willing to accept nothing as they lack outside options. Both offer the same net value to Gamma, but no incremental value. The royalty that the parties agree is zero, as illustrated in Box 4.6.

Box 4.6 An ex ante negotiation with a perfect competitor

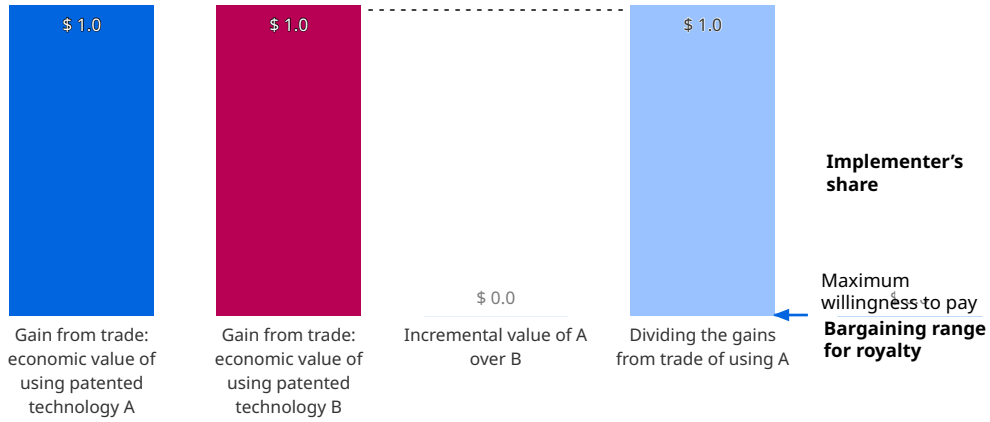
Net value of option A ≥ net value of option B

= value of A – royalty for A ≥ value of B – royalty for B

So:

Royalty for A ≤ value of A – value of B + royalty for B

Royalty for A ≤ 1.00 – 1.00 + 0.00 = $0.00



Note: This box offers a simple, illustrative example of an ex ante negotiation with a perfect competitor. The factors highlighted are not exhaustive, and negotiations can be affected by other factors. See Section 4.2.2 below.

4.2.2 Contentious issues when establishing a reasonable hypothetical negotiation

The outcome of the hypothetical negotiation depends on how it is set up. In the context of FRAND valuation for SEPs, three issues in particular require careful consideration.

1. **Timing**. At what point in time should the hypothetical negotiation be placed?
2. **Information**. Should the model use only information available ex ante, or may it rely on ex post evidence about value?
3. **Role of the bargaining range**. Does the model identify a single FRAND rate, a ceiling or simply a bargaining range that must then be applied with judgment?

4.2.2.1 The timing of the negotiation

The issue here is whether modeling a hypothetical negotiation *immediately before the standard is set* provides reasonable terms.

The issue

In non-SEP reasonable royalty analysis, the hypothetical negotiation is often placed at the "eve of infringement" – typically linked to the implementer's first use. In the SEP context, that timing is less informative. By the time infringement occurs, the standard has already been specified and the relevant technologies are essential to it; in many cases, viable technical alternatives may already have been eliminated. Placing the negotiation at this point in time can therefore undermine the motivation for an ex ante framework, as the implementer already lacks effective outside options to constrain the royalty demands.

For this reason, the conventional ex ante framing for SEPs places the hypothetical negotiation earlier: immediately before the relevant technical solution is selected into the standard (the "eve of standardization"). At that stage, implementers can still choose between competing technical proposals – through the standard-setting process. This timing is attractive because it captures the central ex ante intuition: competition between alternatives constrains the royalty that a successful technical proposal can command.

A key criticism, however, is that this timing can be asymmetric. It occurs before *implementers* of the standard are locked into the standard, but after *innovators* of the standard are locked in. Implementers retain outside options, leveraging competition between patent holders. Innovators do not: their R&D costs are sunk, and the network effects that will form around the winner mean that the losing technical proposals cannot viably compete against the proposal that becomes the standard. Furthermore, the selected technical proposal cannot leverage competition between the implementers for access to the benefits it provides, as the innovator cannot implement or license their technical solution exclusively – the implementers form a de facto monopsony, particularly where the prospect of standardization drives strong coordination and interoperability benefits.

That criticism has been used to dismiss the approach entirely. However, analyzing the dynamics of the bargaining process can help a valuation. So, in principle, one potential solution proposed to address this criticism is to further modify the timing of the hypothetical negotiation to a point when *neither* implementers nor innovators are irreversibly committed to the standard.[5] In practice, that means setting the hypothetical negotiation at a point in time before the innovator has incurred the cost and risk of development. At that point, the costs of development are incremental, and so inform the innovator's minimum WTA. Competitive pressure will still encourage it to reduce its demands, but not to the point where it would make a loss from developing the technology. Below that "break even" point, or "hurdle rate," it would be better off not to compete at all. The principle of the ex ante framework therefore remains, but an innovator is not irreversibly committed to a loss-making agreement. Of course, establishing the minimum amount that an innovator would hypothetically have been willing to accept before it was committed is difficult in practice.

Reasons to keep the conventional timing

Some economists do not consider the outcome of the conventional timing to be necessarily paradoxical. Innovation is inherently risky: firms invest ex ante without certainty of selection or commercial success, and a successful technical solution may still earn less than originally hoped. Low royalties may simply reflect strong ex ante competition and the presence of close substitutes. Essentially, even a successful innovation might not make the money that was initially expected.[6] Furthermore, if the sales volume of products implementing the standardized technology are expected to be very large, inclusion of a technical solution in the standard and the ability to earn even marginal royalties over close substitutes may provide sufficient incentive to engage in R&D. This perspective also notes that many non-SEP patents earn little or no royalty because they do not offer meaningful incremental advantages over competitive alternatives.

5 Sääskilahti P. and A. Tuffin (2023). What the ex-ante benchmark reveals about the reasonable price for SEP licences . Compass Lexecon.

6 Melamed, D. and C. Shapiro (2018). How antitrust law can make FRAND commitments more effective . *Yale Law Journal*, 127(7), 2110–2141. This is not a problem that is unique to standards, per se. Standards and SEP portfolios often consist of many patents and not every patent will be a "winner." As noted above, it is the long-term expected value of a potential portfolio of patents that draws firms to participate in innovation markets.

The issue may, however, be mitigated. In many real-world settings, the "zero-royalty" result is an edge case associated with perfect (or near-perfect) substitutes. Where alternatives are imperfect, incremental value is positive, and the benchmark can yield royalties that plausibly reward successful innovators. Even where the criticism is accepted in principle, it need not undermine the usefulness of the ex ante framework. A common practical approach is to retain the ex ante incremental-value logic as the core discipline, while recognizing that extreme outcomes may require careful scrutiny – particularly where they would imply implausible incentives given the scale of investment and the nature of competition.

Reasons to adjust the framing to reflect innovators' ex ante incentives

The alternative view is that competition should not systematically imply that there is no expected return for efficient innovators where the technology creates value for users. The concern is that, if selection into a standard is expected to eliminate innovators' effective outside options and push royalties toward zero even when the technology is valuable, participation in and intensity of competition to develop valuable technologies may weaken – particularly for firms that rely on licensing to fund R&D.

In this view, innovation may skew toward vertically integrated firms, which can recoup returns through downstream product sales rather than licensing, reducing the pool of potential innovators that could compete to contribute to standards. It also makes it more likely that standards rely on spillover innovation, where technologies are developed primarily for other markets and only incidentally contribute to standards. Finally, innovators would have incentives to contribute in settings where competition is expected to be weak, where they anticipate earning returns closer to the full value of their technology.

4.2.2.2 Information in the hypothetical negotiation

The issue here is whether a hypothetical ex ante negotiation may use information that emerges ex post.

The issue

In practice, many key inputs are uncertain at the time of standard setting: how widely the standard will be adopted; what products and use-cases will emerge; and how much value a given feature will create in the market. If the negotiation takes place before the innovator has incurred any development costs, then all information about future costs and benefits may be particularly uncertain at that point in time.

A central modeling question is therefore whether the hypothetical negotiation must be restricted to what parties *could* have known in practice when that negotiation took place, or whether the negotiation may appeal to foresight – informed by evidence that only emerged subsequently.

A literal ex ante approach

Under a literal approach, the hypothetical negotiation is modeled using *only information that was available at the time*. This has two consequences:

- **Uncertainty** – the model must incorporate uncertainty about adoption, demand and costs, and about the performance and commercial significance of alternatives.
- **No benefit of hindsight for either party** – the implied bargaining range must reflect the value expected at the time, not value realized later. If realized value turns out to be higher than expected value, the model does not retroactively increase the royalty (in the licensor's favor); if realized value is lower than expected, it does not retroactively reduce it (in the licensee's favor).

This approach resembles how parties would actually contract a fixed price under uncertainty and avoids the bias of hindsight.

An ex ante negotiation with ex post evidence

This approach allows the parties to have *"perfect foresight" during the negotiation*. They negotiate with *full knowledge of the evidence that becomes available ex post*. This allows them to more accurately estimate the value that the parties are bargaining over. The core rationale is that the ex ante benchmark is meant to remove distortions from lock-in and ex post bargaining power, not to freeze the valuation in the face of uncertainty that is unrelated to opportunism.

On this approach, ex post evidence can help measure value more accurately. For instance, it will be clearer what performance improvements were achieved, what use-cases emerged and how consumers responded. That evidence does not re-create hold-up, as it does not affect the licensor's bargaining leverage in the hypothetical negotiation – rather, it refines the estimate of the surplus to be shared.

However, it may also introduce error. In particular, parties make decisions without perfect foresight, so that risk affects their incentives. If risk is not adequately factored into the negotiation, then it might not truly represent the prices that the parties would have been willing to pay or accept. In that case, use of ex post evidence must be as an input must be viewed with caution.

4.2.2.3 The role of the bargaining range

The issue here is whether the ex ante bargaining range is determinative. There are two aspects to this discussion.

What does the hypothetical negotiation yield: a FRAND rate, a ceiling or a range?

Within the bilateral negotiation model, the implementer's WTP sets the ceiling and the licensor's WTA sets the floor; any price between these could, in principle, be FRAND. Any price lower than the WTP makes an implementer better off than it would have been with the next-best alternative. Any price above the WTA makes the licensor better off than it would otherwise have been without the agreement.

Most applications would stop at identifying this bargaining range and not identify a single price. The exact price would depend on other frictions that the model typically abstracts – in particular, the factors that affect the parties' relative patience and negotiation skills, which may be hard to parameterize in an ex ante setup immediately before the standard is specified.[7]

If the hypothetical negotiation is modeled as an auction among rival technologies for inclusion in the standard, then WTP may effectively pinpoint the price rather than set the ceiling of a range.

How determinative should the model be in real cases?

The framework shows a close link between outside options, the bargaining range described by parties' willingness to pay and to accept, and the agreed price.

Like all models, that relationship is a deliberate simplification. It is designed to isolate how lock-in changes pricing negotiations relative to a world in which implementers could still choose among alternatives. It is not intended to be a literal reconstruction of all ex ante bargaining dynamics.[8]

7 Thus far, the discussion has focused on one patented technology, but there is also the consideration of complementary technologies, which is discussed further below.

8 The starting point for hypothetical bilateral negotiation is Nash (1953). Here, the approach does not model the firms' literal behaviors but finds the solution assuming certain axioms – of which, the main ones are: rational players, binding agreements, Pareto efficiency, independence of irrelevant alternatives and availability of complete information. Sutton (1986) provides an overview of the bargaining literature, including: (i) Rubinstein model, (ii) some alternative games with outside options, (iii) the role of incomplete information and (iv) negotiations with more than two players. Nash, J. (1953). Two-person cooperative games. *Econometrica: Journal of the Econometric Society*, 21(1), 128–140; Sutton, J. (1986). Non-cooperative bargaining theory: An introduction. *The Review of Economic Studies*, 53(5), 709–724.

In real negotiations, additional factors can shift outcomes relative to the model's central prediction: asymmetric information, portfolio effects, risk allocation, repeat interactions and institutional features of standard setting. For example, where there is asymmetric information about the value of each other's outside options, there may not be a direct causal link between the actual value of outside options and the price that the parties agree; it would need to be demonstrated.[9]

In some settings, a party may be able to make a credible take-it-or-leave-it offer, in which case changes in outside options may not translate into proportional price changes. For these reasons, the ex ante bargaining range is often best treated as an organizing framework and a constraint on plausibility, rather than a mechanically determinative rule.

4.3 Step 2: An empirical assessment of technical contributions and their economic value

A bottom-up valuation requires information on the value of both the patent technology and its next-best ex ante alternative to calibrate the hypothetical negotiation. In practice, this involves an empirical assessment, with two component steps.

- **Technical assessment**. This step identifies the incremental technical contribution; that is, what the patented solution contributes relative to the alternatives that could realistically have been adopted at the time of standard setting.
- **Economic assessment**. This step seeks to value that incremental technical contribution, which can then inform both the implementer's WTP and a plausible royalty range.

4.3.1 Assessing the technical contribution of patented technology

The objective of this step is to assess the patented solution's incremental technical performance relative to contemporaneous alternatives – the options that the SDO considered, or could reasonably have considered, for the same part of the standard.

The analysis is typically led by technical experts, drawing on the evidence submitted during the standard-development process, which typically scrutinizes the relative technical merits of rival proposals in expert working groups.[10] The aim is to identify what area of the standard's functionality the patented solution improves – for example, in wireless standards, a particular technical solution may contribute to the performance of data throughput, reliability, latency, power consumption or implementation costs – and how that specific functionality compares to the contribution that rival proposals, if any, could have contributed in their place. The next-best alternative proposal provides the outside option in the hypothetical negotiation. The assessment should also note that some improvements may involve trade-offs – for instance, higher peak speeds may come at the expense of greater power consumption.

A practical limitation in such an assessment is scale. In many standards, an SEP holder may declare hundreds or thousands of SEPs. In principle, the bottom-up approach would value them all individually. In practice, that patent-by-patent assessment may not be feasible.[11] In addition, the technical contribution of a single patent can be difficult to identify in isolation, because it may operate in conjunction with related patents. For these reasons, courts and parties often conduct the analysis at the portfolio level, covering all related patents for a specific innovation area rather than individual patents.

9 For instance, in Nash (1953), an outside option is just an exogenous "threat" that is relevant even if it is worse than the expected outcome. This simplification is unintuitive. Sutton (1986) notes "only threats which are credible will have an effect on outcomes." Nash, J. (1953). Two-person cooperative games. *Econometrica: Journal of the Econometric Society*, 21(1), 128–140; Sutton, J. (1986). Non-cooperative bargaining theory: An introduction. *The Review of Economic Studies*, 53(5), 709–724.

10 See the discussion of the ETSI/3GPP process in Section 1.2 above. See Gupta, K. (2017). How SSOs work: Unpacking the mobile industry's 3GPP standards . SSRN.

11 For example, in *TCL* v. *Ericsson*, Ericsson owned over 200 SEP families essential to the 2G, 3G and 4G cellular standards. The court set portfolio FRAND rates based on top-down and comparable license analyses rather than patent-by-patent assessments. *TCL Communication Technology Holdings Ltd.* v. *Telefonaktiebolaget LM Ericsson*, No. 8:14-cv-00341, (C.D. Cal. Dec. 21, 2017) (link) , amended and superseded (C.D. Cal. Sept. 14, 2018) pp. 33, 98 –104, rev'd in part, vacated in part 943 F.3d 1360 (Fed. Cir. 2019) , cert. denied 141 S.Ct. 239 (2020).

Box 4.7 gives two simplified examples of technical contribution assessments for hypothetical SEP portfolios relating to Wi-Fi and cellular standards.

Box 4.7 Technical contributions of patents

Simplified fictional example: Wi-Fi, battery vs. speed trade-off

During development of a Wi-Fi standard, the working group must choose a method for how devices schedule transmissions when the network is busy. The goal is to increase throughput without draining the battery life in phones and laptops.

Two proposals are considered for the same function:

- **Proposal A (selected).** This technical contribution improves average throughput in a crowded network from 90 Mbps to 100 Mbps (about 11%), but it increases device power consumption by 3% because it requires more frequent signal processing.
- **Proposal B (next-best alternative).** This technical contribution would have improved throughput from 90 Mbps to 96 Mbps (about 7%), with only a 1% increase in power consumption.

The incremental technical contribution of Proposal A over Proposal B is therefore not simply "faster Wi-Fi." It is the *difference* between them: an extra 4 Mbps of throughput (100 – 96), at the cost of a 2% increase in power consumption (3% – 1%).

Simplified fictional example: Cellular reliability feature

In a cellular standard, a working group evaluates ways to improve reliability for users at the edge of a cell (e.g., on a train or in a lift), where signals are weak and dropped connections are common. The function at issue is how the network retransmits data when packets are lost.

One proposal was considered:

- **Proposal A (selected).** This technical contribution reduces the packet-loss rate from 1 in 100 packets to 1 in 1,000 packets (a tenfold improvement), but it requires extra signaling messages that add 2 milliseconds of processing delay and increase chipset memory requirements.
- **Option B (next-best alternative).** No other technical solution was proposed. Therefore, the next-best alternative would have been not to include proposal A at all, and to have maintained the preexisting functionality, with a packet-loss rate of 1 in 100 packets.

The technical assessment concludes that Proposal A delivers a clear reliability improvement over not adopting it into the standard (packet losses fall from 1 in 100 to 1 in 1,000) but it comes with a latency penalty.

Note: This box offers for illustrative purposes a simplified fictional example highlighting factors that may be relevant when considering the technical contribution of a focal patent. They are neither necessary, nor exhaustive.

4.3.2 Assessing the value of the technological contribution

This second step is the economic component of the assessment. It seeks to translate the incremental technical improvements into some measure or indicator of the incremental value – for example, the financial benefits to the implementer that the incremental technical contribution provides through greater sales volumes, higher prices or lower costs.

The valuation of the incremental technical contribution should be quantitative – relying on, for example, demand estimations, conjoint studies, consumer surveys, cost models or engineering studies. Where no such evidence is available, conclusions may be qualitative – for example, whether there is evidence that a technological contribution enabled a meaningful capability or use-case change, or if it was a minor incremental refinement – but the results of the valuation may only be indicative.

The relationship between technical improvements and their value may be non-linear. There are several reasons for this, in particular the following two.

- **Improvements in use-case performance that have diminishing marginal utility**. Once a use-case has been satisfied, additional performance may not add to consumer value to the same degree. There may be diminishing marginal utility. For example, moving from "minutes" to "seconds" to download a small file may be highly valuable initially, but further speed increases may matter far less for that particular use case. In principle, there may also be cases of increasing marginal utility.
- **Changes in primary use-cases, increasing marginal utility**. Performance improvements can unlock entirely new uses, which result in step changes in the value of a technical improvement, rather than smooth linear gains. For instance, the increase in cellular wireless data speeds and usage over the past 10 years has not simply resulted in people performing the same tasks they performed 10 years ago, but faster. It has changed what they use their phones and that data for. The majority of cellular data usage is consumed by high-definition video, which was not possible using previous generations of cellular technology. Enabling a new use-case may result in a step change in the incremental value that an improvement in technological functionality provides.

In practice, the valuation typically takes one of two forms.

- **Direct valuation of the technical contribution**. In the experience of the contributors to this Report, this is the preferred approach of competition authorities and US courts. The techniques applied use the method referred to above. Unfortunately, many of the decisions are not publicly available, and experts' reports are not typically publicly disclosed.
- **Relative valuation**. This second application assesses how technical contributions protected by a particular portfolio of SEPs compare to those of SEPs that are essential to the relevant standard on average. The core idea is that when comparing patent portfolios to benchmark their values, patented technologies with perfect substitutes would receive a lower royalty than those with imperfect substitutes or no good substitutes. This variation in patent values is also consistent with economic studies.[12]

The second approach was adopted by the court in *Innovatio*, for example, when it conducted an analysis of "The Importance of Innovatio's Patents to the 802.11 Standard," including "Alternative Technologies that Could Have Been Adopted Into the Standard" and the specific contributions of *Innovatio's* related SEPs. [13] The court then took these bottom-up considerations into account when deciding where to place Innovatio's patents in the distribution of all patents.

4.3.3 Practical considerations

A bottom-up valuation raises practical challenges that can materially affect results. Three issues are particularly important for applying the approach reliably:

- **granularity**: whether to assess individual patented technologies or to value coherent patent groups;
- **complementarity**: how to treat technologies whose value depends on other technologies, either within the standard or outside the standard but implemented in the product; and
- **aggregation of implementers**: how to treat differences in willingness to pay across products, markets and implementers.

4.3.3.1 Considering granularity

Individual SEPs often protect narrow contributions within complex standards comprising many thousands of specifications. This creates two opposing issues.

12 Vigil, R. and X. Zhang (2022). Determining the price for one when all you have is the price for many . Analysis Group Forum 2022.
13 *In re Innovatio IP Ventures, LLC, Patent Litigation*, 921 F. Supp. 2d 903 (N.D. Ill. 2013) (link) , pp. 34-49, specifically, for the quoted text, pp. 34 and 36.

The first issue is that this can discourage parties and courts from examining technical contributions at all. This lack of examination, however, may raise a backward induction problem. In licensing negotiations, the parties will work backward from the end of litigation; if courts only ever evaluate whether SEPs are valid and essential, and not their technical and economic contributions, then negotiations will not focus on these issues. In turn, licenses signed under these conditions will also not reflect the economic value, but other considerations.

The second issue is the aggregation (or heap) fallacy – the observation that although each patented contribution may be small enough that its contribution seems insignificant in isolation, that does not entail that the aggregation of those parts is also insignificant. Each minor contribution may appear irrelevant to the overall functionality and value of the standard, and yet the value of those contributions in aggregate may be substantial.

In practice, this approach seeks to assess the value of patents at the most granular level that is feasible and efficient. Valuing at the level of individual patents is conceptually closest to the bottom-up principle, because it attempts to measure the contributions of the individual patent rights actually being licensed. This approach can be informative when the number of relevant patents is limited, when each patented contribution can be clearly identified and accurately measured, and when the evidentiary record supports a meaningful comparison with alternatives. In some cases, while it may be difficult to assess all or even a large number of patents, it may be possible to evaluate a subset of patented technologies to assess whether the licensor has made significant contributions to the standard.

However, the valuation often requires greater pragmatism: for example, grouping patents into manageable groups, such that economic value to users of the incremental technical contribution can be meaningfully assessed. In many technical standards, patent-by-patent assessment is not feasible and can create false precision, especially where individual patents cannot be understood independently of related filings. A common and sensible alternative may be to assess coherent groups of patents linked to discrete, consumer-relevant features. This preserves the spirit of a bottom-up assessment while reducing cost and improving technical interpretability. Courts and experts have sometimes taken this approach in the case of complex standards.[14]

4.3.3.2 Considering complementarity

Many patented contributions to a standard are complements: they work together, so that the value attributable to one depends partly on the presence of others. If each patent is valued in isolation – "holding everything else fixed" – the sum of the individually assessed contributions can exceed the value generated by the technology collectively. This happens if each patent receives the full marginal "technical contribution" which is created jointly by the standard.[15]

For example, in a cellular standard, patents that improve power efficiency and patents that increase data throughput both increase the value to consumers of an implementing product – but the value of each depends partly on the other. Higher data speeds raise power demand, which increases the benefit of superior power-saving technology; conversely, better power management makes high-speed use-cases more attractive. Valuing each separately without accounting for the joint (overlapping) value can therefore overstate their combined value.

14 For instance, *In re Innovatio IP Ventures, LLC, Patent Litigation,* 921 F. Supp. 2d 903 (N.D. Ill. 2013) (link) , pp. 40–58 and 84–86. First, Judge Holderman assessed patents in three related groups: The Channel Sharing Patent Family; Multi-Transceiver Family; and Sleep Family. Second, Judge Holderman determined that Innovatio's patents were among the top 10 percent of Wi-Fi SEPs and, using research submitted by the manufacturers that found that the top 10 percent of the patents accounted for the top 84 percent of the value, he attributed 84 percent of the profit margin on the chip to the top 10 percent of patents. He then calculated the royalty due to Innovatio based on its numerical share of the top 10 percent of Wi-Fi SEPs. Also, on the pragmatic need for some degree of aggregation when assessing SEP portfolios, see *Unwired Planet* v. *Huawei* [2017] EWHC 711 (link) (Pat), para. 182: "There was ample evidence before me that apart from Ericsson (see below), parties negotiating SEP licences in fact use methods which are based on patent counting. That is evidence which supports a finding that a FRAND approach to assessing a royalty rate is to engage in some kind of patent counting. Indeed when one thinks about it some sort of patent counting is the only practical approach at least for a portfolio of any size. Trying to evaluate the importance of individual inventions becomes disproportionate very quickly."

15 For a full discussion on applying the ex ante incremental value approach to complementary SEPs, see Layne-Farrar, A., A. Jorge Padilla and R. Schmalensee (2007). Pricing patents for licensing in standard-setting organizations: Making sense of FRAND commitments. *Antitrust Law Journal*, 74(3), 671–706.

Complementarity can be analyzed, and there are theoretical methods suggesting how to allocate joint value – for example, the "Shapley value" and related cooperative-game approaches.[16]

In practice, however, addressing complementarity pushes the analysis toward a top-down approach (see Part 5), rather than a pure bottom-up one. A middle ground may suffice, that avoids excessive aggregation, but which permits grouping of related and complementary patents where separate valuation would materially distort the results.

Box 4.8 illustrates the potential challenges in separately assessing the contribution of complementary patented technologies.

Box 4.8 Complementary patented inventions

In complex products, certain patented inventions produce value only in combination with others.

Suppose that implementing four patented inventions – A, B, C and D – together add $100 per unit to the value of the implementer's product. Assume, however, there is no viable alternative, and none of the value can be realized without all four.

Assessed individually, without the other three also being implemented, none of the them would contribute any value at all. However, each would contribute $100 per unit if assessed individually when the other three are all also implemented. Each can claim the full $100 per unit contribution, and each effectively blocks the others.

In contrast, the problem is avoided if the value of the four inventions is assessed collectively, as a combined whole. That value may then be shared among all contributors under an agreed allocation rule. These situations complicate a bottom-up valuation.

Note: This box offers a simple, illustrative example of when complementary patented technologies are a significant consideration. The factors highlighted are neither comprehensive nor exhaustive, and the potential for specific combinations of technologies to produce value can be affected by other factors.

4.3.3.3 Considering aggregation of implementers

Conceptually, an implementer's WTP for a patented feature will reflect how that feature affects its own profits – by increasing demand, enabling higher prices and/or reducing costs. In practice, therefore, WTP will not be uniform across implementers. Those that stand to gain greater benefit will be willing to pay more than those that stand to earn less.

In practice, the benefits may vary across:

- **product categories**: such as the value that Wi-Fi technology provides devices with high-resolution screens and IoT devices with different data needs;
- **market segments**: such as the value that a particular technology provides to a device maker with premium features versus a competitor with budget features; and
- **implementers' business models**: depending on their position in the value chain, business strategy and portfolio of complementary products.

This raises a practical question when establishing the value of a technical contribution. To some extent, its value is in the eye of the beholder. If the hypothetical negotiation is framed as a bilateral negotiation between one licensor and a specific implementer, then technically the value is defined solely by that implementer's WTP. In contrast, the negotiation may treat implementers collectively – sometimes implicitly as all "similarly situated" implementers – as though they act as a collective single buyer in an auction or tender framework.

16 Shapley, L.S. (1953). A value for n-person games. In Kuhn, H.W. and A.W. Tucker (eds), *Contributions to the Theory of Games (Vol. II)*, *Annals of Mathematics Studies*, 28. Princeton University Press, 307–317.

Where the negotiation concerns a specific implementer and there is reliable evidence on the value of the technology in that implementer's products, in principle it may be preferable to estimate that specific implementer's WTP. This aligns the valuation with the economic value actually realized in the relevant products and markets. However, in practice that can be challenging, as it is subject to uncertainty and could make the assessment of non-discrimination within a product market difficult.

Where implementer-specific WTP cannot be reliably established (particularly for an individual patent or a small subset of a portfolio), aggregation can be a practical simplification. However, aggregation should be treated with caution. Averaging – lumping together implementers or product markets with materially different WTPs – can produce an "average" that is too high for low-value applications and too low for high-value ones.

Pragmatically, it is often preferable to analyze implementers in coherent groups of similarly situated parties, where their WTPs should be broadly similar, based on the specific benefit that the technical contribution adds to the implementers' products. Where the products compete directly with each other, it is more likely that the value which the technical contribution adds to each one is broadly similar, and their manufacturers would be willing to pay similar rates for those benefits. Where products do not directly compete with one another, the technical functionalities might not provide the same value to each, and so the royalties for each product may be better assessed separately from each other.

4.4 Summary

The bottom-up framework offers a structured way to estimate FRAND terms by anchoring valuation in the **ex ante incremental value benchmark**: the royalty (or range of royalties) that the parties would have regarded as reasonable **before** the standard was set, when implementers could still choose between competing technical alternatives.

The core intuition is that ex ante competition constrains royalties to reflect the patented technology's incremental contribution over the next-best alternative, rather than the value that arises solely from ex post lock-in to the standard and exclusion of competition.

As this part has shown, the approach may be appealing in principle insofar as it seeks to reward the patented technological contribution while excluding additional value arising solely from the inclusion of that technology in the standard. However, it depends heavily on modeling choices, evidence and practical judgments.

The hypothetical negotiation must be specified in a way that is economically plausible, including careful consideration of the **timing** of the negotiation, what **information** about value may be used (ex ante expectations versus ex post evidence), and whether the model yields a **bargaining range** rather than a single price estimate.

Calibrating the model requires an empirical assessment of:

- the patented technology's **incremental technical contribution** relative to contemporaneous alternatives considered (or reasonably considered) during standard setting; and
- the **economic value** of that incremental technical contribution – recognizing that technical improvements and economic value may be nonlinear and may need to be assessed quantitatively or, where data is limited, qualitatively.

The principles of the bottom-up approach or ex ante incremental value benchmark may be used in combination with other valuation approaches. First, to benchmark the potential value of one SEP portfolio against the value of a license for a potentially comparable SEP portfolio. Second, in combination with the top-down framework, where the complementarities between patented technologies mean that they need to be valued at a higher collective level of aggregation, to avoid the risk of royalty stacking.

Part 5 explores top-down valuation methodologies.

5 The top-down framework

Topics covered in Part 5:

- **An overview of the top-down framework**
- **Step 1: Methodologies used to establish the reasonable aggregate royalty rate**
- **Step 2: Methodologies used to allocate the reasonable aggregate royalty rate to a specific portfolio**

5.1 An overview of the top-down framework

The top-down framework can be used to estimate FRAND licensing terms for a disputed SEP license by:

- identifying a **reasonable aggregate royalty rate**[1] for the relevant standard (or set of standards) for a given product; and
- allocating an appropriate share of that aggregate amount to the licensor's portfolio, based on **the portfolio's contribution to the standard**.

Parties, courts and arbitration panels have used the top-down framework as a standalone valuation method for determining FRAND terms.[2] The framework has also been used as a secondary analysis: a cross-check to assess the reliability of rates derived from other valuation approaches, including rates inferred from comparable license agreements.[3]

5.1.1 The rationale

Strictly, the top-down approach is not a single valuation methodology; it is a framework to which different inputs and analytical techniques may be applied. The framework has two core elements.

1. **The reasonable aggregate royalty rate for the relevant standard**. This is a benchmark for the total FRAND royalty that an implementer would reasonably agree to pay, in the relevant market and for the relevant product, for access to all patented technologies that are essential to practicing the standard.
2. **The licensed SEP portfolio's contribution to the relevant standard**. This identifies the proportion of the aggregate royalty rate that the licensor is entitled to receive – i.e., its "share" of the reasonable aggregate royalty rate. It is typically proxied using evidence such as the number of relevant SEPs in its portfolio, adjusted for factors including essentiality, validity, infringement and technical importance, relative to all relevant SEPs.

1 The term "aggregate royalty *burden*" is sometimes used interchangeably with "aggregate royalty *rate*", but the terms are sometimes used to refer to different concepts: aggregate royalty burden meaning the actual amount that the licensee pays, and aggregate royalty rate referring to the whole stack of FRAND royalties charged by all licensors. This Report uses the term "rate" rather than "burden," as it is addressing the hypothetical underpinning of the calculation.

2 *In re Innovatio IP Ventures, LLC, Patent Litigation*, 921 F. Supp. 2d 903 (N.D. Ill. 2013) (link) , and Munich Regional Court I, final judgment of 30.04.2026 – 7 O 64/25

3 For example, see *Optis* v. *Apple* [2025] EWCA Civ 552 (link) ; and *Unwired Planet* v. *Huawei* [2017] EWHC 711 (Pat) (link) .

Simplifying the practical considerations discussed below, Box 5.1 illustrates how two hypothetical parties may use the framework to inform a negotiation for cellular SEPs in smartphones.

Box 5.1 License negotiations using a reasonable aggregate royalty rate benchmark

SEP holder A and implementer B (the parties) negotiate a license for a portfolio of cellular SEPs (3G, 4G and 5G) in smartphones.

The reasonable aggregate royalty rate. The parties conclude, based on, for instance, the value to the implementer of the technical functionalities that the patented inventions enable, that a smartphone implementer would reasonably pay **$40 per device** – or 8% of a device's $500 wholesale price – to license all SEPs essential to the 3G, 4G and 5G standards.

The licensed SEP portfolio's contribution to the relevant standards. SEP holder A owns 10% of all declared patents essential to the relevant standards. After assessing the essentiality, validity, technical importance and geographic variation of the patent portfolio – relative to all relevant SEPs – SEP holder A and implementer B agree that the portfolio contributes 5% of the value of the standards.

Determination: The parties agree a royalty rate of $2.00 per unit for the license, reflecting SEP holder A's share of the value enabled by the relevant standards (5% × $40 = $2).

Note: This box offers a simple, illustrative example to highlight the rationale for using a reasonable aggregate royalty rate benchmark to inform negotiations for cellular standard licenses. It is purely intended to illustrate the mechanics of the approach; it does not attempt to show the outcomes of real negotiations. It ignores practical considerations, both for establishing the benchmark and for allocation to portfolios due to differences in validity, essentially, technical importance or geographic differentiation – as discussed below and in Part 3, when considering the reasons why the value of different portfolios may vary.

In principle, the appeal of establishing a reasonable *aggregate* royalty rate is that it anchors the analysis to what implementers seek to obtain: **the functionality delivered by the standard as a whole**, which is implemented through the combined use of many complementary patented technologies.

Using this anchor addresses the inherent difficulty of establishing how much an implementer would pay for the incremental benefit contributed by one SEP or by a portfolio of SEPs. The benefit can be difficult to isolate, particularly where each SEP-protected invention contributes only a minor part to a greater whole. For instance, in many cases, a standard's core functionalities – such as data capacity, latency and power efficiency – may provide substantial value, but that value typically depends on many complementary contributions working together. Their value is therefore generated by the combination, rather than by any single SEP-protected invention alone.

By first establishing the value of the entire bundle of complementary SEPs, the top-down approach also seeks to mitigate the potential for royalty stacking. When complementary rights are licensed separately, then the sum of individually assessed royalties can exceed what an implementer would pay for access to the rights if they were licensed as a single complete bundle. By starting from an economically justified benchmark for the total value of the standardized technology, use of the top-down framework prevents that risk; starting at the "top" internalizes the complementarities. The aggregate amount is then allocated across SEP holders in proportion to their portfolio shares, ensuring that the aggregate royalty cost cannot add up to more than the sum of its parts.

Adopting an analogy using physical property, Box 5.2 illustrates the problem of royalty stacking when ownership is fragmented between multiple strictly complementary rights. The user – in this case, the tenant of an apartment – seeks to rent and values the entire property as a unified whole. However, when ownership is fragmented, the sum of uncoordinated bilateral negotiations with each "landlord" might not reflect the value of that property.

Box 5.2 Illustrative analogy of the top-down approach

An apartment is owned by five independent landlords. A tenant is willing to pay $400 a week to rent the apartment, based on its facilities, the local amenities and transport links, and competition from other properties. Negotiations over rent can take one of two paths.

- An **uncoordinated approach**, where each landlord values its claim independently. Without considering the aggregate cost, each landlord seeks $100, totaling $500 a week – an amount that exceeds the reasonable price for the benefits that the tenant actually receives and is willing to pay for.
- A **top-down approach**, which, in contrast, takes $400 a week as the starting point and then asks what proportion of that rate each of the five landlords is entitled to, based on their relative stakes in ownership.

In practice, a top-down framework can provide several useful functions.

- **Greater clarity on the maximum potential costs of licensing**. By establishing a maximum aggregate FRAND royalty for a given product market, the top-down framework addresses a principal concern of manufacturers: uncertainty about the maximum potential *accounting* cost of accessing the entire standard.
- **A broader range of use-cases**. The framework may be applied where comparable licenses are scarce or unavailable – for example, where the parties are negotiating a license for emerging technologies or new product categories.
- **An independent cross-check**. Even in established markets with comparable contracts, parties may dispute whether those agreements are FRAND – e.g., due to hold-up or hold-out.[4] A top-down analysis can serve as an independent benchmark against which the reasonableness of rates inferred from comparables can be tested.[5]

5.1.2 The top-down framework's two-directional approach

The framework can be applied in two directions:

- a **conventional (forward) application**, to *determine* a FRAND royalty; and
- a **reverse application**, to *evaluate* whether a proposed portfolio royalty implies a plausible aggregate royalty rate for the relevant standard.

5.1.2.1 The conventional (forward) top-down framework

In its conventional form, the framework aims to determine a FRAND royalty. It proceeds in two steps, detailed below.

- **Step 1: Establishing the reasonable aggregate royalty rate for all relevant SEPs**.[6] In this step, the parties establish a benchmark for how much an implementer would reasonably pay to license *all SEPs* for use in the relevant product.
  - For instance, SEP holder A and implementer B may agree $40 per unit (or 8 percent of a phone with an average wholesale price of $500) to license all SEPs essential to cellular standards.
  - At this stage, the number and nature of SEPs are irrelevant. In principle, the value enabled by the standardized technologies is the same whether there are 10 genuine SEPs or 10,000. What matters is the collective value of all relevant SEPs for the enabled functionalities.

4 This was the case in *Microsoft Corp.* v. *Motorola, Inc.,* No. C10-1823JLR (W.D. Wash., 2013) (link) , in which the court rejected various licenses because they did not provide a good indication of FRAND. For example, with respect to one license (covering certain SEPs), the court concluded that "there is no indication that [the parties] negotiated for the patents at issue […] under the RAND obligation" (para. 441). The court also cited potential "royalty stacking" issues with respect to Motorola's demanded rate (para. 456, "Motorola's royalty request […] raises significant stacking concerns"). The court ultimately decided that "the court must determine a reasonable royalty rate for Motorola's SEPs based on the principles underlying the RAND commitment, one of which is the concern of royalty stacking" (para. 460).

5 *Optis* v. *Apple* [2025] EWCA Civ 552 (link) , paras 137–146; *Unwired Planet* v. *Huawei* [2017] EWHC 711 (Pat) (link) , para. 476.

6 See Section 5.2 for methodologies.

– **Step 2: Allocating a share of the reasonable aggregate royalty rate to the licensed SEP portfolio**.[7] The second step is to establish the proportion of the reasonable aggregate royalty rate that the SEP licensor is entitled to, based on the contribution that the specific SEP portfolio makes to the relevant standards (for example, 5 percent).

Box 5.3 The conventional (forward) application of the top-down framework

The reasonable royalty for a specific SEP portfolio

= reasonable aggregate royalty rate × portfolio's contribution to the relevant standard

= $40 per unit × 5%

= $2 per unit

Note: This box offers a simple, illustrative example demonstrating a forward application of the top-down framework to determine a FRAND royalty rate. It is purely intended to illustrate the mechanics of the approach; it does not attempt to show the outcome of a real calculation.

5.1.2.2 The reverse top-down framework

The reverse top-down framework applies the logic of the top-down approach, but as a consistency check for a proposed royalty for a specific SEP portfolio. Given the proposed royalty rate and the portfolio's contribution to the relevant standards, the reverse approach asks whether the proposal, if generalized to all SEPs, *implies* an aggregate royalty that aligns with the benchmark for a reasonable aggregate royalty rate.

For instance, SEP holder A and implementer B negotiate a license for the use of A's portfolio of cellular SEPs in B's smartphones. Using, for example, the comparable contracts approach, A proposes that $3 per unit is a FRAND rate for its portfolio.

To assess that rate, they use the reverse top-down framework, applying the following steps (Box 5.4).

– **Step 1: Establishing the implied aggregate royalty rate**. This step determines what the aggregate royalty rate would be if every SEP holder priced its portfolio in line with the royalty rate proposed for the Focal Contract. To do so, the parties take the proposed rate and scale it up by the licensed SEP portfolio's contribution to the relevant standard – which, as above, they agree is 5 percent.
– **Step 2: Evaluating the implied aggregate royalty rate against a benchmark**. That benchmark may be:
  – the **reasonable aggregate royalty rate** – which provided the starting point for the conventional top-down framework: e.g., $40 per unit; or
  – the **total value that depends on the licensed technology** – which reveals whether the implied aggregate royalty rate would leave implementers (and consumers) with a commercially reasonable share of that value: e.g., the parties estimate that $80 of the implementer's product *depends* on the functionalities enabled by the licensed technology.

Here, the implied aggregate royalty rate is $60 per unit ($3 per unit divided by 5 percent).[8] The evaluation establishes that the rate is too high. First, it is considerably higher than the benchmark for the reasonable level ($40). Second, the proposed rate would leave an implementer with 25 percent of the value that depends on the licensed technology and provide 75 percent to licensors, which the parties agree would be unbalanced in this case.

7 See Section 5.3 for methodologies.
8 Note: This is a simplified model that does not take factors such as geographic distribution of sales into account.

In response, the parties may review the analysis underpinning the proposed rate, identify errors and revise it. Alternatively, they may apply the conventional top-down approach instead. The accuracy of the implied aggregate royalty rate will depend on how effectively differences in the average value of the portfolio per patent compared with all SEP have been accounted for (e.g., differences in average validity, essentiality, importance or geographic coverage). As discussed in Section 3.3.2 above, the implied aggregate royalty rate is sensitive to these issues, particularly for small SEP portfolios. As a result, caution should be exercised. The practical considerations are discussed in Section 5.3.2 below.

Box 5.4 Application of the reverse top-down framework

Establishing the implied aggregate royalty rate

The implied aggregate royalty rate

= rate proposed for SEP license ÷ SEP portfolio's contribution to the relevant standard

= $3 per unit ÷ 5%

= $60 per unit

Evaluating the implied aggregate royalty rate

1. Against the reasonable aggregate royalty rate
   = $60 per unit v. $40 per unit
   = implied rate exceeds reasonable rate.
2. Against the total value that depends on the licensed technology
   = implied aggregate royalty rate ÷ total value that depends on technology
   = $60 per unit ÷ $80 per unit
   = proposed rate provides licensor with 75% of the value that depends on the technology

In both cases (1) and (2), the parties consider that $60 is too high and revise the estimate down.

Note: This box offers a simple, illustrative example demonstrating the application of a reasonable aggregate royalty rate benchmark to inform negotiations for a cellular standard license. It is purely intended to illustrate the mechanics of the approach; it does not attempt to show the outcome of real negotiations.

5.1.3 Application in practice

The top-down framework has been considered by various parties, courts and arbitrators around the world to value licenses for SEPs – either directly or as a supplementary analysis to cross-check proposals based on other valuation methodologies. Some relevant examples are discussed below.

However, in practice, there is no single conventional approach that is used to estimate each of the framework's two core elements: (i) the **reasonable aggregate royalty rate** and (ii) the relevant **portfolio's contribution to the standard**. The specific methodologies used for each have varied, reflecting differences in the evidence available and how the relevant issues have been assessed in each case. The sections that follow outline the main approaches used for each element and discuss their respective strengths and limitations.

5.2 Step 1: Methodologies used to establish the reasonable aggregate royalty rate

The **reasonable aggregate royalty rate** for the relevant standard (or set of standards) is the conceptual foundation of the top-down framework. It represents a benchmark for the total royalty that an implementer would reasonably pay, in the relevant product market, for a license covering all SEPs essential to practicing the standard.

In practice, several methods have been used to estimate benchmarks for the reasonable aggregate royalty rate. We begin by distinguishing this conceptual benchmark from the aggregate *accounting* costs of the royalties that implementers actually pay. We then outline four approaches that have been applied or proposed to estimate the reasonable aggregate royalty rate:

- licensors' public statements about the likely aggregate royalty rate (where available);
- the profit margin of the smallest saleable patent-practicing unit (SSPPU);
- a proportion of the standard's price premium in the relevant implementing device; and
- a proportion of the product's economic value that depends on the licensed technology.

Note that these approaches should not be considered as universally accepted methodologies. There are debates about their validity in principle and in practice, which are covered below. Rather, these are approaches that have been applied and proposed and may arise in negotiations and in litigation.

5.2.1 Disambiguation: the conceptual aggregate rate and the observed aggregate rate

In the top-down framework, the aggregate royalty rate is a benchmark for the total FRAND royalty associated with the functionalities collectively enabled by the SEPs. Conceptually, it estimates what an implementer would pay for licensing all the patented technology essential to a standard, if all SEPs were licensed on FRAND terms.

This *conceptual* aggregate royalty rate may differ from the *observed* aggregate royalty rate – that is, the aggregate royalties actually paid (see Box 5.5). Several factors contribute to the difference.

First, in practice, not all SEP holders actively seek cash royalties from all implementers.[9] Some SEP holders may have portfolios that are too small, too weak or too costly to license relative to expected returns, such that they do not pursue licenses. Others may not require royalties to fund their commercial activities. For instance, if it is vertically integrated, an SEP holder may only seek cross-licenses from other SEP holders, rather than cash royalties.

Second, even where cash licenses are agreed, the royalties observed in those agreements might not coincide with the rate that would be determined under a FRAND assessment. Rates might be above or below a FRAND benchmark – either in aggregate or for particular portfolios.

Box 5.5 Example of the difference between the conceptual and observed aggregate royalty rate

Assume that the reasonable aggregate royalty rate to license all SEPs essential to standard X for use in product Y is $40 per unit.

SEP holders A to E hold all the SEPs of standard X, with the following shares:

- A, B and C each hold 25% of the relevant SEPs
- D holds 15%
- E holds 10%.

9 For instance, in *Optis* v. *Apple* [2025] EWCA Civ 552 (link) , the court notes that Apple has 4G licenses with licensors that account for "about 50%" of the "stack" of 4G SEPs (para. 57). For a general discussion of why patent holders might not seek royalties, see Heiden, B. and J. Baron (2024). The economic impact of patent holdout. *Harvard Journal of Law & Technology*, 38(3), 637–669.

A and B have already concluded licenses with the implementer at $10 per unit each. The implementer's aggregate accounting cost for SEPs is now $20 per unit.

C and D do not actively seek licenses. This may be because they rely on cross-licensing, focus on product revenues or do not consider licensing commercially worthwhile. The implementer's aggregate *accounting* cost for SEPs remains $20 per unit.

E now seeks to negotiate terms for a license. Under the top-down framework, its royalty is determined by its share of the *conceptual* reasonable aggregate royalty rate:

SEP holder E's benchmark royalty = 10% × $40 = $4 per unit

Importantly, in a top-down analysis, royalties are assessed against the conceptual and reasonable aggregate royalty rates, not from "what remains" after deducting royalties already paid to other licensors. The fact that parties C and D have (so far) chosen not to enforce their rights is irrelevant.

Note: This box offers a simple, illustrative example highlighting relevant factors when considering the difference between the *conceptual* and *observed* aggregate royalty rate. The factors highlighted are not exhaustive, and the example does not attempt to show the outcome of real calculations.

5.2.2 SEP holders' public statements on the likely aggregate royalty rate

Public statements by SEP holders about the aggregate royalty rate for a standard have been used as evidence when assessing FRAND terms. This section explains the rationale for relying on such statements, gives examples of their use in litigation and highlights practical and conceptual issues that arise in applying the approach.

5.2.2.1 The approach

In some disputes, courts and tribunals have considered public statements by SEP holders – for example, press releases, policy statements or "patent pledge" announcements – regarding the aggregate royalty rate they expected the relevant standard to attract. Where such statements exist, they can be used as evidence to establish a benchmark aggregate royalty rate for the standard, which is then allocated among SEP holders according to the assessed strength and share of their portfolios.

This approach has been used most often in the context of cellular standards, where major SEP holders have sometimes made public undertakings about aggregate royalties at or around the time when a new generation of technology is being promoted for adoption. Box 5.6 provides a hypothetical example of how it may be applied.

Box 5.6 Benchmarking the reasonable aggregate royalty rate to ex ante statements

Two technologies compete ex ante to become the industry standard: technology A and technology B. Both incorporate patented technologies, owned by different firms.

- Patent holders A to E own patents that protect the technologies essential to technology A.
- Patent holders M to Q own patents that protect the technologies essential to technology B.

Before adoption, patent holders announce expected rates.

- Patent holders A to E, collectively, announce that they expect the aggregate royalty rate for technology A to be a "single-digit percentage of the product price." Patent holder A announces that it expects the rate to be 8%. Patent holder B announces the rate will be "no more than 10%."
- Patent holders M to Q make no announcement.

Implementers choose technology A, which becomes the market-wide standard. After adoption, the statements regarding technology A's aggregate royalties are used as evidence of a reasonable aggregate royalty rate.

The reasonable aggregate royalty rate is considered to be 8–10%. In a subsequent negotiation, when the product is $500, the reasonable aggregate rate is set at $40–50, which is then allocated to the specific portfolio of SEPs.

Note: This box offers a simplified, hypothetical example illustrating relevant factors when considering the theoretical rationale for benchmarking the reasonable aggregate royalty rate to ex ante statements. It is purely intended to illustrate the mechanics of the approach; it does not attempt to show the outcome of real benchmarks.

5.2.2.2 The rationale

The rationale for relying on SEP holders' announcements is that, in some circumstances, they may reflect an ex ante competitive price – that is, a price free from hold-up. The idea is that SEP holders make these announcements before a standard is set or widely adopted – and therefore have an incentive to ask for lower royalties (*in order to* attract implementers).

In principle, the competitive pressure on announcements could take two forms, both of which lower the announced royalty.

- **Competition between alternative standards**. Where implementers can credibly choose between rival technologies that are competing to become a standard, SEP holders may have incentives to signal that aggregate royalties will remain within a reasonable range in order to encourage adoption. This logic was discussed when valuing the 4G cellular standard, LTE, based on statements that SEP holders made when LTE faced competition from rival technology WiMAX. LTE became the global 4G cellular standard.
- **Absence of "lock-in," even without a "head-to-head" rival**. Even if there is no clearly defined rival standard, if implementers have not made irreversible investments, then SEP holders may still face pressure not to announce rates that could deter or delay adoption. The underlying idea is straightforward: if announced aggregate royalty rates are perceived to be excessive, implementers may delay adoption, reduce implementation scope, resist commercial rollout or look for alternative technical solutions.

The hope, therefore, is that these statements identify an aggregate royalty benchmark that approximates the rate what would be observed in an ex ante negotiation for all SEPs relevant to a standard, rather than the ex post rate determined when implementers are already locked in. Box 5.7 provides an overview of the approach in different jurisdictions.

Box 5.7 Public statements in FRAND cases (case examples)

Public statements regarding aggregate royalties have been treated as relevant evidence in several jurisdictions, including as part of top-down analyses or cross-checks.

United States: *TCL* v. *Ericsson*. The district court relied on public statements on the aggregate rate that the SEP holder expected for the 4G cellular standard LTE. The statements included references to "single-digit" aggregate levels and ranges such as "6–8%" of the implementing product's selling price.

China: *Huawei* v. *Samsung* (Shenzhen), *Huawei* v. *Conversant* and *OPPO* v. *Nokia* (China's Chongqing Intermediate Court). These follow the approach using SEP holder expectations to benchmark the reasonable aggregate royalty rate for LTE.

Japan: *Apple* v. *Samsung* (IP High Court, 2014). The court applied a calculation approach that incorporated an aggregate cap (reported as 5% for UMTS) when determining a FRAND royalty amount.

United Kingdom: *Unwired Planet* v. *Huawei* (2017). The court expressed reservations about relying on public statements, describing them as "obviously self-serving" – as a licensor could claim that the aggregate royalty rate would be low, but its own share was high. It highlighted internal inconsistency between them, and the difficulties of establishing a single rate that could be derived from those statements. Nonetheless, when applying a reverse top-down cross-check, the court noted that the statements were in line with its determination.

Note: This box offers a sample of public statements in FRAND cases from across four jurisdictions for illustrative purposes. This list is not exhaustive.

Sources:*TCL Communication Technology Holdings Ltd.* v. *Telefonaktiebolaget LM Ericsson*, No. 8:14-cv-00341, (C.D. Cal. Dec. 21, 2017), amended and superseded (C.D. Cal. Sept. 14, 2018) (link) pp. 22-24, rev'd in part, vacated in part 943 F.3d 1360 (Fed. Cir. 2019) , cert. denied 141 S.Ct. 239 (2020), pp. 22-24; *OPPO* v. *Nokia* [2021] The People's Republic of China Chongqing First Intermediate Court Civil Judgment Yu 01 Min Chu No. 1232, pp. 99–100 (an unofficial translation is available); *Apple* v. *Samsung* [2014] Intellectual Property High Court 2013 (Ne) 10043 (link) , pp. 131–132 (Issue 7, D); *Unwired Planet* v. *Huawei* [2017] EWHC 711 (Pat) (link) , para. 269 on public statements as "obviously self-serving," and para. 476 on use as a "cross-check."

5.2.2.3 Practical considerations when using SEP holders' public statements to benchmark the aggregate rate

Where available, public statements can be informative, but their relevance is heavily dependent on the context within which they were made. Three issues arise:

- practical issues in establishing a benchmark aggregate rate;
- the extent to which expectations constitute a credible commitment ("promise to the market"); and
- the extent to which a SEP holder's business model affects the rates that it announces.

Practical issues in establishing a benchmark aggregate rate

The first practical consideration is that this approach is only available where sufficiently meaningful public statements exist, which is not always the case. Where such statements are made, they may reflect a range of considerations. In some circumstances, SEP holders may consider that announcing rates could encourage adoption of the technology in the standard-setting process, for example by signaling attractive licensing conditions relative to alternatives or by reducing concerns about high or uncertain licensing costs. Conversely, where standards face limited competitive pressure, SEP holders may have less reason to make such statements.[10]

10 For instance, few SEP holders chose to make public statements about the aggregate royalty rate that they expected for 5G, and those who did were not specific. For instance, Huawei announced that it "anticipates that reasonable aggregate royalty rates for the 5G standard with respect to handsets **are likely to be lower** than what has prevailed in the 4G context, particularly as **the range of devices** incorporating communications technologies continues to broaden significantly with the development of the IoT and as more traditional mobile devices like smartphones become increasingly complex and multi-functional." *(Emphasis added).* See Assessing the reasonableness of 5G headline royalty rates , IAM, September 8, 2021.

Practical factors can affect how easily statements can be translated into a reliable benchmark aggregate royalty rate for a specific standard and product. The following factors are particularly important.

- **Coverage**. The reliability of the benchmark depends on the number of SEP holders announcing rates and the proportion of all SEPs that they cover. If many SEP holders, covering 80 percent of all SEPs, announce a rate, that is stronger evidence than if one SEP holder with only 1 percent of SEPs announces a rate.
- **Consistency**. Where multiple SEP holders make announcements, the reliability of the benchmark depends on how consistent their statements are. Collective or consistent statements may carry greater weight. Divergent announcements require more interpretation and judgment on the part of the analyst.
- **Specificity**. The reliability of the benchmark depends on whether statements clearly identify: (i) the relevant standard (or standard generation), (ii) the relevant product category (e.g., handsets versus infrastructure), and (iii) the precision of the rate announced. The more vague the statement, the less evidential weight it carries as it requires interpretation.

Where statements are numerous, specific and broadly consistent – and made by major SEP holders – they are more plausibly characterized as market-facing undertakings about aggregate licensing levels. Where they are sparse or vague, greater interpretation is needed and the approach becomes less robust. Box 5.8 illustrates and compares the two situations.

Box 5.8 Establishing aggregate royalty rates from public statements

The table below shows this approach applied in two scenarios.

	Scenario 1	Scenario 2
Coverage	**Broad**	**Narrow**
	• 12 SEP holders	• 3 SEP holders
	• Owning 90% of SEPs	• Owning 4% of SEPs
Consistency	**Consistent**	**Inconsistent**
	• Joint announcement	• Divergent unilateral announcements
Specificity	**Specific**	**Vague**
	• $40 per unit in Product Group A	• “Low single-digit percentage”
	• $20 in Product Group B	• “High single-digit percentage”
	• $5 in all other products	• “In line with previous rates”
Strength	**Strong**	**Weak**

In scenario 1, it is straightforward to establish a practical benchmark from the SEP holders’ joint announcement. The announcing SEP holders are numerous and represent the majority of SEPs, and their statements are specific and consistent.

In scenario 2, the approach is difficult to apply reliably. Only a few SEP holders make announcements, and they hold few of the relevant SEPs. The announcements are vague and inconsistent. Establishing a benchmark of the rate that would commit all SEP holders is practically difficult in this context.

Note: This box offers a simplified, illustrative example highlighting relevant factors when considering whether aggregate royalty rates can be established from announcements in two different scenarios. The list of factors is not exhaustive, and other factors can affect the strength of announcements.

The extent to which expectations constitute a credible commitment ("promise to the market")

Another practical consideration is whether, in a given case, statements about aggregate royalties can be treated as a credible "promise to the market," or merely as non-binding expectations.

This issue has been debated in both case law and policy. There are two related points.

- **Whether licensors' statements regarding the aggregate royalty rate are reliable**. Public statements may not always provide a stable indication of the royalty level that would ultimately be supported in licensing negotiations or litigation. For example, an SEP holder may endorse a relatively low aggregate level while also maintaining that its own portfolio accounts for a relatively large share of that total. This concern has been recognized in litigation.[11]
- **Whether aggregate royalty rates are binding or can be revised**. Conventionally, implementers update their prices in response to changes in market conditions. Some SEP holders have argued that they too should be able to adjust their prices to reflect changing market conditions – for instance, if their assumptions about adoption rates, market sizes, product prices and the scope of use-cases prove to be inaccurate.[12] On this basis, the rates announced were merely expectations, not binding commitments.

However, with SEP licenses there is a dilemma. If announcements are not binding, that introduces the risk of ex post opportunism. The court in *TCL* v. *Ericsson* therefore treated the statements as commitments.[13] However, if the commitments were based on assumptions that prove to be wrong ex post, then the price that licensors expected to be reasonable ex ante may not be reasonable in the circumstances that actually emerge ex post.[14]

The extent to which a SEP holder's business model affects announced rates

The final consideration is that a SEP holder's business model may influence its incentives when making public statements.

Vertically integrated SEP holders. It has been argued that firms that are both licensors and implementers may be incentivized to endorse aggregate royalty levels that reflect both sides of the market – because they may pay, as well as receive, royalties.[15]

11 In *Unwired Planet* v. *Huawei* (link) , the court was concerned that licensors' statements about the aggregate royalty rate were "self-serving" and inconsistent, and therefore unreliable. The issue was that each licensor only provided access to a subset of SEPs, so it could not be held to account against the aggregate royalty rate it had announced – each could claim that the rate was low, but also that their fair share of it was high. The judgment stated: "In my judgment the statements set out above have little value in arriving at a benchmark rate today for a number of reasons. The claims are obviously self-serving. The statements about aggregate royalties in particular are statements about other people's money on the footing that the person making the statement says at the same time that the cake is quite small but they are entitled to a large piece of it. As an illustration, if one assumes Alcatel's 2% royalty claim means they claim at least 20% of the Relevant SEPs (because in April 2008 Alcatel put their name to a "single digit percentage aggregate" and 2% is 20% of 10% (10% being just higher than the highest single digit percentage)) then the total shares of Relevant SEPs just mentioned in these statements add up to about 100% without including other major industry players such as Motorola, Qualcomm, and Samsung. The figures in Huawei's own claim are not closely internally consistent either. A low single digit percentage aggregate sounds like a figure of no more than 5% but to produce that with a 15-20% share of Relevant SEPs represents a royalty of 0.75%-1%. To produce a royalty close to the 1.5% limit referred to requires an aggregate of 7.5%-10%.", Unwired Planet International Ltd v Huawei Technologies Co Ltd [2017] EWHC 711 (Pat), para. 269.

12 *TCL Communication Technology Holdings Ltd.* v. *Telefonaktiebolaget LM Ericsson*, No. 8:14-cv-00341, (C.D. Cal. Dec. 21, 2017), amended and superseded (C.D. Cal. Sept. 14, 2018) (link) pp. 19–25, rev'd in part, vacated in part 943 F.3d 1360 (Fed. Cir. 2019) , cert. denied 141 S.Ct. 239 (2020).

13 *TCL Communication Technology Holdings Ltd. v. Telefonaktiebolaget LM Ericsson*, No. 8:14-cv-00341, (C.D. Cal. Dec. 21, 2017), amended and superseded (C.D. Cal. Sept. 14, 2018) (link) pp. 25–26, rev'd in part, vacated in part 943 F.3d 1360 (Fed. Cir. 2019) , cert. denied 141 S.Ct. 239 (2020).

14 See the discussion in Chapter 1, "The advantages and limitations of a principle-based approach to FRAND" and, on incomplete contracts, Tsai, J. and J.D. Wright (2015). Standard setting, intellectual property rights, and the role of antitrust in regulating incomplete contracts. *Antitrust Law Journal*, 80 (1), 157–188.

15 See for instance *TCL Communication Technology Holdings Ltd. v. Telefonaktiebolaget LM Ericsson*, No. 8:14-cv-00341, (C.D. Cal. Dec. 21, 2017), amended and superseded (C.D. Cal. Sept. 14, 2018) (link) pp. 25–26: "Ericsson was a licensor and licensee, giving it stronger incentive to be fair and reasonable with its own estimate.", rev'd in part, vacated in part 943 F.3d 1360 (Fed. Cir. 2019) , cert. denied 141 S.Ct. 239 (2020).

– The opposite has also been argued: because cross-licensing can reduce a vertically integrated firm's exposure to high cash royalties, such firms may tolerate an aggregate royalty rate that imposes high cash costs on any rival that lacks its own SEP portfolio.[16]

Non-practicing SEP holders. Firms that rely primarily on licensing revenues may face differ incentives again. Depending on context, they may seek higher royalties to maximize their licensing income. Alternatively, if adoption and scale are the central drivers of long-run returns, they may have incentives to support a *reasonable* aggregate level that promotes widespread adoption of the standard. An excessive rate may reduce both adoption and their expected overall revenue.[17]

These practical considerations do not necessarily make public statements irrelevant. However, they underline why the valuation must examine who made the statement, when, under what competitive conditions and with what commercial incentives, before placing any weight on it.

5.2.3 The profit margin of the smallest saleable patent-practicing unit

This section describes an approach that uses the profit margin earned on the smallest saleable patent-practicing unit (SSPPU) as a reference point for the aggregate royalty rate. It uses the profit margin to indicate the value of the benefits that the licensed technology provides. There is significant disagreement about whether it offers a reliable benchmark for that value, in principle or in practice. This section first explains the motivation for the approach and how it may be applied, then sets out some practical considerations regarding its use.

5.2.3.1 The motivation for the approach

The aim of this approach is to isolate the value that is attributable to the licensed technology.

In complex downstream products, such as laptops or smartphones, their price and profitability reflect the contribution of many features and technologies. The price (or profit) earned on the consumer product therefore provides limited information about the incremental value attributable to any given functionality. For example, a manufacturer may sell a laptop for $800 and earn $100 profit, but it may be difficult to disentangle how much of that value is attributable to Wi-Fi, as opposed to processors, screens, operating systems, storage, industrial design or other features.

By contrast, the SSPPU-margin approach assumes that a chipset implementing the relevant functionality can provide a better reference point. The underlying assumption is that this upstream product's price and profit is directly attributable to the value of the relevant technology. It further assumes that the chipset manufacturer's profit on the unlicensed SSPPU represents the maximum amount that could be paid for a license before the chipset manufacturer would make a loss. On that view, the unlicensed profit margin functions as an upper bound for the reasonable aggregate royalty, after which the cost of the chipset (including the license) would exceed its price *if the SSPPU manufacturer could not adjust its selling price*.

5.2.3.2 Application of the approach

Under this approach, the aggregate royalty rate benchmark is inferred from the profit margin earned on the SSPPU – that is, the first separately traded product in the supply chain that implements the relevant standardized functionality. The SSPPU is typically a chipset that downstream manufacturers of consumer devices include in their products.

16 If two vertically integrated SEP holders, A and B, cross-license to each other for a notional royalty of $*x*, then the cash cost for them is zero, as they each provide licenses of the same value. However, if a downstream competitor, C, has no SEPs, then it must pay the royalty in cash. If $*x* was a reasonable price, this is not an issue. However, the vertically integrated companies could set $*x* at *any* level, and pay no cash royalty. C, on the other hand, would be excluded. It has been argued that this was effectively the case in the Global System for Mobile Communications (GSM) era, and it helps to explain why all major implementers were vertically integrated SEP holders. For example, according to its leadership at the time, Sony agreed its Joint Venture with Ericsson as it had no SEPs of its own and could not afford the cash royalties, which it would avoid if it was in partnership with Ericsson. See Bekkers, R, B. Verspagen and J. Smits (2002). Intellectual property rights and standardization: The case of GSM. *Telecommunications Policy*, 26(3–4), 171–188; and Pringle, D. (2005). Dial time: Hidden asset could let Nokia capitalize on boom for 3G phones. *The Wall Street Journal*, March 10.

17 See Lemley, M.A. and Melamed, D. (2013). Missing the forest for the trolls. *Columbia Law Review*, 113(8), 2117–2189.

The approach treats the profit margin on the unlicensed SSPPU as an upper bound on the aggregate royalty rate for the relevant standardized functionality, on the assumption that the chipset manufacturer would fund the royalty out of its existing margin and could not (or would not) increase prices to reflect the license cost.

Box 5.9 sets out the key elements of the approach, and examples of its use are given in box 5.10.

Box 5.9 The SSPPU benchmark

For the relevant SEPs in the relevant product:

reasonable aggregate royalty rate = the profit margin on an unlicensed SSPPU

Assume that, for the relevant product category, downstream manufacturers purchase unlicensed Wi-Fi chipsets for $20 on average, and chipset manufacturers earn a 15% profit margin:

reasonable aggregate royalty rate for Wi-Fi SEPs in the relevant product category

= average SSPPU price × average SSPPU margin

= $20 × 15%

= $3

The $3 royalty sets the aggregate royalty rate for all SEPs, but that does *not* imply that licenses must be taken by SSPPU manufacturers. An SEP holder may license its technology at either the component level or consumer device level in the value chain, but the rate is the same.

Note: This box offers a simplified, illustrative example highlighting factors that may be relevant when considering the SSPPU benchmark in calculations of aggregate royalty rate. It is purely intended to illustrate the mechanics of the approach; it does not attempt to show the outcomes of real calculations.

Box 5.10 Examples of the SSPPU benchmark

A US court adopted this approach in 2013. In *In re Innovatio IP Ventures* the court had to determine RAND royalties for patents asserted as essential to aspects of the 802.11 (Wi-Fi) standard, implemented in routers. It used the average profit margin earned on unlicensed Wi-Fi chipsets as a benchmark for the reasonable aggregate royalty rate for all Wi-Fi SEPs, reasoning that it revealed the maximum amount that implementers would be willing to pay. It then allocated the relevant patent holder its share of that rate, based on the strength of its portfolio.

The SSPPU-margin approach has been advanced in subsequent disputes but has not been accepted (in public decisions). In *Optis* v. *Apple* (UK High Court, 2023), the court considered an argument that the profit earned on a baseband chipset should be used as the reference point for a reasonable aggregate royalty rate for cellular SEPs implemented in smartphones. The court rejected that argument, describing its rationale as “wrong in its essence.”

Sources: *In re Innovatio IP Ventures, LLC, Patent Litigation*, 921 F. Supp. 2d 903 (N.D. Ill. 2013) (link) , (link) *Optis* v. *Apple* [2023] EWHC 1095 (Ch) (link) , paras 214–223; [2025] EWCA Civ 552 , paras 31, 32 and 33. The judgment at first instance was appealed, but its dismissal of the SSPPU approach was not a ground of appeal.

5.2.3.3 Practical considerations when using the SSPPU to benchmark the aggregate royalty rate

The SSPPU-margin approach is contested because it depends on a fundamental assumption about pass-through. In particular, it assumes that chipset manufacturers would sell licensed chipsets at the same price as unlicensed chipsets, and could not pass any of the license cost through to downstream customers through higher prices.[18]

This assumption is central because the unlicensed profit margin is treated as the point at which royalties would otherwise eliminate profit and push the chipset manufacturer into loss. If, however, the chipset manufacturer can adjust prices after taking a license – so that the selling price of the chipset reflects some or all of the license cost – then the unlicensed profit margin no longer constrains the royalty, and does not provide a stable benchmark for the value of the licensed technology.

Box 5.11 provides a simplified illustrative example comparing the impact that differing assumptions about pass-through may have on the approach.

Box 5.11 The interpretation of pass-through with the SSPPU approach

An unlicensed SSPPU sells for $20, with a 15% profit margin: $3. The production cost is $17.

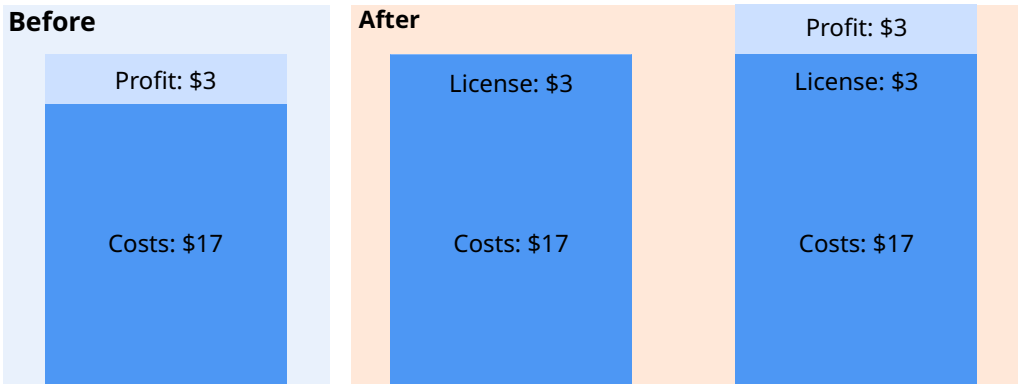
The profit margin is used to benchmark the reasonable aggregate royalty rate for Wi-Fi SEPs.

Scenario 1: A licensed SSPPU with no pass-through

- The aggregate royalty rate is applied to the SSPPU, increasing "production" cost from $17 to $20.
- The additional cost of the royalty is not passed on. The sales price remains $20.
- The royalty cannot be any greater than $3, or the cost would exceed the price and the SSPPU manufacturer would incur a loss.

Scenario 2: A licensed SSPPU with full pass-through

- The aggregate royalty rate is applied to the SSPPU, increasing "production" cost from $17 to $20.
- The additional cost of the royalty is fully passed on. The price increases to $23, maintaining the SSPPU manufacturer's unlicensed profit.
- In principle, the royalty could have been higher or lower than $3. The profit was no constraint. Demand for the licensed chipset – taking its new costs and benefits into account – is sufficient to pass on the costs either way.



Note: This box offers a simplified hypothetical example illustrating the factors that may be relevant when considering the interpretation of pass-through when the SSPPU approach is applied. They are not comprehensive or exhaustive, and interpretations of pass-through can be affected by other factors.

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18 The reasonable aggregate royalty rate is FRAND, so it would apply to all SSPPU manufacturers equally. So, the prices of unlicensed chipsets should not constrain the prices of licensed chipsets.

So, the key question is whether a chipset manufacturer, after taking a FRAND license that is equal to the entire profit on its unlicensed chipsets, would adjust its prices. There are two opposing views.

- **Manufacturers would not adjust SSPPU prices**. Advocates of the SSPPU-margin cap assume that chipset manufacturers could not, or would not, increase chipset prices to reflect the license cost, so that royalties would largely be paid out of existing margins. This assumption underpinned the reasoning in *Innovatio* that the margin on the unlicensed SSPPU was, therefore, an upper bound on what an implementer would pay for a license.[19] However, even on its own terms, this ceiling is highly stylized: in ordinary commercial negotiations, parties rarely agree to pay away the entirety of a product's profit margin.
- **Manufacturers would adjust SSPPU prices**. Critics argue that, to the extent that competitive conditions allow, a chipset manufacturer would adjust its prices to reflect (i) any increase in costs or (ii) any increase in the value of selling a licensed component (as opposed to an unlicensed one). The licensed SSPPU would offer both: it includes the cost and benefit of a license, which otherwise an implementer must purchase separately. This was the essence of the criticism in *Optis* v. *Apple*, where the court reasoned that it was unsafe – in the absence of clear market evidence to the contrary – to assume that a chipset manufacturer would simply forgo profit rather than pass through at least part of the cost.[20]

As a basic economic principle, manufacturers would adjust their prices and pass through FRAND licensing costs *to the extent that competitive conditions allow*. They would increase prices up to the point where their overall profits are maximized, given their higher costs after taking a license. However, they may not be able to pass through the entire cost: at some point, higher prices reduce sales sufficiently to outweigh the additional profit per unit. The precise amount passed through will depend on the intensity of competition and demand, among other factors.

5.2.4 A proportion of the standard's price premium in the downstream consumer device

This section describes an approach that benchmarks the aggregate royalty rate using an estimate of the standard's price premium in the relevant downstream product.

In principle, the price premium is the incremental price associated with products that implement the standardized functionality, controlling for other features and factors that also affect price. However, there can be significant disagreement about whether it provides a reliable benchmark in practice. This section first explains the motivation for the approach and how it may be applied, then sets out some practical considerations for its use.

5.2.4.1 The motivation for the approach

Like the SSPPU approach, this approach seeks to isolate the value that is attributable to the licensed technology. In doing so, it aims to address the same problem discussed above: the value of a complex downstream product, such as a laptop or smartphone, is affected by many features and technologies, not just the licensed technology. It may be difficult to disentangle the extent to which a product's value is attributable to a specific technology, such as Wi-Fi, as opposed to other features and technologies it may have, such as its processor, screen, operating system, storage or industrial design.

Strictly, the price premium does not directly measure the value that the technology enables. It is a proxy for the value that the technology provides to the implementer: that is, the additional profit it earns, due to implementing the licensed technology.

19 *In re Innovatio IP Ventures, LLC, Patent Litigation,* 921 F. Supp. 2d 903 (N.D. Ill. 2013) (link) p. 80, footnote 31.
20 See [2023] EWHC 1095 (Ch) , para. 218: "[t]here is no reason why the baseband chipset manufacturer would have to fund the licence fee to the stack out of the US$5 profit [that it earns on unlicensed chipset sales]. Indeed, it is quite absurd to presuppose that the manufacturer of a baseband chipset would forego any part of their profit unless absolutely compelled to do so. It is much more likely that baseband chipset manufacturers would increase the price of their product to reflect the added value to purchasers of that product of having a licence to the SEPs comprising the stack. Absent extremely clear market evidence, the assumption that the baseband chipset manufacturer would absorb the costs of the licence and not pass them on is almost certainly both unsafe and wrong."

Understanding a technology's price premium

In principle, the price premium should isolate the impact that implementing the relevant standardized technology has on product price, *controlling for differences in other features and factors that also affect price*.[21] These controls are essential. To see why, compare Box 5.12 and Box 5.13.

Box 5.12 illustrates a stylized comparison of average prices between two groups of products: one with the relevant standardized technology, and one without it – in this case, phones with 5G and phones with 4G. The difference between their average (wholesale) prices is large, but that is not attributable only to the standardized technology. The 5G phones also have greater screen resolution and more memory, which may also contribute to the price difference. Other differences, not shown in Box 5.12, may also help to explain the large price difference between the two groups of phones.

Box 5.12 Example of a price premium comparing prices without controlling for confounding factors

When launched, smartphones with 5G were priced substantially higher, on average, than products without 5G. However, they also differed in other respects. For instance, they typically had superior screen quality, memory and processing power. The observed price difference therefore cannot be attributed to 5G alone.

Variable	Phones with 5G	Phones without 5G	Difference	Difference (%)
Price ($)	**550**	**239**	**+311**	**+130%**
5G (%)	100	0	+100pp	
Selected other features				
• screen resolution (ppi)	410	329	+81	+25%
• RAM (GB)	7.8	4.5	+3.3	+73%

Note: pp = percentage points, ppi = pixels per inch and GB = gigabytes. These figures are illustrative, based on the ranges presented in Hietamäki, E., P. Sääskilahti, A. Tuffin and L. Väänänen (2025). Evaluating royalties against the value of the benefits that depend on the licensed technology SSRN, 4 June.

In contrast, Box 5.13 illustrates the difference between the same groups of products, but this time *controlling for all other differences*. In this stylized example, the price difference is much lower than in Box 5.12. This is because, if controlled for adequately, the price difference is no longer affected by the differences in screen resolution and memory, which also, in this example, affect product prices. The intention, therefore, is that, if the impact that all confounding factors have on price is successfully controlled for, then the price premium should isolate the impact that the standardized technology has on the relevant products' average price.

21 Ideally, the price premium should capture the incremental impact on wholesale prices. The practical challenges that arise when analyzing retail prices are discussed below.

Box 5.13 Price premium: comparing prices with controls for confounding factors

A price premium seeks to isolate the impact on price that *depends* on the relevant technology. In this case, that means comparing 5G devices to non-5G devices that are otherwise comparable in the characteristics that affect price (i.e., they have the same quality of screens, memory, processing power and so forth). In this illustrative example, 5G's price premium over otherwise identical 4G phones is only 20%.

Variable	Phones with 5G	Phones without 5G	Difference	Difference (%)
Price ($)	**550**	**458**	**+92**	**+20**
5G (%)	100	0	+100pp	
Selected other features				
• screen resolution (ppi)	410	410	+0	+0
• RAM (GB)	7.8	7.8	+0	+0

Note: pp = percentage points, ppi = pixels per inch and GB = gigabytes. These figures are illustrative, based on the ranges presented in Hietamäki, E., P. Sääskilahti, A. Tuffin and L. Väänänen (2025). Evaluating royalties against the value of the benefits that depend on the licensed technology . SSRN, 4 June.

b. Using a technology's price premium as a proxy for value to the implementer

This approach uses the price premium to approximate the value that licensed technology provides to an implementer. The rationale is that the licensed technology enables functionality that increases consumer demand for the implementer's product. That increase in demand allows the implementer to sell more products and charge a higher price for them, reflecting the product's greater attractiveness to consumers. So, in essence, the price premium captures the value of the benefit for which the implementer is paying.

Strictly, that value to the implementer is not measured by the incremental price alone, but by the incremental profit, taking into account changes in prices, costs and sales volumes. The price premium is therefore a proxy. In some cases, it can be refined; for example, by deducting incremental costs to estimate the profit per unit attributable to the licensed technology while controlling for other factors. Generally, the impact that the technology has on sales volumes is more difficult to incorporate. These issues are examined below, together with practical considerations.

5.2.4.2 Application of the approach

To establish a benchmark aggregate royalty rate, this approach applies two steps.

- **Step 1: Estimate the price premium empirically**. Although the virtue of a price premium is relatively straightforward to understand *in principle*, it needs to be estimated accurately *in practice*.
- **Step 2: Split the price premium between innovators (collectively) and the implementer**. As discussed in Section 1.1.2 above, the impact that technology has on the value of a product is not *solely* attributable to the technology, it depends *jointly* on the patented technology and the implementer's product. Therefore, that value – which in this case is approximated by the price premium[22] – is shared between the innovator and the implementer.

22 As discussed, the price premium seeks to measure the incremental impact that the technology has on price, which is a proxy for the value the technology provides to the implementer. Where possible, that proxy may be further refined *before* splitting it between the licensor and the implementer; for instance, by deducting incremental costs to estimate the incremental profit per unit that the technology generates. These refinements are discussed below, alongside other practical considerations.

Step 1: Estimating a price premium

In practice, a price premium is estimated empirically. Two methods for estimation are presented here:

- product matching; and
- hedonic regression.

Estimating a price premium by product matching. This method identifies products that are closely comparable in all ways that affect their price *except for* implementation of the relevant standardized functionality – for example, two versions of a phone from the same model line, which are identical except that one offers 5G and the other offers 4G.

To illustrate this, Box 5.14 shows seven models of phone where (i) all the principal product features listed in the data are identical *except* the generation of cellular technology and (ii) each model had a 4G version and a 5G version. For each model, the 5G version of the phone has a higher price than the 4G version (22 percent on average). In principle, it should be possible to attribute these price differences to the 5G technology, as there are no other differences between the products.

However, two practical limitations arise.

Comparable pairs may be rare. Implementers often upgrade multiple attributes at once, so there may be few model "pairs" that differ only in the functionality of interest. Where pairs are sparse, it becomes harder to assess whether the observed price premium in those specific products is representative of the wider market. This is illustrated in Box 5.14, which shows that, out of 3.7 billion smartphones sales, only 13.8 million (0.4 percent) of those can be paired with a phone that is potentially an "otherwise identical model." Of those, only seven models of phone are released with a 4G and 5G version.

Unobserved differences may remain. Two products may appear to be otherwise identical according to the information recorded in data and yet differ in unobserved ways that influence price. In other words, the data fails to capture all relevant factors that affect price. For example, the data may record features such as screen resolution and memory, but not regional band support, storage variants, bundled services, launch timing or differences in suppliers and associated costs. The more accurately all relevant attributes are captured in the data, the more confidently can the residual price difference be attributed to the standardized functionality.

- For instance, consider Model 4 and Model 2 in Box 5.14. Assume that the 5G and 4G versions of Model 4 genuinely have no other differences in product features or external circumstances. As the 5G version sells for 19 percent more than the 4G version, we should be relatively confident that the price difference is attributable to 5G. However, now assume that, although the 5G and 4G versions of Model 2 appear to be identical on paper, in fact that they use different processors. That superior processor may explain, at least partially, why the 5G version sells for 28 percent more than the 4G version.

Box 5.14 Illustrative example of product matching

In the first five years after 5G phones were released, some smartphone companies released models with a 5G version and a 4G version.

Contract	Sales	Phones without 5G	Phones with 5G	Price Difference
Model 1	2.6	$1,100	$1,365	+24%
Model 2	2.5	$155	$199	+28%
Model 3	0.6	$490	$560	+14%
Model 4	2.2	$299	$355	+19%
Model 5	5	$455	$555	+22%
Model 6	0.9	$230	$255	+11%
Model 7	0.1	$240	$285	+19%
All pairs	**13.8**	**$485**	**$590**	**+22%**
All phones	**3,739.40**	**$239**	**$550**	**+130%**

Note: These figures are a stylized example, based on Table 2 in Hietamäki, E., P. Sääskilahti, A. Tuffin and L. Väänänen (2025). Evaluating royalties against the value of the benefits that depend on the licensed technology . SSRN, 4 June.

Estimating a price premium by hedonic regression. Regression is an econometric technique that uses information about characteristics to estimate relationships between them. Hedonic regression refers to a particular use of regression: it seeks to model the relationship between a product's price and its observable attributes (e.g., brand, screen quality, memory, processor, launch date, region), including a variable indicating whether the product implements the relevant standardized functionality. The coefficient for that technology variable is interpreted as the estimated price premium associated with the functionality, holding the other included attributes constant.[23]

The principle is simple. Each product is viewed as a bundle of the features it offers, each of which contributes to how well that product attracts consumers and the price it commands. By comparing the prices that different combinations of characteristics command, it is possible to build a model that reveals the contribution that each characteristic makes to the price of a product that offers it. Box 5.15 provides a stylized example explaining how a hedonic regression seeks to explain the different prices of four products by analyzing the variation in their prices and whether or not they offer four specific product features.

23 The seminal paper is Rosen S. (1974). Hedonic prices and implicit markets: Product differentiation in pure competition. *Journal of Political Economy*, 82(1), 34–55.

Box 5.15 Stylized example of hedonic regression

Four products are sold with a set of common features. Some also offer one or more of four optional features: A, B, C and D. Each optional feature adds functionality that attracts consumers to the core product and allows implementers to charge higher prices.

The table below shows the four products' prices and features.

Product	Wholesale price	Common features	Optional feature A	Optional feature B	Optional feature C	Optional feature D
Product 1	$730	Yes	**No**	**Yes**	**Yes**	**Yes**
Product 2	$630	Yes	**Yes**	**No**	**Yes**	**Yes**
Product 3	$560	Yes	**No**	**No**	**No**	**Yes**
Product 4	$570	Yes	**Yes**	**No**	**Yes**	**No**

In its simplest form, regression expresses a relationship between the price of a product and the specified features. If a product has a particular feature, then it is assumed that that feature will have a particular impact on the product's price.

The relationship between price and features is expressed by the "regression model," for example:

$$\log(\boldsymbol{price}i) = \boldsymbol{\alpha}0 + \boldsymbol{\alpha}1 \bullet \mathbf{A}i + \boldsymbol{\alpha}2 \bullet \boldsymbol{X}i + \boldsymbol{\varepsilon}i$$

where the price (expressed as a logarithm) of any product, *i*, is given by:

- a constant, $\boldsymbol{\alpha}0$, that applies to all products, regardless of the specific features;
- the variable of interest, $\boldsymbol{\alpha}1 \bullet \boldsymbol{A}i$, where the price of the product always increases by α_1 when it has feature A, but by zero when it does not – for instance, feature A may be 5G;
- variables for all other specified features – here, $\boldsymbol{X}i$ represents a matrix of the other specified features that affect price, product features B, C and D – which, for instance, may cover features such as screen resolution or brand; and
- εi is a term capturing the impact of unobserved product characteristics.

By comparing the different products' prices and combinations of features, the model gives an estimate of the impact that each feature must have. In this case, it estimates that the common features contribute $500, and the optional features A to D contribute $50, $150, $20 and $60, respectively.

Note: This box offers a simple, hypothetical example of hedonic regression. It is purely intended to illustrate the mechanics of the approach; it does not attempt to show the prices of real products.

In practice, applying hedonic regression well can be challenging. Hedonic regression is an established econometric technique, but – as with any empirical method – the reliability of its results depends on the underlying assumptions of the model, the quality of the data used and what modeling choices are made. It is not possible to comprehensively cover the relevant issues in detail here – they are technical and whether they apply in a particular case will depend on the particular facts and approach, and they are covered in standard statistical textbooks.[24] However, it is useful to be aware of the significance of the following issues.

24 For instance, see Wooldridge, J.M. (2020). *Introductory Econometrics: A Modern Approach* (7th edn). Cengage Learning; and Cameron, A.C. and P.K. Trivedi (2005). *Microeconometrics: Methods and Applications*. Cambridge: Cambridge University Press.

Omitted variable bias. This arises where the regression model excludes a factor that (i) affects price and (ii) is correlated with whether the product implements the standardized technology. In that situation, the estimated "technology premium" may partly reflect the omitted factor rather than the technology itself.

– *Example*: Suppose most early 5G phones are also "flagship" devices with superior cameras and premium materials, but the dataset does not include variables capturing camera quality or materials. These features contribute to higher prices. However, that is not captured by the regression, as these features are omitted from the model of the relationship between price and product features. As such, the regression may attribute some of the price impact of the premium cameras and materials to 5G, thereby overstating the 5G premium.

Multicollinearity. This occurs where implementation of the standard is highly correlated with other variables (or with combinations of them) that *are* specified in the regression model. As these features tend to appear together, the model struggles to estimate the effect that each factor has on price in isolation. The result is often unstable coefficients and wide confidence intervals, even if the overall model "fits" prices well.

– *Example*: Imagine that all 5G phones in the dataset have a superior processor to 4G phones. In this extreme example, the model cannot distinguish between the impact that 5G has on price and the impact that the processor has on price, as the two always appear together. The stronger the correlation, the greater the challenge.

Limited data or limited variation. Hedonic regression identifies the contribution of a feature by comparing products with different bundles of attributes. If there are too few observations, or if the data contain little meaningful variation in the relevant attributes, estimates become imprecise. A particular problem arises where the standard is almost always bundled with the same set of other features, leaving the model with few "comparisons" that isolate the technology.

– *Example*: If, in the sample period, nearly all phones with 5G also have OLED screens and nearly all phones without 5G have LCD screens, there are few (or no) observations in which 5G varies independently of screen type. The model cannot reliably separate a 5G price premium from an OLED price premium.

The practical implication of these issues is that hedonic evidence requires **robustness checks** – for example, estimating the price premium under alternative model specifications (different control variables and functional forms), testing its sensitivity to different sample choices (time period, regions, price segments) and reporting confidence intervals. Greater confidence can be placed in results that remain broadly stable across a range of different plausible specifications.

Conceptually, there may be **identification issues**: that is, whether the coefficients of a hedonic regression do in fact capture preferences for the related component or if they actually capture something else. A general critique of hedonic regression is that the coefficients will reflect a combination of factors, including consumer preferences, but also competitive conditions and other factors. So, for example, the technology could be highly valuable, increasing consumer demand for the product, but in a highly competitive environment, implementers would not be able to increase prices and so the price premium would be small – largely reflecting incremental costs. Conversely, another component may add less value but be supplied by a monopolist, in which case its price premium would be higher. Below, we discuss how these conceptual issues affect the price premium's use as an effective proxy for value.

Step 2: Split the price premium between innovators (collectively) and the implementer.

Regardless of how the price premium is estimated, it would not determine the reasonable aggregate royalty rate directly. As discussed in Section 1.1.2 above, that contribution depends *jointly* on the technology and the product – the value created by *combining* the innovator's technology with the implementer's product, complementary features and commercialization efforts. So, the price premium (after deducting incremental costs) is split between the implementer and the SEP holders. The proportion allocated to the SEP holders establishes

the benchmark for the reasonable aggregate royalty rate. The proportion allocated to the implementer is its residual profit – the price premium minus the aggregate royalty rate.

How the price premium is split between the relevant SEP holders and the implementer can differ depending on whether the conventional (forward) top-down framework or the reverse top-down framework is used.

- The conventional approach requires an explicit assumption or estimate regarding the proposed split. This can be challenging to substantiate. As discussed below, simple allocation rules – such as dividing the incremental benefit equally between the SEP holders and the implementer – without further justification have been dismissed by courts.
- Alternatively, using the reverse top-down framework, the implied aggregate royalty rate for all SEPs can simply be compared to the price premium. The implied split between the SEP holders and the implementer can then be evaluated to assess whether it is reasonable – i.e., whether the amount of the price premium left for the implementer after deducting the implied aggregate royalty rate is reasonable.

5.2.4.3 Examples of hedonic regression in case law

While the hedonic regression approach has been accepted in some contexts, it has also been challenged by other courts. This emphasizes the importance of the practical considerations discussed below.

Some courts have used price premia, estimated by hedonic regression, to inform their decisions on FRAND disputes. For instance, China's Nanjing Intermediate People's Court in *Huawei* v. *Conversant* adopted a hedonic price model to estimate the value in the Chinese market of 3G mobile phones (12.5 percent) against the value in major developed countries (28.8 percent).[25] In addition, in *OPPO* v. *Nokia*, China's Chongqing Intermediate People's Court determined that the incremental value of 5G over 4G was limited and set the applicable 5G aggregate royalty rate at 4.3% to 5.3%, based on a set of hedonic regression results proposed by the plaintiff.[26] In contrast, in *ZTE* v. *Samsung*, the same court arrived at a substantially higher range of 7.8% to 8.5% for the applicable aggregate 5G royalty rate, based on a different set of hedonic regression results proposed by the plaintiff.

Some courts have rejected approaches that rely on hedonic regressions, but not because the empirical approach was invalid.

The UK High Court of Justice in *InterDigital* v. *Lenovo* considered evidence on the 3G, 4G and 5G price premia, which were estimated to be 26 percent, 21 percent and 21 percent, respectively. As shown in Box 5.16, the approach was rejected on procedural grounds. Generally, the evidence had not been presented at an early enough stage for the counterparty to properly consider its merits and respond. Specifically, the approach's *second* step – which *allocated* the price premia equally between the implementer and licensor – had been insufficiently supported.[27]

In the United States, the Court of Appeals for the Federal Circuit vacated the original ruling in *VLSI Technology* v. *Intel*. The court was presented with a "three-pronged" damages model, of which hedonic regression analysis was one of the prongs, used to estimate the specific price premium that consumers were willing to pay for microprocessor speed improvements attributable to the patented technology. The court vacated the award because the inputs used in the model were unreliable, and the apportionment of the price premium to the patented technology was poorly justified. The court explicitly stated that the regression methodology itself had not been persuasively shown to be improper or unreasonable.[28]

25 InterDigital pointed to a passage in Dr Wang's evidence where she said: "While it has limitations in this application, it has recently started to be applied in evaluating SEPs in telecommunication matters alongside other traditional valuation methods." *InterDigital* v. *Lenovo* [2023] EWHC 539 (Pat) (link) , para. 874. Indeed, the Nanjing Intermediate People's Court in *Huawei* v. *Conversant* (2018) Su 01 Min Chu No. 232, 233 and 234 adopted a hedonic price model which was used to estimate the value in the Chinese market of 3G mobile phones (12.52 percent) against the value in major developed countries (28.82 percent).

26 *OPPO* v. *Nokia* [2021] The People's Republic of China Chongqing First Intermediate Court Civil Judgment Yu 01 Min Chu No. 1232, pp. 100–102 (an unofficial translation is available).

27 The three grounds for allocating equal shares between implementer and licensor are described in para. 861 and considered in paras 870–871. See *InterDigital* v. *Lenovo* [2023] EWHC 539 (Pat) (link) , paras 861, 870 and 871.

28 *VLSI Technology LLC* v. *Intel Corporation* (2023) (link) [US Court of Appeals for the Federal Circuit], p. 28.

In *Stragent LLC* v. *Intel*, the matter related to one of 19 "reliability, availability, and service" (RAS) features found in Intel microprocessors. The regression estimated that, collectively, they represented 42.0 percent of Intel's average microprocessor selling price. However, they appeared together or not at all. For a hedonic regression to isolate the value of a single patented feature, it requires variation in that feature while holding others constant. The analysis, therefore, simply allocated the price premium equally between the technologies. The court considered that to be inadequate, ruling that the methodology had relied on arbitrary assumptions that have no basis in the facts of this case or hedonic analysis in general.[29]

Box 5.16 Case example of hedonic regression evidence: Interdigital v. Lenovo

The claimant proposed reasonable aggregate royalty rates for 3G, 4G and 5G, based on the following.

- **Price premia**. These estimated the incremental price attributable to licensed technology and were calculated using hedonic regression – expressed as a percentage of the relevant product's average selling price.
- **A proposed split between the SEP holders and the implementer**. In this case, it was proposed to split the price premium equally, on the basis that, "under very general conditions, economic equilibrium implies an equal division of the gains from trade if bargaining positions are symmetric," experimental economic studies of bargaining on the meaning of "fair," and that "many telecommunication firms are both implementers and innovators, and so must adopt the bargaining positions of both."

The court rejected the approach presented to it, on the basis that the split between the implementer and SEP holders was a "critical step" that had, procedurally, not been properly pleaded and was insufficiently supported.

Estimates put forward in *InterDigital* v. *Lenovo*

	3G	4G	5G
Price premium	26%	21.0%	21.0%
Proposed split	50%	50.0%	50.0%
Proposed aggregate royalty rate	13%	10.5%	10.5%
Retained by implementer	13%	10.5%	10.5%

Note: This example is used purely to illustrate the approach. The discussion points below still apply – for instance, incremental costs may not have been deducted from the price premium in this example before allocating the "benefit" between the parties.

Source: *Interdigital* v. *Lenovo* [2023] EWHC 539 (Pat) (link) , paras 844, 861 and 870–872.

5.2.4.4 Practical considerations

Even if the empirical estimation of the price premium is applied well and robustly, there are several other practical considerations that must be taken into account before the price premium can be used to establish a reliable benchmark. Here, we divide the key issues into two groups:

- assessing whether the price premium can provide an adequate proxy for value;
- assessing whether the price premium can be used to establish a benchmark for the reasonable aggregate royalty rate.

In both cases, there is disagreement about whether all the relevant issues can, in practice, be adequately addressed.

29 *Stragent LLC* v. *Intel Corporation* (2014), p. 9.

Using the price premium as a proxy for value

Even where the analysis gives a reliable estimate, the price premium has several limitations as a proxy for the incremental *value* to the implementer's product that can be attributed to the licensed technology.

Using the price premium to assess incremental profit per unit. A price premium measures incremental impact on the product's price that is attributable to the technology. However, the licensed technology may also increase the implementer's production costs (for example, where required components are more expensive). Ignoring such cost increases would therefore overstate the value that the technology provides to each product.

It may be possible to refine the price premium as a proxy for value, by deducting incremental costs. That, in principle, would provide a better metric: the incremental profit per unit that is attributable to the technology, controlling for other factors.

For instance, if the price premium is estimated at $80, and the relevant chipsets cost $10 more than those used in the previous generation, the incremental profit per unit would be $70. In this example, part of the observed price premium reflects higher input costs, rather than an increase in the implementer's profit per unit.

A further complication may arise where the hedonic regression relies on retail prices. Retail prices incorporate the margins of downstream distributors. Where possible, the price premium should instead reflect the incremental impact on wholesale prices.

Using the price premium only captures the benefit *per unit,* not the impact on product sales. The price premium focuses on the impact that the licensed technology has on price per unit. It does not capture any effect on total sales volumes arising from the technology. Where standardized technology increases consumer demand, this will typically affect both the price of the product (the "price premium") and the number of units sold (a "quantity premium"), each measured relative to the counterfactual without the technology.

However, both effects can benefit the implementer, increasing its profits. For example, the technology may increase demand such that the implementer can charge prices that are 20 percent higher and sell 10 percent more units than for an otherwise identical product without the technology.

Excluding the impact on sales is an imperfection of this approach.

Using the price premium only seeks to measure the value to implementers, not to consumers. A price premium is calculated from market prices and therefore reflects the portion of value that implementers can monetize through higher prices. It does not capture the additional value that consumers may enjoy (consumer surplus) from superior products. This limitation can be particularly important in competitive markets, where implementers may have limited ability to increase prices, even when consumers value the functionality enabled by the licensed technology highly.

For example, a technology may enable features that consumers value and increase demand. However, intense competition between implementers may keep prices relatively low: close to their marginal costs. In this situation, consumers benefit: sales increase, due to the additional consumer demand, but the price premium is modest. In this scenario, the low price premium does not, however, imply that the functionality generates only modest value. Consumers have a high willingness to pay for the benefits they receive. Rather, it reflects competitive constraints on price, such that consumers, not implementers, capture more of the value that the technology enables in the product.

In some cases, it may be possible to address these limitations directly; for example, by adjusting the price premium to account for an increase in incremental costs. In some cases, it may not be possible.

In all cases, these limitations mean that price premium evidence must be interpreted with care. For instance, a low price premium leads to different conclusions in different competitive circumstances. In some markets, a low premium may understate the total value enabled by the standardized functionality, and additional evidence (e.g., on demand responses, substitution patterns or willingness-to-pay) may be needed to assess whether the implied aggregate royalty rate is proportionate. In others, a low price premium may reveal that the technology provides modest benefits.

Using the price premium to benchmark the reasonable aggregate royalty rate

Where a price premium has been estimated (and adjusted for incremental costs), a further step is required to translate that evidence into a reasonable aggregate royalty rate.

The central question is how the remaining gains associated with the standardized functionality should be divided between (i) SEP holders (through royalties) and (ii) implementers (through residual profit).

From an economic perspective, the main considerations for assessing an appropriate split are as follows.

The price premium measures value ex post, not incremental value over the next-best ex ante alternative technology. A price premium seeks to measure the value of having the functionality compared with not having it. That is not necessarily the same as the incremental value of the technology relative to the next-best technology or technical option that *could have been adopted*.

For example, assume that the premium associated with implementing LTE in Product X is $100 relative to "no 4G functionality." If a plausible alternative standard (e.g., WiMAX) would have produced a price premium of $80, then the incremental advantage of LTE over that next-best alternative is $20. In principle, that incremental value may be a relevant benchmark for the reasonable aggregate royalty rate. In practice, it cannot be measured empirically.

The significance is that, all other things being equal, the more valuable the ex ante alternative was (relative to the technology that was actually implemented in practice), the lower the innovator's share of the price premium would be, and the greater the implementer's share would be.[30]

The aggregate royalty rate must provide both sides with ex ante incentives to participate. Any split should leave both sides better off, viewed from an ex ante perspective (i.e., it should not assume that either side will accept terms that would have caused them to walk away if they were not already locked into the standard).

For example, if a proposed allocation assigns SEP holders nearly all the price premium (after deducting costs), implementers would have lacked ex ante incentives to invest in development, implementation and product commercialization. Conversely, if implementers retain nearly all of the price premium, then innovators may have lacked ex ante incentives relative to the risks and costs of contributing technology that becomes essential.

Balancing parties' *incentives* does not necessarily require equal *reward*. Equally valuable contributions warrant equal reward. Each side of an SEP negotiation incurs some risk to contribute to the value that their contributions enable. In economic terms, this cooperative effort creates a "double-sided moral hazard" problem, which leads to the following dilemma: the greater one side's own share of the reward, the more likely that side is to take the risk to compete, contribute and benefit; but the smaller the other side's share, the less likely that side is to compete and contribute, which then constrains the size of the pie that the side with the lion's share enjoys. In these circumstances, when the contribution made and risk incurred on each

30 See Part 4 for a discussion of how parties would divide between them the economic value (or "gains from trade") – which is represented here by the price premium – based on the strength or weakness of ex ante alternatives.

side is equal, both sides will benefit most when they agree to an equal split of the value that their cooperation generates.[31]

However, contributions are not necessarily equal. Balancing incentives between innovators and implementers, in principle, should recognize that. A party may reasonably claim a greater proportion of the price premium where an asymmetric allocation of returns is necessary to:

i. incentivize it to contribute and take on greater risk that the counterparty faces (for example, because the counterparty's contributions may be relatively cheaper or easier, or many other firms may offer competitive solutions); and
ii. incentivize implementation of complementary technologies in products – the value attributable to implementing a standardized technology may overlap with the value attributable to implementing other complementary technologies. In these cases, implementers need some incentive to combine technologies where that would benefit consumers.

These issues require consideration whenever a price premium is used in the top-down framework. However, the application differs depending on which approach is being used. In a **forward top-down analysis**, an explicit allocation rule is needed to convert a price premium into a reasonable aggregate royalty rate. In a **reverse top-down analysis**, precise apportionment may not be necessary: the price premium can be used as a sense-check against an implied aggregate royalty rate, to test whether the implied total royalties appear proportionate to the estimated incremental benefits associated with the standardized functionality.

5.2.5 A proportion of the product's economic value that depends on the licensed technology

This approach seeks to estimate the total economic *value* of all incremental benefits that depend on the licensed technology. It aims to capture not only the impact that the technology has on prices, but also its effect on sales volumes and on consumer surplus – the benefit that consumers receive beyond the price they paid.

In this section, this is referred to as an "economic value added" approach. It is a counterfactual market analysis that compares outcomes in a market *with* the relevant licensed technology with outcomes in a market *without* it, and uses that comparison to inform an aggregate royalty rate benchmark.[32]

5.2.5.1 The motivation

This approach has been proposed because it seeks to estimate the full economic value of the benefits that depend on the licensed technology for *all parties*, including consumers, and to model how different royalties would affect market outcomes.

The particular aims of the approach are as follows.

- **Capture benefits to both implementers and consumers**. Unlike a price premium alone, this approach seeks to account for the effects of the technology on demand, consumer surplus and implementers' sales volumes.
- **Assess incremental costs and pass-through**. The approach can accommodate incremental production costs associated with the technology and estimate how royalties (as a cost increase) may be reflected in prices and quantities under the competitive conditions assumed.

31 Bhattacharyya, S. and F. Lafontaine (1995). Double-sided moral hazard and the nature of share contracts. *RAND Journal of Economics*, 26(4), 761–781. The "Shapley value" would also lead to a 50/50 split for perfect complements, which the jointly created value of innovators and implementers would be. See Layne-Farrar, A., A. Jorge Padilla and R. Schmalensee (2007). Pricing patents for licensing in standard-setting organizations: Making sense of FRAND commitments. *Antitrust Law Journal*, 74(3), 671–706.

32 Economic value added has been presented in the European Commission's Group of Experts on Licensing and Valuation of Standard Essential Patents: Contribution to the debate on SEPs (January 2021), Annex 5. The methodology is called the "present value-added" approach there, but we prefer "economic value added" because it characterizes the concept and methodology better.

– **Support incentive analysis**. By showing how different royalty levels change the distribution of value, the model can help to assess whether proposed aggregate royalty rates plausibly preserve ex ante incentives for contributions to both innovation (development and participation in standardization) and implementation (product development and commercialization).

As a counterfactual market analysis, the approach is conceptually similar to modeling techniques used in other contexts, such as merger simulations used by competition authorities to assess the potential impact of proposed mergers on consumer welfare and market competitiveness. In both use-cases, the focus is on the incremental effects – whether from the presence of the licensed technology or from a merger – on market dynamics.

5.2.5.2 The approach

The economic value added approach compares the total economic value in a product market with and without the benefits and costs of the licensed technology. This comparison reveals the extent to which the licensed technology benefits consumers, implementers and licensors by accounting for its effect on demand, prices, quantities and costs – including royalty payments.

The analysis is grounded in an economic model of the relevant market. It has four core steps:

Step 1: Specify and calibrate the model of the relevant market (the factual scenario).
An economic model is calibrated to replicate the outcomes in the market – prices, sales volumes, costs and competitive intensity between implementers.

Step 2: Construct counterfactual scenarios, with and without the licensed technology.
The factual scenario is then adjusted to estimate how outcomes would differ under two counterfactual settings:

– a scenario in which all products reflect *both* the costs and the benefits of the licensed technology; and
– a scenario in which no products have *either* those costs or benefits.

Step 3: Measure changes in outcomes and total economic value. The comparison estimates how the technology affects demand, prices, quantities and costs, and therefore how the value that depends on the licensed technology is distributed between:

– **licensors**, through incremental royalty income;
– **implementers**, through incremental profits; and
– **consumers**, through incremental surplus.

Step 4: Assess how counterfactual royalty rates impact outcomes. Unlike the price premium analysis, the model can be used to assess how different aggregate royalty rates would affect prices, sales volumes and the division of value between parties, including the extent of cost pass-through.

Box 5.17 illustrates the economic value of a product market with and without the costs and benefits of the licensed standardized technology. The illustration is intended for readers familiar with basic microeconomic concepts, such as demand curves and consumer and producer surplus.

Box 5.17 A product market's economic value with and without the costs and benefits of the licensed technology

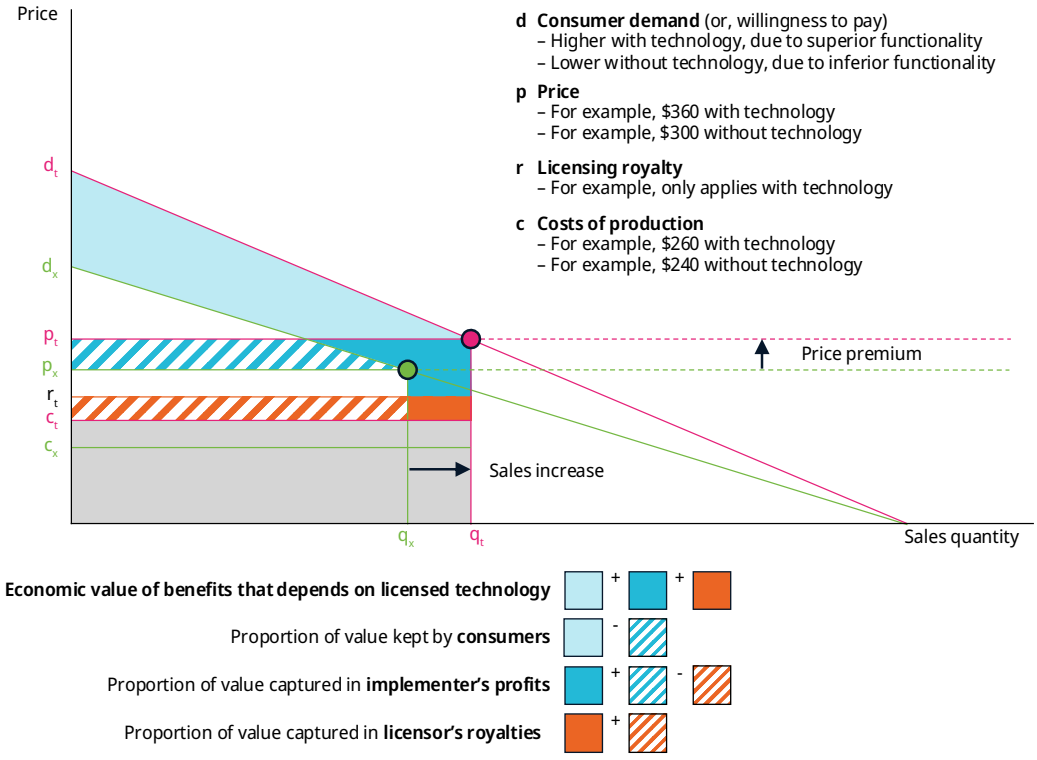
This example illustrates the value of a product market when it implements a licensed technology (shown in red) and when it has neither the benefits nor the costs of that technology (shown in green). **The key building blocks are as follows:**

Consumers value the product more with the technology. When the product includes the licensed technology, it offers better or additional features. As a result, consumers are willing to pay more for it. In the chart, this is shown by higher demand (d_t) compared to demand without the technology (d_x). The sloping lines represent the distribution of how much different consumers are willing to pay.

Prices and sales are higher with the technology. Because demand is stronger, manufacturers can charge higher prices and sell more units. These are shown in the chart as ***p*** (price) and ***q*** (quantity). The difference between the two scenarios reflects the additional sales and higher prices that depend on the technology. The size of this effect depends on how much demand increases, how much production costs (***c***) rise and how competitive the market is.

The overall market is more valuable. The shaded areas in the chart show that the total economic value of the market is higher when the technology is included. They also illustrate how this extra value is shared between consumers, manufacturers and SEP holders.

Assessing how different royalty rates would affect value. Manufacturers must pay royalties (***r***t) to use the standardized technology, which adds to their costs. The model can be used to assess how different royalty levels affect the total value of the market and how that value is divided between the different groups.



Note: This box offers a simplified, hypothetical example to illustrate relevant factors when considering a market's economic value with and without costs and benefits of the focal licensed technology. It is purely intended to illustrate the impact of a given licensed technology; it does not attempt to show the dynamics of a real market.

5.2.5.3 Practical considerations when using the economic value added approach to estimate reasonable royalties

Assessing the reliability of the modeling

As with any model-based approach, reliability depends on the model's structure, assumptions and data.

Model sophistication can vary. The economic model may be highly detailed, capturing product-specific supply and demand relationships, competitive intensity and pricing dynamics. Alternatively, it can be a simplified representation of the market that still reflects the key relationships between prices, quantities and outcomes for producers and consumers. In either case, the model enables an equilibrium analysis that shows how the licensed technology affects product market prices and quantities, and thereby firm profits and consumer surplus (i.e., including all the benefits, monetary and non-monetary, that consumers get from the product).

Simplifying assumptions should be assessed against the purpose of the model. Modeling will often involve simplifying assumptions. Common simplifications include treating the market as a single "average product," imposing linear demand or assuming a particular competitive structure. Simplification reduces data requirements and can make results more transparent, but it may also omit important features, such as product differentiation. The principal issue is whether the simplifications materially affect the conclusion for the relevant analysis – for example, bounding a reasonable aggregate royalty rate or testing whether an implied aggregate royalty rate is proportionate.

Calibration requires data (or justified substitutes). Data requirements depend on the complexity of the model, but may include prices, quantities, cost structures, margins, market shares and measures of the technology's effect on demand, which, for instance, may be informed by price-premium evidence. Where the technology has not yet been widely deployed, historical market data may be lacking or irrelevant – particularly in the case of disruptive innovations. In such instances, survey-based demand estimation can serve as a viable alternative. This method is used in merger control and new product pricing, and in evaluations of intangible or non-market benefits, such as sustainability impacts.

Using the model to determine a reasonable aggregate royalty rate

As with the price-premium approach, the economic value added approach does not, by itself, dictate a unique aggregate royalty rate. A royalty benchmark still requires a judgment about how the incremental value created by the technology should be shared between licensors and implementers.

In principle, the same considerations apply: terms should preserve ex ante incentives on both sides; the division of value should reflect relative contributions and risks; and implementers generally require sufficient residual return to support investment in product design, integration and commercialization, including in complementary innovations that increase the technology's realized value.

The approach is also well-suited to reverse top-down analysis. Because it can translate an implied aggregate royalty rate into predicted effects on prices, quantities, implementer profits and consumer surplus, it can help to evaluate whether an implied aggregate rate appears disproportionate relative to the benefits that depend on the technology under plausible market conditions.

5.3 Step 2: Methodologies used to allocate the reasonable aggregate royalty rate to a specific portfolio

After establishing a reasonable aggregate royalty rate for the relevant standard (or set of standards), the top-down framework allocates a share of that aggregate rate to the particular SEP portfolio being licensed. The aim is to estimate the portfolio's relative contribution to the standard, compared with all SEPs that contribute to it. As already illustrated, the licensor's contribution may differ from its proportion of declared SEPs. If the proportion of its portfolio that is essential, valid, infringed and technically important is less than for all SEPs on average, its contribution will be less. If the proportion is greater than average, its contribution will be greater too. Differences in where the licensee sells or manufactures its device can also be assessed and accounted for, as discussed below.

This section sets out the basic allocation approach and the main considerations when applying it in practice.

5.3.1 The approach to allocation

The baseline approach allocates a licensor's share of the aggregate royalty rate in proportion to its SEP portfolio's share of the total SEP "stack". The allocation starts from an average value assumption, before considering refinements for observable differences between portfolios.

5.3.1.1 Baseline allocation: patent counting or share of the stack

The simplest approach – often described as "patent counting" – allocates a licensor's share of the aggregate royalty rate in proportion to the size of its SEP portfolio relative to the total SEP "stack" for the standard (see Box 5.18).

This approach does not require the assumption that every patent has identical value. Rather, it relies on an **average value** assumption, which is that, absent evidence to the contrary, the average value of the licensor's SEPs is broadly similar to the average value of all SEPs in the stack – based on their essentially, strength and technical importance.

5.3.1.2 Refining the baseline

In practice, parties may seek to refine the average value assumption by adjusting for observable differences between portfolios that may systematically affect their value. The practical considerations are summarized below.

Box 5.18 Allocating a reasonable aggregate royalty rate to a portfolio

SEP holder A and implementer B negotiate terms for a license covering SEPs essential to standard S, for use in product X. They have determined that a reasonable aggregate royalty rate is $40 per unit.

Portfolio's reasonable aggregate royalty rate
= reasonable aggregate royalty rate × portfolio's contribution to the standard

Allocation by patent counting

SEP holder A owns 5% of all declared SEPs. So, on a simple allocation, it receives 5% of the reasonable aggregate royalty rate: $2 (5% × $40).

	Stack of all SEPs	SEP holder A's portfolio
Number of declared SEPs	100,000	5,000
Proportion of declared SEPs	100%	5%
Reasonable aggregate royalty rate	$40	$2

The average value assumption

Not all of SEP holder A's declared SEPs are essential, valid, infringed or technically important. However, that does not affect its allocation *if* the proportion of its SEPs that are essential, valid, infringed and technically important reflects the rates that apply to all SEPs. The assumption, therefore, is that, on average, its declared SEPs contribute to the standard's value in the same proportion as all declared SEPs.

To illustrate, assume that for both SEP holder A's portfolio and the stack of all SEPs, 20% are essential and 50% are valid. There are 10,000 SEPs that are valid and essential; the reasonable aggregate royalty rate for these SEPs is still $40 (as the non-essential, invalid patents do not contribute to that value). SEP holder A owns 5% of the valid and essential SEPs, so it still receives 5% of the reasonable aggregate royalty rate: $2 per unit.

	Stack of all SEPs	SEP holder A's portfolio
Declared SEPs	100,000	5,000
(share)	(100%)	(5%)
Essential SEPs: 20% rate	20,000	1,000
(share)	(100%)	(5%)
Valid SEPs: 50%	10,000	500
(share)	(100%)	(5%)
Reasonable aggregate royalty rate	$40	$2
(share)	(100%)	(5%)

Note: This box offers a simplified, hypothetical example illustrating the relevant factors to consider when allocating a reasonable aggregate royalty rate to a portfolio.

5.3.2 Practical considerations

When refining the average value assumption, differences can arise between the average quality of a specific portfolio and the average quality of all declared SEPs. These can occur for several reasons, the most frequently cited being differences in the proportion of declared SEPs that are:

- truly essential (as opposed to merely declared);
- infringed;
- valid (or likely to be held to be valid if tested);
- technically important to the relevant products; and
- relevant to the license scope, including the jurisdictions where products are sold and where patent rights can be enforced.

5.3.2.1 Differences in essentiality

Not all declared SEPs are ultimately found to be, in fact, essential. Standards bodies generally encourage participants to declare any patents that may be essential, to reduce the risk that an undisclosed patent later "blocks" implementation of the standard. The pool of declared SEPs is typically larger than the set of patents that would be found essential on closer analysis.[33]

A licensor's share of declared SEPs therefore does not necessarily correspond to its share of SEPs that would be found essential on closer analysis. In the top-down framework, that licensor's share of the aggregate royalty rate should reflect its share of all genuinely essential SEPs. Therefore, if a licensor's portfolio has a higher-than-average rate of declared SEPs that are truly essential, its share of the aggregate royalty rate would increase relative to the share based on its share of declared SEPs. If its essentiality rate is below average, its share would decrease. See for example, *TCL Communication Technology Holdings Ltd*. v. *Telefonaktiebolaget LM Ericsson*, No. 8:14-cv-00341, (C.D. Cal. Dec. 21, 2017), amended and superseded (C.D. Cal. Sept. 14, 2018) (link) , rev'd in part, vacated in part 943 F.3d 1360 (Fed. Cir. 2019) , cert. denied 141 S.Ct. 239 (2020).

Several issues have arisen in the assessment of essentiality rates.[34] Estimates of "actual" essentiality rates can vary widely between studies that ostensibly assess the same portfolios. The reason for substantial differences is not always clear, as the methodologies for such assessments are often "black boxes" or the assessments have been completed within a limited time, resulting in some degree of uncertainty about the results. In practice, this can be a barrier to controlling for these differences effectively – in *Optis* v. *Apple*, for example, the essentiality study was rejected.[35]

5.3.2.2 Differences in infringement

SEPs may not be infringed, even in products that comply with the standard. Some SEP-protected functionalities are not mandatory, so a product may simply avoid infringing the patents. Others may apply to some products but not others. For example, technology that is mandatory in standard-compliant infrastructure may not be relevant to smartphones or other terminals that connect to that infrastructure.

As a result, a licensor that holds 5 percent of declared SEPs does not necessarily hold 5 percent of SEPs that are genuinely infringed. If the licensor has a higher-than-average proportion of non-mandatory SEPs, and the licensor does not implement those non-mandatory features, then its share of the aggregate rate would be adjusted down accordingly.

33 Studies vary as to the estimate of the actual essentiality proportion – for instance, one publication estimated that between 10 percent and 50 percent of cellular SEPs are genuinely essential. European Commission (2017). Setting Out the EU Approach to Standard Essential Patents . Communication from the Commission to the European Parliament, the Council, and the European Economic and Social Committee.

34 An issue around the average value assumption is that it *encourages* over-declaration of SEPs or simply patenting to the standard. See *Unwired Planet International Ltd* v. *Huawei* [2017] EWHC 711 (Pat) (link) , paras 200–202, where the judge noted that "[a] very significant reason why one cannot just count up declared patent families is recognition of the problem of over declaration. There was no dispute this exists" and that "[I]t must also be recognised that the fact that rates are negotiated by counting patents creates a perverse incentive to declare as many patents as possible, making over-declaration worse."

35 *Optis* v. *Apple* [2023] EWHC 1095 (Ch) (link) , paras 136 and 137.

5.3.2.3 Differences in patent validity

In a given patent portfolio, some patents will be valid and others will not. Patents that have been proven to be invalid have no value. Patents proven to be valid command their full value. This means that a patent's value *prior* to a validity assessment is probabilistic (i.e., between zero and its full value, based on the likelihood that it would be proven valid if assessed).[36]

In principle, as with essentiality, the issue is that the proportion of valid patents varies between portfolios, such that some may be stronger than all SEPs on average, and some may be weaker. If a licensor's portfolio has a higher than average rate of declared SEPs that are valid (or likely to be held to be valid), then its share of the aggregate royalty rate would increase relative to the share based on its share of declared SEPs. If its rate is below average, its share would decrease.

In practice, however, some courts are cautious about attempting to make portfolio-level validity comparisons using broad metrics. In *Optis* v. *Apple*, for example, the court stressed the fragility of assuming "better than average" validity in the absence of reliable evidence and noted that assessing validity across a large stack is "extremely unsafe."[37]

5.3.2.4 Differences in importance of SEP-protected invention for the technology standard

Even among patents that are both valid and standard essential, not all inventions are equally significant. Some SEPs protect inventions that are central to the standard's core functionality, while others do not. Portfolios may therefore differ substantially in average value depending on the importance of the SEP-protected inventions for the technology standard they cover.

It can be difficult to control for differences in importance of SEP-protected inventions for the technology standard in a reliable way. Broadly, assessments fall into two categories:

- **Qualitative**. Portfolios can be assessed as "important" or "moderately important" through expert testimony regarding the technology's functionality and available alternatives prior to standardization. Where the justification provided for those classifications is insufficient, courts have rejected them.[38]
- **Quantitative**. Some quantitative metrics are correlated with patent value, so potentially these can be used to assess *variation* in value between portfolios. For instance, the academic literature has used "patent citations" – the citations that a patent receives from subsequent patents – to indicate a patent's influence on subsequent innovations.[39] Academic literature has found that forward citations are correlated with patent value.[40] Courts tend not to rely on such metrics, particularly where the correlation is loose or explains only a small percentage of the variation in patent value.[41]

A further complication with assessment of the importance of SEP-protected inventions for the technology standard is complementarity. The technical importance of a particular invention protected by a single SEP may be difficult to isolate from the value it creates in combination with other related SEP-protected inventions. As such, in practice, technical importance tends to be considered for broad groups of patents that all contribute to a related area or part of the standard, not for individual patents[42]

36 See Lemley, M.A. and C. Shapiro (2005). Probabilistic patents. *Journal of Economic Perspectives*, 19(2), 75–98.
37 *Optis* v. *Apple* [2023] EWHC 1095 (Ch) (link) .
38 *TCL Communication Technology Holdings Ltd. v. Telefonaktiebolaget LM Ericsson*, No. 8:14-cv-00341, (C.D. Cal. Dec. 21, 2017, amended and superseded (C.D. Cal. Sept. 14, 2018 (link)), rev'd in part, vacated in part 943 F.3d 1360 (Fed. Cir. 2019) , cert. denied 141 S.Ct. 239 (2020). Also, for instance, "this court has determined that *Innovatio's* patent portfolio is of moderate to moderate-high importance to the 802.11 standard", *In re Innovatio IP Ventures, LLC, Patent Litigation,* 921 F. Supp. 2d 903 (N.D. Ill. 2013), (link) p. 71.
39 Trajtenberg, M. (1990). A penny for your quotes: Patent citations and the value of innovations. *The Rand Journal of Economics*, 21(1), 172–187; Sampat, B.N. and A.A. Ziedonis (2004). Patent citations and the economic value of patents. In Moed, H.F., W. Glänzel and U. Schmock (eds), *Handbook of Quantitative Science and Technology Research*. Dordrecht: Kluwer, 277–298; Harhoff, D., F. Narin, F.M. Scherer and K. Vopel (1999). Citation frequency and the value of patented inventions. *Review of Economics and Statistics*, 81(3), 511–515.
40 Trajtenberg, M. (1990). A penny for your quotes: Patent citations and the value of innovations. *The RAND Journal of Economics*, 21(1), 172–187.
41 Harhoff, D., F. Narin, F.M. Scherer and K. Vopel (1999). Citation frequency and the value of patented inventions. *The Review of Economics Statistics*, 81(3), 511–515.
42 As discussed in Section 4.3.2 (on the bottom-up approach), citing the assessment of technical importance in *In re Innovatio IP Ventures, LLC, Patent Litigation*, 921 F. Supp. 2d 903 (N.D. Ill. 2013) (link) , pp. 34–49.

5.3.2.5 Differences in exposure to relevant patent jurisdictions

As discussed in Part 3 on valuation from comparable contracts, the value of a portfolio can depend on (i) where the licensee sells products and (ii) where the licensor holds enforceable patent rights.

Because the reasonable aggregate royalty rate is often framed as a benchmark for a global license, a top-down allocation may, where justified by evidence, take account of whether a particular portfolio (or licensee) has materially greater than average exposure to regions where effective rates are systematically lower – for instance, due to weak patent coverage in that region, enforcement or market conditions.[43]

Judge Selna used this approach in *TCL* v. *Ericsson*[44] For example, Ericsson's royalty rate was adjusted to account for its lower portfolio strength in countries where TCL sold or manufactured its products. The method that was used is illustrated in Box 5.19. *TCL* v. *Ericsson* applied the adjustment in a forward-looking top-down context, but the same principles would apply if the reverse top-down framework was used.

Box 5.19 Illustration of geographic adjustment: *TCL* v. *Ericsson*

Ericsson's royalty rate =

$$\text{Total Aggregate Royalty} \times \left(\frac{\text{Number of unexpired SEPs owned by licensor}}{\text{Total number of SEPs in the standard}} \right) \times \text{Regional strength ratio}$$

USA:	5%	$\times \left(\frac{12}{365} \right)$	$\times$	100%	=	0.16402% of ASP
Europe:	5%	$\times \left(\frac{12}{365} \right)$	$\times$	72.20%	=	0.11842% of ASP
ROW:	5%	$\times \left(\frac{12}{365} \right)$	$\times$	54.90%	=	0.090049% of ASP

Source: *TCL Communication Technology Holdings Ltd.* v. *Telefonaktiebolaget LM Ericsson*, No. 8:14-cv-00341, (C.D. Cal. Dec. 21, 2017), amended and superseded (C.D. Cal. Sept. 14, 2018) (link) pp. 17, 46, rev'd in part, vacated in part 943 F.3d 1360 (Fed. Cir. 2019) , cert. denied 141 S.Ct. 239 (2020).

The approach in *TCL* v. *Ericsson* reflected the significant variation in Ericsson's portfolio strength across the key markets where TCL sold and manufactured its products. The court began by assessing a FRAND rate for Ericsson's US portfolio, where Ericsson's portfolio was largest. Taking 2G as an example, and recognizing that Ericsson's portfolio was weaker in Europe, the court applied a downward adjustment such that the rate for Europe was 72.2 percent of the US rate. For devices sold in the rest of the world, the court applied a downward adjustment to 54.9 percent of the US rate, which was based on Ericsson's portfolio strength in China. The court assessed these "regional strength ratios" by taking into account those technologies which fell in the public domain, whether because they had expired or because they were unpatented in a particular jurisdiction.[45] The consequence was that Ericsson's portfolio strength in Europe (for example) was not assessed by reference to a Europe-specific stack, because doing so would incorrectly appropriate the value of those unpatented technologies. Because TCL manufactured its devices in China, the court treated Ericsson's Chinese portfolio rate as the lowest rate that

43 See the discussion of how geographic variation in patents and sales can affect the value of a license in Section 3.2.2.
44 The District Court judgment is used to illustrate the applied methodology. The judgment was vacated in part, reversed in part and remanded, as the District Court deprived Ericsson of its Seventh Amendment right to a jury trial by deciding the legal relief of a release payment for past unlicensed sales in a bench trial. See *TCL Communication Technology Holdings Ltd. v. Telefonaktiebolaget LM Ericsson*, 943 F.3d 1360 (Fed. Cir. 2019) (link) p. 27.
45 *TCL Communication Technology Holdings Ltd.* v. *Telefonaktiebolaget LM Ericsson*, No. 8:14-cv-00341, (C.D. Cal. Dec. 21, 2017), amended and superseded (C.D. Cal. Sept. 14, 2018) (link) pp. 36, 43-46, rev'd in part, vacated in part 943 F.3d 1360 (Fed. Cir. 2019) , cert. denied 141 S.Ct. 239 (2020).

TCL would pay on all devices that were sold outside of the United States and Europe, often referred to as a "manufacturing floor."[46]

Theoretically, a licensor may choose to collect royalties for an individual product either in the country of manufacture or in the country of sale, and it would in principle choose the country where its portfolio is stronger. There are, however, additional considerations. First, as a general economic principle, patents which are held in the location of manufacture may be less valuable than the location of sale (where the value of the product is realized), for example because it may be easier for the implementer to move its place of manufacturing than to alter the composition of its market segment of end users. Second, because TCL manufactured exclusively in China, implementing a manufacturing floor was relatively straightforward. In cases where an implementer manufactures across a wider range of countries, including those where the SEP holder's portfolio is not particularly strong, then accounting for a manufacturing floor requires a more detailed assessment to correctly reflect the value of the underlying rights.

5.4 Summary

The top-down framework offers a structured way to estimate FRAND terms by anchoring valuation in a reasonable aggregate royalty rate for the standardized technology as a whole and then allocating that total among SEP holders according to their relative contributions.

As this part has shown, both steps are feasible in principle, but they both depend heavily on evidence and assumptions:

- benchmarks for the **reasonable aggregate royalty rate** for all SEPs may be inferred from public statements, component-level economics, price premia or broader market-value models; and
- a **particular SEP portfolio's share** of that aggregate royalty rate is typically proxied, using patent counts that are refined (where reliable evidence permits) depending on the portfolio's essentiality, validity, infringement, technical importance and geographic scope compared with all declared SEPs.

In practice, the framework is therefore often used both as an independent valuation method and as a cross-check on results derived from other valuation methods, such as comparable licenses.

46 *TCL Communication Technology Holdings Ltd.* v. *Telefonaktiebolaget LM Ericsson*, No. 8:14-cv-00341, (C.D. Cal. Dec. 21, 2017), amended and superseded (C.D. Cal. Sept. 14, 2018) (link) p. 44, rev'd in part, vacated in part 943 F.3d 1360 (Fed. Cir. 2019), cert. denied 141 S.Ct. 239 (2020).

Epilogue – making progress in a polarized debate

Debates about FRAND licensing are often polarized. “Hold-up” and “hold-out” are sometimes deployed as accusations, rather than as considered assessments of the parties’ conduct and bargaining power. The terms that the different parties present as reasonable can differ by an order of magnitude. And the parties may not only disagree about *whether* terms are fair and reasonable, they may not even agree on what the terms “fair,” “reasonable” and “non-discriminatory” *mean,* and on which facts should be relevant considerations when assessing them.

Yet much of what determines FRAND outcomes is neither mysterious nor wholly determined by jurisdictional differences or by the IPR policies of particular SDOs. The assessment of FRAND terms has an important economic dimension. It turns on recurring issues: the value that standardized technology creates, how license terms divide that value between innovators and implementers, and the evidence that can credibly anchor those assessments in the circumstances of a particular negotiation.

Reliable valuation methodologies matter because FRAND is not self-executing. It is a commitment to a set of principles, which must be translated into concrete license terms in practice. Legal frameworks and procedures differ. The availability of injunctions, the treatment of global portfolio licenses, the weight given to comparable agreements, and the role of competition law can vary across jurisdictions and, at times, across tribunals within the same jurisdiction. Parties differ too. Some have large portfolios and global sales; others are smaller firms for whom the costs and risks of litigation loom large. Some are experienced repeat players; others are new market entrants. These differences can interact in ways that push some parties to agree terms that are above the range that willing parties would agree. Others are pushed to agree terms below that range.

The variation described above means that no single valuation approach is likely to be reliable and persuasive in every setting. Comparable licenses can demonstrate market practice, but they can also reflect bargaining distortions, differences in scope or timing and terms that are difficult to unpack. Bottom-up reasoning can clarify how incremental contribution constrains what a willing implementer would rationally pay, but it can be hampered where portfolios are large, patents are complementary and information is incomplete. Top-down frameworks can impose discipline by requiring portfolio claims to fit within a plausible aggregate royalty rate, but they are sensitive to the choice of benchmark and to how the aggregate royalty rate is allocated. Seen in this light, the more productive question is often not *which* approach should prevail, but *when* each approach should be used, and *how* they can best be used together – combining their strengths and mitigating each other’s limitations.

Polarization surrounding these issues can obscure a simpler point. The economic purpose of reasonable terms is to ensure that both innovators and implementers continue to have incentives to contribute to the value that standard-compliant product markets create, both for the firms involved and, most importantly, for consumers. If expected returns to innovators are systematically pushed below what is required to sustain investment and participation in standard development, future contributions will tend to diminish. If implementers’ expected aggregate licensing costs are systematically inflated beyond the value of the standardized technology, adoption and diffusion may slow, and the benefits of interoperability may be

curtailed. FRAND seeks to avoid both outcomes. It seeks to ensure that terms do *in fact* reflect and protect the parties' mutual interest in value creation, rather than promoting private advantage gained from opportunism once competitive alternatives have largely fallen away.

That perspective also helps to place disagreements about legal doctrine in context. Jurisdictions may legitimately differ on remedies, procedure and the legal character of the FRAND undertaking. Those differences matter, and they will continue to shape negotiating behavior. But they do not answer the underlying economic question. The commercial logic of a reasonable agreement must be anchored in value and incentives.

Good valuation may not mechanically provide the "right" answer. It is not (only) a matter of calculation. Rather than seeking to *replace* judgment, reliable valuation provides a framework and evidence that *disciplines* judgment: it ensures that assumptions are explicit, identifies what drives disagreement, and shows how conclusions may alter when contested inputs change. On the same basis, a well-supported valuation analysis will not necessarily eliminate polarization, but it can narrow its range.

This economic Report examines how fair, reasonable, and non discriminatory (FRAND) terms for standard essential patent (SEP) licensing can be determined and discusses the practical and theoreticl considerations relevant to that assessment.

Intended for a broad audience including policymakers, judges, arbitrators, SMEs and practitioners, the Report highlights how structured valuation approaches can contribute to greater clarity, ensure objectivity, facilitate licensing negotiations as well as dispute resolution, and support balanced incentives for both innovation and implementation in the area of standardized technologies.

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