IEEE's Empirical Record of Success and Innovation Following Patent Policy Updates

Further Empirical Analysis of Patent and Standardization Activities at IEEE

April 2018

I Introduction & Executive Summary

The IEEE (Institute of Electrical and Electronics Engineers) is the world's largest technical professional organization, with hundreds of thousands of members. As a US-based standard-setting organization (SSO), the IEEE has successfully standardized thousands of fundamental technologies, including critical communications standards such as Wi-Fi and Ethernet.

In 2015, the IEEE updated its policy for patent licensing, which address how participants at the IEEE commit to license their "standard essential patents" (SEPs) covering IEEE standards on "reasonable and non-discriminatory" (RAND) terms. In March of 2017, in response to various claims that the IEEE's standardization work had been adversely affected by the policy update, IPlytics undertook a careful empirical analysis of the IEEE's work since the update.[1] We concluded that, by every reasonable metric, IEEE's standardization work and success remained as strong, or stronger, than it had ever been.

Since then, additional commentary has circulated addressing the IEEE's activities. We take this opportunity to update our prior analysis, and to evaluate various assertions regarding the IEEE's status. While some of the commentary has been critical, other information and reports based on IEEE's relevant data suggest that IEEE has experienced ongoing successes in its technical development and standardization activities.[2] With this report, we seek to address, among other things, whether the rate of innovation and standards development at IEEE has been affected, positively or negatively, subsequent to the IEEE's patent policy changes.

Based on the publicly available information we derived the following conclusions, further to our March 2017 study:

- More standards documents were completed and published in 2017 than in any other year in the IEEE's history;
- More new standardization projects were launched at IEEE in 2016 and 2017 than ever before in the organization's history;
- IEEE's membership has grown considerably since 2015, and it remains the world's largest standardization organization.

[1] Our March 2017 analysis is available at http://www.iplytics.com/general/ieee-active-patent-policy-change/.

[2] Konstantinos Karachalios, *IEEE's Continued Leadership in Standardization*, IEEE-SA Document (2017), available at https://works.bepress.com/konstantinos-karachalios/1/

- Contributions to technical working groups at IEEE, and in particular in the 802.11 working group, are at historically high levels;
- The largest technology contributors at IEEE continue to declare their patents subject to the IEEE's patent policy;
- The handful of companies that have issued negative declarations are not now, and never have been, among the more active contributors to 802.11; the data indicates that they are each relatively minor players in development of the standard, and some are not contributors at all.

The updated data through the end of 2017 verifies our prior conclusions that contributions to IEEE standards and technical work within IEEE working groups have only increased since the updated patent policy was approved.

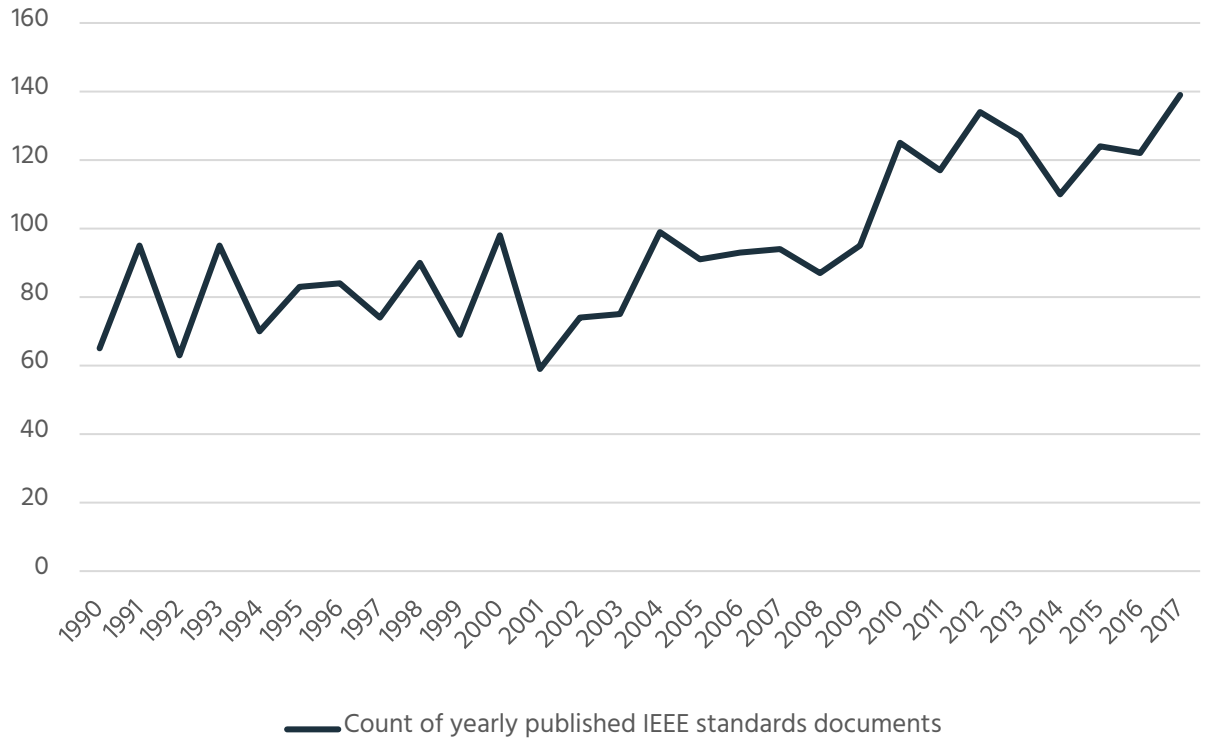
II The Empirical Record at IEEE Through 2017

In the following we update and build upon our March 2017 analysis. Now that data for the entirety of 2017 is available, we can further examine the empirical record at IEEE.

While increased activity and publication of standardization materials is not a sole measure of SSO success, such activity does suggest that companies and other innovators in the community are continuing to engage with the SSO and participate in its projects. At IEEE, there were more standards published in 2017 than any other year in its history.

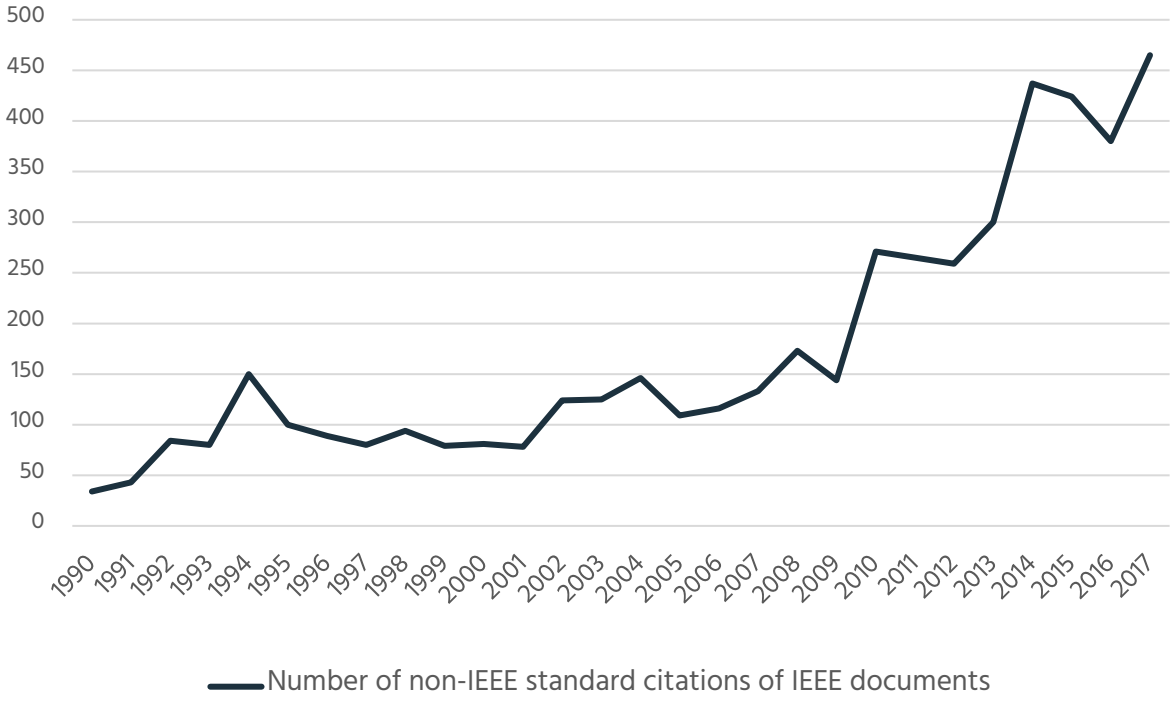
Specifically, and as shown in Figure 1, the number of published IEEE standards documents had been decreasing from 2012 to 2014 (prior to the IP Policy updates), but that trend was reversed in 2015 when the updates came into effect – culminating in 2017's new historic peak.

Figure 1: Count of yearly published IEEE standards documents 1990-2017



Similarly, to estimate the acceptance of IEEE standards in other SSOs, we can count the number of references made to IEEE standards documents in standards published at other SSOs; in other words, an "acceptance of peers" test. Once again, we can see that in 2017, IEEE established a new historic record for the highest number of third-party SSO citations (figure 2). This would seem to provide further confirmation that IEEE standards remain accepted by technology developers worldwide, and that the IEEE continues to provide valuable technologies for use by others in the standard-setting community.

Figure 2: Number of non-IEEE standard document citations of IEEE documents in 1990-2017[3]

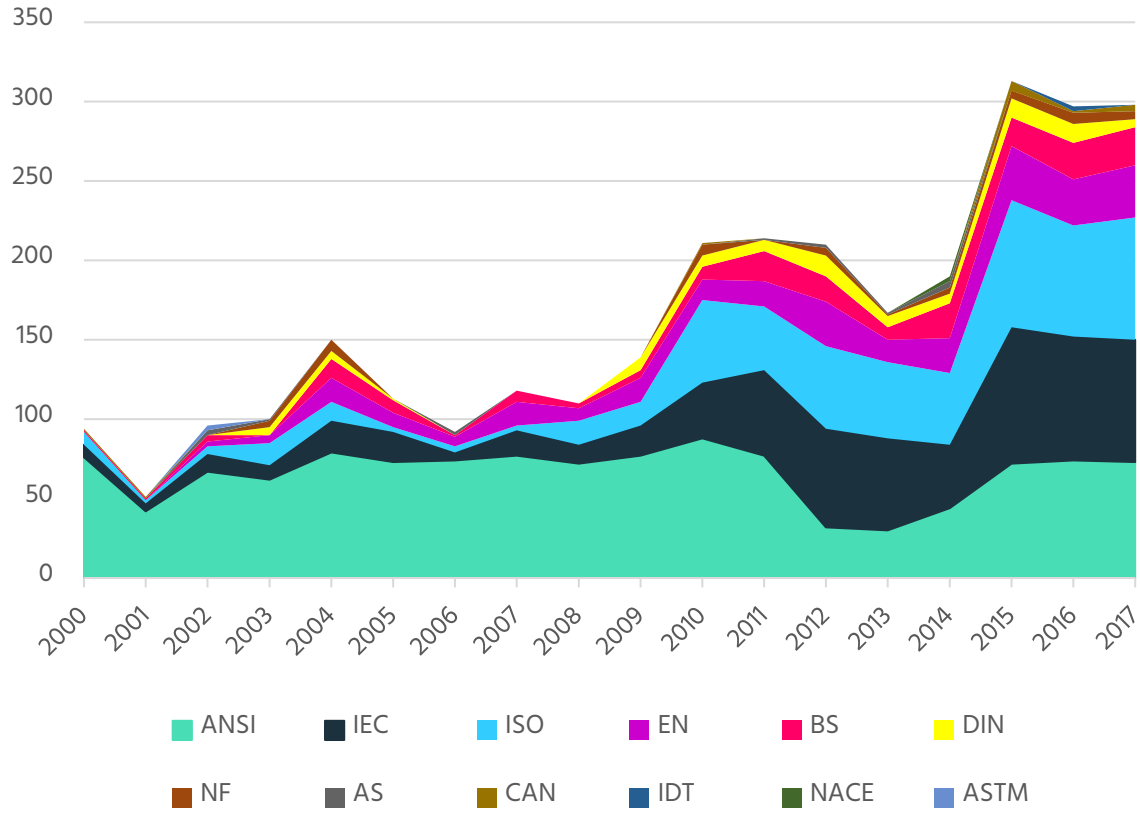


Another indication of "acceptance" of IEEE standards might be the rate of accreditation of IEEE standards by other standards organizations. We reviewed the international accreditation rates for IEEE documents in recent years. Here we count the number of accredited IEEE standards[4] per year. Results presented in figure 3 confirm a positive trend in of the international accreditation of IEEE beyond 2015.

[3] IEEE was cited by other organizations such as ISO, IEC, ETSI, ANSI, SAE, DIN, ASTM, BS, NS, NICE and others

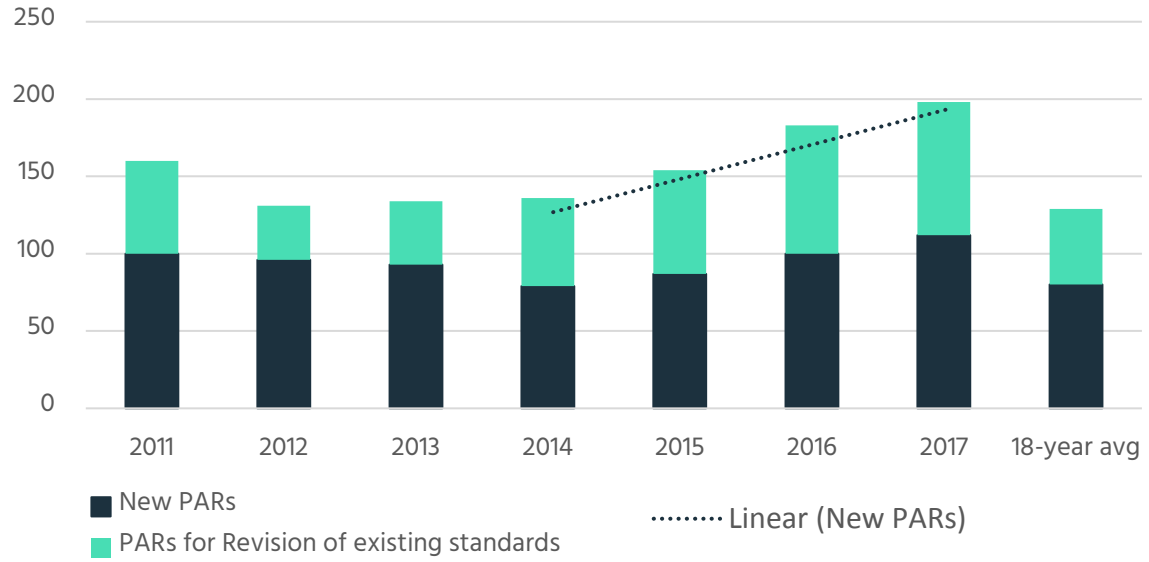
[4] National as well as international standards organization such as ANSI, ISO or IEC accredit standards specified at national level or in informal standards consortia. Once a standard has been accredited a new international document is published e.g. *IEEE 802.11 (2012)* was published as *IDT*ISO/IEC/IEEE 8802-11 (2012-11).*

Figure 3: Number of international IEEE accreditations documents in 2000-2017



It is not just legacy standards that are active at IEEE; new standardization work was also at a historic peak in 2017. In IEEE, members can request to initiate new standards projects by submitting a New Project Authorization Requests (or "PAR"). In 2017, a record of 112 new PARs were submitted to IEEE, along with about 85 PARs for updates to existing standard. Measuring either way (by counting either "new" PARs or total PARs), 2017 was IEEE's most active year to date for new standardization work (figure 4).

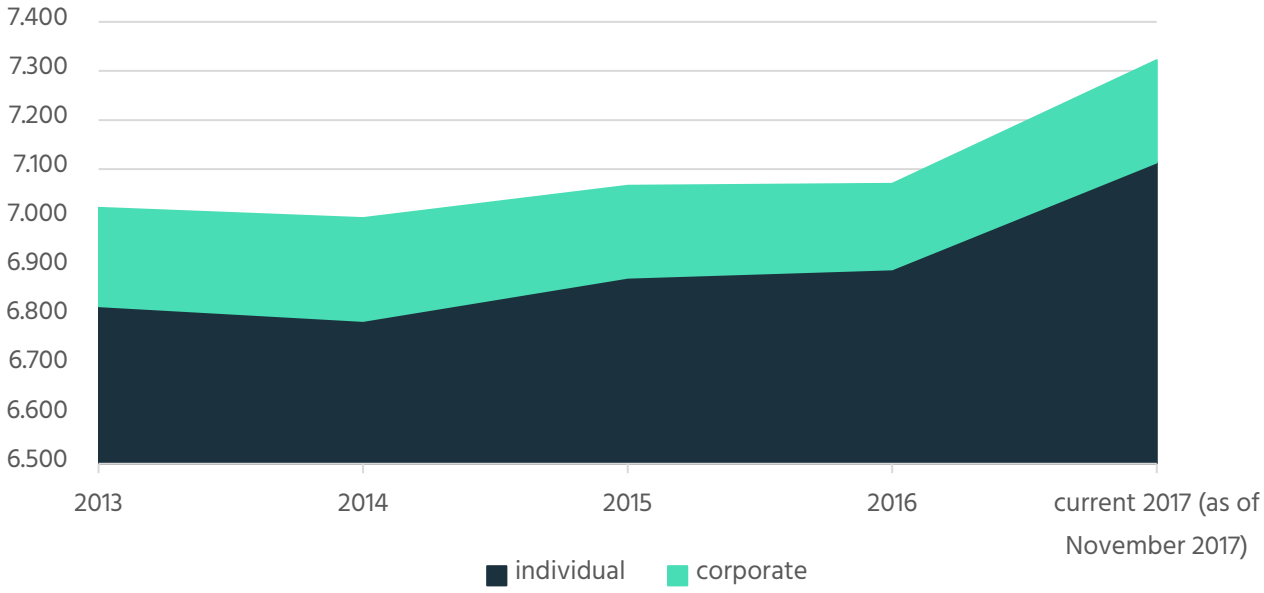
Figure 4: Number of new and revised PARs in 2011-2017



Another metric to consider in assessing the health of an SSO is simple membership counts. SSOs generally are open to all interested stakeholders in an industry. If companies and individuals value an SSO, they may decide to join the SSO; if they do not support the SSO's approach to patents or other issues, they are always free to not join or to not renew an existing membership. Thus, membership data can serve as a good source of information regarding the interest and commitment of market participants in a particular SSO's activities.

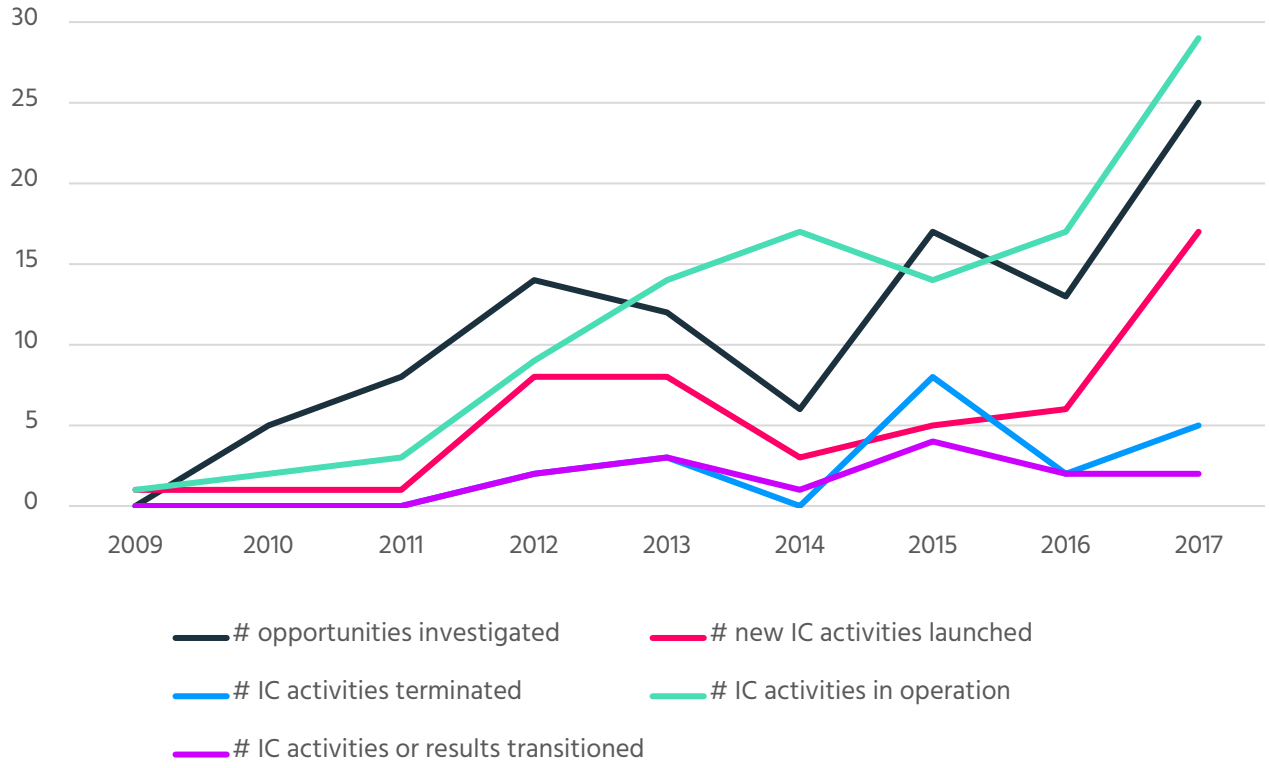
IEEE is the world's largest technical organization, with more than 400,000 members in 2017 – the largest number of members in IEEE's history. Moreover, as the numbers presented in figure 5 demonstrate, at IEEE-SA (Standard Association), IEEE's primary standardization arm, membership is increasing both for individuals and for corporate members, with yet another historic peak in 2017.

Figure 5: Yearly IEEE-SA membership as of 2013-2017



We can also seek to measure IEEE's activity in engaging with industry and assisting the adoption of IEEE standards in various vertical markets. Specifically, the IEEE-SA's Industry Connections (IC) program helps to facilitate new standards and related products and services by facilitating collaboration among organizations in the industry. Figure 6 shows that IEEE-SA Industry Connections increase especially for new standard setting investigations, operations and launches – with (again) the IEEE setting new historical records for industry engagement.

Figure 6: Yearly IEEE-SA Industry Connections as of 2009-2017



Switching focus from general standards work at IEEE to specific work in connection with IEEE's ubiquitous 802.11 standard for Wi-Fi, we can identify similar positive trends since the updated Patent Policy was adopted. 802.11 is a particularly "patent heavy" standard, with (according to court findings) many thousands of patents declared as essential under the IEEE patent policy. We can identify activity relating to the 802.11 working group using IEEE's online tools.[5]

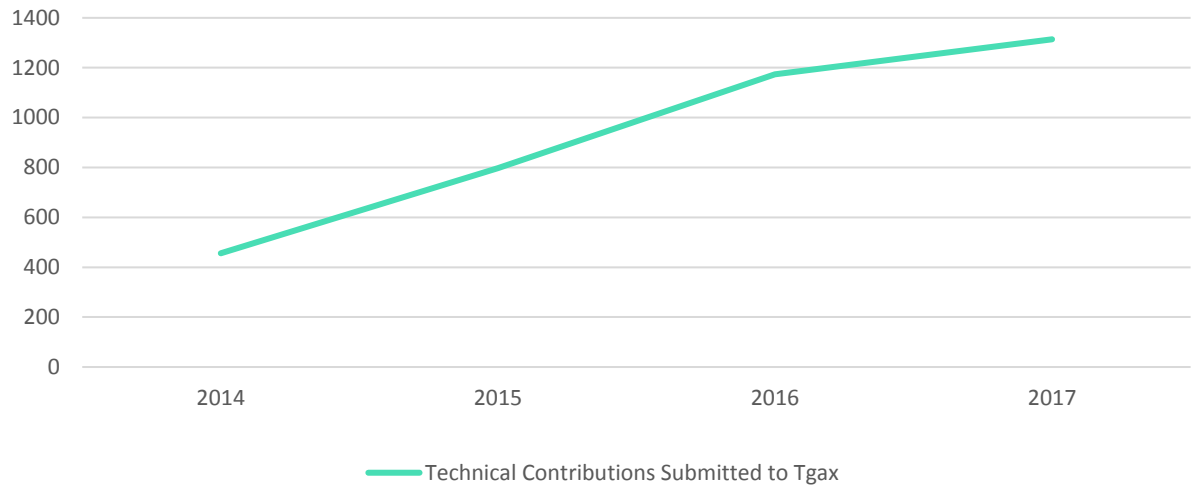
As a starting point, we simply review the number of contributions submitted to the three most significant 802.11 working groups in recent years (TGn, TGac and TCax),[6] as that may serve as one measure of activity, engagement and willingness to contribute proprietary innovation within the 802.11 technical group. Figure 7 presents the yearly counts of documents contributed to the 802.11ax working group. Figure 7 illustrates

[5]https://mentor.ieee.org/802.11/documents?is_dcn=DCN%2C%20Title%2C%20Author%20or%20Affiliation&is_group=0000

[6] TG is IEEE's parlance for "Technical Group", where the key technical development efforts occur. The IEEE database is sortable to identify contributions to these groups. We filtered to include documents contributed to the most relevant 802.11 technical groups, 802.11n, 802.11ac and 802.11ax, . These three TGs were chosen because 802.11n and 802.11ac are the two most recent highly-commercialized versions of the 802.11 standard, and 802.11ax is expected to be the next such commercial version. Assessing these groups over time can provide a helpful landscape of the key technical contributors to 802.11. A summary table of contributions to each technical group is provided as Appendix A hereto.

that contributions to the 802.11ax working group hit an historic peak in 2017 (more than 1,300 submissions). The sharp increase of technical contributions from 2014 to 2017 confirms that activity in the 802.11 working group has not receded following the 2015 patent policy updates.

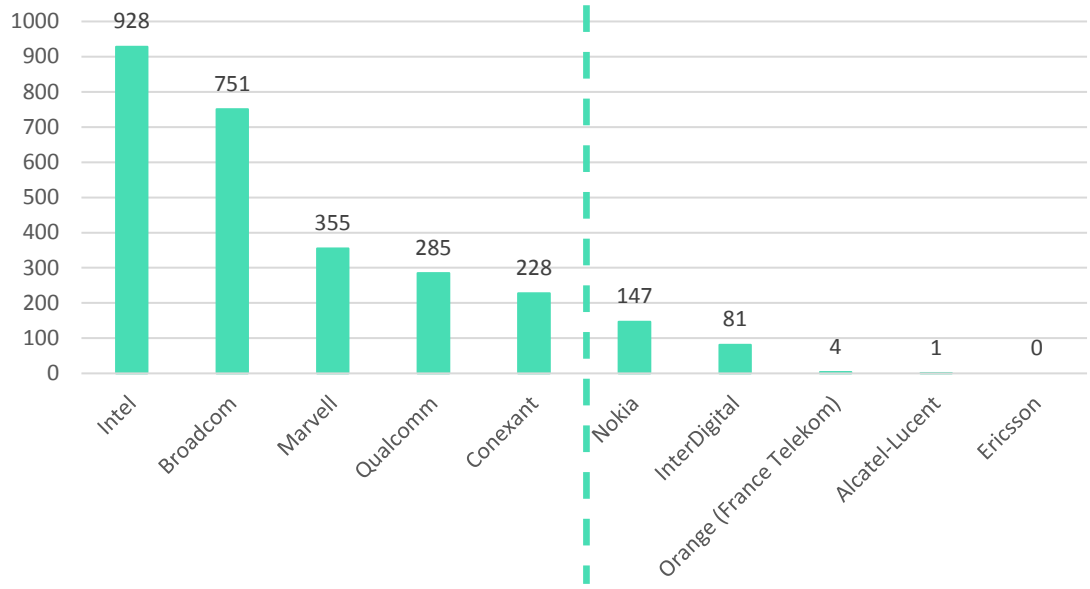
Figure 7: Technical contributions submitted for 802.11ax



We can also sort the IEEE's data to identify the companies that are the most active technical contributors to 802.11. Figure 8 shows that main IEEE 802.11n contributors were, in order, Intel, Broadcom, Marvell, Qualcomm, and Connexant. 802.11n was under active development from 2005 through 2009, well before the IEEE's Patent Policy updates were completed. Reports indicate that a handful of companies have submitted so-called 'negative' letters of assurance following the 2015 policy updates, in which patent owners indicate their willingness to license on a basis other than the new IEEE patent policy (eg, a previous policy basis). As indicated in Figure 8, companies that have – following the 2015 policy updates – submitted so-called "negative LOAs",[7] only two (Nokia and InterDigital) had any meaningful number of contributions to the development 802.11n, and the others had only four (France Telekom) one (Alcatel-Lucent) or zero (Ericsson) contributions.

[7] Namely Nokia (including its subsidiary Alcatel-Lucent), InterDigital, Orange (France Telekom) and Ericsson (the "Negative 5 companies").

Figure 8: Technical Contributions to 802.11n (Out of 4,167 total contributions); Top 5 contributors as compared to "Negative 5 companies".



This quite modest participation was further reduced for 802.11ac, which was primarily developed between 2009 and 2013. The top five technical contributors to 802.11ac were, in order, Intel, Qualcomm, Broadcom, Cisco and ETRI. As shown in Figures 9 and 10, only about 2% of technical contributions came from the Negative 5 companies – far less than the contributions submitted by the top five contributors.

Figure 9: Technical Contributions to 802.11ac (Out of 2,290 total contributions); Top 5 contributors as compared to "Negative 5 companies".

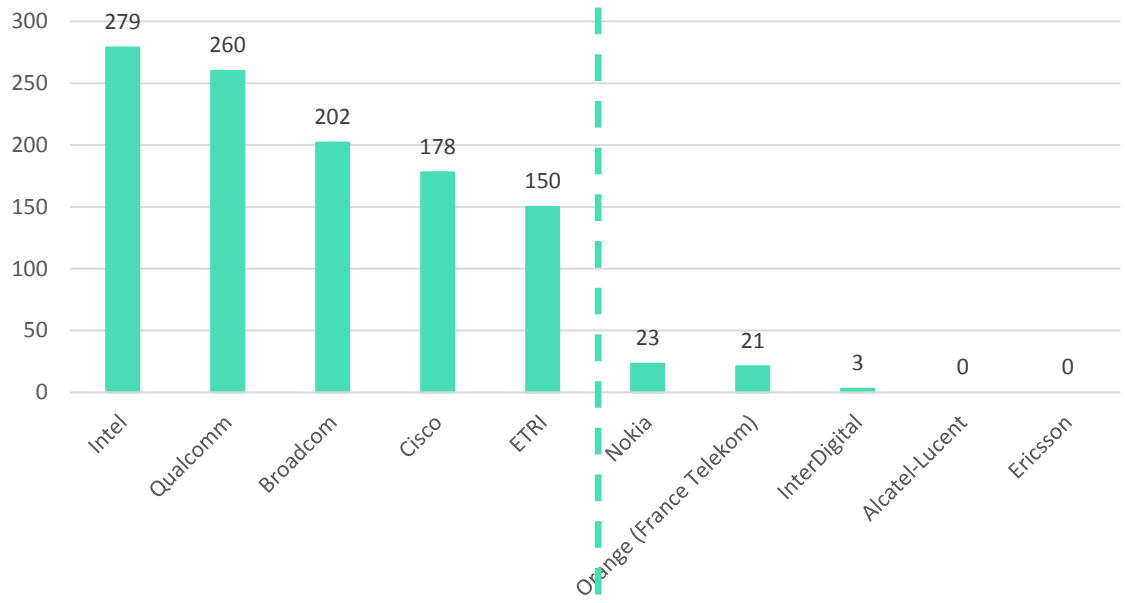
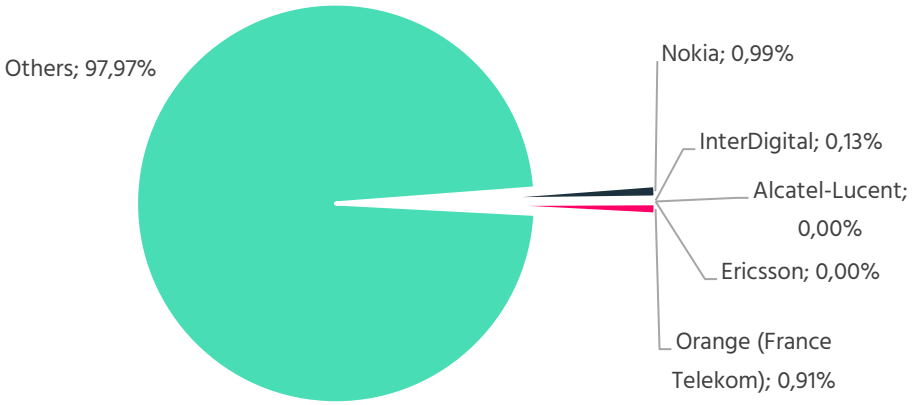


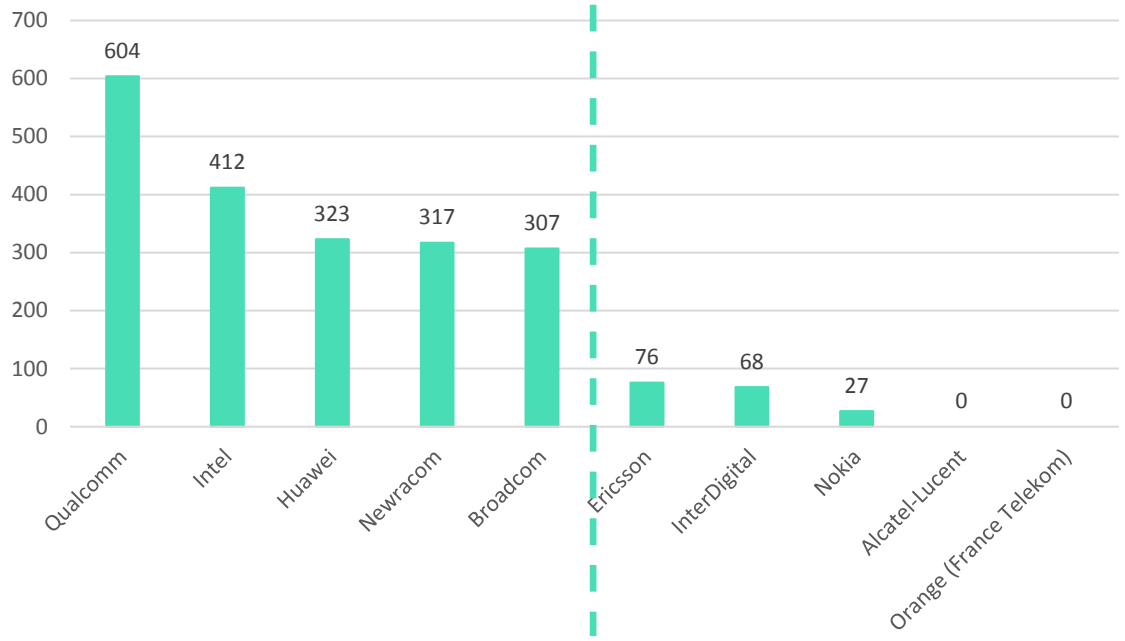
Figure 10: Relative Technical Contributions to 802.11ac (Out of 2,290 total contributions)



This trend is further apparent for the most recent 802.11ax development project, which spans from 2014-2018. As shown in Figure 11, the leading technical contributors to 802.11ax have been Qualcomm, Intel,

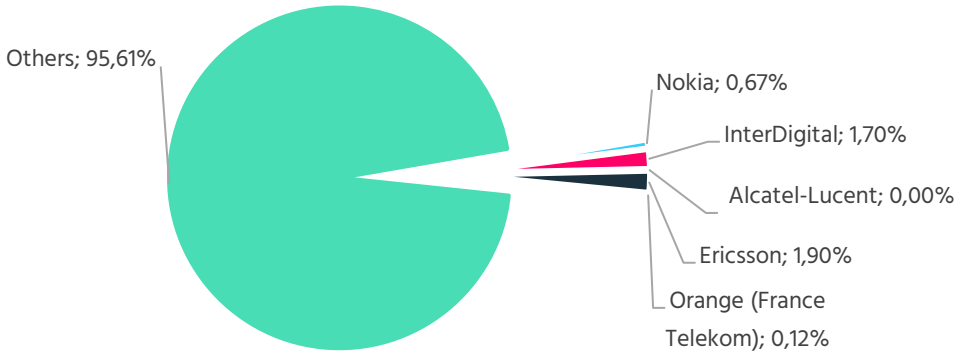
Huawei, Newracom and Broadcom. Intel and Qualcomm together were responsible for about 25% of all technical contributions to the 802.11ax project. Other "top ten" contributors include Broadcom, Marvell, MediaTek, LG, ZTE and Apple.

Figure 11: Technical Contributions to 802.11ax (Out of 3,968 total contributions); Top 5 contributors followed by Negative 5



Participation in 802.11ax spans the time when the IEEE policy was updated, but we do not see a substantial activity around technical contributions from the Negative 5 companies either before or after the policy was updated. For example, Ericsson submitted only about half of the number of contributions as the number ten contributor, Apple, which some authors have sought to portray – it would seem incorrectly – as a mere implementer of standards. The same trend can be seen with InterDigital, whose contributions are even lower. Nokia was the twenty-third leading contributor, with only 0.67% of the overall contributions. Orange submitted 0.12% of the technical contributions. And Alcatel-Lucent did not contribute anything at all to 802.11ax (figure 12).

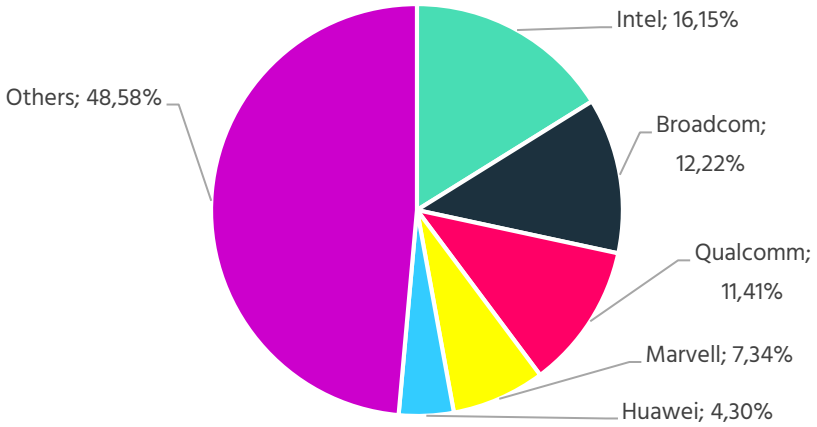
Figure 12: Relative Technical Contributions to 802.11ax (Out of 2,290 total contributions)



In short, all of the most active technical contributors to 802.11 – both before and after the IEEE's policy updates were issued, have submitted LOAs to abide by the IEEE Patent Policy through their own statements or through blanket LOAs, and none of them have issued negative LOAs.[8] As described in Figure 13, of the approximately 10,000 contributions to 802.11n, 802.11ac and 802.11ax since 2005, the top five 802.11 contributors (in order, Intel, Broadcom, Qualcomm, Marvell and Huawei) are responsible for more than 50% of the overall technical contributions. The top twelve companies (including LG, Mediatek, Newracom, Cisco, Connexant, Samsung and Apple) are responsible for nearly 75% of the overall technical contributions. By contrast, the five companies that have submitted negative LOAs are responsible for about 4.5% of the overall technical contributions – less than one-third what Intel alone has submitted over the same time period.

[8] Qualcomm had committed its patents pursuant prior to the IEEE Patent Policy update, based on a blanket commitment submitted by its subsidiary CSR Technologies that is applicable to all 802.11 projects, including those undertaken after 2015. *See* https://mentor.ieee.org/802.11/dcn/15/11-15-1026-00-0000-communication-to-patcom-related-to-802-11ah.pdf.

Figure 13: Relative Technical Contributions to 802.11n, 802.11ac, 802.11ax (Out of 10,425 total contributions)



In short, suggestions that work at IEEE has been negatively affected because a few companies – none of which have been particularly active technical contributors – have chosen not to support the updated IEEE Patent Policy in a single Working Group (802.11) are demonstrably incorrect. It appears that the IEEE technical ecosystem is such that technical development has and is being led by other companies.

III Evaluating IEEE Based on Counting LOA Submissions

As demonstrated above, there are multiple metrics by which one might evaluate the strength and health of an SSO such as IEEE. As discussed in our March 2017 report, however, one metric that is *not* particularly helpful at an SSO such as IEEE - where blanket Letters of Assurance (LOAs) are common - is to count the number of LOAs submitted.

Unfortunately, a few authors addressing IEEE have sought to draw conclusions regarding IEEE's ongoing innovation based on "counting stats" relating to submitted LOAs. Theoretically, it might seem possible that counting the number of submitted LOAs might provide some insight into which companies are most active in supporting technical development for an IEEE standard. But as we outlined in our March 2017 report, and as further demonstrated above, that theoretical possibility does not really apply at IEEE. Rather, like many

SSOs the IEEE permits so-called "blanket" LOAs that do not specify particular patents, but instead commits the submitting organization to RAND licensing for any and all SEPs that it may own.

Also, LOA counting does not provide much insight in assessing such organizations because "blanket" LOAs often are not updated when new patents are filed that become standard essential. In other words, while "blanket" declarations can provide broader FRAND assurances, they limit the accuracy and usefulness of patent-counting. As one court has estimated, patents subject to "blanket" declarations for the 802.11 outnumber specific declarations by at least about 9 to 1.[9] Given these court estimates that about 90% of all patents essential for IEEE standards are declared in "blanket" declarations, and only a small fraction of SEP declarations discloses specific patents, one can readily see what counting LOAs is a mostly meaningless endeavor.

In our March 2017 study we created several charts to demonstrate that number of submitted LOAs at IEEE was in line with prior experience, while always noting the limitations of quantifying these numbers. In this paper we have further noted that it is not only impossible to quantify the number of SEPs subject to "blanket" LOAs, but also not applicable to derive trends from LOA submissions. As one recent study focusing on LOAs correctly – albeit ironically – notes, "blanket declarations do not need such updating for the same standard or, in some cases, even for amendments thereto…".[10] The same study further elaborates that an update of LOAs with regard to the new patent policy is stated to be not required since "…the new patent policy is not a new policy but a mere clarification". In other words, even if an IEEE member contributes to an IEEE standard and files new patents relevant for the standard, these patents are covered by earlier LOAs and a new submission is not obligatory. Oddly, however, the author of this study proceeds to argue that based on an alleged decline in LOA submission, the IEEE has experienced a purported decline in innovation. It seems very difficult to appreciate the conclusions of this analysis considering the author's own recognition that "blanket" LOAs are *not* expected to be updated. One would expect to see a decrease of "blanket" LOA submissions by design, since patent owners might choose to submit "blanket" LOAs only in the beginning of a standard project.

Given the findings that approximately 90% of all patents essential to certain IEEE standards have been submitted through "blanket" LOAs, it seems dubious to focus on a "statistically significant" decreasing rate of LOA submission; this rate's relation to actual SEP commitments cannot be quantified and timed, and so

[9] Microsoft Corp. v. Motorola, Inc., Findings of Fact and Conclusions of Law, 2013 U.S. Dist. LEXIS 60233 at paragraph 335 (W.D. Wash., Apr. 25, 2013) (finding that non-blanket declarations for the 802.11 only represented a small fraction (estimated around 10%) of the actual number of patents actually essential for 802.11.).

[10] Mallinson, *Development of innovative new standards jeopardised by IEEE patent policy*, Wiseharbor (2017).

it is largely meaningless. The far more likely conclusion would be that companies like Intel, Broadcom, Qualcomm and Marvell that utilize blanket LOAs and are the leading contributors to projects such as 802.11 are committing dozens or even hundreds of new patents to IEEE without needing to submit new LOAs.

In short, and as a matter of plain fact, an increase or decrease of patents essential to IEEE standards cannot be assessed by counting LOAs. Claims to the contrary are erroneous.

IV Conclusions

In our March 2017 study, we demonstrated that simply counting specific patent declarations to IEEE (via LOAs) – and thus ignoring the vast majority of SEPs that are subject to parties' blanket declarations – was at best misleading. We further demonstrated that there are far better ways to evaluate the health and success of an SSO other than by mere LOA counts. For example, using that methodology, even respected SSOs such as ETSI could have been (mis)cast as falling into significant decline in recent years. Unfortunately, the methodological mistakes we noted in prior studies seem to have carried over into a few subsequent papers, all focusing on LOA counts rather than the far more important data we previously had presented.

Rather than seek to rebut yet again the mistaken premises of these types of analyses, in this update to our March 2017 report we have endeavored to take a new look at the updated empirical data, and offer our updated analysis grounded in (the most relevant) facts. As demonstrated above, the facts are that 2017 was a record year for IEEE's standardization work, both generally and within the 802.11 working group. We conclude that, by far more meaningful measures than mere LOA counting (or negative LOA counting from companies that are not leading technical contributors in any event), IEEE's standardization work continues to thrive.

About IPlytics

IPlytics is an IP-Intelligence company specializing in analyzing the relation of patents and standards. IPlytics Platform links over 90 million patents to 2 million standards documents, 5 million records on meeting minutes and technical contributions as well as 250k declared SEPs. IPlytics Platform is a widely-used tool to analyze patent ownership, patent value and a patent's likelihood of essentiality for standards.

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