# THE ESSENTIALS OF INTELLECTUAL PROPERTY

## QUANTIFYING TECHNOLOGY LEADERSHIP IN THE DEVELOPMENT OF THE LTE STANDARD

SEPTEMBER 2010

*Prepared by Signals Research Group, LLC*

*Paper developed for Ericsson*

SIGNALS Research Group
www.signalsresearch.com

On behalf of Ericsson, Signals Research Group, LLC leveraged some of its earlier research on the topic of essential IPR to provide some perspectives on some of the commonly-used means of determining who owns essential LTE patents, including why these various methods frequently produce erroneous or at least misleading results. Additionally, we conducted an audit of a database designed to track the degree to which each company involved in the development of the LTE standard actually contributed suggestions that were ultimately accepted by its peers. Through this effort we have been able to determine the degree to which each participating member in the development of the LTE standard influenced the standard through its technology leadership and contributions.

As the sole authors of this paper, we stand fully behind the analyses and opinions that are presented in this paper. In addition to providing consulting services on wireless-related topics, Signals Research Group is the publisher of the *Signals Ahead* research newsletter and *The Dollars and Sense of Broadband Wireless,* the first independent in-depth study of next-generation broadband wireless network economics (*www.signalsresearch.com*).

# Table of Contents



# Index of Figures

## 1.0 Executive Summary

In the last decade there has been a tremendous increase in the interest of intellectual property rights (IPR) and how it relates to the wireless industry at large. The high level of interest is due, in large part, to the influence that intellectual property (IP), or to be more specific the licensing of IP, can have on the adoption and future success of a wireless technology and the companies in the industry that lay claim to that IP.

Unfortunately, this renewed interest has also resulted in the dissemination of inaccurate or at least misleading information pertaining to IP. In particular, numerous attempts have been made to determine who owns the essential patents that apply to LTE in order to illustrate how the IP landscape will change with LTE and to identify those companies who are best positioned to benefit with the introduction of LTE from an IP licensing perspective.

The renewed interest in intellectual property, in particular as it applies to LTE, has resulted in the dissemination of inaccurate or at least misleading information pertaining to the IP.

Two of the more widely-used means to count essential patents leverage the ETSI IPR database or rely on key word searches in various public patent databases to identify the essential patents and their respective owners. In the case of the ETSI IPR database, the results of such an exercise merely reflect the entire list of patents that companies self-proclaim are essential without any third-party validation while a very large percentage of the submissions reflect patent filings for which an actual patent may never be granted, or for which a patent that is eventually granted has a much narrower scope than what was originally sought. Relying solely on a company's self-proclamation that its patents are essential is comparable to a judicial system that renders a verdict based solely on the defendant proclaiming his innocence.

An essential patent counting exercise that leverages key word searches produces results that are even more misleading. In addition to the resultant query containing a large number of patent applications and not actual patents, the query of patents would include patents that may contain the key word (e.g., MIMO), while the actual patent itself pertains to something entirely different. In some cases, the patent may not have anything to do with the wireless industry.

The reality is that it is virtually impossible for any outside organization, however well-informed and well-intended they may be, to independently determine the ownership of the essential patents that are required to implement LTE. Instead, the only credible means of determining the ownership and distribution of essential LTE patents is to have first-hand knowledge of the cross-licensing deals that companies are signing and the patents that are involved. Even then, a complete picture will not be possible for years to come, or until after all of the cross-licensing deals have been signed and all of the companies claiming that they own essential patents have had a chance to prove their claim.

As part of this effort, over the course of a two month period Signals Research Group, LLC (SRG) conducted a third-party audit of an analysis that was first done by Ericsson in an effort that originally took six man months to complete. The purpose of our audit and the original analysis done by Ericsson was to determine the extent to which each participating member company contributed to the development of the LTE standard (Release 8) during a two-year period between 2007 and 2008. To be clear, we made no attempt to determine the number of essential patents that Ericsson owns, however, we believe that the results of this exercise can

provide a strong indication of how well positioned Ericsson is when it comes to the ownership of essential LTE patents.

Our analysis of 3GPP documentation suggests that Ericsson was the single biggest contributor to the LTE standard over a two-year period when a large majority of the Release 8 standard was originally developed.

Based on our analysis of publicly-accessible 3GPP documentation we conclude that Ericsson was the single biggest contributor to the LTE Release 8 standard. To be more specific, Ericsson accounted for 18% of all approved submissions that were made within the 3GPP technical working groups responsible for developing the standard. The next closest contributor had 22% fewer approved submissions. Following these two companies, there is a considerable drop-off, or approximately 60% fewer submissions, to the next grouping of four companies who all have a comparable number of approved submissions.

We can't conclusively state that a company's technology leadership within 3GPP has a direct correlation to its LTE essential patent strength. However, a company that is an active [and successful] contributor to the 3GPP standardization process is in a much stronger position to shape the LTE standard such that it incorporates some of its home-grown technology – technology that could prove to be covered by essential patents held by the company.

Further, given the important emphasis that the wireless industry and the individual companies involved in the standardization process place on essential patents and IPR, it is more likely than not that a company who makes a technical submission to the LTE standard does so with the belief that it will benefit if the submission is approved, either because the submission enhances the performance of its solutions or because it has secured patents which pertain to the proposed implementation features described in the technical submission.

In a similar fashion, it is more likely that a company that is actively involved in the standardization process will end up owning a large number of essential patents than a company that was not a participant. This outcome is largely because the 3GPP member companies are working on specific problems for a technology that is still in its infancy so they would have an inherent advantage when it came to coming up with a specific solution that addressed one of these problems, getting their specific solution adopted by the 3GPP standards body, and ultimately owning an essential patent. Companies that are outside of the standardization process may not have the foresight to recognize the problems associated with implementing LTE, and if they so happened to lock on to a real world implementation problem, their patented solution to the problem would likely differ from the approach adopted within the standardization process. After all, granted patents have a limited scope so just because the patent is related to a concept used within the LTE standard doesn't necessarily mean that it applies and is, therefore, essential.

Chapter 2 provides a primer on IPR, the definition of an essential patent, the implications of FRAND (Fair Reasonable and Non-discriminatory) licensing practices, and a perspective on how companies license each other's patents. Chapter 3 describes some of the more popular patent counting methodologies that have been used to determine who owns essential LTE patents as well as some of the fallacies with these approaches. Finally, Chapter 4 discusses the methodology that we used to determine technology leadership within the 3GPP standards body and the results from our study. Following Chapter 5, which provides some important conclusions, we include an appendix, which contains some additional figures that provide more information from the study.

## 2.0 An IPR Primer

Intellectual property rights (IPR) pertains to an individual's or company's legal right to own an idea or technical feature that it has created. With the establishment of IPR as a legal precedent, a company is able to invest significant amounts of capital for research and development efforts knowing that its investment will be protected through its patents or through the licensing of its patents. While the intent of this paper is not to offer a historical dissertation on IPR, it is interesting to note that the legal enforcement of IPR is credited as being one of the single most dominant factors for the technical advancements that society has experienced since the early 20th century.

In many industries, such as the pharmaceutical industry, companies fiercely protect and guard their IP so that their competitors do not have access to it. In the wireless industry, or in any industry that depends on open standards for its success, there needs to be a fine balance between protecting the individual rights of the patent holders and the overall success of the industry at large. Each industry ultimately adopts a philosophical approach that is in its best interests, hence there isn't a formula for IP licensing that is universally applied.

In this chapter we provide some important background information about intellectual property, in particular as it applies to the wireless industry. We explain the differences between essential and non-essential patents, we discuss how essential patents are licensed through the use of FRAND, and we highlight how companies in the wireless industry typically make their patents available to others and gain access to other companies' patented ideas through the use of cross-licensing agreements.

### *2.1 The Definition of an Essential Patent*

Before we can look at some of the popular methods that are used to determine who owns the essential LTE patents, we first need to explain what an essential patent is. After all, not all patented technologies are essential; in fact, as we discuss throughout this whitepaper, very few patents actually end up being classified as essential.

The General Assembly of ETSI (European Telecommunications Standards Institute) is responsible for developing standards for various information and communications technologies, including mobile technologies. In this regard, it has direct responsibility for the oversight of the 3GPP (Third Generation Partnership Project), the standards body responsible for developing the family of GSM technologies, including GPRS/EDGE, UMTS/HSPA/HSPA+, LTE, and ultimately LTE-Advanced.

According to ETSI, the definition of an essential patent is as follows:

> "ESSENTIAL" as applied to IPR means that it is not possible on technical (but not commercial) grounds, taking into account normal technical practice and the state of the art generally available at the time of standardization, to make, sell, lease, otherwise dispose of, repair, use or operate equipment or methods which comply with a standard without infringing that IPR. For the avoidance of doubt in exceptional cases where a standard can only be implemented by

> technical solutions, all of which are infringements of IPRs, all such IPRs shall be considered ESSENTIAL.[1]

Within the group of essential patents there are two types of essentiality. The highest level is an explicit essential patent, meaning that the language contained in the standard essentially spells out the description of the patented technology that is provided in the legally binding patent claim. The next class of essential patents is referred to as implicit, which means that the patent is not explicitly written into the standard, but that in practical terms there are no other commercially viable means of executing the standard other than to use the patented technology. As one might surmise, most essential patents fall into the implicit so their treatment as an essential patent becomes a bit more subjective.

Companies develop and patent new technologies for several reasons. They could be trying to establish a pool of patents in the hopes that one or more of the patents becomes essential to a wireless standard; they could be trying to improve the performance or introduce a key feature in an existing product portfolio, thus creating a differentiated solution; or they could be trying to develop an entirely new technology that ultimately gets standardized or remains proprietary to the company that developed it.

Most patented technologies never earn the status of being an essential patent.

Regardless of a company's underlying motivation, it is important to point out that most patented technologies never earn the status of being an essential patent. From what we have observed, most patents are used to enhance a company's solution or the patent pertains to a proposed feature or implementation within a wireless standard that never gets adopted. Interestingly, in some of the recent and well-publicized patent infringement lawsuits, some the patents that were at the heart of the litigation were not even essential patents. The point being that just because someone infringes on another company's patent doesn't mean that the patent is essential, only that it was used by a non-licensed entity.

### *2.2 The Meaning of FRAND*

In standard setting organizations, such as the 3GPP, participating member companies have an obligation to license their essential patents using a fair, reasonable and non-discriminatory licensing practice, or FRAND. In its IPR policy, ETSI also points out that, "IPR holders… should be adequately and fairly rewarded for the use of their IPRs in the implementation of standards and technical specifications." [2]

FRAND is intended to maintain the delicate balance between the interests of the IP holder and the needs of the broader set of companies that need access to the essential IP.

FRAND is intended to maintain the delicate balance between the interests of the IP holder, who may be heavily investing its own capital resources at risk to develop more advanced technologies, and the needs of the broader set of companies that require access to the essential IP in order to make the standard a success. If companies are not somehow rewarded for their R&D investment then they will no longer have an incentive to develop new technologies. After all, the underlying technologies that comprise LTE were only *agreed* to within the 3GPP standards body. It was the individual members who *developed* those technologies. On the other hand, if

[1] *ETSI Rules of Procedure,* Annex 6, paragraph 15.6: ETSI Intellectual Property Rights Policy, 8 April 2009

[2] *ETSI Rules of Procedure,* paragraph 3.3

the combined licensing fees of all essential patents holders are too onerous then the technology will fail to achieve widespread success as it would be too expensive to implement.

Just as determining whether or not a patent is essential is a bit subjective, the definition of FRAND is somewhat open to interpretation. By definition, FRAND means that companies must license their essential patents using fair licensing terms and they must request a reasonable licensing fee that is applied equally to all licensees. However, one company's definition of fair and reasonable may be entirely different than another company's view. The subjective nature of FRAND has resulted in litigation and claims that a company is or isn't abiding by the FRAND terms.

More recently, the major mobile operators involved in the NGMN (Next Generation Mobile Networks) Alliance have made FRAND a key criterion for LTE. As a result of their effort, numerous patent holders have publicly disclosed the licensing fee that they charge licensees for access to their essential patents. While this disclosure helps mitigate non-discriminatory licensing practices, companies may still use different interpretations of what is fair and reasonable. Further, the disclosed licensing fees are generally exclusive to LTE and they do not necessarily include the legacy technologies which must still be supported.

### *2.3 IP licensing within 3GPP/ETSI*

Although we are not privy to all of the details surrounding IP licensing deals that have taken place in the wireless industry, we do have a pretty good perspective on how the process works. Understanding this process is important since it helps explain why some companies are better positioned than others when it comes to licensing essential patents – even if they don't own any essential patents – while we also leverage this insight to discuss how essentiality is ultimately determined.

Within the 3GPP community, companies generally enter into bilateral licensing agreements with those companies who possess IP that they want or need access to. When two companies sit down at the table they first share their available patent portfolio. This disclosure allows each company the opportunity to evaluate the portfolio that it seeks to license. During this evaluation process, the company's team of patent experts determines the patents that they wish to license as well as what they believe those patents are worth to them. Ultimately, the value of those patents is offset by the value of their own company's patents that the other company licenses. Assuming both sides reach an agreement, a licensing deal is stuck and both companies walk away with the patents that they wanted or needed to license.

There are a few observations that can be made about this process.

**Most licensing deals are not exclusively focused on LTE.** Most companies who own or claim to own essential LTE patents also have essential patents that apply to legacy wireless standards. Conversely, a company who is licensing essential 3GPP patents for the first time most likely requires a license to use essential patents for GSM/EGPRS and UMTS/HSPA. It could be that the two companies have already licensed each other's essential patents for pre-LTE standards, but if this was not the case, the two companies would want to ensure that they had all of the

patents that they needed. Furthermore, a company may wish to knowingly license a nonessential patent (if possible) if they needed or at least wanted that patented technology for other purposes (discussed in a subsequent bullet).

**Companies without essential 3GPP patents may still own valuable patents that it can license.** Imagine a company that had patented an advanced audio/video compression technology or an innovative touch screen mechanism that made data entry onto a mobile device far superior to other solutions. Arguably, there are probably many companies in the industry that would want to use that technology in their own products. Through the cross-licensing process the company with the valuable, albeit nonessential patents, could use their desired patents to barter a more attractive deal with a company that owned essential patents and who wanted access to those technologies. Through cross-licensing, this scenario is possible and it rewards companies with patented innovative technologies, even if they are not considered essential to the implementation of a standard. That said, companies are under no obligation to license nonessential patents that they possess, and they may not want to do so if that patented technology gave them a distinct advantage in the market segment in which they competed. FRAND only applies to essential IPR and not to the universe of patents.

**A company's stated LTE licensing fee can be offset by patents that it wishes to license**. Although a company may disclose that it charges a certain percentage for its essential LTE patents, the net licensing fee that the company signs with a licensee may reflect an entirely different rate. Such a practice is not necessarily discriminatory since the net licensing fee reflects the value of the patents that it needs or at least wants to license, while it may also offer the licensee additional patents which were not included in the list of essential patents.

**A company's claim that it owns essential patents must be vetted by its licensees.** If we were to take everything at face value, nearly every company would own essential LTE patents, nearly all of their declared essential patent filings would be essential, and the total sum of each company's claimed share of the essential patents would exceed 100%. Clearly, this scenario is completely unrealistic. As discussed in the next chapter, through the cross-licensing process companies reach their own independent conclusions about how many essential patents the other party at the negotiating table has in its patent portfolio, not to mention their belief about how valuable those patents are to them. It is only through the bi-lateral negotiation process that the true validity of an essential patent claim can be verified.

## 3.0 The Challenges of Determining A Company's LTE IP Portfolio Strength

In the last decade there has been a tremendous increase in the interest of IPR and how it relates to the wireless industry at large. To some extent, the interest has even resulted in the formation of its own cottage industry. Numerous industry analysts (including SRG) have published and sold reports on the topic; financial analysts and investors use IP when trying to determine the valuation of a company; companies have been created for the sole purpose of dealing with IP licensing; and well-publicized lawsuits centered on intellectual property have taken place that have subsequently been widely followed by the mainstream media.

The high level of interest is due, in large part, to the large influence that IP, or to be more specific the licensing of IP, can have on the adoption and future success of a wireless technology. Furthermore, as took place in some of the legal disputes over the last several years, the misuse or perceived misuse of a company's IP can result in the disruption of a critical wireless service or impact a critical piece of the supply chain. Additionally, through the efforts of the NGMN Alliance, commercial initiatives on the part of a few private companies, and the stated intent of several companies, including Ericsson, to keep the aggregate royalty rate to a reasonable level (e.g., FRAND), there is a move to introduce new licensing policies with the introduction of LTE in order to better control the economic influence of IP licensing.

Unfortunately, this renewed interest has also resulted in the dissemination of inaccurate or at least misleading information pertaining to IP. In particular, numerous attempts have been made to determine who owns the essential patents that apply to LTE in order to illustrate how the IP landscape will change with LTE and to identify those companies who are best positioned to benefit with the introduction of LTE from an IP licensing perspective.

It is virtually impossible for any outside organization to independently determine the ownership of the essential patents that are required to implement LTE.

The reality, and as discussed throughout this chapter, is that it is extremely difficult for any outside organization, however well-informed and well-intended they may be, to independently determine the ownership of the essential patents that are required to implement LTE. This statement is especially true when the process used to count essential patents is based on some of the methodologies described in this whitepaper. Instead, the only credible means of determining the ownership and distribution of essential LTE patents is to have first-hand knowledge of the cross-licensing deals that companies are signing and the patents that are involved. Even then, a well-informed understanding of the essential patent landscape will not be possible for years to come, or until after all of the cross-licensing deals have been signed and all of the companies claiming that they own essential patents have had a chance to prove their claim.

In order to illustrate why an accurate representation of essential LTE IP ownership is virtually impossible to establish, we will take a look at two popular essential IP counting methods that are being used today and discuss why they are not a good means of determining LTE patent leadership. We will then go into more detail about why the only accurate means of determining the ownership of essential LTE patents is through the courts or through the cross-licensing process.

### *3.1 Patent Counting using the ETSI Database*

The most popular method that is being used today to determine the distribution of essential LTE patents is to use the ETSI IPR database to count the patents that each company claims apply to the implementation of LTE. At first glance, this method seems entirely reasonable and, if nothing else, it results in some very quantitative results which look very credible to the uninformed reader. However, there are several fallacies with this method which reduce the results to being anecdotal at best, or more likely flat-out wrong and completely misleading.

The ETSI database is a popular starting place for most LTE patent counting exercises. In addition to being easily accessible online through the ETSI website, there is an aura of "correctness" in the information contained in the database since it is maintained by ETSI. ETSI, we note, "is recognized as an official European Standards Organization by the European Union" and it is a key constituency in the development of 3GPP standards, which include LTE. Additionally, the criticality of this IPR database and the whole concept of essential IP is reinforced at each 3GPP meeting when member companies are reminded that:

> The attention of the delegates to the meeting of this Technical Specification Group is drawn to the fact that 3GPP Individual Members have the obligation under the IPR Policies of their respective Organizational Partners to inform their respective Organizational Partners of Essential IPRs they become aware of.
>
> The delegates are asked to take note that they are thereby invited:
>
> - to investigate whether their organization or any other organization owns IPRs which were, or were likely to become Essential in respect of the work of 3GPP.
> - to notify their respective Organizational Partners of all potential IPRs, e.g., for ETSI, by means of the IPR Statement and the Licensing declaration forms *(http://webapp.etsi.org/Ipr/)*. [3]

The ETSI IPR database contains literally thousands of patents or patent submissions (23,366 at last count) that ETSI member companies submit when they believe their patent is essential or could be essential to the implementation of an ETSI project (109 projects at last count). ETSI is one of several standards bodies that belong to the 3GPP, with other standards bodies including ANSI (American National Standards Institute) and TIA (Telecommunications Industry Association). Like some of the other standards bodies, ETSI has a strict requirement for its members that they must declare their essential patents for standards that they support, or what these companies believe are their essential patents. In the case of ETSI, access to its database of self-proclaimed essential patents is relatively straightforward, and perhaps that is one of the reasons for its popularity. That being said, the database is by no means the only source where people can turn to look for a laundry list of patents that may apply for a particular wireless standard.

[3] 3GPP RAN Plenary TSGR #40 Meeting Notes, May 2008 (identical text appears in all 3GPP meeting reports for each technical working group.)

Within the database, these patents are categorized according to the company that owns the patent, the country or countries where the patent application was filed, the date the patent was declared, the application and publication number of the patent (if available), and the technology, or project, which the patent supposedly covers.

Creating a list of "essential LTE patents" for each member company and then counting the number of patents in the list is relatively straightforward and perhaps this is another reason why the ETSI IPR database is widely used for patent counting. However, the results that are obtained from this approach – however quantitative the information may appear to be – produce erroneous conclusions about the official ownership of essential LTE patents.

Given the ETSI requirement there is the natural perception that its database contains a list of essential LTE patents. However, there are several fallacies associated with relying too heavily on this database for the sole purpose of determining the ownership of essential LTE patents, including:

**The submission process is self-policing.** While 3GPP member companies are obligated to disclose what they believe are their essential patents and to submit information about those patents to the ETSI IPR database, there is no mechanism in place to ensure that those patents are, in fact, essential to the standard. In other words, just because a company submits a patent that it claims is essential doesn't mean that it is essential. Taking a company's word that its patents are essential would be comparable to exonerating a defendant because he said he was innocent or awarding the FIFA World Cup Championship trophy to the team whose fans screamed "We're number one" the loudest.

Companies actually have an incentive to overstate their patent strength by submitting any and all patents and patent applications that could theoretically be essential patents.

For various reasons, and because there is no independent policing of these claims, companies actually have an incentive to overstate their essential patent strength by submitting any and all patents and patent applications that could theoretically be essential patents. First, there is no penalty for submitting a non-essential patent while failing to disclose an essential patent in a timely manner could limit the company's ability to license the patent to other member companies in the future. Second, companies don't always know for certain whether or not a patent is really essential until the cross-licensing process begins and its peers have had the opportunity to make their own determination while the ever-evolving development of the standard could one day result in the patent becoming essential, even if it wasn't originally essential to the standard. Finally, companies are keenly aware that the IPR database is a popular source that is used for counting essential patents so it doesn't hurt to look good in the subsequent analyses, even if the results are misleading.

When SRG first researched the subject of IPR in 2005 – at that time it was for the original 3G standard – we leveraged the ETSI database to look at the distribution of 3G patents. However, we also recognized and made it clear in our report that the database included a large number of non-essential patents and therefore the database contained what we described as a large amount of chaff in addition to the wheat. Instead of using the database to show essential 3G patent leadership, we used the database to demonstrate that a large number of companies were

claiming a large number of essential patents. Our conclusion at the time was that it would be virtually impossible for us [or anyone] to determine who actually owned essential 3G IP without inside knowledge into the cross-licensing deals that were taking place. Instead, counting each company's submissions in the database and declaring each submission as an essential patent would only serve to muddy the waters.

Unfortunately, over the years the ETSI IPR database has been used to extract information and reach conclusions that it was not intended to support. In fact, there is a very visible disclaimer that appears when someone first gains access to the database. The disclaimer states:

> The present database provides data that is based on the information received. ETSI has not checked the validity of the information, nor the relevance of the identified patents/patent applications to the ETSI Standards and cannot confirm, or deny, that the patents/patent applications are, in fact, essential, or potentially essential. No investigation, or IPR searches, have been carried out by ETSI and therefore no guarantee can be given concerning the existence of other IPRs which are, or may become, essential.
>
> Potential Licensees should use the information in this database at their discretion and should contact the patent holder, for example to establish the asserted status for a disclosed patent family, prior to making a patent licensing decision. I have read the terms upon which the present information is made available. [4]

**The database includes patent applications that may never be granted or which are subsequently revised to limit their scope.** According to ETSI guidelines a company must notify them in a timely manner if a company believes that it has an essential patent which may apply to a standard that falls under the auspices of ETSI. Therefore, companies generally notify ETSI of a potential essential patent after they have submitted the patent application but before the patent is issued. This preemptive action is important because it generally takes at least 3 to 5 years for a patent to be approved, and waiting 5 years or in many cases even longer to notify the ETSI of a patent that is potentially essential to one of its standards may not qualify as timely. Therefore, the ETSI IPR database includes patents that have been granted by the pertinent patent authorizing agency and patents applications that have been filed, but for which no patent has been granted yet.

Since there is no means of knowing whether or not the patent will ever be granted, counting patent applications as issued patents will overstate a company's actual patent portfolio.

The problem arises when a patent counting exercise treats patent applications as approved patents. Since there is no means of knowing whether or not the patent will ever be granted, counting patent applications as issued patents will overstate a company's actual patent portfolio – whether or not the patent is essential is an entirely different manner, as discussed in the previous bullet.

There are many reasons why a patent may not be issued for a patent filing. Patent applications that contain a vague description of what technology the proposed patent is intended to protect or patent applications that attempt to extend the reach of the proposed patent beyond

[4] ETSI IPR Database Portal *(http://webapp.etsi.org/IPR/IPR-confirmation-page.asp?url=Content1.asp)*

a reasonable limit will probably not be issued. There is also the likelihood that another organization has already received a patent for a very similar technical idea. Keep in mind lots of companies are developing technologies and filing patent applications left and right that could be used in a next-generation wireless networks (e.g., LTE) and until the patent issuing authority has fulfilled its responsibilities there is no way to know whether or not someone else has already tried to patent the idea.

Even if a patent is issued for a patent application there is a good probability that the patent granting organization will limit the scope of the patent from what was proposed in the application. As an extreme, and somewhat hypothetical, example to make our point, a patent application may try to patent "space travel" thus making it virtually impossible for anyone to build and launch a rocket ship without infringing on the patent. During the review process, the patent examiner might recognize a portion of the claim in the patent application that is patentable and award a patent for an improved and innovative means of making freeze-dried food.

Clearly, the published patent still has some intrinsic value to the patent holder, but the scope of the original claim has been greatly reduced. In the case of a patent that seemingly relates to LTE, a reduction in the scope of the claim could turn what appears to be an essential patent into a non-essential patent.

While we didn't spend a lot of time with the ETSI database, we did put forth enough effort to realize that it contains a high percentage of patent applications that have not been granted patents. Specifically, we targeted two large patent filers and determined that only 30% of their entire submissions to the ETSI IPR database had an actual patent number, indicating that a patent had been issued. With submissions that are specific to LTE we suspect that the percentage of actual patents relative to the number of patent filings is much lower given that the 3GPP just started working on the LTE standard in the 2005-2008 timeframe, meaning that the ownership of much of the intellectual property that pertains to LTE is still in legal limbo, pending the outcome of the patent application review process.

Furthermore, there is an approximate 18 month window between the time an application is filed and when an application number is granted, at which point the general public can view the patent. Since the LTE standard is relatively new there is also the possibility that a patent application for what ultimately has essential IPR falls within this window and it would not be counted. This occurrence would be even more likely for patent counting exercises that were done shortly after the LTE standard was completed.

**The database includes multiple patents within the same patent family.** Companies frequently file a patent application for the same patented idea in multiple countries, thus creating a patent family if those countries ultimately issue a patent. Further, companies tend to file slight modifications to one of their existing patents, thus effectively extending the life of the original patent even if the new patent is largely redundant with the original pattern. While both practices are generally accepted within certain boundaries, it can introduce erroneous results when simplistic patent counting exercises are used.

For example, an extension or slight revision to an existing patent would result in two patents appearing in the database. Although the second patent would largely replicate the first patent a patent counting exercise would still give it full credit as a unique patent. Identifying instances where this phenomenon exists would be nearly impossible without a thorough analysis of each patent.

Presumably, it should be possible to remove duplicate patents that result from multiple countries granting a patent for the same patented technology since this information is more apparent in the database. However, unless the database was sorted and thoroughly scrubbed for these occurrences, multiple counting of the same patented idea across several countries would result. In a similar fashion, a patent issued in only one country could be unenforceable in other countries where the patent wasn't granted. For this very reason most companies try to simultaneously file their patent application on a global basis, but this situation does not always take place.

Said another way, a patent that is enforceable across a large number of countries is far more valuable than a patent that is only enforceable in a single country. Conversely, a patent that exists in multiple countries appears multiple times in the database. In either instance, a simple counting of the submissions, without removing duplicates or without heavily discounting the intrinsic value of a patent that only applies to a single country, would result in misleading conclusions regarding the patent strength of the patent holder.

While not specifically related to the notion of a patent family, companies may also link their database submissions to multiple ETSI projects. For example, the database separately lists "LTE," "LTE Release 8," "LTE Release 9," "LTE Release 10," "SAE," "3GPP," … as viable ETSI projects. To the extent that a company tags a submission to multiple projects that all relate to the same underlying project the submission would appear multiple times in the same query and unless a careful scrub of the query was made, each appearance would get counted as a unique submission.

**The database does not include patents which ETSI members have not submitted.** ETSI requires its member companies to declare their essential, or potentially essential, patents in a timely manner, but the exact definition of what is meant by a timely manner is a bit vague. Presumably, by this point companies have notified ETSI of all intellectual property that they believe applies to LTE Release 8, but this situation did not always exist, meaning that at one time the list of LTE Release 8 submissions would have been incomplete. Similarly, the submissions in the database are most likely incomplete even today with respect to future advancements of LTE, such as Release 10 (LTE-Advanced).

**The database excludes patents from non-ETSI members.** Companies involved in the 3GPP standardization process must declare their essential, or potentially essential, patents to ETSI. The same requirement does not apply to non-ETSI members, meaning that the database potentially contains an incomplete list of patents/patent applications for the various ETSI projects. As discussed later in this whitepaper there is a high probability that most of the essential patents that apply to LTE belong to companies that are actively involved in the standardization process.

If for no other reason, these companies are all very active when it comes to filing patent applications while there is a natural tendency for a company to make technical submissions in the standardization process which it believes coincide with the intellectual property that it possesses. Whether or not this intellectual property ultimately gets patented or becomes essential to the standard is an entirely different matter. Nevertheless, one should not assume that the database contains the entire universe of patents that are essential to the LTE standard.

**Net-Net:** While the ETSI IPR database contains a wealth of information, its contents, in and of itself, are a poor source for determining who owns patents that are essential to the implementation of LTE. Buried within the thousands and thousands of submissions there probably exists most of the patents that ultimately are essential to the LTE standard. Unfortunately, the preponderance of non-essential patents, patent applications which never get approved, duplicate submissions which exist for reasons previously mentioned, equal treatment of all submissions regardless of how extensive their geographic coverage is, and the potential absence of at least some essential patents, makes it virtually impossible to identify all of the essential patents with any degree of accuracy. Instead of correctly identifying the distribution of essential IPR, a simplistic patent counting exercise of the ETSI IPR database merely rewards those companies that take a more aggressive approach when it comes to identifying their essential IPR.

That being said, the ETSI IPR database is a good source from which to begin a more thorough analysis of each patent to determine its potential essentiality. In addition to being a laborious exercise that would be virtually impossible for any one person or organization to thoroughly complete, the results would still be subjective to the opinion of the reviewer. Furthermore, to the extent a non-member company happened to own an essential patent, it would not be contained within the database.

### *3.2 Patent Counting using Key Word Searches in Various Open Patent Databases*

Another method that has been used to determine the ownership of essential LTE patents is to use the engine search features that are available for various patent databases, such as the one maintained by the US Patent and Trademark Office (USPTO). With this methodology the user types in a key word or phrase that theoretically will produce a list of all patents that include that word somewhere within the patent. The underlying assumption with this approach is that a search using a key search word, such as "OFDMA," "MIMO," "LTE," etc will produce a list of all essential patents that exist for the LTE standard. For various reasons, this patent counting methodology produces results that are potentially even less meaningful than the results derived from the aforementioned ETSI IPR database methodology.

One fallacy with using key word searches in various open patent databases is that it will produce false positives, or patent filings that have absolutely nothing to do with the search word.

One fallacy with this approach is that it assumes the proposed patented technology actually applies to the LTE standard. As an extreme example of why this approach will produce false positives, we did a search for patent filings using the search word "MIMO" since MIMO is a key feature of LTE. It is also a key feature of other technologies, including IEEE 802.11n, 802.16e and various proprietary technologies that exist, but that is an entirely different argument for why this methodology is flawed. In doing this search we quickly discovered a patent (#7,756,591) for a "System for optimizing oxygen in a boiler." While we found "MIMO" mentioned in the

patent (e.g., the search produced a valid hit), it was quite evident that in this context Multiple Input, Multiple Output had absolutely nothing to do with an advanced antenna technology and more to do with a "neural network based dynamic model."

Even when a word, such as MIMO, is used in a patent filing to refer to an advanced antenna technology, there is no guarantee that the patent has anything to do with the implementation of MIMO or that the MIMO feature being patented is actually used in the LTE standard. For example, we found a patent (#7,760,127) entitled "Portable position determining device" which also used the term MIMO. In this case, the context of its usage was specific to 3G, but the patent dealt with determining the precise location of a device that supports the technology described in the patent. Any informed analysis of this patent should conclude that the inference to MIMO within the patent does not suggest that the patent is an essential LTE patent or that the patent even pertains to the implementation of MIMO. Nonetheless, the patent would presumably get counted using this approach.

There is also the situation where the patent seems to meet all of the important criteria for being an essential patent, but it is still not an essential patent. Instead, the patent could reflect a feature that was considered, but not adopted in to the LTE standard or the patented idea could have been adopted as an optional feature or enhancement to the LTE standard that companies would not have to implement if they chose not to do so.

One must also recognize that the term LTE is a relatively new term in the industry that may actually precede patent applications that have essential IPR for LTE. One foreseeable situation would be a patent that contains essential IPR for a feature used in GSM or UMTS, which is also essential in LTE. A key word search for "UMTS" would identify the patent, but with this methodology it would probably not even be considered as containing essential LTE IPR.

Assuming that most people do not have the time to read hundreds if not thousands of patents, companies could even interject many of these "buzz words" into their patent filings on the premise that these patent filings would get flagged with this search methodology. Similarly, companies frequently embed hidden buzz words within their website in order to produce more hits through some of the popular Internet search engines.

Even if someone took the time to thoroughly read the patent, he or she could still reach an inaccurate conclusion regarding its essentiality to the LTE standard. For example, in doing some earlier research on the topic of MIMO it became evident to us that the 3GPP was considering multiple and largely dissimilar ways of implementing MIMO – ultimately, only one of the approaches was adopted into the standard. Assuming that all of these different flavors of MIMO have been patented then it would stand to reason that at least some of the patents wouldn't even apply to the currently proposed implementation of MIMO, and they obviously wouldn't be essential to its implementation. This same argument can be used for the previously mentioned ETSI IPR database approach.

Finally, to the extent these databases contain granted patents and patent applications, the search results would include patent filings which may never get issued a patent, or which get issued a patent with a more narrow scope than applied for.

**Net-Net:** The use of key word searches within various patent databases can produce completely meaningless results. In addition to the search returning patent applications which may never a patent or which receive a patent for a greatly reduced scope, the search would identify patents which make a passing reference to the key word but which deal with an entirely different technology. Even if the patent description dealt specifically with the key word used in the search, the patent wouldn't necessarily be essential or it may not even reflect how the technology was being implemented within the standard (it could be an alternative approach that wasn't adopted or the issued claim could include elements that are not incorporated into the standard).

### *3.3 Using Patent Citations to Determine if a Patent is Essential*

To date, the practice of using patent citations to determine the quality of a patent that pertains to LTE has not been used, nor has this method been used to determine if it is essential, but this methodology still merits a few comments.

At first glance, the methodology does seem to have its merits since the earning of a citation largely depends on the independent assessment of the patent reviewer. When a patent reviewer is reading a patent application, he or she lists earlier patents which are relevant to the patent application that is being reviewed. Furthermore, with some patent issuing agencies, such as the USPTO, the patent filer is required to identify patents that are relevant to the patent application. Thus, it would seemingly stand to reason that the more times a patent is cited, the more valuable the patent is, and, in turn, the more likely it is an essential patent. There are some important caveats which must be considered.

When a patent reviewer cites an earlier patent in a new patent application that is under review, the citation is almost always due to the contents of the body of the patent and not the actual patent claim itself. For example, if an earlier patent contained an eloquent and detailed explanation of the basic principles of MIMO, it would probably be cited in subsequent patents. At the extreme, the body of the patent could theoretically describe a laundry list of every single basic concept that applies to LTE, even though the actual patent claim only deals with one very specific feature of only one of those concepts described in the body of the patent. In other words, one must completely separate the contents of the body of the patent from the potential value and scope of the patent claim.

To be clear, the patent is cited because of the descriptive language in the body of the patent. The actual patent claim itself may not be that noteworthy and it may have little relevance to the very specific ways that MIMO is used in LTE.

**Net-Net:** Patent citations are used by patent reviewers to identify earlier patents which are similar in nature to the patent application under review. However, the similarities are based on the descriptive body of the text and not the actual patent claim itself. Those patents which do

a great job of describing a basic technology concept that is too large in scope to be patentable (e.g., our space travel example in an earlier section) will often be cited in subsequent patents, but it will say very little about the underlying quality and scope of the patent, and even less about its essentiality.

### *3.4 How a Patent's Essentiality is Ultimately Determined*

When we first looked at the topic of IPR we interviewed a large number of IP experts from many of the leading firms in the wireless industry. While we are by no means patent experts and we probably wouldn't recognize an essential patent if we saw one, we do have a pretty good understanding of how companies in the industry ultimately determine which patents are essential to the implementation of a standard.

As previously discussed in the last chapter, an essential patent means that it is not possible to implement the standard on technical grounds without infringing on the intellectual property protected by the patent. However, the process under which this determination is made is a bit convoluted and almost entirely hidden from the public domain. As such, the simplistic methodologies described earlier in this chapter would fail to capture the intricacies of how a patent becomes essential.

The process under which a patent is deemed essential is a bit convoluted and almost entirely hidden from the public domain.

When companies enter into cross-licensing negotiations each side reviews the other side's patent portfolio in order to determine the portfolio's perceived value relative its own patent portfolio. Given that the number of patents being analyzed by either side is relatively small in comparison with the universe of potential patents (e.g., the ETSI IPR database) and the importance of the analysis to the financial well-being of the companies involved, patent experts with a wealth of knowledge about the technologies they are licensing are able to conduct a thorough review of each patent.

Even in these situations, they don't necessarily flag each patent as "essential or "non-essential." Instead, a company merely reaches a conclusion about which patents it wishes to license and the value of those patents relative to its own patents. Over time, each company involved in the cross-licensing deals will develop a better appreciation of its peers' patents and reach certain conclusions regarding the distribution of essential patents among those companies where it has completed cross-licensing deals. Given the expertise of the individuals involved in the analysis and the amount of time that they spend reviewing all of the patents (inevitably a multi-year event), their conclusions regarding the distribution of essential patents is probably fairly close to reality. However, since essentiality is somewhat subjective, there may not even be universal agreement among these companies regarding which patents are actually essential.

The court systems are frequently used to settle patent disputes, in particular they are used when one company claims that another company is infringing on one or more of its patents. However, while the courts may rule on whether or not a patent is being infringed, they do not necessarily rule on the essentiality of the patent. This statement is especially important since it is just as likely that a company has infringed upon a non-essential patent. That said, companies could

leverage these court rulings to help them determine if a company holds patents that they may also need to license in order to prevent a future patent infringement lawsuit.

**Net-Net:** The essentiality of a patent is largely a subjective determination. Over a multi-year period, and after all of the cross-licensing deals have been reached, companies involved in the licensing process should have a good perspective on who owns the essential patents for LTE. At this point in time even companies that are heavily involved in the licensing process do not have a complete understanding of the patent strength of their peers. It is, therefore, a bit of a stretch to suggest that any of the conclusions being presented today about the distribution of LTE patents are accurate.

## 4.0 LTE Technology Leadership

As we have discussed in the previous chapters of this whitepaper the commonly-used approaches for determining the distribution of essential LTE patents across companies in the wireless industry have, to varying degrees, numerous flaws. The one "advantage" of these approaches, if you will, is that the analysis can be completed fairly quickly even if the actual results are not accurate.

In theory it might be possible for an outside third party to determine the distribution of essential patents among the key patent holders, but in practice it would be virtually impossible to achieve. It would require a thorough review of all published patents and patent applications that have not been approved, including those patent applications which may not be in the public domain (e.g., the aforementioned 18 month window), and it would require a complete understanding of the LTE standard. Further, and most importantly, determining essentiality is still somewhat of a subjective process, regardless of one's technical and legal expertise. In effect, the only credible means of determining a patent's essentiality is done when companies seek to cross-license each other's patents or through a legal decision in the event that a company is believed to be infringing on another company's patents. Even then, different companies may reach different conclusions regarding the essentiality of a patent while the courts will not necessarily rule that a patent is essential, only that the company is infringing on the patent through the implementation of its solution.

It is, however, possible to examine the origins of the LTE standard and the companies that were instrumental in developing the standard within the 3GPP standardization process. While the results of such an exercise would not provide specific information about the ownership of essential LTE patents, the results would identify the companies most heavily involved in developing the standard. It is also important to realize that the wireless industry and the companies involved in the development of its standards have always placed a strong emphasis on the importance and value of the associated patents. This phenomenon is even more prevalent since the development of the original 3G standard as evident in the large number of self-proclaimed essential patents in the ETSI database that pertain to LTE.

Therefore, it would be logical to assume that companies who make technical submissions in these standards meetings do so with the belief that the acceptance of their submission would be in their best interest; for example, they have already filed a patent application for the idea. It wouldn't be logical for a company to spend all the time and effort associated with making the submission and backing up their recommendations with analytical support, simulation studies, etc., if the net result was that it would benefit another company from a licensing perspective. Additionally, by analyzing the technical leadership of companies involved in the 3GPP standardization process it is possible to identify discrepancies in which a company claims to own a large number of essential patents yet it did very little, if anything, to get its [potentially patented] ideas adopted into the standard.

To the best of our knowledge, and until now, no one has ever sought to quantify leadership within the 3GPP standardization process. If for no other reason, and as we have discovered in

the process, the effort requires several man months to complete. In the next section we discuss our methodology, followed by our analysis of the results.

### *4.1 Methodology*

Over a two-month period, Signals Research Group conducted a third-party audit of an analysis that was first done by Ericsson. In the original effort, which took a reported six man-months to complete, Ericsson assembled an exhaustive list of all technical submissions that were made to the various working groups (RAN1, RAN2, SA2, SA3 and CT1) within the 3GPP standards body that contribute to the technical implementation of 3GPP standards during the period of 2007-2008.

The study was limited to these particular working groups since their areas of responsibility are most closely aligned with the patented technologies that a new entrant, in particular a device manufacturer, would need to license in order to enter the market with an LTE product. Conversely, the other working groups focus on areas, such as the various interfaces within the core network, that a device manufacturer would not have to license or in some cases the working group is largely responsible for developing procedures to confirm a solution's adherence to the standard (e.g., RAN 5). This two-year period was selected since it includes the meetings during which a large majority of the work on the LTE standard (Release 8) was conducted. Since 2008, LTE has continued to evolve, including the pending completion of LTE-Advanced (Release 10), but the majority of the specifics regarding the original implementation techniques associated with LTE should have already been in place by the end of 2008.

Once the complete list of all submissions was assembled, including the company or companies who made the submission, each individual submission was categorized as either pertaining to LTE or pertaining to other work that was ongoing during these 3GPP working groups during this time period. Finally, and most importantly, each submission was also tagged according to whether or not the pertinent working group approved the submission. While arduous, this last step is particularly important since a company's submission only has an influence on the standard if it is accepted by the working group.

A company's submission only has an influence on the standard if it is accepted by the working group.

We audited 100% of Ericsson's original effort. This effort included reviewing the database that Ericsson had created of all 3GPP submissions which were made during the two-year period to confirm that it was complete, that all of the approved LTE documents were properly labeled, that the source of each submission was correctly identified, and that the overall methodology used to consolidate and calculate the results was correctly implemented. While such an audit was very time consuming, it was also feasible to complete since the information used to populate the database of company submissions is publicly available on the 3GPP website if one knows where to look.

In order to ensure that each company was given credit for all of its approved contributions, the counting methodology that was used for the analysis combined the contributions for companies which have since been brought together through an acquisition or merger –Alcatel Lucent is an example. The one exception to this rule is that the results separately count Motorola's

contributions since at the time Ericsson conducted its analysis the acquisition had not been announced. It is also unclear to us which group within Motorola was responsible for each submission so it would have been extremely difficult for us to correctly attribute the submissions to the remaining Motorola assets versus the assets that NSN will be acquiring later this year. In the event that multiple companies contributed to an approved submission each company was awarded partial credit.

The methodology used to determine the results in the next session and the details of our audit process are identified in more detail in the following bullets.

- **Identify and capture all 3GPP submissions.** The first step was to assemble a complete list of all 3GPP submissions during 2007-2008 for the aforementioned working groups. In addition to the title of the submission, the database also captured other important information, including the meeting number, Tdoc number, source or author of the submission, and the agenda item number. All of this information was obtained from the 3GPP website. Depending on the working group, the complete list of submissions was contained in a spreadsheet format, thus making it relatively easy to assemble, or in some cases it had to be manually extracted from the meeting reports from each meeting. The following working groups and their associated meetings were used in the analysis.

  **RAN1:** RAN1#47bis through RAN1#55
  **RAN2**: RAN2#56bis through RAN2#64
  **SA2:** SA2#56 through SA2#69
  **SA3:** SA3#46 through SA3#53
  **CT1:** CT1#51 through CT1#55bis

  This effort resulted in a database of 42,318 submissions. A large percentage of these submissions, or 45%, had nothing to do with LTE, but it served as the starting point from which the analysis could begin.

- **Identify those 3GPP submissions that pertain to LTE.** Once there was a consolidated list of all submissions to the pertinent 3GPP working groups those submissions which pertain to LTE were labeled as such. For this step the agenda item number assigned to each submission was used to determine its classification. In advance of each working group meeting commencing the chair of the working group establishes an agenda for the meeting. In turn, when a company submits a document that it wants to present at the meeting, it notes the appropriate agenda item on the submission.

  For example, there might be 10 agenda items during a particular meeting with the 8th agenda item pertaining to LTE. All LTE submissions for that meeting would be tagged Agenda Item 8 so that all of the LTE documents would be discussed at the appropriate time during the meeting. Therefore, for each meeting the reviewer (Ericsson or SRG) had to identify the agenda item that was used for LTE and then tag all of the submissions from that meeting with that agenda item number as being an LTE document. Given the multi-party review

process of the 3GPP meeting reports we assumed that all documents were appropriately labeled with the correct agenda item number.

- **Identify and tag those 3GPP submissions that pertain to LTE which were approved.** Once all of the LTE submissions were identified, the reviewer then had to determine which LTE submissions were "approved" or "agreed" versus "noted" or "withdrawn." Those documents which were approved or agreed were tagged as such so that they could be counted in the next step in the process. Those submissions which contain meeting report or liaison submissions between various working groups were excluded.

Throughout this entire process no attempt was made to determine the technical merits of each submission. To be specific, we know that some of the approved documents contain language which describes how the particular LTE feature should be implemented and to a layman the document seemingly describes something that could be patentable. Likewise, we also know that some of the approved documents merely contain minor tweaks, such as editorial comments, to a particular 3GPP specification that was being discussed. In at least some of these instances, we doubt that the document introduced a patentable technology, but it was still counted as a contribution to the development of the LTE standard.

As part of our audit, we could have attempted to pass our own subjective analysis on each document to determine its technical merits but that would have opened us up to the same criticism that we raised earlier in this report since we felt there was a lot of grey area where the technical merits of a document were not particularly obvious. Furthermore, in the grand scheme of things the all-inclusive approach does not impact the over-arching conclusions of the study although it could have had modest implications for some of the specific findings.

- **Give credit or partial credit to each company who authored the submission.** Once the complete list of all approved LTE submissions had been consolidated, the reviewer then gave credit to the source or sources for the submission. In the case of a multi-party submission the counting methodology used in the analysis gave partial credit to each company. For example, if three companies cosigned a document then each company received 0.33 points.

To the extent that two companies merged after 2008 and/or two closely-related companies made their own submissions, those submissions were combined into one entity in order to give them as much credit as possible. This means that the separate contributions of Alcatel and Lucent were combined into Alcatel Lucent. Ericsson and ST Ericsson contributions were combined in a similar fashion. In the case of Nokia and Nokia Siemens Networks (NSN) they are two separate companies although they frequently co-sign submissions. In order to give them the full credit they deserve and to not misrepresent their participation, they were treated as a single entity. For example, if three companies (e.g., Nokia, NSN and Vendor A) co-signed a submission, Nokia/NSN received 0.5 points and Vendor A received 0.5 points.

While not shown in this paper, we did a partial analysis in which we did not combine the results for companies that have since joined forces or who are closely related. We found that the results were very similar in nature, namely that Ericsson was still the top contributor to the development of the LTE standard.

### *4.2 Results and Analysis*

We can make several observations and reach certain conclusions following our analysis of the data. These observations are provided in bullet format throughout the remainder of this section. In summary, our analysis suggests that Ericsson was the single biggest contributor to the development of the LTE standard as defined by its success in getting its recommendations and ideas incorporated into the LTE Release 8 standard.

While there is not a direct correlation between the number of approved submissions and the number of essential patents a company possesses, it does stand to reason that a company which expends a tremendous amount of effort to put forward a recommendation has done so with the belief that it owns the rights to the idea. Further, if a company is claiming a large number of essential patents, yet it has had very little success in getting its ideas approved within 3GPP, one should naturally question the company's self-proclaimed patent strength.

Ericsson was the single biggest contributor to the development of the LTE standard as defined by its success in getting its recommendations and ideas incorporated into the Release 8 LTE standard.

Two things are certain. First, unlike patent-counting exercises which rely upon a company's self-proclamations to determine how many essential patents it has, this approach relies on an independent source – the 3GPP working groups – to determine what has and what has not been incorporated into the LTE standard and who should get credit for the contribution. Second, this approach doesn't include predictions of which documents (e.g., patent declarations) actually get approved and published. Instead, it only counts documents (e.g., approved 3GPP submissions) after they have been approved by a company's peers.

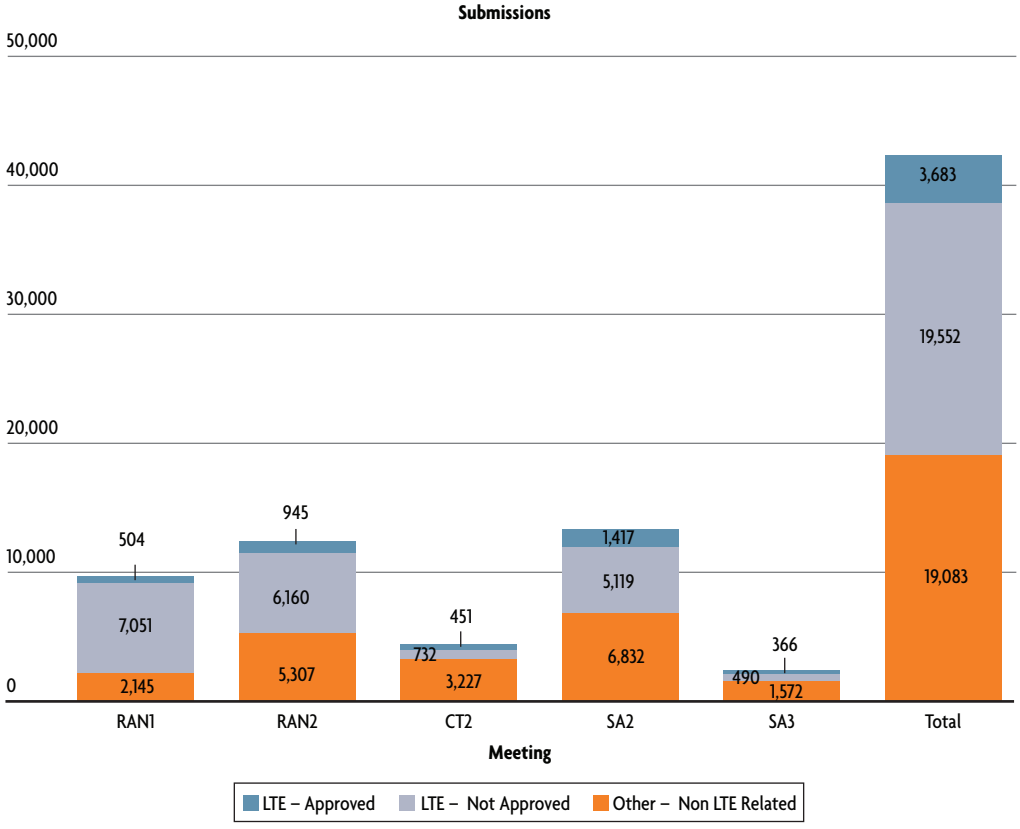
- **Our third-party audit suggests the results, which we summarize in the following bullets, are accurate.** Before we could endorse Ericsson's conclusion that it was a technology leader during the development of LTE, we felt obligated to conduct our own audit of its work. During our audit we did uncover some anomalies in which we discovered submissions that were not correctly labeled and we discovered a couple of meetings that were overlooked and one meeting where all of the submissions were double counted. The results, as shown in this whitepaper, are based on an updated spreadsheet which we believe properly categorizes those submissions. To the extent there remain slight discrepancies which we and Ericsson inadvertently overlooked – a very foreseeable situation given the mammoth undertaking – we believe they would be of little consequence to the over-arching results.

  We also believe that the approach used to identify technology leadership during the development of LTE is appropriate and that it gives each company the credit it deserves. Great care was taken to maximize each company's efforts with a consistent and unbiased methodology. If a company was a partial contributor to a submission it was given the appropriate amount of partial credit. For those companies that have since merged we counted the combined efforts of each individual company since this approach would reflect their contributions in the best light.

- **Most 3GPP submissions never get approved.** Although there were a large number of company submissions during the two-year period that we reviewed, approximately half of them deal with LTE, and of those LTE submissions, only a modest percentage actually were approved. To be specific, we counted 42,318 submissions across the five working groups over the two-year period, of which only 23.235 submissions pertain to LTE. The remaining submissions relate to other 3GPP work activities, such as HSPA+, that were taking place at the time. Of the LTE-specific submissions, only 3,683 documents, or 15.9% of all LTE submissions, were approved by the pertinent 3GPP working group, meaning that the contents or suggestions contained in the document were incorporated into the LTE standard. The remaining LTE submissions were withdrawn, noted (but not approved), revised, or not acted upon by the working group. Most of the unapproved submissions fell into the latter classification.

  Figure 1 provides a summary of the 3GPP activity for the 2007-2008 time period. It shows the number of total submissions by working group, the number of submissions that pertain to LTE and the number of LTE submissions which were approved.

**Figure 1. 3GPP Submission Activity – by Working Group**



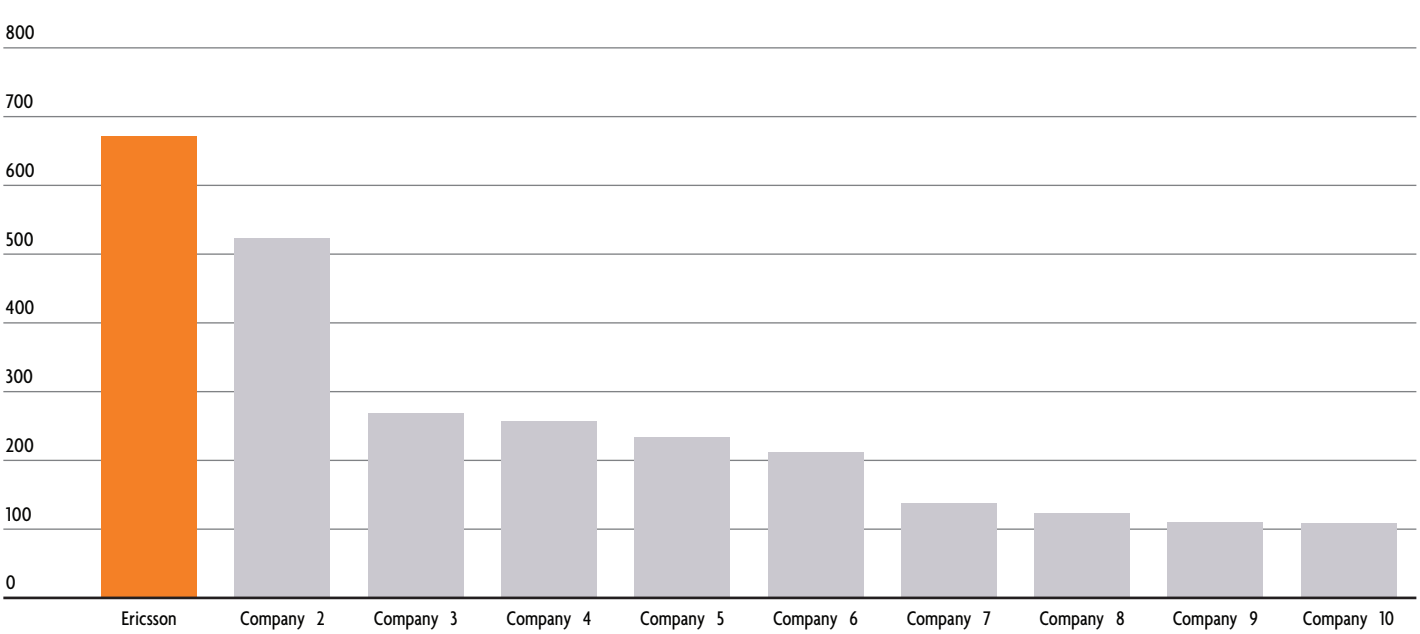

Source: Signals Research Group, LLC

This observation also reinforces the critical distinction between a company making frequent submissions to the 3GPP standards body and its actual contribution to the published standard. The former is helpful since it gives the standards body the opportunity to consider another idea in the pursuit of developing the best possible standard; the latter is more indicative that the company can rightfully claim that the standard has incorporated some of its suggestions, and potentially even some of its patented ideas.

- **Ericsson, including ST-Ericsson, was the single greatest contributor to the development of the LTE standard.** According to our analysis, Ericsson accounted for 18% of all approved 3GPP submissions that pertain to the LTE Release 8 standard. The second greatest contributor following Ericsson had 22% fewer approved submissions. Following these two companies, there is a considerable drop-off, or approximately 60% fewer submissions, to the next grouping of four companies who all have a comparable number of approved submissions.

  Figure 2 illustrates the top ten contributors to the LTE standard along with the number of approved contributions that they made to the standard. In total, these ten companies account for 72% of all approved submissions, meaning that the remaining 89 companies account for 28% of the approved submissions. Also worth noting, of the remaining companies who made at least some contribution to the LTE standard, no single company accounted for more than 3% of all approved submissions with most companies only able to claim a fractional percentage of the approved submissions. In other words, the top ten contributors to the LTE standard can rightfully claim that their combined efforts represent the majority of the work done on the LTE standard and of these ten contributors, Ericsson is by far the leading contributor.

**Figure 2. 3GPP Approved Submissions for the LTE Release Standard – by Company**




Source: Signals Research Group, LLC

- **The companies who are frequently identified as major holders of essential LTE patents are not necessarily leading contributors to the 3GPP standardization process.** As indicated in the previous bullet, the top ten contributors account for 72% of all approved submissions for the LTE Release 8 standard. If the various patent-counting methodologies that are frequently used are an accurate reflection, or at least representative, of a company's true essential LTE patent portfolio then one would expect those companies to also appear on the list of companies who have successfully contributed to the standardization process. This relationship, to a large degree, does not exist.

  As one might expect, some of the companies that are frequently mentioned in some of the recently published reports as having a large percentage of the essential LTE patents are on the list of top ten contributors. We note, for example that most of the unidentified companies in Figure 2 are companies that are typically associated with being leading contributors to legacy 2G and 3G technologies.

  However, the ranking and strength of those companies which are frequently mentioned as having a commanding number of essential LTE patents is meaningfully different when we look at their actual contributions to the LTE standard versus their claimed patent leadership which is merely a reflection of select words that they insert into a patent filing or patents that they otherwise claim are essential. Most interestingly, there are companies that are frequently mentioned as having a leading LTE patent position yet they fail to crack the list of top ten contributors who are responsible for 72% of the approved submissions.

  We can't conclusively state that a company's ability to get its submissions accepted by its peers in the 3GPP standards body has a direct correlation to its LTE patent strength, just as we cannot conclude that a company that seldom contributes to the 3GPP standardization process does not have any essential LTE patents. However, a company that is an active [and successful] contributor to the 3GPP standardization process is in a much stronger position to shape the LTE standard such that it incorporates some of its home-grown technology – technology that could prove to be essential and patented by the company.

  Likewise, a company that is an infrequent or largely unsuccessful contributor to the LTE standard could, through the course of happenstance, end up with some patents which turn out to be essential to the standard. However, given the important emphasis that the wireless industry and the individual companies involved in the standardization process place on essential patents and IPR, this scenario is less likely while the companies most heavily involved in the process should stand a much better chance of obtaining a large number of essential patents.

- **The limited number of approved 3GPP submissions calls into question the accuracy of the various patent-counting methodologies that are frequently used.** As previously mentioned, there were 3,683 approved submissions from the five working groups during the period of 2007-2008 which went on to form the basis of the LTE Release 8 standard. For comparison purposes, some of the frequently used patent-counting methodologies

suggest there are anywhere from 1,500 essential LTE patents to potentially tens of thousands of patents that may apply to LTE. We have also come across individual companies that claim to have more than 1,000 essential LTE patents.

As discussed in a previous bullet, some of the companies that are mentioned as having a large number of essential LTE patents did not make a meaningful number of contributions to the standard. It is also hard to imagine a scenario in which the number of essential LTE patents is anywhere close to the number of approved submissions – recall that we included all approved submissions, including those submissions that may not contain any patentable ideas. Obviously, it would be even more difficult to envision how there could be far more essential LTE patents then there are approved submissions.

In almost all cases, a submission to a 3GPP working group focuses on one very specific topic, for example, why a certain feature should be implemented a certain way. As such, the singular focus of the submission generally means there is, or at least could be, a single underlying patent that is associated with the submission. There are also many instances in which a submission is clearly not patentable. The implication is that there are more likely hundreds of patents that are really essential to the implementation of LTE and not the thousands or tens of thousands of essential patents that serve as the denominator with many of the patent-counting approaches.

The actual number of essential LTE patents is not necessarily relevant to the analysis that we conducted. However, it is relevant in the sense that some of the recently published studies which presuppose the existence of thousands and thousands of essential LTE patents are clearly basing their results on an unsubstantiated and clearly inflated list of essential patents. It is therefore not surprising that those studies identify companies with lots of self-proclaimed essential patents, but who in reality did not contribute in a meaningful way during the standardization process.

## 5.0 Conclusions

The topic of essential patents is one that will likely remain at the forefront of the industry, in particular with the commercialization of LTE, which, in theory, represents an opportunity for new technology leaders to emerge. This theoretical shift in technology leadership and its implications on the ownership of essential patents has gained credence due to the published findings of several recent reports which claim to accurately identify who owns essential LTE patents. The reality is somewhat different.

As discussed in this whitepaper, the underlying methodologies used in those studies contain numerous flaws, resulting in results that are erroneous or at least misleading. The fact of the matter is that it is virtually impossible for any third party to accurately identify all of the essential LTE patents while ignoring all of the patents which are nonessential or which patent optional features that manufacturers do not have to implement.

In addition to the enormity of the task, it would require a thorough understanding of the LTE standard and a comparison of all related patents to determine which company actually owned the essential patent(s) for that particular technology feature. By all accounts, this task is best left to the individual companies to resolve through the course of cross-licensing their patents.

It is, however, possible to identify those companies who contributed to the LTE standard and the degree to which they were successful in their efforts. In addition to the information being readily available, there is the additional benefit that the information used in this type of analysis is largely unbiased since it represents the collective work and approval of a multi-party organization, the 3GPP standards body.

Following a six man month effort on the part of Ericsson, followed by our audit of their work over a two month period, we conclude that Ericsson was the single biggest contributor to the development of the LTE standard. We also conclude that the companies most frequently associated with the development of the 2G and 3G standards within 3GPP were also actively involved with the LTE standard. This observation suggests that the distribution of technology leadership among the 3GPP member companies will remain largely unchanged, at least among the top contributors.

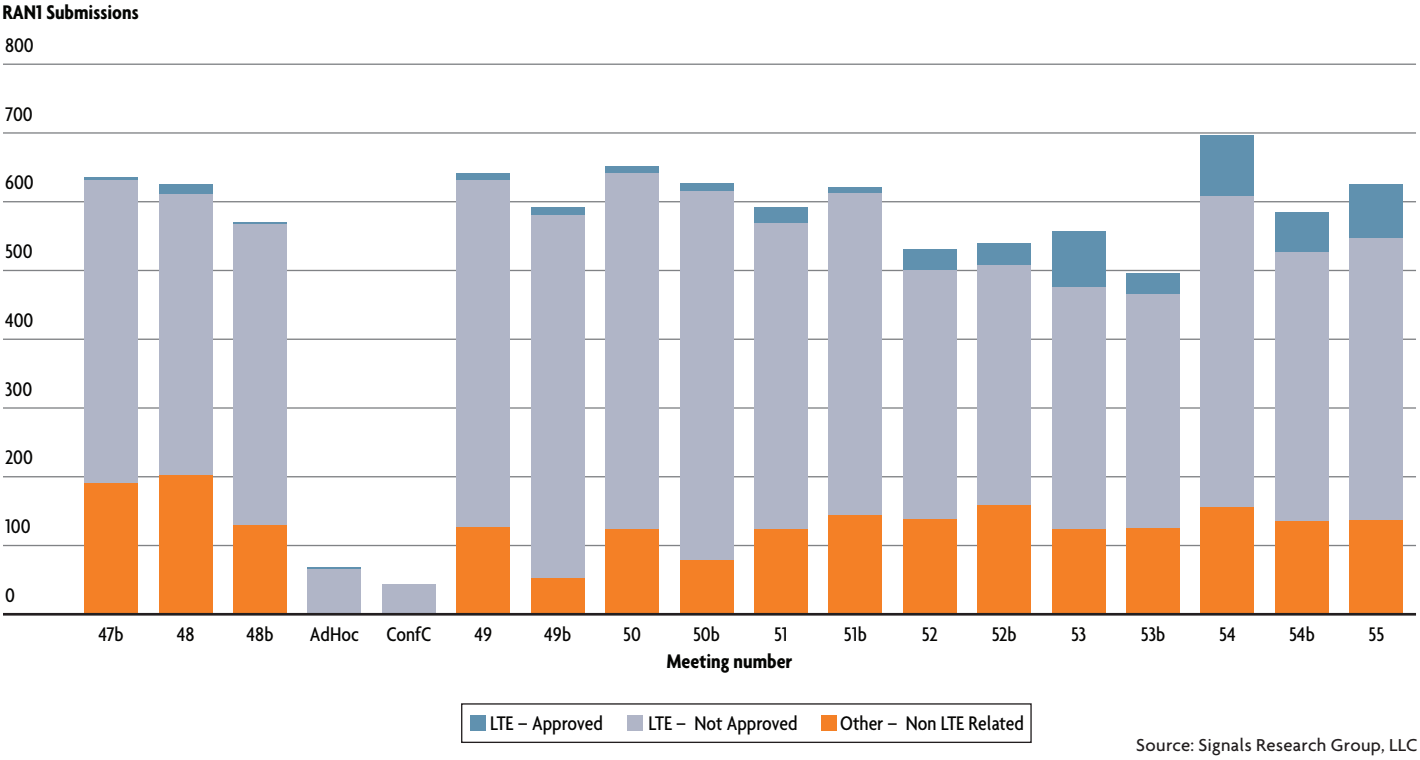
And while the results of our analysis do not necessarily reflect the actual distribution of essential LTE patents, we do believe they are a good indicator of the relative strength of each company's portfolio of essential patents. After all, it is unlikely that a company would go to all of the trouble and effort associated with making a submission and providing all of the necessary backup information and analysis if it didn't believe that the submission was in its best interest. Generally, this means the company has already taken the necessary steps to submit a patent application in the hopes that the submission is approved and that its patent application one day turns into a published essential patent that is required to implement LTE.

## 6.0 Appendix

In the appendix we include several figures which provide additional insight into the number of approved submissions by working group over the two-year period. For each meeting that was held during the two-year period, the figures provide the total number of submissions, the number of submissions which pertain to LTE, and the number of those submissions which were actually approved.

Figure 3 provides this information for RAN1 (Radio Access Networks Working Group 1), which is "responsible for the specification of the physical layer for the radio interface." [5]

**Figure 3. Tracking the Progress of the LTE Standard – RAN1 Working Group**

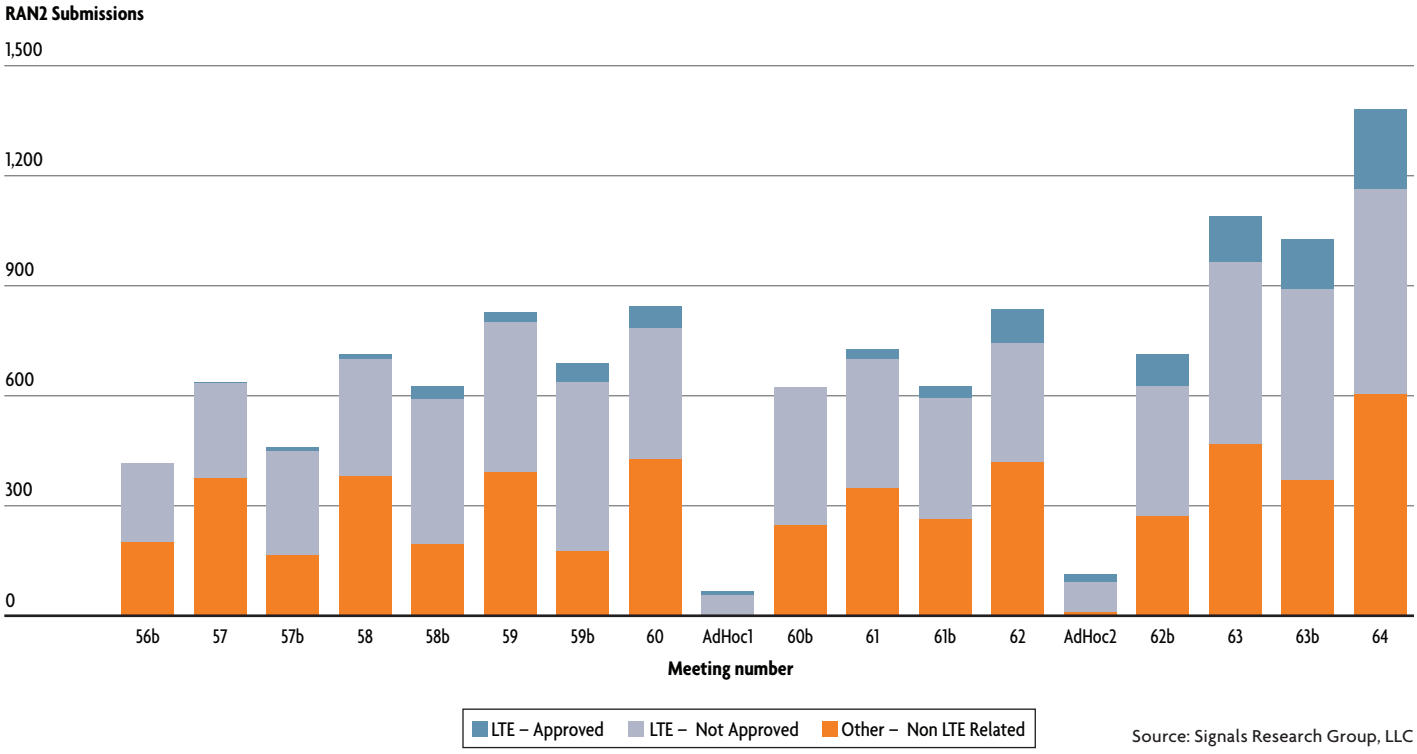



Source: Signals Research Group, LLC

[5] 3GPP website

Figure 4 provides the information for RAN2 (Radio Access Networks Working Group 2), which is responsible for the "radio resource control protocol, the strategies of radio resource management, and the services provided by the physical layer to the upper layers." [6]

**Figure 4. Tracking the Progress of the LTE Standard – RAN2 Working Group**

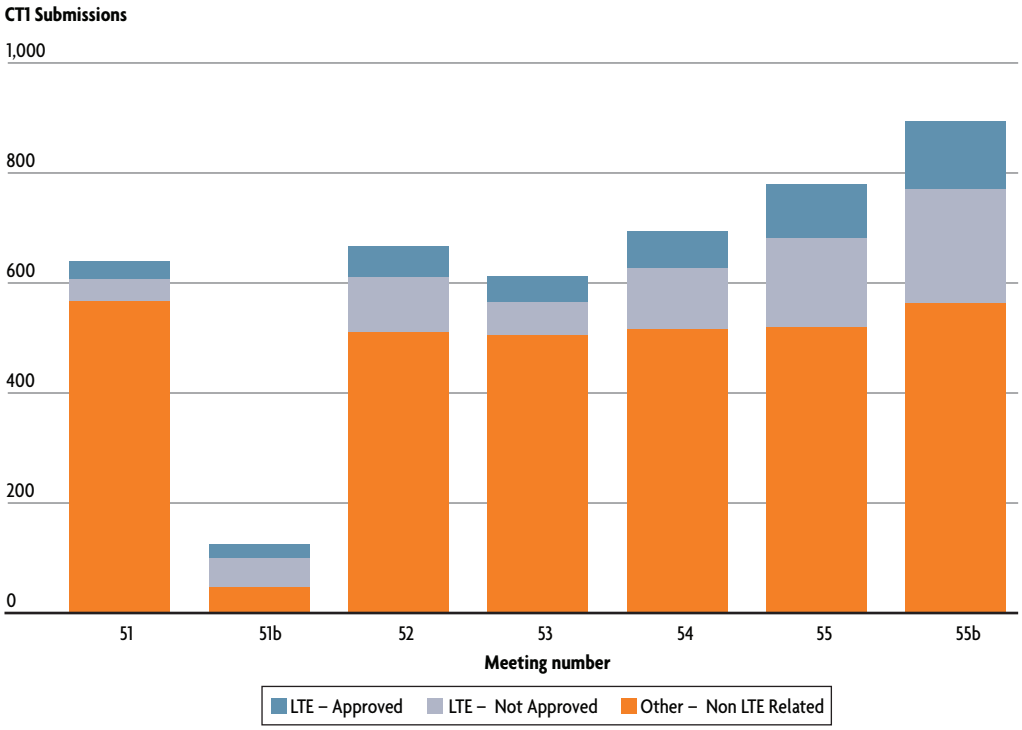



Source: Signals Research Group, LLC

[6] 3GPP website

Figure 5 provides the results for CT1 (Core Networks and Terminals Working Group 1) which is "responsible for the 3GPP specifications that define the user equipment - core network L3 radio protocols and the core network side of the Iu reference point." [7]

**Figure 5. Tracking the Progress of the LTE Standard – CT1 Working Group**

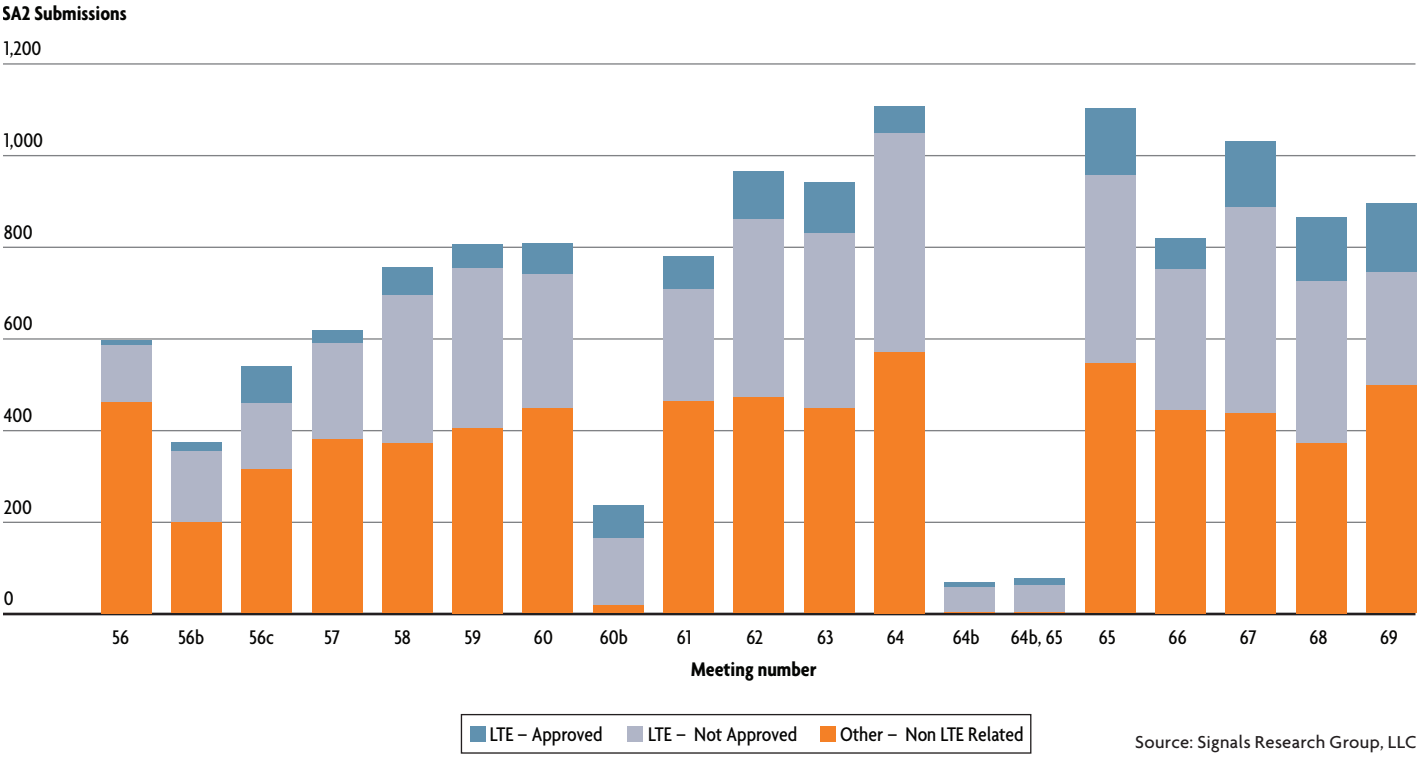



Source: Signals Research Group, LLC

[7] 3GPP website

Figure 6 provides the information for SA2 (Service and System Aspects Working Group 2), which "is in charge of developing the Stage 2 of the 3GPP network." The group also "decides on how new functions integrate with the existing network entities." [8]

**Figure 6. Tracking the Progress of the LTE Standard – SA2 Working Group**

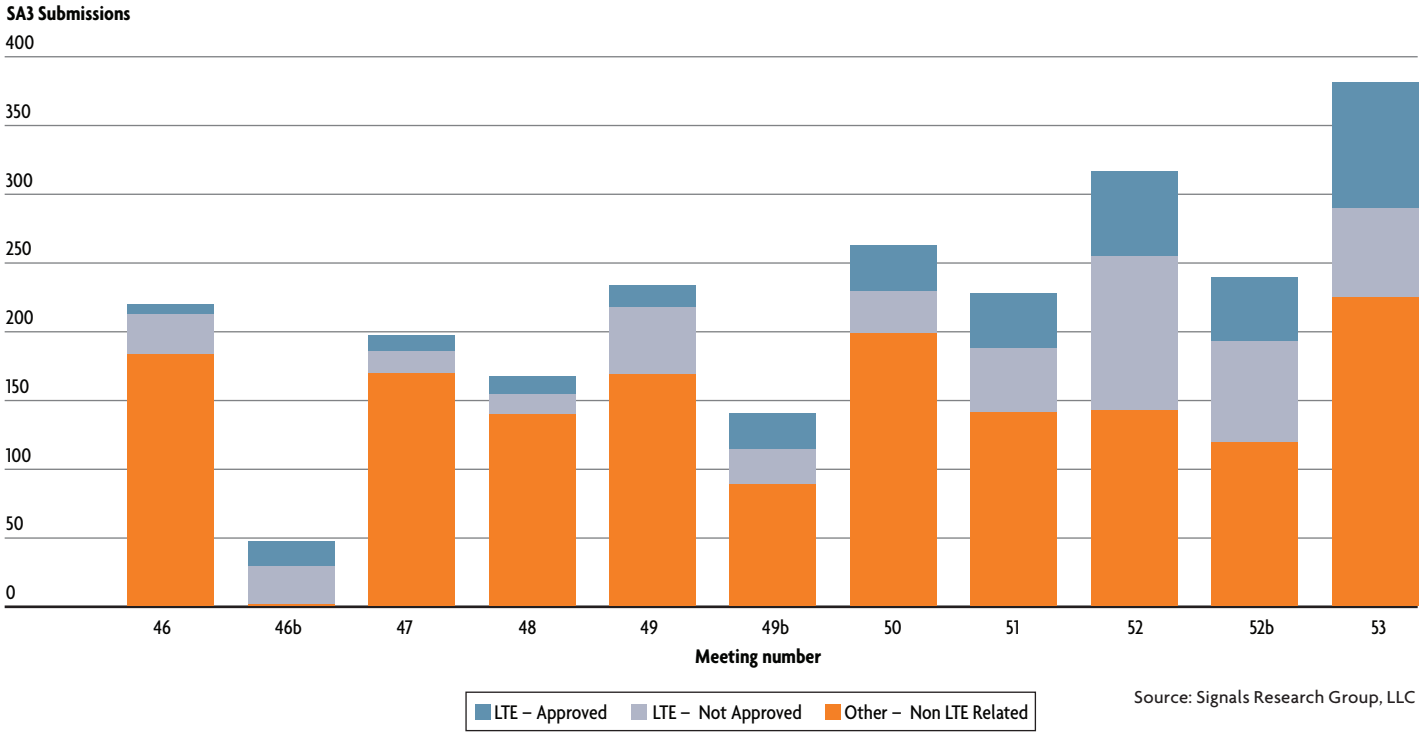



Source: Signals Research Group, LLC

[8] 3GPP website

Figure 7 provides the information for SA3 (Service and System Aspects Working Group 3) which is "responsible for the security of the 3GPP system, performing analyses of potential security threats to the system, considering the new threats introduced by the IP based services and systems and setting the security requirements for the overall 3GPP system." [9]

**Figure 7. Tracking the Progress of the LTE Standard – SA3 Working Group**




Source: Signals Research Group, LLC

[9] 3GPP website

SiGNALS
Research Group
www.signalsresearch.com