EXHIBIT N

IS THE PATENT AMBUSH PREREQUISITE MET? ASSESSING THE EXTENT OF EX ANTE IPR DISCLOSURE WITHIN STANDARD SETTING

Anne Layne-Farrar*

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Abstract

As part of its "policy project to examine the legal and policy issues surrounding the problem of potential patent 'hold-up' when patented technologies are included in collaborative standards", the Federal Trade Commission held an all-day workshop on June 21, 2011. The first panel of the day focused on patent disclosure rules and much of the discussion centered on the conditions required for patent hold up or patent ambush to occur. One of the conditions identified was early – particularly before a standard is set – disclosure of intellectual property rights. When patents are disclosed ex post, after a standard is defined, the patent holder may have enhanced bargaining power that it can exploit to charge excessive royalties (e.g., greater than the value the patented technology contributes to the standard). The theoretical debate over hold up and ambush often assumes that most standards participants disclose their patents ex ante, such that the few disclosing ex post can be considered to be bad actors at least considering hold up. In this paper, I take an empirical look at the timing of IPR disclosures within standard setting organizations. I find, contrary to the implicit assumption underlying the patent ambush debate, that most participants officially disclose their potentially relevant IPRs ex post, not ex ante, and sometimes considerably so. On the other hand, I also find that the delay in declaring IPRs to standards has been shrinking over time, with disclosures occurring closer to (although for the most part still after) the standard publication date for more recent standards as compared to earlier ones. This empirical finding has important policy implications for the treatment of patent hold up.

* Anne Layne-Farrar is a Vice President at Compass Lexecon. The author thanks Roger Brooks, Damien Geradin, Daniel Garcia-Swartz, Jorge Padilla, and Richard Taffet for helpful comments and suggestions and Charmaine Alcain, Dhiren Patki and Sokol Vako for invaluable research support. Financial support from Qualcomm is gratefully acknowledged. The ideas and opinions in this paper are exclusively the author's, as are any errors. Comments should be sent to alayne-farrar@compasslexecon.com.

1. INTRODUCTION

The Federal Trade Commission (FTC) has been interested in the timeliness of patent disclosure within standard setting organizations (SSOs) – and the lack thereof leading to patent hold up and ambush – for many years now. It brought its first-failure-to-disclose case in the mid 1990s, against Dell.[1] At the time, Dell was participating in the standard consortium VESA, on the development of a computer bus standard, but Dell failed to disclose that the standard would read on at least one of Dell's patents. The FTC found that Dell's failure to disclose its relevant IPRs violated US antitrust law, at which point Dell agreed not to assert its patent against companies implementing the VESA bus standard. The next case of this ilk came in 2002, when the FTC began its long running *Rambus* case.[2] Rambus was accused of failing to disclose relevant patents and patent applications, along with other deceptive conduct. And then a year after the start of the *Rambus* matter, the FTC charged Unocal of participating in the development of gasoline standards with the California Air Resources Board (CARB), but failing to disclose relevant patents as well as making misleading statements about any intellectual property rights it held.[3] The FTC's June 2011 workshop, titled "Intellectual Property Rights in Standard Setting: Tools To Prevent Patent Hold-Up", can therefore be seen as one in a long line of steps that the Commission has directed toward IPR disclosure within standard setting contexts.

Commentators on the various FTC cases have largely been in agreement that failing to adequately disclose intellectual property rights (IPR) that might be essential to implement a standard early on in the standard development process is conduct that, at a minimum, should be discouraged and that in the extreme may constitute an

[1] FED. TRADE COMM'N DECISIONS, IN THE MATTER OF DELL COMPUTER CORPORATION, DOCKET NO. C-3658 CONSENT ORDER, ETC., IN REGARD TO ALLEGED VIOLATION OF SEC. 5 OF THE FEDERAL TRADE COMMISSION ACT, May 20, 1996 (Commissioner Azcuenaga dissenting) *Available at* http://www.mwe.com/info/pubs/ftc_volume_decision_121_(January_-_June_1996)pages_561-655.pdf.
[2] FED. TRADE COMM'N, IN THE MATTER OF RAMBUS INCORPORATED DOCKET NO. 9302, COMPLAINT, June 18, 2002, ¶ 119 at 31 *Available at* http://www.ftc.gov/os/adjpro/d9302/020618admincmp.pdf.
[3] FED. TRADE COMM'N, IN THE MATTER OF UNION OIL COMPANY OF CALIFORNIA DOCKET NO. 9305, COMPLAINT, March 4, 2003 *Available at* http://www.ftc.gov/os/adjpro/d9305/030304unocaladmincmplt.pdf.

antitrust violation.[4] Some, including the FTC, argue that a failure to disclose coupled with deceptive behavior aimed at keeping the IPR from coming to light amounts to anticompetitive conduct – hence the *Rambus* investigation and the many related lawsuit claims.[5] Others argue that the conduct is more appropriately deemed a breach of contract with the standards body, but nonetheless agree that deceptive patent "ambush" should be stopped.[6]

The economic theory underlying the concern over a failure to timely disclose IPR is one of exploitation. If licensors, especially those that are upstream specialists (like Rambus), are seen as withholding relevant patent disclosures while standard discussions are underway within an (SSO), disclosing their patents only after the standard had been defined and member firms may be "locked into" the chosen technology, then those licensors can charge "excessive" licensing fees. In particular, licensors following this kind of opportunistic strategy can not only charge licensing fees based on the value their IPR contributes to the standard but also can appropriate some portion of licensees' upfront and irreversible investments to implement the standard in products and services in the downstream market – the definition of patent hold up.

As may be evident from the description above, two key conditions (perhaps among others) underlie the ability to practice patent ambush. The first is SSO members' lack of knowledge of the undisclosed patents, or an element of surprise. If potential licensees were unaware of a licensor's IPR on technologies important for a standard during its development, then the licensor would be able to use the element

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[4] The debate surrounding the *Rambus* case is illustrative. While many aspects of that case have been the subject of much debate and controversy, the general notion that IPR holders should disclose ex ante was not in dispute. See e.g., Stanely M. Besen & Robert J. Levinson, *Standards, Intellectual Property Disclosure, and Patent Royalties After Rambus*, 10 NC J. L. & TECH 233 (2009) *available at* http://jolt.unc.edu/sites/default/files/Besen_Levinson_v10i2_233_282_0.pdf ; Mark R. Patterson, *Inventions, Industry Standards, and Intellectual Property*, 17 Berkeley Tech. L. J. 1043 (2002); George Leopold, *Rambus Ruling to Fuel Reforms*, INFORMATIONWEEK, Feb 12, 2007, *available at* http://www.informationweek.com/news/global-cio/showArticle.jhtml?articleID=197005088.

[5] "The foregoing conduct by Rambus, during and after its involvement in JEDEC's JC-42.3 Subcommittee, has materially caused or threatened to cause substantial harm to competition and will, in the future, materially cause or threaten to cause further substantial injury to competition and consumers…" See FED. TRADE COMM'N, IN THE MATTER OF RAMBUS INCORPORATED DOCKET NO. 9302, COMPLAINT, June 18, 2002, ¶ 119 at 31 *Available at* http://www.ftc.gov/os/adjpro/d9302/020618admincmp.pdf; see also Rambus Inc. v. Infineon Techs. Ag, 318 F.3d 1081 (Fed. Cir. 2003).

[6] See e.g., Bruce H. Kobayashi & Joshua D. Wright, *Federalism, Substantive Preemption, and Limits on Antitrust: An Application to Patent Holdup*, 5 J. COMPETITION L. & ECON 469 (2009).

of surprise after these firms were irrevocably committed to the standard – that is, after they had made unrecoverable investments – to hold up licensees by charging "excessive" royalty rates that exploited the cost of switching to any alternative technologies. In contrast, had member firms known of the licensor's IPR in advance of defining and implementing the standard, especially at a time when the licensors' technology may have faced competition from other technologies viable for use in the standard, then such exploitation would not be possible. With ex ante knowledge of the IPR, the SSO members could either have voted an alternative technology into the standard, excluding a given licensor's patented technology altogether, or else they could have negotiated fair and reasonable royalties with a particular licensor ex ante, under the credible threat of switching to one of the alternative technologies.

A second key condition required for profitable patent ambush is the presence of viable alternative technologies ex ante. If the licensor's patents faced reasonable substitutes before the standard was voted on and the licensor attempted to charge more for a license than its technology was perceived to be worth, then potential licensees could simply turn to the next best substitute; the licensor has little to no bargaining power in this case. If instead the patented technology is unique and irreplaceable – at least at a reasonable cost for the standard components at issue – then even if the SSO members had known about the licensor's IPR in advance of defining the standard they would nonetheless not have been able to credibly threaten to exclude the technology from the standard. In this latter case, the licensor has bargaining power even ex ante and without resort to any exploitation of switching costs derived from a lack of disclosure.

With unique patented technology, with no meaningful or viable substitutes, the question is whether the licensor can still exploit licensees' ex post irreversible investments to implement the standard. If the technology truly is essential for the standard under development, then the only credible alternative to taking a license, either ex ante *or* ex post, is to abstain altogether from producing products implementing the standard. Of course, ex post a licensee may already have made its irreversible investments, which will likely affect its willingness to walk away, but clearly the degree to which ex post IPR disclosure can play a role is considerably

weakened in this scenario as compared to the case where viable alternatives are available ex ante. In fact, under certain circumstances it can make financial sense for SSO members to pay somewhat more than a patent's "incremental value" over the next best alternative, even before any irreversible investments are made, if the profits available to licensees through implementing the standard with the patented technology are higher than the profits available without it.[7]

Given the conditions necessary for patent ambush or hold up to be successful, the debate over hold up begs the question of whether ex ante IPR disclosure within standard setting contexts is actually the general rule or not. This question is the focus of the remainder of this paper. In particular, I present quantitative analysis of IPR disclosures within an SSO to provide an indication of whether ex ante notification is the behavioral norm, as is generally assumed in discussions of patent ambush.

The remainder of the paper is organized as follows. The following section (Section 2) lays out the empirical approach taken, describes the data used to conduct the analysis, and presents the results. Section 3 then concludes. In an ideal world, the analysis would cover disclosure patterns at numerous SSOs to control for any institutional or cultural differences. Unfortunately, the data do not exist to allow that approach. Instead, the analysis here is based on IPR disclosures made to the European Telecommunications Standards Institute (ETSI) because it offers relatively detailed data in comparison to the very limited public records at other SSOs.

The analysis reveals two key findings. First, contrary to the implicit assumption behind much of the policy debate surrounding optimal SSO IPR disclosure rules and patent hold up, the data suggests that ex ante IPR disclosure is not, in fact, the norm – at least not at ETSI. While it is impossible to precisely define the demarcation line between "ex ante" and "ex post" (as explained below), analysis using a reasonable definition for that dividing line indicates that the majority of the official IPR disclosures at ETSI have been made "ex post".

[7] See Anne Layne-Farrar, Gerard Llobet, and Jorge Padilla, *Payments and Participation: The Incentives to Join Cooperative Standard Setting Efforts* (Working paper, July 2011, available online at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1904959).

While a failure to disclose IPR appears to be a necessary condition for the practice of patent ambush, other conditions must be required as well. Otherwise, we should have seen far more complaints of ex post opportunism, given that ex post disclosure is rampant. One candidate for an additional necessary condition might be SSO members having no window into their fellow members' R&D and patenting efforts outside of formal SSO disclosure. Firms whose R&D is in the public eye for other reasons can be expected to hold patents on their core technology areas, whether they formally disclose ex ante or not. Another candidate is likely to be a lack of ongoing stakes in the relevant industry.[8] Repeat players will have much at risk within the SSO (and the industries dependant on the standards that SSOs promulgate) and will therefore be less likely to attempt hold up or ambush strategies.[9] A third candidate for additional necessary conditions might be the existence of specific capital investments made on the part of standard implementers. It may be that irreversible investments in implementing a standard do not occur immediately after a standard has been defined, but instead take a year or more to accumulate to a level that would be worth hold up. This would leave SSO members some room to disclose after the standard was defined, but before any implementers were locked in, so that reasonable licensing terms could still be negotiated.

A second key finding from the analysis is that the timeliness of IPR disclosures has been improving over time. This is evident when we consider disclosure delays over the years and when we compare the delay in disclosing IPR's between the older generation mobile telecom standard (2G standard) with newer generations of that standard (3G and 4G). The average disclosure delay for 2G wireless standards is 2 years; that figure falls slightly to 1.91 years for 3G, but drops considerably to 0.75 years for 4G.[10]

[8] Hall and Zidonis (2007) report preliminary findings that suggest hold up strategies may be more likely to come from firms exiting an industry. Bronwyn Hall and Rosemarie Ziedonis, "An Empirical Analysis of Patent Litigation in the Semiconductor Industry", Working Paper January 2007.

[9] The *Dell* and *Unocal* cases put firms on notice that participating in an SSO comes with the obligation of following that SSO's rules. While Rambus approached many JEDEC members for royalties (and sued several as well), the strategy is nonetheless a relatively short-term one as Rambus is now branded as a deceptive firm; it cannot try an ambush strategy with any later standards.

[10] The mean difference is statistically significant at the 1% level. The medians for the two generations are, however, not statistically different from one another, at 0.63 and 0.93 for 2G and 3G, respectively.

In reporting that the norm appears to be ex post IPR disclosure I do not mean to suggest that patent ambush is not a cause for concern. Clearly successful patent hold up would have detrimental effects on competition and could raise consumer prices if the affected licensees passed on increased licensing costs to end consumers. That being said, given that the vast majority of disclosures are evidently made after the standard has been defined, it is apparent that more than ex post IPR disclosure is needed for patent hold up to emerge. As is true in many aspects of standard setting, the reality is far more complex than the policy debate typically assumes, which suggests that any policy proposals aimed at standards should understand the reality of IPR disclosures.

2. QUANTIFYING PATENT DISCLOSURES

As explained above, the analysis here focuses on the timing of patent disclosures to an SSO as compared to the contemporaneous status of the standards under development. Ideally, this study would consider numerous standards bodies to understand general disclosure norms and any variation amongst organizations or across industries. Unfortunately, most SSOs do not make public the data required for that assessment. ETSI is notable in this regard because it maintains an extensive database that, among other things, contains information on members' patent disclosures. These disclosures represent the official written notices that member firms make to ETSI, although other informal (verbal) notices could have come earlier. To keep the analysis manageable, I restrict my focus to ETSI projects related to the development of the mobile telecommunication standards.[11]

Formal IPR disclosure rules are spelled out clearly in ETSI's Guide on IPR.[12] As a result, all members are informed on where to look for the list of potentially

[11] Standard projects included are: 3GPP, 3GPP/AMR-WB, 3GPP/AMR-WB+, 3GPP/EMS, AMR, GERAN, GPRS, GSM, GSM/AMR-NB, GSM/TDMA, LCS, LCS-128 Pos, LTE, Lawful Interception, Smart Card, UICC, UMTS, UMTS FDD, UMTS/CDMA and WCDMA.

[12] ETSI Guide on IPR, available at http://www.etsi.org/legal/home.htm. Note that 3GPP is an umbrella organization of which ETSI is a part. According to the 3GPP website (http://www.3gpp.org/About/WP.htm) "Individual Members shall be bound by the IPR Policy of their respective Organizational Partner [ETSI in this case]. Individual Members should declare at the earliest opportunity, any IPRs which they believe to be essential,

essential IPR declared for any standard, project, or technical specification in which they are active. Moreover, it is my understanding that working group meetings (where the nitty gritty details of the standard specifications are determined) typically begin with the group's chair reminding attendees that potentially essential IPR should be disclosed as soon as practicable.

A. The Data

The key element of any analysis of IPR disclosure timing is obviously the definition of what constitutes "ex post" versus "ex ante". While a precise identification of this point is quite difficult given the evolving nature of the standard setting process, for the purposes of this analysis we can rely on an objective proxy. Specifically, "ex post" can be discerned by comparing the disclosure date for a patent named essential for a particular standard component to the publication date for that standard component's specifications. Under this approach, when disclosure dates precede the relevant publication dates, they can be considered "ex ante"; when they follow publication dates, they can be considered "ex post".

In order to assess the timing of patent disclosures made to ETSI, I collected all mobile telecom-related patent declarations made to ETSI by member firms as of December 23, 2010.[13] I include both granted patents and patent applications in the analysis. A typical disclosure posted on ETSI looks something like this:[14]

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or potentially essential, to any work ongoing within 3GPP. Declarations should be made by Individual Members to their respective Organizational Partners."

[13] These data are available at http://webapp.etsi.org/IPR/home.asp. I collected declarations to the following mobile telecom related ETSI projects: 3GPP, 3GPP/AMR-WB, 3GPP/AMR-WB+, 3GPP/EMS, AMR, GERAN, GPRS, GSM, GSM/AMR-NB, GSM/TDMA, LCS, LCS-128 Pos, LTE, Lawful Interception, Smart Card, UICC, UMTS, UMTS FDD, UMTS/CDMA and WCDMA.

[14] Id.

Table 1: Representative ETSI IPR Disclosure Entry

Company name	Nokia Corporation
Project	UMTS
Patent title	Communication of pictorial data by encoded primitive component pictures
Country of registration	UNITED STATES
Application No.	
Patent No.	6137836
Countries applicable to App./Patent	
Work Item or ETSI Deliverable No. with Section and Version	3GPP TS 26.140 Section:4.8 Version:5.2.0; ETSI TS 126.140 Section:4.8 Version:5.2.0; 3GPP TS 26.234 Section:2 Version:5.4.0; ETSI TS 126 234 Section:2 Version:5.4.0
Declaration date to ETSI	7/6/2005
Notes	The SIGNATORY and/or its AFFILIATES hereby declare that they are prepared to grant irrevocable licenses under the IPRs on terms and conditions which are in accordance with Clause 6.1 of the ETSI IPR Policy, in respect of the STANDARD, to the extent that the IPRs remain ESSENTIAL.
Other Patents/Applications in same family with countries	
Status	Active

Each IPR declaration is supposed to indicate the standard project that the patent reads on (such as GSM, UMTS, or LTE), the specific work item, deliverable or technical specification (TS) relevant for the patent, and the version number for the TS (reflecting the evolution of the standard's specification details over time). As the example above illustrates, a given patent declared to ETSI can identify more than one deliverable. In other words, the same patent may be relevant for multiple components of a particular standard and may even be relevant for multiple generations of a standard.[15] The TS and version number define the precise component of the standard for which the patent holder believes the disclosed patent may be essential.

Within the analysis here, a "declaration" is defined as each item declared to ETSI regardless of the number of technical specifications that the declaration reads on. An

[15] For example, a patent may be originally disclosed for the 2G mobile telecom standard, GSM, but reiterated for 2.5G (GPRS) or 3G (UMTS).

"entry", on the other hand, is defined as each combination of a technical specification and a version made within a declaration. Some declarations therefore have multiple entries.

For each unique entry I collected the TS version publication date. This date is the proxy "standardization" date that determines a disclosure entry's ex ante or ex post status. While it is clear that standards tend to evolve over a long period of time, and a particular version is just one iteration of that evolution, publication marks an official consensus among the working group members that the specification in the published version is the one to be adhered to (at least until replaced by a subsequent published version). Therefore, a TS may continue to evolve after publication, but if so it will have a higher version number associated with it. These publication dates therefore offer reasonable points in time to separate ex ante from ex post, in relation to components of the overall standard. Comparing an entry's disclosure date (the date of the official IPR declaration letter posted to ETSI) to the TS version publication date listed in the patent's declaration therefore defines the timing of the disclosure for the analysis presented here.

Because this study is centered on disclosure timing, certain fields were critical to the analysis. Any declaration that did not provide a declaration date or a specific deliverable was deleted from the dataset. In addition, I deleted declarations that were subsequently withdrawn (presumably because the IPR holder determined they were not essential).[16]

Many of the declarations made to ETSI have patents filed with and/or granted by the US Patent and Trademark Office (USPTO), the European Patent Office (EPO), the Japanese Patent Office (JPO), plus many other smaller jurisdictions, such as individual European nations. All patent jurisdictions in the declarations were included in the data. The final dataset contains 14,127 declarations made up of 34,571 entries.[17]

[16] Only the standard projects listed in supra note 11 were included in the analysis.

[17] ETSI reports a total of 25,827 declarations made to mobile telecom projects as of December 23, 2010. I made sure that patent numbers were of an appropriate format (i.e. patent number was not given as N/A, cancelled, pending, fallen, removed, to be completed, or to be provided) and that it did not contain any alpha/numeric characters that designate year of submission or document type submitted (character placement and document code

Even though there are over 34,000 entries in the overall dataset, only a third of those entries are complete in that they contain all the necessary data for the analysis (version number and deliverables). Table 2 summarizes the completeness of the data. The companies that report a version number but have no deliverable information are excluded from the analysis because timing cannot be determined for these declarations. This leaves 14,102 declarations, 34,546 entries.

Table 2: Breakdown of Declarations and Entries

	Number of Declarations	Number of Entries
Number in Initial Sample	14,127	34,571
…No Deliverables (excluded)	25	25
…With Deliverables but no Version	9,187	22,689
…With Deliverables and Version	4,915	11,857
Final Numbers	14,102	34,546

Note: The number of declarations includes all declarations that have at least one complete entry (i.e., deliverable and version information are included).

Table 3 below shows the jurisdictional distribution of the declarations and entries. The US is the most common jurisdiction. Roughly 27% of the complete entries and declarations (first panel) have the US as country of registration. Of the partial declarations/entries (second panel), roughly 37% list the US as the country of registration.

description vary across jurisdictions). I then extracted the multiple entries of each declaration and made each combination of a declaration and an entry as one observation resulting to 38,335 observations. Of these I deleted 478 withdrawn declarations, 1,287 blanket patents (e.g. application number and patent number = missing, n/a, pending, PCT, unpublished, to be provided, unknown, cancelled, Fallen, Removed) and 1,999 non-relevant projects (e.g. declarations where project not in 2G, 2.5G, 3G or 4G). I then removed complete duplicates that matched across the following fields: company name, project, patent title, declaration date, deliverables, country of registration, status countries applicable application/publication). Duplicate entries were then removed from the dataset (i.e. all other fields being equal including version numbers, ETSI TS 125 101 and 3GPP TS 25.101 is considered as just one declaration). To match the ETSI declarations with the correct Version Publication Dates, I also ensured that the technical specifications as well as the version numbers were consistent in format with the variables in the Version Publication dataset. Where version number is not complete (i.e., Version:5.X.Y, Version: Release 8, Release 6) the version number released right after the declaration date was used. If no other declarations with the same release number were made after the declaration date, the publication date of the same version family right before the declaration date was used. I then visually inspected the data for any mismatch in the grouping that could have caused to exclude relevant declarations or include irrelevant observations. After these processes, the dataset contained 14,127 declarations and 34,571 entries.

Table 3: Breakdown of Declarations and Entries by Jurisdiction

Country of Registration	Number of Declarations	Number of Entries
Final Dataset with Version		
United States	1,314	3,182
European Patent Office	474	1,007
Patent Cooperation Treaty	429	919
Japan	297	704
Germany	294	685
Korea (Republic of)	275	597
China, Taiwan & Hong Kong	261	721
United Kingdom	142	253
France	122	242
Other	1,307	3,547
Total	4,915	11,857
Final Dataset with Deliverables, No Versions		
United States	3,361	8,318
China, Taiwan & Hong Kong	1,183	2,105
European Patent Office	525	1,214
Patent Cooperation Treaty	496	716
Japan	482	1,208
Korea (Republic of)	278	744
Canada	258	839
Finland	214	483
Other	2,390	7,062
Total	9,187	22,689

Note: The number of declarations includes all declarations that have at least one complete entry (i.e., deliverable and version information are included).

As a final description of the data, Table 4 presents the top ten assignees by declarations made. In total, 47 different entities account for 4,915 complete declarations (first panel). Only 10 ETSI members have made more than 100 complete declarations: Nokia, Motorola, Qualcomm, InterDigital Technology, Nokia Siemens, Ericsson, Samsung, NTT Docomo, Siemens, and Philips Electronics. These ten firms account for 87% of all complete entries.

Table 4: Breakdown of Entries and Declarations by Company

Company	Number of Declarations	Number of Entries
Final Dataset with Deliverables, With Versions		
Nokia Corporation	962	1,595
Motorola Inc	773	1,551
Qualcomm Incorporated	581	3,728
InterDigital Technology Corp.	502	1,205
Nokia Siemens Networks	296	373
Ericsson AB	284	376
Samsung Electronics Co., Ltd	283	345
NTT Docomo, Inc.	240	513
Siemens AG	188	402
Philips Electronics N.V.	146	146
Other	660	1,623
Total	4,915	11,875
Final Dataset with Deliverables, No Version		
Nokia Corporation	1,465	2,446
Qualcomm Incorporated	1,313	4,127
InterDigital Technology Corp.	1,135	3,680
Motorola Inc	830	5,389
InterDigital Patent Holdings Inc	644	1,437
Huawei Technologies Co., Ltd	628	743
Samsung Electronics Co., Ltd	544	703
LG Electronics Inc.	413	540
Philips Electronics N.V.	383	432
ZTE Corporation	232	312
Other	1,600	2,880
Total	9,187	22,689

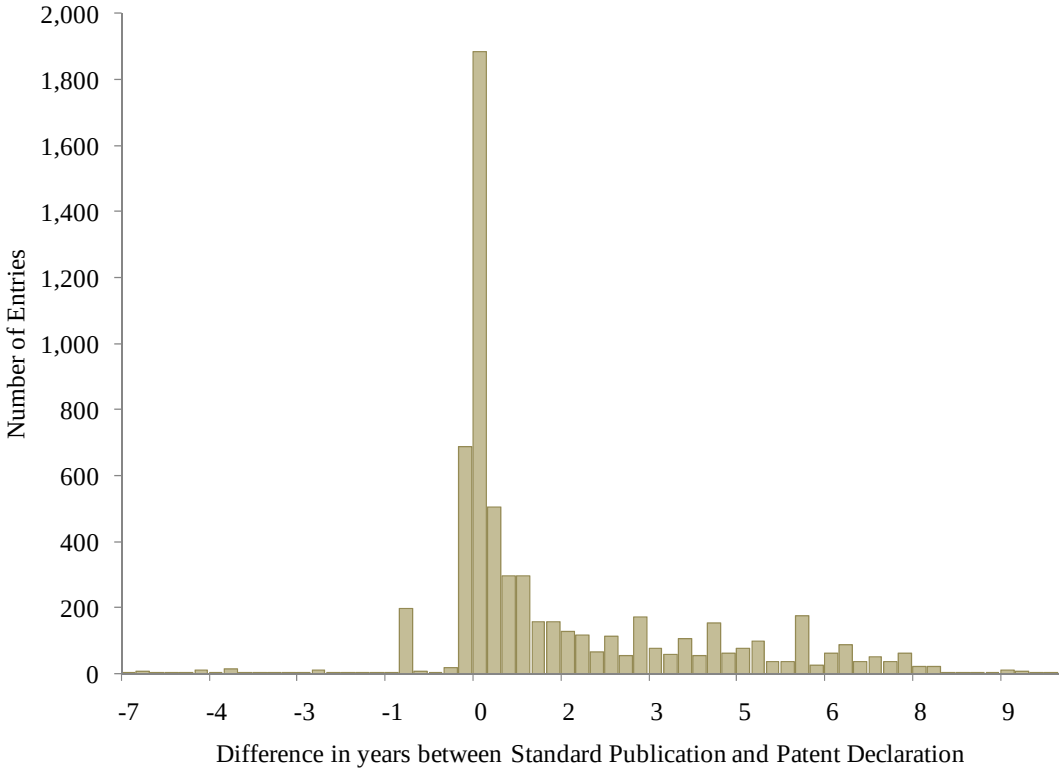
Note: The number of declarations includes all declarations that have at least one complete entry (i.e., deliverable and version information are included).

B. Disclosure Timing in the Aggregate

Consider first the complete records: those declarations that provide all information necessary for calculating the difference between the date of disclosure and the date the standard component was finalized. Figure 1 below presents the difference, in years, between the date of the official IPR disclosure and the date of the declared TS version publication date. A negative one indicates that the patent was declared one year prior to the listed TS version publication (e.g., ex ante) while a positive one indicates that the patent was declared one year after the listed TS version publication date (e.g., ex post).

Figure 1: Patent Disclosure Timing

Complete entries



As the figure clearly shows, the overwhelming majority of the complete entries were made *after* the publication of the technical specification named as relevant by the patent holder. Only 710 (11.3%)[18] of the complete entries were made ex ante. While most entries were declared ex post, the distribution is highly skewed with a mean of 1.5 years delay between publication date and declaration, a mode of 4 months, and a median of 6 months. In other words, many official declarations were made shortly after the relevant publication date. The distribution has a very long tail, however, indicating that 1,792 (28.54%) declarations were made two or more years after the relevant version was published.

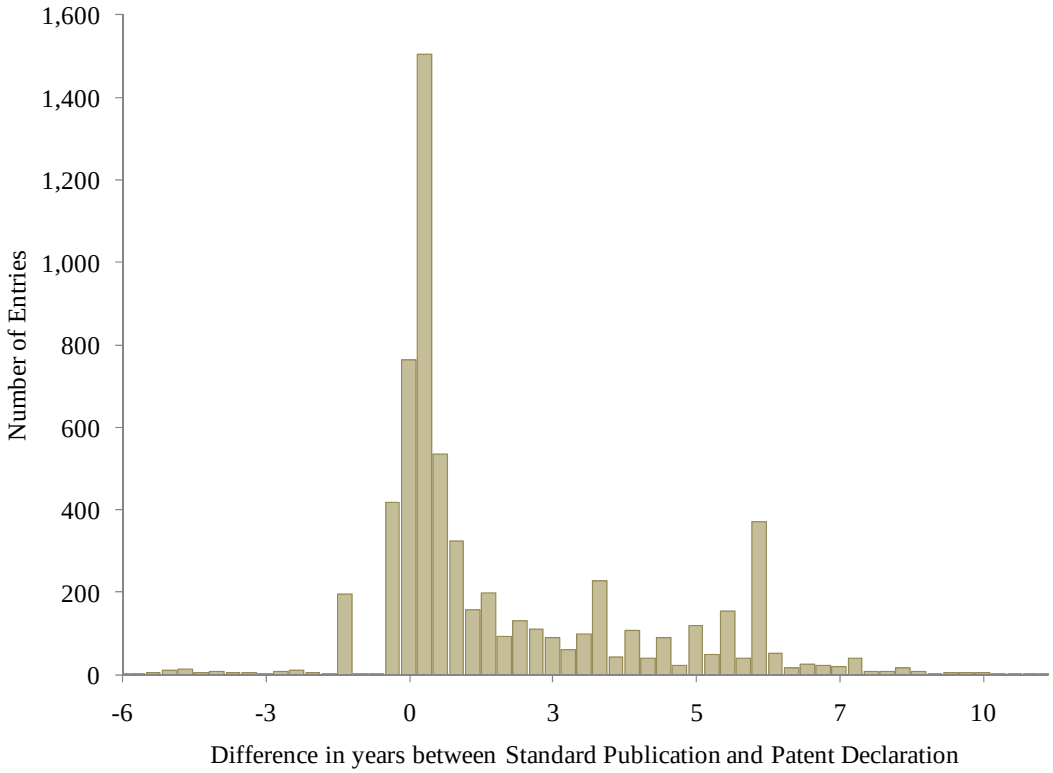
As shown in figure 2, the same pattern emerges when we consider the average delay for the broader group of those declarations that have at least one complete

[18] Note that even though 11,857 entries included a version number I was only able to find the publication dates for 6,280 entries due to incomplete information in the ETSI website or ambiguities in the entry itself.

entry. These initial calculations suggest that ex post declarations are far more common than is generally acknowledged in policy debates.

Figure 2: Average Patent Disclosure Timing

Declarations with at least one complete entry



Another way to consider the data is by ETSI project. Figure 3 breaks the disclosure data down for the four largest standard projects at ETSI during the timeframe analyzed.[19] The oldest project included is GSM, the 2G mobile standard, which had its first component vote in 1990.[20] The modal declaration for this project is 4 months after the relevant publication date; the median delay is 7.5 months. GPRS is the next project, representing an evolution of 2G (often referred to as 2.5G), with its first publication date in 1997. The modal delay is again 4 months after publication, but this project has a lower median of 4.5 months. The third group

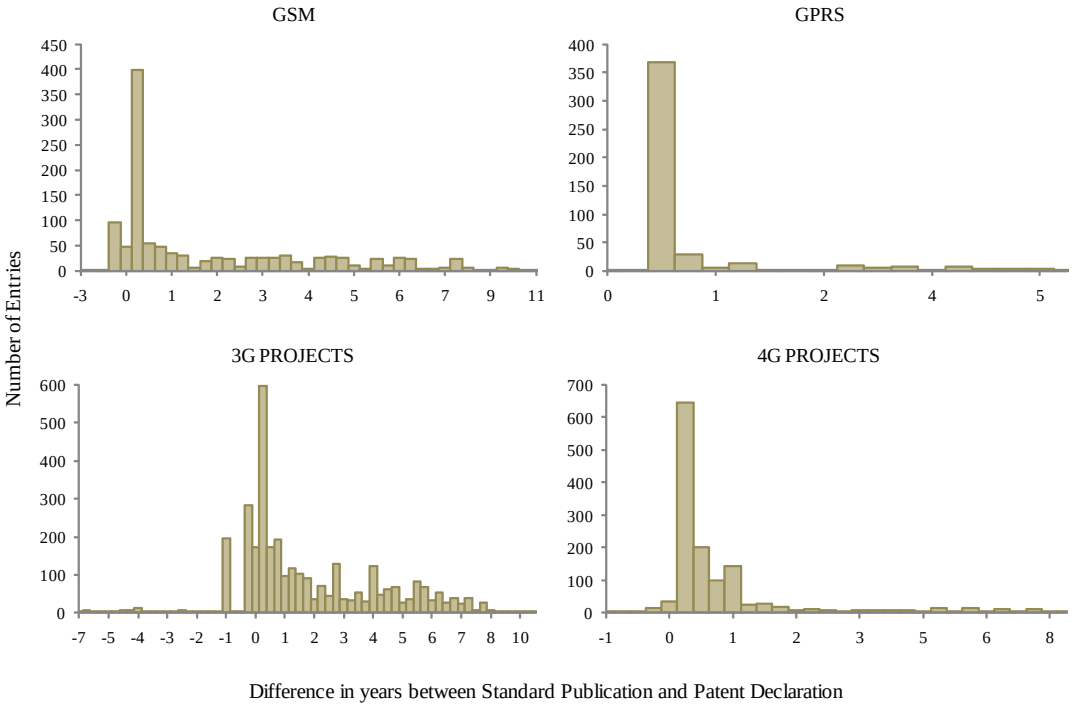
[19] No other project reached significant numbers of declarations to warrant separate analysis.
[20] GSM includes the following: GSM, GSM/AMR-NB GSM/TDMA, LCS, LCS-128 Pos, Lawful Interception and UICC.

analyzed is the 3G standard, which had its first publication in 1999.[21] While the mode is far lower at less than one month, the median delay is 11 months, higher than the GSM median and considerably higher than the GPRS median. The 4G standard, which had its first publication in 2002, has a 4 month median delay and a modal delay of 11 months.[22]

Considering the proportion of declarations made no more than one year after the relevant standard publication date presents another picture of IPR disclosure conduct. Only 47.2% of the GSM declarations were made within one year of the relevant publication, whereas 87.4% meet this criterion for GPRS, 34.2% met it for 3G, and 82.1% met it for 4G. GPRS therefore has the tightest period of declarations, although the more recent 4G is close behind.

Figure 3: Average Patent Disclosure Timing

Declarations with at least one complete entry



[21] 3G Projects include 3GPP, 3GPP/AMR-WB, 3GPP/AMR-WB+, 3GPP/EMS, UMTS, UMTS FDD, UMTS/CDMA, WCDMA, AMR, and Smart Card.

[22] 4G Projects include LTE.

Table 5: Declarations and Entries made by Ex Ante and Ex Post by Standard

Project	Number of Entries	Ex Ante	% Ex Ante	Ex Post	% Ex Post
2G	1,159	100	8.6%	1,059	91.4%
2.5G	461	1	0.2%	460	99.8%
3G	3,314	562	17.0%	2,752	83.0%
4G	1,346	47	3.5%	1,299	96.5%

Table 5 considers the data in terms of a simple before and after calculation, by standard generation. While the statistics above indicate that disclosure delays have been falling over time, the table above makes it clear that the majority of IPR disclosures is still ex post, even for the most recent mobile telecom generation.

Based on the statistics and charts above, the project level analysis suggests that average disclosure times have generally tightened over the years, but not in any consistent or smooth fashion.[23] Despite the general improvement, however, the majority of declarations continue to be made ex post and the disclosure timing distribution continues to have a long right tail.

C. Firm Level Analysis

Differences in timing are further explored by considering company level data. First consider the simple average and the median delay for the more active ETSI members in terms of the number of declarations and entries. Table 6 below looks at the top 10 ETSI members with 100 or more entries.

[23] Statistical tests comparing the mean differences in entry disclosure timing by project confirm that the observed differences are statistically significant. In particular, Bonferroni multiple mean comparison tests were run. Results on file with the author.

Table 6: Average Entry Disclosure Timing by Company

Company	Number of Entries	Average Delay in Years	Median Delay in Years
Nokia Corporation	1,331	0.61	0.40
Qualcomm Incorporated	1,130	0.64	0.37
InterDigital Technology Corp.	1,126	3.45	4.19
NTT Docomo, Inc.	476	2.29	0.92
Ericsson AB	344	0.49	0.16
Siemens AG	324	1.71	1.14
Nokia Siemens Networks	304	2.21	0.92
Samsung Electronics Co., Ltd	257	1.20	0.46
Coding Technologies	149	0.50	0.57
Philips Electronics N.V.	136	3.66	2.93
Other	703	1.65	1.05
Total	6,280	1.58	0.50

Note: The number of entries includes all entries that have version number and publication information.

While many of the average delays are small (falling under a year), Table 6 makes clear that late IPR declarations are an industry wide practice for mobile telecom standards. Entries are declared to ETSI on average about 1.5 years after the relevant technical specification is adopted. The average delay in declaration across firms ranges from 0.49 years (Ericsson) to 3.66 years (Philips).[24] Of the 43 firms that have at least one complete entry, only 2 have an average difference between declaration and publication date that indicates ex ante disclosures (i.e., a negative average). However both of these firms, Dilithium Networks and LG Electronics, are relatively minor contributors, having only 6 complete entries in total.[25]

Median delays tell a very similar story. Ericsson has the lowest median delay at around two months, while InterDitigal Technology has the highest at 4.19 years. And again, of the 43 firms with at least one complete entry, Dilithium Networks and LG Electronics are the only firms with ex ante median declaration dates.

Next consider an analysis of complete entries that examines the different telecom projects to which the firms assigned their declarations, presented in Table 7.[26]

[24] I treat the 33 firms with the lowest number of entries as a single entity for this analysis. I confirmed the results of Table 6 by conducting multiple mean comparison tests. The tests indicate that all but two firms make their declarations late (i.e. each firm's average is statistically significantly higher than zero).

[25] Both of these firms are included in "Other" in Table 5.

[26] The ETSI projects have been classified as follows: 2G—GSM, GSM/AMR-NB, GSM/TDMA, GERAN, LCS, LCS-128 Pos, Lawful Interception, and UICC; 2.5G—GPRS; 3G—3GPP, 3GPP/AMR-WB, 3GPP/AMR-WB+, 3GPP/EMS, UMTS, UMTS FDD, UMTS/CDMA, WCDMA, Smart Card, AMR; 4G—LTE.

Disclosure lag appears to have tightened considerably between 2G and 2.5G technology, but increased again somewhat from 2.5G to 3G. 4G lags are inconsistent across firms, with some showing improvement from 3G and others increasing the disclosure lag. On average, 2.5G entries are declared roughly 8 months earlier than 2G entries; 3G entries are declared roughly 6 months earlier than 2G entries; and 4G entries are declared somewhat more than 1 year earlier than 2G.

Table 7: Mean and Median Differences in Entry Disclosure Timing by Company and Project—2G through 4G

	2G		2.5G		3G		4G		Overall	
Company	**Mean**	**Med.**	**Mean**	**Med.**	**Mean**	**Med.**	**Mean**	**Med.**	**Mean**	**Med.**
Nokia Corporation	1.50	0.89			0.31	0.39	0.33	0.25	0.61	0.40
Qualcomm Incorporated	0.36	0.36	0.36	0.36	1.08	0.37			0.64	0.37
InterDigital Technology	3.69	4.37			3.19	3.69	4.27	4.52	3.45	4.19
NTT Docomo, Inc.					4.64	5.39	0.61	0.46	2.29	0.92
Ericsson AB	5.99	6.65	1.67	1.67	3.75	4.65	0.23	0.16	0.49	0.16
Siemens AG	2.05	1.51	2.00	1.49	1.63	1.02	0.44	0.43	1.71	1.14
Nokia Siemens Networks	3.99	3.12			3.13	3.03	0.52	0.46	2.21	0.92
Samsung	1.05	0.93			1.71	0.97	0.30	0.15	1.20	0.46
Coding Technologies					0.50	0.57			0.50	0.57
Philips Electronics					3.66	2.93			3.66	2.93
Other	2.82	3.32	1.05	0.52	1.78	1.29	0.48	0.30	1.65	1.05
Total	2.00	0.62	0.67	0.37	1.91	0.93	0.75	0.25	1.58	0.50

Note: The number of entries includes all entries that have version and publication information.

It is important to note that firms tend to make many IPR declarations at once. In other words, disclosure is "lumpy" and does not occur smoothly over time. The table below shows the highest count and proportion of complete entries and declarations by firm.

Table 8: Counts of Entries and Declarations with the Same Declaration Date

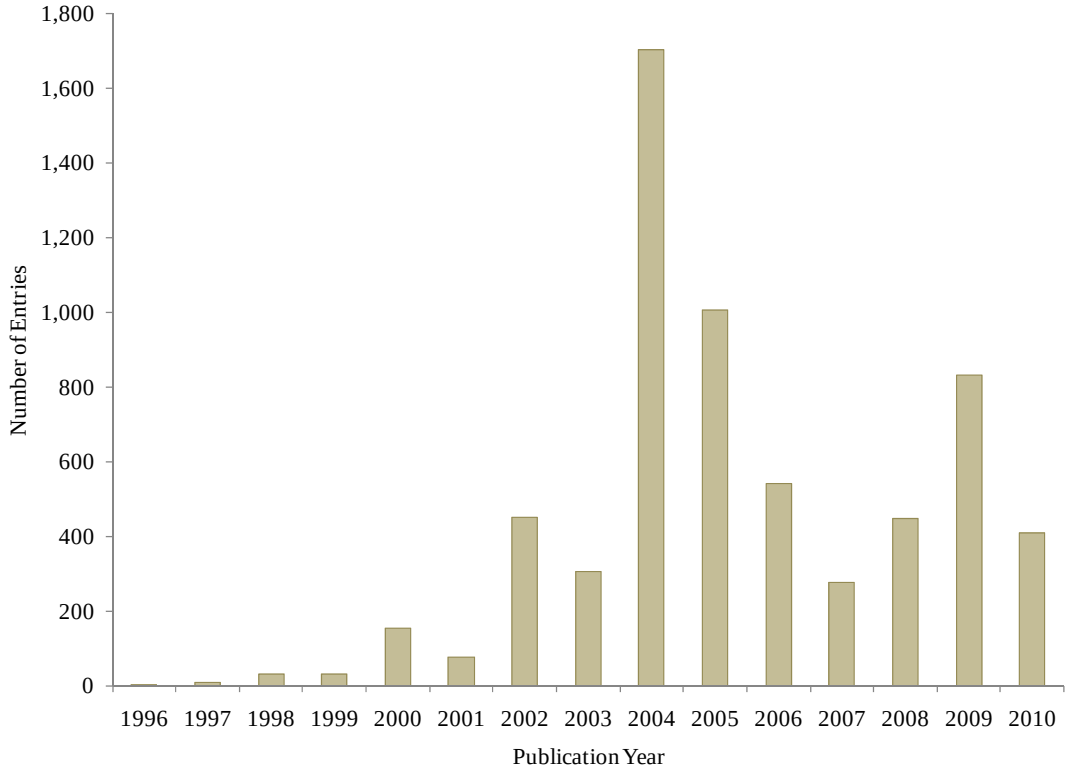
	Date with Most Declarations		Top 2 Most Declaration Dates	
Company	**Entries**	**Declarations** [24]	**Entries**	**Declarations**
Nokia Corporation	187 (14%)	187 (22%)	256 (19%)	235 (27%)
Qualcomm Incorporated	1,029 (91%)	513 (88%)	1,124 (99%)	576 (99%)
InterDigital Technology	326 (29%)	326 (66%)	989 (88%)	463 (93%)
NTT Docomo, Inc.	129 (27%)	68 (31%)	211 (44%)	132 (60%)
Ericsson AB	74 (22%)	57 (21%)	144 (42%)	106 (40%)
Siemens AG	69 (21%)	33 (20%)	107 (33%)	58 (35%)
Nokia Siemens Networks	79 (26%)	60 (25%)	122 (40%)	103 (43%)
Samsung	76 (30%)	74 (33%)	140 (54%)	122 (54%)
Coding Technologies	149 (100%)	29 (100%)	149 (100%)	29 (100%)
Philips Electronics	136 (100%)	136 (100%)	136 (100%)	136 (100%)
Other [25]	508 (81%)	298 (79%)	613 (90%)	377 (91%)

Note: The number of entries includes all entries that have version and publication information.

As the table indicates, a single declaration date tends to cover double digit percentages of a given firm's total disclosed IPR. In fact, two firms posted *all* of their relevant IPR on a single date. The fact that declarations come in bursts is not surprising given the time and cost involved in identifying patents to declare as potentially reading on a standard currently under development. In light of the effort involved, firms are likely to make such determinations infrequently, on an as-needed basis.

Figure 4 corroborates this point. As the chart below illustrates, declarations peaked in 2004, with 2005 and 2009 showing spikes as well.

Figure 4: Entries by Publication Year



D. Are Delays Shrinking?

As was shown in the prior section, even though there is some variation in the average delay, almost all firms, and certainly all the major industry players, typically declare their patents to the SSO after the relevant standard component (TS) has been published. As also noted, however, overall the average delay for later projects (3G and 4G) is lower than for earlier projects (2G). In this section, the pattern over time is further explored by conducting a variety of statistical analyses. If firms are shortening their disclosure lags, it could be the case that the standard setting body is taking a more active stance on late disclosure of intellectual property, or that firms are fully aware that the FTC is cracking down on such behavior, or simply that firms are generally more aware of regulatory concern about patent ambush and hold up and are therefore making a greater effort to disclose in a timely fashion.

In fact, ETSI records indicate that a policy change may be responsible for some portion of the improved timeliness of IPR disclosures. In November 2005, at its 46th

General Assembly, ETSI adopted a modification to its IPR Policy. Specifically, the wording of clause 4.1 of the Policy changed from "Each MEMBER shall use its reasonable endeavors, in particular to timely inform ETSI of ESSENTIAL IPRs…" to "…each MEMBER shall use its reasonable endeavors, in particular during the development of a STANDARD or TECHNICAL SPECIFICATION where it participates, to inform ETSI of ESSENTIAL IPRS in a timely fashion…".[27] Thus, after 2005, what "timely" meant became considerably more precise and was defined in relation to the development of standards and technical specifications.

Table 9 shows the number of entries by TS publication year along with the average and standard deviation in disclosure delay. There is a clear downward pattern beginning in the late 1990s; the average delay is markedly lower for the later years, dropping from 3.66 in 1996 to 0.25 by 2010. A similar pattern can be seen for the median delay over time. The trend is clear: firms are declaring their intellectual property more quickly after publication of the relevant standard component.[28] That being said, even as late as 2010 the disclosure norm remains ex post and improvements in timeliness have yet to translate into substantial ex ante disclosure.

[27] See ETSI Guide on Intellectual Property Rights (IPRs), Version adopted by Board #70 on 27 November 2008, 4.6.1 History of Changes, p. 61.

[28] Regressing the average delay on the publication year produces a negative and statistically significant coefficient, as seen in Table 9. This suggests that censoring of the data toward the late years does not drive the regression result.

Table 9: Summary Statistics of Complete Entries by Year of Publication of the Relevant Technical Specification

Year	Number of Entries	Mean Delay in Years	Median Delay in Years	Standard Deviation
1996	2	3.66	3.66	1.01
1997	8	2.43	2.46	1.25
1998	32	3.06	2.56	1.66
1999	31	4.00	3.32	1.86
2000	155	4.04	4.18	2.66
2001	78	5.13	4.48	2.46
2002	452	4.52	5.63	2.69
2003	305	4.59	6.16	2.42
2004	1,702	1.03	0.36	1.75
2005	1,007	1.32	0.86	2.15
2006	541	1.93	2.56	1.81
2007	276	1.26	1.40	1.37
2008	448	0.67	0.88	1.19
2009	833	0.43	0.25	0.42
2010	410	0.25	0.18	0.29
Total	6,280	1.58	0.50	2.24

Note: The number of entries includes all entries that have version and publication date information.

Regression analysis is presented next. I run a regression of the difference in years between declaration and publication on year-specific fixed effects. Table 10 shows the results. The baseline is the average delay in the beginning year (1996), represented by the constant; the coefficients on the years indicate the presence and extent of any delay (negative numbers indicate shorter delays as compared to 1996). There is a decline in the first couple of years, followed by an increase in the length of the average delay, which peaks around 2001. Most of the early coefficients, however, are not statistically significant, meaning they are not likely any different from the base year 1996 (although this result may be partially driven by the fact that in the early years we have considerably fewer entries than in the later ones). A structural break appears to occur in 2004, when the length of the average delay collapses from 3.66 years to about 1.03 years (3.66-2.63), a change that is highly statistically significant. The timing of this break suggests that debate in anticipation of the ETSI General Assembly rule change may be responsible. From 2004 on all the differences relative to the baseline are statistically significant. Interestingly, disclosure delay increases from 2005 to 2006 (the year after the ETSI policy rule went into effect), but from 2007 on there is a consistent decline in disclosure delay.

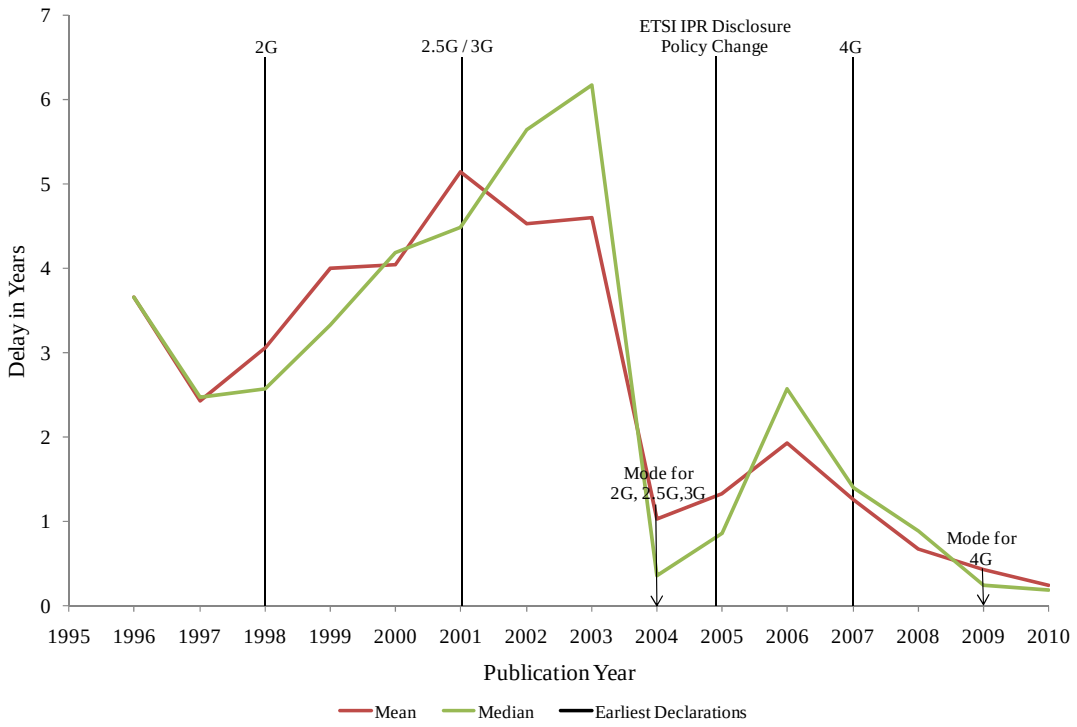
Table 10: Regression Analysis – Dependent Variable is the Difference in Years between Declaration and Publication Date

	Coefficient	Robust Standard Error	P>|t|	
1997	-1.231	0.653	0.059	
1998	-0.601	0.583	0.303	
1999	0.340	0.604	0.573	
2000	0.383	0.549	0.486	
2001	1.474	0.577	0.011	*
2002	0.864	0.522	0.098	
2003	0.935	0.525	0.075	
2004	-2.629	0.508	0.000	**
2005	-2.336	0.511	0.000	**
2006	-1.729	0.512	0.001	**
2007	-2.397	0.513	0.000	**
2008	-2.992	0.509	0.000	**
2009	-3.226	0.506	0.000	**
2010	-3.410	0.506	0.000	**
Constant	3.657	0.506	0.000	**
N	6,280			
R-sq	0.373			

*Notes: *p<0.05, **p<0.01*

When considered in tandem, these results confirm the results from the previous sections, suggesting that overall ETSI members are declaring their intellectual property more quickly after publication of the relevant component specification, albeit still ex post. The figure below summarizes the findings, noting the start dates for each standard generation, as well as the date of ETSI's policy change.

Figure 5: Entry Disclosure Delays by Year of Publication of Relevant Technical Specification



Note: Standard generation vertical lines mark the first disclosures made for the respective generation.

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When viewed in the aggregate, the results presented in this section point to two distinct findings. First, declarations occur most often ex post, after the relevant technical specification for the patents being declared has been published. This is true even after ETSI revised its IPR Policy to more explicitly define that "timely" disclosure means during the development of the standard. Second, there is strong evidence that while declarations remain ex post on average, firms are becoming quicker to declare relevant patents after publication of a standard and that trend has been continuing for many years now.

3. CONCLUSIONS

As the FTC's "policy project" on IPRs and standards continues – and indeed as the general debate over how far antitrust can extend its reach into standard setting

and IPR licensing issues continues – it is important to step back on occasion to examine the assumptions underlying the primary antitrust concerns. One of the key assumptions behind the patent ambush and hold up issue is that most (or all well-meaning) SSO members disclose their IPRs relevant to a standard on an ex ante basis, while the standard is still under development and while competition over which technologies to include in the standard might still be a factor. The analysis presented above illustrates that the assumption of mostly ex ante IPR disclosure is likely to be a heroic one.

At ETSI, over the past 15 years, the majority of IPR disclosures have instead been ex post, coming after the publication of the component the patent is declared as relevant for. While the modal delay in disclosure has fallen steadily over time, from a peak of 7.39 in 2002 down to -0.92 in 2005 and then back up again to 0.29 in 2010, most IPR disclosures at ETSI continue to be made ex post. The findings presented here therefore suggest, to the extent that ETSI is representative of other SSOS, that the IPR disclosure norm is indeed ex post, not ex ante. It may be that other constraints against the practice of hold up are at work to minimize any negative effects from late IPR disclosure. Indeed, the analysis presented above underscores the long-run nature of standard setting: most of the firms present in the dataset appear in numerous consecutive years, with an average term of 5 to 6 years (and counting, given that ETSI continues to develop the 4G standard).[29]

The good news is that disclosure delays are falling. If the trend toward more timely disclosures continues, we would expect the transition from ex post to ex ante to occur eventually. However, the lumpy nature of IPR disclosures, as companies review their IPR holdings only periodically and then make disclosures in broad tranches, suggests that at least some patents will always be declared ex post, just as a practical matter.

To the extent that it takes time after a standard has been published for SSO members to make irreversible investments in implementing the standard, modest delays in IPR disclosure of a few months may not be problematic. If standard

[29] Based on the set of firms making at least one complete IPR disclosure.

implementers still have enough time to negotiate licenses without any investment lock-in, then patent hold up cannot be practiced.[30] Indeed, if implementation investments take over a year to complete, then the "ex post" clock may not start ticking until that point, regardless of when technology votes occur in the SSO. This logic would imply that the ex ante / ex post demarcation is firm specific, triggered by an individual SSO member's irreversible investments, and is not universal to the standard overall. This is an interesting avenue for future research.

Regardless of any necessary conditions for patent hold up to be practiced, however, the empirical analysis presented here suggests that ex post IPR disclosure is widespread (unless ETSI is an outlier among SSOs) and has been the norm for many years. This finding is contrary to the implicit assumption underlying much of the patent hold up debate and thus suggests a new area of consideration to move the policy debate forward.

[30] The time and expense of shifting the standard specification to an alternative technology, should one exist, would still remain though.