I. GAMING THE SYSTEM: A SCATTER-GUN APPROACH TO 5G SEP DECLARATIONS

My research on 5G patent declarations demonstrates that the number of patents declared as potentially essential to technical standards should not be used for any purpose, including to evaluate technological leadership.

Participants in standards setting organizations (SSOs) are obliged to disclose their patents that are potentially essential to the standards.[1] SSOs expect those companies to make their essentiality determinations and declarations in good faith. However, some companies make significantly more and broader declarations than are cautiously needed to meet SSO disclosure requirements, protect their patent rights and shield them from charges of anticompetitive patent ambush. Some companies are "gaming" the system to feign technology leadership by "over-declaring" where individual patents are essential as well as how many of them are essential.

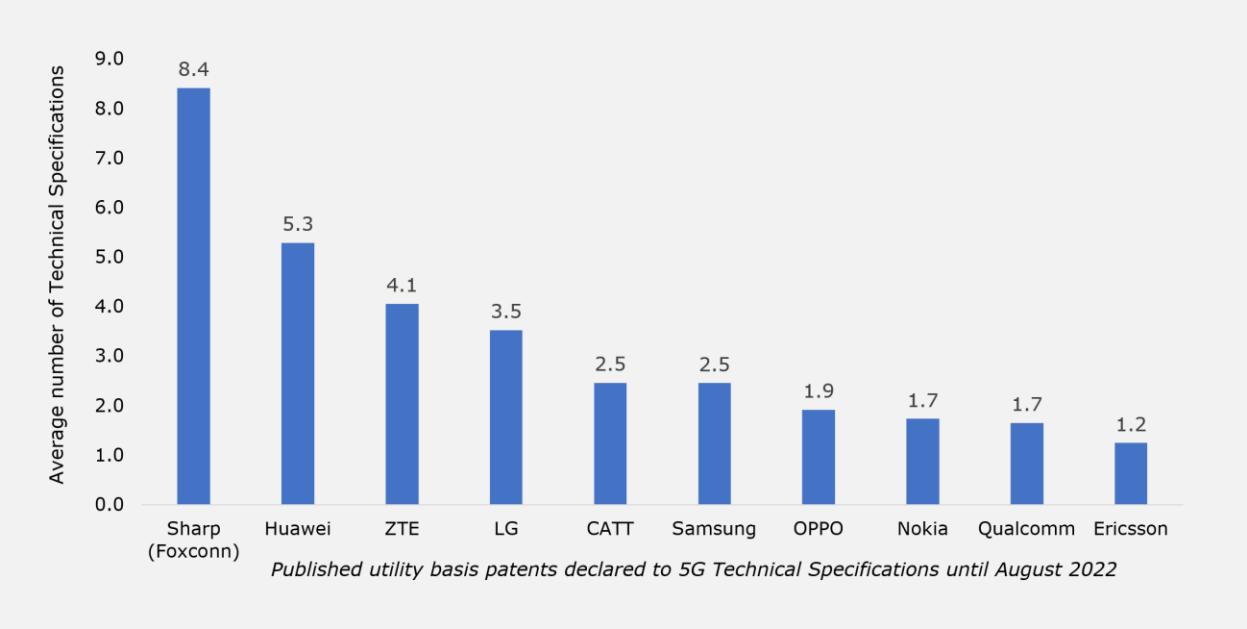

Exhibit 1: Some companies declare patents essential to many different Technical Specifications

[1] Companies disclose a "basis patent" as representative of all patents in the same family.

Declaration practices differ among participating companies, but with all of them reasonably declaring some patents that would never actually be found standard essential if tried in litigation by courts of law. However, with the increasing use of patent counts as a measure of companies' respective patent strengths, some companies are making much broader and more numerous declarations than others.

As shown above, companies' declaration practices in 5G Standard Essential Patents (SEPs) vary widely.[2] The companies towards the right side of this chart appear to consistently make relatively targeted declarations to standards specifications for each patent, whereas the companies to the left side declare their patents to different specifications far more widely.

Companies making declarations to large numbers of standards specifications may be performing a less rigorous analysis of which patents are essential to which particular standards specifications. For example, in the extreme, a company could declare its patents to nearly every standards specification in the hope that one of those is relevant to the patented invention. Companies on the other end of the spectrum may be determining more precisely which standards specifications are relevant to the invention.

SSO participants expansively declaring their patents may be attempting to enhance the perceived value of their patent portfolio or company IP in various ways. This paper does not research potential motivations that could explain observed declaration practices. Rather, this paper objectively measures the practices of companies that declare the most patents as standard essential. I present my findings in Section IV below, after a brief introduction to the standards bodies and their patent policies (Sections II-III). My work is based on standards and technical

[2] Technical Specifications related to 5G (https://portal.3gpp.org/#/55936-specifications)

specifications information at 3GPP and patent declaration data in the ETSI Intellectual Property Rights (IPR) database until August 2022.[3]

II. OVERVIEW OF SSOS, STANDARDS, AND DECLARATIONS

SSOs specialize in the formation of technology standards via voluntary, consensus-based participation among members including participants in working groups. Major standards include 802.11 WiFi standards developed by IEEE; video compression standards AVC/H.264 and HEVC/H.265 developed by ITU; various standards for the Internet developed by IETF; and 3G UMTS, 4G LTE and 5G NR cellular standards developed by 3GPP. Although there are differences across SSOs, the structures and processes that lead to cooperative setting of technical standards are similar. My study focuses on 5G cellular communications standards, and therefore I discuss the 3GPP-related policies in more detail below.

3GPP stands for the Third Generation Partnership Project. It is a partnership of seven SSOs from around the world, formed to create common wireless communications standards. These communication standards have resulted in the widely adopted and enormously successful third and fourth generation (3G and 4G) cellular standards, as well as the burgeoning 5G standard. Most company members of 3GPP participate through the European Telecommunications Standards Institute (ETSI)[4] and make their SEP declarations and associated Fair Reasonable and Non-Discriminatory (FRAND) licensing commitments to this 3GPP partner.

[3] The patent declaration and standards data was collected and evaluated by Dolcera (www.dolcera.com).
[4] https://www.etsi.org/

The 5G standard became widely available to the industry through the publication of Release 15, at the end of 2017,[5] and to the public with the first commercial launches of 5G networks and devices in 2019.

SSO IPR policies set out how companies that develop technologies identify their patented contributions to the standards. Standardization is an open process that makes these technologies for interoperable communications systems readily available to any implementer. IPR policies also enable innovators to receive fair and adequate compensation for their patented contributions.

Technology developers spend many billions of dollars on standard-essential technology developments every year.[6] The value of 5G— including its impact on industries outside of telecommunications—is expected to be in the trillions of dollars by 2025.[7]

A. What are standards and declarations?

A standard, such as 5G for mobile communications, is a compendium of documents which each define a collection of wireless capabilities and how those are implemented technically.

Technical Specifications are organized portions of a standard. 3GPP defines dozens of groups, or series, of specifications which set out the 3G, 4G (*i.e.*, LTE) and 5G mobile communications standards. Each specification focuses on one part of the standard. For example, Series 24 contains the requirements for signaling protocols, which enable efficient and effective communication and control among the different parts of cellular systems. Series 36 specifies the LTE air interface, including LTE-Advanced/Pro radio technologies. Series 38 specifies

[5] https://www.3gpp.org/release-15
[6] Innovation in the 5G communications platform and the IoT, by Keith Mallinson, RCR Wireless, November 2017 (https://www.rcrwireless.com/20171116/5g/innovation-5g-communications-platform-iot)
[7] Massive growth in IoT leveraged by fulcrum of 4G and 5G technologies, by Keith Mallinson, Enterprise IoT Insights, May 2017 (https://enterpriseiotinsights.com/20170517/opinion/analyst-angle-massive-growth-in-iot-leveraged-by-fulcrum-of-4g-and-5g-technologies-tag10)

5G. There are hundreds of different documents for each of these series of specifications, some of them comprising several hundred pages including appendices, tables and charts. Various different 3GPP Working Groups organize portions of the standard into separate Technical Specification documents having different document numbers—in 5G there are 519 separate Technical Specifications as of October 2022.

Although some SSO documents, including Technical Reports, relate to study items for work undertaken prior to setting the Technical Specifications, most Series 36 and Series 38 documents are Technical Specifications for a feature or an enhancement to a feature. For example, there are many documents in Series 36 that deal with important technologies in the LTE and 5G standards, such as carrier aggregation, including different downlink and uplink channel combinations and aggregation between LTE FDD and LTE TDD carriers. 3GPP generally updates standards specifications quarterly and issues a new Release including major enhancements every year or two.

IPR policies and declaration forms, such as that of 3GPP partner ETSI, require the identification of applicable standards and Technical Specifications upon which an owner's patents are believed to potentially read.[8] All SSOs require participants to disclose patents that must be infringed through the practice of their standards. This requirement is strict—if a party can practice the standard through a less desirable commercial or technical implementation, the patent is not "essential" to the standards. The participants must also commit to license these SEPs on FRAND terms. Declarations to ETSI[9] must identify all patents individually, and for

[8] https://www.etsi.org/intellectual-property-rights?jjj=1584459040860
[9] While 3GPP is a partnership for seven regional and national SSOs, declarations are made to ETSI and are published in its IPR database.

each standard. Declarations of 3GPP-based standards identify what the declarant believes are the applicable Technical Specifications on which the patents read.

B. Why do companies declare their patents to standards bodies?

Representatives of firms participating in the standards setting process submit technical contributions setting forth prospective technical solutions. The various iterations of study and other work result in Technical Specifications. Technology implementers including manufacturers and network operators can then develop and commercialize standard-compliant products and services.

In the case of 3G, 4G and 5G mobile standards, most members are registered through ETSI, which maintains a database of patents declared as potentially essential to 3GPP standards. All the SSOs that are organizational partners of 3GPP also require their members to commit to license their SEPs on FRAND terms. ETSI states that the purpose of its policy is to "reduce the risk that the investment in the preparation . . . of [standards] could be wasted as a result of an [essential] IPR . . . being unavailable"[10] and that, "IPR holders . . . should be adequately and fairly rewarded for the use of their IPRs."[11]

Consequently, by implementing a FRAND licensing policy, SSOs seek to prevent an SEP holder from refusing to license its SEPs on reasonable terms—thereby denying implementers access to the technology. At the same time, SSO IPR policies aim to ensure that SEP holders will be fairly and adequately compensated for their contributions to the standard.

[10] https://www.etsi.org/images/files/IPR/etsi-ipr-policy.pdf (3.1).
[11] https://www.etsi.org/images/files/IPR/etsi-ipr-policy.pdf (3.2).

III. PRACTICE FOR STANDARDS DECLARATIONS

A. Difficulty in determining essentiality

There are significant concerns about the determination of which patents, among those declared, are "truly essential." The determination of patent essentiality and associated declarations is fraught with massive uncertainties, as it involves matters that are in flux. First, the technical specifications evolve with significant changes. Second, managing the process of patent prosecution (or examination) in multiple patent offices worldwide makes it difficult to determine which patents/claims will be granted, in what jurisdictions, and which of the former will become or remain truly essential to the evolving standard. And, more fundamentally, assessing essentiality is a highly fact intensive, complex and rather idiosyncratic task. Different assessors often disagree about whether a patent is truly essential, due to bias and various factors.[12]

3GPP and its partners, like all other SSOs, do not attempt to verify the essentiality of the patents declared by individual members, nor do they generally perform any other patent searches to identify which patents are SEPs. The patent declaration process is very demanding in terms of cost, effort, and knowledge requirements. Some firms spend significant resources to identify potential SEPs for declaration in their portfolios – a costly burden that is prohibitive for SSOs. More significantly, it is only a court that can ultimately determine and rule as a matter of law that a patent is not invalid, infringed and essential. Essentiality determinations in court and between private parties are often very contentious.

[12] Do not Count on Accuracy in Third-Party Patent-Essentiality Determinations, by Keith Mallinson, IP Finance, May 2017 (https://www.wiseharbor.com/wp-content/uploads/2017/05/Patent-Counting-article-for-IP-Finance-12-May-2017.pdf); Essentiality Rate Inflation and Random Variability in SEP Counts with Sampling and Essentiality Checking for Top-Down FRAND Royalty Rate Setting, by Keith Mallinson, IP Finance, September 2021 (https://www.wiseharbor.com/wp-content/uploads/2021/09/Perils-of-sampling-SEPs-Mallinson-30-Sept-2021.pdf); Essentiality Checks Might Foster SEP Licensing, but they Won't Stop Over-Declarations from Inflating Patent Counts and Making them Unreliable Measures (https://www.wiseharbor.com/wp-content/uploads/2022/11/Mallinson-on-essentiality-checks-and-patent-counting-16-November-2022.pdf)

1. Process for identifying potential essentiality

As noted above, identifying essential patents is not a simple task. It requires a company to examine the patent's claims—and any disclosures and evidence necessary to identify the meaning of those claims—and compare the claims to particular standard's functionality. It follows, therefore, that to conclude that a patent is potentially essential, the declaring company would have had to draw that conclusion in comparison to a particular portion of the standard. In some cases, this may be a single Technical Specification. For example, a channel coding patent may be solely relevant to TS 38.212. In other cases, such a patent might read on several Technical Specifications. For example, a patent covering handset user equipment (UE) that receives information from the base station in multiple ways may map to portions of both TS 38.214 and 38.331. However, a potential mapping will generally involve a relatively small number of Technical Specifications, and there will be many other specifications that are plainly not relevant to the patent.

Standards documentation is long and complex. Individual Technical Specifications within a standard commonly run for several hundreds of pages; and standards such as 5G comprise hundreds of Technical Specifications. 5G was established in Releases 15 and has been improved with completion of Release16 and Release 17 most recently in 2022. Existing Technical Specifications are being revised and new Technical Specifications are being added throughout the standard's lifecycle, which will last at the very least 10 years. With a new 5G standard release likely every year or two (based on previous 3GPP standards lifecycles), there are likely to be thousands of Technical Specifications relevant to 5G over the course of its lifecycle.

2. Some innovators develop the next generation of communications technology years before standardization even begins

Some technologies that end up being essential to a particular standard are of a fundamental nature and have been developed and patented many years prior to standardization.[13] For example, some patented technologies essential to 5G were already standard essential in 4G. While 5G is a new standard, it incorporates numerous patented technologies from previous generations including the OFDMA waveform, QAM modulation, carrier aggregation and MIMO, as just a few examples. These technologies can continue to constitute fundamental building blocks of the most recent standard.

B. The process of declaring the patent potentially essential to identified sections

The ETSI IPR disclosure form includes, along with fields to identify the patent being declared, a field to identify the corresponding standard document or documents. This is information that should be readily available to any company that has performed its analysis of potential essentiality diligently and in good faith. As explained above, while the process of identifying a potential essentiality mapping is difficult, identifying the specific standard documents relevant to a mapping are necessarily part of any good faith effort.

IV. EXCESSIVE DECLARATIONS BY SOME IN 5G

It is widely believed that significant numbers of patents declared essential to specific Technical Specifications are not actually essential to those Technical Specifications, or to the

[13] Cellular inventions trigger avalanche of activities among companies, by Keith Mallinson, RCR Wireless, June 2018 (https://www.rcrwireless.com/20180629/carriers/analyst-angle-cellular-inventions-trigger-avalanche-of-activities-among-companies)

associated standard at all.[14] Estimates of those numbers vary widely as do estimates of the proportions for one declarer versus another.[15]

A. Declaration practices of top standards declarants

The 3GPP RAN working groups started the work on 5G New Radio (NR) Access Technology by early 2016 (for inclusion in Release 15),[16] where it was distinct from substantial ongoing development of the 4G LTE standard.[17] As soon as the initial version of 5G completed at the end of 2017 in 3GPP Release 15,[18] various companies began declaring their patents as potentially essential to this new standard. Industry observers are reporting on the volume of these declarations, which are held in ETSI's IPR database[19] and on the technical contributions and specifications, which are submitted to and held on 3GPP's portal.[20]

Now that the databases have a reasonably robust set of data regarding 5G declarations and Technical Specifications, it is possible to analyze and draw conclusions about the top

[14] Individual assessors all estimate that some SEP declarers have much higher "essentiality ratios," also called "essentiality rates," (i.e. the percentage of declared essential patents that are considered essential) than others and that average essentiality rates across all declarers are a lot less than 100 percent. For example, Fairfield Resources (2010) estimated essentiality rates in LTE among declarers ranging from 18 percent to 67 percent for those declaring more than five patents, with an average of 50 percent across all declarers. TCL's expert witness, Dr. Ding, in *TCL v. Ericsson* estimated essentiality rates for LTE in 2016 ranging from 20 percent to 58 percent, with an average across all declarers of 36 percent. Other studies, including three in consecutive years by Cyber Creative Institute (2011, 2012 and 2013) also show wide disparities. I find these and other third-party patent essentiality determinations and patent as being inaccurate and unreliable in their results, on both a patent-by-patent and company-by-company basis, for various reasons including the subjectivity of such assessments. I justify this conclusion, in a 2017 report of mine, largely on the wide disagreements in assessments among assessors. However, despite my concerns about these and other patent-counting studies, I see no reason to disagree with their uniform general conclusions that some companies have much lower essentiality rates (i.e. much higher over-declaration rates) than others. I agree that the essentiality rates of some declarers are, indeed, likely to be multiples of others and that large proportions of all patents declared essential are not actually essential, as others have concluded. While other research studies count the number of declared patents and in some cases assess essentiality for these, my new research in this paper measures the numbers of Technical Specifications to which individual patents are declared. Here, I have used systematic analysis to evaluate objectively the relative declaration practices of many SSO participants.

[15] Ibid.

[16] https://5g-ppp.eu/history/

[17] https://www.3gpp.org/news-events/press-clippings/1261-2020-vision-for-lte

[18] https://www.3gpp.org/release-15

[19] https://ipr.etsi.org/

[20] https://portal.3gpp.org/

companies' declaration practices. As discussed below, the 10 companies, in alphabetical order, with highest numbers of declared essential patents to the 5G standard are: CATT,[21] Ericsson, Huawei, LG, Nokia, OPPO, Samsung, Sharp (Foxconn), Qualcomm, and ZTE. Consequently, I focus my analysis on the standards declarations and practices of these companies.

B. Some companies are declaring patents essential to significantly more standards sections than other companies

1. Average numbers of declarations per patent

As I discussed above, a patent can be essential to more than one Technical Specification. My analysis, however, shows that patents are, on average, declared to no more than a few Technical Specifications in 5G. This is because the claimed inventions are typically specific to certain parts of the standard. For example, one would not expect that a patent essential to a new coding technology would also be essential to location or positioning, because these technologies are generally unrelated.

The data corroborate this common-sense conclusion. Ericsson has been identifying its patents as essential to an average of only 1.2 technical specifications, which means that, on average, it declares its patents as potentially essential to one Technical Specification more often than it declares its patents to two or more Technical Specifications. Nokia and Qualcomm have similar practices. There are a few companies, however, that are declaring their patents far more broadly. For example, Sharp (Foxconn) is declaring its 5G patents as essential to an average of 8.4 Technical Specifications, which is seven times more Technical Specifications per patent than Ericsson. Huawei is declaring its patents as essential to more than five Technical Specifications on average, and ZTE is declaring its patents to more than four.

[21] China Academy of Telecommunications Technology

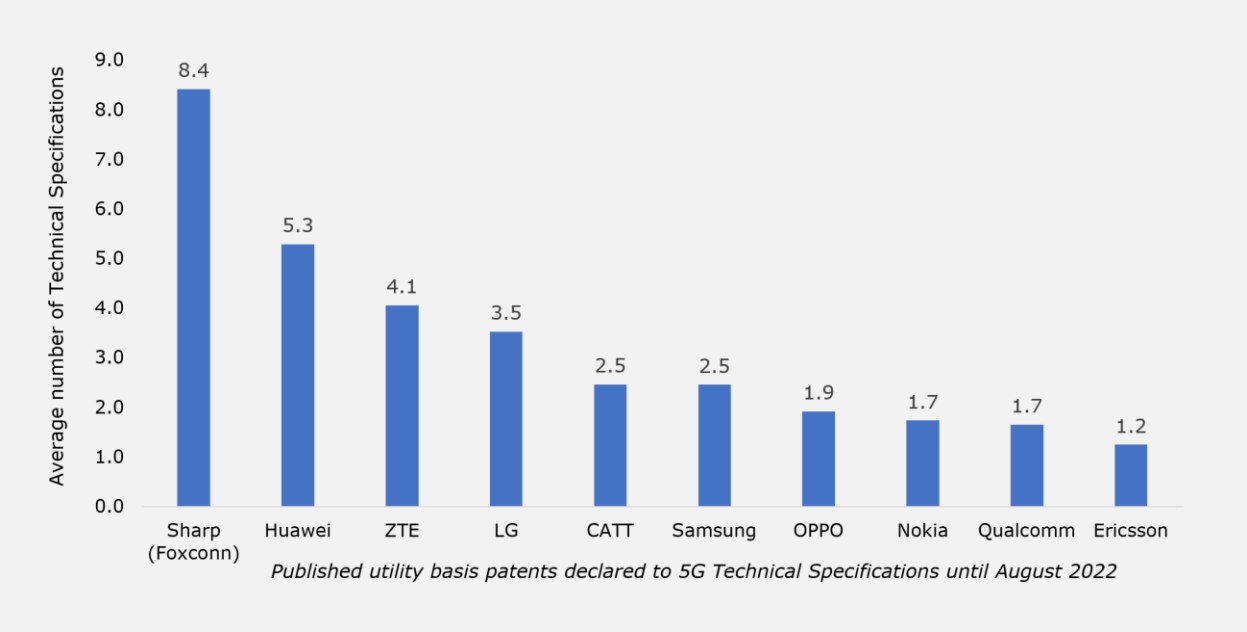

Exhibit 1: Some companies declare patents essential to many different Technical Specifications[22]

As I discussed above, each SSO participant is obliged to make reasonable and good-faith efforts in determining the potential essentiality of their patents, and to declare them on that basis. One inverse measure of the care that companies are taking in identifying patents as potentially essential is the number of Technical Specifications to which patents are declared essential. For example, in the extreme case where a patent is declared potentially essential to *every* Technical Specification, it is clear that the declarant has likely not accurately assessed the essentiality of that patent, because it is extremely unlikely that a patent is essential to all the various and disparate technologies that constitute a standard. While Technical Specifications are largely complementary, some patents read on more than one Technical Specification because there is some limited overlap in scope among certain specifications. Certain patents may implicate technology areas discussed in more than one Technical Specification as well. Typically,

[22] Specifications related to 5G (https://portal.3gpp.org/#/55936-specifications)

however, patents and Technical Specifications are directed to no more than a few related technology areas.

This is borne out by the data plotted above, where the majority of major declarants are declaring their patents as essential to no more than an average of 2.5 Technical Specifications. For the companies that declare their patents to significantly more Technical Specifications, it raises the question whether they identified those specifications with adequate rigor.

2. Review of the most significant standards sections

While 5G already includes 519 different Technical Specifications, including 275 that are unique to 5G and do not relate to 4G, 3G or 2G standards, patent declarations for 5G are very skewed towards certain top Technical Specifications.

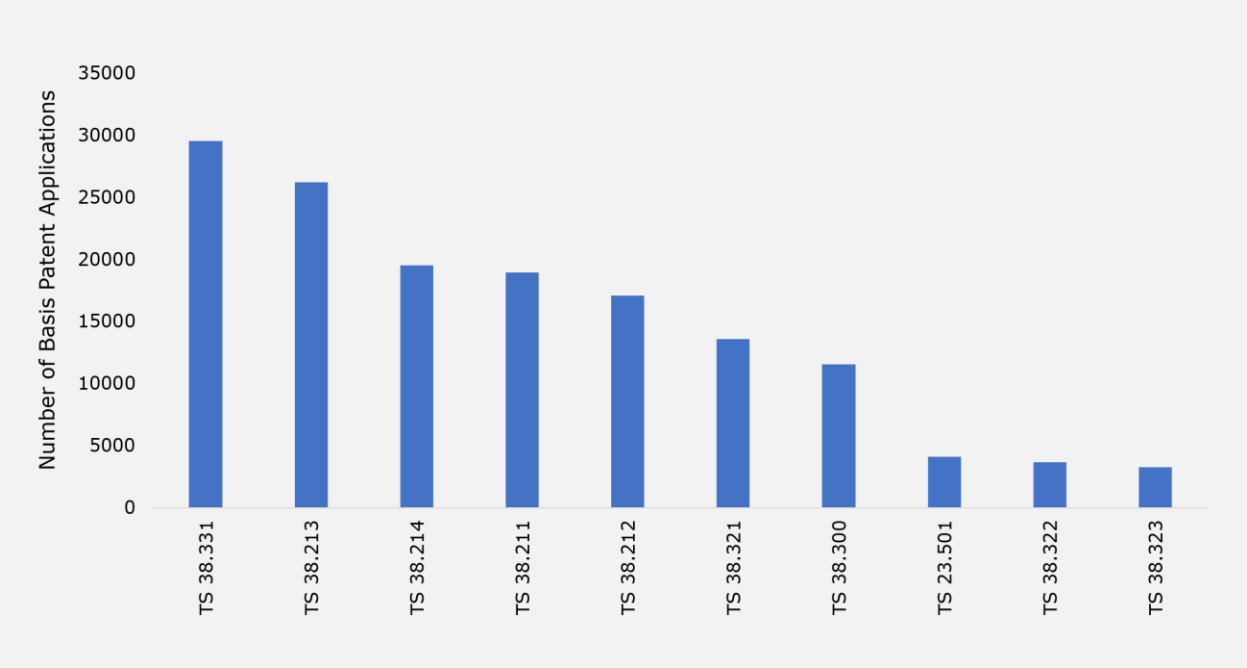

Exhibit 2: Top 10 Technical Specifications by numbers of declarations[23]

[23] Declarations to 5G Technical Specifications until August 2022. Published utility basis patents only.

Exhibit 2 shows the total number of patents that have been declared as potentially essential to the most popular Technical Specifications (in terms of numbers of declarations). Certain Technical Specifications have far more declarations than any other, as indicated by the steep drop-off in declarations between the 7th most popular Technical Specification (38.300) and the 8th most popular Technical Specification (38.501). I now focus on these particular specifications to further analyze the declaration practices of the largest declaring companies.

(a) Certain companies' claims illustrate over-declaration

As discussed, it appears that some companies are over-declaring their patents to numerous Technical Specifications. To analyze this "scatter-gun approach" in more detail, I counted the number of patents that each company has declared to one or more of the Top 12 Technical Specifications.

Exhibit 3 shows that Sharp (Foxconn) has uniquely declared 970 patents as essential to 18 Technical Specifications and 973 as essential to the top 7 Technical Specifications. Huawei has declared 62 patents as essential to all of the Top 12 specifications and declared 2,061 patents as essential to every one of the top 7 specifications. LG Corp and ZTE have also each declared more than 1,400 hundred patents as essential to all five of the top Technical Specifications. No other companies than the above, CATT and OPPO have declared more than *two* patents as essential to more than five of the Top 10 Technical Specifications.

# Specs	18	12	11	10	9	8	7	6	5	4	3	2	1
Company	TS 38.331 TS 38.213 TS 38.214 TS 38.211 TS 38.212 TS 38.321 TS 38.300 TS 38.322 TS 38.323 TS 38.215 TS 38.304 TS 38.201 TS 38.306 TS 38.305 TS 38.202 TS 38.340 TS 38.314 TS 38.307	TS 38.331 TS 38.213 TS 38.214 TS 38.211 TS 38.212 TS 38.321 TS 38.300 TS 23.501 TS 38.322 TS 38.323 TS 23.502 TS 38.215	TS 38.331 TS 38.213 TS 38.214 TS 38.211 TS 38.212 TS 38.321 TS 38.300 TS 23.501 TS 38.322 TS 38.323 TS 23.502	TS 38.331 TS 38.213 TS 38.214 TS 38.211 TS 38.212 TS 38.321 TS 38.300 TS 23.501 TS 38.322 TS 38.323	TS 38.331 TS 38.213 TS 38.214 TS 38.211 TS 38.212 TS 38.321 TS 38.300 TS 23.501 TS 38.322	TS 38.331 TS 38.213 TS 38.214 TS 38.211 TS 38.212 TS 38.321 TS 38.300 TS 23.501	TS 38.331 TS 38.213 TS 38.214 TS 38.211 TS 38.212 TS 38.321 TS 38.300	TS 38.331 TS 38.213 TS 38.214 TS 38.211 TS 38.212 TS 38.321	TS 38.331 TS 38.213 TS 38.214 TS 38.211 TS 38.212	TS 38.331 TS 38.213 TS 38.214 TS 38.211	TS 38.331 TS 38.213 TS 38.214	TS 38.331 TS 38.213	TS 38.331
Sharp (Foxconn)	970	0	0	0	0	0	973	973	975	986	1,095	1,204	1,687
Huawei	0	62	62	62	64	70	2,061	2,275	3,176	3,201	3,224	3,625	4,905
ZTE Corp	0	0	0	0	0	0	0	20	1,435	1,726	1,811	2,584	3,466
LG Corp	0	0	0	0	0	0	1	32	1,537	1,590	1,604	1,797	2,870
CATT	0	0	0	0	0	0	158	159	344	411	496	597	1,267
Samsung	0	0	0	0	0	0	0	1	123	538	845	1,854	3,146
OPPO	0	0	0	0	0	0	2	33	147	214	440	1,256	3,150
Nokia	0	0	0	0	0	0	0	0	0	0	18	83	505
Qualcomm	0	0	0	0	0	0	0	0	6	24	71	305	1,243
Ericsson	0	0	0	0	0	0	1	2	2	9	49	61	808

Exhibit 3: Number of patents companies declare to Top Technical Specifications and Sharp declares to 18 different of them [24]

[24] Declarations until 2022. Published utility basis patents only.

It is also notable that Sharp's declaration practices changed following acquisition of its patents along with other assets by Foxconn.[25] Before the acquisition in 2015, which was prior to the era of any 5G declarations, the average number of 3G and 4G Technical Specifications per declared patent by Sharp was 1.4 including published, unpublished and provisional patents. After the acquisition, from 2016 to August 2022 this figure including 3G, 4G and 5G Technical Specifications rose to an average of 7.7.

Some companies have clearly been systematically over-declaring numerous patents to all of several Top Technical Specifications. Other companies are declaring far fewer patents to multiple top Technical Specifications.

V. CONCLUSION

Although standard-essentiality declarations for 5G began relatively recently over the last few years, we can begin to draw some conclusions from the emerging data. For instance, although it is now clear that not all companies are assessing patents for declaration with the same rigor or focus, as is evident with very widespread declarations by Sharp (Foxconn) and Huawei in particular, as well LG and ZTE, there does appear to be a *generally-accepted* norm by most major declarers for narrow and targeted declarations, which is consistent with competent patent evaluation practices. From a policy perspective, narrow and targeted declarations are desirable, because they indicate that a company has made an analysis of the patent and identified its relevance to the standard. They allow others to more easily verify or disprove that the declaration is accurate, and they provide more insight into the invention practices of the different standards-setting participants. This analysis reveals, however, that the vast disparity in declaration practices means that one cannot compare numbers of declared SEPs to try to evaluate

[25] Foxconn to close some of Sharp's overseas ops, hasten patents to market, Reuters, June 2016 (https://www.reuters.com/article/us-foxconn-agm-idUSKCN0Z80WX)

the relative technical strength of different companies' patented contributions to the 5G standard, or to particular Technical Specifications.

This paper did not research the *reasons* behind the particular standards declaration practices of the companies studied; however, that is a fruitful area for study. My other research on counts of patents declared essential and found essential by assessors shows that essentiality checking does a poor job in mitigating over-declarations due to false positive determinations (i.e. where a patent is found essential when it is not truly essential) inflating patent counts.[26] Declaring patents to multiple Technical Specifications increases the chance that patents are incorrectly found to be essential by human and automated assessors. And, with patents being declared to increasing numbers of Technical Specifications, the time taken and cost for checking essentiality competently also increases accordingly. I encourage other researchers to build on my work to study declaration practices, the motivations for these and their effects, for example, on patent counts and checking costs.

[26] Essentiality Checks Might Foster SEP Licensing, but they Won't Stop Over-Declarations from Inflating Patent Counts and Making them Unreliable Measures (https://www.wiseharbor.com/wp-content/uploads/2022/11/Mallinson-on-essentiality-checks-and-patent-counting-16-November-2022.pdf)

VI. ARTICLE PUBLICATION AND AUTHOR

This article was researched and written by Keith Mallinson. It was originally published in the IP Finance blog and on SSRN on December 5, 2022.

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