Landscaping study on Standard Essential Patents (SEPs)

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Executive summary

Standardized technologies such as LTE, WiFi, NFC, RFID or Bluetooth will strongly contribute to the next technological revolution of the Internet of Things (IoT). In this regard standard-essential patents (SEPs) are increasingly the subject of lively debates among market observers, policy makers and regulatory institutions. Yet little is known about the overall number truly standard essential patents declared in the numerous standard setting organizations (SSOs). In this report all publically available worldwide declared SEPs are analyzed to provide a more transparent understanding on the technological concentration and the regional application of SEPs, an overview of global SEP owners as well as an analysis on activities connected to patent licensing, patent trade, patent litigation and patent essentiality. The objective is thereby to better assess the needs and feasibility of more informative patent declarations.

A majority of the SEPs are declared for large standards projects such as GSM, UMTS and LTE set at the European Telecommunications Standards Institute (ETSI). Therefore, results of this report are differentiated by SSOs, standard projects or technology classification. Since ETSI mainly standardizes telecommunication technologies, most declared SEPs concentrate on digital communication technologies.

The report reveals that the share of declared SEPs from Chinese and Korean companies has been increasing over time, especially in the telecommunications sector. This underlines the later development of the Asian markets and its increasing importance in the global economy. The report furthermore reveals that the regional concentration on patent offices but also on the patent owners' country of origin highly depends on the technological area. Computer technology standards concentrate on US SEPs declared by US patent owners, audio-visual technologies concentrate on Japanese and US SEPs declared by US and Japanese patent owners, SEPs in basic communication technologies concentrate on European patent offices and all the IP5[1], while digital communication is subject to SEPs originally filed in European offices but declared by patent owners from Europe, US and the large Asian players.

The overwhelming majority of declared SEPs are renewed indefinitely, which suggests that all of them have significant market value and may be subject to lucrative royalty income. When comparing the declared SEP portfolios of the different patent owners, the result of this study illustrates varieties in the characteristics of these SEP portfolios.

[1] IP5 patent offices; EPO, JPO, KIPO, SIPO and USPTO. See www.fiveipoffices.org

These differences are connected to the age of the patent portfolio, the regional application as well as to the technological relevance of the patent families.

The licensing commitments connected to the declaration of SEPs highly depend on the individual SSO as well as on the technological focus of the standard. Some SSOs still do not require its members to commit to a license at all, others require default license commitments under royalty free terms or non-assertion agreements. The majority of declared SEPs are, however, declared under FRAND terms. Only a small share of declared SEPs are licensed through a patent pool.

The analysis on the trade of declared SEPs shows a clear pattern of patent transfers from European and US incumbent telecommunication companies to new entrants in the US (Internet), Asia (telecommunication) but also to so called NPEs (non-producing entities). Consequently, some NPEs (Intellectual Ventures, Rockstar, Unwired Planet) have become major SEP owners.

The analysis of litigation in the US reveals that the frequency of litigated declared SEPs has been constantly increasing since the mid-2000. Thus, the share of litigated declared SEPs has been increasing over time. The majority of litigation are based on SEPs registered at ETSI, due to their large numbers; however, proportionately ETSI SEPs are rarely litigated (0.55% of all ETSI SEPs, one of the lowest of all).

The analyses of this report illustrate that declared SEPs may influence the standardization processes. The study shows that declared SEPs lead to more frequent technological updates of standards, but to less frequent changes of standards generations. This result suggests that patents may create incentives to contribute to the incremental technological progress of the current standard generation, while a radical shift to the next standard generation is delayed.

A comparison of declared SEP characteristics with a control group shows that declared SEPs are more frequently traded, more frequently litigated (in the US), more frequently renewed and more frequently cited as prior art. Also, a patent family of declared SEPs is filed on average more internationally, i.e. in more countries jurisdictions, than patents in the control group. These results confirm an overall higher value of declared SEPs. Yet the study does not differentiate if this value is induced via standardization or intrinsic.

The analysis of the timing of SEP declarations illustrates a stark contrast between ETSI (where most declarations take place after the standard release) and ISO/IEC (where most

declarations take place before the standard release). A focus on declared SEP's priority and grant dates also suggest that a share of them are declared before being (possibly) granted. These results, as well as available evidence of an over-declaration issue at ETSI, suggest that the current declaration practices do not convey reliable information on the essentiality of declared patents.

In this context, the legal validity of patent applications claimed as essential is a first major issue. With regard to this challenge and as recommended in the previous 2014 European Commission report on Patent and Standards[2], patent offices should cooperate with the respective SSOs to get access to standards documents early on.[3] This will further increase the quality of granted SEPs.

Essentiality checks may represent the right policy option to reduce legal uncertainty and decrease legal disputes outside and inside European courts. The analysis of costs connected to essentiality checks suggests that carrying out (non-legally binding) essentiality by a central and independent entity with the technical competencies, access to standardization and patent documents and industry recognition could be the most efficient solution. In this sense, essentiality checks could be conducted by patent offices during the granting procedures (e.g. after the substantive examination) or immediately after when also the standard has been released. However, the timing of declared SEP grant and standard release dates may differ as to the specific SSO and its standard setting procedures.[4] Moreover, the assessment of the essentiality may be performed in a "dynamic" way, since some patents are also essential to standards of later generations. Therefore, such service may also be provided after grant.

In addition, it should be further assessed how the cost of these checks would impact the dynamics of standardization. Such a policy option would therefore require further investigation before being practically envisaged.

[2] http://ec.europa.eu/DocsRoom/documents/4843/attachments/1/translations

[3] The EPO has already developed this cooperation to include standards documents in the prior art search at the EPO and regularly cites such documents in its search and examination reports where available; the EPO cited over 19 000 standards related documents as prior art in 2015, an increase of 27% over 2014; and over 60% of patentability reports in certain technical areas cite at least one such document.

[4] This result also suggests that essentiality checks for declared SEPs at ETSI could be conducted during the granting process (e.g. after the substantive examination) and thus after the release of the standard, while such a procedure is less applicable at ISO/IEC where the granting process often takes place before the standard has been set.

Acknowledgements

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I. Intro

ICT - Information and Communication Technology industries are the backbone of the Digital Single Market. ICT is ever-present in our today's society, with over three billion people having Internet access worldwide and approximately 8 out of 10 Internet users owning a smartphone. This rapid growth has led ICT to become a key element of everyday life. ICTs provide essential infrastructures and tools for knowledge creation, sharing and diffusion boosting the innovation capacity of any sector. Stimulating creative activities in the area of ICT has therefore a double effect on the economy: Through the growth of the sector itself, and through the stimulation of R&D and innovation in other sectors of the economy. Internet of Things (IoT) technologies will connect devices, vehicles, buildings and other items with electronics, software or sensors. Embedded ICT allows machines or cars to exchange information yielding a direct integration of the physical world into computer-based systems. Interconnectivity of different systems and the communication across multiple devices relies on the common specification of standards. A standard is a document that sets out requirements for a specific item, material, component, system or service, or describes in detail a particular method or procedure. Technology standards specify a common language for technologies to communicate and interact, ensuring compatibility and functionality of complex technology systems. Standards evolve in markets where returns increase when a large number of firms rely on the same technology. For example, computers, smartphones and tablets connect to the internet or other devices via standardized wireless technologies, such as LTE, WiFi or Bluetooth. Standards enable products to communicate with each other and frequently give rise to substantial consumer benefits. In addition, they provide infrastructure to set up technologies, reduce transaction costs, facilitate trade, allow for economies to scale and build platforms for knowledge sharing. Standards are generally set by Standard Setting Organizations (SSOs), such as e.g. the International Standardization Organization (ISO), the European Telecommunications Standards Institute (ETSI) or the International Telecommunication Union (ITU), with the objective to facilitate the deployment of new technologies on the largest possible scale and to create a level of playing field for competition in related product markets. Even though SSOs seek to align interests of all interested stakeholders, coordination also takes place in industry standards consortia. With over 500 different ICT related standards organizations the landscape of standardization activities is very heterogenic. These standard organizations differ in terms of standard setting processes may be subject to different bylaws.

Participants of ICT standardization are confronted with particularly two major challenges. First, standard setting is expensive and increasingly distributed across

organizations and countries. Second, standardized technologies in ICT are in many cases protected by patents. These so called “standard essential patents” are subject to a new and different legal framework which goes beyond the rights of regular patent law. In the field of ICT, standard setting is no longer a sheer specification of compatibility standards, but in fact a joint development of sophisticated technologies. Thus, standards often frame a large number of innovative technologies (GSM, UMTS, WiFi, DVD, Blue-Ray, MPEG, etc.) which are highly patented. GSM and UMTS ensure communication of mobile phones and smart phones. The Wi-Fi standard provides wireless connection to local internet hosts. CD, DVD or Blue- Ray guarantee that decoders or players read discs to watch movies on TV or computer screens and the MP3 standard allows to listen to high quality music in compressed data formats on multiple devices. The increasing need for interoperability comes along with a rising sophistication of technology standards. In this context, standard setting is much more demanding in terms of R&D activities. Essential patents play an important role in standardization, as they provide incentives for firms to develop technologies for standards and to contribute to the effort of standardization. Standardization entails a costly private investment into a public good. Due to this externality, standard makers underinvest in developing and improving standards. The prospect to include their patented technology into technological standards is an important incentive for firms to increase their investment in standardization. Also, patent holders have a stronger private interest to invest in improvements of existing standards if they can recoup the costs through licensing fees.

Essential patents have a special position on a technology standard because they may leverage market power and lead to exclusive effects. Whereas patents are actually intended to allow its owner excluding others from using a protected invention, the main objective of standards is to encourage the spread and wide implementation of the standardized technology. Manufacturers that create products are not able to bypass standards or invent around standardized technologies, since standards shape the interface to connect, communicate or work on or with other products and platforms. This apparent conflict is resolved by licensing. Standardization participants are expected to allow others the use of their technology, but they can require adequate royalties. As of the data in this study SSOs mandatorily require firms participating at standard setting to disclose any patent that might turn out to be essential for the standard in question. Furthermore, holders of such patents have to submit a declaration whether they accept to commit on fair, reasonable and non-discriminatory terms of licensing for these patents (FRAND commitments). If a firm discloses a patent and refuses to commit on such licensing terms, the SSO will usually set the standard excluding the protected technology. Even though standardization may be accompanied by complex licensing

agreements, the rules for licensing of complementary patents essential for a common standard are often unclear and can be subject to complex discussions. Nevertheless, FRAND commitments are commonly seen as an important instrument to curb anticompetitive and abusive strategies. Antitrust authorities have referred to FRAND commitments as a remedy to the potential competitive risks of standardization. Antitrust law interprets the licensing of essential patents to be a market of its own. Under certain circumstances, a company that owns an essential patent would thus hold a dominant position in this market. The defendant has the right to get a license under FRAND terms, which can be raised as a defense in infringement cases. Special rules also exist on the possibility to request an injunction during court proceeding.

SSOs disclose lists of patents that have been declared, by standard participants, as standard essential. However, simply counting the number of declared patents, as listed, is not a reliable measure. Firstly, SSO's lists of SEPs contain multiple patents that share a common priority, such as provisional applications, divisional applications, or applications to other countries. Secondly, companies can declare essential patents at their discretion. SSOs do not confirm or deny whether the declared patents are actually essential or not. As a result, the definition of relevance to the standards varies, resulting in considerable differences in the number of the declared SEPs. This report aggregates declared SEPs to distinct patent families, identifies the legal status of these patent families and studies the relevance of declared SEPs to particular standard documents with indicators of prior art citation and a comparison of patent filing and to the timing of standard setting.

This study uses data on over 200,000 patents declared as standard essential by the following major standard-setting organizations (SSOs): Advanced Television Systems Committee (ATSC), American National Standards Institute (ANSI), BluRay Disc Association, Broadband Forum, DVD Forum, European Committee for Standardisation (CEN), European Telecommunications Standards Institute (ETSI), International Electrotechnical Commission (IEC); Institute of Electrical and Electronics Engineers (IEEE), Internet Engineering Taskforce (IETF), International Organisation for Standardisation (ISO), ITU Radiocommunication Standardisation Sector, ITU Telecommunication Standardisation Sector, Open Mobile Alliance (OMA), Organisation for the Advancement of Structured Information Standards (OASIS), Society of Motion Picture and Television Engineers (SMPTE) and Telecommunications Industry Association (TIA). All of these SSOs have a comparable formal IP policy and are required to publicly disclose SEPs. The public SEP declaration letter set out information on the patent being claimed as essential for a particular standard, the licensing terms and conditions, information on the declaring company and the date of

declaration. This report analyzes patents declared as SEPs and is consequently focused on patent owners. Company's only implementing standards are left out of the analysis.

In this regard the Directorate General for Internal Market, Industry, Entrepreneurship & SMEs, DG GROW commissioned IPlytics to design a report on the landscaping of standard essential patents ("SEPs"). The objective is to understand recent industry shifts and technological trends for the interplay of patents and standards. The goal is to shed light on different standard setting participants and IPR holders' behaviors. In addition, the report seeks to provide insights on the opportunity, timing and costs of implementing essentiality checks of SEPs by different entities (e.g. selected patent offices, private entities, etc.). The report provides empirical answers to a number of issue raised in the report "Patent and Standards" (EC, 2014) and the related public consultation.[5]

II. Purpose

DG GROW is involved in the policy debate surrounding the area of patents and standards. One essential aspect of developing evidence-based policy is the availability of statistics to define trends in the area of standard essential patents across Europe. Quantitative information on SEPs is necessary to quantity factual evidence to support policy makers as well as to provide further transparency for market players within relevant sectors. The synergy between patents and standards is considered to be an important aspect concerning innovation, competitiveness and growth in Europe with the advent of the Internet of Things and "Industry 4.0".

As mentioned above, the European Commission published a report on the subject of Patent and Standards in March 2014 and has completed a public consultation (February 2015), the results of which have been published end 2015. The report analysed a number of measures towards "Improvements to the patent declaration system", including the routinely checks of essentiality.
Standard essential patents have been experiencing an increasing trend over the last years and are expected to play a prominent role in the area of Internet of Things. This report provides evidence on companies' strategies in the area of SEPs as well as on the interrelation between patents and standards (in particular in the area of telecommunication). Based on data availability, the report targets the following key technological areas: 3G, 4G, WiFi and HEVC (H.264 and H.265 including MPEG/JPEG) as well as Bluetooth. The findings provide evidence to support policy

[5] For more information, please see: https://ec.europa.eu/growth/industry/intellectual-property/patents/standards_en

discussions and inform work on policy measures to improve the governance and licensing of SEPs.

III. Empirical results of the SEP Landscaping Study

Many SSOs require the disclosure of SEPs. The disclosure is usually based on the good faith and personal knowledge of the company representative making the declaration as SSOs do not carry out any verification of the claim that a patent is standard-essential. The data collection of disclosed SEPs relies on the information that is published by the SSOs and makes no attempt at verifying the accuracy of the essentiality declaration itself. By no means, individual SEP declarations can be understood as evidence of actual essentiality of the declared patents. Nevertheless, SEP declarations are typically the only comprehensive and systematic source of information available not only to the researcher, but also to economic agents interested in the standard. SEP declarations therefore provide meaningful information that can be used in economic research.

The report builds upon the public SEP declarations of the major SSOs. All of these SSOs provide online databases of SEP declarations with information provided by the declaring firm, such as the date of declaration, the relevant standards and the patent number of the alleged SEP. In some cases, however, firms make so-called “blanket” declarations, whereby the patent holder only declares to own SEPs for a standard, without disclosing the patent number or otherwise identifying specific patents or claims. SEP declarations can either refer to a particular technical specification (TS) or a standard’s project (e.g. GSM, UMTS or LTE). We have aggregated all SEP declarations to the project level to constantly compare SEPs per standard project. The SEP declarations included in this analysis cover the time period of 1992-2015. To ensure consistency of the results we only considered SEP declarations where we at least have a patent number and a standards document information. Thus “blanket” declarations were not taken into account.

Section 1: Declared SEP families as to SSO, standard project, main IPC and patent office

Figure 1 gives a first overview on the number of declared SEP families as to the respective SSO (standard setting organization). Most SEPs were declared at ETSI representing over 70% of all worldwide SEP declarations. ETSI, similar to TIA or IEEE, focus on communication technologies. SSOs standardizing technologies for media and consumer electronics such as the BluRay Disc Association, the DVD Forum or ISO also constitute a large share of SEP declarations, while SSOs in the computer technology space such as IETS or OASIS have rather small numbers of declared SEPS.

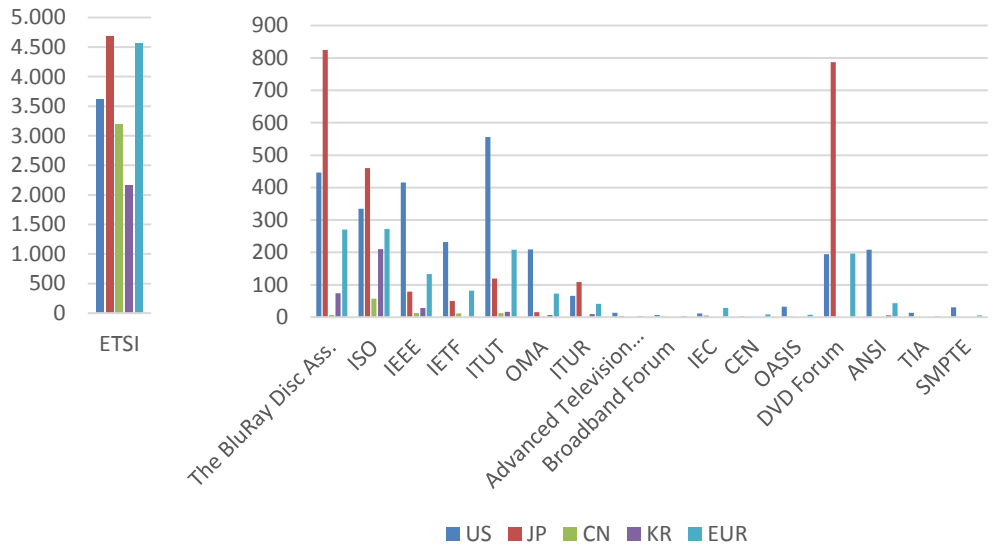

Figure 1: Number of declared SEP families per priority patent office and per SSO

Figure 2 illustrates the share of declared SEPs families per standard and priority patent office. We aggregated priority filings at the EP and all European national offices under EUR (38 EPC countries plus 2 extension states). The graph shows strong concentrations on EUR priority filings for RFID, DVB, MPEG 1, 21 and MP3, US priority filings concentrate on standards such as WiFi, WiMax, HDTV and JPEG, JP priority filings concentrate on DVD, and MPEG 7. The standards projects with the highest number of SEP families such GSM, UMTS and LTE show filings at all offices and we therefore conduct a deeper analysis per standards project over time. The graph shows that for some standards, patent priority filings concentrate on only one or two countries (e.g. MPEG7, DVD, HDTV). This shows that these standardized technologies were most

probably produced and also marketed firstly in the limit of these regions before they were implemented on the global markets.

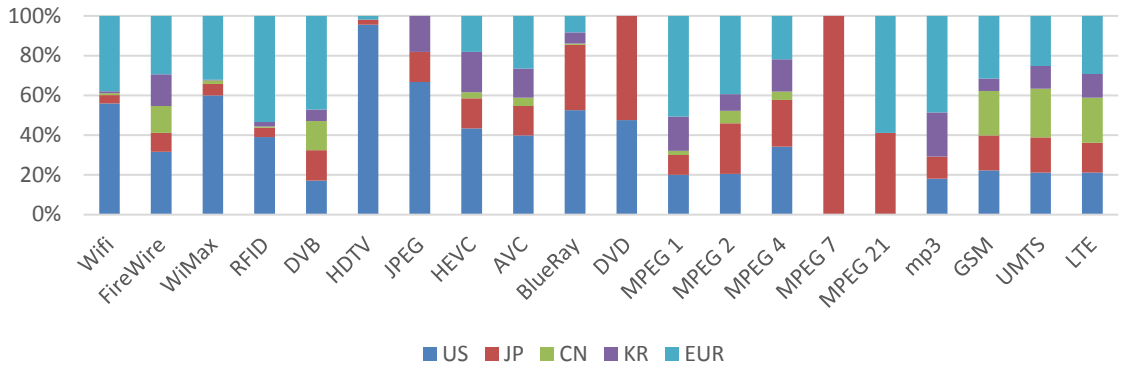

Figure 2: Share of declared SEPs families per standards projects and priority patent office

While for ETSI the number of priority filings for SEP families is rather evenly distributed among all patent offices, we find concentrations of priorities in certain patent offices for most of the other SSOs. SSOs such as the BluRay Disc Association, the DVD Forum or ISO are dominated by US and JP declared SEPs, while CEN or IEC are dominated by European priorities.

To better cluster the declared SEPs for different sectors we make use of the industry classification based on the WIPO IPC industry concordance by Schmoch, Ulrich. "Concept of a technology classification for country comparisons." Final report to the world intellectual property organisation (WIPO), (2008). Figure 3 displays the number of declared SEP families as to the main industry fields.

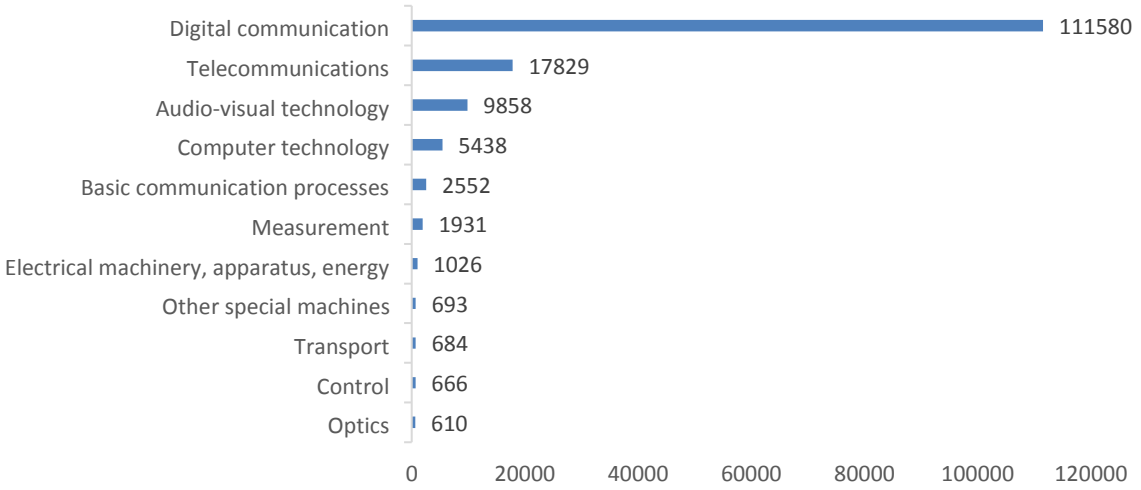

Figure 3: Number of declared SEP families as to main industry classification[6]

[6] Patent families can be classified to multiple industries. The graph only displays the top industries.

Most declared SEP families relate to digital communication and telecommunication industries, followed by audio-visual technology and computer technology. Yet, only a few declared SEP families relate to electrical machinery or transport industries. The latter two industries will probably increase in the coming years in view of future technologies such as connected vehicle or Internet of Things.

To get a better picture on the large number of declared SEP families in the "H" and "G" IPC classification we look at the main IPC classification more granularly (figure 3) and separate the counts by SSOs. Figure 4 shows that the technological concentration very much differs among the SSOs, where e.g. Audio-visual Technologies (G11B) concentrate on the BluRay Disc Association, the DVD Forum or ISO, Basic Communication Processes (H03D) concentrate on CEN and IEC and Computer Technology (G10L) concentrate on OASIS[7], IETF[8] and OMA[9].

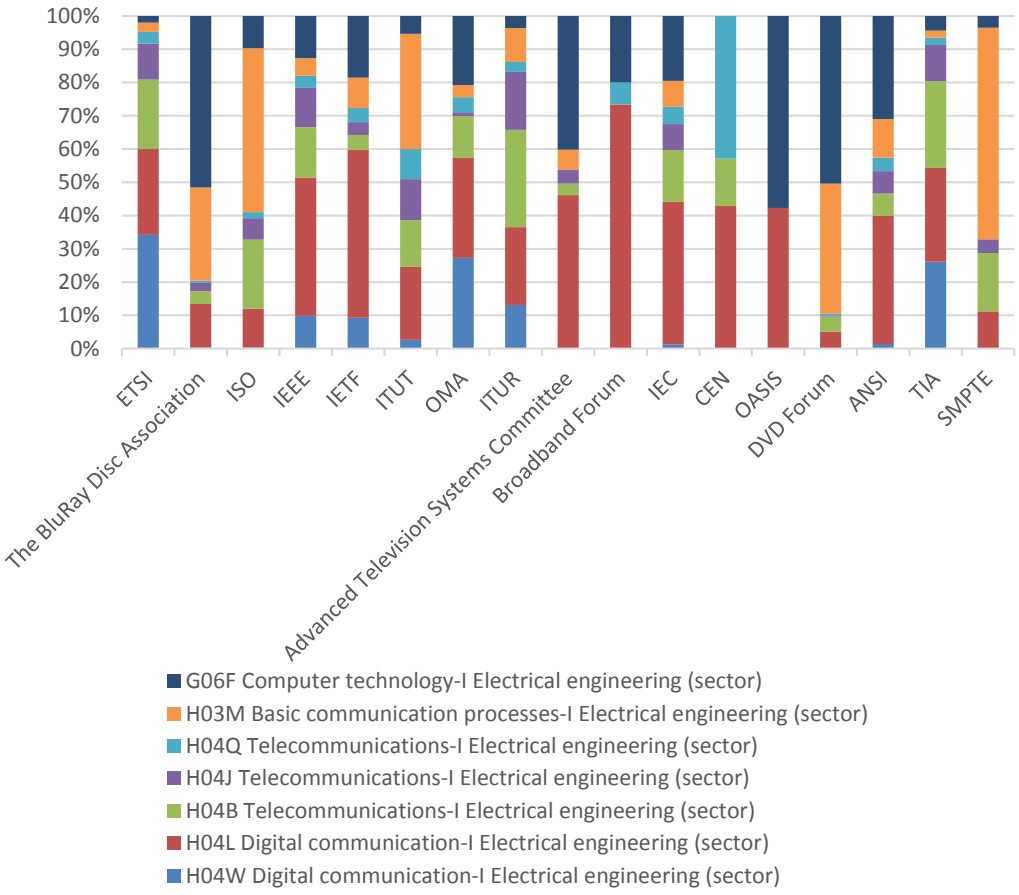

Figure 4: Main IPC classification of declared SEP family share per SSO

[7] Organization for the Advancement of Structured Information Standards
[8] Internet Engineering Task Force
[9] Open Mobile Alliance

Figure 5a and 5b display the IPC concentration by priority patent office for ETSI and IETF. ETSI and IETF constitute a good comparison, because ETSI is mainly focused on standardizing telecommunication technologies and IETF in comparison standardizes computer technology. While the priority patent filings are quite evenly distributed for ETSI, IETF priority filings concentrate on the US patent office. Technologically IETF concentrates on H04L (digital transmission) and G06F (computer technology), while ETSI concentrates more on wireless and telecommunication technologies (H04W, H04L, H04B).

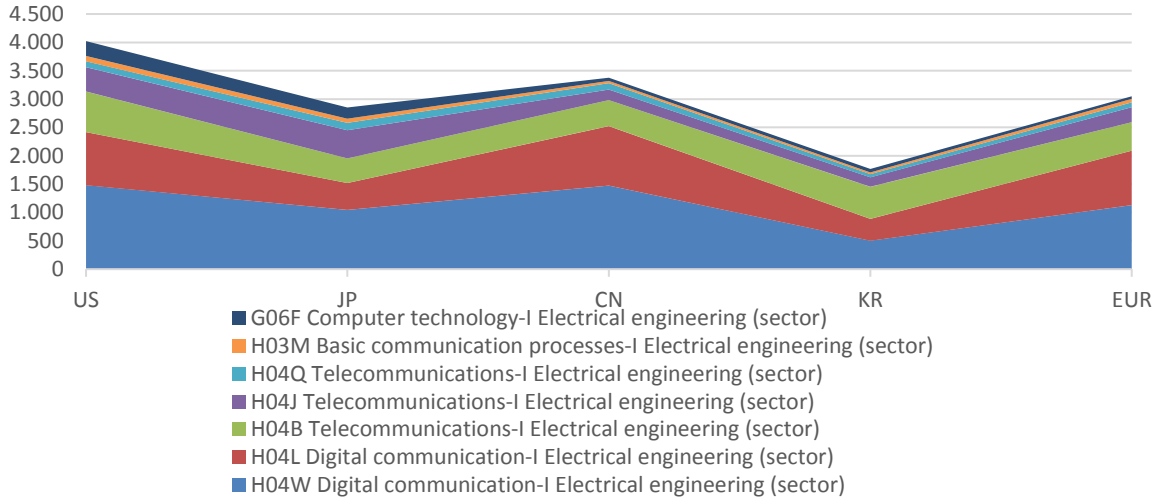

Figure 5a: Main IPC classification of declared SEP families at ETSI per priority region[10]

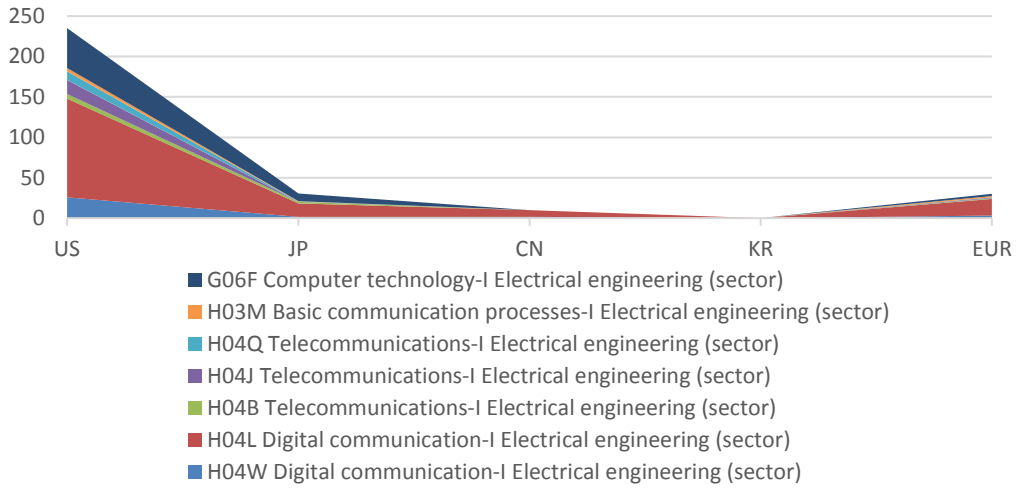

Figure 5b: Main IPC classification of declared SEP families at IETF per priority region[11]

[10] Patent families can be classified to multiple IPCs. The graph only displays the top IPCs.
[11] Patent families can be classified to multiple IPCs. The graph only displays the top IPCs.

In figure 5c we illustrate the ETSI SEP family filings over the past 20 years. Especially H04W (wireless communication) as well as H04B (transmission) and H04H (broadcast communication) have been increasing over the last 5 years.

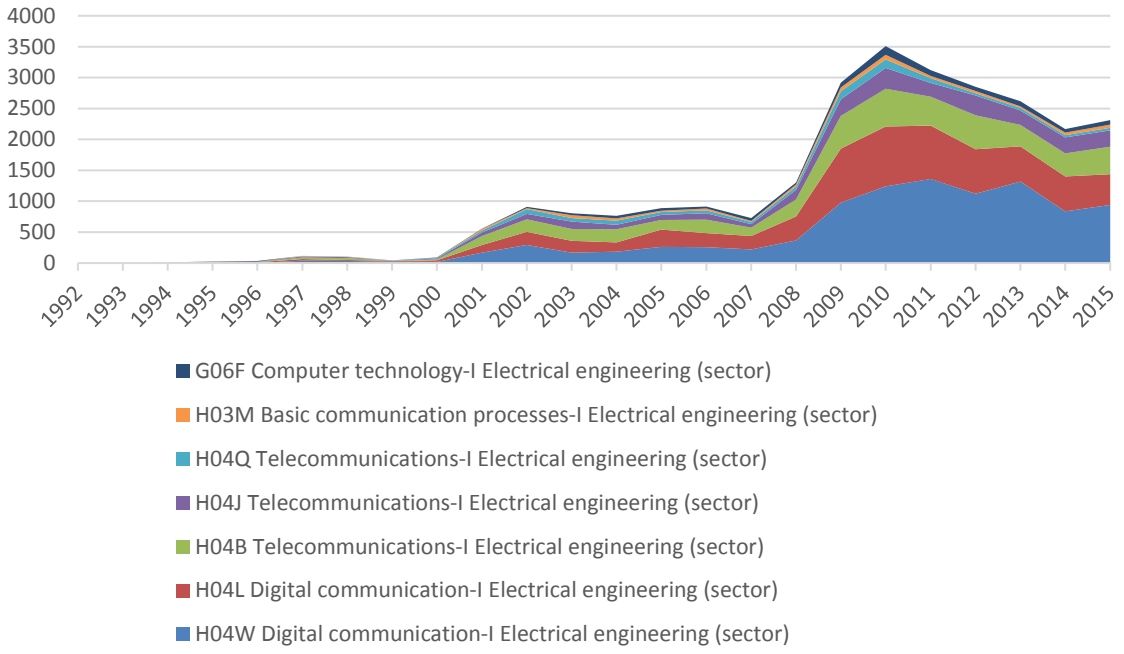

Figure 5c: Main IPC classification of declared SEP families at ETSI per year[12]

Figure 6 illustrates the technological focus of priority filings as to the main IPC classification. The figure confirms that audio-visual technologies and computer technologies remain to be US and JP focused topics with very little priority filings in Europe. In comparison, European priority filings are strong for technologies such as wireless, digital and basic communication technologies.

[12] A patent may be classified in multiple IPCs. Numbers among IPC classes are thus not additive.

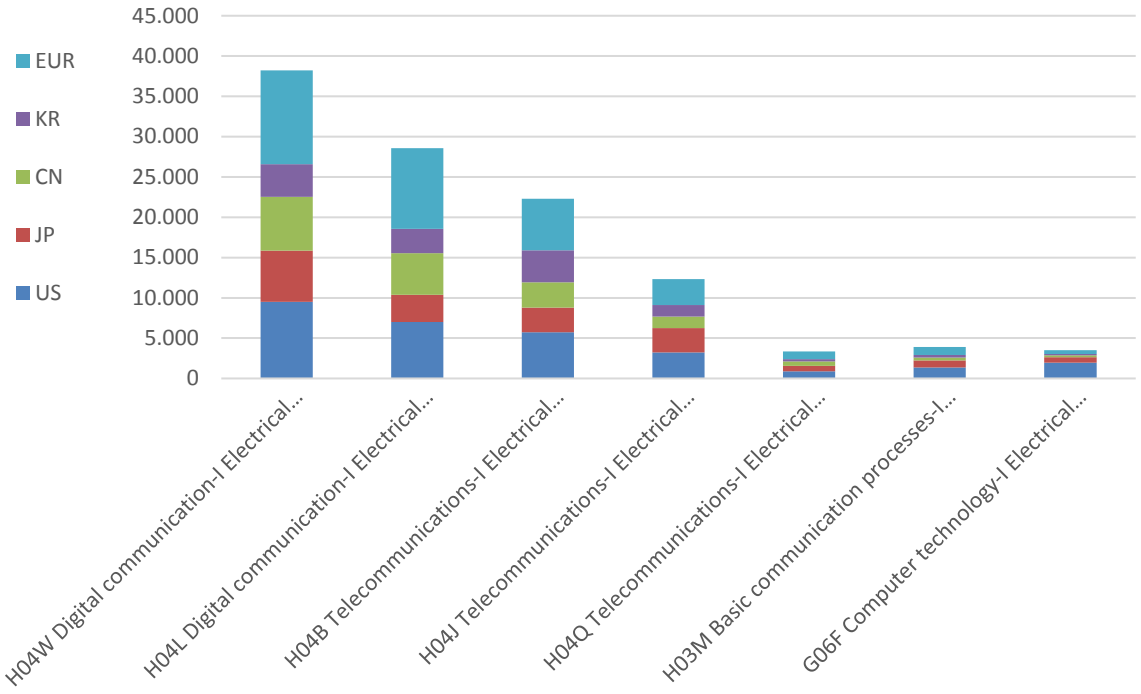

Figure 6: IPC classifications of declared SEPs per priority patent office[13]

Figure 7 shows the declared SEP priority filings over time. Especially in the early 2000s Chinese and Korean filings increased, while the share of European priority filings decreased compared to the filings at the US and JP offices. Since 2009 however, European and US priority filings increase again, which may during the development of the LTE standard.

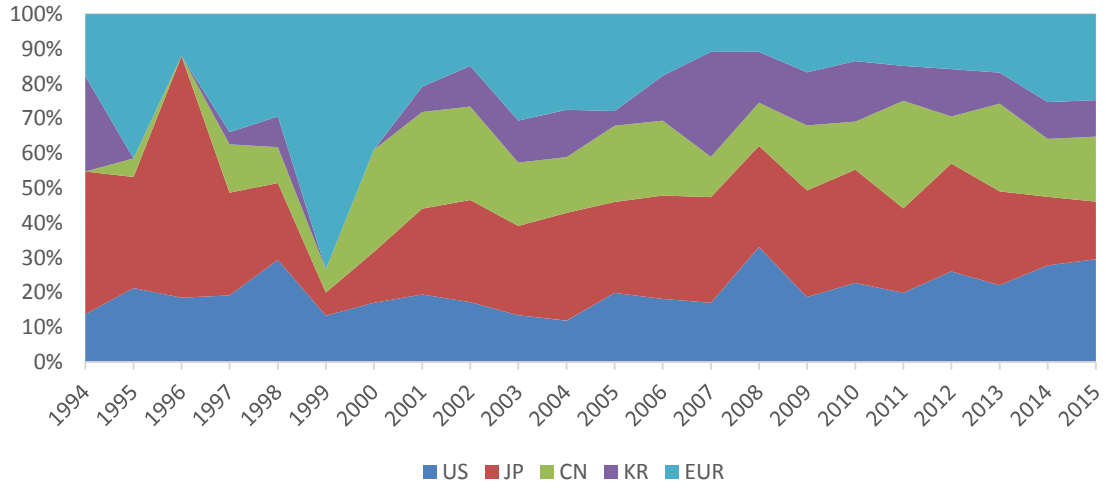

Figure 7: Share of SEPs per priority patent office as to year of declaration

[13] A patent may be classified in multiple IPCs. Numbers among IPC classes are thus not additive.

To better compare the differences of companies active in IT and ICT[14] focused markets we split the top 15 SEP family holder in two groups. For the first group we only count patent filings for IT focused technologies such as G06F (digital data processing) and G10L (speech recognition), compare it with the top 15 SEP holders for ICT focused technologies such as H04W (wireless communication) and H04L (transmission). The comparison includes all SSOs as well as all patent offices and only compares the main IPC classifications of the SEPs. Table 1 shows that big companies such as Nokia, Qualcomm, Huawei or Ericsson actively file declared SEPs for both technology clusters, while Google, Fraunhofer, Hewlett-Packard or Sun mostly focus on IT and Siemens, NTT or NEC mostly focus on ICT.

G06F OR G10L (IT Sector)		H04W OR H04L (ICT Sector)	
Applicant/Assignee	**SEP families**	**Applicant/Assignee**	**SEP families**
Nokia Corporation	190	Huawei Technologies	1,301
ALCOMM Incorporated	141	Nokia Corporation	1,297
Ericsson	115	Samsung Electronics Co. Ltd.	1,262
Samsung Electronics Co. Ltd.	114	QUALCOMM Incorporated	1,253
Huawei Technologies	95	Ericsson	1,078
LG Electronics Inc.	93	InterDigital, Inc.	708
Google	80	LG Electronics Inc.	635
InterDigital, Inc.	64	Nokia Siemens Networks SA	627
Panasonic Corporation	63	ZTE Corp.	582
Sony Corporation	63	Motorola Solutions, Inc.	466
Fraunhofer	48	NTT DOCOMO, Inc.	415
NEC Corporation	29	Panasonic Corporation	335
Hewlett-Packard Oy	27	Siemens Aktiengesellschaft	284
Digital Fountain, Inc.	8	Sharp Corporation	262
Sun Microsystems AB	7	NEC Corporation	256
Dolby Laboratories, Inc.	6	BlackBerry Limited	179

Table 1: Top declared SEP family owner for G06F OR G10L (IT Sector) compared to H04W OR H04L (ICT Sector)

Table 2 separates the top SEP owners as to the company headquarters. The analysis focusses on European patent filings. While some big European patent holders such as Nokia, Ericsson or Siemens still file a large amount of declared SEP families, US and Asian companies such as Qualcomm, InterDigital, Samsung or Huawei are heavily filing priority patents in Europe too. We mainly identify producing companies but also network providers (e.g. Orange, Deutsche Telekom) among the top European patent

[14] While IT technologies refer to computer-based technologies, ICT refers to the range of telecommunication or digital communication technologies that allow systems to communicate.

holders, the US patent holders such as Intellectual Ventures or Unwired Planet, Inc. are companies that can be identified as non-producing entities.

European SEP Owner		US SEP Owner		Asian SEP Owner	
Applicant/Assignee	**SEP Fam.**	**Applicant/Assignee**	**SEP Fam.**	**Applicant/Assignee**	**SEP Fam.**
Nokia Corporation	1,050	QUALCOMM	1,025	Samsung Electronics	872
Ericsson	891	InterDigital, Inc.	417	Huawei Technologies	581
Nokia Siemens	418	Google	313	LG Electronics Inc.	533
Siemens	258	Rockstar Consortium	101	NTT DOCOMO, Inc.	317
Nokia Solutions&N	251	Apple Inc.	64	Panasonic Corporation	284
Alcatel-Lucent	170	Texas Instruments Inc.	40	NEC Corporation	180
BlackBerry Limited	139	Intel Corporation	35	ZTE Corp.	174
Koninklijke Philips	73	Intellectual Ventures	15	Sony Corporation	81
Orange	61	Dolby Laboratories	8	HTC Corporation	63
Nokia Mobile Ph.	36	Hughes Corporation	8	RITT	57
Koninklijke Kpn	27	AT&T, Inc.	7	NTT	39
Fraunhofer	14	Unwired Planet, Inc.	7	Mitsubishi Electric	38
British Teleco	13	IBM	6	Kyocera Corp.	37
Deutsche Telekom	13	Microsoft Corp.	5	Sharp Corporation	32

Table 2: Top companies owning declared SEPs filed where the patent was filed in Europe as to site of company headquarters for Europe, US and Asia (CN, JP, KR, TW)

Figures 8a-10a illustrate the shares of priority filings per year for each of the standards projects GSM, UMTS and LTE. The figures display for each of the standards the total number of European filings per year and per applicant's country of origin. We have created these two figures for each standard to compare the patent filing behaviors at the international patent offices with the country of origin of the patent owners. Thus we analyze how foreign companies file their priority patents in Europe and thus focus their patenting activities on the European market.

Patent filings for GSM increased in the mid 90ies and mainly concentrate at European patent offices and US (figure 8a) offices. Especially from the early to the mid-90ies almost 50% of the GSM priority filings were registered in Europe. Also the companies can be identified as European und US applicants (figure 8b). Starting in the mid-2000s the number of Chinese and Korean applicants increased and also the shares of priority filings at the Asian offices went up. The high amount of priority filings up until 2008 show that the GSM standard had still been evolving until the late 2000s being also relevant for the coming standards generations UMTS and LTE.

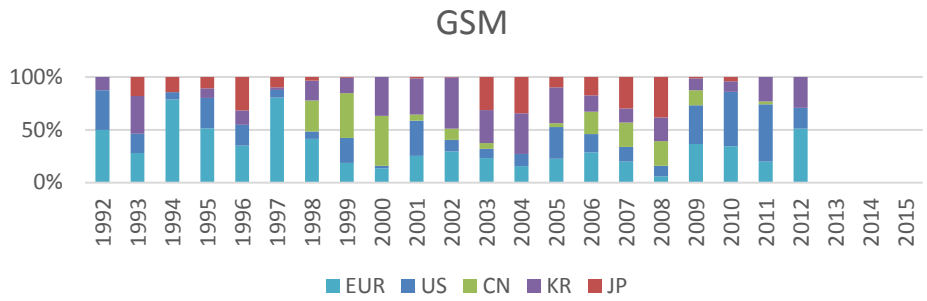

Figure 8a: Share of declared SEP families for GSM as to priority patent office

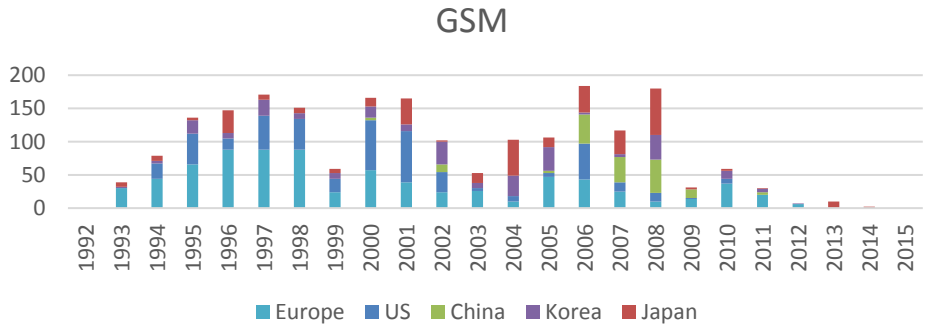

Figure 8b: Number of declared SEP families for GSM per applicant's site of company headquarters

Figure 9a illustrates the shares of priority filings per year for UMTS. While again, European and US priority filings were strong in the 90ies, from the early 2000s we can evidence larger shares of priority filings at the KR, JP and CN offices. As for the last three years the Asian offices dominate the filings. The shares of European priority filings especially decreased after 2004, US priority filings decreased after 2012. Similar to the increasing importance of the Asian markets, also Asian market players increased their filings at the European offices (figure 9b). Especially since the beginning of 2000, Korean, Japanese and a few years later also Chinese companies represent more than 50% of the European filings for UMTS. European applicants remain strongly represented until 2002 but then decrease patent filings in the late 2000s for UMTS (figure 9b).

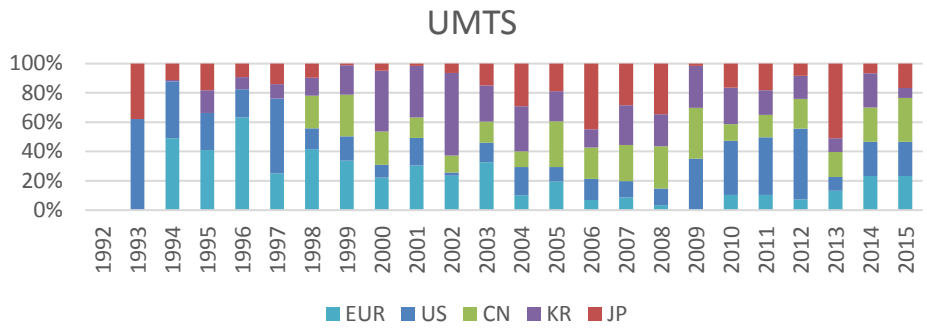

Figure 9a: Share of declared SEP families for UMTS as to patent office

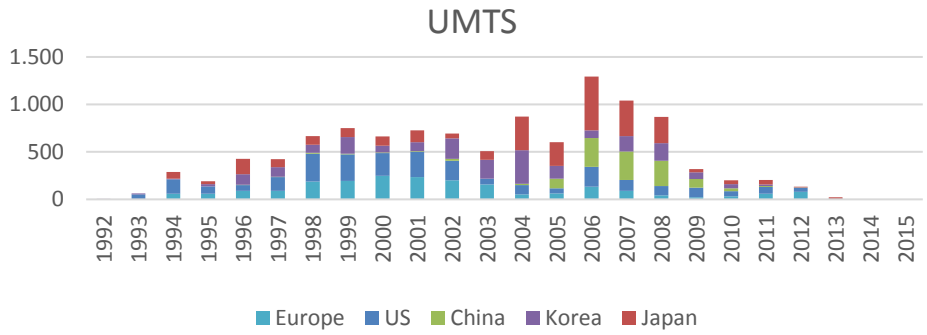

Figure 9b: Number of declared SEP families for UMTS per applicant's site of company headquarters

Figure 10a illustrates the shares of family priority filings per year for LTE. The figure is similar to the developments for UMTS. Also figure 10a shows that especially since the mid-2000s the number of Korean and Chinese applicants has been increasing and up until today dominates the number of filings at the European offices. Overall patent filings for LTE decrease since 2008, showing that the main technology developments were completed and the research concentrates on the upcoming standards generation 5G.

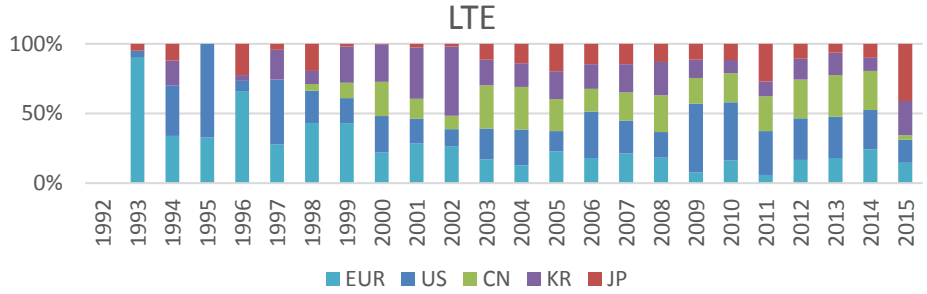

Figure 10a: Share of declared SEP families for LTE as to patent office

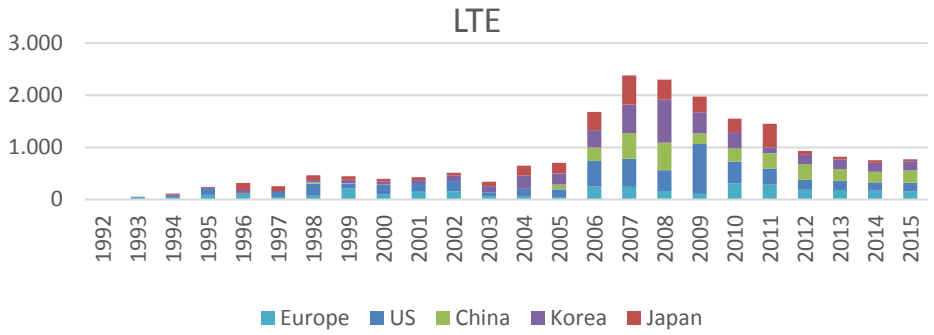

Figure 10b: Number of declared SEP families for LTE per applicant's site of company headquarters

Figure 11 presents the share of declared SEP filings for the top 20 patent holders as to priority patent office. While in many cases the patent owners' country of origin consequently leads to a higher number of patent filings at the home office, we can also identify priority patent filing concentrations at foreign offices.

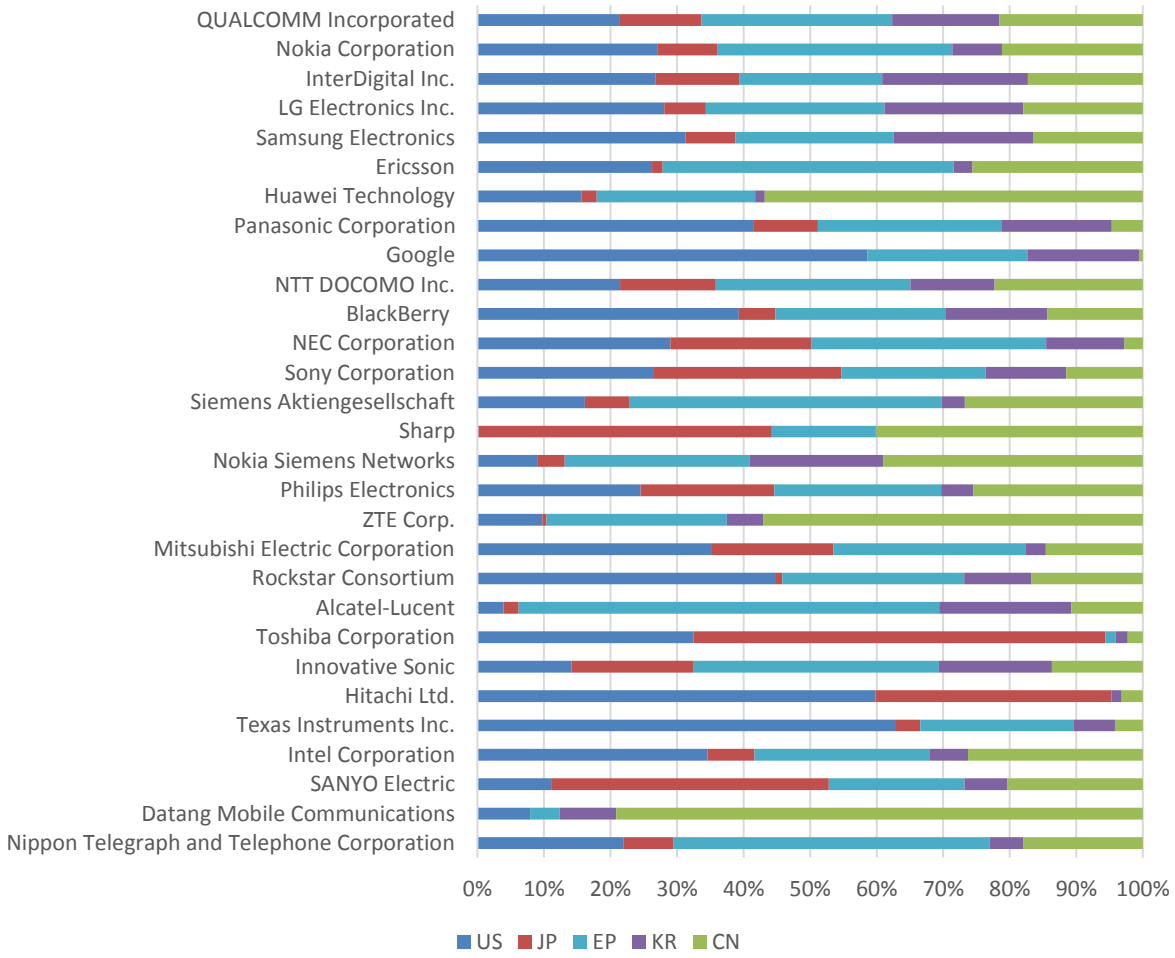

Figure 11: Share of declared SEP priority patent office as to top 20 SEP declaring

Section 2: Declared SEP families as to legal status and US patent litigation

Figure 12 displays the number of patent family filings of declared SEPs as to the current legal status. The graph shows as of 2014 75% of the patents have been granted, only 14% have been lapsed and yet 24% expired. As the average declared SEP ages is around 16 years, the share of lapsed patents is very low. In many other industries a patent's average life time is around 7-8 years, while declared SEPs for many cases have a lifespan of maximum 20 years in key countries. This seems plausible since many SEPs remain relevant even for later standard generations and the lucrative licensing market of these patents lasts until expiration. E.g. SEPs for mp3 have created immense royalty incomes[15] for its holders where the patents just recently expired after the maximum life time of 20 years.

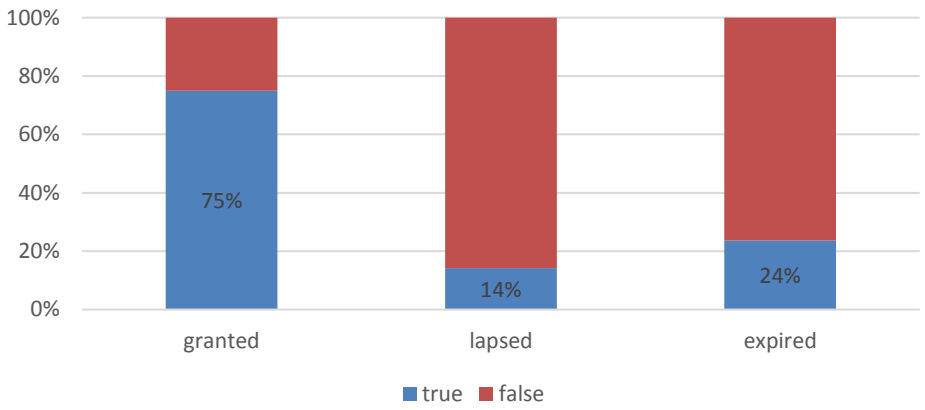

Figure 12: Declared SEP's legal status as of 2014

Figure 13 differentiates the shares of active, lapsed and expired patents as to the different SSOs. While the number of expired patents rather illustrate the age of the standards set in the respective SSOs, the number of lapsed patents gives hints to the technological life cycles of the standardized technologies. ETSI mainly standardizes telecommunication technologies such as GSM, UMTS and LTE and seems to have very low shares of lapsed patents, similar to the BluRay Disc Association, the DVD Forum, TIA and SMPTE. Due to the numbers of ETSI SEPs, these dominate the overview in figure 12.

[15] The Fraunhofer MP3 royalty revenue is estimated to be an amount of two digits million EUR p.a.. However, Fraunhofer is just one out of many patent holders for MP3.

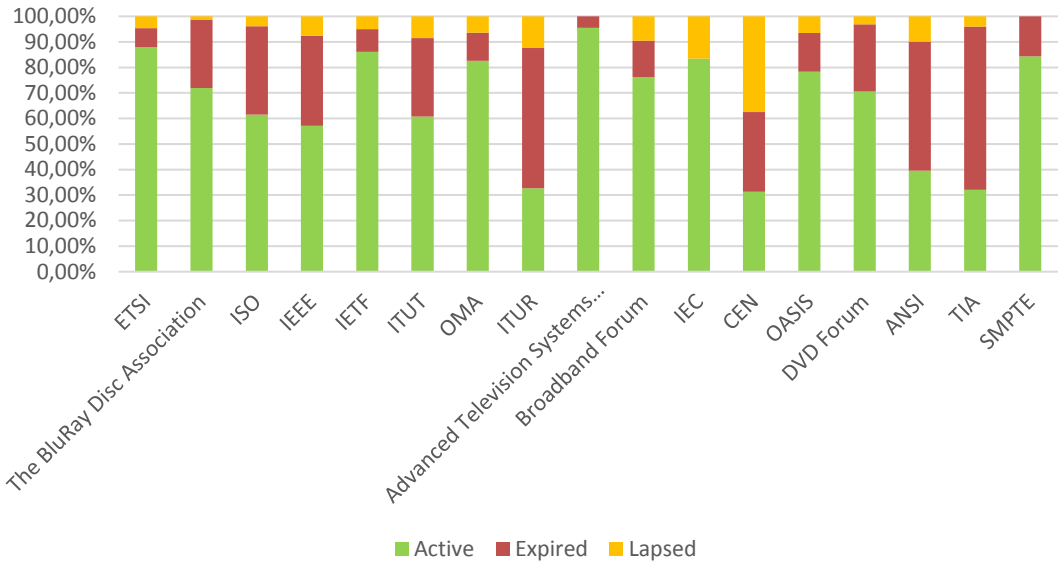

Figure 13: Declared SEPs as to as to legal status as of 2014 and SSO

The success of new technology standards (e.g. WiFi, LTE, Bluetooth) implemented in worldwide devices also had a noticeable effect on the number of disputes. Figure 14 compares the number of declared SEPs and the number of litigated declared SEPs over time. Due to lack of data for Europe, the analysis only takes into account US litigation and counts the number of patents, not the number of cases. Since the mid-2000s the amount of litigation relating to SEPs has increased dramatically. Widely debated cases such as Motorola versus Microsoft or Apple versus Samsung demonstrate not only that cases involving SEPs are more frequent, but also that the length and size of the disputes have increased. The fact that two parties are willing to fight in court for several years reflects the growing financial impact of declared SEPs. While numbers truncate[16] for later years, the trend of litigated declared SEPs has been constantly increasing.

[16] The US litigation data base also accounts for litigations beyond 2015, however SEPs are not always declared on time and therefore the graph is truncated towards earlier years.

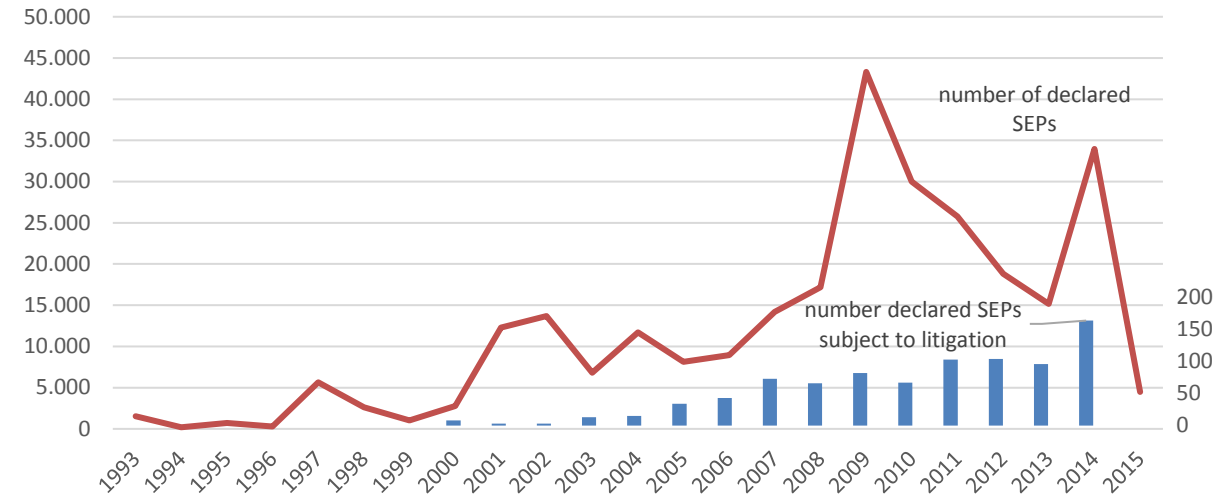

Figure 14: Worldwide declarations as to year of declaration over the number of litigated (US only) SEPs

Figure 15 displays the litigation concentration as to the main IPC classification. We therefore count the number of litigated patent family per main IPC. The rather popular IPC classes such as H04W or H04M present low litigation shares, while the highest shares of litigated declared SEPs can be identified for H03J (basic communication) and G01S (Measurement).

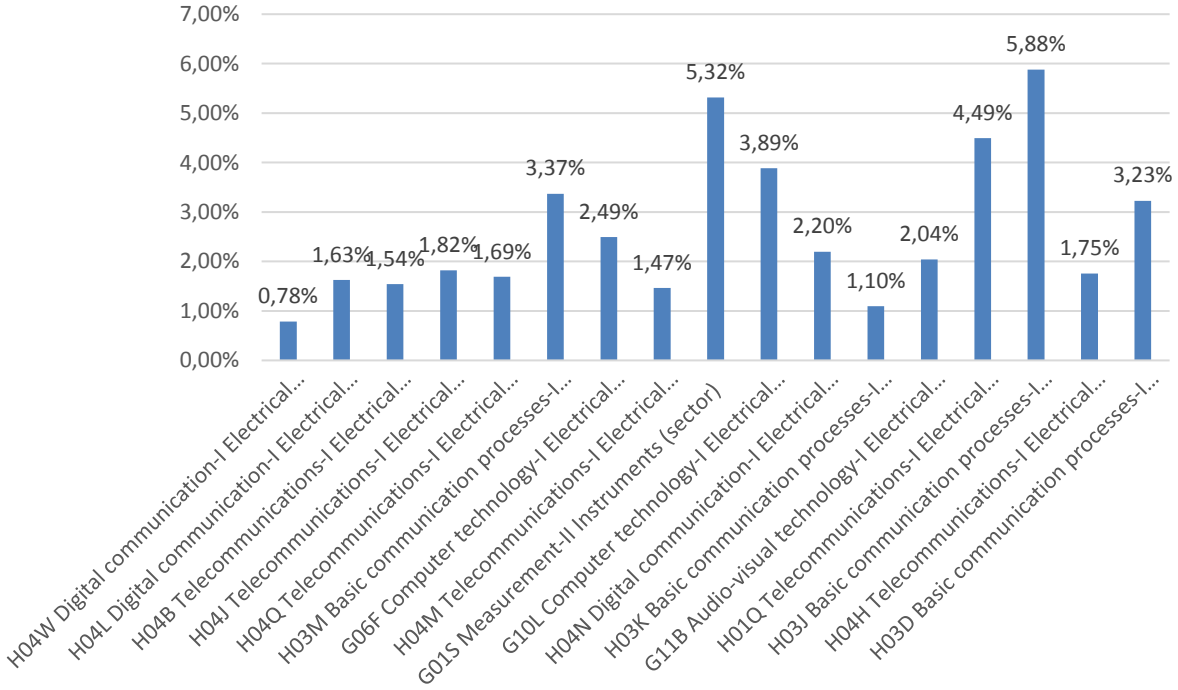

Figure 15: Share of litigated SEP families (US) per main IPC

Figure 16 clusters the share of litigated declared SEPS per SSO and illustrates high shares of litigated declared SEPs for ATSC and SMPTE.

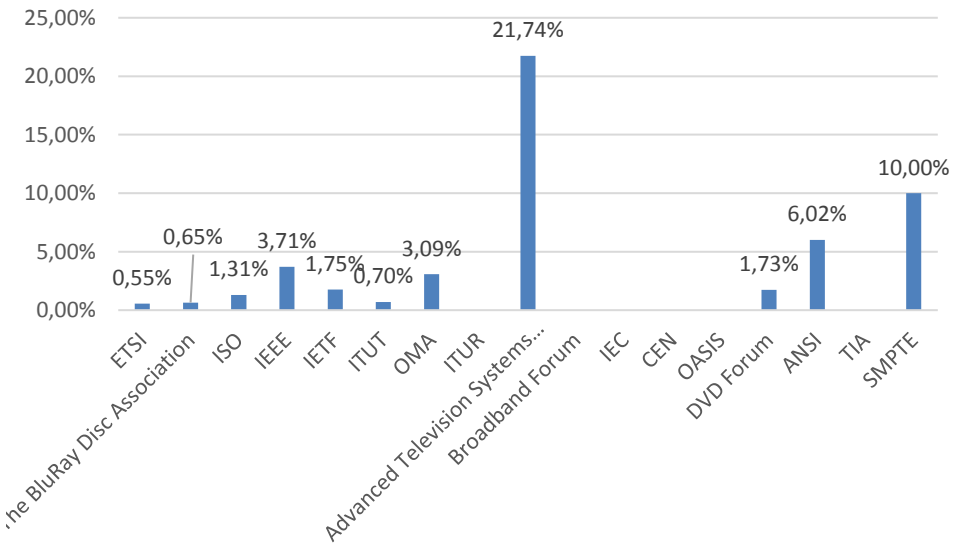

Figure 16: Share of litigated SEP families (US) per SSO

Due to the high number of declared SEPS at ETSI, figure 17 confirms that most of the litigated declared SEPs can be identified at ETSI, followed by ISO, IEEE and the BlueRay Association.

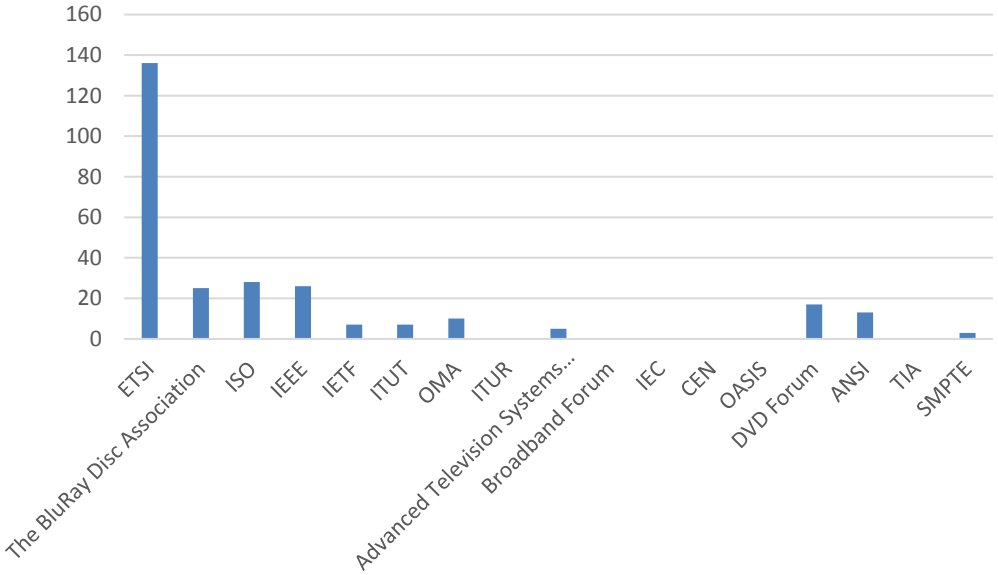

Figure 17: Number of litigated SEP families (US) per SSO

Section 3: Declared SEP families as to patent owner portfolio relevance

Table 3 displays the main SEP owners by nationality, the number of declared SEPs, the average patent portfolio age, the share of active patents, the Market Coverage Index[17] (normalized family size) as well as the Technical Relevance Index[18] (normalized forward citations). The table gives an overview on the different players characterizing the patent portfolios as to size, age, market coverage and relevance, calculated through different analytical methods.

Many market observers (e.g. respondents to the EC's public consultation) have claimed that the number of overall declared SEPs is too high, or at least higher than the actual number of patents that are truly essential. SSOs maintain databases of declared SEPs without investigating whether the patents claim an invention essential for the particular standard or not. Also, SSOs do not check whether the patent has been granted by the respective patent office or is active, lapsed or expired. In order to get an estimate of relevance, we created several value measures for each rights holder[19]. First we calculated the age of the portfolio, as well as the share of active patents that have not yet expired or have not lapsed (due to e.g. failure to pay maintenance fees). The portfolio age illustrates which companies have patented standardized technologies more recently and which companies have been active for several years. The portfolios of companies such as Philips, Siemens, Hitachi and NTT are comparatively old, while companies such as Datang Mobile Communications, ZTE and Huawei own patents that have been filed only recently. The analysis reflects a shift from US, Japanese and European rights holders to Chinese, Korean and Taiwanese rights holders. The share of active patents is surprisingly high for most of the top rights holders and negatively correlates to the portfolio's age.

[17] The Market Coverage Index reflects the normalized (as to a reference group of patents with the same publication year, patent office and main IPC) patent family size as to international applications weighted by countries' GDP. The indicators are normalized by 1, which represents the average. As for e.g. Qualcomm (MC= 1.72, TR= 1.13), the portfolio is 72% more international and 13% more relevant as the overall average. The indicator has been calculated with IPlytics Platform as of an analysis conducted in 2016.

[18] The Technical Relevance Index reflects the normalized (as to a reference group of patents with the same publication year, patent office and main IPC) number of forward citations. The indicator has been calculated with IPlytics Platform as of an analysis conducted in 2016.

[19] All measures and indicators have been calculated with IPlytics Platform as of an analysis conducted in 2016.

Company	Country Code	Declared SEPs	Av. Patent Age	Share Active	Market Coverage Index	Technical Relevance Index
QUALCOMM Incorporated	US	20,678	12.24	83.92%	1.72	1.13
Nokia Corporation	FI	13,393	13.65	83.87%	1.66	0.88
InterDigital Inc.	US	12,522	13.14	86.87%	1.68	0.77
LG Electronics Inc.	KR	10,772	8.69	90.07%	1.76	1.73
Samsung Electronics	KR	10,618	10.40	93.74%	1.54	1.73
Ericsson	SE	9,396	13.86	79.32%	1.62	1.09
Huawei Technology	CN	6,500	8.33	85.40%	1.76	1.28
Panasonic Corporation	JP	6,326	10.45	88.17%	1.77	1.1
Google	US	4,576	12.61	82.54%	1.4	1.26
NTT DOCOMO Inc.	JP	4,216	8.65	91.83%	1.61	1.56
BlackBerry	CA	2,319	8.62	86.61%	1.29	1.28
NEC Corporation	JP	2,299	10.61	87.91%	1.17	0.87
Sony Corporation	JP	2,289	14.50	84.78%	1.39	1.16
Siemens Aktiengesellschaft	DE	2,209	15.00	84.16%	1.03	0.71
Sharp	JP	2,170	8.39	90.20%	1.85	1.52
Nokia Siemens Networks	FN	2,073	7.85	87.69%	1.65	1.13
Philips Electronics	NL	1,704	17.19	72.39%	1.44	0.5
ZTE Corp.	CN	1,640	5.64	96.71%	1.63	1.95
Mitsubishi Electric	JP	1,387	15.78	81.24%	1.26	0.63
Rockstar Consortium	US	1,174	13.13	91.23%	1.29	2.08
Alcatel-Lucent	FR	1,105	8.99	77.50%	1.3	0.98
Toshiba Corporation	JP	953	15.74	86.57%	1.07	0.75
Innovative Sonic	n.a.	796	8.29	83.67%	0.63	1.38
Hitachi Ltd.	JP	549	16.46	86.52%	0.81	0.77
Texas Instruments Inc.	US	487	11.29	93.02%	0.92	1.91
Intel Corporation	US	479	12.96	83.30%	1.34	0.94
SANYO Electric	JP	465	19.70	49.68%	2.05	1.45
Datang Mobile Communications	CN	458	6.91	99.34%	1.31	2.5
NTT Corporation	JP	454	18.29	74.67%	0.77	1.41

Table 3: Main SEP owners by nationality of company headquarters, number of declared SEPs, average patent portfolio age, share active patents, MC and TR

In order to measure the value of the patent portfolios, we calculated bibliographic valuation indicators[20]. First we measured a patent's market coverage by calculating the normalized number of patent family counterparts for worldwide patent offices. This market coverage indicator helps to benchmark a patent portfolio in terms of geographical coverage and perceived patent value. Most of the declared SEP portfolios have a market coverage value above, which is above the average for patents in the same IPC, same publication year and same country. While most portfolios have a similar score, the strongest portfolios in terms of market coverage are owned by LG, Huawei, Panasonic and Sharp. We further measured the technical relevance of the patent portfolio by calculating the normalized number of patent forward citations. A higher technical relevance reflects a higher importance within a technology space. Again, values above one are above the industry, year and country average. As to this indicator, the strongest portfolios are owned by the Rockstar Consortium, Datang Mobile Communications, ZTE and Texas Instruments.

Company	Declared SEPs	Patent Families	Share Citing the Standard	Share Cited by other SEPs
QUALCOMM Incorporated	20,678	1,314	27.40%	6.02%
Nokia Corporation	13,393	1,899	36.42%	5.31%
InterDigital Inc.	12,522	1,081	29.56%	4.72%
LG Electronics Inc.	10,772	1,114	43.99%	3.51%
Samsung Electronics	10,618	1,596	32.44%	3.57%
Ericsson	9,396	1,468	34.68%	3.12%
Huawei Technology	6,500	1,926	48.51%	2.85%
Panasonic Corporation	6,326	1,486	52.56%	1.74%
Google	4,576	1,504	56.13%	1.65%
NTT DOCOMO Inc.	4,216	692	48.05%	1.06%
BlackBerry	2,319	325	43.08%	0.61%
NEC Corporation	2,299	288	46.19%	0.76%
Sony Corporation	2,289	542	26.12%	0.16%
Siemens Aktiengesellschaft	2,209	356	43.82%	0.75%
Sharp	2,170	564	54.82%	0.40%
Nokia Siemens Networks	2,073	591	43.22%	1.34%
Philips Electronics	1,704	298	18.26%	0.45%

[20] All measures and indicators have been calculated with IPlytics Platform as of an analysis conducted in 2016

ZTE Corp.	1,640	560	41.71%	0.86%
Mitsubishi Electric	1,387	239	47.55%	0.59%
Rockstar Consortium	1,174	198	47.53%	0.36%
Alcatel-Lucent	1,105	415	45.63%	0.48%
Toshiba Corporation	953	301	24.66%	0.03%
Innovative Sonic	796	91	61.31%	0.50%
Hitachi Ltd.	549	220	40.07%	0.36%
Texas Instruments Inc.	487	158	44.76%	0.29%
Intel Corporation	479	66	43.63%	0.16%
SANYO Electric	465	64	26.45%	0.24%
Datang Mobile Communications	458	255	33.84%	0.12%
NTT Corporation	454	66	38.11%	0.56%

Table 4: Main SEP owners by declared SEPs, SEP families, share citing the standard, and share cited by other SEPs

In order to quantify the relation of declared SEP portfolios to standardized technologies, we used three standard relevance measures[21]. The first of these are standard related non-patent literature citations, which count whether a declared SEP cites at least one standard document as prior art. We only counted citations of standards that relate to the declaration. This is the case where a patent that has been declared as standard essential, for example, IEEE 802.11 (Wifi technologies) either cites former versions of IEEE 802.11, the same standard as prior art or documents that can be in assigned to the same standards project. This citation count measures the relation of the declared SEP to the standardized technology. Overall, the share of declared SEPs citing standard documents is comparably high, with the portfolios of Innovative Sonic, Google and Sharp having the highest shares of citing relevant standards documents. However, this measure is not normalized by patent office or publication year and thus may also be subject to different practices of prior art search at the respective offices. For example, the European Patent Office (EPO) introduced a new policy in 2009 whereby examiners gained access to documents such as standard drafts, standard documents and standard-setting meeting minutes to better search for prior art publications. Patents filed after 2009 at the EPO may thus more likely cite standards documents as prior art.

[21] All measures and indicators have been calculated with IPlytics Platform as of an analysis conducted in 2016.

The second measure counts the number of citations received by declared SEPs, while discounting self-citations. This measure reflects whether other owners of declared SEPs have cited the declared portfolio. The more citations a portfolio receives, the more relevant it appears to other standard-setting companies. Companies owning patent portfolios with the highest declared SEP citation shares are Qualcomm, Nokia, Interdigital and Samsung. However, patent documents which cite a patent are usually at least 12 months newer than the cited patent itself – this is due to a lag in publishing filed applications. Thus patents that are filed around the same time will rarely cite one another. The measure may reflect the technical relevance of a patent portfolio for later generations (eg, patents that were relevant for UMTS are nowadays cited as being relevant for LTE). In fact, the top four companies mentioned above have contributed to early standard-setting activities for GSM and UMTS, while other rights holders joined the standard-setting process only in later generations (eg, LTE) of standard-setting activities.

Section 4: Declared SEP families as to transfer of patent ownership

The market for patents has been increasing over the last few years as new internet companies such as Google, Twitter and Facebook have actively acquired SEPs. More than 12% of all SEPs have been transferred at least once; for the control group, this is the case for only about 9% of patents. Buying SEPs may be a practice to enter new markets (eg, Google bought the Motorola Mobility portfolio in order to enter the smartphone sector). Patents are more and more used as assets which are traded among different market participants.

We made use of the reassignment information in the legal status field of a patent family. Once a patent has been reassigned in at least one patent office we changed the ownership information for the whole patent family. However, reassignment information is subject to delays. In the US it takes about three years after which 90% of all traded patent are reassigned. In some patent offices e.g. the German patent office (DPMA), traded patents are not reassigned at all. However, since most of the declared SEPs are filed worldwide, these data restrictions may only account for a small share of incomplete information.

Figure 18 illustrates transferred declared SEPs as to the number of patents and patent family trades and its buyers. The most prominent patent trade within the last years was Google's acquisition of Motorola and thus also the reassignment of many declared SEPs. However, patents are not only traded with regard to a merger or acquisition but also in context of a patent portfolio trade connected to particular technologies or standards. Qualcomm, Apple, Blackberry and Intel are the most active buyers of declared SEPs.

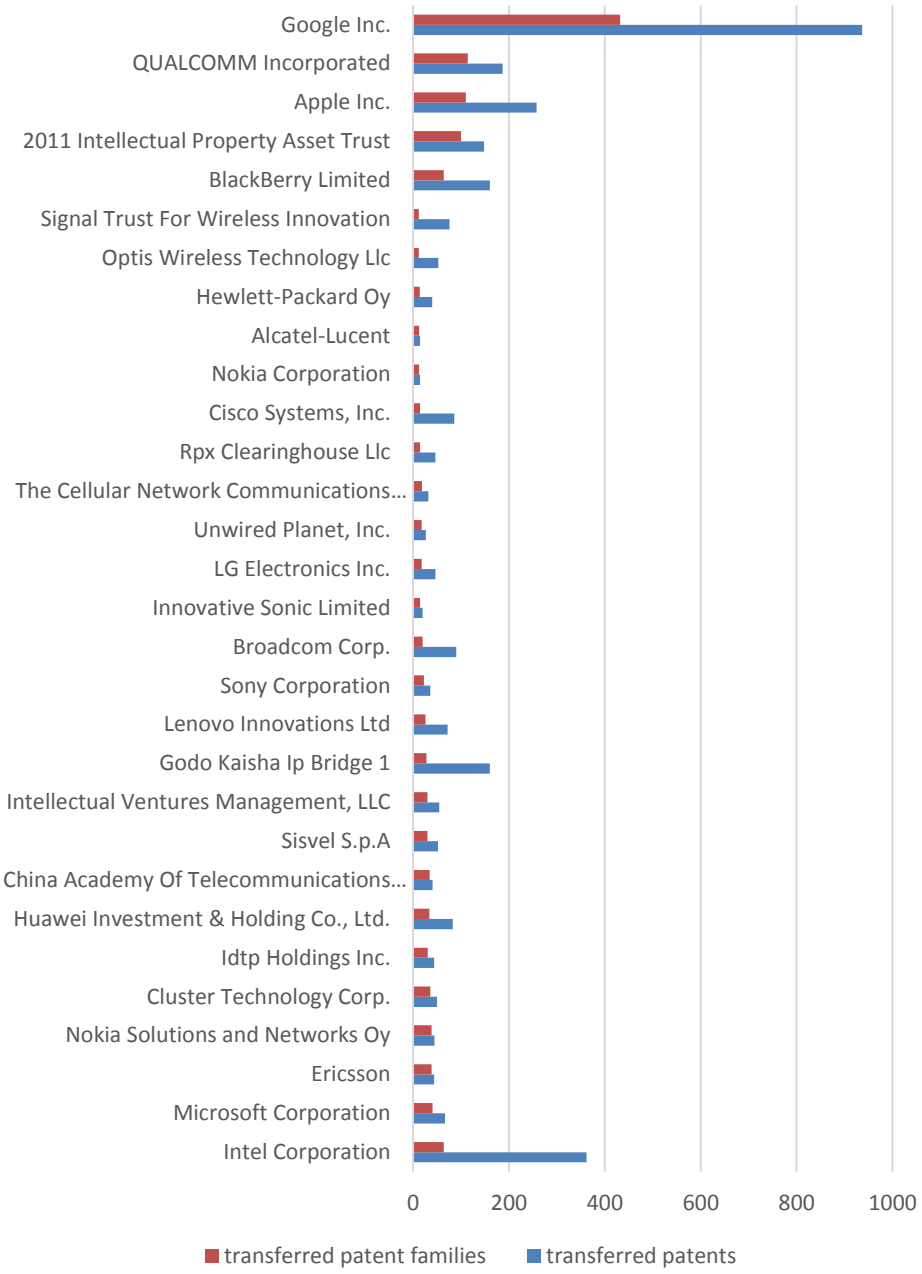

Figure 18: Top 20 declared SEP buyer

Figure 19 shows the top sellers of declared SEPs where Motorola, Nokia, Ericsson, Interdigital and Panasonic have sold the highest number of declared SEPs.

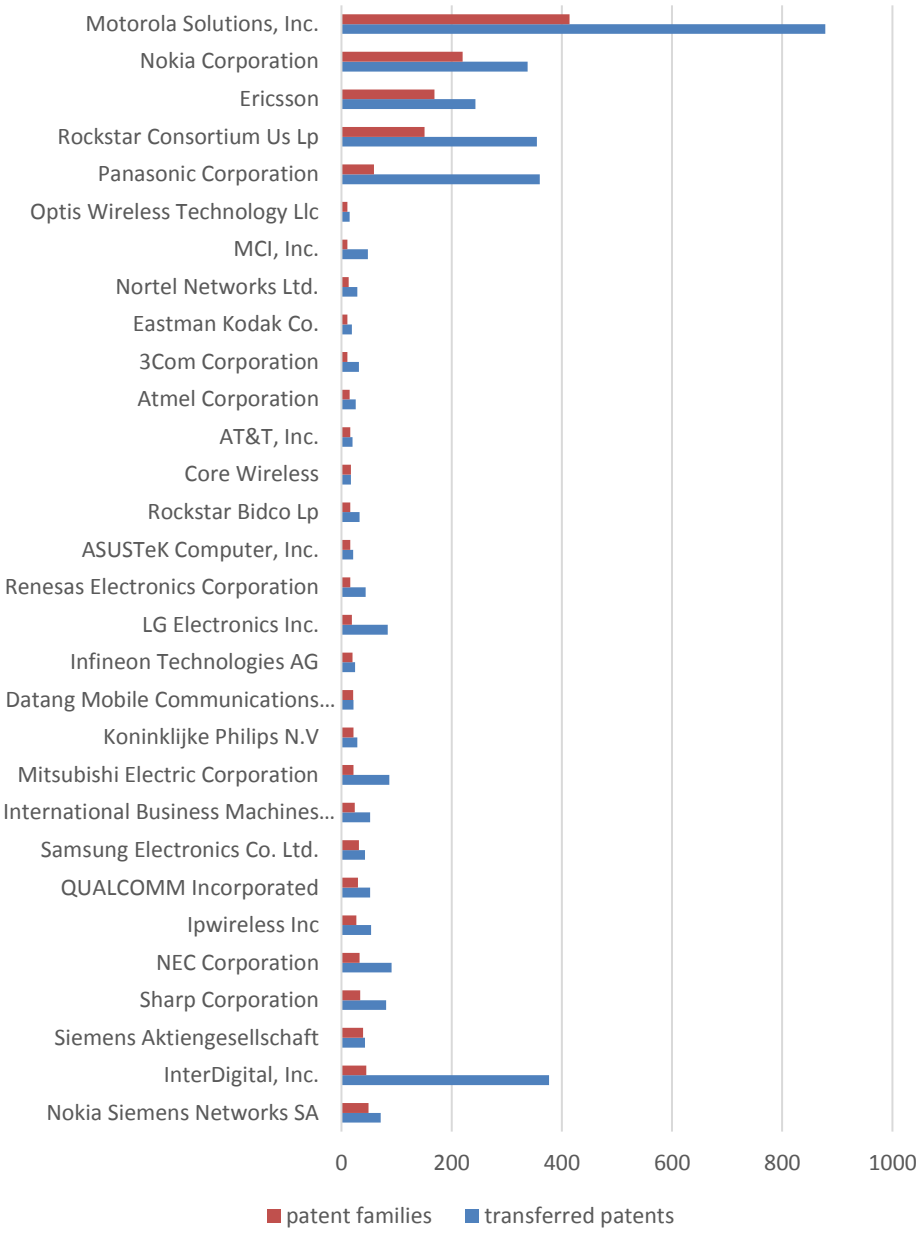

Figure 19: Top 20 declared SEP seller

To get a better picture on the particular patent trade we listed the different patent transfer deals as to seller buyer and business model. Table 5 shows that the largest declared SEP sellers are mainly manufacturer or patent aggregators[22], while we identify also declared SEP buyers to be so called NPE (non-producing entities).

[22] Defensive patent aggregation is the practice of purchasing patents or patent rights to keep such patents out of the hands of entities that would assert them against operating companies. The opposite is offensive patent aggregation, which is the purchasing of patents in order to assert them against companies that would use the inventions protected by such patents (operating companies) and to grant licenses to these operating companies in return for licensing fees or royalties. Offensive patent aggregation can be practiced by operating companies or Non-Practicing Entities (NPEs).

Applicant	Business Model	Assignee	Business Model	SEPs	SEP Families
Motorola Solutions, Inc.	Manufacturer	Google Inc.	Manufacturer	853	403
Rockstar Consortium US LP	Aggregator	Apple Inc.	Manufacturer	184	72
Nokia Corporation	Manufacturer	2011 Intellectual Property Asset Trust	NPE	86	51
Ericsson	Manufacturer	Cluster Technology Corp.	NPE	41	34
Sharp Corporation	Manufacturer	Huawei Investment & Holding Co., Ltd.	Manufacturer	77	32
Nokia Corporation	Manufacturer	QUALCOMM Incorporated	Manufacturer	43	31
Rockstar Consortium US LP	Aggregator	Microsoft Corporation	Manufacturer	50	31
Ericsson	Manufacturer	Idtp Holdings Inc.	NPE	44	31
Panasonic Corporation	Manufacturer	Godo Kaisha Ip Bridge 1	Bank	137	26
InterDigital, Inc.	Manufacturer	Intel Corporation	Manufacturer	275	24
NEC Corporation	Manufacturer	Lenovo Innovations Ltd	Manufacturer	69	23
Nokia Mobile Phones Ltd	Manufacturer	2011 Intellectual Property Asset Trust	NPE	31	22
Nokia Corporation	Manufacturer	Sisvel S.p.A	NPE	41	21
Datang Mobile Communications Equipment Company Limited	Manufacturer	China Academy Of Telecommunications Technology	Manufacturer	21	20
Ericsson	Manufacturer	Unwired Planet, Inc.	NPE	25	18
Nokia Siemens Networks SA	Manufacturer	The Cellular Network Communications Group, Inc.	Manufacturer	28	18
Rockstar Consortium US LP	Aggregator	BlackBerry Limited	Manufacturer	50	18
Ericsson	Manufacturer	BlackBerry Limited	Manufacturer	21	18
Core Wireless	NPE	2011 Intellectual Property Asset Trust	NPE	17	17
Siemens Aktiengesellschaft	Manufacturer	Nokia Solutions and Networks Oy	Manufacturer	18	16
Ipwireless Inc	NPE	Sony Corporation	Manufacturer	22	15
ASUSTeK Computer, Inc.	Manufacturer	Innovative Sonic Limited	NPE	20	15
Renesas Electronics Corporation	Manufacturer	Broadcom Corp.	Manufacturer	43	15
Infineon Technologies AG	Manufacturer	Intel Corporation	Manufacturer	18	14
Rockstar Consortium US LP	Aggregator	Rpx Clearinghouse Llc	Aggregator	40	13

Table 5: Top 20 declared SEP patent transfer deals

Figure 20 displays the declared SEP trades as to the number of patents traded and the type of transaction. We create categories of trade size where 1, 2-4, 5-10, 11-50, >50 patent families are traded in one transaction. We defined “Bare” transactions as trades where solely the patent family was traded, while an “Acquisition” relates to trades where the whole company was acquired. The graph shows that the main transfer deals of declared SEPs are between 2-4 patent families and “Bare” per deal. Small packages of patents are traded directly and not through a whole company acquisition.

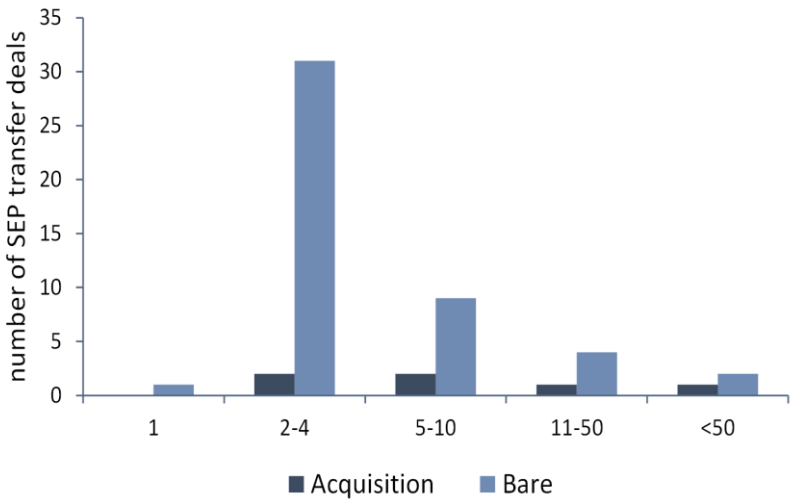

Figure 20: Number as declared SEP transfer deals as to transferred package number and transfer type (company acquisition/ bare transfer)

Figure 21 illustrates the timing of patent trade and shows that most declared SEPs at ETSI were transferred after the public declaration of a SEP (70%) which is in 62% of the cases also after standard release. In other SSOs patents are mainly transferred after standard release (85%) and only in 15% of the cases after SEP declaration. The graph shows that the SEP declaration is more important for a patent trade at ETSI compared to other SSOs. As results for the SEP declaration timing will show later in this report, ETSI is subject to a different SEP declaration behavior, which mainly drives these results.

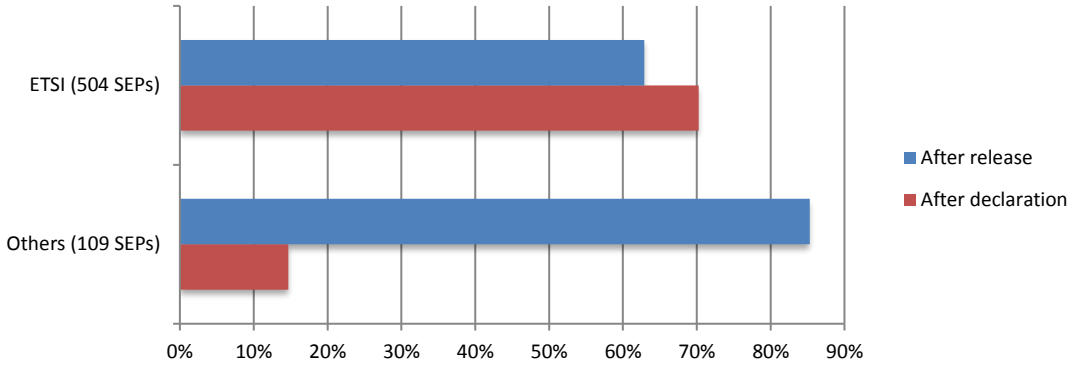

Figure 21: Share of transferred declared SEP as to standard release timing

Section 5: Licensing conditions of declared SEPs

Rights holders commit to license SEPs under certain conditions. Each SSO has a different IP policy and in some cases the declaring company chooses between different licensing options. Rights holders may also create patent pools to license all patents that are essential for a particular standard under a single license contract. These so called "one-stop shops" allow licensees to contact a single entity for a license contract. While many economists suggest that licensing through patent pools is more efficient in terms of transaction costs and double marginalization effects, 91% of the worldwide declared SEPs are licensed individually rather than through a patent pool (figure 22). Rights holders that include their patents in a patent pool commit to license these patents under a maximum price. While the rights holder has an opt-out possibility if the offered royalty is lower than the pool price, higher pricing outside the pool is prohibited. This counts as one reason why rights holders shy away from pools – they fear losing leverage when negotiating cross-licensing agreements for other technologies. Another reason why many patent pool initiatives have failed in the past is that a pool license must integrate the business interests of multiple players (eg, upstream and downstream manufacturers, as well as telecommunications network providers, universities, research organizations, non-practicing entities and privateers). Securing the agreement of all of these players to one single contract is extremely difficult, which could be another reason why only 9% of declared SEPs are pooled.

The most common framework under which SEPs are licensed is FRAND. Licensing terms under FRAND must be **fair** – no bundling and no grant-backs – **reasonable** and **non-discriminatory**. Despite the fact that the term "reasonable" in particular, has been subject to many disputes and even litigation, most market observers still see FRAND as the best basis on which to set royalty rates and 68% of all declared SEPs are declared to allow licensing under FRAND. All of the 32% of declared SEPs not declared as FRAND, do not specify the licensing conditions. Later in this report table 6 will illustrate differences within the SSO's IP policies, that could be the reason for these numbers.

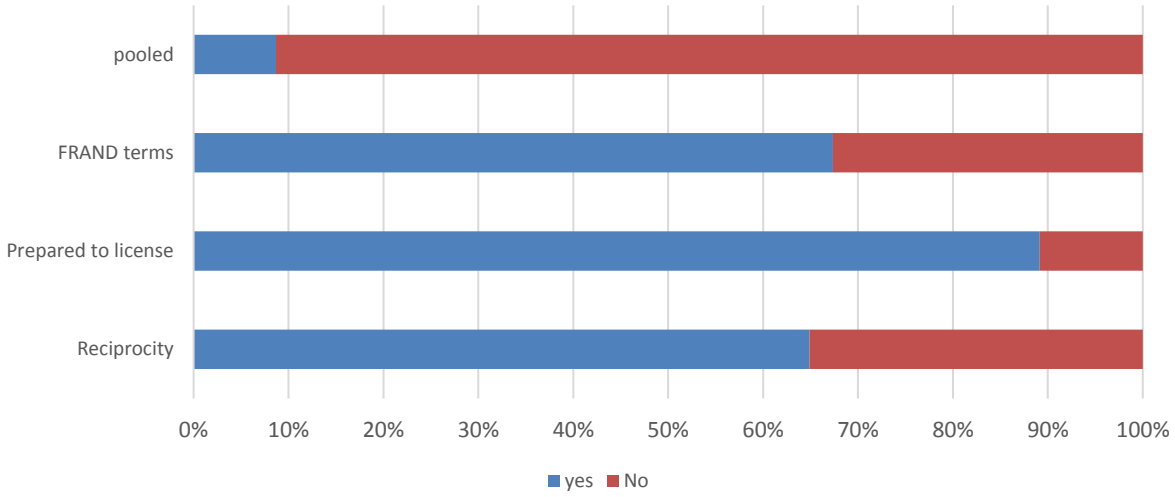

Figure 22: Share of declared SEP as to licensing commitment

In some SSOs the rights holder can state that they are not prepared to license essential patents, provided that it did not commit to license and thus did not participate in the standard-setting process. This was the case for only 11% of declared SEPs. Reciprocity rules describe the possibility of cross-licensing SEPs for a particular standard. Sixty-five percent of the declared SEPs agree to such reciprocity commitments, allowing for the cross-licensing of patents which are relevant for the same standard.

Licensing behavior is very much dependent on differences in technology markets. Figure 23 shows that e.g. patents in the field for audio-visual technologies have the highest share of pooled patents, while patent pooling is yet very uncommon for telecommunication technologies. Digital communication technologies often allow reciprocity licensing and in most cases state to be prepared to license under FRAND conditions.

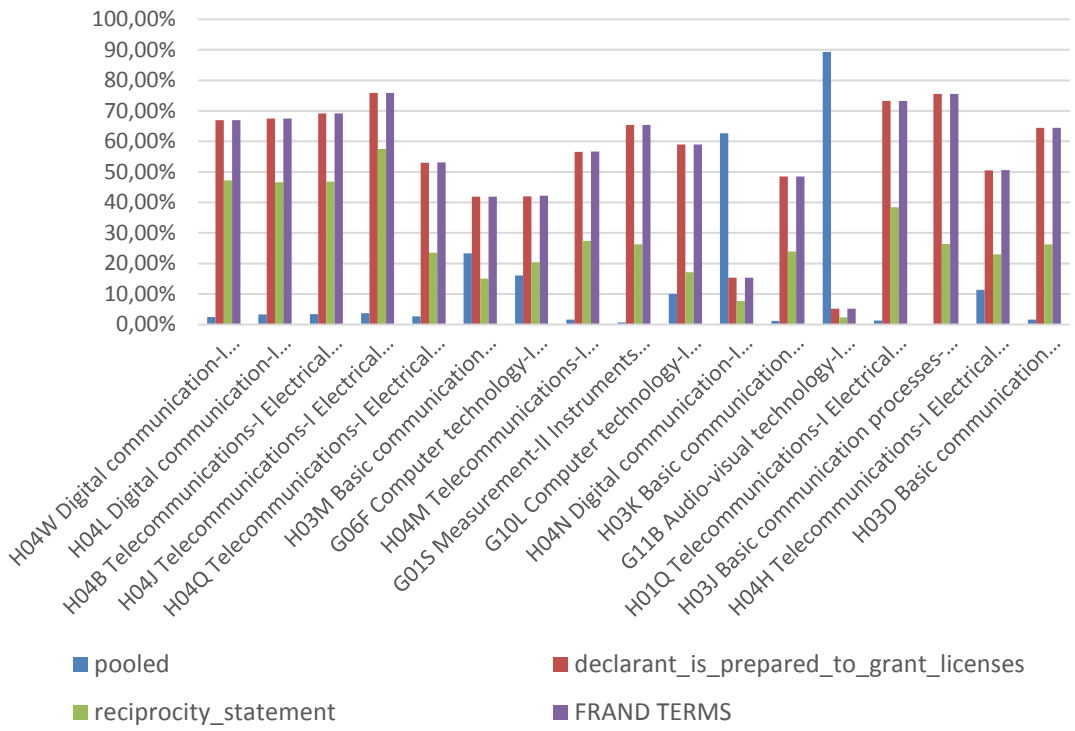

Figure 23: Share of declared SEP families as to licensing commitment per main IPC

Licensing rules not only depend on individual companies' decisions or technologies but also on the rules within the different SSOs. Table 6 displays the different IP policies per SSO with regard to the licensing terms, mandatory licensing, assurance, irrevocability, reciprocity rules for patent transfer and defensive suspension and is based on the classifications of Baron and Spulber. "Technology Standards and Standards Organizations: Introduction to the Searle Center Database." (2015). Table 6 shows that in fact rules may very much differ among SSOs and some rules that concern SEP licensing are not even specified within the IP bylaws of the respective SSO.

Name	Licensing terms	Licensing mandatory for members	Assurance necessary for inclusion?	Binding on Transfer	Reciprocity	Defensive suspension[23]
3GPP[24]	FRAND	Encouraged	Not specified	Not specified	Not specified	Not specified
ANSI[25]	RAND or RF (optional)	Not specified	Yes	Yes	Not specified	Not specified
ASTM[26]	Other than AS: Preference for standards without SEPs					
ATISc	RAND or RF (optional)	No	Yes	Not specified	Not specified	Not specified
CEN/CENELEC	FRAND or RF (optional)	No	In principle yes	Yes	Allowed	Not specified
DVB[27]	RAND	Yes, unless major interest	Not specified	Yes	Yes	Not specified
ECMA	RAND or RF (optional); RF in designated TG	For contributors	Yes, unless 2/3 vote of GA	Not specified	Allowed	No
ETSI	FRAND	Requested	Judgment of chair	Yes	Allowed	Not specified
IEEE	RAND, RF, NA (optional) discl. max. rate (optnl.)	No	Referred to IPR committee	Yes	Allowed	Not specified
IETF	RAND, RF, NA (optional)	No	No, taken into consideration	Not specified	Not specified	Not specified
ISO/IEC[28]	RAND or RF (optional)	No	Yes	Yes	Allowed	Not specified
ITU[29]	RAND or RF (optional)	No	Yes	Yes	Allowed	Not specified
OASIS	RAND, RF or NA (by WG)	For contributors, specific participants	No	Not specified	Allowed	Allowed
OMA	RAND	In principle yes	Not specified	Not specified	Yes	Not specified
TIA	RAND or RF (optional)	No	Yes	Notify assignee	Allowed	Not specified
W3C	RF	For WG participants	Yes	Not specified	Allowed	Allowed

Table 6: Licensing Policy per SSO (F)RAND= Fair and Reasonable and Non-Discriminatory, RF= Royalty Free, NA= Non Assertion [30]

[23] Licensee who brings SEP-based litigation against SEP holder (defensive suspension)
[24] IPR policy of organizational member also applies
[25] Essential requirements applicable to policies of American Standards Developers (ASD)
[26] ANSI policy applies to American National Standards (AS)
[27] Policy applicable in addition to IPR policy of SSO where standard is developed
[28] ISO, IEC and ITU have a common IPR policy with minor variations
[29] ISO, IEC and ITU have a common IPR policy with minor variations
[30] Based on Baron/Spulber (2015) "Technology Standards and Standards Organizations: Introduction to the Searle Center Database."

Section 6: Comparative analysis of declared SEP families and dynamics in the standardization process

To test characteristics of declared SEPs, we created control groups of patents that have not been declared as standard essential, but which were filed at the same patent office with the same publication year and which were categorized in the same main IPC classes. We calculated mean values for several SEP characteristics and compared these to those of the control group.

	Declared SEPs	**Control group**
Average Forward Citations	3.93	2.88
Average Backward Citations	6.12	7.76
Average Family Size	27.93	16.11
Average Number of Claim	20.89	17.79
Average Number of Inventors	2.70	2.50
Average Number of Assignees	1.19	1.25
Average Number of Distinct IPC Subclasses	1.21	1.22

Table 7: Comparison of the characteristics of declared standard essential patent with control groups of patents filed in the same CPC class, same country and same publication year.

Table 7 shows that declared SEPs receive on average almost four prior art citations by other patents, not counting self-citations. Patents in the same year, country and IPC control group receive only about three forward citations on average. Patent citations are reviewed and verified by objective and qualified patent examiners. Statistical studies have proved that receiving frequent citations of prior art is an indicator of patent value. In this regard, declared SEPs appear more relevant compared to other patents. Backward citations are those that a patent must cite as prior art. The more prior art patents cited, the more technologies use that invention. Backward citations may thus reflect how radical an invention is. Following this interpretation, declared SEPs are on average more radical than other patents. The family size – counted by a patent's International Patent Documentation family ID – reflects the number of patents that can be associated with the same priority invention. The more families, the more markets are protected for the invention and the wider its legal strength. Since patent examination fees and maintenance fees result in considerable costs for the applicant at each patent office, counting the family size may reflect not only legal market coverage, but also the value that the rights holder places on a particular patent. The family size of declared SEPs is almost twice as large as that for patents in the control group. The results confirm is may reflect the fact that declared SEPs have a wider market coverage and thus a higher

perceived market value. The average number of claims reveals the legal breadth of a patent, which is on average higher for declared SEPs compared to the control gorup. As for the average number of inventors, assignees or distinct IPC classes, the average values are closely related and differences are negligible.

Figure 24 shows that declared SEPs have on average lapsed in about 67%[31] of cases, whereas patents in the control group have lapsed in over 76% of the cases. Dropping a patent indicates that the rights holder no longer perceives any value in the patented technology. The analysis confirms that patent holders keep declared SEPs alive more frequently and are more willing to keep paying expensive maintenance fees. The results of the litigation frequency[32] analysis confirm that declared SEPs are subject to litigation much more frequently than the patents in the control group. Almost 2% of all declared SEPs have been litigated at least once, while patents in the control group have been litigated in only 0.45% of all cases. The results not only suggest that SEPs may constitute a good bargaining chip in litigation cases, but also indicate sectors in which SEP matters are highly competitive (eg, the smartphone market).

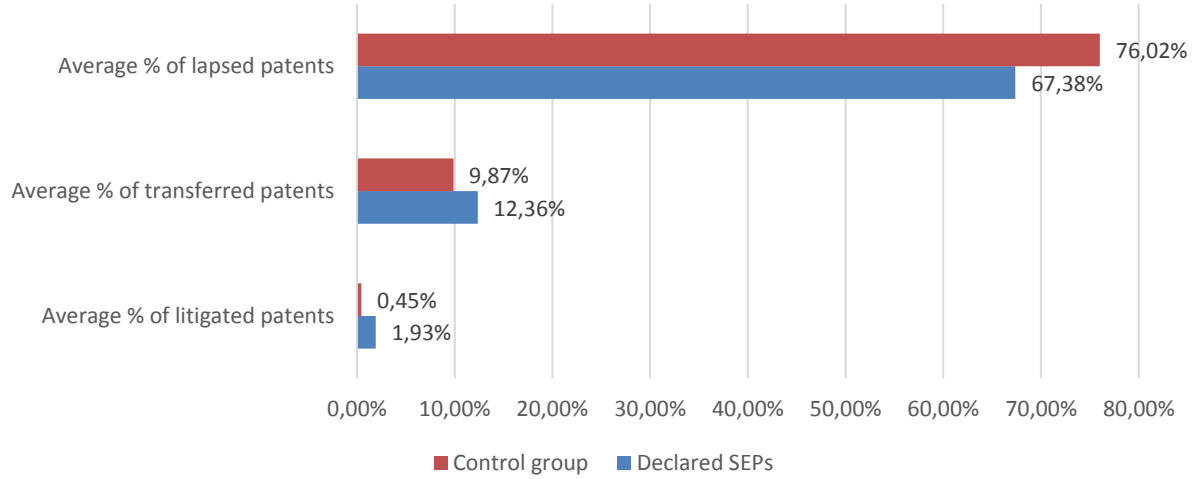

Figure 24: Comparing declared SEPs status, transfer and litigation (US only) average

In order to understand a patent's influence on the development of a technological standard we conduct two comparative analyses on the update and replacement of standards. While a standard upgrade incrementally changes and improves upon an

[31] Figure 24 compares SEPs with a control group. That control group includes patents from the same year, same patent office and same main IPC. Therefore, the lapsed status always compares patents of the same age. The analysis is based as of the end of 2015 and takes into account the single patent applications in each country. That said many SEPs stay alive for 20 years but applications in some less relevant countries are lapsed e.g. out of a PCT patent family after 10 years the FI, the NL and the AU patents were lapsed while the DE, US, KR and CN are still active.

[32] Only US litigations were taken into account for this analysis.

existing standardized technology, standard replacement indicates a discontinuous change in the underlying technology by specifying a whole new standard.

Figure 25 shows estimates of the likelihood (Kaplan-Meier survival estimates) that a standard version has not been withdrawn by a certain time (in years after standard release). The estimates indicate that standard upgrades are more frequent when the standard is subject to a declared SEP.

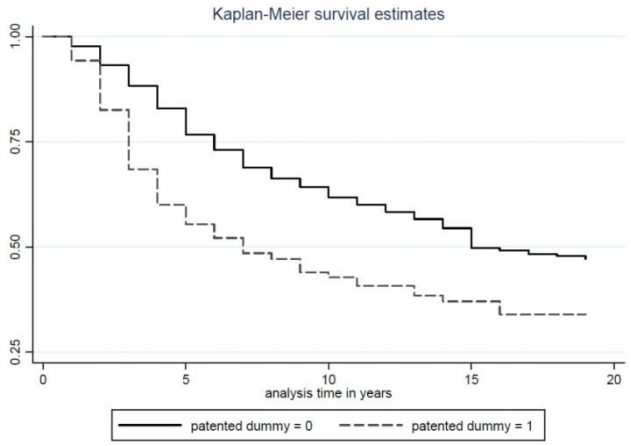

Figure 25: Comparing standard version upgrade as to standards subjects to declared SEPs and a control group of standards not subject to declared SEPs[33]

Figure 26 presents the same analysis for the survival estimate of a standards replacement.

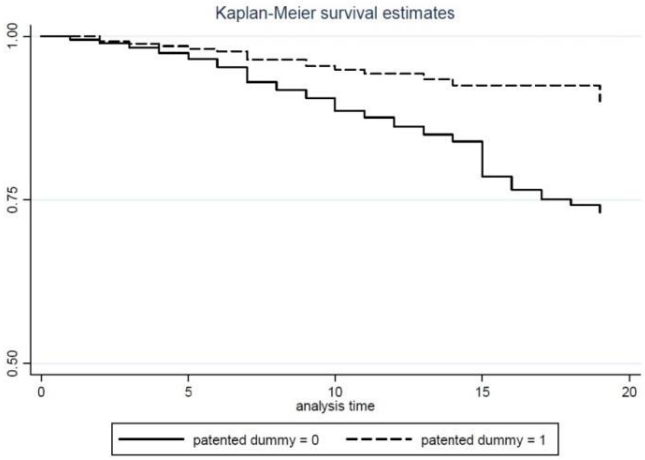

Figure 26: Comparing standard survival rate as to standards subjects to declared SEPs and a control group of standards not subject to declared SEPs[34]

[33] Based on Baron, J.; Pohlmann, T.; Blind, K. (2016): *Essential patents and standard dynamics*, Research Policy, Volume 45, Issue 9, November 2016, Pages 1762–1773.
[34] Based on Baron, J.; Pohlmann, T.; Blind, K. (2016): *Essential patents and standard dynamics*, Research Policy, Volume 45, Issue 9, November 2016, Pages 1762–1773.

The estimates indicate that survival rates of standards including SEPs decrease more slowly than those of other standards. While the existence of SEPs is correlated with a significantly higher number of continuous standard upgrades, standards subject to SEPs are much less likely to experience discontinuous standard replacements. In other words, standards where we evidence SEP declarations are updated more often but the generational change (e.g. DVD to Blueray) is less frequent.

Section 7: Timing analysis of SEP declaration, patent priority and standards release

The setting of standards and the filing of patents are different processes within the standardization process. Figures 27-29 compare the timing of declared SEP priority filings at the EPO as well as the public declaration of SEPs in comparison to the release of the respective standard document. The blue colored bars in figure 27 relate to the timing of priority filings before and after the standard release (t=0) while the red bars relate to the timing of public declaration of a SEP as to standard release. Early priority filings can be identified up to 10 years before the standard has been released with a strong increase in priority filings a few years before and most significantly in the year of the standard release. SEP declarations in comparison rather increase 2-3 years before the standard release with a strong surge at t=0 and a still large share of SEP declarations made years after the standard has been released. The results of this timing analysis confirms that technical development of standards continues even after the first version of the standard has been released. Thus not only the patent filings but also the SEP declaration may take place years after the standards document has been officially released.

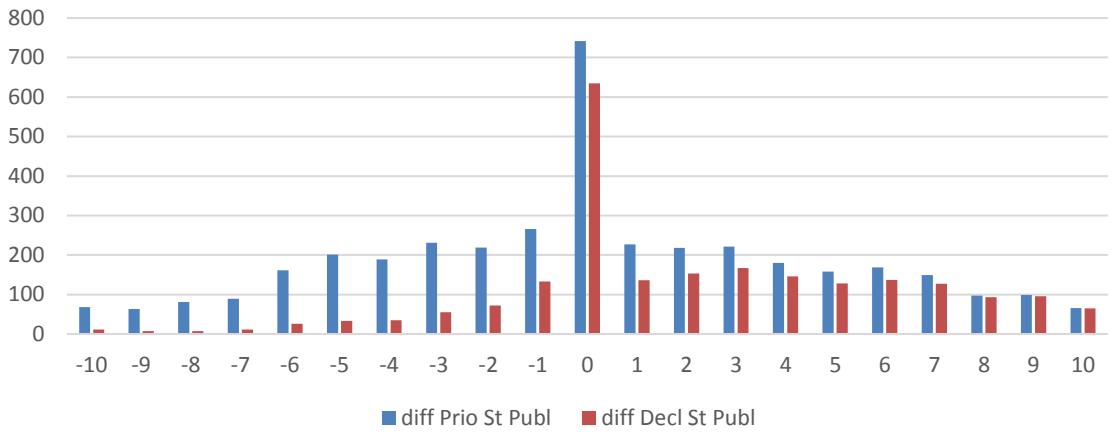

Figure 27a: Comparing the timing of a SEP's priority filing at the European Patent Office and declaration as to standard release for all SSOs

We estimated the grant period time for declared SEPs filed at the EPO. Figure 27a and figure 27b show that overall 71.21% of all declared SEPs are granted after standard release. Especially figure 27b shows that the timing of the declared SEP's grant date and the release of the standard differs strongly among the different SSOs. At ANSI in all cases the standard has not been released when the patent was granted. At IEC, CEN ITUT, ITUR, ISO and IEEE over 50% of the patents were granted before the standard

was released. For all the other SSOs either all or a high percentage of patents were granted after the standard was released. Especially at ETSI, almost 73% of all declared SEPs were granted after standard release accounting for the highest number of declared SEPs.

These figures are important in view of considering to use the information of a patent's SEP declaration for the granting process. Here, the grant of a patent could e.g. be performed in parallel to an essentiality check at the respective patent offices. The report will elaborate the discussion on essentiality checks in more detail in section 8.

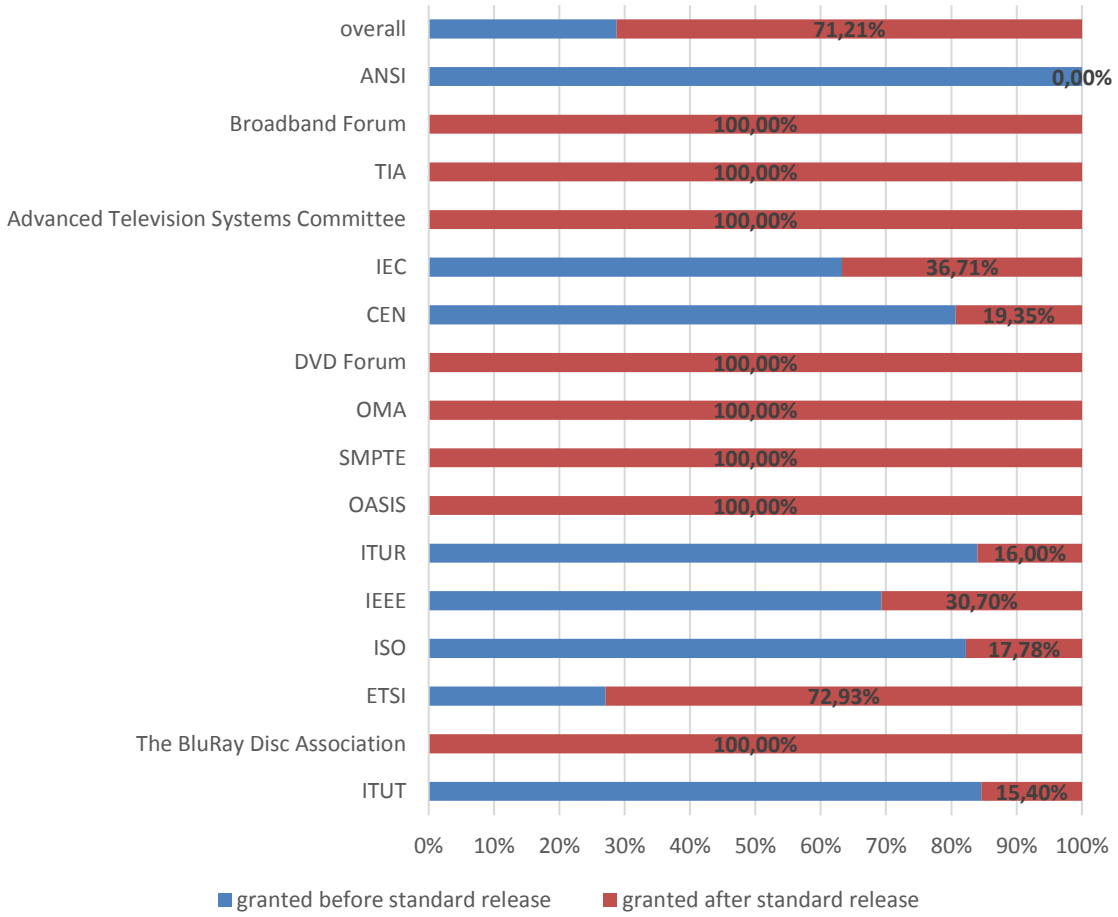

Figure 27: Percentage of granted declared SEPs after the standard was released

The development of technology standards depends on the procedures of standard setting within a SSO. We therefore split the timing analysis as to two different SSOs that follow different standard setting procedures. Figure 28a and figure 28b measure the timing of ETSI and ISO/IEC. This comparison confirms that at ETSI patent filings of declared SEPs continue after standard release, while this is hardly not the case for patent filings of declared SEPs at ISO/IEC. Telecommunication standards developed at ETSI such as GSM, UMTS and LTE are technologies that constantly change before a new generation

introduces a discontinuous technological change, e.g. voice transmission (UMTS) to digital content transmission (LTE). Some of the UMTS technologies are still used for the LTE technology and thus also the patent filings may not stop after the standard is set. At ISO and IEC in comparison audiovisual technologies such as the different MPEG standards have not been subject to so much overlapping technological development. The mp3 technology for example has only incrementally changed over the past years and thus also the patent filings did not increase.

As to granting time averages of declared SEPs[35] filed at the EPO, about 75% of all declared SEPs at ETSI are granted after standard release, while only about 20% of the declared SEPs are granted after standard release at ISO/IEC. These differences show that the technical development of the core standard technology takes place before the standard is officially released at ISO/IEC while at ETSI standard development is ongoing and 75% of all declared SEPs are not yet granted at standard release.

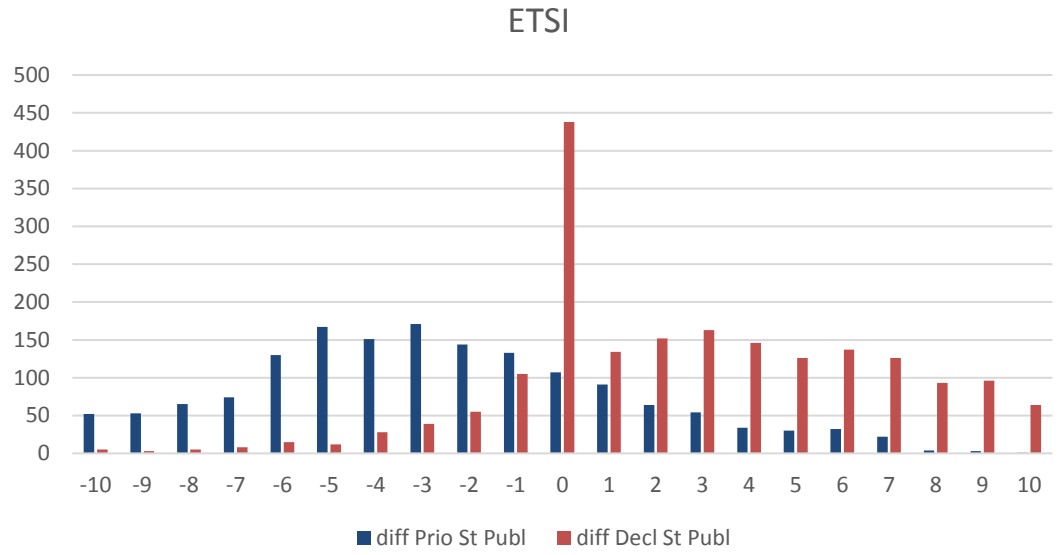

Figure 28a: Comparing the timing of SEP priority filing and SEP declaration as to standard release for ETSI standards

[35] Based on the grant date and declaration date comparisons.

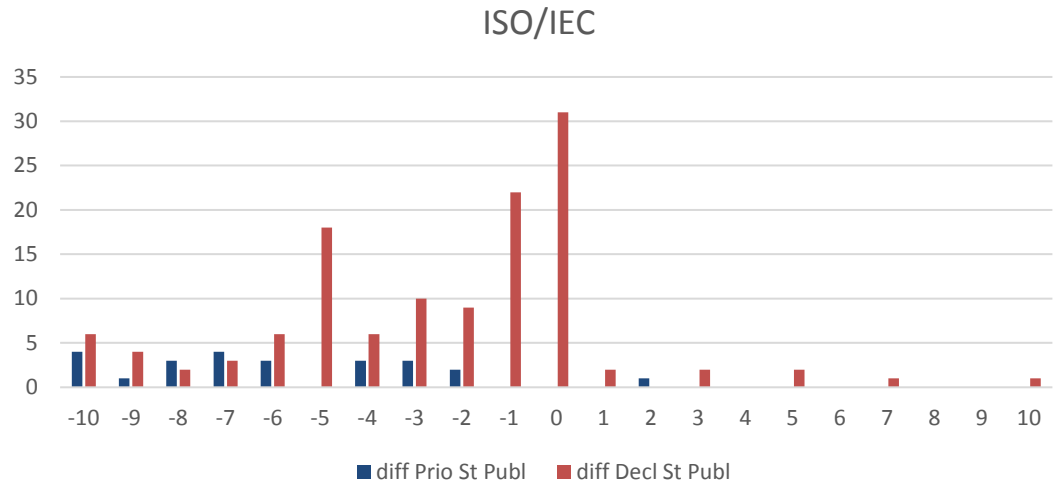

Figure 28b: Comparing the timing of SEP priority filing and SEP declaration as to standard release for ISO/IEC standards

The timing of SEP declaration may not always be prompt and many companies declare SEPs years' after the patent has been filed. Figure 29 confirms that in fact the gap between the priority filing and its SEP declaration may be up to 17 years.

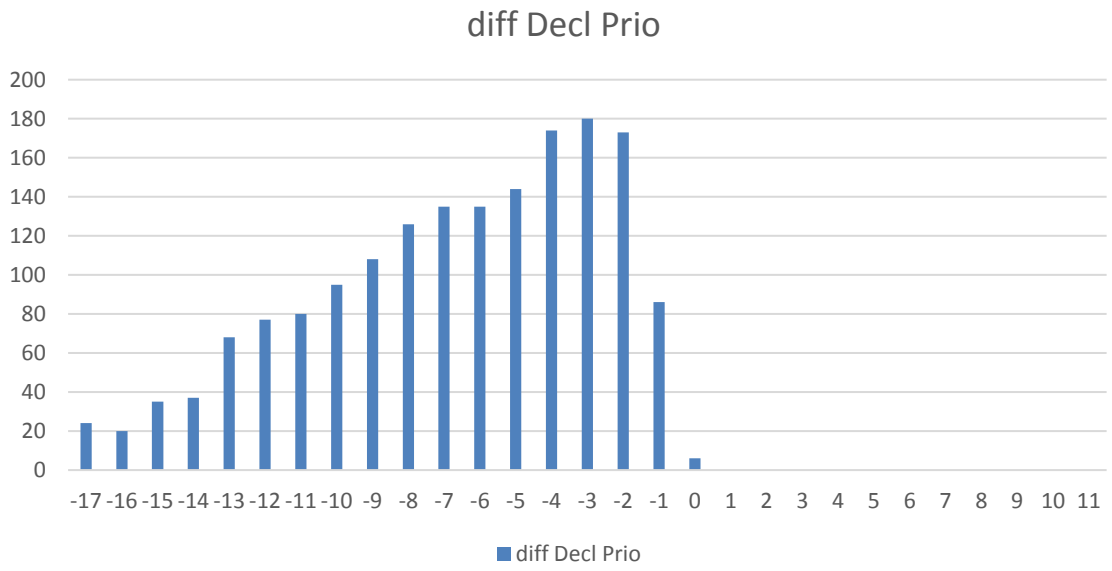

Figure 29: Comparing the timing of SEP priority filing as to SEP declaration

Section 8: Analysis on essentiality checks for declared SEPs

Since it is not publically verified whether or not these patents are truly standard essential, the high number of declared SEPs may cause legal uncertainty for many standard implementers. In order to cope with these difficulties, one can create groupings of SEP declaration as to family, legal status or relevance as conducted in table 3 and table 4 in this study. This is a first step to better evaluate the more realistic number of relevant patent families for each standard. A closer look at the timing of the declared SEP's priority date as to the standard release (figure 26, 27a, 27b) may furthermore help to relate the relevance of a patent to a particular standard. Patents that have been filed several years before the standard was actually created, or several years after the standard was set will probably be less relevant to the standards core technologies as patents filed in years around the release of the standard.

However, these numbers just provide a rather broad indication of how many declared SEPs are actually essential. Especially telecommunication standards (GSM, UMTS, LTE) are constantly updated. New patented technological solutions may thus become part of the standard even after the standard is released. Berger, Blind, and Thumm (2012, Research Policy, 41, 216-225) show that some companies exploit the flexibility within the patent application process to amend the claims of pending patent applications to become standard essential after the standard was set.

Patents filed several years before the standard was released may be standard essential too. Some patents e.g. SEPs declared for GSM were also relevant for succeeding generations since some of the core technologies were also used for UMTS and LTE.

Since SSOs do not verify the essentiality of patents to standards, disputes whether or not a patent really claims an invention reading on a particular standard have to be solved during bilateral negotiations (where the parties may typically produce and argue over claim charts) and may eventually lead a trial. Ultimately, only a court may decide whether a patent is essential or not for a particular implementation of a standard and for a particular application of this standard in a specific product.

A number studies indicates that only 20-28% of patent families declared essential were actually essential for key technologies.[36] For instance, a recent study conducted by the

[36] D. J., & Myers, R. A. (2005), 3G Cellular standards and patents. Proceedings from 2005 IEEE Wireless Communications and Networking Conference. Fairfield Resources Intl. (2007), Analysis of Patents Declared as Essential to GSM as of June 6, 2007; Fairfield Resources Intl. (2008) Review of Patents Declared as Essential to

Cyber Creative Institute identified that only 56% of the LTE and LTE-advanced patents declared as SEP are most likely standard essential. This result hints to an over-declaration of SEPs beyond the actual number of SEPs listed at the SSOs. In various patent licensing deals, SEPs play an important role in defining the royalty rates of a patent portfolio. It thus becomes increasingly important to check the essentiality of patents in a portfolio before entering licensing negotiations.
Patent pools only include declared SEPs that have been verified by third party experts to be standard essential. In practice SEP owners and licensees are also likely to build claim charts for SEPs and argue over them in most if not all serious licensing negotiations. This intermediate form of essentiality assessment is probably the most common one in practice, however very costly and only an option if the discussed license is subject to a certain volume. All the more as negotiating parties are likely not to agree from the outset on their respective claim charts (which may eventually lead to litigation). Moreover, they remain opaque and may lead to considerable cost duplications when the very same patent or patent portfolio is the subject of different bilateral negotiations. Against this background, a centralized and public form of essentiality assessment recognized by all parties could arguably be a powerful way to enhance transparency and cut transaction costs in SEP licensing.

SSOs do not conduct essentiality checks and a large proportion of declared SEPs have never been examined in that regard. Many market participants argue that this legal uncertainty causes litigation on declared SEPs or even leads to excessive royalty payments of patents that are bundled in a licensing package, but which are in fact, not standard essential. For most standard implementers it seems uneconomical to pay an independent expert to examine the essentiality of thousands of patents declared for e.g. GSM, UMTS or LTE. Figure 30 displays costs connected to different levels of essentiality checks proposed by the PA Consulting Group. Overall the PA Consulting Group suggests three options to consider in providing an essentiality analysis: Level 1: A landscaping analysis with high-level technical reviews (a broad check which is less costly). Level 2: A more thorough examination to aid with commercial negotiations by developing claim charts and validity checks (a more precise analysis connected to higher costs). Level 3: A legal validation – providing definitive reference on whether patents are SEPs (requires a deep and valid analysis which is very costly).

WDCMA Through December, 2008. Other studies include Fairfield Resources International. (2010). Review of Patents Declared as Essential to LTE and SAE (4G Wireless Standards) Through June 30, 2009.

Figure 30: Comparing the timing of SEP priority filing as to SEP declaration[37]

In table 8 and table 9 we have calculated the proposed essentiality check unit costs per patent family for different standard projects for level 1 and level 2 essentiality checks. The level of analysis is furthermore differentiated as to checking patent families, checking all declared SEPs including declared provisional applications, divisional applications, or applications to other countries, as well as checking all patent family members even though they have not been declared.

Level of Essentiality Check	Level of Analysis	Average unit price	GSM (M €)	UMTS (M €)	LTE (M €)
Level 1 Landscaping Claim Analysis	all SEP patent families	€ 400	0.3 €	1.1 €	3.7 €
	all SEP disclosures		0.7 €	2.3 €	8.5 €
	all SEPs (family extended)		3.5 €	10.6 €	42.9 €
Level 2 Claim Charts	all SEP patent families	€ 7,500	5.6 €	19.8 €	66.6 €
	all SEP disclosures		12.6 €	41.4 €	153.4 €
	all SEPs (family extended)		63.3 €	190.8 €	772.2 €

Table 8: Essentiality checks as to different standard projects.

[37] Based on estimations from the PA Consulting Group

The cost estimates as of table 8 and 9 confirm that checking essentiality for different standard projects even on a rather board level 1 and 2 creates immense costs. Especially for LTE these costs may approach 800 million Euros.

Level of Essentiality Check	Level of Analysis	Average unit price	Wifi (M €)	FireWire (M €)	WiMax (M €)	RFID (M €)	HEVC (M €)	AVC (M €)
Level 1 Landscaping Claim Analysis	all SEP patent families	400 €	0.2 €	0.1 €	0.2 €	0.2 €	0.1 €	0.3 €
	all SEP disclosures		0.36 €	0.2 €	0.3 €	0.5 €	0.2 €	0.7 €
	all SEPs (family extended)		1.8 €	0.9 €	1.6 €	2.6 €	0.9 €	3.4 €
Level 2 Claim Charts	all SEP patent families	7,500 €	3.2 €	1.6 €	2.9 €	4.7 €	1.7 €	6.1 €
	all SEP disclosures		6.7 €	3.4 €	6.1 €	9.8 €	3.5 €	12.8 €
	all SEPs (family extended)		33.7 €	17.1 €	30.5 €	49.0 €	17.6 €	64.0 €

Table 9: Essentiality checks as to different standard projects

Even though patent claims may differ among patents filed at different offices, it seems to be a more cost efficient solution to first only check the essentiality of one SEP family member. Using broad indicators as proposed in table 3 and table 4 as well as a timing analysis as to figure 26, 27a, 27b essentiality can be filtered to focus on the most relevant declared SEPs. Essentiality checks as to level 1 or 2 could be a first step to get a better picture on the actual numbers of standard essential patents for each standard project. In many cases this could possibly prevent longstanding licensing negotiations or even litigation. If worst comes to worst essentiality checks may need to go deeper (level 3) or may even be subject to a court decision. However, if the likelihood of standard essentiality can be estimated upfront most companies may desist from paying third parties to create deeper essentiality checks.

Results from the timing analysis for ETSI SEP declarations suggest that most patent grants accrue after the final standard has been released. Thus examiners would have the full information of the standard specification to not only check if the standard document may be subject to prior art[38], but also if the claims of the patent application describe an invention that is necessarily essential to the standard. While the prior art search within

[38] As of 2009 the EPO has access to a thorough data base on meeting minutes, draft reports, standard specification and standard document to search relevant prior art. As of last year (2015) the EPO has cited over 20,000 standards in the EPO search reports.

the granting procedure at patent offices in any case requires the examiners conducting such a search could also go one step further to also subsequently check the essentiality of a patent application. This could be done during the granting procedures (e.g. after the substantive examination) or immediately after when the patent claims are established and when also the standard has been released. However, the timing of declared SEP grant and standard release dates may differ as to the specific SSO and its standard setting procedures.[39] Moreover, the assessment of the essentiality may be performed in a "dynamic" way, since some patents are also essential to standards of later generations. Therefore, such service may also be provided after grant.

An examiner might need between 1-3 days to check the essentiality of a not yet granted declared SEP. Essentiality checks by patent examiners could cost around 1000-2000€ per patent application. This number would be between the PA consulting group suggestion of a level 1 and level 2 analysis.[40] However, an examiner at a patent office would conduct claim charts essentiality checks and would therefore be closer to a "Level 2" analysis. In view of these perceptions examiners at a patent office are perfect candidates to conduct patent essentiality evaluations for future standard essential patents.

Technical expertise, patent search reports, access to databases and standardization documents could provide for significant economy of scale and cost advantages. In addition, patent offices have the necessary recognition from industry to carry such a delicate task.

As for the already granted patents, essentiality checks should focus on declared SEPs that seem to be more relevant than others as to the proposed indictors in table 3, table 4 and figure 26-27. Such an analysis would provide a first orientation especially for new market entrants of how many patents are actually standard essential

[39] This result also suggests that essentiality checks for declared SEPs at ETSI could be conducted during the granting process (e.g. after the substantive examination) and thus after the release of the standard, while such a procedure is less applicable at ISO/IEC where the granting process often takes place before the standard has been set.

[40] The 2014 EC study indicates a broad range of costs associated with essentiality tests by SSOs for a first instance analysis (EUR 600-1800), by third party in a patent pool (EUR 5000-15000) and by an expert in the context of a court case (above EUR 20.000). The analysis is based on service costs in the US.

IV. Summary and Policy Implications

The study uses data from worldwide declared standard essential patents published by all major SSOs. It provides insights on the occurrence of SEPs supported by statistical evidence. The main results are summarized as follows:

Technology Trends on SEPs

Most declared SEP families relate to digital communication and telecommunication, followed by audio-visual and computer technologies. The study results indicate that most SEPs were declared at **ETSI representing over 70% of the worldwide SEP declarations (figure1). A large part of these relate to GSM, UMTS and LTE/LTE-advanced.**

On technological progress, the study shows that declared SEPs lead to more frequent technological updates of standards, but to less frequent changes of standards generations. This result suggests that **patents may create incentives** to contribute to the **incremental technological progress of the current standard generation**, while a **radical shift to the next standard generation is delayed**.

Regional Trends on SEPs

The study shows that the share of declared **SEPs filed at the Korean or Chinese patent offices has been increasing over time**, especially in the telecommunications sector.

The SEP filings show a **regional concentration on certain patent offices for certain technologies**. E.g. computer technology standards concentrate on declared US SEPs or the audio-visual technologies concentrate on JP and US declared SEPs.

SEP holders

Big European patent holders such as **Nokia, Ericsson or Siemens still file a large amount of SEP families**, while US and Asian companies such as **Qualcomm, InterDigital, Samsung, Huawei, Google and LG** are also heavily filing in Europe. Other top European companies are network providers (e.g. Orange, Deutsche Telecom, British Telecom), while US non-producing entities are also filing in Europe (table 2).

On particular technologies such as **GSM, UMTS and LTE**, the analysis demonstrates that starting in the mid-2000s the number of Chinese, Korean and Japanese applicants increased (figures 8b, 9b, 10b), though the proportion of priority filings in Europe and the US remain high (figures 8a, 9, 10), indicating that **Asian market players together with US players dominate in terms of their SEPs at the European offices in these technological areas.**

In addition, the analysis on the **age of SEP portfolios owned by companies** reflects a **shift from US, Japanese and European rights holders to Chinese, Korean and Taiwanese** rights holders (Table 3).

SEP transfers

More than **12% of all SEPs have been transferred at least once**. Patents are more and more used as assets which are traded among different market participants. Buying SEPs may be a practice to enter new markets and secure a place in current evolving markets. The analysis reveals that **top sellers** of declared SEPs were **Motorola, Nokia, Ericsson, InterDigital and Panasonic** (figure 19). **Qualcomm, Apple, Blackberry** and Intel are the **most active buyers** of declared SEPs (figure 18).

SEP Licensing

Each SSO has a different IP policy and licensing conditions. The most common framework under which SEPs are licensed is FRAND. Indeed, **68% of all declared SEPs allow licensing under FRAND**. Moreover, **65% of them are subject to reciprocity rules** such as cross-licensing. However, **only 9% of declared SEPs are pooled**, despite patent pool efficiency in terms of transaction costs and double marginalization effects (figure 22). The possibility to obtain higher licensing fees and the difficulties to integrate the business interests of multiple players may explain why rights holders shy away from pools. Another reason might be the continuing evolving standards e.g. in telecoms, where the pool overhead might be considered an undue burden.

Value of SEPs:

The study reveals that declared SEPs are of high relevance, which is most probably connected to the increasing importance of future technological solutions that depend on interconnectivity and compatibility of different systems working together (e.g. 4G, 5G, Internet of Things).

The study measures statistically that **declared SEPs appear to be more valuable** and technically relevant than other patents. However, this analysis is limited to the extent that the results do not differentiate an intrinsic or induced value of declared SEPs. In other words, it is uncertain whether declared SEPs are more valuable and therefore declared essential for a standard, or whether these patents become more valuable only after being declared standard essential.

This report furthermore shows that **the majority of declared SEPs are renewed up until the maximum of 20 years in key countries**, which further demonstrate the **commercial value** of those patents as well as the importance of their essentiality to be validated at early stage (figure 12). In addition, the **much larger average family size** (28 vs 16 for the control group) and its related increased patenting cost is also a significant indication of their value (table 7).

SEP Litigation

Based on an analysis of SEPs litigation **in the US**, the study confirms an **increasing number of litigations around declared SEPs**. Due to the high number of declared SEPs at ETSI, statistics reveals that **most of the litigated declared SEPs can be identified at ETSI**, followed by ISO, IEEE and the BlueRay association (figure 17). However, ETSI SEPs have the lowest overall level of litigation per patent (figure 16). Overall, the increasing litigation trend may create problems especially for smaller market players or new market entrants.

Timing of SEP declaration

Final released final standards documents and granted patents with defined claims are a necessary precondition in order to correctly verify essentiality of patents. However, **in certain cases SEP declarations takes place before the standard is released** (e.g. ISO and IEC) **or the patent is granted before** (Figures 27a, 27b, 28 and 29). Obviously, even post-grant or post standard release declarations are not sufficient *per se* to guarantee transparent information on essentiality.

In particular, the analysis reveals that more than **71% of all declared SEPs are granted after the final release of the standard** with important differences amongst SSOs. For instance, the findings reveal that **73% of SEPs declared at ETSI are granted after the final standard** has been released. The same may not be true for other SSOs, such as **ISO and IEC where only 20% or less of declared SEPs are granted after standard** release.

When considering the relationship between declaration and standard release timing, the statistics reveal **SEP declarations increase 2-3 years before the standard release with a strong surge at release but also years after**.

SEP essentiality checks

Need for essentiality check. The evidence collected in this report reveals a strong case for more transparency with respect to patent essentiality. This is confirmed by existing studies pointing out at over-declaration, the recent EC consultation as well as by the statistical findings in this report. We indeed find a sheer number of declared SEPs, increasing frequency of litigated SEPs and the fact that some NPEs have become major SEP owners promoting assertion of such declared SEPs. **The burden of any willing licensee, especially SMEs, appears large** considering the number of SEPs owners with whom they might have to negotiate.

How to perform essentiality check. The report analyzes in detail three possible **degrees of essentiality check (high level landscaping, detailed examination, legal validation)** and its associated costs (table 8). Considering the increasing costs of the different options, we suggest a **high level essentiality landscaping or detailed examination** that would **not legally confirm the essentiality** of declare SEPs, but provide a more **qualified picture on the potential essentiality**. This would **reduce legal uncertainty** and **legal disputes** outside and inside the international litigation courts. In addition, it could provide a better price signals on SEP licensing and transfers.

Costs. The report shows that the **essentiality check may represent a significant cost**. Moreover, it could be very expensive to carry out essentiality checks for the existing stock of SEPs. For instance, the number of declarations in GMS-UMTS-LTE alone vary upwards and downwards from several hundred patent families to over 3000 per year (tables 8 and 9). However, a systematic requirement to pay for **essentiality checks of future SEP declaration may be feasible** and potentially reduce the number of patents declared essential with no ground. In order to overcome cost issues, one solution could

be to **conduct checks on only one patent within a family** (i.e. the average family size is 28 patent for SEPs). **Central authorities such as the patent offices** have the **technological capacity, industry recognition and may represent a more cost effective way to run essentiality checks**.

Timing. As explained above, assessment of essentiality should take place **after both the standard release and substantive examination of patent applications** to be fully objective. This would increase the quality of these checks, but also further reduce any workload. Indeed, a substantial proportion of all patent applications claimed as SEPs are abandoned or refused, and a significant proportion of those granted have a reduced final scope of protection. Thus, an **essentiality check performed after the substantive search of patents** could be the **most efficient solution** for SEPs. The findings of this report support this solution, as the **vast majority of SEPs declarations occurs both after the patent grant** (70% of all SEPs, 75% at ETSI) **and around standard release** (see figure 29). In addition, the assessment of the essentiality may be performed in a "dynamic" way, since some patents are also essential to standards of later generations. Therefore, such **service may also be provided after grant**.

***Management of essentiality check*.** Central, independent essentiality checks of declared SEPs may contribute to reduce their costs while at the same time reinforcing their recognition by the stakeholders. A centralized essentiality evaluation carried out by a technically competent and independent entity, recognized as such by all parties, would indeed support the production of more precise and thus informative patent declarations. Such one-shop-stop could also help avoid duplication of efforts by entities when producing their own claim charts, and ultimately help them in saving costs. Public entities such as the patent offices are potentially capable of carrying out such essentiality checks at reasonable costs and have the necessary independency and recognition. Workload and legal mandate of patent offices would also need to be further examined. Another key question pertains to who should request (and pay for) the essentiality checks in such a case.

***Limitations*.** The study however highlights various challenges concerning management of any essentiality checks and possible solutions. Standards continue to develop for many years after their first publication. Moreover, some patents are also essential to standards of later generations[41]. A patent may thus need to be checked as being standard

[41] a surge in patents in a later generation (e.g. LTE) may simultaneously cause a surge in UMTS, indicating that these technologies are being included in the previous generation.

essential to succeeding standard documents too.[42] These factors may plead for a "dynamic" approach, as more than one essentiality check for different standards or parts of standard might be required. However, considering existing evidence of over-declaration, a single timely essentiality check against at least one version of the standard might be considered a significant improvement in patent transparency over the existing situation. It also remains to be confirmed whether the additional costs of essentiality checks should not hamper companies' incentives to keep actively participating in standard setting processes. However this study shows different ways to contain costs (e.g. central authority, essentiality check on only one patent within a family, etc.) while providing higher transparency and legal certainty to market players.

Outlook

With regard to the study results we encourage the European Commission to support initiatives to pursue more cost efficient essentiality examinations, especially for upcoming SEPs. Other factors must however still be investigated such as optimum methods of such essentiality checks. Careful piloting to help estimate costs, benefits and feasibilities is also recommended.

[42] Another complexity on a patents essentiality for multiple specifications are normative references. As to the ISO definition "The normative references lists other documents which are indispensable for the application of the standard." Therefore, a standard referencing standards subject to a SEP is thus also affected by the SEP.

Appendix

V. Method and Data

Retrieving information from SEP declarations can be challenging, because the original format of the SEP data is not harmonized. Company representatives typically hand in a SEP disclosure letter (called "Letters of Assurance" or LoA at some SSOs), which is in some cases a form filled out by hand. This declaration form is imported in the format of the SSO's database and saved as a pdf document (as a scan in the case of handwritten forms). IPlytics makes use of PDF parsers to automate the scraping process of the SEP declaration forms. In a second step, the SEP declarations of different SSOs are structured as to a standardized format. This is necessary because different SSOs provide different information on SEP declarations. In a next step the format of patent application and publication numbers listed in the disclosure letter is harmonized and then merges the cleaned patent numbers to retrieve the patent family identification numbers. A patent family is defined as a group of patents with the same priority patent application, and includes e.g. equivalent patents filed in different countries. All patents of the same patent family originate from the same invention.[43]

SEP declaration registers may be subject to spelling mistakes. Furthermore, the automated retrieval of patent numbers from e.g. PDF files of scanned hand-written forms may induce errors. IPlytics therefore conducts quality checks by e.g. comparing whether the first or current assignee of the patent matches the declaring company. In cases where the declaring company is not listed as any of the patent assignees, IPlytics manually checks the patent. In cases of doubt, IPlytics deletes patent observations that seem not to be relevant for the standard in question.

The standard designations from the disclosure letter can reference a unique standard document (a specific version of a standard), a standard (without specifying the version), or entire standardization projects consisting in many different standards (such as LTE). Only very few declarations specify standard sections or chapters or other levels of disaggregation that are more precise than the standard document level. In order to match SEP declarations with the IPlytics standards database, IPlytics splits standard

[43] Many methods and data sources used in this report are based on Baron/Pohlmann (2015): "*Mapping Standards to Patents using Databases of Declared Standard-Essential Patents and Systems of Technological Classification*" presented at the "Fourth Annual Research Roundtable on Technology Standards", Chicago May 2016.

designations into clean standard ids and version numbers. Declarations can be unambiguously matched to standard documents if they reference a standard number and a version number or date, or if they reference a standard number for which only a single version exists (some SSOs assign different document numbers to different versions of the same standard). In many cases, declarations reference standard numbers without specifying the version number or date. This is a match at the standard level, defined as the group of all standard documents sharing a common version history (in most cases, these are different versions of the same standard). All declarations that can be matched on the standard version level can also be matched on the standard level. Many declarations, especially at ETSI, don't reference specific standards, but broader standardization projects e.g. GSM, CDMA, UMTS or LTE. IPlytics establishes a match on the project level when a declaration explicitly references a standardization project, or when a declaration references a standard or standard version which can be assigned to one or multiple standardization projects. We use ETSI data to assign ETSI and 3GPP standards to projects. Cleaning standard designations is only a first step to match standard documents to declared SEPs.

About IPlytics

IPlytics is a Berlin based company that maintains a data platform (IPlytics Platform) providing access to over 80 million worldwide patent documents, 2 million worldwide standard documents and over 200,000 declared standard essential patents. IPlytics connects information on patents and standards taking into account public SEP declarations, prior art references as well as semantic similarities of patent claims and standards documents. Users subscribes to IPlytics Platform on a monthly basis, log-in to the tool with any browser and receive a 24/7 access to worldwide up-to-date data on patents and standards documents. The visual tool allows to easily navigate, analyze, and drill down into information enabling research and monitoring without necessarily being a patent or standards expert. Email alerts allow users to track new SEP declarations, the transfer of patent rights or changes of the legal status changes.

In case you would like to test IPlytics Platform do not hesitate to contact us directly.

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