

## LTE Standard Essential Patents Now and in the Future

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### Driving Next Generation LTE

A portfolio of high quality and comprehensive essential LTE patents that rapidly evolves as the standard changes is key to leadership in the smartphone patent wars. Using a recent data analysis conducted by a leading business data provider and input from members of the Article One Partners patent research community, we attempted to determine companies with the strongest LTE patent portfolio. To accomplish this Article One Partners (AOP) conducted a three---stage review process involving all 3,116 patents and pending patents declared essential, as of September 30, 2011, by members of ETSI (European Telecommunications Standards Institute).

Approach to define strong players in LTE market

Stage 1 – Review of data provider’s determination of essentiality of each patent. Essentiality was determined by the data provider comparing each patent with the ETSI LTE specifications as of November 18, 2011.

Stage 2 – The second step involved prior art checking, or a review of prior art references which were part of the patent application process in the US and Europe. The prior art references were used by the data provider to evaluate the novelty of each patent and to provide a novelty rating for the prior art references.

Approach to analyze LTE technology trends

Stage 3 --- During this stage, the AOP research community was asked to identify patents covering three LTE technology trends. Following this, the Community was asked to provide US patents and pending patents that map to the technology descriptions identified. We then calculated the percentage of patents owned by the majority owners of highly essential and highly novel patents. The top 3 patent owners for each of three LTE technology trend research projects were then determined.

### Summary of Findings

The Stage 1 analysis shows that the top four companies owning the most patents rated as highly essential, Nokia, Qualcomm, Samsung and LG, collectively own almost 48% of the patents rated with highest essentiality.

The Stage 2 analysis shows that the top four companies owning the most patents rated as highly essential and high novelty, Nokia, Qualcomm, Samsung and Ericsson collectively own 55% of the highly essential and most novel patents.

Stage 3 resulted in identifying the following advanced LTE technologies:

1. Multiple Input Multiple Output (MIMO)
2. Advanced Carrier Aggregation
3. Voice Over LTE for Multimedia Applications with Video

Through our Stage 3 analysis it was determined that the four companies identified in stage 2 own the most patents for these technologies. Collectively, they own 31% of the patents belonging to the three advanced LTE technologies discussed above.

Leading mobile communications companies understand the importance of developing forward leaning patents as a means to maintaining the cutting edge of LTE Technology. Key patent percentage ownership can change daily when the market is converging on rapidly changing solutions, such as VoLTE. Companies shown in the AOP technology trend results are driving the filing of patent applications to maintain and grow their prominent position in LTE patents.

## Conclusion

Based on our analysis, Nokia, Qualcomm, Samsung and Ericsson have built the strongest LTE patent portfolios while also taking a leadership position in future LTE technologies. Of course, the landscape is changing rapidly and others, such as those mentioned above are not standing still. It will be an interesting few years as we watch the quest for dominance of the LTE market and the steps companies take to build out their patent assets.

It is also important to note that the huge valuations for patent acquisitions of Nortel and Motorola Mobility at \$4.5B and \$12.5B, respectively, have given Apple, Microsoft, RIM and Google representation in patent ownership of LTE technology. Also, the consortium of Apple, EMC, Ericsson, Microsoft, RIM and Sony owns 2.29% and Motorola Mobility, recently acquired by Google, owns 1.15% of the LTE patents and patent applications submitted by the community for this analysis.

Finally, with respect to the large scale litigations now attracting so much attention in the media and legal communities, it is our bet the smart phone industry will evolve and mature over the next decade and begin to more closely resemble their forbearers, the telecommunications and computer industries. Thus, licensing between the participants will become the norm if for no other reason than in high tech at least, patents rarely exclude competition in the long run.

## Smart Phone Wars – Part I

One would have to be living in a cave not to have noticed the high stakes battle pitting global smart phone giants against each other around the world. This battle is being played out on three fronts: fierce litigation, world---wide, among the deep pocket participants (e.g., Microsoft v. Motorola Mobility, Apple versus Samsung to name a few) in standards bodies such as ETSI (European Telecommunications Standards Institute), and the astounding valuations being applied to intellectual property in the market.

On this last point, just note some headlines from the last year:

- " Android no longer a free agent after the Microsoft Samsung deal"
- " Microsoft Samsung deal strikes a blow at Google"
- " Google acquires Motorola Mobility (and its 17,000 patents) for \$12.5 Billion.
- " Microsoft and Apple purchase 880 Novell patents for \$450 million.
- " Google buys 1000 patents from IBM."
- " Apple, Microsoft, RIM et al, buy Nortel's patents for \$4.5 Billion.
- " Oracle sues Google for \$6 Billion over alleged Android infringement.

On and on!

With so much money at stake is it any wonder the smart phone industry resembles a circular firing squad? How we got here is largely the result of two factors. First, both the telecom and computer industries operated under a legal regime dictated by two 1956 Consent Decrees entered into by two largest high tech research houses, AT&T (Bell Labs) and IBM (Watson). As a result, licensing among the participants was the norm for decades, as both the giants were required to license their intellectual property to all comers under reasonable and non---discriminatory terms. Companies with licensing arrangements rarely found themselves in litigation with their counter parties. This never happened in the smart phone world. Second, virtually overnight, the smart phone became a vitally important platform, multiplying its economic importance and multiplying the stakes at hand.

Underlying this is the reality that intellectual property has become the economic underpinning of today's high tech world, accounting for some 80% of the economic underlying value of the participants. And so we now have the specter of heretofore traditional stock analysts jumping into the fray offering opinions as to the robustness on an individual company's intellectual property portfolio vis-à-vis its competition. The three forces noted above, will play themselves out over time. But it is instructive to try and understand the current intellectual property positions of the antagonists as they stand today.

## Assessment of LTE Patent Strength

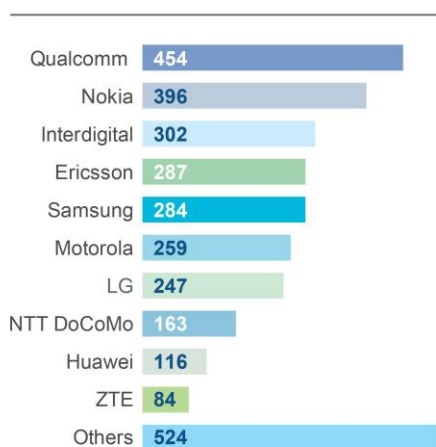
How do we know who the leading companies might be in the battle for market share for mobile communications products? Let's start with the role of ETSI. This standards body publishes specifications of patents that will be essential to building out the next generation of mobile communications technology, referred to as the LTE, or Long Term Evolution, standard. It is expected that LTE will be the sole global standard for mobile communications technology for the foreseeable future.

When a patent is declared essential, the contributing company must also declare licensing terms; although licensing agreements are not available to the public. Patent quality and the degree to which it satisfies essentiality specifications are significant factors in determining ETSI cross-licensing value. There are hundreds of specifications that define essential patents. Interestingly, it is up to each contributing member to determine if the patent is essential. Without a governing body that verifies essentiality or quality of each patent contributed, it is impossible to interpret the relative licensing strength of each ETSI member based on its essential patents.

It is with this in mind, that all 3,116 patents and pending patents declared essential, as of September 30, 2011, by members of ETSI (European Telecommunications Standards Institute) were reviewed.

The review of the ETSI-declared patents and pending patents was performed in two stages. First, essentiality of each patent was determined by comparing it with the ETSI LTE standards as defined by 3GPP (Third Generation Partnership Program). Second, the novelty strength, a significant factor in determining patent quality, was determined. The second step involved prior art checking, or a review of prior art references that were part of the patent application process in the US Patent & Trademark Office and the European Patent Office. The prior art references were used to evaluate the novelty of each patent and to provide a novelty rating for the prior art references. Prior art is information available to the public that might be relevant to the invention prior to the patent grant date. If an invention has been described in prior art, the invention is not novel and a patent on that invention is not valid. Thus a review of the patent claims and comparison to the relevant prior art is a useful exercise when assessing the quality of a patent. This is the first study that we are aware of that examined all US LTE patents and pending patents for both essentiality and novelty strength. The chart below shows the total number of patents and pending patents declared as essential in ETSI as of September 30, 2011.

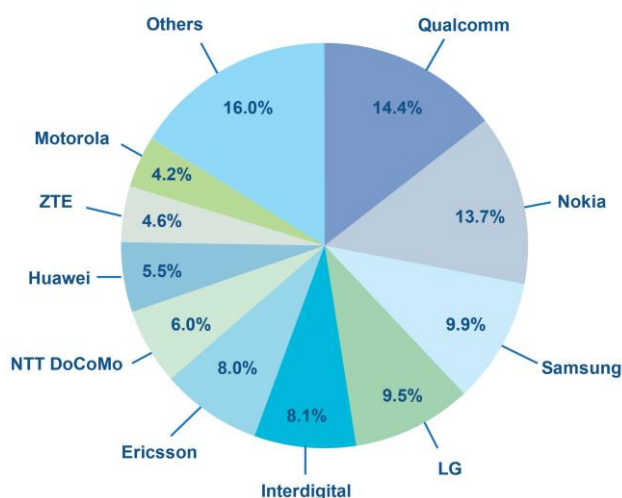
**TOTAL PATENTS AND PENDING PATENTS**



During the first stage of this review, the extent to which the claims of each patent or published application conform to the ETSI LTE standards as defined by the 3GPP (3<sup>rd</sup> Generation Partnership Project), as well as the essentiality of the patent itself, were evaluated. A rating on a scale of A, B, C or D was assigned to each patent based on the two factors described above, with A being the highest for both factors. Detailed criteria for each rating are described below:

- A. Highly relevant / essential to the LTE standards
- B. Relevant, but requires in-depth research to determine the essentiality
- C. Relevant, but unlikely to be essential to the LTE standards
- D. Not believed to be related to the LTE standards

The chart below shows the companies ranked based on their ratio of the highest essentiality ('A' rating).

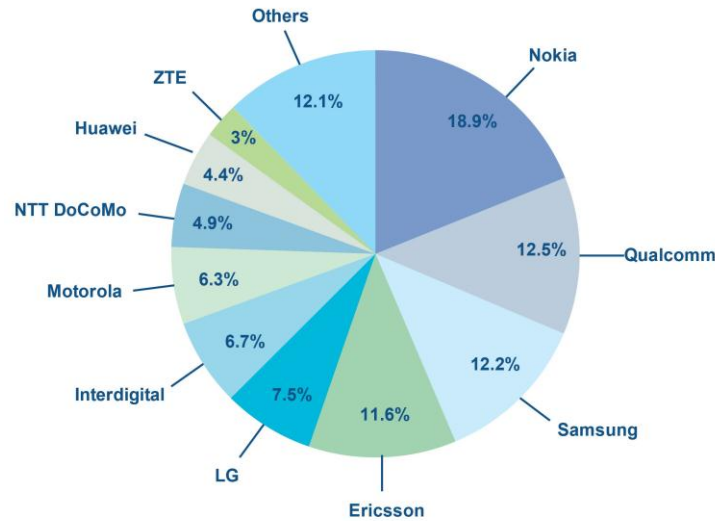


The 2nd stage of the review involved examining relevant prior art references for each patent or application to evaluate the novelty of the patent. Relevant prior art references included those cited by USPTO and EPO examiners during prosecution, and those in the Invention Disclosure Statement (IDS) filed by the applicant. Another rating on a scale of 5, 4, 3, 2 or 1 was assigned to each patent based on the existence and significance of prior art references, with 5 being the highest novelty rating (no relevant prior art references). Detailed criteria for each rating are illustrated below:

- 5: No prior art references or substantially non-relevant prior art references
- 4: Remotely relevant prior art references
- 3: Relevant prior art references
- 2: Good prior art references
- 1: Strong prior art references

The chart below shows the companies with the highest essentiality ('A' rating) ranked based on their ratio of the number of high novelty patents ('4' or '5' ratings). The study revealed that traditional mobile phone makers, such as Nokia, Qualcomm, Samsung and Ericsson, are the ones with strong patent portfolios in the LTE patent space.

### Highly Essential Patents Ranked Based on Ratio of High Novelty Patents



Although this analysis provides useful information about the companies with the strongest LTE portfolios, there are several other important points to consider.

1. The analysis also noted the substantially large number of recent LTE patent filings. Interestingly, many of these patents lack technical novelty so they are likely to go through many amendments during examination and may not be essential to the LTE standard once those patents are issued.
2. The increasing number of patent acquisitions will change the balance of power over time. These factors, together with the rapidly changing LTE standard itself, make for a rapidly moving target.
3. Although the patent quality review employed is technically sound and provides useful data in assessing strength of ones LTE patent portfolio, a more comprehensive novelty review would include seeking validity input beyond that which was provided by the patent owner or used by the USPTO or EP examiner.
4. Companies with large patent portfolios, likely have some strong mobile communications technology patents that may provide significant benefit in the future, though they may not be deemed essential today. These patents will provide advantage when they are declared essential as well as enable assertion against others outside of the standard.
5. Though this analysis is an assessment at a point in time, it gives rise to another interesting question; what are some of the LTE future technology trends and what companies are best positioned in these areas, based on their patent portfolio?

## Community Assessment of Technology Trends

The LTE patent analysis focused on patents under the ETSI LTE standard that are essential and highly novel. LTE technology was started in 2010 and industry commentators present that LTE will be the new 4G network standard of choice. The speed of global implementation demonstrates that LTE is the leading technology solution to accommodate the key growth component of wireless – high throughput and low latency. As industry converges on LTE, companies apply their R&D budgets to develop innovation supporting and enhancing the LTE standard as a baseline. From this, two paths emerge: the technology description in the standard itself evolves as the standard absorbs technology development, and advancement of technology derived from the standard yields new patents. The process is dynamic including cyclical breakthroughs that will help determine the future of the most important high tech sector in history.

The dynamic nature of standard adoption makes identification of related patents a moving target. There is inherent tension due to technology descriptions that industry seeks to map to its patents, innovation driving technology advancement (and new patent applications) and the endorsement by owners of innovations and their attendant patents for inclusion in the next versions of the standard.

The LTE standard, with accelerated adoption and advancement, offers a unique forum to witness the rapid and continuous evolution of technology covered by patents. This has been explored in various attempts to value essential v. non-essential patents and the FRAND (Fair, Reasonable and Non Discriminatory terms) licensing process, with industry stakeholders recently providing public comments. But this complex dynamic is played out even earlier by the interplay between developing technologies that advance the standard, patenting those technologies and endorsing their adoption as the next version of the standard. The wireless industry is focused on how it can leverage the opportunity created by this.

## The Cutting Edge of LTE Advancement

Looking ahead to where LTE technology is going builds even further on the LTE patent analysis. The patents declared under ETSI provide data at a moment in time linked to the most recent LTE standard version that may or may not include these new advancing technologies. The analysis was based on Release 8, 9 and 10 of the 3GPP Specification. Release 11 of the standard is now in progress. Since LTE is an emerging technology, the use of patent applications is much more relevant than for more mature patented technologies.

We believe identifying the cutting edge of the LTE technology can best be achieved by employing the highest quality technology tools. Crowdsourcing taps the worldwide reach of the Internet to harness the collective intelligence of a global community that includes subject matter experts, professional patent researchers, scientists and technologists who apply new approaches to provide comprehensive results. The AOP research community provides publications based on technical mapping to a description of technology presented by AOP. It is important to note that neither Article One nor its community practice law and the AOP results relate to a technology mapping and are not legal advice or an opinion.

Article One (AOP) publishes requests for patent research to its 20,000 global community members at [www.ArticleOnePartners.com](http://www.ArticleOnePartners.com) in 9 languages. The community was requested to identify patents covering the trends in LTE Technology. In less than a week, the community responded with more than 1,000 US patents and patent applications that map to the technology description of the trends.

## The Article One Crowd Researches Patents For Key LTE Technology Trends

There is industry agreement that there are several key technology trends related to the LTE technology value proposition of a global need for data throughput. Three of these trends are: a) *Multiple Input Multiple Output (MIMO)* or the use of multiple transmitters and receivers to “increase both the overall capacity of a cell and the data rate that a single user can expect from the system.” (3GPP) b) *Advanced Carrier Aggregation*, which relates to the use of more than one channel or carrier in contiguous elements of the spectrum or bands, and c) *Voice-Over LTE (VoLTE)* for multimedia applications with video.



The results of the community were reviewed on a technical mapping basis for the technology trend areas and the percentages owned by industry were determined. The data is presented in two forms: first, the percentages of US patents and patent applications owned by the top five companies identified in the data analysis in the combined AOP collections for trend LTE technologies, and second, the percentages of US patent and patent applications for the top three key companies in each of the collections for the three technology trend areas.

Percentage of the technology trend AOP collections owned by the top five (5) companies:				
TR1 Nokia	TR2 Qualcomm	TR3 Samsung	TR4 Ericsson	TR5 LG
6.02%	7.45%	6.88%	8.31%	1.72%

For each of the three Article One LTE Studies, the percentage ownership by the top three companies identified by the AOP community, in response to the Article One Study LTE 2000, is summarized below.

#### *LTE 2000: Multiple Input Multiple Output (MIMO)*

The top companies represented in the results for the LTE 2000 Study are Samsung (TR 3) with 12.90%, Qualcomm (TR 2) with 12.26%, and Nokia (TR 1) with 4.52%.

According to a recent report by Mobile Experts, MIMO is an evolving LTE technology area that is expected to be in 500 million PCs, tablets, and smartphones by 2016. ([Mobile Experts Report](#)). The LTE 2000 Study requested the Article One community to submit US Patents and US Patent Applications that disclose the use of multiple antennas at both the transmitter and receiver to improve communication performance.

MIMO, introduced into Release 8 of the 3GPP Specifications and part of other standards such as IEEE 802.11n (Wi-Fi), 4G, 3GPP Long Term Evolution, WiMAX and HSPA+, is the most developed of the three technology areas presented to the Article One community. This was represented in the results of the community based on the percentage of US patents versus US patent applications received -- 66.4% patents and 33.6% patent applications.

#### *LTE 2001: Advanced Carrier Aggregation*

The top companies represented in the results for the LTE 2001 Study are Ericsson (TR 4) with 16.48%, Nokia (TR 1) with 7.69% and InterDigital with 6.59%.

Industry experts argue that this emerging LTE technology area is key to providing very high peak traffic channel data rates that allows wider transmission bandwidths. ([Eetimes](#)). The LTE 2001 Study requested the Article One community to submit US Patents and US Patent Applications that disclose the use of aggregated bandwidths to achieve 100 MHz or extensions of this limit.

Advanced carrier aggregation technology improvements were submitted for Releases 11 of the 3GPP Specification. So from the standpoint of the LTE standard, this is an evolving technology. The results of the AOP community support this notion of evolving technology based on the percentage of US patents versus US patent applications received. The collection showed a higher percentage of patent applications -- 39.33% patents and 60.67% patent applications.

#### *LTE 2002: Voice Over LTE for Multimedia Applications with Video*

The top companies represented in the results for the LTE 2002 Study are Ericsson (TR 4) with 13.58%, Nokia (TR 1) with 8.64% and Research in Motion with 7.41%.

Voice Over LTE (VoLTE) is a standardized system for transferring voice and video traffic over LTE. Video is

widely recognized as a key driver of next generation mobile networks. While standards are still being reviewed and researched, and appear only as submissions in Release 11, industry players are expected to launch VoLTE service in the near future. According to a recent report by Ericsson, at least four companies have announced plans to offer VoLTE services in 2012: Verizon, MetroPCS, C Spire Wireless (US) and LG U+ (South Korea). ([Examining the Case for VoLTE](#)) The LTE 2002 Study requested the Article One community to submit US Patents and US Patent Applications that disclose the use of IP Multimedia Subsystem solution or the Circuit---Switched.

The responses to the collection primarily relate to IP Multimedia Subsystem (IMS) --- based solutions as opposed to Circuit---Switched Fallback (CSFB). This result supports the technology development that CSFB is considered a temporary solution for VoLTE during the transition to full---fledged VoLTE.

## Conclusion

Leading mobile communications companies understand the importance of developing forward leaning patents as a means to maintain the cutting edge of LTE Technology. Key patent percentage ownership can change daily when the market is converging on rapidly changing solutions, such as VoLTE. Companies shown in the AOP technology trend results are driving the filing of patent applications to maintain and grow their prominent position in LTE patents.

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DISCLAIMER: Article One Partners (AOP) has prepared its Studies and reviewed the results based on its independent methodology, with the belief that it is fair, not misleading and based on reliable public data, which has been individually reviewed by employees of AOP. The data analysis set forth herein was prepared by a third party data provider and is believed to be reliable, but has not been independently verified by AOP. AOP does not practice law. The AOP data is based solely on a technical mapping review first by the AOP community and then by AOP employees and should not be relied upon as a legal opinion or advice. The AOP data constitutes the preparer's best judgment as of the date of preparation, is transient as new patents issue daily and new patent filings are made daily, and therefore is subject to change without notice. AOP, nor any officer nor employee of AOP accepts any liability for any damages or losses, direct, indirect, consequential, arising from any use of this report or its contents.