

Collaborative Standardization and Disruptive Innovation: The Case of Wireless Telecommunication Standards

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Abstract: Collaborative standardization, an efficient and inclusive form of organised innovation under the auspices of standard setting organisations (SSOs), has demonstrated significant technological achievements in the field of wireless telecommunications. At the core of collaborative standardization is a working balance of interests and incentives of all stakeholders involved, i.e. contributors of technology and users of standards, epitomised by licensing on FRAND terms. Standardization contributes to significant gains in consumer welfare, in the form of lower prices, more innovation and more consumer choice and convenience. At the same time standardization fosters competitive markets, upstream and downstream. However, its character as a process of disruptive innovation is widely disregarded; its contribution to the process of creative destruction and its spill-overs to remote sectors of the economy are ignored. Competition policy and enforcement could play a meaningful and beneficial role only insofar as it is firmly based on a realistic view of standardization, its economic significance and its impact to innovation and growth.

Collaborative Standardization and Disruptive Innovationⁱ

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I. Introduction

In the past few decades mobile telecommunications and mobile Internet have given rise to a sweeping transformation of almost every aspect of human endeavour; mobile technologies, being the most rapidly adopted technologies in human history, have fundamentally changed the way we work, learn, travel, consume and communicate with each other.ⁱⁱ This major transformation is best illustrated by the widespread everyday use of mobile devices such as smartphones, tablets and wearable devices. For such devices to operate and communicate seamlessly with each other, common interfaces and technical specifications are required, known as industry standards.

There are, three paths to standardization: the emergence, through fierce competition ‘for the market’, of a technical solution as dominant in the market, that is as a *de facto* standard;ⁱⁱⁱ standardization by government intervention and the regulation of technical aspects of products, also known as legal standards;^{iv} and standardization through industry collaboration under the aegis of standard setting organizations (SSOs), which is the subject of the present article.^v

II. Standardization in the Mobile Telecommunications sector

Collaborative standardization has a remarkable record of breakthrough technological achievements, high-quality, cutting-edge standards, vibrant follow-on innovation in the implementation of standards and open, competitive upstream and downstream markets. Standardization takes place under the auspices of SSOs, voluntary industry bodies governed by rules and regulations agreed upon by their members, which include technology contributors and implementers of standards.^{vi} SSOs are of varying size, membership and formal recognition. In the ICT sector, around 840 SSOs are estimated to be involved in collaborative standardization.^{vii} However, the most important and

commercially successful standards are developed by three SSOs, namely the International Telecommunications Union (ITU), the European Telecommunications Standards Institute (ETSI) and the Institute of Electrical and Electronics Engineers (IEEE).

Standardization is a long-term, resource-draining and intensive endeavour; even after a standard is formally adopted by an SSO it takes several years before it is finally commercialized in the market.^{viii} The standard setting process normally begins with setting out a clear and bold goal for a future level of desired technological performance.^{ix} Once such a goal is set, working groups of technical experts, representing all interested stakeholders, decide upon submitted proposals and choose, on the basis of consensus, the most meritorious technical solutions to be included in the specifications of the standard.^x

Throughout the historical development of standardization in wireless telecommunications, a common pattern emerges. Once the process of open, collaborative standardization was set in motion in the early 1990s, an irresistible dynamic drives the process forward: investment and innovation in telecommunication standards grow markets and consumer demand, and consumer demand, in turn, increases demand for investment and innovation in standardization. At the end of every major standardization effort, conveniently expressed in the iteration of consecutive generations of standards (2G-3G-4G-5G), better-performing standards also bring about ever-larger markets and consumer demand for more innovative services and better performing standards.

III. The Standard Setting Process and its Impact on Competition and Consumer Welfare

Collaborative standardization in wireless telecommunications has a remarkable record of technological achievement and innovation. Collaborative standardization owes its success to its character as an *efficient, open and inclusive* process of organised innovation. To begin with, standard setting organizations have an active interest, in promoting open and unrestricted membership of all interested parties and with a view to foster consensus-based decision making processes.^{xi} Moreover, SSOs compete with each other in the development of the most innovative and commercially successful standards.^{xii} SSOs have powerful incentives to attract, on the one side contributors of the best, cutting-edge technologies, and on the other side numerous implementers that will successfully commercialize developed standards.

This diverse membership implies that participants have diverging interests and business models.^{xiii} SSOs in their IPR policies must represent a sensible compromise of conflicting interests and promote patent licensing that provides strong incentives to contribute and implement standards; this meeting point of the interests of contributors and users of the standard is known as FRAND licensing, i.e. a commitment to make a standardized technology available on fair, reasonable and non-discriminatory terms.^{xiv} The purpose of the FRAND commitment is to ensure that access to the

standard will remain unrestricted, the precise terms of the license being left to the parties to agree upon, in good faith, and in the context of normal commercial negotiations.^{xv}

This working balance of interests and incentives distinguishes collaborative standardization as a process of superior efficiency, in particular compared to *de facto* standardization. FRAND licensing is vital for maintaining a predictable and rewarding structure of returns that provides powerful incentives for contribution of technologies and implementation of standards. On the one hand, licensing revenue from FRAND royalties (as part of FRAND terms), by ensuring that patent holders reap a fair reward for their contributions, provides strong incentives for leading innovators to contribute the best available technologies to the standard setting process.^{xvi} On the other hand, the FRAND commitment ensures that standards will remain accessible and implementation unrestricted. The FRAND commitment ensures implementers that they will not fall victims of opportunistic conduct on behalf of SEP-holders; that they will have access to cutting-edge technology on reasonable terms that allow profitable implementation of the standard; that they will not be discriminated against vis-à-vis their downstream competitors.

Successful collaborative standardization brings significant and tangible benefits to consumer welfare, in the form of enhanced allocative, productive and dynamic efficiency. Interoperability, for instance, allows companies to benefit from economies of scale, specialization and rapid growth of international markets. Consumers, in turn, reap significant gains in prices, product choice and innovation. Compatibility between individual components within a network allows firms to specialize in what they can produce best.^{xvii} Moreover, interoperability between networks and devices results in significant economies of scale, since manufacturers build equipment and devices that serve a much larger, international – or ideally, global – market.^{xviii} Successful international standards also boost consumer confidence that components will work well together, increasing consumer adoption and allowing benefits from economies of scale to realize faster. Interoperability brings further benefits to allocative efficiency in that it brings down non-tariff barriers to international trade, it integrates international markets and spurs competition between firms worldwide.^{xix}

Although, interoperability is indeed a key driver of collaborative standardization, recent standardization efforts have moved beyond this point. Standardization in wireless telecommunications is performance-driven, aiming not merely to integrate networks and devices, but also to integrate them at the highest possible level of performance and capabilities.^{xx} Indeed, there is evidence that SSOs in wireless telecommunications have performed well. The performance of telecommunications network has increased dramatically in all important respects: in capacity, data rates, reliability, latency and security. Adding to that, empirical evidence suggests that patents declared as standard-essential at SSOs are of higher quality and receive roughly three times more citations than their non-SEP counterparts.^{xxi}

Collaborative standardization is successful not only at handpicking the best technologies, but also at organizing transition from inferior to superior technologies in smooth and rapid manner.

Markets with strong network effects exhibit excess inertia in moving to new technologies, due to imperfect information; without complete and reliable information on the real value of a technology, market actors fail to coordinate their transition to a superior technology.^{xxii} SSOs, by including a technology into a standard, send a strong signal to the market that the particular technology is valuable and that their hefty investments in capital expenditure will not go to waste. Thus, SSOs reduce the technological risks of implementation of standards.

Finally, collaborative standardization spurs competition in all relevant markets, upstream and downstream. In the upstream market for technologies, standardization creates fierce rivalry for inclusion in a standard, pressing firms to invest more, to innovate and become more efficient. In the downstream markets for standard-compliant products, standardization promises ever-larger, open markets and access to cutting-edge technologies on reasonable rates, providing strong incentives for firms to outperform their rivals in prices, follow-on innovation and product differentiation.

IV. The Standard Setting Process and Disruptive Innovation

Although the above mentioned benefits of collaborative standardization are within grasp of policy makers, antitrust agencies and consumers, a particular aspect of standardization is not as widely understood. Standardization is a profoundly disruptive process. It involves radical leaps in technology, in business and in everyday life. It is an important accelerator of the Schumpeterian process of creative destruction that drives the society forward.^{xxiii}

Yet the representation and structure of the process might conceal the magnitude of technological leaps. Standardization efforts in wireless telecommunications are expressed in consecutive generations of standards. However, this form of representation creates a misleading impression of continuity and incrementalism. It greatly understates the drastic technological advances between each consecutive standard. Transition from 1G to 2G, for instance marked the astonishing accomplishment of digitization of human voice; 4G-LTE is a radically new technology, yet is represented as direct descendant of 3G. The structure of the process contributes to this misrepresentation. Standards are developed over many years, in thousands of meetings of technical experts, resulting in several consecutive ‘releases’. This incremental, tedious process and the gradual improvements it brings with it conceal the truly drastic character of the core technologies included in a standard.^{xxiv}

However, collaborative standardization accelerates the process of creative destruction in as remote sectors as – among others - manufacturing, banking and entertainment. In particular, high-speed mobile broadband has been the basis upon which a vibrant software apps ecosystem has emerged;^{xxv} with each step forward in standardization, new digital services become online and

transform fields with massive impact, such as healthcare, finance and education.^{xxvi} High-performance standards have created new capabilities and opportunities, but at the same time they have lowered the cost of follow-on innovation and thus have lowered barriers to entry for disrupting new firms and entrepreneurs that challenge much larger incumbents.^{xxvii} The low cost of access to high-speed broadband, as well as the emergence of global markets of billions, allow upstarts with even a modest initial investment to offer new, groundbreaking services and introduce new and disruptive business models.^{xxviii} This disruptive effect spills over a vast range of markets and sectors.^{xxix}

Evidence of disruptive innovation abound. Online mobile banking, for instance, has effectively challenged the centuries-old basis of banking, the brick-and-mortar retail banking, providing consumers online access to the full range of banking services. Entertainment and content are also under drastic transformation. On demand, HD video streaming capabilities have resulted in an explosion in the amount of online content consumed by users. At the same time, it has a profoundly disrupting effect in the business models in entertainment. Much of the consumed content is generated by users in social media platforms, outside the formal entertainment sector.

The Internet of Things presents a vast transformative potential in almost every field of economic activity; it creates new business opportunities from existing and completely new products and services.^{xxx} The IoT radically transforms the way we interact with our environment.^{xxxi} Sensors allow companies to extract massive flows of information from their physical assets and to improve the design and performance of their products through strong, real-time feedback.^{xxxii}

The new capabilities of the IoT will mark a fundamental shift from selling products to providing services.^{xxxiii} Manufacturing of capital equipment is the most typical example of this shift. Sensors embedded in machines will enable monitoring of use and performance^{xxxiv} Manufacturing will be provided as a service, the customer being charged based on use; machine-to-machine (M2M) communication will enable the efficient monitoring of performance and use of raw material; the service provider would provide maintenance and logistics based on real-time data.^{xxxv}

V. Implications for Competition Policy

The integrity of the process and the efficient performance of SSOs on the basis of transparency and consensus should be a prime concern for all major competition authorities. Competition authorities must monitor the actual workings of SSOs at all stages of standard development and ensure that standard setting remains a strictly meritocratic process, open to all to contribute and consensus based (not only in the development of the technical standards but also in the IPR Policies that govern the association). In particular, competition authorities must closely scrutinize SSOs' regulations and ensure that, on the one hand the decision-making process is transparent and on

the other hand, regulations maintain a fair balance between the interests of all parties involved. At the same time, licensing of SEPs must preserve strong incentives to contribute and implement standards, on the basis of FRAND licensing terms.

Competition authorities have intervened, in the context of enforcement of SEPs, in a few occasions, most notably in the EU *Motorola* and *Samsung* cases. The European Court of Justice recently decided on the landmark *Huawei* case, its first antitrust case on SEPs, following a middle path between the more patentee-friendly Orange Book approach in Germany^{xxxvi} and the more pro-licensee approach of the European Commission in *Motorola* and *Samsung* decisions.^{xxxvii} In *Huawei*, the CJEU essentially set out a comprehensive set of rules regulating the overall negotiating behaviour that the parties to a dispute should follow in order to comply with competition rules, and in particular with Article 102 TFEU.^{xxxviii}

However, antitrust enforcement so far is characterized by a narrow and incomplete view of the standard setting process. In particular, there is a very narrow view of the benefits of standardization in terms of efficiency gains, innovation and spill-overs to other markets and the economy overall. Most antitrust agencies fail to distinguish the performance-driven and disruptive character of the process; instead, they tend to limit their analysis to interoperability benefits, and even those viewed narrowly, without reference to its impact on the competitive conditions in upstream and downstream markets. The impact of standardization on innovation is also largely disregarded. This narrow scope has two further implications: competition authorities fail to identify the full range of efficiencies and spill-overs brought about by collaborative standardization; and they also fail to realize the full impact of antitrust enforcement on standardization, on related markets and on other more remote sectors of the economy.

VI. Conclusion

Collaborative standardization in wireless telecommunications has a remarkable record of technological achievement; it has contributed decisively in the development of cutting-edge, high-performance wireless standards. Standardization in wireless telecommunications is driven by a strong, self-reinforcing dynamic: investment and innovation in wireless standards grows markets and consumer demand; consumer demand grows the need for more investment and innovation in wireless standards.

Standardization can be associated with significant efficiency gains: interoperability between networks, devices and components allows implementers to benefit from economies of scale. The meritocratic nature of the process ensures cutting-edge standards with very high performance. The transition of entire industries from inferior to superior technologies runs smooth and fast. The process lowers barriers to entry in both the upstream market for technology and the downstream mar-

kets for standard compliant products, resulting in open markets and strong competition in innovation and price. However, standardization has a more profound and hard-to-discern impact: it is a crucial accelerator in the process of creative destruction, disrupting industries and creating strong competitive pressures from new entrants with innovative business models.

Competition policy has a meaningful role to play, in safeguarding standardization as an open, inclusive and transparent process that brings significant gains to consumer welfare. However, for that role to be fulfilled, antitrust enforcement should demonstrate a better understanding of the benefits of the standard setting process and only intervene in cases of opportunistic behaviour that compromises the credibility and performance of the standard setting process.

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- ⁱ The present article is an abbreviated version of the article “*Collaborative Standardization and Disruptive Innovation: The Case of Wireless Telecommunication Standards*”, Max Planck Institute for Innovation and Competition Research Paper Series 8(2). Available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2783372 (2016). Haris Tsilikas is Junior Research Associate at Max Planck Institute for Innovation and Competition.
- ⁱⁱ The Boston Consulting Group, “*The Mobile Revolution - How Mobile Technologies Drive a Trillion Dollar Impact*”. Available at https://www.bcgperspectives.com/content/articles/telecommunications_technology_business_transformation_mobile_revolution/ (2015), at 3, 7.
- ⁱⁱⁱ A typical example of a de facto standard would be the QWERTY typewriting layout which emerged in the end of the 19th century. See Cabral, “*Introduction to Industrial Organization*” 316-318 (MIT Press, 2000).
- ^{iv} Legal standards are mandatory for all parties engaged in the relevant commercial activity, such as, for instance, fuel emission standards. See Gilbert Richard, “*Competition Policy for Industry Standards*”. Available at http://papers.ssrn.com/sol3/Papers.cfm?abstract_id=2273333 (2012), at 2, 3.
- ^v Geradin Damien and Rato Miguel, “*Can Standard-Setting lead to Exploitative Abuse? A Dissonant View on Patent Hold-Up, Royalty Stacking and the Meaning of FRAND.*”, European Competition Journal 3(1) 104 (2007); see also, Rysman Marc and Simcoe Tim, “*Patents and the Performance of Voluntary Standard Setting Organizations*”, Management Science 54(11) 1920 (2008).
- ^{vi} Epstein Richard A., Scott Kieff, and Daniel F. Spulber, “*The FTC, IP, and SSOs: Government Hold-Up Replacing Private Coordination*”, Journal of Competition Law and Economics 8(1) 10 (2012).
- ^{vii} Bekkers Rudi and Updegrave Andrew, “*A study of IPR policies and practices of a representative group of Standards Setting Organizations worldwide*”. Available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2333445 (2012), at 6.
- ^{viii} Teece David, Sherry Edward and Grindley Peter, “*Patents and Patent Wars in Wireless Communications: An Economic Assessment*”, Digiworld Economic Journal 95(3) 87 (2014).
- ^{ix} For instance, the goal of the development of 3G cellular standards was to increase network capacity ten-fold. See *ibid*.
- ^x European Commission, Directorate General for Enterprise and Industry, “*Patents and Standards. A Modern Framework for IPR-based Standardization*”, Ref. Ares(2014)917720 - 25/03/2014 (2014), at 29, 30; *supra* n. 1, BCG, at 29, 30.
- ^{xi} *Supra* n. 4, Geradin and Rato, at 104; *supra* n. 3, Gilbert, at 3.
- ^{xii} Harkrider John, “*Seeing the Forest Through the SEPs*”, 27(3) Antitrust 23 (2013).
- ^{xiii} Layne-Farrar Anne, “*Business Models and the Standard Setting Process*”. Available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1718065 (2010), at 1.
- ^{xiv} *Supra* n. 4, Geradin and Rato, at 110.
- ^{xv} *Ibid*, at 113; see also Geradin Damien, “*Reverse Hold-Ups: The (Often Ignored) Risks Faced by Innovators in Standardized Areas*”. Available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1711744 (2010), at 4; *supra* n. 5, Epstein, Kieff and Spulber, at 14.
- ^{xvi} *Supra* n. 6, Bekkers and Updegrave, at 9.
- ^{xvii} *Supra* n. 12, Layne-Farrar, at 2.
- ^{xviii} DeLacey Brian, Herman Kerry, Kiron David, and Lerner Josh, “*Strategic Behavior in Standard-Setting Organizations*” (Harvard NOM Working Paper 903214, 2006, at 2). Available at http://papers.ssrn.com/sol3/Papers.cfm?abstract_id=903214.
- ^{xix} *Supra* n. 1, BCG, at 32, 33.
- ^{xx} *Supra* n.9, Patents and Standards, at 25
- ^{xxi} Rysman Marc and Simcoe Tim, “*Patents and the Performance of Voluntary Standard Setting Organizations*”, Management Science 54(11) 1932 (2008).
- ^{xxii} Simcoe Timothy, Graham Stuart and Feldman Maryanne, “*Competing on Standards? Entrepreneurship, Intellectual Property and the Platform Paradox*” (NBER Working Paper 13632, 2007, at 4). Available at <http://www.nber.org/papers/w13632>; Layne-Farrar Anne, Llobet Gerard and Padilla Jorge, “*Payments and Participation: The Incentives to Join Cooperative Standard Setting Efforts*”. Available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1904959 (2011), at 2.
- ^{xxiii} Schumpeter Joseph, “*Capitalism, socialism and democracy*” (Routledge, 2013).
- ^{xxiv} Of course, even a particular release of a standard can represent a drastic innovation. Yet the structure of the process leaves a different impression.
- ^{xxv} *Supra* n. 1, BCG, at 28.

xxvi Ibid, at 7.

xxvii McKinsey Global Institute, *“Disruptive Technologies - Advances that will transform life, business and the global economy”*. Available at http://www.mckinsey.com/insights/business_technology/disruptive_technologies (2013)., at 38.

xxviii In 2013, 100 billion mobile apps were downloaded by consumer; this number is forecast to grow in 2017 to reach the astounding 270 billion. See, Qualcomm, *“The Evolution of Mobile Technologies”*. Available at <https://www.qualcomm.com/wireless-simplified/technology-evolution> (2014), at 2.

xxix *Supra* n. 26, McKinsey, Disruptive Technologies, at 38.

xxx The Economist Intelligence Unit, *“The Internet of Things Business Index - A Quiet Revolution Gathers Pace”*. Available at <http://www.economistinsights.com/analysis/internet-things-business-index> (2013), at 12.

xxxi McKinsey Global Institute, *“The Internet of Things: Mapping the Value Beyond the Hype”*. Available at http://www.mckinsey.com/insights/business_technology/the_internet_of_things_the_value_of_digitizing_the_physical_world (2015), at 1.

xxxii Ibid.

xxxiii Ibid, at 6.

xxxiv Ibid, at 1; Cisco, *“Embracing the Internet of Everything to Capture Your Share of \$14.4 Trillion”*. Available at https://www.cisco.com/web/about/ac79/docs/innov/IoE_Economy.pdf (2013), at 7.

xxxv *Supra* n. 30, McKinsey, The Internet of Things, at 6.

xxxvi *Orange Book Standard*, BGH, 6 May 2009, KZR 39/06, GRUR 2009 694.

xxxvii Commission Decision, *Motorola* (Case Number AT.39985)[2014]; Commission Decision, *Samsung* (Case Number AT.39939)[2014].

xxxviii According to the CJEU, the the SEP-holder must, as a first step, notify in writing the implementer of his alleged infringement and must further identify the specific SEPs that have been infringed and the way they has been infringed. As a second step, *“...it is for the proprietor of the SEP to present to that alleged infringer a specific, written offer for a licence on FRAND terms, in accordance with the undertaking given to the standardisation body, specifying, in particular, the amount of the royalty and the way in which that royalty is to be calculated”*. By fulfilling the above preconditions the SEP-holder discharges his duties from his FRAND commitment and the burden shifts to the licensee. According to the ECJ, it is for the licensee *“diligently to respond to that offer, in accordance with recognised commercial practices in the field and in good faith, a point which must be established on the basis of objective factors and which implies, in particular, that there are no delaying tactics”*. In the event that the licensee finds the terms proposed by the SEP owner as too onerous, he should submit a formal, written counter-offer on terms he views as FRAND. See Case C170/13, *Huawei V. ZTE* [2015].