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5G SEPs – how can early implementers predict aggregate royalties?

By David Kennedy and **Larry Tedesco**, Berkeley Research Group, LLC

There has been tremendous growth in the mobile telecommunications industry since the standards development organisation known as the European Telecommunications Standardisation Institute (ETSI) was formed in 1988 to promote greater harmonisation among European telecommunications systems. The industry has evolved from providing voice services for the privileged few to allowing billions of users around the world to communicate seamlessly and instantly share information in ways never before possible. This growth has been fuelled by the development and worldwide promulgation of the second-generation (2G), third-generation (3G) and fourth-generation (4G) cellular standards.

One of ETSI's primary objectives is to strike a balance between the interests of companies that implement the cellular standards in their products and require access to the cellular standards on reasonable terms and the interests of standard-essential patent (SEP) owners which must be fairly and adequately compensated for the use of their standardised inventions by others. ETSI has fostered this balance with a system under which SEP owners make voluntary fair, reasonable and non-discriminatory (FRAND) commitments – whereby the SEP owner commits to license its patents that are or may become and remain essential to a standard on FRAND terms and conditions, consistent with ETSI's Intellectual Property Rights Policy.

Today, the telecommunications industry is developing the fifth generation (5G) of cellular standards and working to commercialise 5G technologies in their products by 2020. We anticipate that, in the coming months, companies planning to implement the 5G standard in handsets, tablets and other mobile devices will develop business plans and formulate pricing strategies that account for their expectations of the aggregate royalties (often called the 'royalty stack') that they will be required to pay to 5G SEP owners in order to lawfully implement the 5G standard in their products. But given that 5G is pre-commercialisation and 5G SEP licences presumably have not yet been executed, there is an absence of market-based licensing information that could predict the future royalty stack on a 5G mobile device. In this situation, how should implementers estimate and reserve for what they will need to pay in aggregate royalties to license 5G SEPs?

This chapter briefly describes standards development organisations and the FRAND commitment, gives a short overview of the expected social and economic global impact of 5G and discusses several methodologies that, for planning purposes, an early implementer might use to estimate the future SEP royalty stack on a 5G handset.

Standards development organisations

Standards development organisations primarily develop, implement and maintain technical standards that enable the interoperability of systems and devices, such as telecommunications networks and mobile devices. ETSI, one of the most well known of these organisations, has played a leading role in developing the cellular standards since its founding. Together with six other standards development organisations, ETSI is an organisational partner of the industry consortium known as the Third Generation Partnership Project (3GPP). Since 1998, 3GPP has overseen

the ongoing development and maintenance of the 2G, 3G and 4G standards.

The FRAND commitment

As a general rule, when a standard incorporates technology that is patented, the patent is considered essential to implementing the standard. Since a product that complies with that standard must use the patent, ETSI members are required to notify the organisation of their SEPs. In these notifications, SEP owners can voluntarily commit to license the identified SEPs on FRAND terms and conditions. In the absence of such a commitment by the SEP owner, 3GPP presumably would select another technology to use in the developing standard. ETSI has never defined 'FRAND' with more specificity than "fair, reasonable, and non-discriminatory", and there is no universally accepted definition of the term. As a result, the question of what is FRAND for a specific licence is left to be decided by the negotiating parties or – where the parties cannot agree – a court or arbitration panel.

5G – predicted to change the world as we know it

Most technical and industry experts expect 5G to change our lives more than any cellular standard released to date. According to the Centre for Technology at Brookings, the 5G network is expected to support 50 billion connected devices by 2020 and 212 billion connected sensors, as well as enable access to 44 zettabytes of data. *Forbes Insight* predicts that 5G wireless networks will support:

- data rates of 10 gigabits per second per individual user (100 times faster than 4G);
- end-to-end latency as little as 1 millisecond (50 times better than 4G); and
- connections for as many as 1 million devices per square kilometre, or 100 billion devices worldwide.

This is naturally expected to spur innovation at an incredibly fast pace. *The Economist* described 5G and the next generation of mobile networks as something that will "offer users no less than the perception of infinite capacity". It will also enable a massive influx of connected 'smart' devices and machine-to-machine communications (ie, the Internet of Things (IoT)). 5G technology will allow these smart devices to connect seamlessly, bringing us even closer to a connected world that was hard to imagine just a decade ago (see Figure 1).

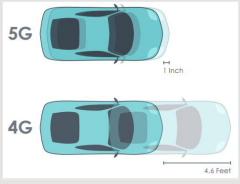
It is predicted that over 30 billion IoT devices will be connected, with as much as $1.7 trillion in annual revenue by 2020. The International Data Corporation's update to its Worldwide Semi-annual Internet of Things Spending Guide forecasts that US organisations will invest more than $232 billion in IoT hardware, software, services and connectivity in 2017 alone, and that IoT revenues will return a compound annual growth rate of 16.1% over the 2015-2019 forecast period. This means that by 2019, the US spend is expected to reach more than $357 billion. A recent Ericsson survey of more than 650 decision makers from eight key industries reported that nearly 90% of respondents "feel that next generation mobile networks are a game changer for their industries".

The mobile telecommunications industry has high expectations for 5G, as evidenced in statements by Alcatel-Lucent, Nokia, Ericsson and Samsung in an EU grant agreement for mmMagic, a pre-5G standardisation project that brings together major infrastructure vendors to focus on researching mmWave technologies to enable ultra-fast mobile broadband service for 5G devices and services. For instance, Samsung – an infrastructure vendor and the world's top handset vendor by sales volume – stated that the growth in the volume of smartphones and other mobile devices, coupled with ever-increasing sophistication and capabilities of these devices to support a wide range of enhanced and new applications (eg, ultra-high definition and virtual presence), is one of the key drivers for the 5G standard and supporting technology components. Alcatel-Lucent, a provider of leading-edge 4G systems with a wide range of functionalities and capabilities, similarly discussed how future 5G systems will far exceed the capabilities of today's systems.

Estimating aggregate royalty stack on a future 5G mobile device

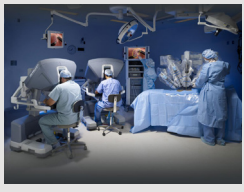
While there are a number of methodologies to determine the fair and reasonable value of a patent portfolio, looking to the terms and conditions of existing licences to the portfolio is the best method of determining that value. This is referred to as the 'market approach' to valuation, because it uses market-based comparable information as a guide to determining value. We believe – and courts have agreed – that this approach is the preferable means of determining whether licensing offers by SEP owners to potential licensees comply with their FRAND commitment. For example, in

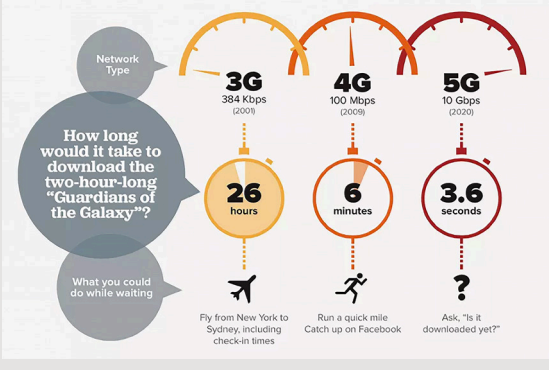
Figure 1. The possibilities of 5G



Driverless trucks and cars will fill the roads, able to respond to navigation commands and unexpected hazards instantly, without distractions, materially reducing collisions and deaths. According to the US Department of Transportation, as many as 80% of all crashes – excluding those in which the driver is impaired – could be mitigated using connected-vehicle technology. With the near instantaneous communication that 5G will deliver, a self-driving car could apply its brakes and stop within an inch (with 4G it would take the same car almost five feet).

Remote surgery will be greatly expanded as latency levels are reduced to small intervals, allowing for extremely precise remote control. Surgeons will be able to use virtual tools and operate machinery using haptic control, which would allow the surgeon to 'feel' what is going on in the machine's environment – a doctor could, for instance, 'feel' his or her patient's body in a distant operating room to avoid slicing through a vein. 5G will also enable experienced doctors to mentor young physicians on proper techniques from a distance. It will also help areas lacking certain medical specialities to benefit from the expertise of more densely populated areas.





The battery life of certain 5G devices is expected to increase significantly to 10 years or more.

Thanks to peak speeds of 10 gigabytes per second, consumers will be able to download media like never before – an entire high-definition movie would take just 3.6 seconds – whereas with 4G, downloading the same movie could take as long as six minutes.

Source: www.cnet.com/news/how-5g-will-push-a-supercharged-network-to-your-phone-home-and-car/

Ericsson v D-Link the Federal Circuit affirmed that "licenses may be presented to the jury to help the jury decide an appropriate royalty award". In *CSIRO v Cisco* the Federal Circuit reiterated its "prior approvals of a methodology that values the asserted patent based on comparable licenses" and explained that "[s]uch a model begins with rates from comparable licenses and then 'account[s] for differences in the technologies and economic circumstances of the contracting parties.' Where the licenses employed are sufficiently comparable, this method is typically reliable because the parties are constrained by the market's actual valuation of the patent".

Today, however – in the early phases of the developing 5G standard, before companies have obtained and started to license 5G SEPs – it is not feasible for an implementer to use its existing 5G SEP licences to estimate and extrapolate the fair and reasonable aggregate cost of licensing 5G SEPs. How then can an implementer make this estimation? Four possible methodologies are presented below. Because these methodologies use real-world market-based evidence to estimate the value of future 5G technology and the aggregate royalties corresponding to that value, their outcomes should reflect what a well-functioning market should offer to incentivise 5G development and commercialisation.

Methodology 1 – analysing statements by industry members

One methodology for an implementer to estimate aggregate royalties for 5G SEPs is to review early statements by industry members that own and use SEPs about their expectations for 5G royalties and/or the 5G royalty stack. Ericsson recently made an announcement regarding its future 5G pricing, but we are not aware of any other such announcements regarding expected 5G pricing to date. However, several announcements were made by industry members in the past about their expectations for the 4G royalty stack. For example, in 2008 Alcatel-Lucent, NEC, Ericsson, NextWave Wireless, Nokia and Sony Ericsson issued a press release indicating that "a reasonable maximum aggregate royalty level for LTE [4G] essential [IP rights] in handsets

David Kennedy
Managing director
dkennedy@thinkbrg.com

David Kennedy is a certified public accountant and an expert in IP licensing, valuation, analysing claims of economic damages related to IP infringement and negotiating the economics of patent sales and licensing agreements. Over 30 years, he has served as the lead negotiator in more than 200 IP-related transactions and performed patent portfolio valuations in a variety of industry segments for investor groups, large public companies and patent holding companies. He has served in International Chamber of Commerce international arbitration and litigation matters as an expert in determining fair, reasonable and non-discriminatory (FRAND) royalty rates. Mr Kennedy has testified in the Court of Federal Claims and in state, federal and bankruptcy courts regarding patent values, royalty rates, licensing practices, lost profits, trade secrets and other forms of economic damages.

Larry Tedesco
Director
ltedesco@thinkbrg.com

Larry Tedesco provides financial damages, valuation, licensing and expert witness services in litigation matters. Over 20 years, Mr Tedesco has monetised intellectual property as an owner and on behalf of clients in a wide range of industries. He has also negotiated more than 100 IP-related transactions. Mr Tedesco's experience includes strategic advisory services to IP owners and companies of all sizes, IP valuations, providing multiple levels of IP damages assessments for plaintiffs and defendants in significant IP disputes, evaluating licensing terms and the intent of parties in patent licensing litigation and calculating reasonable royalty rates for standard-essential patents subject to FRAND commitments. Mr Tedesco is a Certified Licensing Professional and a Certified Valuation Analyst.

is a single-digit percentage of the sales price". The average retail price of a 3G handset was about $450 at the time of this announcement, and presumably the industry expectation was that 4G handsets would have an average retail price of at least that when introduced. One can infer from this that the industry members that made this announcement anticipated a maximum royalty stack exceeding $45 per handset for 4G SEPs. Given the industry consensus that the 5G standard will bring value to a mobile device over and above what was conferred by the 4G standard, it is reasonable to conclude that industry members' expectations for the 5G royalty stack exceed their historical expectations for the 4G royalty stack on a dollar per-unit basis. In light of this, we believe that statements by industry members about their expectations for the 4G royalty stack can provide insight into the industry's current expectations regarding the aggregate royalties that an implementer can expect to pay for 5G SEPs.

Methodology 2 – valuing expected technical benefits of 5G over prior standard generations

A second possible methodology to estimate aggregate royalties for 5G SEPs involves an economic analysis of the expected technical benefits of 5G. This would begin with a study performed by technical experts, who would isolate

specific technical benefits expected from 5G technologies and determine how those benefits will be different from, and more valuable than, the corresponding benefits provided by prior standard generations (eg, the increase in data rates that 5G technology is expected to confer on a mobile device over and above that conferred by 4G technology). The next step would be calculating an economic value for these technical benefits based on that comparison. The overall goal would be to place a dollar value on the technical benefits provided by 5G technology as compared to the presumed next best non-infringing alternative to estimate the economic value that 5G will confer on a mobile device. Because a fair and reasonable royalty should reflect the technical value of the underlying inventions, this calculation – if performed properly – could estimate a fair and reasonable aggregate royalty for 5G SEPs.

Methodology 3 – analysing studies and court decisions regarding 4G royalty stack

A third possible estimation methodology begins by examining publicly available data about the SEP royalty stack on a 4G handset, as seen in studies prepared by industry commentators and in court decisions. For example, in 2011 ABI Research published a study that estimated that aggregate SEP royalties on a 4G multi-mode handset would exceed 30% of the handset price. In another example, in 2014 an Intel in-house counsel and two attorneys from the law firm of WilmerHale authored a paper that estimated the aggregate royalties for SEPs used in a 4G multi-mode handset to be approximately $54, or 14%, on a $400 smartphone. In a third example, in 2017 the UK Patents Court issued a detailed opinion (*Unwired Planet v Huawei*) in which it calculated a FRAND royalty rate that implied aggregate SEP royalties of 8.8% of the price of a 4G multi-mode handset. Given the many indications that 5G technology will confer more value on a mobile device than 4G technology, it is reasonable to infer that the royalty stack for SEPs used by a 5G multi-mode handset will exceed the royalty stack for SEPs on a 4G multi-mode handset. This means that studies and court decisions that give indications of the royalty stack on a 4G multi-mode device (and the examples above are by no means an exhaustive list) can provide insight into what a company can expect to pay, at a minimum, in royalties for SEPs used in a 5G multi-mode handset.

Methodology 4 – mobile device pricing comparison

A fourth possible estimation methodology looks to historical pricing for mobile devices at the time that a new standard generation is commercially released. For example, we have reviewed data showing that in 2012, when 4G LTE smartphones were first sold in significant numbers, the average selling price of a 4G LTE smartphone was around $100 higher than the average selling price of a 3G HSPA (advanced 3G) smartphone with substantially similar features. After accounting for the increased bill of materials for the 4G device, the additional implementer revenue from sales of the 4G smartphone could act as proxy for the additional value conferred on a smartphone by 4G technology, as compared to the prior standard generation, and as a starting point for estimating the value that 5G technology will confer on a smartphone, as compared to 4G technology (which, as mentioned, is expected to be greater than the increase in value between 3G and 4G). We believe that it is reasonable to assume that an implementer can expect to pay a share of this added value in aggregate royalties for 5G SEPs.

Conclusion

In planning for future 5G standard-compliant products, prudent implementers will anticipate and work to estimate the future 5G royalty stack on a mobile device. This chapter will hopefully provide food for thought for companies which are planning to implement 5G standardised technology in future products and preparing for future royalty payments to 5G SEP owners. These companies may consider one or more of the methodologies described above – or other additional market-based methodologies – in order to estimate the future SEP royalty stack on a 5G mobile device. *iam*

Berkeley Research Group, LLC
1005 Alderman Drive
Suite 205
Alpharetta GA 30005
United States
Tel +1 770 954 7979
Fax +1 678 550 6818
Web www.thinkbrg.com