Integrating Open Source Into *De Jure* Standardization: Beyond A Call For The Appropriate License

By Carlos Muñoz Ferrandis, LL.M and Dr. Claudia Tapia, LL.M

Abstract

For many years the unprecedented innovation in the telecommunications technology has been possible thanks to the work done in standard development organizations (SDOs). Such success is mainly owed to the fact that SDOs have managed to attract many participants from different business models and to offer open access to interoperable high-performance technology in exchange for a fair return on investment. Looking forward, to achieve a well-functioning Internet of Things, where billions of devices from diverse industry sectors will be connected, some have advocated incorporating the perceived cheap, quick and efficient Open Source Software development into de jure standardization. This paper will analyze the potential synergies between Open Source and traditional open standards developed in SDOs and propose solutions to harmonize the different IPR Policies to attract as many stakeholders as possible.

Introduction

Through the Internet of Things (IoT) computing devices will be interconnected via the internet, enabling them to collect and exchange data. Cars will be connected to cars, fridges will order food directly from the supermarket, and smart meters will deliver measurements of gas and electricity to smartphones and tablets so that consumers can wirelessly switch on/off the heating at home, even when they are 2,000 miles away. To achieve the IoT, where billions of devices (forecast is 28 billion by 2021)[1] will be connected, interoperability[2] and high performance will be required.[3] Both are possible thanks to standardization efforts.[4] However, adopting standardized cellular technology incorporating connectivity in so many sectors has raised concerns regarding the costs and duration required for such an exercise. Aiming for a quick, efficient and cheap/er standardization process, some have advocated incorporating Open Source Software development into the formal/*de jure* standardization.[5] These paradigmatic interactions, nevertheless, face the challenge to integrate two technical areas which in the past have applied the term "openness" in a different manner and often followed different Intellectual Property Right (IPR) policy models.[6] Furthermore, *de jure* standardization has historically focused on interoperability, thus allowing users of the *de jure* standards to compete on the implementation of said standards, while in Open Source Software (OSS) development the participants collaborate on the implementation itself. Competing against implementation integrated into a Standard Development Organization (SDO) would be extremely difficult, in particular because it could be perceived by the market as the officially endorsed implementation.

The structure of the paper is as follows. It will start

■ Carlos Muñoz Ferrandis,
E-mail: carlosmunozferrandis@gmail.com

■ Dr. Claudia Tapia, LL.M.1,
Ericsson GmbH,
Director IPR Policy and Legal Academic Research,
Herzogenrath, Germany
E-mail: claudia.tapia@ericsson.com

1. Ericsson Mobility Report 2016, available at *https://www.ericsson.com/res/docs/2016/ericsson-mobility-report-2016.pdf.*

2. Kerber, Wolfgang, and Schweitzer, Heike, Interoperability in the digital economy, 2017, Joint Discussion Paper Series in Economics, No. 12-2017. p. 5, available at *https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2922515.*

3. On the Digital Single Market see European Commission Communication, ICT Standardisation Priorities for the Digital Single Market. 2016, p.5.

4. On the relevance of standardization in the future of Europe, see Tapia, Claudia, Securing a competitive future in Europe, The Patent Lawyer, Jan/Febr. 2016.

5. According to the European Commission "[i]ntegration between open source projects and standards development processes is a win-win situation: on one side the alignment of open source and standardisation can speed-up the standards development process and the take-up of ICT standards (especially for SMEs), and on the other side standards can provide for interoperability of open source software implementations." See European Commission's Communication, Setting out the EU approach to Standard Essential Patents, 29th November 2017, p.12, Open source and Standards.

6. Simcoe, Tim, "Open Standards and Intellectual Property Rights," 2005, "Open Innovation: Researching a New Paradigm," (*Oxford University Press*). p.7: "While these groups approach the problem of standardization in very different ways, their common goal is to create new technologies that will be widely implemented and adopted."

with the analysis of the IPR Policies of *de jure* standardization (Section 1) and the Open Source Software (Section 2) respectively, and the definition of Open Standard (Section 3). It will continue with the background, efforts and benefits from Open Source Software development and *de jure* standardization (Section 4) and explain several initiatives from industry and decision makers regarding open source integration (Section 5). Right after, the Open Source MANO project (OSM) in the European SDO ETSI, relating to the Network Function Virtualization (NFV) technology, would be introduced as case study to analyze the integration of Open Source Software development into *de jure* standardization (Section 6). Subsequently, concerns on lack of transparency on how Standard Essential Patents linked with the OSM project will be affected will be presented (Section 7). Finally, this paper will explore viable solutions for a joint IPR Policy that could attract all business models to this new *de jure* standardization (with integrated Open Source Software) (Section 8).

1. Standard Development Organizations and FRAND

The European Commission (EC) defines a standard as a *"technical specification, adopted by a recognised standardisation body, for repeated or continuous application (...)."*[7] The technical specification must be understood as *"a document that prescribes technical requirements to be fulfilled by a product, process, service or system (...)."*[8] In simple words, standards are a set of rules or guidelines that a company follows in order to make its products or services compatible with other companies' products and services. *De jure* standards are created by SDOs in an open, transparent, impartial and consensus-based process, where the best among the contributed technologies (purely based on its technical merits) is selected to be part of the standard.[9] Sometimes, these technical contributions incorporated in the standard are covered by patents. Such patents are called Standard Essential Patents (SEPs), because they are necessarily infringed when implementing the standard in a product or service.

To facilitate the success of a standard, SDOs usually encourage their members to make their patents essential to the standard available on 'Fair, Reasonable and Non-Discriminatory' (FRAND)[10] terms and conditions. As a result, everybody can access the standard under terms that allow users to compete in the market successfully (thus the standard is not blocked), while, at the same time, the SEP holder obtains a "fair return on investment."[11] FRAND terms include both: with and without monetary compensation.

2. Open Source Software and the Variety of Licensing Terms

To date there is no universally accepted definition of 'Open Source Software' (OSS).[12] To the extent of this paper, OSS means software publicly accessible to anyone, available for anyone to inspect, modify and enhance, and which distribution terms must comply with the criteria established by the Open Source Initiative.[13]

7. Article 1 of Regulation (EU) No 1025/2012 of the European Parliament and of the Council of 25 October 2012 on European Standardisation, amending Council Directives 89/686/EEC and 93/15/EEC and Directives 94/9/EC, 94/25/EC, 95/16/EC, 97/23/EC, 98/34/EC, 2004/22/EC, 2007/23/EC, 2009/23/EC and 2009/105/EC of the European Parliament and of the Council and repealing Council Decision 87/95/EEC and Decision No 1673/2006/EC of the European Parliament and of the Council.

8. Article 1 of Regulation (EU) No 1025/2012.

9. See more at Nilsson, Fredrik, Appropriate base to determine a fair return on investment: A legal and economic perspective on FRAND, GRUR Int. 2017, 1017.

10. European Commission, Communication on IPRs and Standardization, COM(1992) 445, available at *http://aei.pitt.edu/1222/1/1222.pdf.* In the U.S. the term often used is RAND (Reasonable And Non-Discriminatory) terms. In practice, both RAND and FRAND are understood as synonyms.

11. As the European Commission acknowledges "[a] balanced policy should take into account a variety of needs: fair return on investment to incentivise R&D and innovation, a sustainable standardisation process, wide availability of technologies in an open and competitive market, and the difficulty for SMEs to participate." See European Commission Communication, ICT Standardisation Priorities for the Digital Single Market, 26 May 2016. Also, the European Telecommunications Standards Institute (ETSI) recognizes "ETSI IPR Policy seeks to reduce the risk that our standards-making efforts might be wasted if essential IPRs are unavailable under Fair, Reasonable and Non-Discriminatory (FRAND) terms and conditions. At the same time, we recognize that IPR holders should be fairly and adequately rewarded for the use of their IPRs in the implementation of our standards." See Essential IPRs in ETSI, available at *http://www.etsi.org/about/how-we-work/intellectual-property-rights-iprs.*

12. Discussions have been raised for many years when it comes to define 'free software' and 'Open Source software'. Stallman, Richard, "Why Open Source misses the point of Free Software," available at *http://www.gnu.org/philosophy/open-source-misses-the-point.html*; Rosen, Lawrence, Open Source Licensing, 2004, Chapter 1, p. 3: "Software Freedom Is The Goal; Open Source Is The Means To That Goal"; Katz, Andrew, Book review: "Open Source Technology and Policy" (Deek & McHugh), *IFOSS* L. Rev., 1(1), pp 45-48, 2009.

13. The Open Source Initiative established the main features that an OSS license must comply with based on the 'Debian Free Software Guidelines': (1) Royalty-Free and without restrictions from selling or giving away the software as a component of an aggregate software distribution containing programs from several different sources, (2) the program must include source code, and must allow distribution in source code as well as compiled form Source code, (3) the license must allow modifications and derived works, permitting them to be distributed under the same terms as the license of the original software, (4) the license must also allow for integrity of the author's source code, and neither discriminate against any person or group of persons nor restrict anyone from making use of the program in a specific field of endeavor, (5) the rights attached to the program must apply to all to whom the program is redistributed without the need for execution of an additional license by those parties, (6) the license must neither be specific to a product nor restrict other software, and (7) the license must be technology neutral. See more at *https://opensource.org/history.*

In simple terms, OSS is software publicly accessible to anyone committing to certain terms and conditions and available to inspect, modify and enhance,[14] aiming for an open process of software development.[15]

The Open Source model is "a way for companies and individuals to collaborate around shared needs on a product that none alone could achieve or, in and of itself, does not constitute a key business differentiator."[16]

In contrast to FRAND terms from *de jure* standardization, the terms and conditions of OSS can vary widely between different projects, as each project is free to choose its own set of licensing terms among the many 'accepted' Open Source licenses available.

3. Definitions of Open (Standard)

Both *de jure* standardization bodies and Open Source (OS) projects claim to set and develop open standards.[17] However, in practice, they often have a different understanding of 'openness.'[18] Lundell, for instance, mentions different uses of the term 'open standard' depending on whether it is defined under the perspective of providers, developers, users or legislators.[19] Open Source communities, on the other hand, tend to link open standards with royalty-free (RF) access.[20]

The UK government defines open standards for software interoperability, data and document formats as those fulfilling certain principles, such as collaboration, transparency, due process, fair access, market support and rights. Regarding the rights, however, the UK government clarifies that those essential to the implementation of the standard are "open" only if they are licensed on a royalty-free basis that is compatible with both Open Source and proprietary licensed solutions.[21]

The EC, on the other hand, understands the characteristic of 'openness' in standards in the sense of access to everyone: "Using ICT systems based on standards instead of proprietary technology will help to open up restrictive public procurement practices, because standards make essential knowledge about a system available to anyone, implying that other potential suppliers could maintain or evolve the system under more competitive terms and conditions."[22] This definition seems to be aligned with most SDOs' understanding of open standards, although SDOs additionally consider other principles established in the WTO Agreement on Technical Barriers to Trade. For example, according to the International Telecommunication Union (ITU), open standards are standards made available to the general public and developed (or approved) and maintained via a collaborative, transparent, impartial and consensus-driven process.[23] Hereinafter, this paper will use the term 'open standards' according to the ITU definition.

4. Open Source and *De Jure* Standardization: Background, Efforts and Benefits

a. Open Source

The Open Source community had its origin in the '60s when software was shared as public domain software.[24] However, it was not until the '90s that it took off. The telecommunications industry started to get involved in Open Source projects mainly at the beginning of 2000 and it is in the last five years that OSS has been attracting more attention from the industry with projects such as Open Daylight,[25] ONAP,[26] Open Stack,[27] OVS,[28] IoTivity[29] and others.[30]

14. What is Open Source?, available at *https://opensource.com/resources/what-open-source.*

15. Krechmer, Kenneth, Advanced Topics in Information Technology Standards and Standardization Research, 2006, Chapter 2, p.28.

16. Open Source Initiative, Ensuring Openness Through and In Open Source Licensing, available at *https://opensource.org/node/906.*

17. De Vries, Henk J., Advanced Topics in Information Technology Standards and Standardization Research, 2006, Chap.ter 1, p.1. Study on the Interplay between Standards and Intellectual Property Rights (IPRs), 2011, Tender No ENTR/09/015, p. 101.

18. Simcoe, Tim, Open "Standards and Intellectual Property Rights," 2005, pp. 8-9, "Open Innovation: Researching a New Paradigm," (*Oxford University Press*); Krechmer, Kenneth, "Advanced Topics in Information Technology Standards and Standardization Research," 2006, Chapter 2, p.33, Table 1.

19. Lundell, Björn, "Why do we need Open Standards?," 2012, The EURAS Board series p.227-240.

20. Open Source Initiative, Open Standards Requirements for Software, available at *https://opensource.org/osr.*

21. Open Source according to a list of Open Source licenses approved by the Open Source Initiative via their License Review Process. See UK Open Standards Principles at *https://www.gov.uk/government/publications/open-standards-principles/open-standards-principles*.

22. EC Communication, ICT Standardisation Priorities for the Digital Single Market, 2016.

23. See different definitions of Open Standard at *http://www.etsi.org/website/document/workshop/sosinterop/sosinteropiiibackground01.pdf.*

24. Cf. Stallman, Richard, "Open Sources: Voices from the Open Source Revolution," O'Reilly 1999; Weber, Steve, "The Success of Open Source," 2004, *Harvard University Press*.

25. Open Daylight is a Linux Foundation project, see more at *https://www.opendaylight.org/.*

26. Open Network Automation Platform is a Linux Foundation project. See more at *https://www.onap.org/*.

27. Open Stack is an open source project seeking to create public and private clouds, see more at *https://www.openstack.org/.*

28. Open vSwitch is a Linux Foundation Collaborative project, see more at *http://www.openvswitch.org/.*

29. IoTivity is a Linux Foundation Collaborative project. See more at *https://www.iotivity.org/.*

30. See more at the Linux Foundation site, *https://www.linuxfoundation.org/projects/.*

The OSS development model has become a core instrument in the 'collaborative innovation era' for the software industry, building communities hosting thousands of developers whose main purpose is software implementation entailing functional innovation.

It is difficult to quantify the R&D efforts needed for Open Source projects since it is not by necessity a homogenous type of project. Building OSS from scratch can be very R&D intensive just like any software development. However, when it is about the implementation of an existing standard, the R&D investment is often far lower.

Traditionally, a part of the software sector has been more skeptical towards patents (in particular software patents), perceiving them as an impediment for the industry to innovate.[31] As a consequence, when patented technology has been, nevertheless, contributed to an OSS project, the Open Source community has often requested its members to license it Royalty-Free (RF).

However, as any sustainable investment requires a return on investment, new alternative revenue models have arisen in the software sector.

For instance, a company, realizing that its component may not be as good as its competitor's, may choose to offer its technology free of charge. As a result, the customer may decide to use the 'free' technology, even acknowledging that the competing technology is superior, due to the economic benefits of obtaining the lower quality technology for free. This, in turn, could allow the company that licensed RF to grow its customer base and perhaps sell its other products while shrinking its competitor's market share.

Also, a company may commit to an RF license for its software if it capitalizes on other assets than the software as such. For example, Red Hat gives the software for free to generate a market presence, which it uses to sell warranties and services.[32] Thanks to the free-of-charge model for the software, the customer enjoys a low initial investment. Another common model is to add additional proprietary offerings on top of the open source software, such as technical assistance and updates, leveraging the existing Open Source Software.

b. *De Jure* Standardization

The need for a collaborative and *de jure* standardization in the telecommunication field was originally discussed in the '70s, when governments recognized the lack of interoperability when developing the radio and the linked network in different national SDOs. In 1982, the Groupe Spécial Mobile (GSM) was created and, six years later, transferred to an ETSI technical committee, which defined the GSM standard as the internationally accepted digital cellular telephony standard.[33] From there on, a joint project of seven SDOs (including ETSI) called 3GPP[34] has continued developing GSM leading to 2G, 3G and 4G standards.

In terms of investment, setting and developing a standard implies massive R&D commitment from the telecommunications industry. Boston Consulting Group has estimated that to develop 4G, 320 companies needed nine years and over one million man-hours[35] and that for the next standard (5G), mobile players will need to invest around $4 trillion in R&D and capital expenditures by 2020.[36]

The benefits that *de jure* standardization has brought to consumers are astonishing. From a 2G to a 4G phone the data-transmission speed is 12,000 times faster. Between 2005 and 2013, the average mobile subscriber cost per megabyte decreased by 99 percent, while the mobile network infrastructure costs fell by 95 percent.[37] Nowadays, a smartphone (4G without a contract) can be bought for less than €40, while the functionalities continuously increase. The economy is also benefiting from this evolution: 3G and 4G wireless cellular standards have generated almost $3.3 trillion in revenue globally and 11 million jobs in 2014.[38]

5. Decision Makers and the Industry's Initiatives

Several initiatives have been taken so far to discuss OSS integration in *de jure* standardization. The EC, for example, organized a workshop on the topic already in 2012.[39] In 2016 the EC issued a communication and commissioned several reports[40, 41] leading to a 'roadmap'[42] and a new communication[43] in 2017. The aim of

31. David S. Evans, Anne Layne-Farrar, "Software Patents and Open Source: The Battle Over Intellectual Property Rights," 2004, *Virginia Journal of Law and Technology*, p.43.

32. See more at *https://www.redhat.com/en.*

33. See more on GSM history at the GSMA website at *https://www.gsma.com/aboutus/history.*

34. See more on 3GPP at *http://www.3gpp.org/.*

35. Boston Consulting Group (2015)

36. Boston Consulting Group (2015)

37. Boston Consulting Group (2015)

38. Boston Consulting Group (2015)

39. "Implementing Frand Standards In Open Source: Business As Usual Or Mission Impossible?," 22. Nov. 2012., *EC Workshop*.

40. Tim Pohlmann; Blind, Knut, "Landscaping study on Standard Essential Patents,' 2016, European Commission; Régibeau, Pierre; De Coninck, Raphael; Zenger, Hans, "Study on Transparency, Predictability and Efficiency of SSO-based Standardization and SEP Licensing," 2016, *European Commission*.

41. "ICT Standardisation Priorities for the Digital Single Market," 2016. The Communication defines Cloud Computing in p.6, Internet of Things in p.7 and 5G in pp.7-8, *European Commission*.

42. "Standard Essential Patents for a European digitalised Economy," *EC Roadmap*. 10 April 2017.

43. "Setting out the EU approach to Standard Essential Patents," 2017, p.12, Open Source And Standards, *EC Communication*.

the latest communication is to increase standardization efforts and furthermore merge *de jure* standards and OSS to speed up the development of the technical pillars of the Digital Single Market,[44] attracting a larger number of stakeholders and building new and solid standardization platforms.

Similarly, countries such as the UK,[45] Sweden[46] and the Netherlands[47]have issued guidelines and action plans promoting open standards, analyzing their principles and working the relation between Open Source and proprietary software.

In general, governments around the world have called for SDOs to adapt their traditional standardization processes and render them more dynamic by introducing Open Source projects.[48] By guiding the continuous software development, which characterizes OSS, into a more rigorous implementation of the standard, proponents of integration seek to avoid constant non-consensual evolution which is one of the risks of OSS projects.

From the software industry side, there have been some initiatives regarding OSS implementation. The Linux Foundation, for instance, has since 2000 provided "unparalleled support for Open Source communities through financial and intellectual resources, infrastructure, services, events, and training."[49] With the publication of 'the Linux Foundation Networking and Orchestrating White Paper'[50] the foundation argued that pure collaborative innovation would only result from a diverse community, meaning if Open Source and *de jure* standards were fully harmonized.

The benefits of future collaboration between OSS development and *de jure* standardization seem to be acknowledged also by the industry members involved in SDOs. For instance, SDOs like ETSI in Europe are intensively discussing towards an IPR Policy for the OSS work which would align with the ETSI IPR Policy. Indeed, industry understands that a balance must be struck to attract (1) the ETSI members who are engaging in drafting the technical specifications (through a *de jure* standardization process) which are often the result of massive R&D investment, and (2) those engaging in the implementation and testing (through the OSS project), running in parallel with the draft specification.

6. First Attempt: Network Functions Virtualization and the ETSI OSM Project

The need for a well-defined integration of OSS development in *de jure* standardization is well reflected in the case of Network Function Virtualization (NFV) within the OSM project. NFV is an initiative to virtualize the network services that are now being carried out by proprietary, dedicated hardware.[51] NFV has been targeted by both OSS and *de jure* standardization, due to its key role in developing 5G and the Internet of Things (*e.g.* in airplanes and autonomous vehicles).[52] NFV is meant to allow the choice between several digital applications and services, creating an "app store for telecom services"[53] and thus fulfilling the service providers' demand for less expensive networks. For all these reasons, NFV is considered to be a technological driver for the digital economy.

The main challenge for NFV is, however, the lack of adopted standards for NFV providers to create solutions that are interoperable with different virtualization environments, which are also interoperable with each other. Rather than following the classical (and successful) telecom standardization path, certain firms have tried to work on Open Source models. Consequently, NFV is suffering from vendor lock-in and a bundle of firms waiting for the creation of NFV standards to feed their business needs.[54]

44. See more information on the Digital Single Market at *https://ec.europa.eu/commission/priorities/digital-single-market_en*.

45. UK Government, Open Standards Principles: For software interoperability, data and document formats in government IT specifications, 2012.

46. Lundell, Björn; Gamalielsson, Jonas, Open-IT Standards, Guideline for the Swedish public sector concerning open standards, 2016.

47. Paapst, Mathieu, Affirmative action in procurement for open standards and FLOSS, 2010, IFOSS L. Rev., 2(2), pp 181—190. Available at *http://www.ifosslr.org/ifosslr/article/view/41.*

48. Lewis James A., Government Open Source Policies, 2010, Center for Strategic and International Studies, *https://www.csis.org/analysis/government-open-source-policies-0*; Wikibooks, FOSS Open Standards/Government National Open Standards Policies and Initiatives, last edited on the 25th August 2017, *https://en.wikibooks.org/wiki/FOSS_Open_Standards/Government_National_Open_Standards_Policies_and_Initiatives#The_European_Union*.

49. See more at *https://www.linuxfoundation.org.*

50. The Linux Foundation, Linux Foundation Networking and Orchestration White Paper: Harmonizing Open Source and Standards in the Telecom World, May 2017.

51. Networks Functions Virtualization definition, available at *http://searchsdn.techtarget.com/definition/network-functions-virtualization-NFV.* Ericsson provides interesting insights about the NFV definition. See *https://www.ericsson.com/en/networks/topics/nfv.*

52. Peterson, Derek, The Building Blocks for NFV's Ramp-Up, LightReading, June 2017, available at *http://www.lightreading.com/new-ip-agency/the-building-blocks-for-nfvs-ramp-up/a/d-id/733969*.

53. Saunders, Steve, Together, We Can Build the Telecom 'App Store', LightReading, May 2017, available at *http://www.lightreading.com/nfv/together-we-can-build-the-telecom-app-store/a/d-id/732416.*

54. Saunders, Steve (2017).

To address this situation, ETSI started the pilot OSM project in 2016. The goal of OSM is to deliver an 'Open Source Management and Orchestration' stack aligned with ETSI NFV. In practice, the NFV technical specification will be, as traditionally has been the case, developed in ETSI whereas the software development (reference implementation) will take place through the OSM.[55] The OSM will, in turn, generate feedback into the next version of the draft specification.[56] The goal is to make the final implementation of the technical specification more efficient by testing parts of the NFV technical specification and providing a reference implementation to the same.

Provided the OSM project is driven in an efficient way, and that the chosen IPR Policy for the integration is a business-neutral IPR Policy, consumers will benefit from standardized products and services which are more reliable products and/or more quickly adopted in the market.

7. Concerns Raised Due to Lack of Clarity on Compatibility Between IPR Policies

a. OSM Project: Differences Amongst Apache 2.0 and ETSI IPR Policy

The OSS license chosen for the NFV ETSI OSM implementation has been the Apache 2.0,[57] a permissive license integrating copyright and patent licenses from contributors[58] of the code.[59] Thus, the source code and the object code may be used with barely no restrictions, allowing the recipient to modify and redistribute the code under any license, whether Open Source or not. Moreover, when the contributor includes code that necessarily infringes its own patent in his work, he agrees to automatically grant a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable license for such patent, to any downstream recipients of the copyrighted material (the code/software).

On the other hand, ETSI, an SDO developing *de jure* standard, establishes that the software essential to the standard for any compliant implementation of the standard will be licensed under RF terms (according to Clause 9.2.1)[60] unless the owner of the copyrighted software expressly declares its wish to enter on a FRAND undertaking relating to his essential IPR.[61] Moreover, the basic principle of the ETSI IPR regime remains FRAND "with no specific preference for any licensing model."[62]

Since the beginning of the OSM project, several ETSI members have raised concerns about adopting Apache 2.0 without a clear indication of how this license will impact SEPs resulting from the NFV specifications. Indeed, following the Apache 2.0, contributors of technical specifications that have also contributed code to the OSM may be forced to license their SEPs related to its contributed code on RF terms. Such scenario would deprive innovators of the chance to obtain a return on investment as they currently do thanks to the well-established FRAND terms.

To avoid legal disputes and costly litigation amongst members, it is indispensable to determine how both IPR Policies, Apache 2.0 for the Open Source project (developing the software implementation of the standard) and ETSI IPR Policy for the *de jure* standardization process (developing the NFV standard) should be integrated. The immediate consequence of not doing so would be the lack of participation of key players in the Open Source project. In fact, this is not a theoretical concern. Until today, key contributors in the development of NFV specifications, such as Nokia, Huawei and Ericsson have decided not to join the ETSI OSM project.

55. ETSI Open Source Management and Orchestration Software, available at *https://osm.etsi.org/.*

56. This is not meant to be the "version" as defined by any SDO but rather an "iteration."

57. Apache license, Version 2.0, available at *https://opensource.org/licenses/Apache-2.0*; Apache 2.0 license for the ETSI OSM, available at *https://osm.etsi.org/about/osm-license.*

58. The contributor can be defined as an individual contributing to an Open Source project. By contributing it can be understood that the contributor works in the project by introducing code, developing code, and implementing it. Furthermore, for the sake of clarity, an implementer in this paper would refer to the firm implementing a standard (in a product).

59. See Mitchell QC, Iain and Mason Stephen, "Compatibility Of The Licensing Of Embedded Patents With Open Source Licensing Terms," 2010, *International Free and Open Source Software Law Review*, 3(1), pp. 6 and 29; Mann, Ronald J., "Commercializing Open Source Software: Do Property Rights still matter?," 2006, *Harvard Journal of Law & Technology* Volume 20, Number 1.

60. "Any member contributing software for inclusion in a standard or technical specification hereby grants, without monetary compensation or any restriction other than as set out in this Clause 9.2.1, an irrevocable, non-exclusive, worldwide, royalty-free, sub-licensable copyright license to prepare derivative works of (including translations, adaptations, alterations) the contributed SOFTWARE and reproduce, display, distribute and execute the contributed SOFTWARE and derivative works for the following limited purposes (...)."

61. Clause 9.2.2: "The copyright license granted in Clause 9.2.1 shall also extend to any implementer of that STANDARD or TECHNICAL SPECIFICATION for the purpose of using the SOFTWARE in any compliant implementation unless the (ii) the contributing MEMBER gives an irrevocable undertaking in writing at the time of contribution that it is prepared to grant an irrevocable copyright license on fair, reasonable and non-discriminatory terms and conditions for the purpose of using the SOFTWARE in any compliant implementation."

62. See more at ETSI Guide on Intellectual Property Rights, available at *http://www.etsi.org/images/files/IPR/etsi-guide-on-ipr.pdf.*

b. Risks if No Clear Indication of How RF and FRAND IPR Policies Will Co-Exist

The following practical and legal concerns have been raised in ETSI when discussing the application of Apache 2.0 within the OSM project:

1. High risk of not obtaining a license.

ETSI follows a clear mechanism to guarantee that IPRs (also unexpected IPRs) covered by an ETSI standard (or technical specification) are licensed under FRAND terms.[63] Introducing RF through Apache 2.0 to ETSI formal standardization would lead to two situations. Firstly, without further clarification from ETSI's side, it would be uncertain what IPR regime applies to ETSI deliverables. Secondly, applying Apache 2.0, there is no guarantee that implementers of the reference implementation (RI) would obtain a license for non-SEPs which are, nevertheless, infringed by the reference implementation. There are three scenarios where there is no license guaranteed for a patent which is not technically essential but may be infringed when implementing the reference implementation:

a. The patent owner contributes software to the RI, but the patent is infringed by another contributor's code.

b. The patent owner does not contribute software to the RI and the patent is infringed by another contributor's code.

c. The patent owner does not contribute software to the RI, but the patent is necessarily infringed by the software contribution.

Lacking a similar process to the one established in ETSI, the owner of a non-SEP that is infringed by the OSM project and not owned by the contributor could (1) refuse to license, (2) discriminate between licensees (in particular SMEs)[64] or, (3) once the RI is widespread and adopted in a commercial product (de facto standard), engage in litigation to obtain excessive royalty rates.

2. Mandatory RF even for non-SEPs.

Currently there is no mechanism, as there is in ETSI, enabling an OSM member or anyone else to object that its non-SEP is included in the RI. Even if it declares that it will not license such patents, the patent holder cannot stop the project maintainers (maybe competitors of the patent holder or pro-RF at any cost) from including or removing the code incorporating such patents. Under such a scenario, the member may be forced to litigate to enforce its rights. However, this could lead in practice, thanks to the Apache 2.0 patent retaliation clause,[65] to a suspension of its existing OSM license.

3. Business neutrality lost.

ETSI attracts all business models through FRAND (which can be with or without monetary compensation). If the OSM project also led to RF for technical specifications, it would only benefit those who can afford to license RF. The SDO would lose its business neutrality by favoring the interests of those who monetize their IPR through product or service sales, as they would not mind losing their IPR through RF licensing. Those companies having a business model where it is necessary to obtain a return on investment would probably not join the ETSI OSM project, without further clarification from ETSI's side that their SEPs will not be licensed under RF.

Until it is clarified that the OSM project would not lead to RF for technical specifications a new problem arises. OSM introduces a continuous testing and verification of the draft specification. This means that the OSS tests and verifies the implementation of the draft specification and, if some implementation does not work (properly), the OSM project sends back the information to the draft specification Working Groups (WGs), so that they amend the draft specification (and, in consequence, the standard) accordingly. The situation gets complicated when representatives of company X and company Y (both members of ETSI OSM) receive a draft specification, including the contribution of a competitor (company Z), not a member of the WG, or simply an external contribution not including the IPR of companies X and Y. In such scenario, these representatives may influence the WG concluding that there is a better way to implement the draft specification and come out with a new version of a draft specification. Why should companies X and Y use their own resources to test company Z's draft specification? Even if the SDO mandated, which it currently does not, pro-

63. Prior to the adoption of a standard, if there is no FRAND understanding for a selected technology covered by an IPR, ETSI General Assembly seeks an alternative technology available for the standard which is not blocked by that IPR and satisfies ETSI's requirements. Lacking a viable alternative technology following attempts to solve the situation, the ETSI Committee should look for alternative solutions. The Director-General of ETSI shall request the member to reconsider its position. Post adoption of the standard and after failed attempts to obtain a FRAND undertaking the ETSI Committee will vote on whether or not to modify the standard or technical specification so that the IPR is no longer essential. The ETSI IPR Policy also foresees the possibility to ask the European Commission what further action may be appropriate. See Section 8 ETSI Rules of Procedure, 5 April 2017, available at *http://www.etsi.org/images/files/IPR/etsi-ipr-policy.pdf.*

64. In the worst-case scenario, the company, *e.g.* an SME, might not even be able to negotiate a license for these patents. This would, in turn, put the company in a weaker position than a competitor (a large company) who may be able to negotiate a license due to a stronger patent position relative to the patent owner, or perhaps because it has already signed a cross-license.

65. According to Apache 2.0, if a licensee files a lawsuit against the licensor for patent infringement, the licensor may suspend the grant of license.

ject maintainers to implement whatever there is in the draft specification, who could guarantee the quality of that job? They may still argue that the exercise (implementation testing) was useless and propose a different way to implement the draft specification to avoid their competitors' contributions (potentially covered by patents) in the standard.

4. Lack of field of use restrictions.

An ETSI member may agree to contribute and license RF a code for a particular implementation and/or for study and research purposes, as long as it is not used in commercial products. However, since there is no field of use restrictions in Open Source, whoever contributes code to the RI may face the situation that such RI is being used in commercial products. ETSI OSM states that "[a]s an operator-led community, OSM is offering a production-quality Open Source MANO stack that meets the requirements of commercial NFV networks."[66] In consequence, if an implementer modifies the reference implementation for use in a commercial product, those patents would be licensed RF, as long as the functionality is still present in the original RI.

5. Possible SME exclusion.

A model in which a participant may contribute software to a testing and verification process to generate feedback into the *de jure* standardization may, as time goes on, develop into an informal requirement to also provide the corresponding code alongside the participant's standard contribution, and failure to provide such code may negatively impact a participant's ability to get standard contributions accepted.

Even if it were not to be held against the participants directly that they themselves could not contribute the necessary code, there are no guarantees that their contributions would be accurately implemented in the testing and verification process, since it would be up to other participants to try to implement said contributions. It is, thus, very possible that a participant who could not provide the necessary code for the implementation for testing purposes could see their share of accepted contributions going down compared to a standardization process where the Open Source Software implementation did not exist. This is simply based on a participating organization's ability to provide corresponding software to their contribution, not the technical merits of the contribution itself.

Undoubtedly some contributions would be modified or rejected based on feedback from this process that causes a re-evaluation of their technical merits, but this is not the scenario described here. A decision not to participate in the OSS work may be based on disagreements over the IPR regime applied (as described above in point 7, a). It may also be a simple question of resources where not all SMEs can shoulder the additional cost associated with software development to go alongside the cost already spent on R&D necessary to make the standards contribution in the first place.

There are many valid business reasons for not disclosing said source code even in the cases where software is already developed internally. For example, when the developing company believes that their implementation (in software) of their contribution will give it an advantage when competing with other standardization participants and users of the *de jure* standard on the implementation of the standard. This would again necessitate creating a sub-optimal implementation of its contribution as proof of concept. The proof of concept (that implies extra cost for the contributor) would be at risk if the contribution is adopted.

The stakes are further raised if one considers that in the worst-case scenario an SME with very limited funds may have spent precious resources, not only on their technical contribution but on two separate software implementations thereof, and may in the end not get their contribution approved, thus rendering both software implementations largely without value. Logically, the solution would be for an SME to always contribute its best software implementation of the contribution, but this would, in turn, expose it to the risk of potentially revealing trade secrets and harm its ability to compete on the implementation since any difference it may have been able to offer its customers is now common knowledge free to use for its competitors.

6. RF used in comparable agreements.

Since the reference implementation would implement all the SEPs, some standard users may extract from the fact that there is a RF implementation of the specification an argument to lower FRAND rates to SEPs implemented in the reference implementation, regardless of who contributed the code implementing them.

8. Suggested Way Forward

a. Implementing a (Reciprocal) RF License

Implementing a reciprocal RF license or simply RF conditions in ETSI IPR policy (also affecting technical specifications) would not be advisable, as this would discourage ETSI members' participation. Geradin and Layne-Farrar distinguish between four categories of business models: pure innovators, pure manufacturers, vertically integrated firms, and firms that (do not create technologies or manufacture products, but rather) buy products that are manufactured on the basis of patented technologies.[67] Relating to the telecom sec-

66. *https://osm.etsi.org/.*

67. Damien Geradin, and Anne Layne-Farrar, "The Logic and Limits of Ex Ante Competition in a Standard-Setting Environment," *Competition Policy International* January, Vol.3, January 2007, pp.83-84.

tor, where pure innovators and vertically integrated firms represent an important number, IPR licensing activities are considered crucial incentives to innovate. On the other hand, companies that just buy products with patented technology seek to maximize their short-term profits avoiding IPR royalties. As Geradin and Layne-Farrar conclude, eliminating royalties in the standards field would have a critical impact on pure innovators, discouraging them to participate in the ICT marketplace.[68]

In general, those who have invested a large amount of time and financial resources to participate in the standardization process trust FRAND to obtain a fair compensation and continue their investments in future standardized technologies. Losing its business-neutral role, such integration would lead to increasing proprietary technology solutions (provided by those who nowadays contribute in a collaborative atmosphere). As a result, consumers would benefit in the short term from cheaper standardized technology (provided that standard users do not keep the margin for themselves), but in the mid to long term would suffer either low quality standards or non-interoperable and costly proprietary products/services.[69]

b. Berkeley Software Distribution

One option to integrate both IPR policies would be to choose the Berkeley Software Distribution (BSD) license. The BSD is at the core of the 'academic license', as it was originally created to permit free disposition of certain software systems of the University of California.[70] Nowadays, these permissive licenses are also called 'commercial licenses,' as they can be later combined with proprietary software licenses.

The BSD[71] is simply composed of a copyright license allowing users almost unlimited freedom with the software, as long as the BSD copyright and license notice are included in the software ("Redistribution and use in source and binary forms, with or without modification, are permitted").

The presence of the term 'use' in the BSD license has entailed discussions about the existence of an implied patent license.[72] Hence, to avoid confusion within the project, it would be advisable to attach a notice to the BSD Policy stating that the BSD license is used as a license under copyright only, hence, for further applicable patent licensing terms the licensee would refer to ETSI IPR policy.

c. Linux Foundation

Another, more advisable, approach to attract major SEP holders involved in technical specifications to the development of OSS would be to develop OSS in Linux Foundation. This way OSS development and *de jure* standardization would run in parallel and there would be no uncertainties on how IPR rules for software implementation affect SEPs.

d. Open Air Interface IPR Policy

A good compromise can be found in the Open Air Interface (OAI) IPR Policy.[73] For copyrights the OAI IPR Policy establishes the following: "Subject to the terms and conditions of this License, Licensor and each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable copyright license to reproduce, prepare Derivative Works of, publicly display, publicly perform, and distribute the Work and such Derivative Works in Source or Object form" (par. 2). For patents, however, the OAI IPR Policy distinguishes between patents for (1) 'study, testing and research purposes', and (2) 'purposes other than study and research.'

(1) When patents are incorporated for study, testing and research purposes the patent holder grants according to OAI IPR Policy a "perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable (except as stated in this section) patent license to make, have made, use, and otherwise transfer (excluding selling) the Work." However, such license applies only "to those patent claims licensable by Licensor or such Contributor that are necessarily infringed respectively by the Work and/or the said Contributor Contribution(s) alone or by combination of their Contribution(s) with the Work to which such Contribution(s) was submitted ("Essential Patents"), (par 3.1). Moreover, such license will, according to OAI, terminate, in case of patent litigation against any entity making

68. Jay P. Kesan, "The Fallacy of OSS Discrimination by FRAND Licensing: An Empirical Analysis," 22. Febr. 2011, *Illinois Public Law Research Paper* No. 10-14, p.23. See also Jorge Padilla, John Davies, and Aleksandra Boutin, "Economic Impact of Technology Standards: The Past and the Road Ahead," September 2017, p.58.

69. As the U.S. Department of Justice Assistant Attorney General recently recognized, "enforcers have strayed too far in the direction of accommodating the concerns of technology implementers who participate in standard setting bodies, and perhaps risk undermining incentives for IP creators, who are entitled to an appropriate reward for developing break-through technologies." See Makan Delrahim, Speech at the USC Gould School of Law's Center for Transnational Law and Business Conference, Los Angeles, 10. Nov. 2017, available at *https://www.justice.gov/opa/speech/assistant-attorney-general-makan-delrahim-delivers-remarks-usc-gould-school-laws-center.*

70. Lawrence Rosen, "Open Source Licensing," (2004), *Prentice Hall* edit, p.73.

71. We refer to BSD as the 3-clause BSD license. See *https://opensource.org/licenses/BSD-3-Clause.*

72. Lawrence Rosen, (2004), p.78.

73. See IPR Policy of Open Air Interface at *http://www.openairinterface.org/?page_id=698.*

use of the Work solely for study, testing and research purposes (par. 3.3).

(2) For 'purposes other than study and research,' which is usually the case of technical contributions in *de jure* standardization, OAI foresees a FRAND license (par. 3.2).

e. RF for Copyrights and FRAND for SEPs

Finally, an easy and advisable way to proceed with the integration could be to amend Apache 2.0 so that RF is requested for copyrights, whereas the FRAND-based license applies to any SEP. This would allow a balance of interests and ensure legal certainty and predictability for contributors, implementers and consumers of standardized technology.

9. Conclusion

IoT represents, according to the EC,, "the next step towards the digitization of our society and economy,"[74] leading to a Digital Single Market with an estimated market value in Europe of over one trillion euros by 2020.[75] For around 30 billion devices to be interconnected, a set of rules will be required. This will be possible thanks to standards. To implement standards in a more efficient way, some have suggested integrating OSS into *de jure* standardization.

De jure standardization has coexisted for many years with informal processes to speed up technology adoption, despite their different treatment with regard to intellectual property. Standard Development Organizations usually offer access to standardized technology on FRAND terms, which can be with or without monetary compensation. In parallel, some informal organizations mainly focused on OSS projects have integrated Royalty-Free (RF) terms in their IPR policies,[76] *i.e.* without monetary compensation for the licensing of patents embedded in their standards.[77]

ETSI has taken an ambitious step forward with the OSM project aiming to merge a *de jure* telecom standard with Open Source, to develop a reference-implementation of the NFV standard. Within the OSM project, stakeholders can contribute to the project via the Apache 2.0 license. However, to date ETSI has not clarified how the 'royalty-free' Apache 2.0 IPR Policy would harmonize with the FRAND-based ETSI IPR policy.

Since the integration is a political and economic issue more than a legal problem, a compatibility between OSS license and ETSI IPR policy can be achieved. The paper presents several options.

For instance, ETSI could adopt the BSD IPR Policy when developing OSS implementation. As an alternative, the Apache 2.0 OSS license for OSM could be amended, so that SEPs are covered under the FRAND-based ETSI IPR Policy.

A third possibility would be to develop OSS in the Linux Foundation, where OSS and *de jure* standardization would run in parallel.

Finally, a compromise-solution could be to adopt the OAI IPR Policy, where the use of patents for purposes other than study, testing and research must be determined in bilateral negations to reach a non-exclusive, non-transferable, non-assignable license of SEPs under FRAND terms and conditions. An RF license, on the other hand, would be granted to copyrights and patents for study, testing and research purposes.

As Mitchell points out,[79] one of the main weaknesses of the majority of OSS licenses is the lack of specific mention of which jurisdiction applies when interpreting the IPR policy. In our case-study, ETSI could introduce in its OSM IPR Policy the interpretation of Open Source licenses under French law, as for every other dispute which could be raised in connection with its IPR Policy.

The proposals raised in the paper are meant to be business-neutral, *i.e.* not favoring any business model over the other. The reason is that consumers benefit, the more participants are willing to share their technology in the standardization process. In some cases, a patent holder may decide to offer its technology free of charge, *e.g.* to achieve compatibility with legacy products or products in development or because it benefits from a rapid expansion of the market covering the services it provides. Equally, some innovative companies may rely on FRAND to obtain a fair return on investment and continue with its innovation activities. This is, in particular, relevant in *de jure* standardization, the complexity of which requires large R&D investments and human resources.[80]

74. See more information about the IoT and the Digital Single Market project of the EC at *https://ec.europa.eu/digital-single-market/en/policies/internet-things.*

75. EC Study available at *https://ec.europa.eu/digital-single-market/en/news/definition-research-and-innovation-policy-leveraging-cloud-computing-and-iot-combination.*

76. World Wide Web Consortium Patent Policy, 5 February 2004, available at *https://www.w3.org/Consortium/Patent-Policy-20040205/#sec-Requirements.*

77. Other informal institutions such OASIS offer three types of licensing for standard essential patents: RAND (synonym of FRAND), RF on RAND Terms, and RF on Limited Terms. See *https://www.oasis-open.org/.*

78. As Mitchell and Mason argue, the OSS and FRAND friction is a political and economic issue more than a legal problem. See QC Mitchell I., S. Mason (2010), p. 55.

79. QC Mitchell I., S. Mason (2010); EC Workshop, Implementing FRAND standards in Open Source: Business as usual or mission impossible?, the 22nd November 2012.

80. As explained above, according to Boston Consulting Group 320 companies needed nine years and over one million man-hours to develop 3G and 4G standards. The Group also estimated that a Digital Single Market will require $4 trillion of investment in R&D and capital expenditure. See Boston Consulting Group (2015).

FRAND regime, being business-neutral, can serve both options. If RF were favored, most key contributors could no longer afford to participate in standard development, and may choose to invest in proprietary solutions instead. This, in turn, could lead to more expensive non-standardized products and services.

The EC's recent directive also recognizes the need for business-neutral solutions, so that "companies working under various business models can compete on an equal footing when providing solutions to public administrations while administrations that implement the standard in their own software (software that they own) can share such software with others under an Open Source license if they so decide."[81] ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=3218558.*

Acronyms

BSD—Berkeley Software Distribution
EC—European Commission
ETSI—European Telecommunications Standards Institute
FRAND—Fair, reasonable and non-discriminatory
GSM—Groupe Spécial Mobile
ICT—Information and Communication Technology
IoT—Internet of Things
IPR—Intellectual Property Rights
ITU—International Telecommunications Union
MANO—Management and orchestration
NFV—Network Function Virtualization
OAI—Open Air Interface
ONAP—Open Network Automation Platform
OS—Open source
OSM—Open source MANO
OSS—Open source software
OVS—Open vSwitch
R&D—Research and development
RF—Royalty-free
RI—Reference implementation
SDO—Standard development organization
SEP—Standard essential patent
SME—Small and medium-sized enterprise
WG—Working group
WTO—World Trade Organization
3GPP—3rd Generation Partnership Project

81. Press Release, European Commission, Commission Adopts Interoperability Strategy and Framework for Public Services—Frequently Asked Questions (Dec. 16, 2010).