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Comparing the Strength of SEP Patent Portfolios: Leadership Intelligence for the Intelligence Community

David J. Kappos*

The next generation of mobile broadband, 5G, is vastly faster, smarter, and more efficient than its predecessors, 3G and 4G. It is set to allow for much improved communication between devices, and therefore people, globally. Beyond enhancing cellular connections, 5G will also improve intelligence, surveillance, and reconnaissance opportunities for sensitive government use. 5G's potential to advance these activities is so significant that the U.S. government has declared 5G critical to national security. This, in turn, makes 5G a focal point for U.S. technological leadership.

Two kinds of national security concerns have been raised in connection with 5G leadership. The first involves leadership in the roll-out of 5G technology to the marketplace, including infrastructure deployment and spectrum allocation. This is a serious issue, to be sure. However, the second kind of national security concern is far more ominous and strategic with regard to long-term leadership in technology innovation. The country and the companies that lead in technological

* David J. Kappos is a partner at Cravath, Swaine & Moore LLP. Previously, he served as the Under Secretary of Commerce and Director of the United States Patent and Trademark Office from August 2009-January 2013.

innovation will determine the ultimate capabilities of 5G, its limitations, and its potential uses. Further, the leading country and companies will control who has "admin" and other unauthorized access to 5G, the ecosystems that will form around the technology, and the monitoring/surveillance of and interface points to the network. For 5G, innovation leadership is strategic leadership.

It is not uncommon for commentators to cast China as the leader in 5G. Experts in the U.S. worry China will use this presumed leadership position to create vulnerabilities that can be used to conduct military or industrial espionage or cyberattacks against the U.S. and its allies.[1] The fear that China is leading in the 5G race is based largely on metrics that show China's most influential national telecom giants are obtaining numerous patents declared as essential to the 5G standard and are named in many contributions to that standard.

However, these metrics are wildly inaccurate measures of the comparative strength of standard essential patent ("SEP") portfolios. This is a serious concern because patents are the tools that enable innovation to reach the marketplace and provide the incentive for risky, failure-prone innovation in the first instance by rewarding investments in innovation. If SEPs are to perform this essential function and encourage real innovators to contribute their innovations to the standardization process, they must be counted in a way that actually correlates with truly innovative contributions. Nowhere is the issue more evident than in the area of innovation-based standards deemed critical to national security like 5G, where patents play the uniquely important role of marking the companies, and thus the national origin, of the key technology incorporated into the standard. With regard to the national security implications for innovation-based standards, failure to appropriately correlate valuable patents to the standard means not only sending windfall credit to non-innovators—thus disincentivizing the real innovators—but also misjudging whether it is domestic or foreign innovators providing the key technology. This makes national-security-critical-innovation-based standards the proverbial bull's-eye of importance for accurate assessment of the comparative strength of SEPs.

But while evaluating patents is critical in discerning the importance of a given technological contribution, comparatively assessing them in the innovation standards context is extremely challenging. This paper will show that equating either the counts of patents declared essential or the counts of technical contributions made to standards with the relative strength of patent portfolios and innovation quality is, at best, a faulty and meaningless comparison in determining 5G leadership. This paper will further show that even the more robust and sophisticated metrics used as proxies for comparing patent portfolios are still imperfect, weak, and noisy. In the national security context, the importance of sensibly valuing patent portfolios and the quality of innovation cannot be overstated. Any systemic fallacy opens a gap in

1. JAMES L. JONES, RECOMMENDATIONS ON 5G AND NATIONAL SECURITY 1-2 (Atlantic Council 2019), https://perma.cc/79HH-MKX6.

understanding, and thus addressing, a perceived U.S. deficit. By discarding faulty metrics, adopting meaningful methodologies, and understanding that no metric can be a substitute for honest expert evaluation, we can base this important national security discussion on a factual and principled basis.

I. STANDARD DEVELOPMENT ORGANIZATIONS PLAY A PIVOTAL ROLE IN THE CREATION OF INNOVATION-BASED STANDARDS

For standards deemed critical to national security, understanding the apparatus by which these standards are created is important to understanding how to accurately compare the strength of patent portfolios, and thus to assessing which companies are contributing most to those standards. This allows for a meaningful assessment of whether or not national security is put at risk.

Standard Development Organizations ("SDOs") are mechanisms for industry innovators to collaborate in collectively identifying and selecting the most promising innovations for standardization. These innovations become the foundation —the standard—upon which new products are built. An SEP protects technology deemed essential to a standard. Technology innovators spend billions of dollars and enormous amounts of time on research and development ("R&D") to invent and perfect new technologies. Through SDOs, these innovators are able to cooperate and contribute their innovations to the development of standards, and the patents covering those innovations become SEPs.

The resulting standards, in turn, are published to facilitate broad adoption. Technology innovators who own SEPs are expected to ensure that technology implementers can obtain access to these SEPs under fair, reasonable, and nondiscriminatory ("FRAND") terms. Such access allows technology implementers to use standards to manufacture compatible products that benefit from the upstream R&D innovators invest into the standard. The resultant products readily interoperate with those of other manufacturers implementing the same standard. Efficiencies engendered by the innovation-based standards paradigm enable broad ecosystems to develop, producing far more aggregate value than the closed proprietary (winner-take-all) model.

One such standard that SEPs protect is 5G. As with other standards, technology innovators' massive investments make the 5G standard possible. For national security purposes, it is important to understand which companies hold the strongest intellectual property ("IP") relating to 5G. A clear-eyed view of comparative IP strength in turn engenders clarity about which countries are leading in 5G innovation, signaling to governments and investors where true strength, and by extension, where global leadership and security-related confidence in 5G lies.

Leadership can only be deciphered through accurate comparisons of applicable patent portfolios and underlying technologies. Commentators who believe China is winning or has won the 5G race point to the number of patents declared as potentially essential to 5G standards (patent counts) or to the number of technical contributions (technical contribution counts) as establishing the relative strength of 5G portfolios. More generally, patent counts and technical contribution counts

have been suggested as metrics for portfolio quality and for the value of contributions to standards across the board. However, these metrics have been proven meaningless, and reliance on them leads to erroneous conclusions, undeserving standards participants gaining a windfall, and perverse incentives for participants to inflate their counts.[2] Meanwhile, those investing significant capital to make valuable contributions to the standards are left underrecognized, undercompensated, and therefore disincentivized from innovating and/or contributing in the future—ultimately harming consumers. Reliance on these faulty metrics also engenders unfounded fear that the U.S. and its allies have lost the 5G race, when, in fact, there is no reason to believe that is the case. Given the real-world importance and effects of patent valuation metrics, it is necessary to confront the fiction of faulty patent quality metrics.

II. SPEAKING TRUTH: WHY PATENT COUNTS ARE A MEANINGLESS MEASURE UNCORRELATED TO THE STRENGTH OF PATENT PORTFOLIOS

There are two fundamental problems with using patent counts as a measure of the quality of innovations conferred to a standard. First, comparing SEP portfolios based on patent counts conflates the volume of patents with the importance of these patents to the core functionality of the standard. In fact, the volume of declared patents is not at all indicative of how critical those patents are to the standard. Studies have shown the distribution of patent value is highly skewed—any given SEP may be crucial or may have very little importance. A raw count of patents does not account for this skew.[3]

Second, it has been shown there is significant over-declaration of patents as potentially essential to a given standard. Over-declaration "occurs when a patent owner publicly asserts that a patent is 'essential,' when, in reality, that patent would not be infringed by a standard-compliant product."[4] This, in and of itself, is not problematic, as companies are encouraged by SDOs to declare all patents that *might* be or become essential. With standards evolving in real time, and patent claims evolving during the patent prosecution process, some over-declaration is inevitable and expected. This fact, in addition to the desire of some standards participants to be viewed as technology leaders, coupled with the further fact that

2. *See generally* Justus Baron, *Counting Standard Contributions to Measure The Value Of Patent Portfolios - A Tale Of Apples And Oranges*, 44 TELECOMM POL'Y, no. 3, 2020, at 1.

3. Mark Schankerman, *How Valuable is Patent Protection? Estimates by Technology Field*, 29 RAND J. OF ECON. 77 (1998). *See also* Zvi Griliches, *Patent Statistics as Economic Indicators: A Survey*, *in* R&D AND PRODUCTIVITY: THE ECONOMETRIC EVIDENCE 287, 335-36 (1998) (examining how differing methods of analysis based on patent numbers can create a "statistical mirage"); Jean O. Lanjouw, Ariel Pakes, and Jonathan Putnam, *How to Count Patents and Value Intellectual Property: The Uses of Patent Renewal and Application Data,* 46 J. OF INDUS. ECON. 405 (1998) (exploring how data such as the number of years a patent is renewed or the number of countries in which a patent is sought can help better measure innovation).

4. Cody M. Akins, *Overdeclaration of Standard-Essential Patents*, 98 TEX. L. REV. 579, 581 (2020). For a discussion of how over-declaration impacts royalty rates in the standard essential patent context, *see* Damien Geradin and Anne Layne-Farrar, *Patent Value Apportionment Rules for Complex, Multi-patent Products*, 27 SANTA CLARA HIGH TECH L. J. 763, 778–81 (2011).

declarations of essentiality are made by patentholders themselves and are not verified by SDOs or others, make reliance on declaration counts as a measure of portfolio strength indefensible. Such reliance confers significance to patent counts that is completely misplaced. A random number generator would serve the purpose nearly as well.

Using declarations as an indicator of strength leads to several negative consequences. One is a market problem—implementers may decide not to undertake the complex work associated with verifying essentiality after conducting a cost-benefit analysis. These implementers determine that it is more cost-effective to instead presume that all potential SEPs would result in infringement if not licensed, and they therefore seek to license all declared patents. As a result, they may end up paying significant sums of money licensing patents that are, at best, marginally useful to the standard or not essential to the standard at all. A second negative consequence stems from the potential for undeserved gain and the unfounded recognition that occurs through reliance on patent counts. Placing such unfounded emphasis on the number of patents declared as essential results in distorted incentives for innovators. Instead of engaging in the knowledge-intensive process required to identify patents that are truly essential to a standard, parties can easily "game" the declaration process, declaring patents that are unimportant or irrelevant to the standard. This leads to both overcompensation and overvaluation to those companies that choose to game this system, as well as under-compensation and undervaluation to those acting diligently.

China-based companies have dramatically increased their 5G SEP declarations as compared to their U.S. and E.U. counterparts.[5] These Chinese companies declare any given 5G patent family to a higher-than-normal number of technical specifications. This increase is underscored by the fact that in previous iterations of the mobile technology, 3G and 4G, Chinese companies had SEP declaration count rates commensurate to those of U.S. and E.U. companies. With no other explanation for such a dramatic change, the sharp escalation in China-based declarations, coupled with the ease by which companies can over-declare patents, points to the likelihood of dramatic over-designation. Reliance on a system of self-declaration that is inherently over-inclusive, unverified, and unfit as a method for assessing portfolio strength, is partly to blame for the erroneous conclusion that China is

5. For instance, of the top 10 companies, as measured by 5G declaration counts reported to the European Telecommunications Standards Institute (ETSI), on average, the leading Chinese companies declared applicable 3G patent families to 1.40 technical specifications, but applicable 5G patent families to 4.64 technical specifications. In comparison, combined, the leading E.U. and U.S. companies, on average, declared applicable 3G patent families to 1.91 technical specifications, compared to 1.95 technical specifications for 5G patent families, according to publicly available data gathered from the ETSI and 3GPP (3rd Generation Partnership Project) websites. Further, the weighted averages for the same 10 companies show that the leading Chinese companies declared applicable 3G patent families to 1.41 technical specifications, but applicable 5G patent families to 5.30 technical specifications, compared to the leading U.S. and E.U. companies, which declared applicable 3G patent families to 1.80 technical specifications, versus 1.77 technical specifications for 5G patent families (all figures referenced in this footnote were tabulated by the author from publicly available sources).

winning the 5G race. Given the skew in patent importance, the tendency to over-declare, and the lack of oversight on declarations, there should be no reliance on volumes of declared patents as a measure of contribution to a standard.

III. TECHNICAL CONTRIBUTION COUNTS ARE SIMILARLY PROBLEMATIC AS INDICATORS OF SEP PORTFOLIO STRENGTH[6]

Some standards commentators point to technical contributions as a measure of SEP portfolio strength. This approach counts the number of technical contributions to a standard in order to calculate the relative importance of an SEP owner's technology to a standard. However, contributions are not required to meet a minimum inventive step threshold in order to be accepted. Even mere editorial changes made only to improve a standard document's readability count towards a company's technical contribution count. Because they are not intended to indicate the criticality of any particular contribution to a standard, technical contributions are not screened to determine whether they are accurate, let alone meaningful enough to deserve significant recognition. Therefore, technical contribution counts are a poor indicator of portfolio strength; the significance of contributions range widely, and to an even greater extent than patent counts, technical contribution counts can be easily manipulated. They are meaningless as a factor in analyzing the comparative strength of SEP portfolios.

IV. THERE IS NO SUBSTITUTE FOR EXPERTS ASSESSING EACH PATENT TO DETERMINE ITS IMPORTANCE TO A STANDARD; EVEN THE MORE ESTABLISHED ROBUST METHODOLOGIES VERSUS COUNTING PATENTS OR TECHNICAL CONTRIBUTIONS ARE INHERENTLY LIMITED

The best method to accurately assess the importance of any given patent relative to a standard is for skilled professionals to employ their expertise to evaluate the patent in detail. However, this process may be too time-consuming or costly to be performed for every SEP. To fill the gap, there are certain identified metrics which, although weak at best, are better indicators of comparative patent portfolio strength than patent counts and technical contribution counts and which can therefore supplement human-centric analysis. Although there is no simple metric or group of metrics that can substitute for human evaluation, the indicators described below are at least established as weak proxies of the strength of patent portfolios by a long-standing body of economic research and IP literature.[7] That being said, even these metrics are unreliable as compared to human evaluation, as the metrics can be manipulated by industry participants and are far removed from commercial value.

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6. Baron, *supra* note 2, at 2 (concluding that "the hope of finding in contribution counts a reliable methodological short-cut to complex value determinations for SEP portfolios . . . to be deceptive").

7. Some companies, like Cipher, have begun working to include more objectively sound metrics to facilitate more reliable patent portfolio valuation comparisons. *See generally Why Cipher*, CIPHER, https://perma.cc/Q88T-SM8X.

Geographic spread

Broad filing of a patent across multiple countries indicates a belief by the filer that the patent has the potential to be a strong company asset.[8] Therefore, large international patent families, if not gamed by the patent owner, can somewhat correlate with the strength of a portfolio, where family size is measured by the number of jurisdictions in which patent protection is sought for an invention.[9]

Number of forward citations

The more times a patent is cited as relevant by later patents of third parties, the more likely other entities are building upon the technology protected by the cited patent.[10] Thus, patents cited more frequently are likely to be more valuable, and the contribution of such patents can be given weight in patent strength analyses.

Age of patents

Renewal fees imposed by governments tend to increase with the age of a patent. Therefore, a patent owner will renew a patent only if the patent is important enough to merit the escalating cost. The longer a patent is kept in force, the more valuable it likely is to the patent owner.[11] It should be noted, however, that the age of a patent tends to have a positive correlation with the number of forward citations the patent receives. This correlation should be accounted for in any strength analysis using both metrics.

Incidence of successful patent defense

Patents that are more valuable have a higher likelihood of being challenged.[12] Those that are upheld against any such opposition, post-grant review or annulment procedure, even on one occasion, tend to be highly valuable.[13]

Combining the above factors into value-weighted patent counts provides some improvements over pure patent counts in comparing the strength of patent portfolios

Although raw patent counts are not at all indicative of the strength of a patent portfolio, patent counts can be weighted such that each patent is given a weighted score. Using the factors discussed above, the most valuable patents can be

8. *See generally* WIPO, *IP Valuation*, *in* IP PANORAMA (2007). *See also* Krista F. Holt, Brian P. O'Shaughnessy & Thomas B. Herman, *What's It Worth? Principles of Patent Valuation*, LANDSLIDE, Sept.-Oct. 2015, at 32.

9. Dietmar Harhoff, Frederic M. Scherer & Katrin Vopel, *Citations, Family Size, Opposition and the Value of Patent Rights*, 32 RSCH. POL'Y, 1343, 1343-63 (2003).

10. Bronwyn H. Hall, Adam Jaffe & Manuel Trajtenberg, *Market Value and Patent Citations*, 36 RAND J. ECON., 16, 19 (2005); Leonid Kogan, Dimitris Papanikolaou, Amit Seru & Noah Stoffman, *Technological Innovation, Resource Allocation, and Growth*, Q.J. ECON., 665, 667 (2017).

11. Schankerman, *supra* note 3, at 93-94.

12. Harhoff, Scherer & Vopel, *supra* note 9, at 1360.

13. By successful patent defense, we mean any successful defense of a patent. We are not aware of any substantial difference, as an indicator of value, between one successful defense and multiple successful defenses.

assigned more weight in a patent count while patents with low scores can be eliminated from the count altogether. This approach provides a proxy for patent strength assessment that is at least more accurate than patent counts or technical contribution counts.

V. THE BEST WAY TO COMPARE THE IMPORTANCE OF SEPS IS FOR SKILLED PROFESSIONALS TO READ PATENT CLAIMS AGAINST SPECIFICATIONS

There is simply no avoiding the fact that discerning the importance of patents to standards is among the most complex of intellectual tasks. It requires deep knowledge and experience of both highly specialized technology and highly specialized patent law. The proxies described above are weak at best in the face of such complexity and specialization. The only way to accurately determine the importance of patents relative to standards is for skilled professionals to read patent specifications and claims against the applicable standards specifications.[14] It should be no surprise that this is the predominant method used when patent license agreements are negotiated, as the parties involved work to judge the value of the licensed patents to the licensee. The value assigned to patents in these negotiations is therefore a strong indicator of market, and by extension, relative patent portfolio strength, with the analysis of skilled professionals embedded in the valuation process of these agreements. In the end, patent license agreements truly embody assessments of the importance of a patent portfolio—the value transferred from the patent holder to the licensee in allowing the licensee to use a portfolio of patents.

Thus, ultimately, to assess the strength of SEP patent portfolios, we must look to comparable patent license agreements as a summation of patent value deduced by skilled professionals. Such patent licenses can be examined to reveal the strength of a given SEP portfolio.[15] Since market participants would only choose to pay significant sums of money to license patents deemed truly important, these license agreements point surely to which companies are contributing the most valuable technology to innovation-based standards.

VI. LEADERSHIP IN 5G MUST BE ASSESSED UTILIZING RELIABLE METHODOLOGIES

Patent counts and technical contribution counts are inappropriate measures for patent valuation. They result in under-valuing the contributions of technology standard innovators who contribute highly valuable technology protected by fewer patents, while overvaluing contributions from parties who do not contribute meaningfully. These inept comparison techniques have led to false conclusions regarding 5G leadership and incorrect information regarding the possible impact on U.S. national security. In addition, these valuation techniques, which are

14. *See Valuation of Intellectual Property: Moving Beyond the Paradox*, INTELL. PROP. EXPERT GRP. (Feb. 26, 2018), https://perma.cc/N2XU-PQFU.

15. *See* Daniel F. Spulber, *Licensing Standard Essential Patents: Preparing For 5g Mobile Telecommunications* 18 COLO. TECH. L.J. 79, 145 (2019).

wrought with problems, may disincentivize American technology innovators from investing further in 5G, which could result in a significant weakness in U.S. national security.

Geographic spread, number of forward citations, age of patents, and incidences of successful patent defense are examples of helpful comparators between patent portfolios, though they are in no way exhaustive. The best use of these metrics is to combine them into a weighted sum that allows for a value-weighted patent count.[16] Even then, the best use of this count is as a supplement to the efforts of skilled professionals.

Innovation-based standards and the SEPs that protect innovation are invaluable to economic progress and national security. Without such innovation, 5G, which is set to dramatically transform the intelligence landscape, would not exist. To discern who leads in 5G innovation, we must utilize a comparative assessment system that accurately identifies the true contributors of innovative substance and adequately compensates those contributors. One way to achieve this is to accurately compare the *quality* of contributions to a standard, rather than merely the *quantity*.

All participants benefit from improved comparison metrics. Innovators who invest mightily to create value will reap the rewards of their investment, including proper compensation and recognition, further enabling and encouraging them to invest in more innovation in the future. Those who pay to utilize the technology can be confident they are giving fair value to those deserving of compensation. Above all, the intelligence community, as a key user of the technology, will benefit from the superior capabilities of the standardized technology and from the ability to make crucial decisions based on accurate knowledge of where the technology truly originates—domestic or foreign.

16. *See* Jonathan Putnam, *Value Shares of Technologically Complex Products* (unpublished manuscript) (Apr. 16, 2014), https://perma.cc/WRF4-U873.

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