FRAN Dtastic License Terms in Standards:
The ex ante Auction revisited

Anna Maria Hoeser
ID: 121326
annamaria.hoeser@emle.eu
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"I hereby declare and confirm that this thesis is entirely the result of my own work except where otherwise indicated. I acknowledge the supervision and guidance I have received from Prof. Pierre Garelllo. This thesis is not used as part of any other examination and has not yet been published."

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Signature: Anna Maria Höser
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1. Introduction

Imagine a world where your iPhone could not use "3G" technology to connect to the internet, but would have to rely on different equipment. 3G (now starting to be superseded by 4G) stands for 3rd generation telecommunication technology that connects smartphones to the internet. It is a standard that ensures that all 3G enabled phones have a reliable and fast internet connection, because they all use the same frequencies and network infrastructure. A smartphone with a different technology would need its own network infrastructure. It would have to rely on different transmission frequencies and telephone masts. iPhones would suffer from "bad signal" because it is unlikely that even a giant like Apple Inc. (Apple) could mount such an infrastructure project by itself. Thus, preventing access to standardised technology leads to high losses for the excluded party. For the past two years Samsung Electronics Co. Ltd (Samsung) has been suing Apple for patent infringements in several jurisdiction. Apple is alleged to have violated one of Samsung’s 3G standard essential patents, while Apple accuses Samsung of not licensing the technology on "fair, reasonable and non-discriminatory" (FRAND) terms.¹

One of the main problems in defining a license contract, which authorises licensees to use the patent of the licensor², is the difficulty of pricing intellectual property³, because its "value [...] is highly volatile and idiosyncratic. It can change suddenly and unexpectedly with the obsolescence of the protected invention."⁴ Additionally, not only the value of the technology but also the quality of the protection needs to be assessed to

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⁴ Pottelsberghe, Zeebroek, The Economics of the European Patent System, 107
ascertain the price of an intellectual property right (IPR). A badly drafted patent is not worth very much, because it provides little protection from competitors using the technology. For simplicity, this essay will assume the same standard of drafting for all innovation and will focus only on how to calculate the appropriate price for the licence of patent-protected technology based on the value of the technology itself. This essay considers a price "appropriate" if it conforms to FRAND terms.

A FRAND licence's objective is to balance "socially optimal incentive for investment in innovative activity [...] against the goal of rapid diffusion of technology."\(^5\)

Thus in the EU, according to the Guidelines on Applicability of Article 101 of the Treaty on the Functioning of the European Union to Horizontal Co-operation Agreements\(^6\), standard setting agreements are protected as pro-competitive if there are no barriers to entry, adherence to a standard is voluntary and IPR are disclosed and licensed on FRAND terms.\(^7\) FRANDs are necessary because the process of setting a standard in itself can weaken competition by choosing only one of several viable technological options, thus excluding the other options from the market.\(^8\) In this way, standard essential patents may create market power and excessive returns for the intellectual property (IP) owner.\(^9\) FRAND terms prevent licensors from disposing of competing innovators and exploiting "the monopoly power derived from inclusion in the standard."\(^10\) Moreover, if several patented technologies form part of the standard,

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\(^5\) Daniel G. Swanson and William J. Baumol, 'Reasonable and Nondiscriminatory (RAND) Royalties, Standards Selection, and Control of Market Power', Antitrust Law Journal, 73 (2005), 1, 2

\(^6\) Commission Notice, Guidelines on Applicability of Article 101 of the Tto Horizontal Co-operation Agreements Official Journal [2011] C 11/1

\(^7\) Thomas Vinje, Ashwin van Rooijen, and Timothy Cornell, 'Addressing Standards Creation: Divergence or Convergence Across the Atlantic?', Antitrust, 25 (2010), 58, 61


\(^10\) Cary, Work-Dembowski, Hayes, 'Antitrust Implications', 1260
adding the licence fees leads to suboptimal use of the goods because prices are higher than marginal costs.\(^\text{11}\) These concerns for the diffusion of innovation at affordable prices are balanced with appropriate compensation, which is based on the chosen standard's advantage over the next best standard with other technology.\(^\text{12}\) Ultimately, competition and IP protection are linked in the quest for dynamic efficiency. Competition enhances consumer welfare, whereas IPRs allow innovators to reap the benefits of investing in research and development so as to give them the right incentives to invest in the first place.\(^\text{13}\) Many authors claim that innovation "has a greater capacity to increase social welfare than static efficiency alone."\(^\text{14}\) FRANDs aim to reconcile the two.

In the Samsung-Apple litigation, Samsung made no attempt to set a price for its licenses, instead it asked for a ban of all Apple devices that use the components covered by Samsung's patent. Some observers believe the litigation serves purely to put pressure on Apple, who earlier had sued Samsung for (non-standard-essential) patent infringement.\(^\text{15}\) The complexity of the cases is exemplified by the diverse positions courts in different jurisdictions took on what is fundamentally the same matter. They all had to discern whether FRAND terms had been breached. In the Netherlands, the court forbade Samsung to refuse to supply Apple with the needed technology,\(^\text{16}\) while more

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\(^{12}\) Mario Mariniello 'Fair, Reasonable and Non-Discriminatory (Frand) Terms: a Challenge for Competition Authorities', *Journal of Competition Law and Economics*, 7(3) (2011), 523, 524

\(^{13}\) Valerio Torti 'IPRs, competition and standard setting : in search of a model to address hold-up', *European Competition Law Review*, 33(9) (2012), 387

\(^{14}\) Ariel Ezrachi 'European Competition Law, Compulsory Licensing, and Innovation' *Journal of Competition Law and Economics*, 8(3) (2012), 595, 596


recently in the US the International Trade Commission allowed the ban. The European Commission on the other hand sees Samsung’s actions as contrary to its FRAND commitment in standards.

Defining FRAND raises questions of competition law, refusal to supply, and the standard setting process. The problem underpinning the issue is however quite clear: What do FRAND terms really mean? What do they allow companies to charge for their technology? What behaviour is acceptable under the terms? Despite the litigation and the certainty of more to come, there is currently no clear or globally accepted interpretation of FRAND terms. The most obvious candidate for a definition of FRAND terms comes from the American Georgia-Pacific case, whose criteria are already well established for royalty damages in the USA. In April 2013 a Western District of Washington court applied them to the standard setting context. Should the judgement find approval, it may shape the interpretation of the debate of FRAND terms in the future. However, despite their apparent relevance, the factors ultimately do "not provide much more meaning than already exists in the ambiguous language of most [...] Standard Setting Organisations’ (SSO) IPR policy statements." The discipline of Law and Economics can give better guidance by introducing factors from outside legal scholarship, specifically economic approaches that can help solving this legal problem.

17 Charles Arthur, 'iPhone 4 sales could be blocked in US after Samsung 3G patent victory' (Guardian, 5 June 2013) <http://www.guardian.co.uk/technology/2013/jun/05/samsung-patent-win-apple-iphone-4> accessed 12 June 2013
19 Georgia Pacific Corp v US Plywood Corp, 318 F Supp 1116 (SDNY 1970)
This essay offers an overview of the current literature on standard setting and FRAND terms for SEPs. It will argue, despite some detractors, that a clear and practicable definition is necessary and possible in the form of a multi-attribute hypothetical ex ante auction. The essay thus concentrates on the models that help discover what licence fee would be respectful of FRAND terms.

To do so, in the first part it will introduce the standard setting process and the problem of hold-up.

It will then discuss different definitions of FRAND terms but will dismiss all of them. Instead, it will concentrate on the hypothetical ex ante model by Swanson and Baumol. The ex ante model proposes to value an innovative technology based on the advantage it provides over its competitors before the standard is set. The essay will discuss its criticisms and argue that though some of them are not fatal, it has serious shortcomings because the auction treats innovation as a one-dimensional good.

It will finally propose an extension of the basic auction model to deal with the multi-attribute nature of technology. Concluding that though there are limitations, the multi-dimensional auction model is better suited to innovative goods, and provides a sound economic footing for the determination of FRAND terms.

2. Standard Setting

In the high technology business setting standardisation has become the norm. According to Baron and Pohlmann, "reliable and economically sensitive rules" are necessary to secure innovation, competition and to prevent anti-competitive strategies.

A standard is a "set of technical specifications which seeks to provide a common design for a product or process". Standardisation has several advantages. Interoperability

improves convenience by allowing users more and cheaper choice of different suppliers of exchangeable products.\textsuperscript{24} It is not only beneficial from the consumer's point of view. It also strengthens competition between firms\textsuperscript{25}, which leads to lower costs, more innovation in products and services, as well as higher output.\textsuperscript{26} Firms no longer have to supply the whole product, but can concentrate on what they do best.\textsuperscript{27} Thus, standards efficiently put new technologies into the market.\textsuperscript{28}

Markets with strong network effects particularly need standards. Especially in telecommunication and computing "technologies can only be successfully deployed when a large number of users share a common, stable technological basis."\textsuperscript{29} Microsoft Windows 7 alone integrates over 60 standards\textsuperscript{30}, which allow it to work with many different programs and devices.

Standardisation may also increase the incentive to innovate by inducing a form of patent race.\textsuperscript{31} Firms invest in innovation before the standard setting process begins, because when the SSO decides on the new standard it considers only existing technology.\textsuperscript{32}

\begin{itemize}
  \item Damien Geradin and Miguel Rato, 'Can Standard-setting Lead to Exploitative Abuse - A Dissonant View on Patent Hold-up, Royalty Stacking and the Meaning of FRAND', \textit{European Competition Journal}, 3 (2007), 101, 103
  \item Geradin, 'Pricing Abuses', 333
  \item Jonathan Hillel, 'Standards × Patents + Antitrust = ∞: The Inadequacy of Antitrust to address patent ambush' \textit{Duke Law and Technology Review}, 017 (2010), 1, 4
  \item Vinje, Rooijen, Cornell, 'Addressing Standards Creation', 58
  \item Hillel, 'STANDARDS × PATENTS + ANTITRUST = ∞ ', 4
  \item Apostolos Chronopoulos, 'Patenting standards - a case for US antitrust law or a call for recognizing immanent public policy limitations to the exploitation rights conferred by the Patent Act?', \textit{IIC}, 40(7) (2009), 782, 786
  \item Justus Baron, Knut Blind, and Tim Pohlmann 'Essential patents and standard dynamics', (2011), 1, 4 <http://www.intertic.org/Conference/Baron.pdf> accessed 8 July 2013
  \item David A. Heiner, 'Five Suggestions for Promoting Competition Through Standards', \textit{Competition Law International}, 7 (2011), 20, 21
  \item ibid.
\end{itemize}
Conversely, some authors argue that standardisation may lead to less innovation since standards stagnate with old technology because of high switching costs.\textsuperscript{33} However, there is little evidence to support the notion of excessive inertia.\textsuperscript{34} For example the mobile communication technology standard is already in its fourth generation (4G).

According to the World Intellectual Property Organization most standards are "developed and revised collaboratively."\textsuperscript{35} The SSO assembles stakeholders, including firms producing technology and end-products, as well as consumers, experts and interest groups, to decide which technology to include in the standard.\textsuperscript{36} Some SSOs are international and more formal, for example the International Telecommunications Institute with "highly developed sets of procedures for certifying new standards."\textsuperscript{37} Others, like the Worldwide Web Consortium (W3C) are less formal and not as big, focusing on specialised issues.\textsuperscript{38} The ecosystem has become more complex and companies have become more involved in the process of setting standards.\textsuperscript{39}

Many of the standards are made up of technologies that are protected by IPR; in this essay mainly patents. In the last years an increasing number of these are SEPs, which "are necessarily infringed by any implementation of the standard."\textsuperscript{40} Only the firm owning the patent is able to legally manufacture products adhering to the standard. All other producers are forced to buy a licence from the owner of the essential patent if they

\begin{itemize}
\item \textsuperscript{33} Baron, Blind, Pohlmann, 'Essential patents', 4
\item \textsuperscript{34} ibid., 22
\item \textsuperscript{36} ibid.
\item \textsuperscript{37} Shanker Iyer, 'Winter 2013 Newsletter', \textit{American Bar Association Antitrust Section Intellectual Property Committee}, 85 (2013), 1, 2
\item \textsuperscript{38} ibid.
\item \textsuperscript{39} ibid.
\item \textsuperscript{40} Baron, Blind, Pohlmann, 'Essential patents', 2
\end{itemize}
want "to avoid facing an infringement action."\textsuperscript{41} As seen in the Samsung-Apple patent wars, this can lead to strategic behaviour to put pressure on competitors.

2.1 Hold-up

The so-called hold-up problem is particularly pertinent in the standard setting process, because it is usually costly for a manufacturer to invent around a SEP, while also losing the privilege of claiming "that its products are compliant and thus assuring consumers that they are fully compatible with the prevailing standard."\textsuperscript{42}

An example of a hold-up comes about when an inventor does not disclose a patent she has over a technology that could become part of the standard. This product may be included precisely because the SSO thinks it is royalty-free. However, once the technology is part of the standard the patent holder is able to extract royalties from the other members of the standard. The incentives to behave strategically with regard to a firm's patent portfolio are strong.\textsuperscript{43} There are many cases where companies engaged in strategic behaviour.\textsuperscript{44} For example Dell did not disclose its IPR\textsuperscript{45}. After the technology was chosen for the standard, Dell sued the other SSO members for infringement.\textsuperscript{46}

Such behaviour and the uncertainty over the cost of including a technology in a standard can lead to "high transaction costs, prohibitive costs for products

\textsuperscript{41} Shapiro, 'Navigating the Patent Thicket', 128
\textsuperscript{42} ibid.
\textsuperscript{43} Baron, Pohlmann, 'The Essential Patents and Coordination Mechanisms', 2
\textsuperscript{44} See for example the cases Broadcom Corp. v Qualcomm, Inc., 543 F.3d 683 (Fed. Cir. 2008) and Rambus [2009] Official Journal C 030/17
\textsuperscript{45} Re Dell Computer Corp 121 F.T.C. 616 (1996)
\textsuperscript{46} Cary, Work-Dembowski, Hayes, 'Antitrust Implications', 1246
implementing a standard and slow diffusion of new technologies, labelled the “tragedy of the anticommons” by Heller and Eisenberg.

The simplest solution, to ask firms to give their patented technology royalty free, as W3C used to do, comes with serious setbacks. The low rewards could slow innovation since firms would no longer give their best technology and compete less to have it included in the standard.

The SSO may also ask all participating technology producers to search and disclose all IPR that could potentially be standard essential. This disclosure mechanism could prevent abuse. However, getting companies to publicise their IPR may sound easier than it is. It is particularly difficult for companies holding many patents, because it "require[s] the complex determination of whether a patent or pending patent application reads on a proposed standard." It can also be argued that the information thus revealed will inform competitors about future technologies in development. Consequently disclosure should be limited to instances when it is strictly necessary. Currently only two organisations are experimenting with this.

Some authors, like Geradin, are not concerned about the problem, because standard setting in the real world is not a one-shot game. Participants in an SSO can "punish" firms that charged disproportionate licensing fees, by for example excluding them

47 Baron, Pohlmann, 'Essential Patents and Coordination Mechanisms', 2
48 ibid.
49 Heiner, 'Five Suggestions', 28
50 Geradin, Rato, 'Can Standard-Setting lead to exploitative Abuse?', 107
52 Geradin, Rato, 'Can Standard-Setting lead to exploitative Abuse?', 107
from a future standard.\textsuperscript{55} Prices are kept reasonable, because licensors depend "on the SSO for its position in the market as the standard evolves."\textsuperscript{56} However it is not clear whether organisations are always in a position to do this. Members may not have a choice but to include the IPR holders if there are no satisfactory alternatives. Moreover, perpetrators may suffer from myopia and may not even take these future costs into account when setting their licence rates. In these cases, it seems unsatisfying to wait for several generations of standards to escape unduly high prices.

2.2. Introducing FRANDs

Another way of preventing the hold-up problem, and one practised by many SSOs today is to ask all participants to commit to fair, reasonable and non-discriminatory (FRAND or RAND in the US) licence terms should one of their patent protected technologies be chosen for the standard.

Generally firms seem to have understood the importance of assuring FRAND terms. In 2011, Google Inc., partly to escape scrutiny after the purchase of Motorola Mobility, assured that the many SEPs acquired would be licensed under FRAND terms.\textsuperscript{57}

However agreeing to FRAND terms is easier said than done. Google committed to “a maximum royalty of 2.25% of a final product's price, before mobile operators' subsidies; [which] on a $500 phone […] makes $11.25."\textsuperscript{58} Whether this is in fact FRAND compliant remains open, because currently there is no clear definition of

\textsuperscript{55} Geradin, 'Pricing Abuses', 338
\textsuperscript{56} ibid.
\textsuperscript{57} Thomas Hoehn and Alex Lewis, 'Interoperability Remedies, FRAND Licensing and Innovation : a Review of Recent Case Law', European Competition Law Review, 34 (2013), 101, 110
\textsuperscript{58} --, ‘Patents and Mobile Devices: FRAND or Foe?’ (The Economist, 18 February 2012) <http://www.economist.com/node/21547811> accessed 5 July 2013
what the commitment actually entails. Often, litigation, for example between Motorola Inc. and Rockwell International Corporation, where the meaning of FRAND is a central issue, ends in settlement. ⁵⁹

The SSOs themselves are not specific either. The European Telecommunications Standards Institute (ETSI), the Institute of Electrical and Electronics Engineers Standards Association, and the Organization for the Advancement of Structured Information Standards all have FRAND terms, but no definition. ⁶⁰ When ETSI tried to further clarify the terms, no consensus between the members could be reached. ⁶¹

Competition agencies may also open investigations themselves. In one of the most famous cases, Rambus received a statement of objections from the European Commission “claiming unreasonable royalties for licensing certain patents.” ⁶² The same happened to Samsung. ⁶³

Often competition authorities interfere in essential patent cases analogously to their reaction to "refusal to supply". Under the essential facilities doctrine ⁶⁴ they may even enforce a compulsory license priced according to FRAND terms. This is the point of connection between private and public litigation of FRAND terms. There is however no guidance from the European Court of Justice about what constitutes FRAND compliance.

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⁶⁰ Valimaki, 'A flexible approach to RAND licensing', 687
⁶¹ Geradin, Rato, 'Can Standard-Setting lead to exploitative Abuse?', 110
⁶² Geradin, 'Pricing Abuses', 330
In the light of more standardisation and more litigation of SEPs, defining FRANDs becomes necessary, if not urgent. Courts and agencies applying FRAND terms have to assure that IPR owners do not have to fear unreasonable reductions of their royalty earnings, while at the same time preventing licensors from "gaming the system" and earning monopoly rents.65

3. FRAND Definitions

Currently, there is no precise legal guidance concerning SEPs on either side of the Atlantic in antitrust or the standard setting context.66 The new judgement from Washington67 only expands on the 15 Georgia Pacific factors, which are not very rigorous. This essay proposes to base FRAND terms on solid economic theory since they are concerned with appropriate licence prices and closely concern innovation. Five approaches and important issues, which have to be considered when designing a rule, will be surveyed. These reach from FRAND terms defined as broadly committing to "good faith" negotiations to royalties based exclusively on the non-discriminatory requirements. It will become clear though, that none of them provides a workable definition of FRAND terms because they either do not address the problems of standard setting, are not based in economic theory, or are exceedingly difficult to apply.

3.1 Good Faith

The broadest interpretation stipulates that FRAND commitments only call on SSO members to negotiate in good faith. Some authors like Geradin and Rato readily embrace this very open FRAND interpretation, because they believe that flexible

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66 Valimaki, 'A flexible approach to RAND licensing', 690
67 Microsoft Corp. v Motorola, Inc., et al., Case No. C10-1823JLR (W. D. Wash. 2013)
terms will "ensure the widest availability of the technology embodied in the standard in the widest possible variety of circumstances." They fear that FRAND commitments could harm dynamic competition because they restrict the return on innovation. In their opinion, reasonable is what rewards the patent owner "for the innovative contribution made and to ask the price that the market is willing to pay for its IPR." The worry is that under FRAND terms the royalty rates will no longer compensate the inventor for developing innovations. Instead licence terms should be established based on the concrete facts of the contracting parties. They should adjust for example for cross-licensing agreements and upfront fees. These authors argue that though there are incentives for competitors to use licensing terms "to raise rival downstream firms’ prices [..., firms] may also be open to cross licensing agreements with other integrated companies, which can hold down royalty rates." Moreover, they assert that downstream producers would rather produce non-standard compliant products if prices were excessive than produce at a loss. However, cross licensing is not available to downstream firms who are not producers of technology themselves. Similarly if the market for non-standard products is very small, downstream firms may not have a valid option to sell their non-compliant products.

Additionally Geradin and Rato criticise the term "FRAND royalty" because it "has no meaning [and] obscures the fact that the royalty rate itself conveys little information as to the fairness and reasonableness of the overall licensing terms." Instead of ordaining a licence rate, licensing agreements should be "left to bilateral

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68 Geradin, Rato, 'Can Standard-Setting lead to exploitative Abuse?', 112
69 Geradin, 'Pricing Abuses', 356
70 Geradin, Rato, 'Can Standard-Setting lead to exploitative Abuse?', 114
71 Mariniello, 'Fair, Reasonable and Non-Discriminatory', 524
72 ibid.
73 ibid., 116
74 Geradin, Layne-Farrar, Padilla 'The Ex Ante Auction', 33
75 Layne-Farrar, Padilla, Schmalensee 'Pricing Patents', 686
76 Geradin, Rato, 'Can Standard-Setting lead to exploitative Abuse?', 116
negotiations between licensors and licensees outside the SSO." Parties would develop their own appropriate understanding of fair and reasonable in this way. According to Lichtman, the vagueness of the definition leads to bilateral and confidential negotiation that furthers competition. These authors dismiss the problem of extortionate royalty rates because they believe that the elasticity of demand of the final product will limit the licence rate to a reasonable level. This is not a given however, as it is possible that the end-product is an innovative good with no significant competition. There is a need to cap licence fees to prevent the "costs of static monopoly power [becoming] magnified." Thus there could be a problem of undersupply at overly high prices and slow diffusion of innovative products.

Moreover, negotiations can lead to suboptimal license rates because firms exploit their bargaining position. Competitors use any way possible to assert an advantage over their rivals. Especially, in the high-tech telecommunications business, there has been a lot of litigation to put pressure on the other party in negotiations. For example Samsung's litigation against Apple's use of its SEP, is likely aimed to improve Samsung's bargaining position for the settlement of Apple's earlier claims for design infringement.

Clear FRAND rules will not only prevent the misuse of litigation as a pressuring device, but also make the negotiations between firms less costly, because it reduces uncertainty about what a reasonable royalty rate is. Leaving FRANDs undefined, and only appealing to "good faith", could instead render them "meaningless, [and] would

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77 Geradin, 'Pricing Abuses', 356
78 Douglas Lichtman speaking at a conference in 2007 cited in Geradin, Layne-Farrar, Padilla 'The Ex Ante Auction', 32
79 Geradin, Layne-Farrar, Padilla, 'The Ex Ante Auction', 33
80 Shapiro, 'Navigating the Patent Thicket', 128
allow unfettered exercise of monopoly power by essential patent holders, and would cause debilitating uncertainty in the standard-setting process.\textsuperscript{82}

3.2 Injunctions

Another important point of discussion of FRAND terms, though it does not provide a way to calculate the FRAND rate, is whether firms holding SEPs give up their right to injunctive relief when they agree to FRAND terms. Geradin argues that such licences "would deter many owners of valuable technology from joining the SSO."\textsuperscript{83} Whereas Miller believes that the waiver reduces transaction costs.\textsuperscript{84}

Generally, forbidding the right to seek injunctive relief would be against EU law and Article 41(1) of the TRIPS agreement.\textsuperscript{85} Eliminating the right to an injunction goes against the fundamental rights of IP holders. A waiver of this right would have to be made explicitly and could not be construed from committing to FRAND terms.\textsuperscript{86}

However, the European Commission recently stated in reference to the Samsung-Apple litigation, that when FRAND commitments have been given and the defendant is willing to negotiate, seeking "an injunction for SEPs can constitute an abuse of a dominant position."\textsuperscript{87} A Dutch court also interpreted the FRAND commitment of SEPs as prohibiting injunctive relief on the same issue.\textsuperscript{88} Conversely, in the US the ban was allowed.

\textsuperscript{82} Cary, Work-Dembowski, Hayes, 'Antitrust Implications', 1262
\textsuperscript{83} Geradin, Rato, 'Can Standard-Setting lead to exploitative Abuse?', 108
\textsuperscript{85} Geradin, Rato, 'Can Standard-Setting lead to exploitative Abuse?', 118
\textsuperscript{86} ibid.
\textsuperscript{88} Florian Mueller, 'Samsung suffers second and even more important FRAND defeat to Apple in the Netherlands' (\textit{Foss Patents}, 14 March 2012) <http://www.fosspatents.com/2012/03/samsung-suffers-second-and-even-more.html> accessed 2 July 2013
Lang argues that the right to injunctions allows the patent holder a strong bargaining position where she may pressure licensees into contracts with excessively high rates. On the other hand, according to Geradin, without injunctive relief the ex ante negotiating position of IP holders would be so weak that it would lead to "under-compensation and underinvestment." Clearly, there are opposing interpretations of what the law does to the bargaining powers of parties.

Ultimately, the problem lies in the nature of litigation about license terms in standards. "Private" conflicts between companies can lead to the involvement of public authorities. In Europe for example, the Samsung-Apple litigation attracted attention not as part of private law, but because of competition concerns, where asking for an injunction was seen as a refusal to supply. The European commission opened proceedings against Samsung on suspicion of "abuse of a dominant position."

It also seems that a difference needs to be made between SEPs and non-essential patents. Only refusing SEP licences leads to competition concerns.

The interwoven nature of litigation on different levels emphasises the necessity of a sound definition of FRAND and its appropriate application. Straightforward requirements will lead to less uncertainty and less distortion, as the parties will be able to judge, which agreement will be struck down and which will be enforced. This could alleviate Lang's concerns, while keeping intact the fundamental rights of patent owners.

89 Lang, 'Eight Important Questions', 35
90 Geradin, Layne-Farrar, Padilla, 'The Ex Ante Auction', 4
92 Philip Elmer-DeWitt, 'Samsung-Apple patent war: The Journal misses the point' (Fortune, 8 May 2013) <http://tech.fortune.cnn.com/2013/05/08/apple-samsung-patent-journal/> accessed 2 July 2013
3.3 Proportionality

Another option is to base the license rate on "reasonable aggregate rates and proportionality."\(^93\) However, economic principles do not support this approach because the number of filed patent stands in no direct relation with a company's bargaining power.\(^94\) Instead, according to Mariniello, the bargaining power depends on the patent's value, which is determined by the probability of the case that there are substitutes for it.\(^95\)

If payments were proportional to the number of patents introduced to the standard, rational firms would, where possible, submit two patents instead of one patent with several claims.\(^96\) They would also have reason to file patents with little innovative value.\(^97\) This would be unfair and inefficient because this system would often "over-remunerate IP holders with relatively worthless patents at the expense of those others with more valuable IP."\(^98\) Thus proportionality is not an adequate way of calculating reasonable royalties.

3.4 Shapely Value

Another proposition is the Shapely value. It is a game theoretical solution to what reasonable royalties within standards could look like. The value solves a surplus game, which describes "the total profits available, as well as the profits any subset of

\(^93\) Mariniello, 'Fair, Reasonable and Non-Discriminatory', 530
\(^94\) ibid.
\(^95\) ibid.
\(^96\) Layne-Farrar, Padilla, Schmalensee 'Pricing Patents', 684
\(^97\) Mariniello, 'Fair, Reasonable and Non-Discriminatory', 531
\(^98\) Geradin, Layne-Farrar, Padilla, 'The Ex Ante Auction', 4
players can assure themselves on their own." The value of the product created through cooperation is divided according to the incremental contribution of the member, taking into account alternative combinations of the technologies. In situations where companies vary substantially in size, a weighted Shapely value can also be used.

The Shapely value defines what a fair licence would be not with reference to market competition but by giving a "just" distribution of the surplus. This leads to some surprising results. Even if technologies are ultimately not included in the standard, their licensors will receive compensation because the value is based on ex ante available alternatives.

Complementary technologies may not receive the same payouts, even though most would view them as having equal value. The reason for this is that their value depends on how many options for the technology exist; the technologies do not have an intrinsic value in this setting. Imagine there are two complementary technologies developed by three firms: two develop technology A and one firm supplies B. Technology A would receive one third of the payoffs (one sixth to each developer) while the developer of B receives two thirds.

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100 Layne-Farrar, Padilla, Schmalensee 'Pricing Patents', 693
102 Layne-Farrar, Padilla, Schmalensee 'Pricing Patents', 693
103 ibid., 695
105 ibid.
106 Oxera Economics Council, 'Untangling FRAND', 3
Some may not consider this as a "fair" way of establishing value. Different fairness axioms "provide conflicting recommendations." Thus arguing that this approach is well suited to the EU because "fairness" is the basis of the distribution, may not be helpful in the discussion of FRANDs.

Furthermore, for this essay's endeavour to define FRAND, the Shapely value is of little help, as the evaluation of the actual market and the different technologies involved in the creation of the standard is strenuous when a dispute about the rate comes before a court. In the same vein, Mariniello criticises that the Shapely value fails in real life, because it would be "extremely difficult to estimate what the value of the marginal contribution of each patent holder [...] to the coalition of patent holders of the adopted technology" had been.

3.5 From FRAND to ND Requirements

Finally, some authors have proposed to stop looking at reasonable rates altogether because the calculations are "complicated, controversial, and subjective." Instead it would be a lot easier for a court to concentrate solely on non-discrimination. Courts already identify royalty discrimination regularly. They would only have to consider rates charged in reality. With all the difficulty surrounding the attempts of defining FRAND terms, courts could simply compare existing license terms.

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107 Salant, 'Formulas', 5
108 Singer, Smith, 'What Does an Economist Have to Say', 17
109 Oxera Economics Council, 'Untangling FRAND', 5
110 Mariniello, 'Fair, Reasonable and Non-Discriminatory', 529
111 Layne-Farrar, Llobet, Padilla, 'Preventing Patent Hold-up', 473
112 ibid.
113 ibid., 474
114 ibid., 448
Firms may prefer this reading, as it levels the playing field. If everybody has to pay the same royalties, they are part of the price in the same way as are labour and materials costs.\textsuperscript{115} Lang even claims that "[i]n many cases 'non-discriminatory' is a more precise criterion than reasonable."\textsuperscript{116} However, to be properly non-discriminatory license terms have to be the same for firms in similar situations.\textsuperscript{117} Thus the payment does not have to be identical, "[o]ne licence may be for a royalty, and another for a lump-sum payment with a fully paid-up licence."\textsuperscript{118} This in turn means the administrative effort and calculation of a licence fee that is non-discriminatory remains complex. Non-discrimination also does not address the problem of extortionate prices, which is at the core of calculating appropriate prices in the standard setting context. Thus, though it seems attractive at first glance, concentrating simply on ND terms would not be as efficient as was hoped.

3.6 Intermediary Result

Consequently, it becomes clear from the literature just how complicated and how pressing the issue at hand is. Defining FRANDs is necessary because "good faith" requirements are too broad to provide any meaningful guidance. Vague rules cannot easily be implemented and there is a higher risk of abuse, as there are no reference points. Negotiations do not necessarily lead to optimal outcomes. The discussion of whether FRAND terms waive the right to injunctions shows how important a definition is for legal certainty. The proposal to use proportionality is not economically sound, whereas the Shapely Value is difficult to administer. Purely concentrating on non-discrimination also does not provide the advantages it promises because the terms also require a clear economic definition while ignoring the

\textsuperscript{115} Geradin, Rato, 'Can Standard-Setting lead to exploitative Abuse?', 114 footnote 42
\textsuperscript{116} Lang, 'Eight Important Questions', 33
\textsuperscript{117} Layne-Farrar, Llobet, Padilla, 'Preventing Patent Hold-up', 467
\textsuperscript{118} Lang, 'Eight Important Questions', 33
remaining potential of industry wide high prices. None of the proposed solutions could stand up to scrutiny.

Without an economically valid definition, courts will likely find it difficult to make sound decisions in this highly complex environment. Appropriate licence rates depend on the technological parameters of the innovation and competition in the market. Lucid FRAND regulations can be enforced more easily and prevent discriminatory licensing to competitors.\textsuperscript{119}

4. Swanson and Baumol's Auction Model

As the proposals of the previous approaches are inadequate, this essay will concentrate on the discussion and extension of Swanson and Baumol's hypothetical ex ante auction model to determine a reasonable licence, so that it reflects the competition that any chosen technology faced before it became part of the standard.\textsuperscript{120} The model operates under all the general assumptions of rationality in an ex ante perfectly competitive market.

In the auction model a reasonable royalty rate is "the incremental value of a technology relative to [the] next best alternative."\textsuperscript{121} The innovation is priced according to its relative advantage over a competitor. Swanson and Baumol propose an ex ante auction "in which the competing holders of IP [...] offer bids of a license fee per unit of output to downstream users who are choosing which patent should be embodied in a standard."\textsuperscript{122} The winning bidder's technology will then be included in the standard at

\textsuperscript{119} Lang, 'Eight Important Questions', 34
\textsuperscript{120} Cary, Work-Dembowski, Hayes, 'Antitrust Implications', 1259
\textsuperscript{121} ibid., 1261
\textsuperscript{122} Swanson, Baumol, 'Reasonable and Nondiscriminatory (RAND) Royalties', 18
the winning price. This way the price takes into account the state of competition between patent holders before technology of the standard is decided. This price is then used as the benchmark for a reasonable royalty rate.

According to the model, the producer with the lowest costs would win this auction. The cost would amount to "the recurring costs of licensing, plus the difference in value between the best and next-best IP alternatives." Layne-Farrar et al. argue that the auction would be the same if costs were kept constant: in that case technology providers would compete on quality.

4.1 The Basic Model

Geradin, Layne-Farrar and Padilla model this auction as follows:

Two symmetric firms A and B compete to have their technology, A or B respectively, included in the standard.

Integrating technology A, "the value of the standard per unit of final product [...] is the downstream price less the cost of production" of technology A.

\[ v(A) = p - c_A \]

Both patent holders always charge a royalty fee (\( f_A \) or \( f_B \)) which is higher than their recurring licensing costs \( t \).

Thus technology A will be selected by the SSO when

\[ v(A) - f_A \geq v(B) - f_B. \]
This model has several attractive features. It can explain high royalty rates, for example if ex ante the chosen technology was without valid alternatives, because they were too expensive or patent infringing.\textsuperscript{129} At the same time the royalty rate will never be above the incremental contribution of the technology because the costs of production of a standard compliant good would be higher than the cost savings for the licensee.\textsuperscript{130}

4.2 Non Discrimination Requirement

Additionally, to fully comply with the FRAND requirements, the licence fee cannot be discriminatory. The patent owner must licence to similar firms on the same conditions. Under the efficient component pricing rule (ECPR) Swanson and Baumol stipulate that "a competitively neutral license fee should compensate the IP owner both for the incremental costs of licensing IP and the opportunity cost of licensing the technology."\textsuperscript{131}

The ECPR, here at the example of technology A chosen for the standard, demands that:

\[ P_A = P_{f,A} - IC_{r,A} \]

This means that firm A would charge itself \( P_A \) for its technology, which is based on the price of the final product using technology A (\( P_{f,A} \)) reduced by its remaining incremental input costs, e.g. labour costs, \( IC_{r,A} \).\textsuperscript{132}

A licensor who sets the license rate accordingly is "indifferent between producing a unit of the final product itself and allowing downstream competitors to produce that

\textsuperscript{129} Cary, Work-Dembowski, Hayes, 'Antitrust Implications', 1261
\textsuperscript{130} Layne-Farrar, Llobet, Padilla, 'Preventing Patent Hold-up', 457
\textsuperscript{131} Layne-Farrar, Padilla, Schmalensee 'Pricing Patents', 687
\textsuperscript{132} ibid.
unit licensing its IP." The licensor is obliged to license to others under the same condition as to itself.

For Samsung this would mean it should charge Apple for its 3G SEPs in the same way as it charges itself. When "downstream barriers to entry are low regardless of competitive conditions in the technology licensing market" the equation will be fulfilled by the auction process.

4.3 Criticisms

However, there are some criticisms directed at the model. Mainly the assumptions of the model have been attacked.

4.3.1 Optional Participation

To lead to FRAND compatible royalty rates, parties must "remain free to contract privately outside the standard-setting process, and [...] participation by potential licensors [...] must] be purely voluntary." This is not very realistic, as joining an alternative SSO is often impossible. Instead, if a firm does not take part in the SSO, it can mean that the company is excluded from the market, as could be seen with 802.11 WLAN technologies. This diminishes the bargaining position of licensors, because their only chance to license their technology is within the standard. It would therefore lead to lower royalty rates. Only if the licensor's technology is highly valuable by itself and does not need other components, may they be able to licence it outside a standard. This is unlikely because standard-

133 Layne-Farrar, Padilla, Schmalensee 'Pricing Patents', 687
134 Geradin, Rato, 'Can Standard-Setting lead to exploitative Abuse?', 115
135 Swanson, Baumol, 'Reasonable and Nondiscriminatory (RAND) Royalties', 39
136 ibid., 17
137 Geradin, Layne-Farrar, Padilla, 'The Ex Ante Auction', 13
138 ibid.
setting mainly occurs in technologies that are complementary goods, which only together have a high value.

4.3.2 Commitment to Auction
Moreover, the model "assumes that at the ex ante stage there is no uncertainty with respect to which patents are relevant to the standard." In reality this is not the case, because in standard setting there is a particularly "high degree of uncertainty during [... standard] development, which could lead to strong incentives to renegotiate ex post." It is a well-known problem that members will not stick to the initial agreements, because they lack the necessary credible commitment and have incentives to defect in the middle of the game, particularly if there is a measure of uncertainty in relation to the standard. Thus it is unlikely that the auction would actually produce a result which resembles the reasonable royalty rate it aimed for.

4.3.3 Vertical Integration
Similarly, the stipulation that there must not be bias or manipulation by the members of the decision-making process may also be far from reality. Contrary to the model's assumptions, technology producers without downstream production are not the only ones taking part in the auction. The participant's business model and its degree of vertical integration can lead to inefficient royalty rates independent of how the ex ante auction is designed. The model assumes that the bidding parties are completely symmetric: They have the same business

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139 Geradin, Layne-Farrar, Padilla, 'The Ex Ante Auction', 24
140 ibid.
141 ibid., 11
142 Swanson, Baumol, 'Reasonable and Nondiscriminatory (RAND) Royalties', 17
143 Geradin, 'Pricing Abuses', 352
144 Geradin, Layne-Farrar, Padilla, 'The Ex Ante Auction', 6
model, wield the same bargaining power and offer the same quality, only their costs are different.145 In reality, there are firms which produce technologies, earning their profits mainly from licensing, and others that, while also producing technologies, are mainly active in the downstream market.146 In the ex ante auction, this leads to an advantage for a vertically integrated firm. They can licence their technology more cheaply because they can recover the costs on the manufacturing and sales side, which is not possible for a pure innovator.147 Thus there is an inherent bias for a vertically integrated firm.

4.3.3.1 Toeholds
Vertically integrated firms are at the same time seller and buyer of their innovation, they are simultaneously licensee and licensor.148 Such a firm has a so-called toehold which means that if its technology becomes part of the standard it will cut costs as a producer, while other companies also have to pay the firm as the innovator. This means that it can bid more aggressively because its gains from winning are higher than for its competition.149 The greater the commercial interest at play, the greater the "company’s preference for its own technological solution."150 In 2000 a study by Betton and Eckbo of 1353 tender offer contests showed firms with bigger toeholds had a higher probability of winning, while lowering the probability of competitors entering the contest.151

145 Geradin, ‘Pricing Abuses’, 353
146 ibid., 354
147 Geradin, Layne-Farrar, Padilla, ‘The Ex Ante Auction’, 18
148 Geradin, ‘Pricing Abuses’, 354
149 Geradin, Layne-Farrar, Padilla, ‘The Ex Ante Auction’, 18
150 Baron, Blind, Pohlmann, ‘Essential patents’, 7
Not only do such SSOs member have larger incentives to manipulate the auction to their advantages, but because of their downstream profits, they may also be in a position to "subsidise" their technologies and win the auction.\textsuperscript{152}

Because of this, the standard may include technologies that are not the most valuable.\textsuperscript{153}

Non-integrated licensors need to bid at lower prices to win the auction and overcome this bias.\textsuperscript{154} Moreover, if a pure innovator wins, by bidding lower, they in fact reduce costs and increase profitability of the manufacturing side of a vertically integrated firm.\textsuperscript{155}

Formally, Geradin, Layne-Farrar and Padilla model firm B having a toehold, which is denoted by $\alpha$ ($0 < \alpha \leq 1$), as follows:\textsuperscript{156}

When technology B wins, its gains are:

$$v(B, \alpha) - f_B = \alpha(p - c_B - f_B) + f_B - (1 - \alpha)t$$

While when A wins, because of B’s share of the downstream business, B’s gains are:

$$v(A, \alpha) - f_A = \alpha(p - c_A - f_A)$$

B will be selected if

$$v(B, \alpha) - f_B \geq v(A, \alpha) - f_A$$

According to this model, there is a unique Nash equilibrium, only when there is no vertical integration ($\alpha = 0$), but there is no equilibrium in the case of vertical integration ($\alpha > 0$).\textsuperscript{157}

\begin{itemize}
  \item \textsuperscript{152} Geradin, Layne-Farrar, Padilla, 'The Ex Ante Auction', 12
  \item \textsuperscript{153} ibid., 6
  \item \textsuperscript{154} Geradin, Layne-Farrar, Padilla, 'Competing Away Market Power?', 443
  \item \textsuperscript{155} Geradin, Layne-Farrar, Padilla, 'The Ex Ante Auction', 12
  \item \textsuperscript{156} Geradin, Layne-Farrar, Padilla, 'Competing Away Market Power?', 443
\end{itemize}
When A has a licence fee of \( f_A = t + \Delta \), B has an incentive to win the auction process by setting its own licence fee at \( f_B = t - \varepsilon \), where \( \varepsilon > 0 \) and arbitrarily small.\(^{158}\) B benefits from this as a reduction in its licensing costs equal to \( \alpha(t + \Delta) \).\(^{159}\) Thus the impact on B's profits are \( \alpha t - (1 - \alpha)\varepsilon \), which is positive provided \( t > 0 \).\(^{160}\) Which means that as long as there are costs to licences "B has an incentive to undercut A's licensing fee to win the auction."\(^{161}\)

4.3.3.2 Winner's Curse

Added to this, the non-integrated pure innovators are more likely to suffer from the "winner's curse", where they over-estimate the value of winning, because the integrated firms true valuation of winning is actually lower.\(^{162}\) Bidding low means below optimal returns on the non-integrated firms' technology investments, which reduces incentives to innovate, participate in SSOs and may even lead to the ceasing of research activities.\(^{163}\) Geradin argues that courts and competition authorities who use the model to calculate a benchmark would thus "unwittingly contribute to eliminating firms that have legitimately opted for a licensing business model."\(^{164}\) From this point of view it is dangerous to allow the "mechanistic application of the \textit{ex ante} benchmark"\(^{165}\)

Overall the model is judged inadequate and would do more harm than good.

\(^{157}\) ibid., 453  
\(^{158}\) Geradin, Layne-Farrar, Padilla, 'Competing Away Market Power?', 453  
\(^{159}\) ibid.  
\(^{160}\) ibid.  
\(^{161}\) ibid.  
\(^{162}\) Geradin, Layne-Farrar, Padilla, 'The Ex Ante Auction', 18  
\(^{163}\) ibid., 7  
\(^{164}\) Geradin, 'Pricing Abuses', 356  
\(^{165}\) Geradin, Layne-Farrar, Padilla, 'Competing Away Market Power?', 443
4.4 Response: Hypothetical Nature of the Auction

These criticisms, however, do not do the model justice. The ex ante approach would be fraught with a lot of problems if SSOs did actually engage in this auction process. However, courts and competition authorities are not necessarily concerned with how the standard is set but with the licence rate and the market power involved. It is important to remember that the ex ante auction proposed by Swanson and Baumol is a model that aids the decision maker in determining whether a licence rate fulfils FRAND requirements. It is not a model to prescribe to SSOs their selection process.

The courts are asked to decide on the reasonable value of a license in a standard ex post. There is no intention to have SSOs hold auctions in reality. In fact "the practical challenges of designing, organizing, and implementing such an auction"\(^{166}\) prevent it from being anything else than an aid in calculating a benchmark.

The model assumes that all auction participants have valid outside options and are non-integrated upstream firms. Their royalty rates are higher because they can walk away, while they cannot "subsidise" their technologies. The benchmark is thus above the licence rate than actual firms engaging in an auction process would reach. A court uses this benchmark, which balances reasonable license rates with concerns for innovation incentives better than a "real" auction would. Because it is purely hypothetical, it purpose is solely to inform the benchmark, the ex ante auction does not have to withstand problems of moral hazard either.

Nevertheless, it is important to consider that in reality when standards are set, vertically integrated firms may engage in these kinds of behaviours and that thus the

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\(^{166}\) Layne-Farrar, Llobet, Padilla, 'Preventing Patent Hold-up', 452; though there have been proposals for real live auctions, see David Newman, 'Going Once ... Going Twice ... Licensed Under the Most Reasonable and Non-Discriminatory Bidding Terms ! Reasonable and Non-Discriminatory Bidding Terms !', *Northwestern Journal of Technology and Intellectual Property*, 11 (2013), 139, 161
licensing fees generally adopted may be too low. This could lead to industry wide licence fees, which are under-compensatory for pure innovators. Accordingly, vertically integrated firms may sue upstream innovators for charging prices, which are higher than average, despite the fact that they are appropriate for the product. It is thus dangerous if courts only orient themselves by looking at the customary rates.

If courts only account for the licence fee that is generally charged, they may ask innovators to lower their fees below the optimal level. This is precisely the reason to encourage courts to not only rely on the observed industry licence rates, but to take economic models into consideration to calculate a benchmark. On the other hand, if the IP owners of patents included in the standard charge excessive prices, courts and competition agencies should interfere. Thus what courts and competition agencies really need is an adequate benchmark against which to judge the licence rate, to help them figure out whether the licence rate is actually FRAND abiding. The auction model could be the solution to calculating an objective benchmark.

4.5 Problems of Single-Attribute Auctions

Nevertheless, one criticism remains valid: the licence fee amount calculated may still not be high enough to stimulate innovation as it may not exceed the cost of investment.167 Particularly in technology markets where strong competition is the norm, the incremental value could decrease to zero, which "would not represent the value of the chosen technology."168 The reason for this is that competition is measured purely in price; in reality technologies compete in quality as well. So the benchmark royalty rate can never produce the actual value of the innovation within the standard.

167 Geradin, 'Pricing Abuses', 356
168 Layne-Farrar, Llobet, Padilla, 'Preventing Patent Hold-up', 459
As a side note, the criticism that FRAND royalties will not compensate for innovation investment is a far-reaching one, and there is still discussion even outside of the SSO context whether patents can actually compensate firms adequately, especially in the presence of cumulative innovations. This is however too far-reaching, and this essay will concentrate on the problem at hand, which is the danger that the auction model in its design undervalues an innovative technology because firms only compete on price, but not on quality. This is not a problem of the ex ante model in itself, but of the one-dimensionality of the auction.

Clearly, the basic auction model fails because it ignores the multiple dimensions of innovative processes and standardisation. In reality members of SSOs propose technology with different prices and quality.\textsuperscript{169} Auctions with multi-attribute goods, which only compete on price cannot be efficient.\textsuperscript{170} Though standardisation and competition between innovation are exceptionally complex, there are successful propositions for designing auctions that can solve problems of multi-dimensionality.

Thus, so far this essay has shown that the ex ante model has the highest potential to be the best economic model to define FRANDs, though currently its shortcomings prevent it from supplying a satisfactory solution to the problem. This essay proposes to extend the model by integrating multi-dimensionality.

5. Extension

While this essay may dismiss the criticisms that the model is not realistic enough because it is purely hypothetical, it cannot ignore the multi-attribute nature of patented

\textsuperscript{169} Geradin, 'Pricing Abuses', 353
\textsuperscript{170} Geradin, Layne-Farrar, Padilla, 'The Ex Ante Auction', 20
technology itself and the uncertainty that comes with it. A multi-attribute auction could solve the problem.

Geradin, Layne-Farrar and Padilla only briefly consider the possibility of the hypothetical ex ante auction to provide for multi-dimensional goods. They dismiss two stage auctions, where in a second stage members bargain about the quality, straightaway because "in the context of IP rights, the competing technologies are likely to be complex and different in nature, and the members might fail to negotiate efficiently with the patent holder."\textsuperscript{171} Similarly, courts would also need further information about the efficient level of quality to model bargaining in negotiations, which would be difficult to ascertain.

5.1 Scoring Functions

This extension alternatively will consider the possibility of constructing a multi-attribute auction based on a scoring function, which courts and competition authorities can use to calculate a benchmark. As with the basic model, it is not concerned with describing an auction process to be performed in the real world, but a hypothetical ex ante auction to help a court decide whether a royalty rate is fair. The multi-attribute auction takes into account the non-price attributes of the technologies considered. The auction model calculates a price and quality at which utility is maximised. This is the reasonable price, which is then subjected to the ECPR requirement of non-discriminatory licensing analogous to the basic model.

At the centre of this auction model stands the design of the scoring function that adequately balances price and quality. If the function is chosen incorrectly it leads to

\textsuperscript{171} Geradin, Layne-Farrar, Padilla, 'The Ex Ante Auction', 22
bad incentives and inefficiencies.\(^\text{172}\) It may be difficult to ask the SSO to rate their assessment of cost and quality. However in modern auction scholarship it is unlikely that the scoring function would be an inadequate "naive linear function of the two components of the bids", as feared by Geradin, Layne-Farrar and Padilla.

Decision analysis provides several approaches where the decision makers do not have to be exact in their valuation of attributes; uncertain estimates suffice.\(^\text{174}\) Modern decision analysis can "use fuzzy sets for weights and individual scoring functions and fuzzy operators for the aggregation of those fuzzy sets."\(^\text{175}\)

Another approach, multi-attribute utility theory (MAUT) compares all combinations of pairs of attributes in a symmetric matrix in a compensatory optimisation employed by a rational decision maker.\(^\text{176}\)

The analytical hierarchy process (AHP) also optimises decisions by comparing options but relaxes the rationality assumption. It assumes that people are better at making comparisons than absolute valuations.\(^\text{177}\) It can thus accommodate circumstances where "criteria metrics are not easily aggregated, measurement scales vary over wide ranges, and units are incommensurate or incomparable."\(^\text{178}\) The more advanced algorithms can even model interactions between the different attributes, though most decision makers use more basic versions.\(^\text{179}\)

\(^{172}\) Geradin, Layne-Farrar, Padilla, 'The Ex Ante Auction', 22
\(^{173}\) Geradin, Layne-Farrar, Padilla, 'Competing Away Market Power?', 443
\(^{175}\) ibid.
\(^{176}\) Gregory Kiker, et al., 'Application of Multicriteria Decision Analysis in Environmental Decision Making', *Integrated Environmental Assessment and Management*, 1(2) (2005), 95, 97
\(^{177}\) Kiker, et al., 'Application of multicriteria decision analysis', 98
\(^{178}\) Kiker, et al., 'Application of multicriteria decision analysis', 98
\(^{179}\) Bichler, Kalagnanam, 'Winner Determination', 4
Modellers can also simply compare alternatives, if decision makers do not need attribute-level utility assessments. This SMART approach reduces complex procedures and has even been shown to outperform AHP, when there are many possible alternatives.

This brief survey already shows the options decision makers have. All these alternatives are in use today and have been proven successful in many policy decisions of the EU, for example in water resources management and hazardous substance transportation. Though it is difficult to design a scoring function, it can and has been done successfully without prohibitive costs.

Therefore in the SSO context, courts, when calculating the FRAND licences benchmark, should first discover the objectives of the organisation using decision analysis to construct a suitable scoring function. After the appropriate approach has been chosen, the auction can easily be designed.

5.2 Auction Design

Che introduced several options of how to construct a multi-attribute auction: First score, second score and second preferred offer. First score auctions are similar to

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180 ibid., 5
182 Kiker, et al., 'Application of multicriteria decision analysis', 102
"the first-price format in the standard auction." 184 In the second score auctions the winning bid would have to match the next best offer's quality. Similarly in a second score preferred offer auction the technology offered for the lowest price wins the auction but will have to match the highest quality offered. Intuitively these different approaches lead a firm to behave differently. In the second offer, a rational firm would only place a bid if the difference between producing the quality of the second lowest cost producer and the licence fee was big enough to make a profit. Similarly, in the second preferred offer auction, it would only bid if it could still make a profit from the licence revenue, while producing at the highest quality.

This shifts the weight from low prices to high quality products. Auctioning in this way would lead to somewhat higher licence fees and thus also stimulate innovation. Second preferred offer auctions would actually lead to over-investment into quality from the SSO's point of view. This is not an issue for the first score auction, which can remedy the problem with the right scoring function. 185 Thus the extension will use a first score format.

5.3 The Multi-Attribute Model

The extension of Swanson and Baumol's basic auction model is based on a multi-attribute procurement auction design proposed by Nishimura. 186 Procurement auctions for complex multi-dimensional products have already proven useful.

185 Che, 'Design Competition', 670
186 The essay only provides the most pertinent equations. For more detailed mathematical proofs and assumptions, see Nishimura, 'Optimal Design', 1, 35
EU for examples allows in its guidelines procurement based on "best economic value" and based on a published scoring function.\textsuperscript{187}

In a SSO, technology compete on quality \((q)\) and price \((p)\). Additionally quality is assumed to be multi-dimensional and thus symbolised by \(q\) as a vector. This assumption suits the nature of technological innovations and patents well. Not only are they of "good" or "bad" quality, there are many technology specific quality aspects (for example longevity, security and operating speed).

To achieve the right level of quality and efficient incentives, the auction is based on a first score bid where the "winner \(i\) is awarded a binding contract \((p_i, q_i)\) he offered in the auction.\textsuperscript{188}

The design of the auction is simple and follows those of basic auctions. Firstly, all technology producers are given cost-functions, of which they have private information. Then they make a bid with a stated quality and cost simultaneously and independently. The bidder with the highest score based on the scoring function wins, if he surpassed the threshold of a reserve score, and enters into a binding contract with the SSO.\textsuperscript{189} For simplicity the reserve score here is 0.\textsuperscript{190}

To determine the optimal scoring function the model supposes " that the virtual surplus \(\Phi\) is quasi-supermodular in quality."\textsuperscript{191} Quasi-supermodular games satisfy the ordinal complementarity conditions, and have single-crossing properties.\textsuperscript{192}

\begin{flushright}
\textsuperscript{187} John Asker and Estelle Cantillon, 'Properties of scoring auctions', \textit{The RAND Journal of Economics}, 39(1) (2008), 69, 70
\textsuperscript{188} Nishimura, 'Optimal Design', 7
\textsuperscript{189} Nishimura, 'Optimal Design', 4
\textsuperscript{190} ibid., 7
\textsuperscript{191} ibid., 13; see 9 for a definition of the virtual surplus
\textsuperscript{192} Rabah Amir, 'Supermodularity and Complementarity in Economics : An Elementary Survey', \textit{Southern Economic Journal}, 71(3) (2005), 636, 656
\end{flushright}
Complementarity means that when one attribute increases so does the other one.\textsuperscript{193} This is a reasonable assumption because the different aspects of quality are complementary, they are also additive in relation to the SSO’s utility.

From these assumptions follows "a quasi-linear scoring rule \( s^* \) which implements the optimal mechanism and is supermodular in quality."\textsuperscript{194} It is standard in game theory to assume a quasi-linear scoring functions.\textsuperscript{195}

The scoring rule is thus defined as

\[
S(p, q) = s(q) - p \quad \text{\textsuperscript{196}}
\]

A company \( i \) offering its technology has an individual cost profiles with a random cost parameter \( \theta_i \).\textsuperscript{197}

The firm \( i \)'s profits if it wins the bid \((p, q)\) are \( p - c(q, \theta_i) \) where the production costs are positive \( c(q, \theta_i) > 0 \).

The SSO's benefit when it choses company \( i \) "is a weighted sum of consumers’ surplus and profits, i.e. \( v(q) - p + \alpha(p - c(q, \theta_i)) \), where \( v(q) \) is the valuation for a product of quality \( q \) and \( \alpha \in [0, 1] \) is a weight on profits."\textsuperscript{198}

The optimal values \( q^* \) and \( p^* \) based on the resulting bidding strategy of the licensor are accordingly: \textsuperscript{199}

\[
q^*(\theta) \in \arg \max_{q \in Q} \left[ s(q) - c(q, \theta) \right] \\
p^*(\theta) = c(q^*(\theta), \theta) + \int_{\theta}^{\theta^*} c_\theta(q^*(z), z) \left( \frac{1 - F(z)}{1 - F(\theta)} \right)^{N-1} dz
\]

\textsuperscript{194} Nishimura, 'Optimal Design', 13
\textsuperscript{195} Bichler, Kalagnanam, 'Winner Determination', 2
\textsuperscript{196} Nishimura, 'Optimal Design', 7
\textsuperscript{197} ibid., 6
\textsuperscript{198} Nishimura, 'Optimal Design', 6
\textsuperscript{199} ibid., 8 for the proof
Adopting these values, the competing firms chose a price that maximises the quality score minus their production cost in equilibrium.\textsuperscript{200} "In equilibrium the most efficient supplier wins\textsuperscript{201} as long as his type $\theta_i$ is within the defined set.

This shows that it is possible to design an optimal scoring function, which maximises utility and from this derive optimal quality and price. Courts and government agencies can then use this price as a benchmark for the FRAND abiding license rates.

The main advantage is that the multi-attribute auction takes into account the nature of innovation. Adopting the multi-dimensional approach will lead to a better understanding of optimal royalty rates in the SSO context. Rigorously applied this will lead to more certainty in the standard setting process, less litigation and will prevent strategic behaviour of companies, while still rewarding firms who invest in high-quality innovations.

5.4 Limitations

Of course, open questions remain with this analysis. The authors assume that the most efficient technology suppliers are superior in all quality attributes. This means that the supplier with the best cost profile can produce all aspects of quality more cheaply than the other producers with different cost profiles.\textsuperscript{202} There is no supplier that can increase quality in one area, whereas another producer is more cost efficient in others.\textsuperscript{203} In reality, it is possible for example that one producer can cheaply provide a technology that is very secure in the transfer of data, but has higher costs

\begin{flushright}
\textsuperscript{200} ibid., 9  \\
\textsuperscript{201} ibid.  \\
\textsuperscript{202} Nishimura, 'Optimal Design', 20  \\
\textsuperscript{203} ibid.
\end{flushright}
for speed than all other suppliers. This is less likely in the innovation industries however. Costs are often based on the overall organisation of a company, which affects the dimensions of quality equally. Innovation depends on the successful harvesting of human ingenuity and creativity. If a firm has a very efficient system to solve the problem of security, it should also be able to come up with a solution for speed at lower cost than its competitors, as the costs of material stay similar.

Yet, it may be possible that for example in a telecommunications technology connection security and connection speed are not complementary attributes. Increasing speed may decrease security. Other components, though, may be complementary. For example stable connections could increase transfer security. In the context of a court calculating the FRAND benchmark complementarity should not be too much of a problem. Often cases only refer to a patent over one component of a product, which only does one specific thing, which reduces the number of attributes and decreases the likelihood of non-complementarity. Moreover, the licence is analysed after the standard has already been set, the courts are able to concentrate on the smallest number of relevant quality attributes, abstracting away from attributes that can be held constant for all competitors. This means that the number of quality attributes can be reduced and only the minimum amount have to be considered.

There is also a question about how the court should design the optimal scoring rule. The process of choosing the right methodology may not be as much of a problem as the normative implications of whose scoring rule to use. Administratively it may be easier for courts to define their own scoring rule. They could do so according to public interests, balancing the needs of the consumers and the market, though it may
be argued that a court lacks the necessary expertise to balance these interests correctly. Nevertheless, this options could be particularly attractive to a competition agency, who could prefer to define its own scoring rule according to wider regulatory policies. However, this could be regarded as being quite interventionist.

Conversely, it may actually not be more difficult to collect the necessary data from SSOs with the approaches discussed above than in any other case involving economic assessments. This would lead to a more "market mimicking" benchmark. It seems likely that courts, in private litigation, would aim to emulate the actual scoring function of the SSO (through questioning) and calculate the benchmark from there, as it fits better with a court’s overall objective to enable smooth business interactions. Competition agencies may be more likely to come up with their own scoring rule, trying to balance innovation and diffusion.

These limitations, questions of cost profiles, complementarity, and which scoring functions to chose, are not fatal. They can often easily be solved. Importantly, they must be addressed before designing the auction to avoid undermining the validity of the benchmark.

6. Conclusion

This essay has taken a closer look at the discussion concerning FRAND terms and the ex ante auction model. So far courts have paid little attention to economic models in deciding on FRAND terms. As the economic model could provide important insights and help find a workable definition of the conditions, an analysis rooted in law and economics is particularly relevant to the issue.

To further the understanding of the FRAND requirements, this essay has sketched the standard setting process and the aims of the FRAND commitments. It has surveyed the
literature on the problems and solutions available to SSOs. The essay has tried to demonstrate that it is worthwhile to clearly define FRAND terms since leaving them too flexible will lead to more uncertainty for companies, courts and agencies. The alternative of bilateral negotiation is not preferable as it facilitates strategic behaviour and impeaches the standard setting process.

After surveying the shortcomings of proportionality and the Shapely value, the hypothetical ex ante auction emerged as a valid tool in computing reasonable royalty rates. Courts should make reference to it. As it is only used as an evaluation tool, most criticisms based on practical problems with its implementation do not hold.

Nevertheless, the model could be improved by accounting for the multidimensional nature of technological innovation and the quality of a technology. Companies do not only compete on price, but also on quality, in their aim to have their technology included in a standard.

Of course, the extended hypothetical auction model is not perfect and courts need to be aware of its limitations and the normative implications in choosing a scoring rule.

This paper has tried to provide some insights on questions that will need to be addressed. It has aimed to enrich the debate. The issue of what FRAND terms exactly entail has not been solved once and for all, but with the amount of cases coming to court at the moment economically sound foundations are necessary to make good decisions.
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