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International Standards in Flux: A Balkanized ICT Standard-Setting Paradigm and its Implications for the WTO

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ABSTRACT

Voluminous studies have documented the rise of international standards and their ramifications for the World Trade Organization (WTO), though most of these studies have focused on environment, food safety, public health, and financial regulations issues. An equally important, yet less explored, area is the information and communications technology (ICT) industry. This article seeks to contribute to the literature by examining the concept of an international standard in the ICT industry and its implications for the WTO.

Drawing upon empirical data, this article makes four claims. First, today, the WTO policymakers are facing a 'balkanized' standard-setting paradigm in the ICT sector. Global standard-setting in the ICT industry is no longer the sole domain of the 'Big Three': the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), and the International Telecommunications Union (ITU). Numerous industry consortia, mostly based in the USA, have emerged on the scene and in some way compete with the Big Three. Second, this paradigm shift engenders intense legal and political interest among major trading partners in the WTO, namely the USA and the EU. Applying the current WTO jurisprudence to this new paradigm, this article suggests that certain consortia may qualify as 'international standardizing bodies' for the purpose of the WTO. To the extent that standards developed by these consortia are recognized by the WTO, firms operating outside the US-based standardizing environment would bear higher costs in global trade. Additionally, this article argues that, while the Big Three seeks to respond to evolving market demands, their structural changes undercut the legitimacy as an international standardizing body. Fourth, intellectual property in the ICT standard-setting context is an eminent threat to the WTO. Ambiguities in licensing rules of the standardizing bodies—be they the Big Three or the industry consortia—may provide loopholes for

emerging economies moving up the global value chain to use selectively an international standard.

'The noisiest of those competitive battles will be about standards. The eyes of most sane people tend to glaze over at the very mention of technical standards. But in the computer industry, new standards can be the source of enormous wealth, or the death of corporate empires. With so much at stake, standards arouse violent passions'.[1]

I. INTRODUCTION

Standards are of paramount importance to the information and communication technology (ICT) industry.[2] Among other functions, standards serve to facilitate interoperability by allowing various devices to communicate with one another.[3] In a complex technological system that involves communication and computing functions, there must be appropriate interfaces through which signals can pass.[4] Most, if not all, ICT devices and components cannot work unless they can connect to, and interoperate with other devices and components.[5] For this reason, a number of standards exist to bring these ICT devices to work together. For instance, Wi-Fi—which stands for 'wireless fidelity', enables greater distance between wireless devices and fosters use of the Internet in a variety of daily tasks. Universal Serial Bus, better known as 'USB', allows users to connect smart phones, keyboards, printers, and many other peripheral devices to their computers. HTML, an acronym for 'HyperText Markup Language', is the primary markup language used by web designers to create web pages and information that can be displayed in a web browser.

Wi-Fi, USB, and HTML are just three of many ICT standards that link critical elements which comprise the digital environment. In fact, a list of such elements

1 *Do It My Way. (Technical Standards in the Computer Industry)*, 27 February 1993, *The Economist*, available at: http://www.highbeam.com/doc/1G1-13512301 (visited 20 February 2014).

2 There is no universally agreed definition on ICT industries among legal scholarship. Nor does the WTO provide an answer about the scope of the ICT industries. For present purposes, the term 'ICT industries' or 'ICT sector' is broadly understood to encompass economic activities that fall within the ambit of 'ICT Sector' and 'Content and Media Sector' as defined by the OECD. We adopt a broader definition for factual and analytical reasons. As a factual matter, rapid and dramatic innovations over the past few decades give rise to 'technological convergence', thus breaking down the traditional boundaries between different economic sectors. In response to such dynamic changes, some firms restructure their business models, while others look for new opportunities through coordination with other market participants in different lines of businesses. Thus, many collaborative efforts, including standard activities, would involve a variety of stakeholders across the value chain in one way or another. For that reason, and for the purpose of our analysis, it seems appropriate to cast a wider net to capture more actors that may play a role in the standard-setting process. For a detailed definition of ICT sector, see OECD Guide to Measuring the Information Society (2011), available at: http://www.oecd.org/science/sci-tech/oecdguidetomeasuringtheinformationsociety2011.htm (visited 20 February 2014).

3 For a comprehensive account of interoperability in the cyberspace, see John Palfrey and Urs Gasser, *Interop: The Promise and Perils of Highly Interconnected Systems* (New York: Basic Books, 2012).

4 Jeffrey K. Mackie-Mason and Janet S. Netz, 'Manipulating Interface Standards As An Anticompetitive Strategy', in Shane Greenstein and Victor Stango (eds), *Standards and Public Policy* (Cambridge: Cambridge University Press, 2007) 231.

5 Brad Biddle et al., 'The Expanding Role and Importance of Standards in the Information and Communications Technology Industry', 52 *Jurimetrics* 177 (2012), at 179; Martin C. Libicki, 'Standards: the Rough Road to the Common Byte', in Brian Kahin and Janet Abbate (eds), *Standards Policy for Information Infrastructure* (Cambridge, MA: MIT Press, 1995) 35.

would be almost endless. Yet, while these standards have far-reaching effects on the global information infrastructure, many are originating not from the traditional standard-setting bodies familiar to trade policymakers, but, rather, from a variety of new players in the ICT sector. Wi-Fi, for instance, is based on the 802.11 standard first introduced by the Institute of Electrical and Electronics Engineers (IEEE),[6] while USB and HTML standards are established by the USB Implementers Forum, Inc. (USB-IF),[7] and World Wide Web Consortium (W3C), respectively.[8]

The standard-setting paradigm of the ICT industry, as discussed below, has witnessed dramatic changes over the past few decades. Today, global standard-setting is no longer the sole domain of the 'Big Three': the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), and the International Telecommunications Union (ITU).[9] A number of new actors have emerged on the scene and are actively competing with these traditional standard-setting organizations (SSOs) in one way or another.[10] Such a paradigm shift can be rather problematic for trade policymakers. The WTO Agreement on Technical Barriers to Trade (TBT Agreement) requires Members to use relevant international standard as a basis for their technical regulations, unless such standards represent an ineffective or inappropriate means to fulfill the legitimate objective pursued.[11] Regulations based on the relevant international standards are presumed to be in line with the Member's obligations under the WTO, whereas a derogation may be challenged as a non-tariff trade barrier.[12]

6 Strictly speaking, Wi-Fi is a trade mark registered by the Wi-Fi Alliance (formerly, the Wireless Ethernet Compatibility Alliance) to certify IEEE 802.11-compliant products. See Kenneth R. Carter et al., 'Unlicensed and Unshackled: A Joint OSP-OET White Paper on Unlicensed Devices and Their Regulatory Issues', United States Federal Communications Commission, OSP Working Paper No. 39 (2003), at 26–29, available at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-234741A1.pdf (visited 31 December 2013).

7 See USB-IF, *About USB Implementers Forum, Inc.,* available at http://www.usb.org/about (visited 2 January 2014).

8 See *Facts About W3C*, The World Wide Web Consortium, available at http://www.w3.org/Consortium/facts (visited 2 January 2014).

9 For simplicity, throughout this article, the term 'traditional international SSO' or 'Big Three' refers to the ISO, IEC, and ITU, and 'non-traditional SSOs' or 'grey SSOs' denotes the new standard-setters in the ICT industry. By 'grey SSO', we emphasize the fact that there may be disagreement as to whether and to what extent such new actors should be recognized by the WTO Members.

10 See generally Kai Jakobs, *Standardisation Processes in IT: Impact, Problems and Benefits of Users Participation* (Vieweg: Braunschweig/Wiesbaden, 2000) 18–19 [hereinafter Jakobs, *Standardisation Processes in IT*]; Kai Jakobs, 'ICT Standardisation: Coordinating the Diversity', in Innovation in NGN - Future Network and Services: First ITU-T Kaleidoscope Academic Conference (IEEE 2008), at 119–26 [hereinafter Jakobs, 'Coordinating the Diversity'].

11 The TBT Agreement distinguishes 'technical regulations' from 'standards' based on its binding character: compliance with the former is compulsory for market access to be granted for foreign products, whereas compliance with the latter is optional. Note that however to the extent that ICT standards are concerned with trade in services, such standards would be subject to the General Agreement on Trade in Services (GATS). I am grateful to Professor Mavroidis for this point.

12 For an analysis of the TBT disciplines, see generally Peter Van den Bossche and Werner Zdouc, *The Law and Policy of the World Trade Organization: Text Cases and Materials*, 3rd ed. (Cambridge: Cambridge University Press, 2013) 850–93; Andrew T. Guzman and Joost H.B. Pauwelyn, *International Trade Law*, 2nd ed. (New York: Aspen Publishers/Wolters Kluwer, 2012) 565–91; Petros C. Mavroidis and Mark Wu, *The Law of the World Trade Organization: Documents, Cases and Analysis*, 2nd ed. (St Paul,

Yet, despite these provisions, the concept of international standard is far from clear. The TBT Agreement is silent on the definition of international standard and there is often disagreement among WTO Members as to which SSOs standard is 'relevant'.[13] Interjecting these ambiguities into the ICT standards universe raises a set of normative questions: First, which SSOs qualify as TBT-sense international standardizing bodies? Should such a status be confined to the ISO, the IEC, and the ITU? If so, would such an arrangement adequately address legitimate standardization issues? What if a trade dispute involves new technological domains in which the existing international standard is set by new actors other than the Big Three? In such cases, then, can WTO adjudicators use the output of these new players in the ICT sector as a benchmark for the purpose of addressing Article 2.4 of the TBT Agreement?

These questions are far more than a mere theoretical debate. To illustrate, consider a concrete example. In 2003, China mandated a homegrown encryption standard for wireless communications, called WAPI, which stands for Wireless LAN Authentication and Privacy Infrastructure. WAPI is incompatible with wired equivalent privacy (WEP) security protocol used by the 802.11 standard which was first established by the IEEE in 1997 and later adopted by the ISO/IEC Joint Technical Committee (JTC 1) as an international standard (ISO/IEC 8802.11:1999).[14] Inclusion of WAPI technology would increase the cost of market entry for foreign suppliers and thus raise trade concerns.[15] While many have argued that China's WAPI initiative violated Article 2.4 of the TBT Agreement for deviation from the

MN: Thomson/West, 2013) 593–627; Michael Trebilcock, Robert Howse and Antonia Eliason, *The Regulation of International Trade*, 4th ed. (New York: Routledge, 2012) 309–32.

13 Erik Wijkström and Devin McDaniels, 'Improving Regulatory Governance: International Standards and the WTO TBT Agreement', 47(5) *Journal of World Trade* 1013 (2013), at 1015.

14 See Peter Anker et al., 'The Governance of Radio Spectrum: License-exempt Devices', in Wolter Lemstra et al., (eds), *The Innovation Journal of Wi-Fi: The Road to Global Success* (Cambridge: Cambridge University Press, 2011) 305. On ISO/IEC's ratification of IEEE 802.11, see generally Kai Jakobs et al., 'Creating A Wireless LAN Standard: IEEE 802.11', in Lemstra et al., (eds), ibid, at 77.

15 WAPI raised strong criticism from the USA, among other WTO Members. After bilateral dialogues in the US–China Joint Committee for Commerce and Trade (JCCT) in 2004, the Chinese government agreed to an indefinite delay in the implementation of WAPI for WLAN products. In 2009, however, China mandated that mobile handsets with WLAN capacity to be sold in China must conform to both the WAPI standard and the IEEE-802.11 standard. It is reported that as of May 2010, several major suppliers, such as Dell and Apple, began to sell WAPI-compliant smartphones in China. This measure has been raised by the USA and European Union (EU) in the TBT Committee. See Owen Fletcher, *Apple Tweaks Wi-Fi in IPhone To Use China Protocol*, PC World, 3 May 2010, available at: http://www.pcworld.com/article/195524/article.html (visited 6 March 2014). For a detailed recount of US–China tensions over WAPI standard in 2003, see e.g. The US International Trade Commission, Investigation No. 322-514, USITC Publication 4199, 'China: Intellectual Property Infringement, Indigenous Innovation Policies and Frameworks for Measuring the Effects on the US Economy' (November 2010), at 69–70 (2010) [hereinafter USITC Report 2010], available at: http://www.usitc.gov/publications/332/pub4199.pdf (visited 6 March 2014); Christopher S. Gibson, 'Globalization and Technology Standards Games: Balancing Concerns of Protectionism and Intellectual Property in International Standards', 22 *Berkley Technology Law Journal* 1403 (2007); Baisheng An, 'Intellectual Property Rights in Information and Communications Technology Standardization: High-Profile Disputes and Potential for Collaboration Between the United States and China', 45 *Texas International Law Journal* 175 (2009) [hereinafter An, 'IPR and Communications Technology']. For discussions about the WAPI standard in mobile handsets in the TBT Committee, see e.g. WTO Committee on Technical Barriers to Trade, Meeting of 10–11 November 2011, G/TBT/M/55, 9 February 2012, para 319.

existing global standard 802.11,[16] the reasoning behind their arguments is less clear. Is it justified by the ISO/IEC's recognition,[17] or because of widespread use of the IEEE 802.11 standard over years and that the IEEE meets certain criteria in the TBT Agreement?[18] The former seems to reflect what I term the 'centralized approach'. Under such an approach, recognized international standardizing bodies are confined to certain institutions, such as the ISO and the IEC; only standards adopted or ratified by such bodies can be interpreted as relevant international standards for the purpose of the TBT Agreement. The latter view, by contrast, takes a markedly 'decentralized approach' in the sense that nontraditional SSOs, such as the IEEE, may also qualify as TBT-approved international standardizing bodies, so long as they comply with certain conditions, and regardless of whether their standards are ratified by the traditional international SSOs.

Either view can be problematic. The former view, or the centralized approach, raises an immediate and rather intriguing question. What if the IEEE-802.11 standard had never been converted into an ISO/IEC standard? Under such a scenario, would a WTO Member be able to make a TBT claim by arguing that the IEEE is an international standardizing body? In a complex and dynamic ICT sector, it is very likely that traditional international SSOs cannot address the evolving demands in a timely and effectively manner.[19] Many standards that have become an integral part of our daily lexicon were neither created, nor rarified by the Big Three. Thus, it seems less realistic to exclude, a priori, those new actors in the ICT sector from the list of candidates. Yet, this does not mean that the decentralized approach should be accepted altogether. Not every SSO carries the legitimacy required for the purpose of the TBT Agreement. Either approach, as discussed in greater detail later, would likely engender intense political and economic interest and would thereby become a subject of intense controversy among major trading partners in the WTO.

Given the penetration of ICT devices into every aspect of life and the vast economic interests at stake in the ICT standard-setting context, it is conceivable that WTO policymakers and adjudicators will, at some point, be called upon to assess the role of these nontraditional SSOs. Notwithstanding their profound impacts, shifts in ICT standards universe are not well understood and have received scant scholarly attention to date.[20] This article represents an effort to fill that gap. We shed light on the regime transformation of the ICT standards universe and its potential ramifications

16 See e.g. Zia K. Cromer, 'China's WAPI Policy: Security Measure or Trade Protectionism?' 4(1) *Duke Law and Technology Review* (2005), paras 3, 13; Gibson, above n 15, at 1404, 1437; Aimee Boram Yang, 'China in Global Trade: Proposed Data Protection Law and Encryption Standard Dispute', *I/S: A Journal Law and Policy for the Information Society* 892 (2008) 897, 913.

17 See Gibson, above n 15, at 1435.

18 Zia Cromer, for instance, seems to argue that the IEEE is the international standardizing body in the area of wireless technologies. See Cromer, above n 16, paras 3, 13. See also Yang, above n 16, at 898.

19 For instance, the standard for High-speed USB (USB 2.0) was introduced by the USB-IF in 2000 but was endorsed by the IEC until 2012. See IEC, *IEC Endorses Four USB-IF Standards*, available at: http://www.iec.ch/newslog/2012/nr0812.htm (visited 3 January 2014).

20 Some notable exceptions, see e.g. Branislav Hazucha, below n 272; Gibson, above n 15; An, 'IPR and Communications Technology', above n 15; Jane K. Winn, 'Globalization and Standards: the Logic of Two-Level Games', 5 *I/S: A Journal Law and Policy for the Information Society* 185 (2009) [hereinafter Winn, 'Two-Level Games']; Baisheng An, 'The Global Governance of Standardization: The Challenges of Convergence', Indian University Research Center for Chinese Politics and Business, Working Paper

for the WTO by asking three sets of questions. First, why did the ICT standard-setting paradigm evolve in the first place? Until the 1970s, development of standards in the ICT sector was effectively a monopoly comprised of the Big Three. Why has this monopoly been dismantled? Section II examines these issues by unpacking the driving forces behind the paradigm shift over the past four decades. Second, what are the positions of the WTO Members toward this new paradigm, and why? What interests are at stake? How can this new paradigm be squared with the WTO based on current WTO jurisprudence? These issues will be discussed in Section III. In Section IV, we examine in depth the issues that would turn on the legitimacy of the international standards by focusing on several broader issues. What is the role of the Big Three in the new ICT standard-setting landscape? Are they still the 'relevant' international standardizing bodies? A related question is: By placing the Big Three in the center of the ICT standard-setting landscape, can we reduce divergence that results from the fragmentation? Beyond the fragmented ICT standard-setting paradigm itself, what are the emerging threats to all SSOs? How might these affect the concept of international standards in the context of the TBT Agreement? Section V concludes.

II. ICT STANDARDS WORLD: FROM UNIFICATION TO 'BALKANIZATION'

A. The old regime

Over the past four decades, the ICT standard-setting landscape has changed dramatically, transforming from a straightforward and static paradigm toward a fragmented and dynamic one.[21] Back in the 1970s, the development of ICT standards at the global level was by and large carried out by the ITU, the ISO, and the IEC.[22] The ITU is an intergovernmental organization that is structured as part of the United Nations.[23] The ITU, through its International Telegraph and Telephone Consultative Committee (formerly CCITT, now renamed ITU-T), published international telecommunications standards in the form of 'Recommendations'.[24] The ISO and the IEC, both nongovernmental organizations, were in charge of most of the rest of the standards activities in the ICT sector.[25] The ISO handled a wide range of standards across industries other than those of electronic engineering, one realm that was

No. 32, 2012 [hereinafter An, 'The Global Governance of Standardization'], available at: http://www.indiana.edu/~rccpb/pdf/An_RCCPB_32_Standards_Nov_2012.pdf (visited 6 March 2014).

21 See Jakobs, 'Coordinating the Diversity', above n 10, at 119.

22 Note that however while the IEC was established in 1906, it played a relatively marginal role in the ICT standards development in the 1970s. I am grateful for Professor Jakobs for this point.

23 Gerd D. Wallenstein, *Setting Global Telecommunication Standards: the Stakes, the Players and the Process* (London: Artech House Publishers, 1989) 83.

24 The International Telegraph and Telephone Consultative Committee (CCITT, from French: Comité Consultatif International Téléphoniqueet Télégraphique) developed standards in the telecommunications industry. In 1992, the CCITT was renamed as the Telecommunications Sector of the International Telecommunications Union (ITU-T). See generally *CCITT: 50 Years of Excellence* (2006), at 14 available at: http://www.itu.int/ITU-T/50/docs/ITU-T_50.pdf (visited 3 January 2013). For a detailed historical recount of the ITU, see George A. Codding, Jr., 'The International Telecommunications Union: 130 Years of Telecommunications Regulation', 23 *Denver Journal International Law and Policy* 501 (1995).

25 Jakobs, 'Coordinating the Diversity', above n 10, at 119; Jakobs, Standardisation Process in IT, above n 10, at 18.

the preserve of the IEC.[26] The three institutions coordinated activities to avoid duplication of effort, especially in the interface, where the computer industry meets telecommunications lines and terminal apparatus.[27] As information technologies became more intertwined with electronic engineering over time, in 1987, the ISO and IEC formed a Joint Technical 1 (ISO/IEC JTC 1)—an amalgam of one ISO technical committee (TC 97) and two IEC committees (TC 47B and TC 83)—in charge of ICT standards.[28]

The CCITT was generally run by the national postal, telegraph and telephone (PTT) firms and Recognized Private Operating Agencies (RPOAs) that enjoyed monopoly power in their respective countries at the time.[29] The ISO and the IEC, on the other hand, consisted of national members who represented the interests of their countries.[30] Beyond the three institutions, according to Kai Jakobs, the European Computer Manufacturers Association (ECMA) was the only SSO with some global influence during this period.[31] The ICT standardization universe in the 1970s is illustrated in Appendix 1.

B. The new regime

Although the ITU-ISO-IEC system remained rather stable for several decades, their monopoly has undergone a number of challenges since the 1980s. Appendix 2 shows today's ICT standard-setting paradigm. While the Big Three still play an important role, they are no longer perceived by many stakeholders as the only ideal route for standardization.[32] For some, regional SSOs provide a strong alternative to the ITU-ISO-IEC. The rise of the European SSOs is an eminent example. For many others, industry consortia have become most popular among other venues to flex their muscles in the development of ICT standards. As a recent study shows, these industry groups account for approximately 60% of today's ICT standards, a high percentage that has not been seen in any other economic sector.[33] In some contexts, these new SSOs may collaborate with the Big Three,[34] while in others, they compete with one another or with the traditional international SSOs.[35] Such shifts are driven by,

26 Carl F. Cargill, *Information Technology Standardization: Theory, Process, and Organizations* (Bedford, MA: Digital Press, 1989) 126.

27 Wallenstein, above n 23, at 84.

28 For an overview of the ISO/IEC JTC 1, see generally Cargill, above n 26, at 131–38.

29 Jakobs, 'Coordinating the Diversity', above n 10, at 119.

30 Ibid, at 120; Cargill, above n 26, at 127, 139. See also Krishna Jayakar, 'Globalization and Legitimacy of International Telecommunications Standard-Setting Organizations', 5 *Indiana Journal of Global Legal Studies* 711 (1998), at 722.

31 Jakobs, *Standardization Processes in IT*, above n 10, at 18.

32 Tineke M. Egyedi, 'Institutional Dilemma in ICT Standardization: Coordinating the Diffusion of Technology', in Kai Jakobs (ed.), *Information Technology Standards and Standardization: A Global Perspective* (Hershey, Pennsylvania: IGI Global Book, 2000) 52.

33 Patrick Van Eecke et al., 'EU Study on the Specific Policy Needs for ICT Standardization', July 2007, at 7 available at: http://ec.europa.eu/enterprise/sectors/ict/files/full_report_en.pdf (visited 6 March 2014) (prepared for the European Commission) [hereinafter DLA Piper—EC Study].

34 The regional SSOs and consortia do collaborate with the Big Three through different mechanisms. See below nn 115–17, 168 and accompanying text.

35 More problematic is the fact that these new actors would compete with one another. In the ICT sector, it is not uncommon to see multiple SSOs focus on competing standards. In recent years, the standards war

among others, government policy, technological changes, business strategy, regional integration, and a new ideology among scientists and engineers. We discuss below.

1. Liberalization of global telecommunications markets

Dramatic regulatory reforms in the telecommunications sector provided a strong catalyst for the paradigm shift in the ICT standards world. In early days of telecommunications, standards were not a critical issue given the primitive technology, relatively few investments in infrastructure, and the lack of interconnection.[36] Regulators and market participants were left with space to adopt incompatible systems within their borders and to use such standards as nontariff barriers to trade.[37] At the time, international trade in telecommunications equipment and associated services was slight.[38]

Such a segmented and self-contained regime was changed soon after the wave of privatization swept telecommunications markets in the world in the 1980s and 1990s.[39] PTTs increasingly lost their dominant position and had to compete with an explosive number of private carriers and associated firms. Liberalization sparked intensive competition among market participants, which in turn resulted in large increases in research and development (R&D) costs and cross-border mergers.[40] Since then, telecommunications had turned into a transnational technology. The telecommunications industry became more globalized in character: manufacturers focused more on international markets to increase sales, while network operators began to form strategic alliances to compete in foreign markets.[41] As the network continued to expand in terms of physical scope and functional capacity, private carriers and manufacturers had strong incentives in standards development to ensure interconnection and interoperability across networks.[42]

waged by two industry consortia—Blu-Ray Disc Association and DVD Forum—over the high-definition DVD standard is a notable example. See e.g. Nick Flaherty, 'Battle of the Blues', 50(4) *IEE Review* 48 (2004).

36 Jayakar, above n 30, at 722. William Drake underscores this point by quoting Irmer: 'Standardization in those early days was restricted to a few points in the networks. Because of manual operation, only the international operators had access to international circuits, whereas the equipment in the national network was practically not involved in international standardization'. See William J. Drake, 'The Transformation of International Telecommunications Standardization: European and Global Dimensions', in Charles Steinfield et al. (eds), *Telecommunications in Transition: Policies, Services, and Technologies in the European Community* (Thousand Oaks, CA: SAGE Publications, 1994) 71, 74 (original footnote omitted).

37 Drake, above n 36, at 74.

38 See Philipp Genschel, 'How Fragmentation Can Improve Co-ordination: Setting Standards in International Telecommunications', 18 *Organization Studies* 603 (1997), at 605.

39 Wei Li and Lixin Colin Xu, 'The Impact of Privatization and Competition in the Telecommunications Sector Around the World', 47 *Journal of Law and Economics* 395 (2004), at 396 (noting that in 1980, only 2% of telecommunications operators in 167 countries were privately owned. By 1988, the number was 43%).

40 Genschel, above n 38, at 605.

41 Ibid, at 606.

42 Jayakar, above n 30, at 723.

2. Rapidly changing innovation and market structure

Contrary to the telecommunications industry, the computer and semi-conductor sectors—traditionally less regulated industries—had a fast-moving and highly competitive culture in standardization.[43] Although IBM Corporation and its *de facto* standards once dominated these industries in the 1970s, the emergence of new firms soon broke up IBM's dominance through the introduction of mini-computers and then micro-computers.[44] Such a new culture, coupled with the liberalization of the telecommunications sector, affected the manner in which technological changes were implemented.[45]

Firms sought to increase the return on their investment by shortening product life cycles, promoting customized systems, and accelerating diffusion across borders.[46] Shorter product life cycles require a shorter and more flexible standard-setting process.[47] Yet, formal standardizing bodies that follow specific procedural rules typically take several years to release their final standards document and thus can hardly meet the needs of high-tech industries.[48]

This steady stream of innovations led to technological convergence, thereby adding a further wrinkle to the ICT standardization. By the early 1970s, communications were sent via analog signals. Audio, video, and text once existed in different formats: audio in magnetic tapes, videos in films, and text in paper.[49] After 1971, however, the world began to move toward a digital format.[50] Communications migrated toward a binary system consisting of a series of zeroes and ones—known as 'bits'.[51] Digital technology had a profound impact on business models of the ICT industry. As digital technology continued to evolve, firms could thus offer a variety of products or services via a single conduit that were previously available only on separate and stand-alone media. Thus, the ICT industry began to merge. Where there once existed clear lines between computers, telecommunications, and televisions, such

43 Timothy Schoechle, *Standardization and Digital Enclosure: The Privatization of Standards, Knowledge, and Policy in the Age of Global Information Technology* (New York: Information Science Reference, 2009) 33.

44 Janet Abbate, *Inventing the Internet* (Cambridge, MA: MIT Press, 1999) 148 ('In the 1970s the computer manufacturers controlled the market for network product: there were no commercially available non-proprietary network systems… ').

45 As we shall see in Section II. B.5, the open source movement is another key driver behind the new culture of ICT standards world. The giants in the ICT industries at the time, such as IBM and Oracle, turned their attention to this new trend as a business opportunity and thus changed their business models. On this score, see e.g. Chris DiBona et al., 'Introduction', in Chris DiBona et al. (eds), *Open Sources: Voices from the Open Source Revolution*, 1st ed. (Sebastopol, CA: O'Reilly Media, 1999) 8.

46 See Drake, above n 36, at 80.

47 Kunt Blind and Stephan Gauch, 'Trends in ICT Standards: The Relationship between European Standardization Bodies and Standards Consortia', 32 *Telecommunications Policy* 503 (2008).

48 See e.g. Roy Rada, 'Consensus Versus Speed', in Jakobs (ed.), above n 32, at 20 ('The ISO process from first correspondence to a published international standard typically takes years); Jayakar, above n 30, at 723 (noting that 'the standard-setting process in the ITU took anywhere from eighteen months to eight years to produce a final standard').

49 Jayraj Ugarkar, *The Essentials of Telecommunications Management: A Simple Guide to Understanding a Complex Industry* (Bloomington, Indiana: AuthorHouse, 2008) 170.

50 In 1971, the Intel Corporation developed the first microprocessor that can be used to read digital computers. See Milton Mueller, 'Digital Convergence and Its Convergence', 6 *The Public* 11(1999) 12.

51 Jonathan E. Nuechterlein and Philip J. Weiser, *Digital Crossroad: American Telecommunications Policy in the Internet Age* (Cambridge, MA: MIT Press, 2005) 115, 116.

boundaries are now broken down.[52] In reaction to such convergence, market participants sought to extend their activities beyond their core business. A large number of alliances, takeovers, or joint ventures have thus arisen in the past two decades.[53]

Coordination among market participants is premised on technical and commercial know-how in order to, on the one hand, exploit new business opportunities in the global supply chain,[54] and on the other, foster interoperability between different ICT devices. The latter is of particular importance.[55] In the post-convergence era, the incorporation of various services and applications into all aspects of telecommunications networks to satisfy users' demands resulted in significant heterogeneous systems, thereby raising problems of interoperability. Many standards initiatives carried out by industry consortia reflected an effort to ensure interoperability and to meet user requirements.[56] The USB standard is an example of this. In the early days of personal computers, one of the biggest challenges facing market participants was the diversity in the technologies used to connect peripheral devices to computers.[57] To encourage the purchase and use of personal computers, a group of firms led by Intel Corporation, later known as USB-IF, undertook what is termed as the 'ease-of-use' initiative and created the USB standard.[58] While the USB standard first emerged

52 Technological convergence thus leads to regulatory changes in telecommunications sector. See generally Stuart Minor Benjamin et al., *Telecommunications Law and Policy*, 3rd ed. (Durham: Carolina Academic Press, 2012) 35–36.

53 See *Commission Green Paper on the Telecommunications, Media and Information Technology Sectors, and the Implications for Regulation*, at 2, COM (97) 623 (final) (3 December 1997).

54 Network effect is another crucial factor driving the formation of alliance. Given the strong positive feedback and increasing returns in the ICT industries, there is a natural for the market to 'tip', a phenomenon that makes the strong get stronger and the weak get weaker. For that reason, many of these consortia's agenda actually go beyond standardization. They are also interested in creating business communities by connecting different vendors along the supply chain—from the suppliers of primary technologies that underpin the digital infrastructure to those who provide complementary products and services. This sort of collaboration would create users' confidence in new technologies and standards which will help these firms secure a large installed base to compete for the network market. See Alfred G. Warner, 'Block Alliances and the Formation of Standards in the ITC Industry', in Kai Jakobs (ed.), *Information Technology and Standardization Research* (Hershey, Pennsylvania: IGI Global Book, 2006); Richard Hawkins, 'The Rise of Consortia in the Information and Communication Technology Industries: Emerging Implications for Policy', 23 *Telecommunications Policy* 159 (1999), at 162. On the network effect, see generally Carl Shapiro and Hal R. Varian, *Information Rules: A Strategic Guide to the Network Economy* (Cambridge, MA: Harvard Business School Press, 1998) 173–225; Joseph Farrell and Paul Klemperer, 'Coordination and Lock-in: Competition with Switching Costs and Network Effects', in Mark Armstrong and Robert H. Porter (eds.), *Handbook of Industrial Organization* (Amsterdam: North-Holland/Elsevier, 2007), vol. 3, 1967–2072.

55 Jayakar, above n 30, at 723 (noting that '[b]ecause the new service or device must interface with an ever-larger number of existing networks and applications, standardization and compatibility must be introduced into the design process'.)

56 See Carl Cargill and Sherrie Bolin, 'Standardization: A Failing Paradigm', in Shane Greenstein and Victor Stango (eds), above n 4, at 308.

57 Before the advent of the USB standard, a user must go through several steps to attach an external devices to computers, including restarting computers and inserting the card containing the electronics that would allow the peripherals to work with the operating system of the computer. See generally *Multivideo Labs, Inc.* v *Intel Corp.*, 200 WL 12122 at 2 (S.D.N.Y. 7 January 2000).

58 To remove the major barriers to an increased demand for computers, the ease-of-use initiative aimed for 'Plug and Play' in the sense that consumers can simply plug the peripheral device into computers and go to work. To this end, Compaq, Digital Equipment, NEC, Microsoft, IBM, Intel Corporation and

as a voluntary standard adopted by a small group of firms, it has evolved to become the *de facto* standard, sponsored by more than 700 companies in the ICT sector, and it has been accepted by the IEC as an international standard.[59]

3. Intellectual property rights and collaborative innovation by firms

The ICT sector is by and large an intellectual property intensive market.[60] Hence, the nature of intellectual property rights (IPR) plays a critical role in standards activities. In more traditional contexts, products such as fish and gas are rivalrous in the sense that their consumption by one person makes them less available for consumption by another.[61] In contrast, IPR is nonrivalrous on the supply side, meaning that one firm's use does not take away from the amount left over for others. If, for instance, 10 manufacturers have the rights to produce a product covered by a patent, each of them can make as many as they wish without affecting the number that others can make. This very fact provides a strong setting for collaborative innovation at the outset.

The cost structure of innovation in the ICT sector also plays a role here. For many high-tech firms (especially hardware manufacturers), fixed costs are often high compared to marginal costs.[62] Semi-conductor firms, for instance, can spend several billion dollars to build a chip fabrication plant but can produce an incremental chip for just a few dollars.[63] Once technology is developed, it can be used a number of times. Thus, the same logic that makes the IPR nonrivalrous across different firms can provide incentives for undertaking joint R&D projects to reduce costs.[64] Further, innovative programs in the ICT sector typically entail high risk. Through collaborative R&D efforts, firms can mitigate the risk of failure.[65] Collaborative innovation is thus a cost-effective choice for market competition.[66]

Among others, a patent pool is perhaps most popular in collaborative innovation efforts. A patent pool is, in essence, an extension of a cross-licensing agreement. It is often formed by two or more patent (in some cases, copyright) holders to license

Northern Telecom (now Nortel Network Corporation) formed the USB-IF in 1995 for the purpose of promotion, adoption, and advancement of USB technology and associated products. See ibid, at 3.

59 See *Members*, USB-IF, available at https://www.usb.org/members_landing (visited 9 January 2014).

60 One striking feature of the ICT industries, as Mark Lemley puts it, is the multiplicity of patents that ICT developers have to deal with. See Mark A. Lemley, 'Ten Things to Do About Patent Holdup of Standards (And One Not To)', 48 *Boston College Law Review* 149 (2007), at 150.

61 Herbert Hovenkamp, 'Antitrust and the Movement of Technology', 19 *George Mason Law Review* 1119 (2012), at 1122 [hereinafter Hovenkamp, 'Antitrust and Technology'].

62 Hal R. Varian et al., *Economic of Information Technology: An Introduction* (Cambridge: Cambridge University Press, 2005) 3.

63 Maureen A O'Rourke, 'Striking A Delicate Balance: Intellectual Property, Antitrust, Contract, and Standardization in the Computer Industry', 12 *Harvard Journal of Law and Technology* 1 (1998), at 35 (noting that the market for personal computer operating systems and microprocessors have high-fixed costs but the marginal costs to produce one more chip is relatively low.)

64 Hovenkamp, 'Antitrust and Technology', above n 61, at 1122.

65 Ibid.

66 Besides cost structure and IPR, competition policy—especially the America's antitrust law—significantly implicate these collaborative R&D and standardization efforts in the ICT industry. See e.g. Steven W. Usselman, 'Public Policies, Private Platform: Antitrust and American Computing', in Richard Coopey (ed.), *Information Technology Policy: An International History* (Oxford: Oxford University Press, 2004) 97.

the bundling of the IPR to each other or a third party.[67] A patent pool comes in a variety of forms, ranging from an informal understanding that is similar to multiparty cross-licensing arrangements to a pool that in some ways resembles a joint venture.[68] By pooling, various actors can clear a multiplicity of blocking or complementary patents, thus reducing the risks of infringement litigation.[69] To date, patent pools have been utilized in a large number of widely adopted standards in the ICT industry.[70]

4. The rise of regional standardization bodies

In standard-setting, firms and governments choose the optimal institution to solve standards issues based on different strategies.[71] To pursue a standard on the international plane is not always the best choice. The emergence of European SSOs (ESOs) is a good illustration. ESOs provided a strong setting for firms and governments to devote additional resources to standards activities at the regional level. At the international level, while the ITU-ISO-IEC system witnessed certain changes after the 1960s, the system continued to struggle with structures and rulings that affected its ability to promote further cooperation with industry participants.[72] By contrast, several changes in Europe in the 1980s created a good environment for regional standards. First, the number of members in the European Union (EU)[73] increased from six to twelve in the mid-1980s. This enlargement paved the way for regional R&D and standardization efforts. And, despite such growth, its members remained much smaller compared to those of the traditional SSOs.[74] Second, and more importantly, beginning in 1985, the European Commission introduced a new regulatory approach called the 'New Approach' in response to the trade-impeding effects arising from divergent national standards by Member States.[75] Under this New Approach, the legislative harmonization at the European level is limited to essential requirements for products to be legally placed on the common market, while the task of specifying

67 Carl Shapiro, 'Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard Setting', in Adam B. Jaffe et al., (eds), *Innovation Policy and the Economy* (Cambridge, MA: MIT Press, 2001) 133.

68 Mark Lemley, 'Intellectual Property Rights and Standard-Setting Organizations', 90 *California Law Review* 1889 (2002), at 1950 [hereinafter Lemley, 'IPR and SSO'].

69 Herbert Hovenkamp, 'Competition for Innovation', 2012 *Columbia Business Law Review* 799 (2012), at 823.

70 Recordable compact discs (CD-R) and rewriteable compact discs (CD-RW) specifications (the so-called 'Orange Book' standard), jointly developed by Philips, Sony, and some other high-tech firms, is a famous example of this kind. On this score, see e.g. *Princo Corp.* v *Int'l Trade Comm'n,* 616 F.3d 1318, 1322-23 (Fed. Cir. 2010) (en banc).

71 See generally Marc T. Austin and Helen V. Milne, 'Strategies of European Standardization', 8 *Journal European Public Policy* 411 (2001).

72 These changes include, for example, the creation of the ISO/IEC JTC 1 and the cooperation between JTC 1 and the ITU, some mechanisms to expedite standard-setting process. Such changes, as Egyedi argues, were in response to pressure from inside and outside these traditional SSOs. See Egyedi, above n 32, at 52–53.

73 For simplicity, this article uses the terms European Communities (EC) and European Union (EU) interchangeably.

74 By 1981, for instance, the membership of the ITU had exploded to include 158 voting members, almost 30% increase since 1962. See Austin and Milne, above n 71, at 422.

75 See generally European Commission Guide to Implementation of Directives Based on A New Approach and a Global Approach (2000), available at: http://ec.europa.eu/enterprise/policies/single-market-goods/files/blue-guibide/guibidepublic_en.pdf [hereinafter Blue Book] (visited 6 March 2014).

details is delegated to three ESOs: the European Committee for Standardization (CEN), the European Committee for Electrotechnical Standardization (CENELEC), and the European Telecommunications Standards Institute (ETSI).[76] While the European standards are voluntary, Member States are nevertheless obligated to assume that products in line with such standards meet the essential requirements and can enjoy free movement within the single market.[77] By creating incentives for compliance with such standards, the New Approach helped the ESOs move towards a more central position.[78]

For Europe-based firms, going regional seems economically rational. This is not only because of the benefit derived from the presumption of conformity, but also because of two important factors. First, European companies once lacked interests in coordinating standards at the regional level and were much more concerned with standards for various domestic markets.[79] However, as information technologies changed rapidly after the liberalization of telecommunications, it became clear for the high-tech firms that the better way to reduce their lag in innovation and recoup their large investment in R&D was through regional sales rather than domestic sales. Following this, high-tech firms became 'the most visible proponents of European standardization',[80] which led to the creation of the ETSI.[81]

Second, regional coordination may increase the international competitiveness of these European companies. The costs for these firms to recruit the votes in favor of their own standards in the regional context are much less than that in the global arena.[82] This is especially important for firms who are not technology leaders to compete in the global market.[83] In setting regional standards, European firms can prevent standardization based on rival technologies and may also cooperate with other less competitive firms to develop a competing standard.[84] The case of High Definition Television (HDTV) is an illustrative example. Despite Japan's worldwide

76 European Parliament and Council Directive 98/34/EC, Article 1(7), Annex I, 1998 O.J. (L204) 37.

77 Blue Book, above n 75, at 29; Jacque Pelkmans, 'The New Approach to Technical Harmonization and Standardization', 25 *Journal of Common Market Studies* 249 (1986–87), at 254.

78 See Cargill, above n 26, at 156, 158. Harm Schepel points out that given the costs associated with additional testing and conformity control for products that do not follow these standards, such standards are *de facto* binding upon economic operators. See Harm Schepel, *Constitution of Private Governance: Product Standards in the Regulation of Integrating Market* (Oxford: Hart Publishing, 2005) 226.

79 Michelle Egan, *Constructing a European Market* (Oxford: Oxford University Press, 2001) 136.

80 Ibid, at 137.

81 Before the ETSI, European Conference of Post and Telecommunication (CEPT) was in charge of standardization in telecommunication sector. CEPT, however, was slow in coordinating members' actions and failed to respond to the growing demand in the industry. More importantly, various stakeholders, such as manufacturers of telecommunication equipment, private service providers and users felt their interests were inadequately represented in that process. These factors, together with the competition from outside the EU, prompted the Commission to restructure its standard body in the telecommunication sector in its 1987 Green Paper. See generally Green Paper on the Development of the Common Market for Telecommunication services and equipment, COM (87), 30 July 1987. For a historical recount, see Egan, above n 79, at 146–49.

82 See Austin and Milne, above n 71, at 415–16, 424.

83 See ibid. See also Egan, above n 79, at 146–47 ('nationally segmented markets would impede innovation and discourage cross-border development in comparison to the changes underway in the USA and Japan').

84 Austin and Milne, above n 71, at 413.

dominance in consumer electronics and its first-mover advantage in the development of HDTV,[85] European firms blocked the proposed international standard based on Japanese HiVision technology in the ITU in the 1980s.[86] Instead, in 1986, 19 European countries formed the so-called Eureka 95, a joint venture funded by the EU to develop a competing standard, namely, Multiplexed Analogue Components (MAC), which was later adopted by the EU as the transmission standards for HDTV.[87]

5. Ideology shifts: toward an open system and peer production

More recently, open source movement adds further complexity to the ICT standard-setting paradigm.[88] Open source movement presents a new ideology in response to the claims in favor of cyber freedom and growing user demand in the complex computing environment.[89] In the software segment of the ICT sector, vendors view their source code as intellectual property or a trade secret. Hence, they generally distribute software to a third party only in the form of object code or release the source code under very strict licensing terms.[90] Yet, such a proprietary model is unsatisfactory for

85 Japan developed the first analog HDTV system in the late 1960s. See generally Joseph Farrel and Carl Shapiro, 'Standard Setting in High-Definition Television', in William C. Brainard and George L. Perry (eds), *Brookings Papers on Economic Activity: Microeconomics* (Washington, DC: Brookings Institution Press, 1992) 1, 7.

86 Ibid, at 10 (noting that European delegates, especially the French, blocked the consensus); Joy R. Bulter, 'HDTV Demystified: History, Regulatory Options, and The Role of Telephone Companies', 6 *Harvard Journal Law and Technology* 155 (1992), at 160–61, 174 ('the Western European nations blocked acceptance of the standards under consideration—the Japanese-developed 1125 line, sixty Hz—at the 1986 Plenary Assembly of the International Radio Consultative Committee'.); George Snyder, Jr., 'Setting Standards for High Definition Television: Federal Policy Must Promote More Than Just a Better Picture', 40 *Buffalo Law Review* 613 (1992), at 631.

87 Bulter, above n 86, at 160–61.

88 The story of open source movement can be dated back to 1984, when Richard Stallman at the Massachusetts Institute of Technology started to work on a nonproprietary operating system called GNU. For an authoritative account of open source movement, see generally Yochai Benkler, *The Wealth of Networks: How Social Production Transforms Markets and Freedom* (New Haven: Yale University Press, 2006) [hereinafter Benkler, *The Wealth of Network*]; Yochai Benkler, 'Coase Penguin, or, Linux and the Nature of the Firm', 112 *Yale Law Journal* 369 (2002). Some commentators take the open source community as some sorts of consortia creating the ICT standards. See e.g. Cargill and Bolin, above n 56, at 306; Andrew Updegrove, 'Consortia and the Role of the Government in Standard Setting', in Brian Kahin and Janet Abbate (eds), *Standards Policy for Information Infrastructure* (Cambridge, MA: MIT Press, 1995), at 321, 328–29. Other scholars, however, view open source movement an institution that stands apart from consortia. See e.g. Jay P. Kesan and Rajiv C. Shah, 'Deconstructing Code', 6 *Yale Journal of Law and Technology* 277 (2003–04), at 325.

89 See Greg R. Vetter, 'The Collaborative Integrity of Open-Source Software', 2004 *Utah Law Review* 563 (2004), at 594; Fabrizio Marrella and Christopher S. Yoo, 'Is Open Source Software the New Lex Mercatoria?', 47 *Virginia Journal of International Law* 807 (2007), at 809.

90 Source code is a computer language for programmers to communicate with the machines (e.g. Java, C, or C++). Before source code can be processed by a computer, however, it must be 'complied' into object code, which is a string of zeroes and ones. Computers can read object code easily, but it is very difficult for humans to decipher and re-translate into source code. See Mathias Strasser, 'A New Paradigm in Intellectual Property Law? The Case Against Open Sources', 2001 *Stanford Technology Law Review* 1 (2001), at 4–5; Lawrence Lessig, *The Future of Idea: The Fate of the Commons in a Connected World* (New York: Random House, 2001) 50–51. On source code licensing restrictions, see e.g. Maureen A. O'Rourke, 'Drawing the Boundary between Copyright and Contract: Copyright Preemption of Software License Terms', 45 *Duke Law Journal* 479 (1995), at 493–94.

open source movement advocates. As stated earlier, interoperability is central to this modern digital environment in which a number of diversified applications and peripheral devices run by users over the network. The lack of the source code and restrictions on code modifications make it difficult for users to fix bugs and resolve interoperability problems.[91] By allowing greater access to the source code, users and programmers around the world can easily participate in the development of software via the Internet.[92] This can give rise to better and more reliable software and foster innovation, thereby generating economic efficiency.[93] Further, it helps prevent users in both private and public sectors from vendor lock-in.[94]

While the open source movement seems to run counter to traditional economic theory,[95] this decentralized, collaborative, and nonproprietary model—in Yochai Benkler's terms, 'commons-based peer production'—has attained technological, social, and commercial successes.[96] To date, the open source community, which is comprised of various users, programmers, groups, and organizations interested in cyberspace, has been successful in creating a large number of alternatives to proprietary solutions, such as Linux, Apache, PERL, and Sendmail, to name just a few.[97] As open source software has gained widespread acceptance by major ICT firms and their corporate clients, these like-minded developers have coalesced into networks of differing degrees of formality.[98] These networks effectively act as standard-setting bodies to create various specifications for the digital environment.[99] Such an ideology of openness is reflected in many of the ICT standards activities.[100]

91 Marrella and Yoo, above n 89, at 810.

92 See e.g. Open Source Initiative, available at: http://www.opensource.org/ (visited 12 January 2014).

93 Lawrence Lessig, 'Open Code and Open Societies: Values of Internet Governance', 74 *Chicago-Kent Law Review* 1405 (1999), at 1406.

94 See Shapiro and Varian, above n 54, at 230. Vendor lock in problem may also occur in the public sector, thereby raising public policy concerns. In recent years, a growing number of governments began to embrace open source and open standards initiatives to ensure interoperability and flexibility. See generally K. D. Simon, 'The Value of Open Standards and Open-Source Software in Government Environments', 44 *IBM Systems Journal* 227 (2005).

95 It seems puzzling why, in the absence of financial incentives, peer production ideology existed at all. Some suggest that the open source community is motivated by altruism, while others argue that these participants are driven by reciprocity, a faith that others would contribute their fair share to the community. Still others suggest signaling incentives drives this movement. By signaling their outstanding skills to the world, the developers may get a better job offer, or may be invited to participate in commercial projects. See e.g. Simon P. Anderson et al., 'A Theoretical Analysis of Altruism and Decision Error in Public Goods Games', 70 *Journal of Public Economics* 297 (1998); Dan M. Kahan, 'The Logic of Reciprocity: Trust, Collective Action, and Law', 102 *Michigan Law Review* 71 (2003); Josh Lerner and Jean Tirole, 'Some Simple Economics of Open Source', 50 *Journal of Industrial Economics* 197 (2002); Klaus M. Schmidt and Monika Schnitzer, 'Public Subsidies for Open Source? Some Economic Policy Issues of the Software Market', 16 *Harvard Journal of Law and Technology* 473 (2003).

96 Benkler, *The Wealth of Network*, above n 88, at 60.

97 Linux, for instance, poses a threat to Windows, a *de facto* standard controlling operating system market, while over 50% Web server in the world runs on the Apache Web server. Ibid, at 64. For an overview of notable outputs of open source movement, see e.g. Marcus Maher, 'Open Source Software: The Success of An Alternative Intellectual Property Incentive Paradigm', 10 *Fordham Intellectual Property, Media and Entertainment Law Journal* 619 (2000), at 621–24.

98 Jonathan Band and Masanobu Katoh, *Interfaces on Trial 2.0* (Cambridge, MA: MIT Press, 2011) 183, 184.

99 Ibid.

100 See Benkler, *The Wealth of Network*, above n 88, at 394 (arguing that 'the drive for openness is based on individual and voluntary cooperative action…The social practices of openness take on a

C. Multiple actors in the ICT standard-setting landscape: a snapshot

1. Regional SSOs

While national SSOs traditionally work closely with the ITU, the ISO, and the IEC, the rise of regional SSOs has in some ways affected this paradigm. This section examines selected regional SSOs. In so doing, we will better understand not only the overall picture of the fragmented ICT standards universe, but also the underlying tension between WTO Members, which will be addressed in greater detail later.

i. European SSOs Among other regional SSOs, the most notable example is the ESOs: CEN, CENELEC, and ETSI.[101] CEN and CENELEC—the nonprofit entities incorporated under Belgian law—are the regional equivalents of the ISO and the IEC, respectively.[102] The members of CEN and CENELEC are the 'National Standards Bodies' and the 'National Electro-technical Committees' of 33 European nations, including all EU Members, three European Free Trade Association (EFTA) countries (i.e. Iceland, Norway, and Switzerland), and two EU candidate countries (i.e. Turkey and the Former Yugoslav Republic of Macedonia).[103] The CEN's mission covers all sectors with the exception of the electro-technical sector, one area that is managed by the CENELEC.[104]

More important for the ICT sector is ETSI. ETSI, a French-based nonprofit organization, is a regional standards institution comparable to the ITU. ETSI describes itself as setting 'globally-applicable standards for Information and Communications (ICT), including fixed, mobile, radio, converged, broadcast and internet technologies'.[105] In contrast to the restrictive membership policies adopted by CEN and CENELEC, ETSI is flexible: any entity with an interest in creating telecommunications and related standards can become an ETSI member.[106] Today, ETSI has more than 750 members from 62 countries across five continents, including national SSOs, network operators, manufacturers, service providers, users, research institutions, universities, consulting firms, and so forth.[107]

All of these three SSOs are officially recognized by the EU as 'European Standards Organizations', and only their output represents 'European Standards'.

quasi-normative face when practiced in standard-setting bodies like the Internet Engineering Task Force (IETF) or the World Wide Web Consortium (W3C)').

101 For an overview, see e.g. Egan, above n 79, at 133–65.

102 While CEN and CENELEC became more visible after the 1980s, the two institutions are not new. CENELEC (formerly, CENELCOM) was created in 1959 whereas CEN was established in 1961. Ibid, at 136–38.

103 *Members*, European Committee for Standardization, available at http://www.cen.eu/cen/members/pages/default.aspx (visited 15 January 2014); *Members*, European Committee for Electrotechnical Standardization, available at http://www.cenelec.eu/dyn/www/f?p=WEB:5:3327842356890653 (visited 15 January 2014).

104 *About Us*, European Committee for Standardization, available at http://www.cen.eu/cen/AboutUs/Pages/default.aspx (visited 15 January 2014).

105 *About ETSI*, European Telecommunications Standards Institute, available at http://www.etsi.org/about (visited 15 January 2014).

106 *Membership*, European Telecommunications Standards Institute, available at http://www.etsi.org/index.php/membership (visited 15 January 2014).

107 Ibid.

These ESOs play a critical role in standards activities at both regional and international levels.[108] At the regional level, compliance with European Standards confers on firms the benefits of presumption of conformity under the New Approach. Additionally, regional collaboration may enhance global competiveness by setting standards of European origin without relying on rival technologies.[109] At the international level, while the ESOs once had a rather limited role and were restrained from competing with the traditional international SSOs, they became more visible on the global stage after the 1980s.[110] Several reasons may explain this. First, there was a 'race to the bottom' concern about deference to international standards since the standards that accommodate the heterogeneous interests of different states and regions were often less stringent than European standards.[111] Second, until standards activities were placed at the center of the single market program, it was relatively difficult for European policymakers to manage the linkages between European standards and international standards, as well as European standards and national standards.[112] The expanding role of the ESOs provided a sound setting to coordinate the Member States and, more importantly, to promote European standards in the international arena.[113] Meanwhile, the EU also attempted to make its standards initiatives more influential through the 'European Neighbourhood Policy'.[114]

Over time, the influence of these ESOs spanned beyond Europe through a set of arrangements. All of these ESOs, for instance, cooperate with their international counterparts via various agreements, such as the Vienna Agreement between the ISO and CEN,[115] the Dresden Agreement between CENELEC and the IEC,[116] and the Memorandum of Understanding between ETSI and the ITU-T.[117] Beyond that, these ESOs may also exert their influence over other SSOs. ETSI, for instance, hosts a number of conferences and maintains an active liaison with industry

108 DLA Piper EC Study, above n 33, at 26 ('With the creation of the three ESOs and the implementation of the New Approach, EU standardisation activity has moved substantially away from the national to the European and international level').

109 See discussion above Section II. B. 4.

110 Egan, above n 79, at 138.

111 Ibid.

112 Ibid.

113 See generally Communications from the Commission to the European Parliament and the Council on the Role of European Standardization in the Framework of European Policies and Legislation, at 1, 7, COM (2004) 674 final (18 October 2004).

114 Ibid, at 5. See also Communication from the Commission, European Neighborhood Policy Strategy Paper, at 1, 20–21 COM (2004) 373 final.

115 See International Organization for Standardization (ISO) and European Committee for Standardization (CEN), *Agreement on Technical Cooperation Between ISO and CEN (Vienna Agreement)*, available at http://isotc.iso.org/livelink/livelink/fetch/2000/2122/4230450/4230458/01__Agreement_on_Technical_Cooperation_between_ISO_and_CEN_%28Vienna_Agreement%29.pdf?nodeibid=4230688&vernum=-2 (visited 16 January 2014).

116 See International Electrotechnical Commission (IEC) and European Committee for Electrotechnical Standardization (CENELEC), *Agreement on Common Planning of New Work and Parallel Voting (Dresden Agreement)*, available at http://www.iec.ch/about/globalreach/partners/regional/iec_cenelec_agreement.htm (visited 16 January 2014).

117 See International Telecommunication Union (ITU) and European Telecommunications Standards Inst. (ETSI), *Memorandum of Understanding*, available at http://www.itu.int/en/ITU-T/extcoop/Documents/mou/SKMBT_28312070315450.pdf (visited 16 January 2014).

consortia, fora, and many other SSOs.[118] Notwithstanding the membership restrictions, CEN and CENELEC collaborate with third-country national SSOs and/or regional SSOs through various channels.[119]

ii. Other regional SSOs There are some other regional SSOs that are more loosely organized than the ESOs. The Pacific Area Standards Congress (PASC), comprised of 26 members in the Pacific Rim region, provides a forum to coordinate the national SSOs while acting as a consultative liaison with international and other regional SSOs.[120] Subject to an affirmative vote of a majority of its members, PASC's membership is open to any state or territory (i) in the Pacific Rim whose standard body is a full, subscriber, associate, affiliate, or correspondent member of the ISO and the IEC, or (ii) whose national SSOs determined are by PASC as capable of making a contribution to the objectives of PASC.[121] Much like the ESOs, PASC has entered into cooperative agreements with regional and international SSOs.[122]

PASC's counterpart in the Americas is the Pan American Standards Commission (COPANT). COPANT is a nonprofit organization comprised of national SSOs of the Americas to facilitate trade among and between American countries and other regions and to improve participation of its members in international standardization.[123] Generally, only national SSOs of the Americas recognized by the Assembly of COPANT are eligible for 'Active Member' status, while other SSOs at different levels across regions may only join as an 'Adherent Member'. Currently, COPANT has 31 Active Members and 9 Adherent Members from Africa, Europe, and Oceania.[124] Table 1 summarizes the above regional SSOs.

2. Industry consortia

i. General remarks There is no one-size-fits-all definition of a consortium. In its most general sense, a consortium refers to a loose alliance composed of firms,

118 See *Our Global Role,* the European Telecommunications Standards Institute, available at http://www.etsi.org/about/our-global-role (visited 15 January 2014); Schoechle, above n 43, at 34.

119 There are generally four models of cooperation. Third-country national SSOs may cooperate with CEN/CENELEC through either 'Affiliation', 'Standardization Partnership', or 'Agreement', while 'Memorandum of Understanding' is intended for establishing the official relationship between CEN/CENELEC and other regional SSOs. See generally Comité Européen de Normalisation, CEN/CENELEC Guide No. 13, *The Concept of Partner Standardization Body with CEN and CENELEC* (2008), available at ftp://ftp.cencenelec.eu/CENELEC/Guibides/CENCLC/13_CENCLCGuibide13.pdf (visited 6 March 2014).

120 *Membership*, The Pacific Area Standards Congress, available at http://www.pascnet.org/roster.jsp (visited 16 January 2014); Pacific Area Standards Congress, Charter Article 2 (as amended in April 2008) [hereinafter PASC Charter].

121 PASC Charter, above n 120, Article 3.

122 See e.g. International Organization for Standardization (ISO) and Pacific Area Standards Congress, *Agreement on Cooperation between ISO and PASC*. available at http://publicaa.ansi.org/sites/apdl/Documents/About%20ANSI/Memoranda%20of%20Understanding/2006-09%20PASC-ISO%20MoC.pdf (visited 16 January 2014).

123 *Structure, About COPANT*, the Pan American Standards Commission, available at http://www.copant.org/en/web/guest/estructura (visited 16 January 2014).

124 *Members, About COPANT*, the Pan American Standards Commission, available at http://www.copant.org/en/web/guest/miembros (visited 16 January 2014).

Table 1. Selected examples of regional SSOs

Name		Number of members	Global reach (i.e. cooperation w/other national, regional and/or international SSOs)
ESOs	CEN	33	Yes
	CENELEC	33	Yes
	ETSI	750+	Yes
PASC		26	Yes
COPANT		31	Yes

Source: CEN, CENELEC, ETSI, COPANT, and PASC (as of January 2014).

organizations, and individuals that is funded by membership dues or otherwise for technological and commercial reasons.[125] A consortium can be organized in a number of ways depending on its motives and strategies. There are several major approaches for firms to set standards.[126] The single promoter model is the simplest form for a firm to develop standards for industry adoption.[127] While this model is, in a strict sense, not a consortium, many standards are created through this approach.[128]

In other contexts, firms jointly set standards by the contractual model.[129] The corporate model, however, is perhaps the most popular approach among the options.[130] Such consortia are typically organized under the not-for-profit laws of a

125 See Hawkins, above n 54, at 161.

126 For an overview of different legal forms of consortia, see Biddle et al., above n 5, at 185–91. See also Andrew Updegrove, 'Chapter 6: Forming a Successful Consortium Part II—Legal Considerations' [hereinafter Updegrove, 'Legal Considerations], available at: http://www.consortiuminfo.org/essentialguibide/forming2.php (visited 17 January 2014).

127 Biddle et al., above n 5, at 185.

128 To foster a broader adoption by the industry, the promoter often pledges not to assert patented technologies necessary to implement the standards—also known as 'essential claims'—against the implementers. Microsoft's 'Open Specification Promise' (OSP) is an example. See Open Specification Promise, Microsoft Corp., http://www.microsoft.com/openspecifications/en/us/programs/osp/default.aspx (visited 20 January 2014).

129 Under the contractual model, firms often follow the 'Promoter-Adopter' structure where a group of core members enter into the so-called 'promoter agreement' setting out basic terms that governs, for instance, cross-licensing arrangements for the certain necessary IPR in the context, and the procedural rules for developing the standards. In order to drive a wider adoption, firms would allow third parties to involve in the standardization process and implementation by what is termed 'contributor agreement' and 'adopter agreement'. Biddle et al., above n 5, at 186–88.

130 The corporate-type consortia are often structured around a number of documents, such as the certificate of incorporation, bylaws, membership agreements, IPR policy, and so forth. Although the corporate model seems burdensome, it does have some advantages over noncorporate model.
First, existing corporate law lays down many ground rules that contractual model must otherwise create from the scratch. Second, corporate model may provide better protection to officers, staffs, and directors. See Updegrove, 'Legal Considerations', above n 126.

jurisdiction.[131] And still other consortia opt for either the hybrid model[132] or the host model.[133]

Despite the variances in legal formalities, consortia are often described as carrying out 'grey standardization' activities in the sense that they operate outside the governmental framework familiar to policymakers in the past.[134] These grey SSOs vary in their appreciation of the ties with the formal standardization route.[135] Some prefer a closer relationship with the formal SSOs, such as the Big Three, the ESOs, or national SSOs, while others opt to standardize independently.[136]

ii. Geographic origins and global reach It has been reported by CEN/CENELEC that as of August 2012, more than 230 industry-led SSOs had been formed.[137] As Figure 1 shows, the USA is at the top with 157 consortia, followed by the UK with 16, Belgium with 15, and Switzerland with 5. Yet, despite their variance in terms of geographic origin, these consortia are often international rather than national in their

131 Ibid.

132 The hybrid model lies somewhere between contractual model and corporate model. This sort of consortium would base on contractual arrangements to govern standardization, while setting up a separate legal entity to handle the logistic matters, such as marketing, adopter relationship, and promotion of industry adoption. USB-IF is an example of this model. See Articles of Incorporations, USB Implementers Forum Inc., available at: http://www.usb.org/about/usbif_articles_of_incorp052605.pdf (visited 6 March 2014); USB 2.0 Adopter Agreement, USB Implementers Forum Inc., available at: http://www.usb.org/developers/docs/USB_2_0_Adopters_Agreement_final_021411.pdf (visited 6 March 2014). For an analysis of this model, see Biddle et al., above n 5, at 190.

133 The host model is the most innovative approach among others. Certain SSOs provide hosting services to serve standards activities of other bodies to alleviate the burdensome administrative tasks. The most famous example is the Institute of Electrical and Electronics Engineers Industry Standards and Technology Organization (IEEE-ISTO). The IEEE-ISTO is a non-profit organization that runs as an umbrella institution to serve various industry programs. SSOs under this model rely on the host institution for infrastructure and services while maintaining a fair amount of autonomy setting out its governance, membership dues, and other technical programs. See ibid at 190–91; Updegrove, 'Legal Considerations', above n 126.

134 See Egyedi, above n 32, at 54–55; Daniel Benoliel, 'Technological Standards, Inc.: Rethinking Cyberspace Regulatory Epistemology', 92 *California Law Review* 1069 (2004), at 1110.

135 Egyedi, above n 32, at 55.

136 In the USA, for instance, the IEEE has been recognized by the American National Standards Institute (ANSI) as 'Accredited Standards Developer' while other key players, including W3C, and IETF are not. And in Europe, ECMA has long sought to give their standards a broader base through national channels and their liaison relationship with the traditional international SSOs. See ibid, at 55–56. On the ANSI accredited SSOs, see American National Standards Institute, ANSI Accredited Standards Developers, available at http://publicaa.ansi.org/sites/apdl/Documents/Standards%20Activities/American%20National%20Standards/ANSI%20Accredited%20Standards%20Developers/JAN14ASD_basic.pdf (visited 20 January 2014).

137 See generally *ICT Consortia*, The European Committee for Standardization, http://www.cen.eu/cen/sectors/sectors/isss/consortia/pages/default.aspx (visited 17 January 2014). There are two caveats about this data. First, we do not claim that the CEN/CENELEC list to be complete. To the best of our knowledge, there is at least one alternative to the CEN/CENELEC list sponsored by a US-based law firm. And according to this data, there are over 800 consortia involved in the ICT standards activities. Second, while this section proceeds based on the CEN/CENELEC data, it does not imply that the author accepts EU's (or the US's) view as to whether or to what extent these consortia should be recognized under national or international laws. We will return to this in Section III. A. For an alternative consortia list, see generally Standard Setting Organizations and Standards List, ConsortiumInfo.org, available at http://www.consortiuminfo.org/links/linksall.php (visited 17 January 2014).

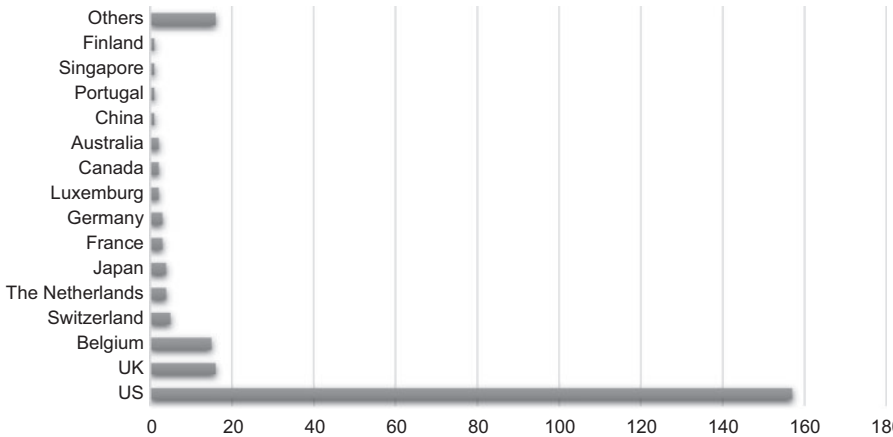

Figure 1. Number of ICT consortia by country.
Source: Compiled by author based on CEN/CENELEC Comprehensive Consortia List (17th ed.).

membership.[138] As Andrew Updegrove suggests, the rationale is two-fold: First, the founders of these bodies are usually multinational in terms of business operations.[139] For this reason, these consortia set standards targeted at global rather than national adoption.[140]

iii. Some selected examples Among these consortia in existence today, some flourish, while others attain only limited success. And still others fail even to gain any attraction at all. To be sure, however, a number of consortia are more powerful than those formal SSOs—be they national, regional, or international—in transforming our information society. We do not intend to outline all of these grey SSOs, but illustrations of some key players with global influence are warranted:

1. IEEE is a nonprofit organization incorporated in 1963 under the New York State NonProfit Corporation Law.[141]It is the world's largest technical professional association, whose aim is to 'foster technological innovation and excellence for the benefit of humanity'.[142] Thus, IEEE brings together students, engineers, scientists, and professionals who work in its fields of

138 See Andrew Updegrove, 'Chapter 1: What (and Why) is An SSO?' [hereinafter Updegrove, 'What (and Why) is SSO?'], available at: http://www.consortiuminfo.org/essentialguibide/whatisansso.php (visited 17 January 2014)

139 Ibid.

140 Ibid.

141 See *History of IEEE, About IEEE*, The Institute of Electrical and Electronics Engineers, available at http://www.ieee.org/about/ieee_history.html (visited 18 January 2014). For an overview of the IEEE, see e.g. Eliza Varney, 'Institute of Electrical and Electronic Engineers, Inc.', in Christian Tietje and Alan Brouder (eds), *Handbook of Transitional Economic Governance Regimes* (Brill Publisher, 2009) 561 [hereinafter Varney, *IEEE*].

142 *IEEE Mission and Vision, About IEEE*, The Institute of Electrical and Electronics Engineers, available at http://www.ieee.org/about/vision_mission.html (visited 18 January 2014).

expertise, including all aspects of electrical, electronic, computing and related areas of science and technology.[143] As of December 2012, IEEE had more than 425,000 members in over 160 countries, more than 50% of whom come from outside the USA.[144] Standards development in the ICT sector is a major task of the IEEE. It has produced thousands of ICT standards through the IEEE Standards Association (IEEE-SA).[145] The 802.11-series standards for WLAN are perhaps most notable, among other achievements.[146]

2. The Internet Engineering Task Force (IETF) is an international community of network designers, operators, vendors, and researchers who contribute to the evolution of Internet architecture.[147] Unlike the IEEE, IETF is not an incorporated consortium.[148] Rather, it is a loosely organized forum open to anyone who intends to participate in the development of Internet standards.[149] IETF has been successful in creating voluminous standards that make the Internet work, such as Transmission Control Protocol/Internet Protocol (TCP/IP), routing, and security protocols.[150]
3. W3C was founded in 1994, five years after Tim Berners-Lee invented the World Wide Web.[151] W3C is organized as a contractual consortium that is jointly hosted by four institutions across three continents: (i) the Massachusetts Institute of Technology Computer Science and Artificial Intelligence Laboratory (CSAIL) in the USA, (ii) the European Research Consortium for Informatics and Mathematics (ERCIM) in France, (iii) Keio University in Japan, and (iv) Beihang University in China.[152] Meanwhile, W3C maintains various regional offices to ensure its role as an international organization.[153] It is open to any entity that can sign the membership agreement, including for-profit, nonprofit, governmental or nongovernmental entities, and individuals.[154] As of the time of this writing, W3C has 388 members from around the world.[155] W3C describes its mission as

143 *IEEE At-a-Glance*, *About IEEE*, The Institute of Electrical and Electronics Engineers, http://www.ieee.org/about/today/at_a_glance.html (visited 18 January 2014).

144 Ibid.

145 *About IEEE-SA*, *About Us*, The IEEE Standards Association, available at http://standards.ieee.org/about/index.html (visited 18 January 2014).

146 Varney, *IEEE*, above n 141, at 562.

147 *About the IETF*, The Internet Engineering Task Force, available at http://www.ietf.org/about/ (visited 18 January 2014) [hereinafter *About IETF*].

148 See Scott Bradner, 'The Internet Engineering Task Force', in DiBona et al. (eds), above n 45, at 47.

149 See Jonathan Zittrain, *The Future of the Internet and How to Stop It* (New Haven: Yale University Press, 2008) 141 (noting that the IETF has no 'membership' and anyone can join).

150 Bradner, above n 148, at 47.

151 *Fact About W3C*, *About W3C*, The World Wide Web Consortium, available at http://www.w3.org/Consortium/facts#history (visited 18 January 2014).

152 Ibid.

153 Ibid ('Regional offices play an important role in W3C being an international organization'.)

154 *Membership FAQ*, *Membership*, The World Wide Web Consortium, available at http://www.w3.org/Consortium/membership-faq#who(visited 18 January 2014).

155 *Current Members*, *Membership*, The World Wide Web Consortium, available at http://www.w3.org/Consortium/Member/List (visited 18 January 2014).

leading the World Wide Web to 'its full potential by developing protocols and guidelines that ensure the long-term growth of the Web'.[156] HTML is one among many examples of that effort.

4. The Organization for the Advancement of Structured Information Standards (OASIS) was founded in 1993 under the name of 'SGML Open'.[157] It is a Pennsylvania domestic nonprofit corporation, with its head office in Boston, Massachusetts.[158] Any company, organization, or individual is eligible for membership in the OASIS.[159]OASIS has more than 5000 participants representing more than 600 institutions and individual members in over 65 countries.[160] To date, OASIS has become a major source of worldwide standards in Cloud computing, cyber security, Web services, and other related areas.[161]
5. ECMA International, founded in 1961, is a not-for-profit industry association organized under the Swiss Civil Code.[162] Its mission is to set standards of the ICT and consumer electronics.[163] The creation of ECMA was triggered by the need in the computer industry in the late 1950s.[164] The proliferation of different operational techniques as well as input/output codes made it difficult for products and equipment from different manufacturers to interoperate and led to duplications of work by market participants. In response to such challenges, certain key players in the computer industry, such as IBM and Compagnie des Machines Bull, agreed to form an association of computer manufacturers in 1960.[165] This association, originally established under the name of the European Computer Manufacturers Association, was renamed as 'ECMA International' in 1994 to reflect its global outreach.[166] To date, it has five categories of membership: one for not-for-profit entities and four for companies.[167] Since its

156 *W3C Mission, About W3C,* The World Wide Web Consortium, available at http://www.w3.org/Consortium/mission.html (visited 18 January 2014).

157 *Organization, About Us,* Organization for the Advancement of Structured Information Standards, available at https://www.oasis-open.org/org (visited 18 January 2014).

158 *FAQ, About Us,* Organization for the Advancement of Structured Information Standards [hereinafter OASIS FAQ], available at https://www.oasis-open.org/org/faq (visited 18 January 2014).

159 *Categories and Dues, Join,* Organization for the Advancement of Structured Information Standards, available at https://www.oasis-open.org/join (visited 18 January 2014) [hereinafter Join OASIS].

160 *Members, About Us,* Organization for the Advancement of Structured Information Standards, available at https://www.oasis-open.org/member-roster (visited 18 January 2014).

161 Ibid.

162 See Bylaws of ECMA, Article 1.1. [hereinafter ECMA Bylaws], available at: http://www.ecma-international.org/memento/Ecmabylaws.htm (visited 19 January 2014).

163 *What is ECMA,* ECMA International, available at http://www.ecma-international.org/memento/index.html (visited 19 January 2014). For an overview of ECMA, see Eliza Varney, 'ECMA International', in Tietje and Brouder (eds), above n 141, at 553 [hereinafter Varney, 'ECMA International'].

164 *History of ECMA,* ECMA International, available at http://www.ecma-international.org/memento/history.htm (visited 19 January 2014).

165 Ibid.

166 Ibid.

167 *ECMA Members,* ECMA International, available at http://www.ecma-international.org/memento/members.htm (visited 19 January 2014). See also Varney, 'ECMA International', above n 163, at 554.

inception, ECMA has issued over 400 standards, many of which have been adopted by the ISO/IEC as international standards or by ESTI as European standards.[168]

III. THE IMPLICATIONS FOR THE WTO

A. Centralized approach versus decentralized approach

1. TBT's silence and US–EU divergence

One recurring problem for trade policymakers and adjudicators is the notion of international standards in the TBT Agreement. That said, Article 2.4 of the TBT Agreement obliges WTO Members to use international standards as a basis for their technical regulations wherever appropriate. Yet, 'international standard' is not a defined term in the TBT Agreement. And, unlike the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement),[169] the TBT Agreement lacks a list of international standardization bodies whose outputs count as an 'international standard'. It is thus possible that there is more than one SSO that engages in standards activities relevant to a given measure for the purpose of Article 2.4 of the TBT.[170] Such a possibility raises questions of contestation between different international standard-setters,[171] and the issue has been raised on various occasions since the late 1990s.[172]

In 2000, WTOs TBT Committee enacted a decision relating to 'Principles for the Development of International Standards' which laid down six principles to be observed when international standards are elaborated, including transparency, openness, impartiality and consensus, effectiveness and relevance, coherence, and

168 ECMA's Open XML standard is a notable example endorsed by the ISO/IEC. See Press Release, ECMA Int'l, ISO and IEC approve Office Open XML document format standard, (1 April 2008), available at http://www.ecma-international.org/news/TC45_current_work/ISO_and_IEC_approve_Office_Open_XML.htm (visited 19 January 2014). For a complete list of ECMA standard and the equivalent in the ISO/IEC, ITU, and ETSI, see generally *ECMA Standards*, ECMA International, available at http://www.ecma-international.org/publications/standards/Standard.htm (visited 19 January 2014).

169 Agreement on the Application of Sanitary and Phytosanitary Measures (SPS), 15 April 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1A, Multilateral Agreements on Trade in Goods, 33 I.L.M. 1154 (1994) [hereinafter SPS Agreement].

170 See Trebilcock et al., above n 12, at 318.

171 Robert Howse, 'A New Device for Creating International Legal Normativity: The WTO Technical Barriers to Trade Agreement and "International Standards"', in Christian Joerges and Ernst-Ulrich Petersmann (eds), *Constitutionalism, Multilevel Trade Governance and Social Regulation* (Oxford: Hart Publishing, 2006) 392–93.

172 See e.g. Committee on Technical Barriers to Trade, *U.S Paper on the First Triennial Review*, G/TBT/W/40 (25 April 1997) [hereinafter *US Paper on First Triennial Review*]; Committee on Technical Barriers to Trade, *Issues Concerning International Standards and International Standardization Bodies: Submission from Japan*, G/TBT/W/113 (15 June 1999) [hereinafter *Issues Concerning International Standards: Japan*]; Committee on Technical Barriers to Trade, *On the Conditions for the Acceptance and Use of International Standards in the Context of the WTO Technical Barriers to Trade Agreement: Note from the European Community*, G/TBT/W/87/Rev.1 (30 September 1999) [hereinafter *Note from the EC*].

development dimension.[173] Despite its efforts to shed some light on international standard-setting in light of the norms and priorities of the trade community,[174] this Decision does little to resolve the ambiguities.[175]

In recent years, growing concerns about technical trade barriers and the emergence of various new players in the standards game rekindled debates over the concept of international standards in the TBT context. Members are generally split into two camps: one favoring the centralized approach by designating certain SSOs as international standardizing bodies for the purpose of the TBT Agreement, and the other upholding the decentralized approach by citing relevant international standards and bodies on a case-by-case basis.

The EU is a strong advocate for the centralized approach. In its proposal to the Negotiating Group on Market Access, the EU, while noting that interested parties and consortia in the sectors covered by the WTO's Information Technology Agreement[176] may develop 'alternative standardization documents' (ASDs) to facilitate production and marketing of innovative products, was nevertheless conservative about incorporating these ASDs into the WTO/TBT regime.[177] Citing the need for regulatory convergence, the EU instead proposed to designate the ITU, the ISO, and the IEC as 'international standardizing bodies' for the purpose of the TBT Agreement with regard to safety of electrical equipment and electromagnetic compatibility for certain products.[178] The EU proposed, as a second step, that these ASDs should be allowed if and only if they are approved by the Big Three under certain requirements, as shown in Table 2.[179]

In contrast, the USA has assumed the lead role in the decentralized approach. Such a liberal view has been identified on various occasions.[180] In the USA's view, while it is important to facilitate trade through greater harmonization, it does not make sense to designate particular bodies as 'relevant international standardizing bodies'.[181] There are several reasons for this. First, whether a given standard is

173 Committee on Technical Barriers to Trade, *Decisions and Recommendations Adopted by the Committee Since 1 January 1995*, G/TBT/1/Rev.10, Annexes (9 June 2011) [hereinafter 2002 TBT Committee Decision].

174 Howse, above n 171, at 392–3 (describing this Decision as the WTO's attempt to 'hegemonise' the international standard in the name of 'undistorted markets' and 'technological development'.)

175 Harm Schepel, 'The Empire's Drains: Sources of Legal Recognition of Private Standardization under the TBT Agreement', in Constitutionalism, Joerges and Petersmann (eds), above n 171, at 406 (noting that this Decision is a 'blatant agreement to disagree between the major trading partners', and 'does little but add ambiguity to the process'.)

176 World Trade Organization, Ministerial Declaration on Trade in Information Technology Products of 13 December 1996, WT/MIN (96)/16 (1996) [hereinafter ITA Agreement].

177 WTO Negotiating Group on Market Access, Communication from the European Union: Negotiating Text: Understanding on the Interpretation of the Agreement on Technical Barriers to Trade as Applied to Trade in Electronics, at 3, TN/MA/W/129, 7 December 2009 [hereinafter Communication from the EU].

178 Ibid, at 2.

179 Ibid, at 3.

180 In *US-Tuna II (Mexico)*, for instance, the USA agreed with Mexico that certain SSOs, such as IEEE, can qualify as an international standardizing body for the purpose of the TBT Agreement. See Panel Report, *United States–Measures Concerning the Importation, Marketing, and Sale of Tuna and Tuna Products*, WT/DS381/R, adopted 13 June 2012, para 7.655 [hereinafter Panel Report, *US - Tuna II (Mexico)*].

181 WTO Negotiating Group on Market Access, Communication from the United States: International Standards, at 1, TN/MA/W/138, 28 June 2010 [hereinafter Communication from the US].

Table 2. Requirements for alternative standardization documents

Requirement	Remarks
Six Principles	Principles set out in the 2002 TBT Committee Decision
Scope of Products	The technical specifications in such alternative documents are used in the design of a specific product category, such as electrical and electronic equipment, electronic household appliances, and consumer electronics.
Procedure	ASDs should be presented by at least two members of the relevant international standardizing bodies (i.e. ITU, ISO, and IEC), jointly with a clear demonstration of how the six principles have been respected with a view to its adoption as international standard.
Timing	Within a period of three–five months following the presentation of the ASDs, the relevant international standardizing bodies shall publish such documents in accordance with appropriate procedure.
IPR Issue	The interested parties or industry consortia that have elaborated the ASDs do not restrict the use of technical specifications through licensing or other otherwise and should disclose all the technical information necessary to implement the standards.

Source: Communication from the EU (TN/MA/W/129).

'relevant' for the purpose of the TBT Agreement would depend on the standard, not the body. The EU's centralized approach effectively endorses 'standards that such [designated] bodies produce', regardless of their content and 'whether those standards are ones that ultimately meet specific regulatory or market needs'.[182] The USA, then, points out that as a practical matter, many SSOs other than the Big Three set standards that can better serve regulatory and market needs, and the IEEE is a classic example of this dynamic in the ICT sector.[183] The USA rejects the EU's view by underscoring technological changes as follows:

> The simple reality is that bodies developing standards in any particular area have changed, and will continue to change over time, as product technologies evolve and new products are developed in ways that cannot be anticipated. For example, mechanical parts have been increasingly replaced with electronic IT parts in automobiles over the last decades, which has implications for the relevance of the underlying standards and the bodies that produce them.[184]

Furthermore, the USA argues that this centralized approach would not facilitate developing countries' participation, since it can barely provide a nonfail, one-stop shop

182 The USA also argues that this centralized approach would 'establish a presumption that technical regulations and conformity assessment procedures based on standards developed by a designed body are not unnecessary obstacles to trade', even if their standards are inappropriate, outdated or otherwise flawed. See ibid, at 2–3.

183 Ibid, at 2.

184 Ibid.

for developing countries in search of relevant standards.[185] The USA suggests, more importantly, that the centralized approach would run counter to the 'development dimension principle' in the 2002 TBT Committee Decision in the sense that it would automatically render any standard set by the designated SSOs as 'relevant' for the purpose of the TBT Agreement, even if such standards do not meet the needs of developing countries.[186] Finally, the USA adds, on top of these concerns, the centralized approach would foreclose any flexibility to use more than one standard that may be responsive to regulatory or market needs.[187] Such a loss of flexibility may be at the expense of market participants and global trade.[188]

2. Why divergence? Economic and political interests at stake

As discussed, two major trading powers on both sides of the Atlantic have different views as to how to treat those new standard-setters in the TBT Agreement. This divergence reflects, in part, the USA's dominance in standards activities in the ICT sector. The USA, as illustrated earlier, is home for most of the ICT industry consortia. Today, more than 150 consortia are US-based, and none of the European nations are even close to the USA in terms of size. Even if one counts European nations as a whole, North America (with 157 in the USA and two in Canada) still has a significant lead, with 68% when compared to Europe's 20% in the ICT consortia universe (see Figure 2). Designating the Big Three as international standardizing bodies for the purpose of the TBT Agreement effectively keeps these consortia in a secondary role. It comes as no surprises that the decentralized approach is in the USAs favor.

The USAs opposition to the centralized approach also reflects the EUs greater influence over the traditional international SSOs. As noted above, ESOs maintain institutional links with the Big Three in coordinating standards activities. Such closer links can be exemplified by, for instance, the cooperation between CEN and the ISO. Under the Vienna Agreement, CEN and the ISO set out detailed procedures for cooperation in various ways, including exchange of information, mutual representation at meetings, and parallel approval of standards at the global and European levels.[189] Standards development can be led by the ISO or CEN. When a new international standards project is proposed, members in the relevant ISO technical committee would decide which body should take the lead. In the majority of cases, as Tim Büthe and Walter Mattli point out, 'ISO takes the lead, but voting on the final draft standard is parallel with CEN'.[190] However, if standards are required to

185 Ibid.

186 Ibid, at 3.

187 Ibid, at 4.

188 Ibid.

189 Vienna Agreement, above n 115, Article 4. See also International Organization for Standardization (ISO) and European Committee for Standardization (CEN), *Guidelines for the Implementation of the Agreement on Technical Cooperation between ISO and CEN (the Vienna Agreement)*, available at http://isotc.iso.org/livelink/livelink/fetch/2000/2122/4230450/4230458/02__Guibidelines_for_the_implementation_of_the_Agreement_on_Technical_Cooperation_between_ISO_and_CEN_%28the_Vienna_Agreement%29_6th_ed._Jan_2014.pdf?nodeibid=4230689&vernum=-2 (visited 25 January 2014).

190 Tim Büthe and Walter Mattli, *The New Global Rulers: The Privatization of Regulation in the World Economy* (Princeton: Princeton University Press, 2011) 158.

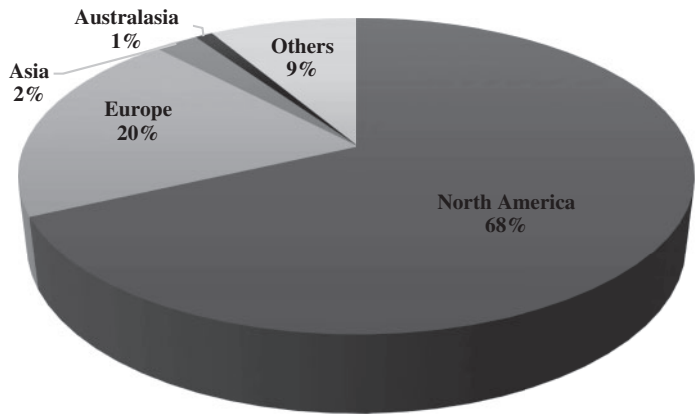

Figure 2. ICT consortia by region.
Source: Compiled by author based on the CEN/CENELEC Comprehensive Consortia List (17th ed.).

reflect specific needs of the EU, the lead is generally in the hands of CEN.[191] Voting on a draft standard then takes place in both institutions; if accepted by both, the 'European-made standard becomes an international standard without further technical discussions at the ISO'.[192] As a result of such close collaboration, it is reported that around 30% of CEN-approved standards are identical to ISO standards.[193]

For these reasons, there have been criticisms that these sorts of collaborative mechanisms effectively 'serve as vehicles to unduly influence global standardization processes and discriminate against non-European interests'.[194] The USA made clear in its submission to the WTO that:

> [I]t is notable that the bodies that the proposals would designate are ones in which the EU, in many instances, has a greater voice than other Members, or reflect infrastructure or conditions prevalent in Europe but not elsewhere. This is true of the UNECE 1958 Agreement, as well as ISO and IEC, where the combination of the Vienna and Dresden Agreements and the participation of 27 EU member states can result in the EU having greater influence in ISO and IEC than other countries.[195]

191 Ibid.

192 Ibid.

193 See Products, European Standards (EN), European Committee for Standardization, available at http://www.cen.eu/cen/products/en/pages/default.aspx (visited 25 January 2014). The percentage is even higher for CENELEC-approved standards: 79% of CENELEC standards are identical or based on the IEC international standards. See *CENELEC Facts and Figures, What We Do, About CENELEC,* European Committee for Electrotechnical Standardization.

194 Such criticisms are often from the USA. See Büthe and Mattli, above n 190, at 158; Michael Koeble, 'Article 1 and Annex 1 TBT', in Rüdiger Wolfrum et al. (eds), *Max Planck Commentaries on World Trade Law: WTO-Technical Barriers and SPS Measures* (Leiden: Brill, 2007) vol. 3, 178, 191 ('[S]uch understanding may fuel fears that European countries may abuse their numerical superiority in the classic international standardizing bodes in order to proliferate their European standards globally').

195 Communication from the US, above n 181, at 4.

The disagreement reflects, more fundamentally, the different institutional endowments and local political and economic cultures of the two major trading powers.[196] The US's private-sector dominated standardization tradition, as Jane Winn remarks, has its roots in the so-called 'liberal market economy' (LME).[197] In a typical LME like the USA, firms often coordinate their activities primarily through competitive market arrangements.[198] It works in a way that is more individualistic, more market-oriented, and less dependent on government intervention. In contrast, the EUs standards structure have the features of the 'coordinated market economy' (CME).[199]In a CME, firms rely more on nonmarket mechanisms to coordinate their endeavors with other actors to 'construct their core competencies'.[200] As a result, the EUs standardization system is 'hierarchical, coordinated, and regulated', and standards activities operate within a framework of government oversight.[201]

Such divergent regulatory philosophies may in part explain why most of the ICT consortia are not from the EU, but the USA It also illustrates why EU regulators would prefer, even at the global level, a coordinated and hierarchical standard-setting paradigm. Any attempt to reconcile these differences implicates institutional changes. These domestic and regional institutional standard-setting systems, however, can be self-reinforcing and are likely to remain in place over time due to path dependence.[202] This can, as Büthe and Mattli argue, create 'powerful organizational and social interests that vehemently oppose any radical overhaul of the domestic institutional systems bound to undermine their power'.[203] Transition costs can be significant. Thus, one might expect the persistence of this divergence between the two major trading powers for an extended period of time. One may wonder, then, what the WTO adjudicators' preference might be. When a dispute touches on new arenas that fall within the purview of those consortia, how would WTO adjudicators seat these new players under the TBT regime? The next section examines relevant case law and applies it to the ICT standards context.

196 See Kenneth W. Abbot, 'US-EU Dispute over Technical Barriers to Trade and the "Hushkit" Dispute', in Ernst-Ulrich Petersmann and Mark A. Pollack (eds), *Transatlantic Economic Disputes: the EU, the US, and the WTO* (Oxford: Oxford University Press, 2003) 247, 257; Jane K. Winn, 'Governance of Global Mobile Money Networks: the Role of Technical Standards', 8 *Washington Journal of Law, Technology and Art* 197 (2013), at 203–04.

197 See Winn, 'Two Level Games', above n 20, at 189–90. For a detailed classification of modern capitalism, see generally Peter A. Hall and David Soskice, 'An Introduction to Verities of Capitalism', in Peter A. Hall and David Soskice (eds), *Varieties of Capitalism: The Institutional Foundations of Comparative Advantage* (Oxford: Oxford University Press, 2001).

198 Hall and Soskice, above n 197, at 8.

199 The UK is one of a few exceptions that is labelled as LME within the EU. Most other Members, such as Austria, Belgium, Denmark, France, Germany, and the Netherlands, are CME. See Hall and Soskice, above n 197, at 59. Despite being a LEM, the UK nevertheless has a long tradition of a coordinated and hierarchical standardization system. See Büthe and Mattli, above n 190, at 151–55.

200 Hall and Soskice, above n 197, at 8.

201 Büthe and Mattli, above n 190, at 151; Winn, 'Two Level Games', above n 20, at 190.

202 On path dependence, see e.g. Stanley J. Liebowitz and Stephen E. Margolis, 'Path Dependence', in Boudewijn Bouckaert and Gerrit De Geest (eds), *Encyclopedia of Law and Economics* (Cheltenham: Edward Elgar, 2000), vol. 1, 981–98; Mark Roe, 'Chaos and Evolution in Law and Economics', 109 *Harvard Law Review* 641 (1996).

203 Büthe and Mattli, above n 190, at 219.

B. Application of WTO jurisprudence to the ICT standards context

The TBT Agreement is silent on the definition of 'international standard'. However, several provisions are relevant here. First, in the absence of a specific definition, Annex 1 to the TBT Agreement refers to the ISO/IEC Guide 2: 1991 (ISO/IEC Guide 2), which defines 'international standard' as a 'standard that is adopted by an international standardizing/standards organization and made available to the public'.[204] According to the Explanatory note for Annex 1.2, 'standards prepared by the international standardization community are based on consensus', while 'documents that are *not* based on consensus' are also covered by the TBT Agreement.[205] Additionally, Annex 1.4 refers to an 'international body' as a body 'whose membership is open to the relevant bodies of at least all Members'.[206] Drawing on these provisions, the Appellate Body (AB) in *US – Tuna II (Mexico)* clarified in detail certain requirements for 'international standards' under the TBT Agreement.[207] We discuss below.

1. Focusing on 'Standardizing Body' in the determination of international standards

In *US – Tuna II (Mexico)*, the AB noted, as an initial matter, that the subject matter of a standard is not material to the determination of whether the standard is 'international'.[208] Instead, in the ABs view, it is the 'characteristics of the entity approving a standard' that make a standard an 'international standard'.[209] A document, simply put, can count as an 'international standard' if it is adopted by an 'international standardizing body'.[210] It follows, then, that whether the outputs of the consortia can be accepted as an international standard for the purpose of the TBT would depend in significant part on the features of each SSO.

2. Formality issues

The AB in *US – Tuna II (Mexico)*, after finding that it is the entity rather than the subject matter that matters in this context, examined key elements necessary for a body to qualify as an 'international standardizing body'. The AB first addressed the formality issue. The AB found that there is a difference between the ISO/IEC Guide 2 and the TBT Agreement with which a type of legal entity is eligible to approve an international standard: the ISO/IEC Guide 2 uses the term 'organizations' when defining international standards. Annexes 1.2 and 1.4 of the TBT Agreement, by contrast, refer to 'body' and 'international body or system', respectively.[211]

The AB has pointed out that a 'body' is a 'legal or administrative entity that has specific tasks and composition', while an 'organization' is a 'body that is based on the

204 TBT Agreement, Annex 1.
205 Ibid (emphasis added).
206 Ibid.
207 Appellate Body Report, *United States – Measures Concerning the Importation, Marketing and Sale of Tuna and Tuna Products*, WT/DS381/R, adopted 13 June 2012 [hereinafter Appellate Body Report, *US – Tuna II (Mexico)*].
208 Ibid, para 353.
209 Ibid.
210 Ibid, para 356.
211 Ibid.

membership of other bodies or individuals and has an established constitution and its own administration'.[212] This distinction led the AB to conclude that under the TBT Agreement, international standardizing bodies, '*may, but not necessarily, be organizations*'.[213] Such a reading would appear to allow a wide range of consortia to pass the formality test, regardless of which model these SSOs choose.

Consider, for instance, the selected consortia discussed above. The IEEE, OASIS, and ECMA International are nonprofit organizations which plainly fall within the scope of 'body' as determined by the AB. The W3C and IETF, while not being legal entities, nevertheless maintain some sort of administrative mechanisms for their standardizing activities: W3C is administered via a joint agreement between four institutions in three continents. Additionally, the IEFT is organized as a collaborative forum of volunteers; its standards development task is divided into eight areas carried out by multiple 'Working Groups'.[214] As such, the five selected SSOs would appear to clear the formality hurdle. Below, we consider the substantive elements as set out by the AB.

3. Substantive elements

i. Open to the relevant bodies of at least all WTO Members According to the AB in *US – Tuna II (Mexico)*, in order for a body to qualify as an 'international' standardizing body, its membership should be open to the 'relevant bodies of at least all Members'.[215] The term 'open' is defined by the AB as 'accessible or available without hindrance', 'not confined or limited to a few', and 'generally accessible or available'.[216] Moreover, the AB accepted the 2002 TBT Committee Decision as a 'subsequent agreement' by the WTO Members within the meaning of Article 31(3)(a) of the Vienna Convention on the Law of Treaties (VCLT), which hence bears directly on the interpretation of the term 'open'.[217] On this basis, an international standardizing body should be open in a 'non-discriminatory' manner. The AB thus concluded that any 'provisions for accessions that *de jure* or *de facto* disadvantage the relevant bodies of some Members as compared to other Members' would imply that a body is not an 'international' standardizing body.[218]

In *US – Tuna II (Mexico)*, the AB further ruled that two additional elements play a role here. First, the AB found that if the accession is subject to invitation, such a body will be considered 'open' only if the 'invitation occurred automatically once a Member or its relevant body has expressed interest' in joining that body.[219] The AB added, moreover, that a standardizing body must be open 'at every stage of standards development'.[220]

212 Ibid, para 355.
213 Ibid, para 356 (emphasis added).
214 *About IETF*, above n 147.
215 Appellate Body Report, *US – Tuna II (Mexico)*, above n 207, para 358.
216 Ibid, para 364.
217 Ibid, para 371–72.
218 Ibid, para 375.
219 Ibid, para 386.
220 Ibid, para 374.

Before we turn to examining whether and to what extent the consortia would overcome the first hurdle, some clarification regarding the idea of 'relevant bodies' of all WTO Members is required. The term 'relevant bodies' of WTO Members may be interpreted either as governmental or nongovernmental.[221] However, in the case of nongovernmental bodies, according to Annex 1 of the TBT Agreement, such bodies must have 'power to enforce a technical regulation'.[222] The link of legal power is critical in the determination of whether a given SSO can pass the openness test.[223]

Against this context, four of our selected SSOs seem to have no trouble overcoming the first hurdle. For the IETF, anyone who is interested in its work can be part of it by registration online.[224] This would include, presumably, government officials on behalf of the regulators.[225] The W3C and OASIS broadly define the qualifications of membership while encouraging the participation of government agencies.[226] The IEEE-SA is open to 'individuals', 'not-for-profit enterprises', and 'for profit enterprises'.[227] While the membership class of individuals, as in the case of the IETF, would allow some space for regulators, the IEEE-SA explicitly refers to 'not-for-profit enterprises' broadly to include a 'government agency' at all levels.[228] Additionally, the membership policies of the four SSOs do not advantage or disadvantage relevant bodies of certain WTO Members.

Some SSOs have preferential membership rates for certain government agencies. OASIS, for instance, sets a special rate for government agencies from non-OECD countries, which encourages developing countries' participation in OASISs standards development.[229] W3C takes a similar approach.[230] Such arrangements should not be treated as discriminatory in that they take into account the needs of developing countries, as required by Article 12 of the TBT Agreement and the 2002 TBT Committee Decision.

221 Joost Pauwelyn, 'Non-Traditional Patterns of Global Regulation: Is the WTO "Missing the Boat"'? in Joerges and Petersmann (eds), above n 171, at 210.

222 TBT Agreement, Annex 1.

223 See Pauwelyn, above n 221, at 210 ('private standardizing bodies or NGOs which set code of good practice including those open to national NGOs from all WTO members…, are unlikely to be accepted as setting "international standards" as long as the national NGOs have not been granted the legal power to enforce a technical regulation'.)

224 Info for Newcomers, About the IETF, The Internet Engineering Task Force, available at http://www.ietf.org/newcomers.html (visited 1 February 2014).

225 Joe Waz and Phil Weiser, 'Internet Governance: The Role of Multistakeholder Organizations', 10 *Journal of Telecommunications and High Technology Law* 331 (2012), at 339 (noting that the IETF, while welcoming representatives of sovereign governments, treats them as merely 'one voice among many'.)

226 OASIS, for instance, specifically sets a lower membership due for national government agency or local government agency. See Join OASIS, above n 159.

227 IEEE Constitution and Bylaws 2014, Sec. I-403, available at: http://www.ieee.org/documents/ieee_constitution_and_bylaws.pdf (visited 1 February 2014).

228 Ibid.

229 For the category of 'contributor member', the OASIS has a different rate for government agencies in OECD and non-OECD countries. See Join OASIS, above n 159.

230 According to W3C, it sets membership fees by taking into account the annual revenues, type, and location of headquarters of an organization to promote a diverse membership that represents the interests of organizations around the world. See *Membership Fees, Membership*, The World Wide Web Consortium, available at http://www.w3.org/Consortium/fees (visited 5 February 2014).

However, whether ECMA International can pass this test is less clear. ECMA International's membership is restricted to 'companies' and 'not-for-profit' (NFP) organizations. Unlike the IEEE-SA, W3C or OASIS, there is no explicit reference to government agency in its membership policy in either category, nor can we infer from its current member list that the link of legal power would ever exist.[231] These issues place a question mark over ECMA International's qualifications as a TBT-sense international standardizing body in the first place.

In terms of the second hurdle, the IETF, the IEEE, W3C, and OASIS would seem to satisfy this requirement, since none condition membership upon invitation.[232] The accession to ECMA International, to the contrary, is subject to a two-thirds majority vote by the Ordinary Members of the General Assembly (GA).[233] Plainly, ECMA International fails this hurdle.

As for the last element, we note from the relevant data that members seem to be able to take part in every stage of standards development in the IEEE,[234] W3C,[235] the IETF,[236] and OASIS.[237] With regard to ECMA International, while all members—including NFP members—can participate in standards activities at the Technical Committee stage,[238] final approval of a standard is subject to the ballot in the GA, where only Ordinary Members have a voice.[239] ECMA International, again, is less likely to satisfy this requirement.

In sum, our selected SSOs, with the exception of ECMA International, would seem to meet the openness requirements. Next, we continue to examine whether these four SSOs can pass other tests as required by WTO adjudicators.

ii. Recognized activities In *US – Tuna II (Mexico)*, the AB added further that a standardizing body must have 'recognized activities in standardization' to qualify as an

231 Most of ECMA International's NFP members are universities and institutions, such as Aarhus University, British Library, Brown University, ETH Zurich, Library of Congress (US), Stanford University and so forth. See *Not-for-profit Members*, ECMA International, available at: http://www.ecma-international.org/memento/NFP.htm (visited 2 February 2014).

232 See e.g. Organization for the Advancement of Structured Information Standards, Bylaws, Article 12 (as amended 13 September 2010), available at: https://www.oasis-open.org/policies-guibidelines/bylaws (visited 2 February 2014).

233 ECMA Bylaws, above n 162, Article 4.2.

234 See e.g. IEEE-SA Standards Broad Bylaws, Sec. 5.2.1.4 [hereinafter IEEE-SA Board Bylaws], available at: http://standards.ieee.org/develop/policies/bylaws/sb_bylaws.pdf (visited 1 February 2014) ('Openness is defined as the quality of being not restricted to a particular type or category of participants. All meeting involved standards development shall be open to all interested parties').

235 See World Wide Web Consortium Process Document [hereinafter W3C Process Document], available at: http://www.w3.org/2005/10/Process-20051014/ (visited 1 February 2014).

236 The IETF is a stunning example for those who are familiar with the face-to-face meeting in traditional context. A Working Group (WG) in the IETF is, in essence, a mailing list for which anyone can sign up, thereby participating in standards development. See generally The Internet Engineering Task Force, The Tao of IETF: A Novices Guide to the Internet Engineering Task Force (August 2001) [hereinafter Tao of IETF], available at: http://www.ietf.org/tao.html (visited 1 February 2014).

237 Organization for the Advancement of Structured Information Standards Policies, Technical Committee (TC) Process (1 August 2013), available at: https://www.oasis-open.org/policies-guibidelines/tc-process (visited 1 February 2014) [hereinafter OASIS TC Process].

238 ECMA Bylaws, above n 162, Article 12.2.

239 Ibid, Articles 3.5, 8.

'international standardizing body'.[240] The AB interpreted the term 'recognize' as 'acknowledge the existence, legality, or validity of, especially by formal approval or sanction; accord notice or attention to; treat as worthy of consideration'.[241] The meaning of the term 'recognize', as the AB reasoned, ranges from 'a factual end (acknowledgement of the existence of something) to a normative end (acknowledgement of the validity or legality of something)'.[242]

The AB found, as an initial matter, that the factual aspect would require, at least, that 'WTO Members are aware, or have reason to expect, that the international body in question is engaged in standardization activities'.[243] The AB then pointed out that the 2002 TBT Committee Decision, as a subsequent agreement among WTO Members, informs the interpretation of recognized standardization activities in both factual and normative dimensions.[244] On that basis, the AB ruled that if a standardizing body disseminates information about its standards activities in a transparent manner consistent with the 2002 TBT Committee Decision, such a body would 'presumably be acknowledged to exist, accorded notice or attention, and treated worthy of consideration by all WTO Members'.[245] In the same vein, from a normative perspective, it would be easier for a standardizing body to be 'recognized' to the extent that it follows the principles and procedures which WTO Members have decided 'should be observed' in the development of international standards.[246]

The IETF, the IEEE, W3C, and OASIS would seem to have no trouble obtaining recognition by WTO Members from a factual perspective in the sense that they all meet the transparency requirement.[247] Transparency takes various forms. To be sure, they all disclose essential information in terms of their organizational structure and governance, as well as standard-setting processes.[248] Beyond that, they promote wider participation in standards activities. As noted earlier, everyone can take part in standardization and other activities of the IETF via electronic mailing lists.[249] The IEEE allows everyone—including nonmembers—to view ongoing projects via the 'my Project' platform maintained by the IEEE-SA.[250] Likely, with regard to OASIS and W3C, public review is required before the approval of a final standard.[251]

240 Appellate Body Report, *US – Tuna II (Mexico)*, above n 207, para 376.

241 Ibid, para 361 (internal bracket and quotation mark omitted).

242 Ibid.

243 Ibid, para 362.

244 See ibid, para 376.

245 Ibid.

246 Ibid.

247 Note that IEEE and OASIS are, in fact, ANSI-accredited among the five selected SSOs discussed herein.

248 See e.g. OASIS TC Process, above n 237; W3C Process Document, above n 235; Standards Process, About IETF, The Internet Engineering Task Force, available at: http://www.ietf.org/about/standards-process.html (visited 5 February 2014); Develop Standards, IEEE Standards Association, available at https://standards.ieee.org/develop/policies.html (visited 5 February 2014).

249 Email List, The Internet Engineering Task Force, available at http://www.ietf.org/list/(visited 6 February 2014).

250 e-Tools, IEEE Standards Association, available at https://development.standards.ieee.org/my-site/home (visited 5 February 2014).

251 OASIS TC Process, above n 237, section 3.2 ('Before the TC can approve a Committee Specification Draft as a Committee Specification, the TC must conduct a public review of the work.'); See W3C Process Document, above n 235, section 7.4.1 (which requires the first 'Working Draft' to be published to other W3C groups and the public.)

The IEEE, the IETF, W3C, and OASIS would also seem to satisfy the requirements for recognition from a normative perspective. Each of them follow, to varying degrees, principles and procedures found in the 2002 TBT Committee Decision. First, the IETF, the IEEE, and W3C explicitly underscore consensus policy in relevant documents that govern the standard-setting process.[252] While it is not explicitly stated,[253] OASIS does implement consensus rule in practice.[254] By putting consensus policy into practice, these four SSOs ensure impartiality and take into account the views of all parties concerned. To that end, some go further by requiring participants in the standards development process to disclose relevant information to avoid potential conflicts of interest.[255] Second, each maintains some sort of collaboration with major players in the ICT standards world.[256] Such cooperation would avoid duplication of efforts of other SSOs, thereby promoting coherence.

Third, the four SSOs would seem to meet the effectiveness and relevance requirement. Various standards set by these four SSOs, as illustrated above, effectively define today's digital environment. While it is arguable as to whether their outputs are always responsive to the regulatory needs of various nations, these standards would seem to meet market needs given their worldwide adoption. Additionally, preferential membership fees and the method of participation encourage developing countries' participation. Lower membership rates would accommodate interested stakeholders in developing countries with nascent economies, and electronic platforms provide a more effective and efficient alternative for developing countries in

252 See e.g. IEEE-SA Standards Bylaws, above n 234, section 2.1 ('The approval and publication of an IEEE standard implies that the document represents a consensus of the parties who have participated in its development and review'); W3C Process Document, above n 235, section 3.3 ('Consensus is a core value of W3C. To promote consensus, the W3C process requires Chairs to ensure that groups consider all legitimate views and objections, and endeavor to resolve them'); Tao of IETF, above n 236, at 4, 7, 17 (noting that one of IETF's founding beliefs is that '[w]e reject kings, presidents and voting. We believe in rough consensus and running code'.); OASIS FAQ, above n 158 ('Members themselves set the OASIS technical agenda, using a lightweight process expressly designed to promote industry consensus and unite disparate efforts').

253 OASIS FAQ, above n 158 ('Members themselves set the OASIS technical agenda, using a lightweight process expressly designed to promote industry consensus and unite disparate efforts').

254 See Email from Carol Geyer, Senior Director of Communications and Development for OASIS, to author (3 February 2014) (on file with author). Email from Scott McGrath, Chief Operating Officer for OASIS, to author (7 February 2014) (on file with author).

255 See e.g. IEEE-SA Standards Board Bylaws, above n 234, section 5.2.1.5 ('Every member and participant in a working group, Sponsor ballot, or other standard development activity shall disclose his or her affiliation'); W3C Process Document, above n 235, section 3.1.1 ('Individuals participating materially in W3C work **must** disclose significant relationships when those relationships might reasonably be perceived as creating a conflict of interest with the individual's role at W3C');

256 IEEE, for instance, underscores the importance of cooperative efforts to avoid duplication of works. See IEEE Standards Association Operations Manual, section 7.5, available at: http://standards.ieee.org/develop/policies/sa_opman/sa_om.pdf (visited 6 February 2014). For a detailed list of liaisons of these four SSOs, *see Formal Liaison*, Develop Standards, IEEE Standards Association, available at http://standards.ieee.org/develop/intl/liaisons.html (visited 6 February 2014); Liaisons, The Organization for the Advancement of Structured Information Standards, available at https://www.oasis-open.org/liaisons (visited 6 February 2014); *Liaison, Participate*, The World Wide Web Consortium, available at http://www.w3.org/2001/11/StdLiaison (visited 7 February 2014); Liaison, The Internet Engineering Task Force, available at http://www.ietf.org/liaison/(visited 7 February 2014).

the process. Such mechanisms, coupled with regional offices on various continents, would help these SSOs reach out to more participants in developing countries.

Taken together, the IEEE, the IETF, W3C, and OASIS would seem to satisfy the principles laid down by the 2002 TBT Committee Decision. To the extent that they have the required characteristics, as the AB ruled in *US – Tuna II (Mexico)*, these four SSOs would be, from a normative perspective, recognized by WTO Members. And if my analysis is correct, it follows that the decentralized approach is likely to be accepted by the WTO adjudicators. The analysis of this section is summarized in Appendix 4.

IV. REFLECTIONS ON SHIFTING PARADIGM

As illustrated, any SSO in the ICT standards world may arguably become an international standardizing body for the purpose of the TBT Agreement, so long as it can satisfy the required elements. Several observations follow.

A. Switching costs and power redistribution: Hooray for the USA?

The first observation pertains to switching costs and power redistribution. Market participants, as Büthe and Mattli aptly put it, have strong incentives to influence the process of international rule-making in order to minimize their switching costs, and such costs will be minimal for those who 'succeed in pushing their domestic standards for adoption as an international standard'.[257] For the past few decades, firms in the ICT industry have successfully promoted their standards through consortia or fora. Their outputs, to a varying degree, dominate the global market. To the extent that these standards gain worldwide acceptance and the SSOs meet the required elements for the purpose of the TBT Agreement, firms and regulators whose interests are aligned with these SSOs would pass on the switching costs to those who are outside of the SSOs. Switching costs can be substantial in the ICT sector. Plainly, this new paradigm favors firms in those countries that advocate for the decentralized approach, most notably the USA.

The dark side of this paradigm shift is clear to those who advocate for the centralized approach, including, among others, the EU. Indeed, as Büthe and Mattli argue, 'firms operating in a hierarchical and coordinated domestic system are likely to win because their system fits more naturally with the global structure'.[258] The institutional structure of ESOs enables firms in this region to possess better information about international standards initiatives and to pursue their interests more effectively than their US rivals.[259] Robust growth of US-based consortia and deep penetration of their standards over decades turn the tables toward disadvantaging the EU.

Facing such a paradigm shift, not surprisingly, the most vexing problems for EU policymakers today is not whether, but how and under what conditions the work of the consortia should be incorporated. Recognizing the fact that dramatic changes in the ICT standard-setting landscape have not been reflected in the EU standardization policy, the EU Commission remarks that: '[w]ithout decisive action the EU risks

257 Büthe and Mattli, above n 190, at 9.
258 Ibid, at 13.
259 Ibid, at 160.

becoming irrelevant in ICT standard setting which will take place almost entirely outside Europe, and without regard for European needs',[260] adding 'if Europe wants to have ICT standards in a timely manner, a **permanent dialogue** between public authorities … and a dialogue between standards development organisations, including fora and consortia, are a must'.[261] Global ICT consortia and fora, hence, 'should play a more prominent role in fulfilling public policy objectives and societal needs' in the EU, so long as they follow a set of criteria.[262] Toward this end, in 2011, the EU rolled out the 'European Multistakeholder Platform on ICT Standardisation' (MSP),[263] whose membership is comprised of European national standardizing bodies, the ISO, the IEC, the ITU, and various consortia, including, among others, the ECMA, the IEEE, the IETF, OASIS, and W3C.[264] It remains to be seen what harvest the MSP, as an advisor to the European Commission, will reap. Nevertheless, the MSP represents a critical step for the EU: it would, on one hand, help the EU to avoid being marginalized as irrelevant in the ICT standards games, and on the other, reduce the possibilities of trade disputes as a result of two major trading powers' divergence on standards policies in the WTO.

B. Revisiting international standards in the ICT sector

1. How legitimate are those traditional international SSOs?

Legitimacy is a compelling concern from a normative perspective. International standards, for the most part, are of a voluntary nature and are not binding upon States. Yet, by requiring WTO Members to base their decisions on an international standard, the TBT Agreement may allow, as Robert Howse puts it, 'a very broad range of normative material, including privately generated norms' to be converted into international legal obligations.[265] Viewed in this light, the WTO has more or less delegated the task of developing international standards to specific functional bodies.[266] Such regulatory delegation may raise agency problems in terms of whether

260 Commission White Paper: Modernising ICT Standardisation in the EU—the Way Forward, at 2, 3, COM (2009) 324 final, 3 July 2009, available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0324:FIN:EN:PDF (visited 7 February 2014).

261 Communication from the Commission to the European Parliament, the Council and European Economic and Social Committee: A Strategic Vision for European Standards: Moving Forward to Enhance and Accelerate the Sustainable Growth of the European Economy by 2020, at 16, COM (2011) 311, 1 June 2011, available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0311:FIN:EN:PDF (visited 7 February 2014) (emphasis original).

262 Ibid, at 4.

263 Commission Decision of 28 November 2011 on Setting up the European Multistakeholder Platform on ICT Standardization, 2001/C/349/4, available at: http://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetailDoc&ibid=4708&no=1 (visited 7 February 2014).

264 For a complete list of MSP members, *see Group Details – Commission Expert Group*, European Commission, available at: http://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetail&groupIBID=2758 (visited 7 February 2014).

265 Howse, above n 171, at 383–84.

266 See Joel P. Trachtman, 'Addressing Regulatory Divergence through International Standards: Financial Services', in Pierre Sauvé and Aaditya Mattoo (eds), *Domestic Regulation and Service Trade Liberalization* (Washington DC: The World Bank, 2003) 27, 30.

and to what extent these SSOs are faithful to the objectives of the WTO.[267] These issues turn on the legitimacy of the international standards and their creators.

Presumably, WTO Members would be less concerned with the ISO, the IEC, and the ITU. They take as a given the ICT standards set by these traditional international standardizing bodies. As discussed below, however, structural changes to these standard-setting entities that stem from the evolving nature of the ICT sector may undercut their legitimacy as faithful agents of the WTO.

Consider, for instance, the ISO/IEC JTC 1. There are two major routes for the ISO/IEC JTC 1 to incorporate standards set by consortia: Publicly Available Specification (PAS) Transposition Procedure[268] and Fast-track Procedure.[269] Both mechanisms provide a short-cut for the ISO/IEC JTC 1 to review and adopt draft standards created by consortia. While these expedited processes help the ISO/IEC JTC 1 to respond to market needs and technological changes more effectively, they may raise legitimacy concerns in the context of the TBT Agreement. In the fast-track procedure, for instance, a document can be submitted directly for approval as a draft international standard to ISO members' standardization bodies or, if a document has been developed by an international standardizing body recognized by the ISO Council, as a final draft international standard.[270] Either way, the fast-track approach would allow the ISO/IEC JTC 1 to skip at least three stages (i.e. proposal stage, preparation stage, and committee stage). In such cases, one may wonder whether and to what extent the ISO/IEC JTC 1 would pass the hurdle requiring 'open at least every stage' of the standards development process as delineated by WTO adjudicators.

Indeed, many consortia that submit draft international standards to the ISO/IEC JTC 1 would also meet the elements required by the TBT Agreement. W3C and OASIS are two such examples.[271] These consortia, to the extent that they would qualify as international standardizing bodies as delineated by WTO adjudicators, may downplay concerns regarding procedural or legitimacy deficits. However, this is not always the case.

A more problematic issue facing WTO policymakers and adjudicators is that draft international standards can also be submitted by industry consortia that fall short of the required elements in the TBT context. For example, it has been reported that the DVD Forum (formerly the DVD Consortium) submitted relevant technical standards for DVD technology to the ISO/IEC JTC 1 for approval via ECMA International.[272] One may wonder, then, whether ECMA International and the DVD Forum pass all hurdles required by WTO adjudicators.

267 Ibid, at 31.

268 *JTC 1 PAS Submitters*, IEO/IEC JTC 1 [hereinafter *JTC 1 PAS Submitters*], available at: http://jtc1info.org/?page_ibid=517 (visited 7 February 2014).

269 *Stages of Development of International Standards*, International Organization for Standardization standards, available at: http://www.iso.org/iso/home/standards_development/resources-for-technical-work/stages_of_the_development_of_international_standards.htm (visited 7 February 2014).

270 Ibid.

271 W3C and OASIS, for instance, are two among nine PAS Submitters approved by the ISO/IEC JTC 1. See *JTC 1 PAS Submitters*, above n 268.

272 Branislav Hazucha, 'Technical Barriers to Trade in Information and Communication Technologies', in Tracey Epps and Michael J. Trebilcock (eds), *Research Handbook on the WTO and Technical Barrier to Trade* (Cheltenham: Edward Elgar Publishing, 2014) 525, 539–40.

Worse still, in some cases, the ISO/IEC adopts the output of a single promoter as an international standard. In 2008, for instance, the ISO/IEC JTC 1 approved the Office Open XML (OOXML) standard for word-processing documents.[273] OOXML is, in essence, based on Microsoft's proprietary technologies. Microsoft submitted OOXML to, again, ECMA International for adoption as ECMA standard 376.[274] Later, ECMA International, in its liaison status, submitted the standard to the ISO/IEC JTC 1 for approval as an international standard via the fast-track procedure.[275] This approval generated controversy.[276] Melanie Chernoff, for instance, lamented that:

> ISO's JTC-1 directives were designed to provide a fair, consensus-based way to design standards that are portable, interoperable, and adaptable to all languages and cultures. The OOXML proposal has suffered from two basic problems: (1) voting irregularities, and (2) the use of a fast-track process for a complex, new, large specification that has not received adequate industry review. The resulting specification was driven almost exclusively by one vendor, has not achieved industry consensus, and has had thousands of issues logged against it…Although resolutions have been proposed for many of the issues that have been raised, there is virtually no time to review these resolutions to determine whether they fix the problems. And the voting irregularities have raised serious issues with the fairness of the process.[277]

Chernoff's points are well taken. It is clear that at the stage when Microsoft created its standard, there were no WTO Members—including the USA—who could have had a say in the process. The same may also hold true at the stage in which ECMA International became involved in promoting the standard. In such cases, if a WTO Member decides to act unilaterally by rejecting OOXML as an international standard, it would seem problematic if other WTO Members chose to challenge this measure.

All of these questions would seem to point to the trade-offs between effectiveness and legitimacy. While the ISO/IEC JTC 1 seeks to speed up its standard-setting process by borrowing the standards of those new actors, it may, to a varying degree, lose legitimacy as a regulatory agent. What the ISO/IEC JTC 1 has in mind in this context would appear to be 'effectiveness and relevance' rather than 'openness'. As Tineke M. Egyedi puts it, outside pressure prompts ideology changes of these traditional international SSOs: they shift from 'pure standards development' to the

273 See Press Release, International Organization for Standardization, ISO/IEC DIS 29500 Receives Necessary Votes for Approval as an International Standard (2 April 2008), available at: http://www.iso.org/iso/news.htm?refibid=Ref1123 (visited 8 February 2014).

274 Ibid.

275 Ibid.

276 See An, 'IPR and Communications Technology', above n 15, at 192 ('Brazil, India, South Africa, and Venezuela were against this result. The EU was also concerned with interoperability problems).

277 Melanie Chernoff, 'ISO Approval: A Good Process Gone Bad', *Red Hat Magazine*, 24 March 2008, available at: http://magazine.redhat.com/2008/03/24/iso-approval-a-good-process-gone-bad/ (visited 8 February 2014).

inclusion of 'formalization of external standards',[278] and their 'democratic ideals have been slightly adapted to cater to economic demands for timely standards'.[279]

This observation, if correct, would lead to the next question: Would the ISO/IEC JTC 1 still be a 'relevant' international standardizing body? In such cases, it would appear that it is the consortia that draft and develop standards in the first place, rather than the ISO/IEC JTC 1, are more 'relevant' for the purpose of the TBT Agreement. A related, more fundamental question, follows: Would it be appropriate, in such circumstances, to defer to the ISO/IEC JTC 1, which, as an agent, re-delegates its authority to third parties? If the answer is yes, the WTO may in some ways lose control over its regulatory agent by writing a blank check to the ISO/IEC JTC 1. Such agency costs can be high for WTO Members. While it is hard to predict whether WTO adjudicators will defer directly to the consortia and their standards without the imprimatur of the traditional international SSOs, these questions would appear to create some space for WTO Members to defend their deviation from international standards in this context.

2. Can the Big Three contribute to convergence?

One recurring argument in support of the centralized approach is the fostering of convergence. To be sure, while competition is often a good thing, two standards or more—especially incompatible ones—may not always be better than one. The traditional international SSOs, at times, may serve as a focal point to facilitate coordination among market participants by ending a fight-to-the-death standards war.

The ITU, for instance, played a role in the standards battle of the 56K modem. For several years, there were two competing standards for the high-speed modem generated by two industry consortia: one led by 3Com (formerly US Robotics) and the other by Rockwell.[280] At stake was a lucrative global market of some 100 million mechanisms that connect computers through telephone lines.[281] Neither camp gave way on the 56k modem standards; a bitter war thus ensued. Although the two standards served similar functions, they were incompatible. If a user selected one standard while the user's Internet service provider (ISP) followed the other, the data transfer speed declined to 28k or 33k.[282] Users and ISPs who were afraid of being stranded thus hesitated to adopt either standard. Such a pattern delayed the transition to faster modems.[283] The stalemate was eventually broken when the ITU, in late 1997, stepped in by introducing the 'v.90' standard, which reconciled these two rival

278 Egyedi, above n 32, at 56, 57 (noting that the priorities of these traditional standard-setters have shifted from process, to outcome, and use. And their ideological rationale also migrate from democracy toward economic efficiency).

279 Ibid.

280 See generally Shapiro and Varian, above n 54, at 267–70.

281 Frederick Rose, 'Modem Makers Reach Accord on Standards', *Wall Street Journal*, 8 December 1997, at B6.

282 See Angelique Augereau et al., 'Coordination versus Differentiation in a Standards War: 56 K Modems', 37 *RAND Journal of Economics* 887, 890 (2006).

283 According to Augereau et al., until October 1997, barely 50% of the US ISP market adopted 56k modems; moreover, none of the large ISPs (e.g. AT&T, AOL) adopted. Ibid, at 905.

technologies.[284] This standard soon gained market acceptance and spurred modem sales.[285]

Yet, it is less clear whether these traditional international SSOs can always serve as successful mediators. For one thing, the slow standards development process creates unpredictability. While, for instance, the ITU only spent around two years in helping the market settle the v.90 standard, such an approval was widely regarded as 'fast' in historical terms.[286] The timing issue, coupled with uncertainty about the ultimate choice of the ITU, would arguably affect firms' strategies, thereby undercutting the likelihood for coordination and convergence.

In addition, there is evidence showing that at least in some cases, traditional international SSOs would not help much in reducing divergence. The ITU, for instance, is tolerant of several competing standards for third-generation (3G) cellular systems, such as CDMA2000 (USA), W-CDMA (Europe), and TD-SCDMA (China).[287] The same statement also applies to the ISO/IEC JTC 1: while having approved the Open Office Format (ODF) for Office Application, it nevertheless adopted the OOXML standards.[288] Overall, while it seems plausible that traditional international SSOs would in some ways moderate divergence among competing international standards, we note from mixed evidence that this may not always be the case.

3. Challenges ahead: vexing IPR problems and backlash from emerging economies

That said, in the ICT industry, standards go hand in hand with IPR.[289] At the time of this writing, for instance, there are more than 400 patents used in the ISO/IEC JTC 1 standard,[290] and 3874 patent declarations can be found in the ITU-T Patent Statement and Licensing Declaration Database.[291] While incorporating IPR into standards would facilitate collaborative innovation and increase the value of the

284 Shapiro and Varian, above n 54, at 270.

285 Ibid, (noting that 'the sales of 56k modems would rise from 10.8 million in 1997 to 33 million in 1998').

286 See Shane Greenstein and Marc Rysman, 'Coordination Costs and Standards Setting: Lessons from 56K Modems', in Greenstein and Stango (eds), above n 4, at 137 ('this speed was viewed as sooner than the most optimistic forecast when the process started two years earlier').

287 For a background, see e.g. Rudi Bekkers and Joel West, 'The Limits to IPR Standardization Policies as Evidenced by Strategic Patenting in UMTS', 33 *Telecommunications Policy* 80 (2009); Mobile Telecom: Time for Plan B, *The Economist*, 26 September 2002, available at: http://www.economist.com/node/1353050 (visited 9 February 2014); Up, up and Huawei, *The Economist*, 24 September 2009, available at: http://www.economist.com/node/14483904 (visited 9 February 2014).

288 The OASIS submitted ODF to the ISO/IEC JTC 1 for approval as ISO/IEC 26300: 2006 through the PAS procedure. See JTC 1 PAS Submitter Standards, ISO Standards Development, available at http://isotc.iso.org/livelink/livelink?func=ll&objIbid=8913248&objAction=browse&sort=name (visited 9 February 2014).

289 Bruce H. Kobayashi and Joshua D. Wright, 'Intellectual Property and Standard Setting', George Mason University Law and Economic Research Series, Paper No. 09-40, 2009, at 4, available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_ibid=1460997 (visited 10 February 2014) [hereinafter Kobayashi and Wright, 'IP and Standard Setting'].

290 List of IEC Patents Declaration received by IEC, The International Electrotechnical Commission, available at: http://patents.iec.ch/ (visited 18 February 2014).

291 ITU-T Patent Database, International Telecommunication Union, available at: http://www.itu.int/net4/ipr/search.aspx (visited 18 February 2014).

standards for consumers,[292] there are some real drawbacks.[293] The presence of proprietary technologies in standards may have broad implications for international trade.[294] More importantly for the present purpose, they may turn on certain requirements for the TBT-sense international standard. While this article is not intended to be a comprehensive analysis of IPR issues in a standard-setting context, a general understanding of the underlying conflicts that would affect the concept of the term 'international standard' is necessary.

IPR misuse is a source of controversy in the ICT standard-setting context. While IPR grants an exclusive right, there is no guarantee regarding the market power of the IPR holder. If a proprietary technology is incorporated into a standard that is widely adopted by the industry, however, everything would change radically.[295] If a standard becomes successful and is widely adopted in the marketplace, firms that own essential IPR for the implementation of that standard would possess significant market power. In the ICT sector exhibiting strong network externalities, such power can be tempting and induce certain firms to extract greater returns through a practice called 'holdup'.

This problem may occur *ex ante* and *ex post*. *Ex ante* holdup exists when IPR holders seek to incorporate their proprietary technologies into the standards by deception or fraud so as to raise the price.[296] *Ex post* holdup, by contrast, occurs when IPR holders deviate from their *ex ante* contractual commitments to extract a higher royalty rate.[297] The holdup issue can be problematic, in that after the standard is set and implemented, the costs of switching to alternative standards are very high.[298] To incorporate proprietary technologies in standards would thus impose transaction and information costs on standards implementers.

The Dell case is illustrative. This case concerned the standards for a computer bus design, later known as 'VESA Local Bus' or 'VL-Bus'.[299] The Video Electronics Standards Association (VESA) was the creator of the VL-Bus standard. In the early 1990s, Dell Computer Corp. (Dell) joined VESA and has been actively involved in standards development for VL-Bus ever since. In approving VL-Bus, Dell certified in writing that the VL-Bus standard 'does not infringe on any trademarks, copyrights, or patents' that it possessed. After the VL-Bus standard was included in more than 1.4 million computers within eight months after the adoption of the VL-Bus standard, however, Dell announced that VESA members that implemented this standard

292 Kobayashi and Wright, 'IP and Standard Setting', above n 289, at 4–5.

293 The presence of the IPR in the standardizing process has been a source of controversy in competition law.

294 If, for instance, the competition authority grants compulsory licensing as a sanction for patent misuse, it may create tensions between competition law and the WTO Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). We plan to pursue these issues elsewhere.

295 Janice M. Muller, 'Patent Misuse through the Capture of Industry Standards', 17 *Berkeley Technology Law Journal* 623 (2002).

296 Bruce H. Kobayashi and Joshua D. Wright, 'Federalism, Substantive Preemption, and Limits on Antitrust: An Application to Patent Holdup', 5 *Journal of Competition Law and Economics* 469 (2009) at 488.

297 Ibid, at 493.

298 US Department of Justice and Federal Trade Commission, 'Antitrust Enforcement and Intellectual Property Rights: Promoting Innovation and Competition', at 7 (2007), available at: http://www.justice.gov/atr/public/hearings/ip/222655.pdf (visited 10 February 2014).

299 See *In re* Dell Corp., 121 FTC 616 (1996).

infringed upon its '481 patent' and thus demanded compensation.[300] Dell's conduct led to the intervention of the US Federal Trade Commission (FTC). The FTC condemned, among others things, the fact that Dell 'unreasonably restrained competition', hindered industry acceptance of the VL-Bus standard, and, more generally, created a chilling effect on industry standard-setting efforts.[301] The FTC thus ordered Dell's patents unenforceable due to its anti-competitive practices in the VL-Bus standard-setting process.[302]

The tensions between IPRs and ICT standards, in fact, go beyond private interests to implicate trade policies. And, unsurprisingly, the IPR problems drew particular attention from developing countries. China, for instance, called for the WTO TBT Committee to reflect upon the relationship between IPRs and international standards in the TBT Agreement.[303] In its submission, China stated, in relevant part:

> If Members are not clear of IPRs in the relevant international standard, whether all the IPRs have been disclosed, under what terms the IPRs are to be licensed by the IPR holders, all WTO Members will face difficulties when adopting international standards… From the governmental level, as well as the company level, *there exists the kind of unwillingness of adopting international standards as the basis of their national standards and technical regulations if there is no common rule to regulate IPRs in standardization.* Such a situation will bring a negative impact on implementation of a TBT Agreement…[304]

China's submission should not be read in isolation, but, rather, must be understood in context. This submission was made several months immediately after the suspension of the WAPI standard as a result of dialogue between the highest levels of the Chinese and US governments.[305] Yet, the WAPI saga only shows small facets of the overall picture. In recent years, China has adopted various ICT standards initiatives to support its home-grown technologies, such as Enhanced Versatile Disc (EVD) and TD-CDMA.[306] These measures, in significant part, reflect China's deep frustration with the 'patent trap' over the past decades.[307] Despite its remarkable growth in the

300 Ibid.

301 Ibid.

302 Ibid.

303 Communication from the People's Republic of China, *Intellectual Property Right (IPR) Issues in Standardization*, G/TBT/W/251/Add.1, 9 November 2006 [hereinafter China TBT Committee Submission].

304 Ibid, at 4 (emphasis added).

305 Richard P. Suttmeier and Yao Xiangkui, 'National Bureau of Asian Research, China's Post-WTO Technology Policy: Standards, Software, and the Changing Nature of Techno-Nationalism 28 (2004)', available at: http://www.nbr.org/publications/element.aspx?ibid=257 (visited 19 February 2014) (reporting that Bush administration expressed concerns about WAPI standard in a letter directed to China's Vice Premiers Wu Yi and Zeng Peiyan signed by Secretary of State Colin Powell and US Trade Representative Robert Zoellick).

306 EVD is a competing DVD standard developed by Beijing E-world Technology, an industry consortium based in China. See generally Michael Murphree and Dan Breznitz, 'Innovation in China: Fragmentation, Structured Uncertainty, and Technology Standards', 2013 *Cardozo Law Review De Novo* 196 (2013).

307 Suttmeier and Yao, above n 305, at 11. For instance, as Mark Lemley and Carl Shapiro reported, as of early 2006, the IEEE 802.11 standard contained over 80 patents owned by major ICT firms from the

ICT manufacturing sector and its emergence as a major exporter of ICT products, China has excessively relied on foreign technologies. The over-reliance on foreign proprietary technologies significantly undercut Chinese manufacturers' profit margins. While foreign IPR holders often enjoy a considerable profit margin through their control of IPR and standards, many Chinese firms run their business on razor-thin profit margins.[308] These indigenous technologies and standards are, in essence, a part of China's 'catch-up' strategies to help its domestic ICT industry move up the value chain and shift its subordinate position vis-à-vis its major global competitors.[309]

It follows from the above that developing countries which seek to overcome the patent trap and minimize transactions costs are very likely to pursue standards of their preference, regardless of whether there is a relevant international standard in place. For this reason, ill-defined IPR rules of an SSO may serve as justification for certain WTO Members' deviation from international standardization activities.

Today, most established SSOs maintain IPR policies.[310] These policies can be roughly grouped into two approaches: disclosure rules and licensing rules.[311] Disclosure rules require firms to disclose IPRs relevant to a proposed standard; some SSOs may go further by requiring disclosure of pending applications.[312] The ISO, the IEC, the ITU, the IEEE, the IETF, OASIS, and W3C, require disclosure of existing patents and pending patent applications.[313] Disclosure rules would help these SSOs mitigate *ex ante* holdup problems and choose among alternative standards that do not incorporate proprietary technologies.[314] In doing so, disclosure rules would enhance the SSOs' legitimacy and credibility and help them defend against nontransparency claims under the 2002 TBT Committee Decision.

Unlike disclosure rules, licensing rules are problematic and may be under attack by WTO Members in one way or another. Generally speaking, licensing rules require participants to grant a license on either a royalty-free (RF) basis[315] or under terms

US (e.g. Cisco, Apple, IBM, and AT&T), Europe (e.g. Nokia and France Telecom), and Japan (e.g. Hitachi and Toshiba). It comes as no surprise that China would be more interested in pursuit of its indigenous WAPI standard. See Mark A. Lemley and Carl Shapiro, 'Patent Holdup and Royalty Stacking', 85 *Texas Law Review* 1991, 2027 (2007).

308 Richard P. Suttmeier et al., 'National Bureau of Asian Research, Standards of Power? Technology, Institutions, and Politics in the Development of China's National Standards Strategy 11 (2007)', available at: http://www.nbr.org/publications/element.aspx?ibid=1d5ffd96-9673-4d1c-85ce-bd8d8787e888 (visited 19 February 2014).

309 See Suttmeier and Yao, above n 305, at 10.

310 Lemley, 'IPR and SSO', above n 68, at 1904. Lemley surveyed the IPR policies of 43 SSOs and noted that most of the large SSOs have well-developed IPR policies while those SSOs without any policy were small, industry-specific groups.

311 Kobayashi and Wright, 'IP and Standard Setting', above n 289, at 11–12.

312 Ibid, at 11; Muller, above n 295, at 636.

313 See International Telecommunication Union, 'Common Patent Policy for ITU-T/ITU-R/ISO/IEC', available at: http://www.itu.int/en/ITU-T/ipr/Pages/policy.aspx (visited 19 Feb 2014); IEEE-SA Board Bylaws, above n 234; The Internet Engineering Task Force, Intellectual Property Rights in IETF Technology (March 2005) [hereinafter IETF IPR Policy], available at http://www.ietf.org/rfc/rfc3979.txt (visited 19 February 2014); The World Wide Web Consortium, W3C Patent Policy (5 Feb 2004) [W3C Patent Policy], available at: http://www.w3.org/Consortium/Patent-Policy-20040205/ (visited 19 February 2014); Organization for the Advancement of Structured Information Standards, Intellectual Property Rights (IPR) Policy, https://www.oasis-open.org/policies-guibidelines/ipr#disclosure (visited 19 February 2014).

314 Kobayashi and Wright, 'IP and Standard Setting', above n 289, at 11.

315 Muller, above n 295, at 635.

that are 'reasonable and nondiscriminatory' (RAND) or 'fair, reasonable, and non-discriminatory (FRAND).[316] Among the SSOs discussed herein, the IETF and W3C have adopted the RF approach.[317] This approach would facilitate participation of developing countries in the standards development process. Moreover, it may reduce the possibility of WTO Members attacking the 'openness' of a given SSO because of the level of the royalty rate.

The FRAND approach, in contrast, can be problematic. In general, FRAND serves two major goals: 'freedom to implement the standard along with reasonable return to investors who contribute patented technology to the standard'.[318] While it seems fair enough to promote adoption of standards while providing incentives for innovation, the language of the FRAND commitment offers little guidance as to the meaning of 'fair', 'reasonable', and 'non-discriminatory'.[319] Almost no SSOs define these terms; many SSOs, moreover, explicitly 'disclaim any role in establishing, interpreting, or adjudicating the reasonableness' of FRAND terms.[320] In practice, thus, FRAND is often a subject of controversy. The ITU, for instance, while requiring patent holders' willingness to negotiate licenses on the basis of RF or FRAND terms and leaving such negotiations to the parties concerned outside the ITU, nevertheless failed to avoid the FRAND dispute after the adoption of the v.90 standard for the 56K modem.

The battle between the two camps, in fact, continued after the creation of the ITU's v.90 standard. Following the adoption of the v.90, Brent Townshend, the holder of the patents relating to the implementation of the v.90 standard, joined by 3Com, filed a claim in the USA against Rockwell and its affiliate for infringement.[321] The defendants asserted antitrust counterclaims, alleging, among other matters, that Townshend, while filing the patent application, lobbied the ITU to include the technology, and that the plaintiffs refused to license on fair terms. More specifically, the defendant argued that the plaintiffs violated their FRAND commitments by seeking 'unfair royalty rates, double-charging of customers and manufacturers, mandatory cross-licenses, and reservation of the right to condition licenses on the resolution of litigation'.[322] Noting that 3Com informed the ITU of the pending patent applications covering the 56K modem, the US District Court, contrary to the decision in *Dell*, dismissed the antitrust counterclaims. The Court held that 'a patent owner has the legal right to refuse to license his or her patent on any terms;' thus, 'the existence of a predicate condition to a license agreement cannot state the antitrust violation'.[323]

This case is, however, merely the tip of the iceberg. Such disputes have occurred elsewhere in the ICT standard-setting context. Drawing on Jorge Contreras's most recent

316 Ibid; Mark A. Lemley and Carl Shapiro, 'A Simple Approach to Setting Reasonable Royalties for Standard-Essential Patents', 28 *Berkeley Technology Law Journal* 1135 (2013), at 1137 [hereinafter Lemley and Shapiro, 'A Simple Approach to FRAND']. For the present purpose, we use the term FRAND to refer to both 'reasonable and non-discriminatory' and 'fair, reasonable, and non-discriminatory' terms.

317 IETF IPR Policy, above n 313; W3C Patent Policy, above n 313.

318 Lemley and Shapiro, 'A Simple Approach to FRAND', above n 316, at 1139.

319 Doug Lichtman, 'Understanding the RAND Commitment', 47 *Houston Law Review* 1023 (2010), at 1031.

320 Jorge L. Contreras, 'Fixing FRAND: A Pseudo-Pool Approach to Standards-Based Patent Licensing', 79 *Antitrust Law Journal* 47 (2013), at 51.

321 *Townshend* v *Rockwell Int'l Corp.*, 55 U.S.P.Q.2d 1011 (N.D. Cal. 2000).

322 Ibid.

323 Ibid.

study, we have identified several trends. First, the past few years have seen a sharp increase in FRAND-related disputes. The USA alone accounts for more than 20 instances of litigation from 1995 to 2012.[324] All but two cases arose after 2005. Second, major players in the ICT standards world are all involved in one case or another. For instance, ETSI, while being a regional SSO, seems to be a major battlefield among market participants. Several other major SSOs that may qualify as an 'international standardizing body' for the purpose of the TBT Agreement, including the ITU, the ISO/IEC, and the IEEE, are not immune from FRAND attacks. Third, and more importantly, developing country-based ICT firms, including the HTC (Taiwan), Huawei (China), Realtek Semiconductor (Taiwan), and Samsung (South Korea) have been involved in several disputes.

If the above observations are correct, several trade policy considerations come into play. First, the ambiguity of FRAND commitments may allow opportunistic patent holders to insist on licensing terms, which may lead to litigation in courts.[325] It is, in other words, up to national courts, rather than the WTO adjudicators, to interpret the FRAND terms in the first place—even in cases where non-US-based SSOs (e.g. the ITU, the ISO, and the IEC) are involved. Putting it bluntly, it is more likely that the US courts, rather than Chinese or European courts, will give meaning to FRAND commitments. Whatever the national courts may determine, it would seem less likely to expect that these judges would ever weigh in on the 'development dimension' of the SSO in this context.[326] If so, could a WTO Member disregard relevant international standardizing activities by maintaining that national courts tend to pick a relatively high royalty rate, thereby foreclosing the participation of developing countries? In such scenarios, should WTO adjudicators review the FRAND commitments by themselves? How would the Panel and the AB deal with a dispute where a WTO Member seeks to justify its unilateral technical regulations by arguing that the royalty rate in the FRAND commitments to a given SSO is so high that it is not sensible for developing or least developed countries to engage in the standard-setting

324 Contreras, above n 320, at 95.

325 Ibid, at 52.

326 However, this does not suggest that the national courts have bias against foreign firms. It is simply that national courts and WTO adjudicators have different mandates and focuses. To date, the US court has only in a 2013 case calculated specific FRAND rate. In *Microsoft Corp.* v *Motorola, Inc.*, the US District Court for Western District of Washington, for the first time, laid down five 'Basic Principles' for assessing FRAND terms. First, the FRAND royalty rate 'should be set at a level consistent with the SSO's goal of promoting widespread adoption of their standards'. Second, a proper methodology used to determine FRAND should 'recognize and seek to mitigate the risk of patent hold-up' that such FRAND commitments are intended to avoid. Third, the FRAND royalty 'should address the risk of royalty stacking by considering the aggregate royalties that would apply' if other holders of essential patents made royalty demands of the implementers. Fourth, the FRAND commitments 'must guarantee that holders of valuable intellectual property will receive royalties on that property'. And finally, the FRAND commitment 'should be interpreted to limit a patent holder to a reasonable royalty on the economic value of its patented technology itself, apart from the value associated with incorporation of the patented technology into the standard'. *Microsoft Corp:* v *Motorola, Inc.*, No. C10-1823JLR, 2013 WL 2111217, at *70–74 (W.D. Wash. 25 April 2013). Thus, while it is true that none of these principles explicitly addresses the development dimension, the first principle may play a role in the TBT context. One may argue, for instance, that to the extent that a given SSO's goal is to foster widespread adoption of its standards—including participation and implementation in developing countries, such royalty rate should be set to reflected for that purpose. And if so, it would seem more difficult for WTO Members to attack the development dimension (and by implication, 'openness' requirement) by way of the level of the royalty.

Table 3. ICT SSO and RAND Dispute in the USA (1995–2012)

Involved SSO	Number of the disputes		Remarks
	Involving developed country-based firms	Involving developing country-based firms	
ETSI	6	5	*Samsung* (South Korea): 3 disputes; *HTC* (Taiwan): 1 dispute; *Huawei* (China): 1 dispute
IEEE	7	1	*Realtek Semiconductor* (Taiwan): 1 dispute.
ITU	5	0	–
ISO/IEC	2	0	–
The Advanced Television Systems Committee, Inc.	2	0	–
Blu-Ray Association	1	0	–

Source: Adopted from Jorge L. Contreras, 'Fixing FRAND: A Pseudo-Pool Approach to Standards-based Patent Licensing', 79 *Antitrust Law Journal* 47 (2013). Noted that these disputes include RAND-related claims and some disputes involved multiple SSOs and standards.

process and implementation? If so, how would WTO adjudicators assess the key elements for a TBT-sense international standard such as 'openness', 'development dimension', or even 'impartiality' in this context? Worse still, if WTO adjudicators are not well prepared for such complicated tasks, they are likely to turn to the jurisprudence and analytical framework of the national courts. And if so, what avenues exist to respond to those concerns raised by certain WTO Members? All of these uncertainties and ambiguities would give more space for emerging economies climbing the global value chain to maneuver in ICT standards activities. For this reason, WTO policymakers should address these IPR issues up front in order to reduce the possibility of disputes to a minimum and should also work to develop the necessary tools that would enable WTO adjudicators to function effectively when disputes arise (Table 3).

V. CONCLUDING REMARKS

Standards activities in the ICT sector cannot be understood as purely technical terms. Standards, viewed from a micro-level, determine the wealth or death of a company. From a macro-level perspective, standards often determine which country will be the winner or loser in the global standards game. The rise of consortia not only changes the static, unified ICT standard-setting paradigm once dominated by the ITU, the ISO, and the IEC, but also turns on the redistribution of power among major economic powers. While the EU has successfully promoted its standards as international standards through its coordinated, hierarchical standardization system, it has increasingly lost its leadership as the Big Three gave way to the new standard-setters in the ICT sector. Today, it is the US-based consortia that have taken the lead in shaping the ICT standards world. Some of these new actors, such as the IEEE, the IETF,

OASIS, and W3C, would qualify as 'international standardizing bodies' for the purpose of the TBT Agreement based on current WTO jurisprudence. Others, such as ECMA International, while failing to satisfy the required elements, may nevertheless affect these traditional international SSOs through various procedures, including the fast-track process, PAS, and others. And while such procedural short-cuts would help the Big Three to serve the needs of the market more effectively, they undercut the legitimacy of these SSOs, which have long been seen as faithful regulatory agents of the WTO. Amid the noise, IPR issues add further complexity to the legal grey zone. As disputes surrounding the vexing FRAND commitments have increased sharply in recent years, IPR problems in the standard-setting context loom large. Ambiguities about the FRAND commitments would seem to create space for emerging economies in the global standards game and turn on new battles between developed and developing countries. All of these issues seem to indicate that it is only a matter of time, not a matter of if, when considering the likelihood of trade disputes surrounding ICT standards. It is time for WTO policymakers to examine what has been happening in this complex, dynamic ICT standard landscape, and for academicians to focus greater attention on the specifics of regulatory reform.

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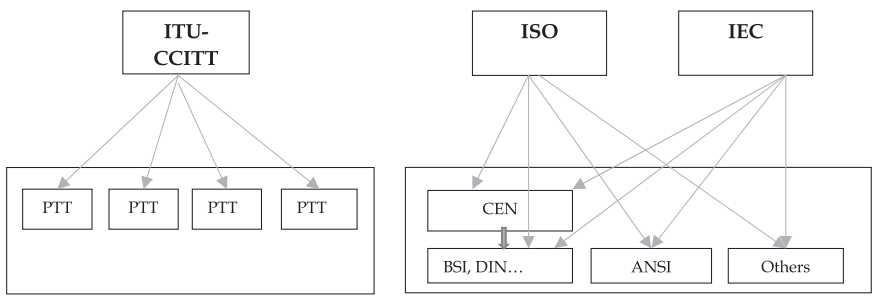
APPENDIX 1

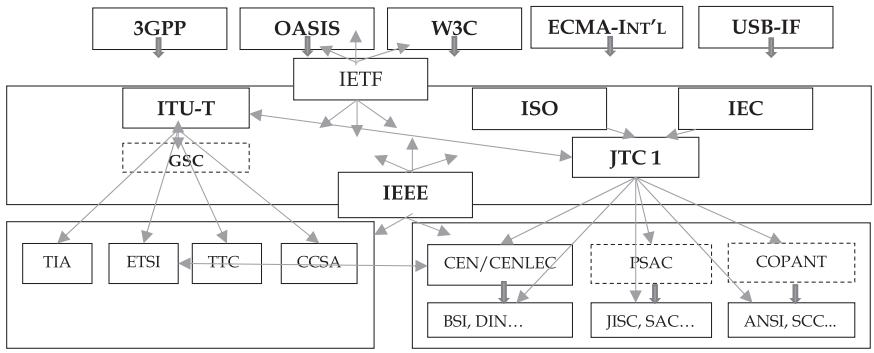
ICT standardization universe in the 1970s (simplified)



Source: Adopted from Kai Jakobs, *Standardisation Processes in IT: Impact, Problems and Benefits of Users Participation* (Vieweg: Braunschweig/Wiesbaden, 2000) 18; Kai Jakobs et al., 'Creating A Wireless LAN Standard: IEEE 802.11', in Wolter Lemstra et al., (eds), *The Innovation Journal of Wi-Fi: The Road to Global Success* (Cambridge: Cambridge University Press, 2011) 87. See Appendix 3 for the explanation of acronym.

APPENDIX 2

ICT standardization universe today (simplified)



Source: Adopted from Kai Jakobs, *Standardisation Processes in IT: Impact, Problems and Benefits of Users participation* (Vieweg: Braunschweig/Wiesbaden, 2000) 18; Kai Jakobs et al., 'Creating A Wireless LAN Standard: IEEE 802.11', in Wolter Lemstra et al., (eds), *The Innovation Journal of Wi-Fi: The Road to Global Success* (Cambridge: Cambridge University Press, 2011) 87. See Appendix 3 for the explanation of acronym.

APPENDIX 3

Explanation of acronym	
International SSOs	
ISO	International Organization for Standardization
IEC	International Electrotechnical Commission
JTC 1	ISO/IEC Joint Committee-1
ITU-T	The ITU Telecommunication Standardization Sector
Regional SSOs	
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
ETSI	European Telecommunications Standards Institute
COPANT	Pan American Standards Commission
PASC	Pacific Area Standards Congress
National SSOs	
ANSI	American National Standards Institute
BSI	British Standards Institution
SAC	Standardization Administration of the People's Republic of China
SCC	Standards Council of Canada
DIN	Deutsches Institut für Normunge.V.
JISC	Japanese Industrial Standards Committee

(*Continued*)

(continued)

Explanation of acronym	
Consortia (Grey SSOs)	
3GPP	The 3rd Generation Partnership Project
CCSA	China Communications Standards Association
ECMA-INTERNATIONAL	European Computer Manufacturers Association- International
GSC	Global Standards Collaboration
IEEE	Institute of Electrical and Electronics Engineers
IETF	The Internet Engineering Task Force
OASIS	Organization for the Advancement of Structured Information Standards
TIA	Telecommunications Industry Association
TTC	Telecommunication Technology Committee
USB-IF	Universal Series Bus Implementers Forum, Inc.
W3C	World Wide Web Consortium

APPENDIX 4

SSO Elements	IETF	IEEE	ECMA	W3C	OASIS
Formality	X	X	X	X	X
Openness	X	X	?	X	X
Transparency	X	X	-	X	X
Impartiality & Consensus	X	X	-	X	X
Effectiveness & Relevance	X	X	-	X	X
Coherence	X	X	-	X	X
Development	X	X	-	X	X
Remarks			ECMA would seem to fail the openness test and is less likely to become a TBT-sense international standard regardless of other substantive requirements are met.		Not explicitly stated consensus but in practice follow this rule.