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A Tale of Two Layers: Patents, Standardization, and the Internet

Jorge L. Contreras

A TALE OF TWO LAYERS: PATENTS, STANDARDIZATION, AND THE INTERNET

JORGE L. CONTRERAS†

ABSTRACT

In recent years, high-profile lawsuits involving standards-essential patents (SEPs) have made headlines in the United States, Europe, and Asia, leading to a heated public debate regarding the role and impact of patents covering key interoperability standards. Enforcement agencies around the world have investigated and prosecuted alleged violations of competition law and private licensing commitments in connection with SEPs. Yet, while the debate has focused broadly on standardization and patents in the information and communications technology (ICT) sector, commentators have paid little attention to differences among technology layers within ICT.

This Article uses both existing and new empirical data to show that patent filing and assertion activity is substantially lower for Internet-related standards than for standards relating to telecommunications and other computing technologies. It analyzes historical and social factors that may have contributed to this divergence focusing on the two principal Internet standards bodies: the Internet Engineering Task Force (IETF) and the World Wide Web Consortium (W3C). It counters the dominant narrative that standards and SEPs are necessarily fraught with litigation and thereby necessitate radical systemic change. Instead, it shows that standards policies that de-emphasize patent monetization have led to lower levels of disputes and litigation. It concludes by placing recent discussions of patenting and standards within the broader context of openness in network technologies and urges both industry participants and policy makers to look to the success of Internet standardization in a patent-light environment when considering the adoption of new rules and policies.

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† Associate Professor, University of Utah S.J. Quinney College of Law and Senior Policy Fellow, American University Washington College of Law. The author thanks Scott Bradner and Wendy Seltzer for their helpful background discussions of IETF and W3C, respectively. The author serves as a legal advisor to IETF, but received no compensation from IETF relating to the preparation of this Article. Support for the preparation of this Article was provided by the Centre for International Governance Innovation (CIGI) and the Royal Institute of International Affairs (Chatham House). An earlier version of this Article appeared as Jorge L. Contreras, *Patents and Internet Standards* (Glob. Comm'n on Internet Governance, Paper Series No. 29, Apr. 2016), https://www.cigionline.org/sites/default/files/gcig_no29_web.pdf.

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We reject: kings, presidents and voting.
We believe in: rough consensus and running code.
Dave Clark, 1992[1]

I. INTRODUCTION

A. Standards and Interoperability

Technical interoperability standards are sets of protocols and design parameters that enable products manufactured by different vendors to work together with minimal user intervention. These standards are embodied in nearly every electronic and technological device today. Broadly adopted interoperability standards can produce significant efficiency-

1. Dave Clark, Senior Research Scientist, Mass. Inst. Tech, A Cloudy Crystal Ball - Visions of the Future, Presentation at the Proceedings of the Twenty-Fourth Internet Engineering Task Force (July 16, 1992), *in* PROCEEDINGS OF THE TWENTY-FOURTH INTERNET ENGINEERING TASK FORCE 543, slide 19 (Megan Davies et al. eds., 1992), https://www.ietf.org/proceedings/24.pdf.

enhancing network effects and other benefits and are integral to the modern technology infrastructure.[2]

Standards may be developed in a variety of settings. Some health, safety, and environmental standards are developed by governmental agencies. Most interoperability standards, however, are developed in the private sector. Individual firms may develop proprietary technologies that, through broad market adoption, become *de facto* standards (e.g., Adobe's "portable document format" (PDF)). In several well-known cases competing firms have engaged in commercial "standards wars" to determine which of their proprietary formats will prevail in the market.[3] Over the past two decades, however, most interoperability standards have been developed by groups of market participants that collaborate within voluntary associations known as standards-development organizations (SDOs).[4] The standards produced within these organizations are often referred to as "voluntary consensus standards," as they are developed through consensus-based collaborative processes, and there is no requirement that participants use the resulting standards.

B. The Architecture of Internet Standardization

Gartner Group estimates that more than six billion devices are connected to the Internet in 2016.[5] The interconnection and communication of these devices is made possible by hundreds of different standards at many different technological layers. The TCP/IP (Transmission Control Protocol/Internet Protocol) data model provides an abstract representation of the four functional layers of a computing or communications system and is frequently utilized to conceptualize the different technology layers that comprise the Internet.[6] In Table 1 below, the four TCP/IP layers are shown with a set of exemplary standards as well as the SDOs responsible for these standards.[7]

2. *See* CARL SHAPIRO & HAL R. VARIAN, INFORMATION RULES: A STRATEGIC GUIDE TO THE NETWORK ECONOMY 186 (1999); *see also* Mark A. Lemley & Carl Shapiro, *Patent Holdup and Royalty Stacking*, 85 TEX. L. REV. 1991, 2025–29 (2007).

3. SHAPIRO & VARIAN, *supra* note 2, at 17 (describing well-known standards wars such as Betamax v. VHS).

4. The alternative term "standards-setting organization" (SSO) is also used in the literature.

5. Press Release, Gartner, Gartner Says 6.4 Billion Connected "Things" Will Be in Use in 2016, up 30 Percent from 2015 (Nov. 10, 2015), http://www.gartner.com/newsroom/id/3165317.

6. *See, e.g.*, ANDREW G. BLANK, TCP/IP FOUNDATIONS 24 (2004).

7. *Id.* Table 3, of course, grossly oversimplifies the vast array of standards and SDOs involved in Internet technologies. In addition to the listed SDOs, at every layer there are numerous smaller consortia and industry collaborations that may compete or cooperate with the listed SDOs.

TABLE 1

INTERNET STANDARDIZATION "STACK"

Layer	Standards	SDOs
4. Application	XML (data exchange) HTTP, HTML (web) IMAP, POP, MIME (email)	W3C, OASIS IETF, W3C IETF
3. Transport	TCP, UDP	IETF
2. Internet	IPv4, IPv6, ICMP, ARP	IETF
1. Network	Ethernet, ISDN, DSL, Wi-Fi, X.25 3G/4G	IEEE ETSI

As Table 1 illustrates, there are three distinct groups of SDOs involved in Internet standardization at different levels of the network architecture.[8] The first group focuses on Layer 1, which corresponds to physical transmission and data link technologies.[9] These include standards for both wired connections (e.g., Ethernet, DSL, and ISDN) as well as wireless connections (2G/3G/4G).[10] The major SDOs that serve these technical areas are ETSI and IEEE, though a host of smaller SDOs and trade associations are also involved in various aspects of this field. Levels 2 and 3 include the "core" Internet protocols TCP and IP.[11] These standards are maintained by IETF. At the Application layer, IETF is joined by W3C, primarily responsible for the HTML descriptor language, and OASIS, which focuses on software interfaces.[12]

In order for the Internet to operate seamlessly, the standards defining each of these layers must interface with the layers immediately above and below it. While this technical compatibility has largely been achieved in today's many Internet-connected devices, there are striking differences among the SDOs that operate at the Network, Transport/Internet and Application levels. One of the largest areas of divergence among these SDOs relates to their treatment of patents.

8. *See generally* BLANK, *supra* note 6, at 24.
9. *See id.*
10. *See id.* at 46–52.
11. *See id.* at 24–25.
12. *Id.* at 55–56.

II. PATENTS AND STANDARDS

A. Standards-Essential Patents

A patent is a form of governmental grant that gives its owner the exclusive right to practice (i.e., make, use, and sell) a claimed invention throughout the issuing country.[13] Patent protection in most countries lasts for a period of twenty years from the date a patent application is filed.[14] Patents may cover any system, device, product feature, process, or improvement so long as it is useful, novel, and not obvious in view of existing technologies.[15] These basic features of patent law are applicable to most developed countries through treaties including, most importantly, the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS).[16] In some countries, including the United States, patents are authorized for the express purpose of promoting innovation and scientific progress.[17]

While patents have historically covered new machines, compositions of matter, and industrial processes, patents covering intangible inventions—such as software and methods of doing business—began to emerge in the last half-century. In the United States, beginning in the early 1980s, the Supreme Court confirmed the patentability of computer software programs[18] (traditionally protected via copyright in the programming code itself). By the late 1990s, patents on "business methods" were also being recognized by the courts.[19] While recent U.S. Supreme Court decisions are believed to have substantially limited the ability to patent both software and business methods,[20] it is estimated that at least 11,000 Internet-related business method patents are still in force in the United States.[21] Outside of the United States, patents on software and business methods are less common, though they may often be upheld if

13. *See, e.g.*, 35 U.S.C. § 101 (2012).

14. 35 U.S.C. § 154(a)(2) (2012).

15. 35 U.S.C. § 102 (2012).

16. Agreement on Trade-Related Aspects of Intellectual Property Rights, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1C, 1869 U.N.T.S. 299 [hereinafter TRIPS Agreement].

17. U.S. CONST. art. I, § 8, cl. 8 (authorizing Congress "[t]o promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries").

18. Diamond v. Diehr, 450 U.S. 175, 179–82, 191–93 (1981).

19. State St. Bank & Tr. Co. v. Signature Fin. Grp., Inc., 149 F.3d 1368, 1375–77 (Fed. Cir. 1998) (holding that "transformation of data . . . by a machine . . . constitutes" patentable subject matter").

20. Alice Corp. v. CLS Bank Int'l, 134 S. Ct. 2347, 2352 (2014) (holding that an intermediated settlement patent covered an abstract idea and was not patenable subject matter); Bilski v. Kappos, 561 U.S. 593, 611–12 (2010) (holding that a risk-hedging patent was not patentable subject matter); *see also* Lois D. Mermelstein, *Cyberspace-Related Patents Since* Alice, 71 BUS. LAW. 343, 34–44 (2015) (describing limitations on software/cyberspace patents since *Alice Corp.*).

21. MICHAEL L. RUSTAD, GLOBAL INTERNET LAW 785 (2014).

they are tied to a "technical effect" or other outcome in the bricks and mortar world.[22]

The product interface protocols and designs specified by technical standards are often covered by patents. Most of these patents are owned by one or more firms engaged in the standards-development process.[23] Patents that will always be infringed by a product conforming to a particular standard are referred to as "standards-essential patents" or "SEPs." Complex technological products may implement dozens or even hundreds of standards[24]—each of which may be covered by hundreds or thousands of SEPs.[25] The result is a very large number of patents covering different aspects of certain standards.

B. Patent Concerns: The Debate over Hold-Up and Stacking

The existence of patents covering standards is not inherently negative, and many argue that the availability of patents provides the financial incentives necessary to fund significant advances in technology. However, once a standard is adopted, patents reduce the ability of competitors to create compatible products and raise prices for consumers.[26] Patents are thus two-edged swords when it comes to standardization; they have the potential to tip the balance of benefits and burdens sharply in favor of one group or another.

In the recent literature, commentators have observed two scenarios in which the balance of equities may tip too far in the direction of patent holders: royalty stacking and patent hold-up. Royalty stacking is a species of collective action problem that can occur when multiple SEP holders each charge a royalty to the manufacturer of a standards-compliant product. While any given royalty, viewed individually, might be reasonable and within market norms, the aggregate royalty burden on the product, accounting for hundreds or thousands of SEPs, could be excessive.[27]

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22. *See Patenting Software*, WIPO, http://www.wipo.int/sme/en/documents/software_patents_fulltext.html (last visited July 23, 2016); *see also* Andrés Guadamuz González, *The Software Patent Debate*, 1 J. INTELL. PROP. L. & PRAC. 196 (2006).

23. SDOs typically hold no patent rights in the standards that they produce.

24. *See* Brad Biddle et al., *How Many Standards in a Laptop? (And Other Empirical Questions)*, INT'L TELECOMM. UNION 123 (Dec. 13–15, 2010), http://www.itu.int/dms_pub/itu-t/opb/proc/T-PROC-KALEI-2010-PDF-E.pdf.

25. *See* KNUT BLIND ET AL., STUDY ON THE INTERPLAY BETWEEN STANDARDS AND INTELLECTUAL PROPERTY RIGHTS (IPRS) 34, 36–37 (2011).

26. *See* SUZANNE SCOTCHMER, INNOVATION AND INCENTIVES 176–78 (2004).

27. Ericsson, Inc. v. D-Link Sys., Inc., 773 F.3d 1201, 1209 (Fed. Cir. 2014). The court in *Microsoft Corp. v. Motorola, Inc.*, observed that

> [t]here are at least 92 entities that own 802.11 [standard-essential patents]. If each of these 92 entities sought royalties similar to [the patent holder's] request of 1.15 % to 1.73 % of the end-product price, the aggregate royalty to implement the 802.11 Standard, which is only one feature of the Xbox product, would exceed the total product price.

Microsoft Corp. v. Motorola, Inc., No. C10-1823JLR, 2013 U.S. Dist. LEXIS 60233, ¶ 456 (W.D. Wash. Apr. 25, 2013) (footnote omitted).

Royalty stacking could, if not curbed, impose barriers to market entry, raise prices for consumers, and reduce innovation in product markets.[28]

Patent hold-up refers to a scenario in which a SEP holder may demand excessive royalties after product manufacturers have made significant investments in a standardized technology. Once such investments have been made, these manufacturers are said to be "locked-in" to the standard.[29] In such cases, the cost of switching from the standardized technology to an alternative may be prohibitive—dramatically increasing a patent holder's leverage in any ensuing licensing negotiation and enabling it to charge excessive royalties.[30]

A heated debate is underway regarding whether patent hold-up and royalty stacking are legitimate threats to standardization and technology markets, or whether they are mere theoretical possibilities. On one hand, some argue that there is little empirical evidence of these market failures in the vibrant and rapidly advancing telecommunications marketplace where prices continue to fall, product capabilities continue to expand, and new market entrants continue to appear from all corners of the globe.[31] Others, however, respond that there is substantial empirical evidence for the general theory of hold-up, that its application to SEP markets is particularly salient, and that evidence of hold-up in these markets is difficult to obtain primarily due to confidentiality restrictions placed on licensing agreements by the parties.[32] It may also be the case that, whatever the theoretical risk of patent hold-up and royalty stacking may be in an unregulated SEP market, affirmative measures already taken by SDOs and enforcement agencies may have reduced the occurrence of these behaviors—demonstrating not that hold-up and stacking are not serious issues, but that they must continue to be policed to prevent future occurrences.[33]

C. SDO Patent Policies

Many SDOs have adopted internal policies intended to reduce the possibility of royalty stacking and patent hold-up. While such policies

28. U.S. Dep't of Justice & U.S. Fed. Trade Comm'n, ANTITRUST ENFORCEMENT AND INTELLECTUAL PROPERTY RIGHTS: PROMOTING INNOVATION AND COMPETITION 61–62 (2007).

29. SHAPIRO & VARIAN, *supra* note 2, at 11, 116; Joseph Farrell et al., *Standard Setting, Patents, and Hold-Up*, 74 ANTITRUST L.J. 603, 608 (2007).

30. Farrell et al., *supra* note 29, at 608; Lemley & Shapiro, *supra* note 2, at 2049.

31. Alexander Galetovic et al., *An Empirical Examination of Patent Hold-Up* 2 (Nat'l Bureau of Econ. Research, Working Paper No. 21090, 2015), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2588169.

32. Carl Shapiro, Patent Hold-Up: Myth or Reality? (Oct. 15, 2015) (unpublished manuscript) (on file with author).

33. In this respect, I have analogized the situation to that of Ebola outbreaks in the United States. As of this writing, there is no evidence of a serious Ebola outbreak in the United States. However, this does not mean that Ebola is not a threat to the public health (as there is ample evidence of its seriousness from other jurisdictions). Rather the absence of Ebola infection in the United States is a credit to our public health agencies and healthcare facilities, which have carefully monitored, contained, and addressed potential outbreaks.

existed as early as the 1950s,[34] SDO patent policies began to assume their current forms in the late 1990s prompted by a settlement that Dell Computer reached with the U.S. Federal Trade Commission (FTC).[35] In this case, the FTC accused Dell of engaging in unfair methods of competition by seeking to enforce patents against implementers of a video bus standard after a Dell engineer had signed a statement certifying that Dell held no patents essential to the standard. In the settlement reached with the FTC, Dell agreed not to assert its patent against any third party implementing the standard.[36]

A second wave of policy revisions occurred in the mid-2000s following litigation involving semiconductor design firm Rambus.[37] In this litigation, the FTC accused Rambus of engaging in anticompetitive practices by concealing, and later seeking to enforce, patents that it otherwise should have disclosed to an SDO.[38] Though Rambus eventually prevailed on technical grounds,[39] the case underscored the importance of drafting extremely clear and detailed SDO patent policies.

The result is that today almost all SDO patent policies impose one or both of the following obligations on SDO participants: (1) an obligation to disclose patents essential to implementation of a standard, (2) an obligation to license patents essential to implementation of a standard—either on a royalty-free (RF) basis or on a royalty-bearing basis at rates that are "fair, reasonable, and nondiscriminatory" (FRAND or RAND).[40]

Yet within these parameters, major differences exist among SDO patent policies. These differences can be observed, to a large degree, when comparing SDOs in the different layers described in Table 1. Thus, SDOs in the Network Layer, including ETSI, ITU, and IEEE, typically permit their participants to charge FRAND royalties for SEPs covering the SDO's standards. The primary Transport/Internet SDO, IETF, per-

34. Jorge L. Contreras, *A Brief History of FRAND: Analyzing Current Debates in Standard Setting and Antitrust Through a Historical Lens*, 80 ANTITRUST L.J. 39, 43 (2015).

35. *In re* Dell Comput. Corp., 121 F.T.C. 616, 623–24 (1996).

36. *Id.* at 616–26.

37. *See generally In re* Rambus, Inc., No. 9302, 2006 WL 2330117 (F.T.C. Aug. 2, 2006), *rev'd*, 522 F.3d 456 (D.C. Cir. 2008) (The FTC "f[ound] that Rambus engaged in exclusionary conduct that significantly contributed to its acquisition of monopoly power in four related markets").

38. *Id.*

39. Though the FTC found that Rambus had engaged in anticompetitive conduct, this decision was reversed by the Court of Appeals for the D.C. Circuit, which held that while Rambus's conduct may have been questionable, the Commission failed to prove any cognizable antitrust harm resulting from Rambus's actions. Rambus Inc. v. FTC, 522 F.3d 456, 459 (D.C. Cir. 2008).

40. In addition to constraints on royalty rates, most SDO patent policies contain a number of additional provisions. RUDI BEKKERS & ANDREW UPDEGROVE, A STUDY OF IPR POLICIES AND PRACTICES OF A REPRESENTATIVE GROUP OF STANDARDS SETTING ORGANIZATIONS WORLDWIDE, U.S. NAT'L ACADEMIES SCI. 48–49 (2012), http://sites.nationalacademies.org/xpedio/groups/pgasite/documents/webpage/pga_072197.pdf; STANDARDS DEVELOPMENT PATENT POLICY MANUAL 27–46 (Jorge L. Contreras ed., 2007); Mark A. Lemley, *Intellectual Property Rights and Standard-Setting Organizations*, 90 CALIF. L. REV. 1889, 1904–05 (2002) [hereinafter Lemley, *Standard-Setting Organizations*].

mits royalties to be charged, but has strong informal norms favoring RF licensing. And Application-focused SDOs such as W3C and OASIS largely produce standards subject to RF licensing commitments.[41]

The reasons for these distinctions and what they mean in practice are explored in the remainder of this Article. For the sake of expediency, in this Article I will refer to "Internet" standards as the network and software layer standards that define the Internet and World Wide Web, because the Network standards published by ETSI, IEEE, and others have utility in a wide range of applications beyond the Internet (e.g., mobile telephony, computer networking, etc.).

III. SEP DISPUTES: IS THE INTERNET DIFFERENT?

A. Patent Acquisition and Standards

Despite the precautionary policy measures taken by many SDOs, over the past decade voluntary consensus standards have become the subject of significant private litigation, regulatory enforcement, and policy debate around the world. As one senior U.S. government official lamented in a 2012 address to the International Telecommunications Union (ITU), "The world . . . is awash in lawsuits related to patented technologies . . . ."[42]

Many recent patent controversies have revolved around the enforcement of SEPs against manufacturers and users of standardized products and the terms on which patent holders may be required to grant licenses permitting use of their SEPs. For example, in both *Apple, Inc. v. Motorola Mobility, Inc.*[43] and *Microsoft Corp. v. Motorola, Inc.*,[44] the SEP owner (Motorola) offered to license SEPs covering two widely-adopted standards at rates that the potential licensees argued were in excess of reasonable levels and thus in violation of Motorola's FRAND commitments.[45] In both cases, the manufacturers of standards-compliant products brought breach of contract actions against the SEP owner for the alleged violation of its FRAND commitments among other things.[46]

Though there is a natural tendency to paint all technologies in the information and communications technology (ICT) sector with the same brush, there are dramatic differences among fields when patents are con-

41. For more detailed comparisons of the terms of different SDO patent policies, see BEKKERS & UPDEGROVE, *supra* note 40, at 13. More detailed comparisons of the terms of different SDO patent policies can also be found in Lemley, *Standard-Setting Organizations*, *supra* note 40, at 1894–95.

42. Renata B. Hesse, Deputy Assistant Attorney Gen., Antitrust Div., U.S. Dep't of Justice, Remarks as Prepared for the ITU-T Patent Roundtable: Six "Small" Proposals for SSOs Before Lunch 9 (Oct. 10, 2012), http://www.justice.gov/atr/public/speeches/287855.pdf.

43. No. 11–cv–178–bbc, 2012 U.S. Dist LEXIS 157525 (W.D. Wis. Nov. 2, 2012).

44. 795 F.3d 1024 (9th Cir. 2015).

45. *Apple*, 2012 U.S. Dist. LEXIS 157525, at *13–14; *Microsoft*, 795 F.3d at 1054.

46. *Apple*, 2012 U.S. Dist. LEXIS 157525, at *4–5; *Microsoft*, 795 F.3d at 1030.

cerned. Recent studies have shown that, by far, the largest number of SEPs have been disclosed in the wireless telecommunications area.[47] In 2015 Baron and Pohlmann collected more than 200,000 patent disclosures from nineteen major SDOs.[48] Of these, nearly 170,000 (84%) disclosures were made at the European Telecommunications Standards Institute (ETSI) alone.[49] In contrast, a total of only 667 patents were disclosed as essential to Internet standards developed at IETF.[50]

This discrepancy of three orders of magnitude is notable given that both ETSI and IETF produce comparable numbers of standards and count many of the same multinational corporations as participants. It arises both from the number of patents that are being filed on aspects of the SDO's technology, as well as the number of patents being disclosed to the SDO. While studies have shown that a degree of patent over-declaration exists, particularly at ETSI,[51] over-disclosure alone cannot account for the dramatic difference in declared patents between these two SDOs. Nor, I suspect, can differences in the inherent complexity of these two technology categories account for this degree of variation. Thus, in addition to over-disclosure, higher patenting levels at ETSI could arise from factors such as the intentional inclusion of optional and non-essential patented features in ETSI standards (sometimes referred to as patent 'stuffing'),[52] more feature-rich standards in general, and greater granularity in patent claim drafting.[53]

B. SEP Litigation Today

Similar contrasts between Network and Internet standards emerge when SEP-related litigation is examined. Table 2 shows all SEP-related cases that reached judgment in the U.S. federal courts and International Trade Commission (ITC), as well as courts in Europe and China, as reported by the Essential Patent Blog.[54]

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47. Justus Baron & Tim Pohlmann, *Mapping Standards to Patents Using Databases of Declared Standard-Essential Patents and Systems of Technological Classification* 9–10 (Regulation & Econ. Growth Working Paper, 2015), http://www.law.northwestern.edu/research-faculty/searlecenter/innovationeconomics/documents/Baron_Pohlmann_Mapping_Standards.pdf; *see also* BLIND ET AL., *supra* note 25, at Table 3-5.

48. Baron & Pohlmann, *supra* note 47, at 8, 12.

49. *Id.* at 12.

50. *Id.* at 10.

51. *See* Jorge L. Contreras, *Fixing FRAND: A Pseudo-Pool Approach to Standards-Based Patent Licensing*, 79 ANTITRUST L.J. 47, 60–61 (2013) (discussing evidence and literature on over-disclosure).

52. Renata B. Hesse, Deputy Assistant Attorney Gen., U.S. Dep't of Justice, Address at the 2nd Annual Antitrust Law Leaders Forum: IP, Antitrust and Looking Back on the Last Four Years, 20–21 (Feb. 8, 2013), http://www.justice.gov/atr/public/speeches/292573.pdf.

53. This area is ripe for further empirical study.

54. Beginning in February 2012, the *Essential Patent Blog* has tracked law and policy developments relating to standards-essential patents and related issues. ESSENTIAL PATENT BLOG, http://www.essentialpatentblog.com (last visited Dec. 27, 2015). The cases in Table 2 are limited to those resulting in reported judicial decisions, which represent a small minority of all SEP-related cases that are brought. *See infra* Table 2. For a more complete picture of SEP litigation relating to

TABLE 2

RECENT REPORTED DECISIONS INVOLVING STANDARDS-ESSENTIAL PATENTS

(2012–2015)

Case	**Court(s)**	**SDO/Standards**
Microsoft v. Motorola (2012)	W.D. Wash. (jury) 9th Cir.	ITU H.264 IEEE 802.11
Apple v. Motorola (2012)	W.D. Wis. N.D. Ill. Fed. Cir.	ETSI UMTS, GPRS IEEE 802.11
Apple v. Samsung (2013)	N.D. Cal. (jury) Fed. Cir. ITC	ETSI UMTS
Golden Bridge v. Apple (2013)	D. Del.	GSMA W-CDMA (part of ETSI UMTS)
In re Innovatio IP Ventures (2013)	N.D. Ill.	IEEE 802.11
Wi-LAN v. Apple (2013)	E.D. Tex. (jury)	ITU CDMA2000 IEEE 802.11
IPCom v. Apple (2014)	Germany - Mannheim	ETSI UMTS
NXP v. Blackberry (2014)	M.D. Fla. (jury)	IEEE 802.11 JEDEC eMMC
InterDigital v. Huawei, Nokia, ZTE, Nokia (2014, 2015)	ITC D. Del. China - Shen-zhen	ETSI UMTS ETSI LTE ITU CDMA2000
Fujitsu v. Tellabs (2014)	N.D. Ill. (jury)	ITU G.692
LSI v. Realtek (2014)	N.D. Cal. (jury) 9th Cir. ITC	IEEE 802.11

seven widely adopted standards (GSM, UMTS, LTE, H.246, 802.11, Bluetooth and USB), see Jorge L. Contreras, *When a Stranger Calls - Standards Outsiders and Unencumbered Patents*, J. COMP. L. & ECON. (forthcoming 2017). For a census of all FRAND-related litigation brought through 2012, see Contreras, *supra* note 51, at Appendix.

Case	Court(s)	SDO/Standards
Ericsson v. D-Link (2014)	E.D. Tex. (jury) Fed. Cir.	IEEE 802.11
Rembrandt v. Samsung (2015)	E.D. Tex (jury)	Bluetooth SIG
CSIRO v. Cisco (2015)	E.D. Tex. Fed. Cir.	IEEE 802.11
Huawei v. ZTE (2015)	CJEU	ETSI LTE

As Table 2 illustrates, all cases pertained to Network standards, either in the field of telecommunications (ETSI and ITU) or computing (Bluetooth and IEEE's 802.11 Wi-Fi standards).

C. Litigation Involving Internet Standards

Notably absent from the SEP litigation picture described in the preceding section are network and software standards pertaining to the Internet. To gain a better understanding of how Internet standards are used in litigation, we compiled all cases in which IETF was requested (either through formal subpoena or an informal request for a written declaration) to authenticate the text or publication date of a standards-track document. These results are presented in Appendix 1.

As shown in Appendix 1, thirty-seven cases involving Internet standards were identified. They involve U.S. district court litigation as well as administrative actions before the U.S. International Trade Commission (ITC) and Patent and Trademark Appeals Board (PTAB).

These data offer a comparison with the telecommunications and computer networking SEP cases described in Table 1. Several distinctions are immediately apparent. First, unlike the cases in Table 1, which relate to a small group of heavily litigated standards (802.11 and 2G/3G/4G), the cases in Appendix 1 relate to a wide range of IETF standards. In fact, other than a handful of fundamental IETF standards such as Internet Protocol (IP, RFC 791) and Hypertext Transfer Protocol (HTTP, RFC 1945), there is almost no overlap among the standards relevant to each particular case. This observation suggests that no particular Internet standard is strongly dominated by patents.

Second, unlike the cases in Table 1, which involve several repeat players (e.g., Motorola, Apple, InterDigital, Huawei, ZTE), there are fewer repeat players involved in litigation relating to Internet standards. This observation may indicate that fewer firms (plaintiffs) in the Internet space make a business of monetizing patents through the initiation of serial lawsuits and that the overall field of market participants (defendants) is larger.

Perhaps the most striking distinction between these two groups of cases is the role that standards play in them. Thus, in the Network-focused cases in Table 1, the plaintiff has often asserted one or more SEPs against manufacturers of standard-compliant products. In some of the cases, the defendant manufacturer has asserted, as a defense, that the SEP owner has violated a FRAND commitment to an SDO. But in almost all of these cases, there is a direct link between the allegedly infringing product, the standard, and the SEPs. In contrast, in most cases involving Internet standards, the defendant has simply sought to use disclosures and developments at IETF as prior art to invalidate a patent asserted by the plaintiff.[55] In these cases the standard does not play a major role in the suit as conceived by the plaintiff and is largely ancillary to the dispute.

Together, these features of the Internet standards landscape suggest an environment in which patents, while valuable, play a more modest role than they do in the Network space. At first blush, the lack of patent acquisition and litigation surrounding Internet standards is surprising. After all, nearly every computer, smart phone, and tablet in the world communicate via the Internet, and the market for Internet-enabled devices is enormous, suggesting that potential verdicts might present lucrative incentives for litigation. Why, then, have the patenting and litigation trends observed among Network technologies not affected the Internet? The remainder of this Article will seek to address this question.

IV. WHAT THE INTERNET IS NOT (YET)[56]

In many respects, the differences in standardization practices between the Network world and the Internet arise from differences in the historical development of these two fields. While the layperson may see no discernable difference between the 4G LTE standard that enables his or her smart phone to connect to a mobile network and the TCP/IP protocols that define the size and configuration of the data packets that traverse that network, these two technical areas exist across a significant gulf of history—a gulf that has shaped the policies and norms that characterize these industries today.[57]

55. If discussion of a technology occurred at an SDO prior to the applicant's filing of a patent application, that discussion can constitute prior art potentially anticipating the patented invention and rendering it unpatentable under 35 U.S.C. § 102(a) (2012).

56. The title of this section owes a debt to Jonathan Zittrain's influential book *The Future of the Internet and How to Stop It*, a cautionary tale about the direction that the Internet could take under increased regulation. *See* JONATHAN ZITTRAIN, THE FUTURE OF THE INTERNET AND HOW TO STOP IT (2008).

57. Over a decade ago, Suzanne Scotchmer recognized the fundamental differences between Internet and telecom standards, even before the most recent wave of SEP-related litigation. *See generally* SCOTCHMER, *supra* note 26. Yet the debate today has lost sight of many of these distinctions.

Standardization in the telecommunications sector began not as a cooperative effort among competing firms, but as a (largely successful) attempt by national telephone monopolies to preserve their control over the industry. This approach was epitomized by AT&T in the United States, which operated under the telling slogan "One System, One Policy, Universal Service."[58] As described by historian Andrew Russell, AT&T standardized many aspects of the U.S. telephony system to ensure that it could obtain a consistent and reliable supply of components from subcontracted manufacturers and to enable local exchanges to connect to its long-haul lines thereby avoiding competition in the long distance market.[59]

Other national operators in Europe and Asia exerted similar levels of control. In Japan, for example, telecommunications standardization was largely driven by its century-old national telecommunications monopoly Nippon Telegraph and Telephone Co. (NTT). For decades, NTT, with the backing of the Japanese government, designed Japan's telecommunications infrastructure and supported a dedicated "family" of equipment manufacturers including Hitachi, Fujitsu, and NEC.[60] The NTT network was, until recently, characterized by proprietary standards developed in NTT's research labs and mandated by the national Ministry of Posts and Telecommunications (MPT) for deployment by NTT's dedicated suppliers.[61]

In most countries, wireless telecommunications were not as heavily regulated as wireline communications, but scarce spectrum still invited governmental allocation and control, and standards were adopted at national and regional levels.[62] The contest among competing technologies, often played out by incumbent telecommunications monopolies, frequently involved wrangling over patents. While first generation analog wireless technologies represented a patchwork of largely incompatible, vendor-specific technical approaches, by the early 1980s the industry recognized the need for second-generation (2G) digital wireless telecommunications standards that would support both voice and data communications.[63]

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58. ANDREW L. RUSSELL, OPEN STANDARDS AND THE DIGITAL AGE: HISTORY, IDEOLOGY, AND NETWORKS 97 (2014); TIM WU, THE MASTER SWITCH: THE RISE AND FALL OF INFORMATION EMPIRES 51 (2011).

59. RUSSELL, *supra* note 58, at 99.

60. Kenji E. Kushida, *Wireless Bound and Unbound: The Politics Shaping Cellular Markets in Japan and South Korea*, 5 J. INFO. TECH. & POL. 231 (2008).

61. *Id.*

62. Peter F. Cowhey et al., *The Peculiar Evolution of 3G Wireless Networks: Institutional Logic, Politics, and Property Rights*, *in* HOW REVOLUTIONARY WAS THE DIGITAL REVOLUTION? 293–95 (John Zysman & Abraham Newman eds., 2006).

63. *See generally* RUDI BEKKERS & JAN SMITS, MOBILE TELECOMMUNICATIONS: STANDARDS, REGULATION, AND APPLICATIONS (1999).

In Europe, Ericsson promoted a 2G standard based on time-division multiplex access (TDMA) technology, which eventually led to the European Groupe Spécial Mobile (GSM) standard. Ironically, the largest holder of SEPs in GSM technology was Motorola, a United States firm that conducted significant manufacturing R&D operations in Europe.[64] A competing 2G proposal was advanced by a coalition of French and German firms, which had strong patent positions in their own technology.[65] Before this coalition agreed to support GSM at the newly-formed ETSI, technology covered by some of these patents had to be included in the standard.[66] By the time that GSM was approved by ETSI in 1990, five firms (Ericsson, Nokia, Siemens, Motorola, and Alcatel) held broad patent coverage of the standard.[67] The situation in the United States was less fractured, but even more patent-centric, as Qualcomm's code division multiplex access (CDMA) technology became the basis for the leading 2G standard.[68] And, as noted above, each successive generation of wireless telecommunications standards has been burdened with more patents, opening the way for further disputes and litigation.

V. THE INTERNET ENGINEERING TASK FORCE (IETF)

In contrast to telecommunications technologies, the Internet developed along a path that emphasized patents and patent enforcement far less. The evolution of the two principal SDOs developing Internet standards—IETF and W3C—is discussed in this and the following sections.

A. The Origins and Growth of IETF

The history of IETF is inextricably entwined with the history of the Internet itself.[69] The Internet was initially conceived and funded by the U.S. Department of Defense through its Defense Advanced Research Projects Agency (DARPA, also known as ARPA). The project was intended to design a reliable and resilient computer network that did not rely on the then-dominant circuit-switched technology.[70] Building on

64. Rudi Bekkers et al., *Intellectual Property Rights and Standardization: The Case of GSM*, 26 TELECOMM. POL'Y 171 (2002).

65. *Id.* at 177.

66. Björn Lundqvist, Standardization Under EU Competition Rules and US Antitrust Laws 59 (2014).

67. Bekkers, *supra* note 64, at 179.

68. LUNDQVIST, *supra* note 66, at 59.

69. The origins of the world's biggest network have been documented many times. *See, e.g.*, LAURA DENARDIS, THE GLOBAL WAR FOR INTERNET GOVERNANCE 2 (2014); KATIE HAFNER & MATTHEW LYON, WHERE WIZARDS STAY UP LATE: THE ORIGINS OF THE INTERNET (1996); RUSSELL, *supra* note 58, at ch. 8; STEPHEN SEGALIER, NERDS 2.0.1: A BRIEF HISTORY OF THE INTERNET (1998); WU, *supra* note 58.

70. Paul Baran at the Rand Corporation was one of the early theorists of distributed computing. He believed that a distributed network was more likely to survive a nuclear attack than a network dependent on end-to-end switching, as the then-existing AT&T network was. *See* Memorandum from Paul Baran, prepared for the United States Air Force Rand Project: On Distributed Communications: I. Introduction to Distributed Communications Networks i, v (Aug. 1964), http://www.rand.org/content/dam/rand/pubs/research_memoranda/2006/RM3420.pdf ("[Th[is]

theoretical work done at MIT and the Rand Corporation in the early 1960s, host computers at UCLA, Stanford, UC Santa Barbara, and the University of Utah were connected in 1969 to form a prototype packet-switched network known as ARPANET. In 1973, Robert Kahn at DARPA and Vint Cerf at Stanford developed the TCP/IP protocols to enable ARPANET to connect with other computer networks, thereby laying the groundwork for the modern Internet.[71] As personal computers, workstations, and local area networks proliferated in the 1980s, the Internet expanded in size and popularity.

Prior to 1985, technical work relating to the Internet was carried out in a series of task forces chaired by leading researchers at DARPA and a few universities. In 1985, this activity was placed under the umbrella of a new, loosely organized organization called the Internet Engineering Task Force (IETF). Around this time, Kahn and other leaders of the Internet project left DARPA, leaving IETF and its sister organization, the Internet Activities Board (now the Internet Architecture Board) (IAB), to chart the future direction of the Internet. One of the over-arching features of all of these organizations was a distinctly non-commercial culture that valued technical capability over than economic returns.[72]

As the Internet grew in popularity and usage, commercial users rapidly began to outnumber earlier academic and government users.[73] In order to create an organization in which commercial, academic, and government representatives could collaborate, a non-profit corporation called the Internet Society (ISOC) was formed in 1992.[74] ISOC became the

memorandum is directed toward examining the use of redundancy as one means of building communications systems to withstand heavy enemy attacks."]; *see also* HAFNER & LYON, *supra* note 69. Some recent commentators have questioned whether nuclear survival was the driving force behind ARPANET, arguing instead that developing remote time sharing capability was the primary motivation for DARPA's interest in distributed computing. *See, e.g.*, Ian Peters, *The Beginnings of the Internet*, NET HISTORY, http://www.nethistory.info/History%20of%20the%20Internet/beginnings.html (last visited July 23, 2016).

71. The original TCP Protocol was published in December 1974 as RFC 675, and the Internet Protocol (IP) was published in 1981 as RFC 791. The IETF document series extends back to an academic Request for Comments (RFC) published in 1968. The term RFC has in recent years lost its meaning as "Request for Comments" and now simply refers to the definitive standards and reference document series published by IETF. *See* DENARDIS, *supra* note 69, at 71–72.

72. *See* Mark A. Lemley, *The Law and Economics of Internet Norms*, 73 CHI.-KENT L. REV. 1257, 1268 (1998) (discussing non-commercial norms of Internet community); Jeffrey V. Nickerson & Michael zur Muehlen, *The Ecology of Standards Processes: Insights from Internet Standard Making*, 30 MIS Q. (SPECIAL ISSUE) 467, 469 (2006) ("The founders of the Internet consciously resisted marketplace pressures, establishing a protected niche in which they could pursue their research. In this way, the Internet is unusual. Most modern inventions occur within a commercial context. The Internet, funded by the government and sheltered in research and development labs for decades, created a broad following interested in both its technical and its social characteristics well before commercial interests sensed its importance." (citation omitted)).

73. *See* *Mother of Consensus*, ECONOMIST (Mar. 5, 2016), http://www.economist.com/news/international/21693920-engineering-internet-too-big-task-one-outfit-mother-consensus.

74. DENARDIS, *supra* note 69, at 70.

"organizational home" of IETF in 1996 and still provides administrative, personnel, and financial support to IETF.[75]

Participation in IETF is, and always has been, on an individual basis even though firms often sponsor attendance and participation by their employees. In recent years, at any given time, over a hundred different working groups are operational within IETF,[76] and between 1200 and 1500 individuals regularly attend IETF's meetings held three times per year.[77] IETF is famously open and transparent.[78] Almost all proceedings, documents, and records are freely available on the IETF web site, and anyone who is interested may join a technical working group. Documents that advance through the "standards track" are based on open consensus processes overseen and managed by a group of semi-elected Area Directors and other leaders. The IETF standardization process is largely "bottom-up," in which technical proposals are generated by individual participants who must defend and advocate their proposals both in written e-mail communications and at in-person IETF meetings.

While IETF's open culture and transparent procedures have been praised by commentators,[79] they have also shown weaknesses. Most notably, the speed of standardization at IETF has flagged, and the organization has become notorious for lengthy technical debates and delays.[80] As discussed below, this slowdown contributed to Tim Berners-Lee's formation of W3C as an independent organization in 1994.

B. Patents at IETF

1. Evolution of the IETF Patent Policy

As described above, the pioneers of the Internet were employed primarily by the U.S. government, its academic collaborators, and a small number of private contractors (e.g., the Cambridge-based Bolt Beranek and Newman (BBN)), leading to a distinctly non-commercial

75. Memorandum from Eric Huizer, Chief Tech. Officer, SURFnet ExpertiseCentrum, on IETF-ISOC Relationship (Oct. 1996), https://tools.ietf.org/html/rfc2031.

76. *The Tao of IETF: A Novice's Guide to the Internet Engineering Task Force*, IETF TRUST, http://www.ietf.org/tao.html (last updated Nov. 2, 2012).

77. Jorge L. Contreras, *Divergent Patterns of Engagement in Internet Standardization: Japan, Korea and China*, 30 TELECOMM. POL'Y 916 (2014).

78. Richard S. Whitt, *A Deference to Protocol: Fashioning a Three-Dimensional Public Policy Framework for the Internet Age*, 31 CARDOZO ARTS & ENT. L.J. 689, 702–03 (2013); A. Michael Froomkin, *Habermas@Discourse.Net: Toward a Critical Theory of Cyberspace*, 116 HARV. L. REV. 749, 787 (2003); LARRY LESSIG, THE FUTURE OF IDEAS: THE FATE OF THE COMMONS IN A CONNECTED WORLD (2001).

79. *See, e.g.*, Froomkin, *supra* note 78, at 702–03; Whitt, *supra* note 78, at 722; Dieter Ernst, *America's Voluntary Standards System — A "Best Practice" Model for Innovation Policy?* 16–18 (East-West Center Working Papers, Econs. Series No. 128, Feb. 2012).

80. *See, e.g.*, Timothy Simcoe, *Delay and de jure Standardization: Exploring the Slowdown in Internet Standards Development*, *in* STANDARDS AND PUBLIC POLICY 261, 268–70 (Shane Greenstein & Victor Stango eds., 2006); Nickerson & zur Muehlen, *supra* note 72, at 479–80.

culture.[81] Large firms such as IBM and AT&T, which were heavily invested in patenting activity, were not part of the early Internet.[82] In the days before the Bayh-Dole Act of 1980,[83] which provided a framework for patenting federally funded inventions, universities and federal agencies engaged in little patenting activity. The combination of these factors resulted in few patents being filed on the fundamental protocols that defined the Internet.[84]

The IETF's first formal patent policy was adopted in 1992 as RFC 1310 to accommodate the needs of the growing community of commercial Internet users.[85] This policy, largely mirroring the language of the American National Standards Institute's (ANSI) patent policy,[86] contained a rudimentary FRAND or RF licensing requirement. The policy was strengthened in 1994 with the publication of RFC 1602.[87] This version of the policy required that patent holders grant a RF license to ISOC and commit to license implementers of IETF standards on RF or RAND terms.

Despite these policy enactments, patents did not play much of a role in deliberations at IETF until 1995 when Motorola disclosed patents claiming features of the PPP Compression Control Protocol (CCP, RFC 1962) and Encryption Control Protocol (ECP, RFC 1968).[88] Motorola initially refused to commit to license these patents to users of the PPP standards, leading to significant opposition within the IETF working

81. *See supra* note 73 and accompanying text.

82. *See generally* RUSSELL, *supra* note 58, at 218, 241–43 (describing tension between IBM-backed OSI networking standard and early Internet proponents).

83. Patent and Trademark Law Amendments (Bayh-Dole) Act of 1980, Pub. L. No. 96-517, §§ 200–01, 94 Stat. 3015 (codified as amended at 35 U.S.C. §§ 200–11 (2012)). The Bayh-Dole Act both authorized and encouraged universities and other government contractors to patent inventions funded by federal agencies. *Id.* Prior to the Act, there was no uniform federal policy regarding patenting of federally-funded inventions, and most of the inventions were not patented. *Id.*

84. *See* Daniel J. Weitzner, *Standards, Patents and Dynamics of Innovation on the World Wide Web*, WORLD WIDE WEB CONSORTIUM (Nov. 2004), https://www.w3.org/2004/10/patents-standards-innovation.html.

85. Memorandum from A. Lyman Chapin, Chair, Internet Activities Bd., on Internet Standards Process, RFC 1310, at 1–3 (Mar. 1992), https://www.rfc-editor.org/rfc/pdfrfc/rfc1310.txt.pdf; *see* Simcoe, *supra* note 80, at 260, 270–72 (describing increased commercial involvement in IETF and Internet standardization).

86. Though ANSI is not itself an SDO, it accredits U.S. SDOs as developers of American National Standards. *See* ANSI ESSENTIAL REQUIREMENTS: DUE PROCESS REQUIREMENTS FOR AMERICAN NATIONAL STANDARDS § 3.1.1, at 10–11 (AM. NAT'L STANDARDS INST. 2015). Among ANSI's requirements for accredited SDOs, which are embodied in its *Due Process Requirements for American National Standards*, are rules regarding the way that accredited SDOs must handle patents held by their participants. *Id.*

87. Memorandum from Christian Huitema, IAB Chairman, & Phill Gross, IESG Chairman, on Internet Standards Process, RFC 1602, § 5.6, at 31–34 (Revision 2 Mar. 1994), https://www.rfc-editor.org/rfc/pdfrfc/rfc1602.txt.pdf.

88. Simcoe, *supra* note 80, at 271–72. One earlier patent disclosure at IETF was made in 1993 by the National Institute of Standards and Technology (NIST) relating to a patent covering its Digital Signature Algorithm. *See Reported Statement from NIST Regarding Use of DSA*, IETF DATATRACKER (Jul. 23, 1993), https://datatracker.ietf.org/ipr/449/. However, NIST committed to license the patent to users worldwide on a royalty-free basis, eliminating any serious concern. *Id.*

group,[89] IETF eventually published the PPP standards with the patented technology, but only after Motorola agreed to offer implementers of the standard licenses on RAND terms.[90]

The PPP incident led IETF to review and revise its patent policy as part of a 1996 overhaul of its standardization procedures (RFC 2026). The IETF's 1996 policy departs from its earlier RAND/RF licensing commitment by requiring only that participants disclose the existence of patents covering IETF standards, but not that they license these patents on any particular terms. IETF's current policy (contained in RFC 3979 and subsequent addenda, collectively known as Best Common Practice (BCP) 79) preserves this disclosure-only approach.[91]

2. IETF's Preference for RF

Given IETF participants' discomfort with Motorola's RAND licensing proposal for PPP, it may seem curious that IETF elected to adopt a policy with no licensing commitment at all. That is, IETF's 1992 policy at least contained an upper bound on royalties charged by participants (reasonableness), whereas the 1996 policy gives SEP holders *carte blanche* to charge anything they wish, or even to withhold licenses entirely.

But the seeming flexibility under this policy is, in practice, an illusion. Rather than empower SEP holders to charge high or unreasonable royalties for their patents, it actually discourages them from charging anything at all. How? If an SDO policy expressly permits a SEP holder to charge RAND royalties, then such royalties are effectively condoned by the organization. But if a policy neither permits nor prohibits royalties, then all decisions regarding royalty-bearing technologies will be made by working groups. As such, IETF continues to exhibit a strong preference for royalty-free standards. It does so in two ways: (a) through express statements of preference in BCP 79 and elsewhere, and (b) through working group deliberations.

a. RF Policy Preferences

While IETF does not require its participants to commit to license their patents on any particular terms, reasonable or otherwise, it does

89. *See* E-mail Archive for IETF Working Group (Dec. 16–18, 1995), https://groups.google.com/forum/#!msg/info.ietf/raixEKiWbMc/IPK9BQuXjnoJ. It is possible that Motorola was unwilling to follow the licensing procedure outlined in RFC 1602 out of (a legitimate) fear that the RF license granted to ISOC would exhaust Motorola's patent rights as to subsequent users of the standard. This likely defect in the IETF patent policy was corrected in 1996 with the adoption of RFC 2026.

90. *See* Memorandum from Frank Kastensholz, FTP Software, Inc., on Internet Best Current Practice, RFC 1915, at 1–3 (Feb. 1996), https://tools.ietf.org/pdf/rfc1915.pdf.

91. IETF patent disclosures are published and archived on the IETF website. *See Intellectual Property Rights (IPR)*, IETF.ORG, www.ietf.org/ipr (last visited Mar. 6, 2016).

express a preference for RF standards in many contexts. For example, Section 8 of RFC 3979 explains that

> In general, IETF working groups prefer technologies with no known [patent] claims or, for technologies with claims against them, an offer of royalty-free licensing. But IETF working groups have the discretion to adopt technology with a commitment of fair and non-discriminatory terms, or even with no licensing commitment, if they feel that this technology is superior enough to alternatives with fewer [patent] claims or free licensing to outweigh the potential cost of the licenses.

Thus, the preference for royalty-free standards at IETF is just that: a preference—and one that is not universally shared. However, the express statement of that preference is telling.

Additional evidence of the IETF community's preference for RF is displayed in connection with specific technology areas such as Internet security. In these areas, which are viewed as critical for Internet integrity, the institutional preference for royalty-free standards is articulated more strongly:

> An IETF consensus has developed that no mandatory-to-implement security technology can be specified in an IETF specification unless it has no known [patent] claims against it or a royalty-free license is available to implementers of the specification unless there is a very good reason to do so.

Thus, while IETF lacks strict positive rules requiring royalty-free standards, these statements are reflective of broadly held community norms. Accordingly, while room is left for IETF to adopt an Internet security standard that is subject to royalties if "there is a very good reason to do so," it does not appear that such a reason has ever been found.

b. Working Group Deliberations

IETF working groups are charged with considering and evaluating the implications of patent burdens on technologies being considered for standardization. RFC 3669, which offers guidance to IETF working groups, provides that

> every working group . . . . needs to take IPR seriously, and consider the needs of the Internet community and the public at large, including possible future implementers and users who will not have participated in the working group process when the standardization is taking place.[92]

92. Memorandum from Scott Brim, Cisco Sys., Inc., on Guidelines for Working Groups on Intellectual Property Issues, RFC 3669, § 5, at 8 (Feb. 2004), https://www.rfc-editor.org/rfc/pdfrfc/rfc3669.txt.pdf.

In addition to statements of preference in IETF policy documents, IETF participants and working groups exhibit their own preferences for RF standards in the selection of technical proposals for standardization. The fact that patents must be disclosed to IETF early in the standardization process enables participants to evaluate the extent to which patented technologies may be essential to draft standards under consideration. If the members of a working group do not wish to include a patented technology in the standard, they have the opportunity to redesign the standard to avoid the relevant patents.

Thus, while explicit group negotiation of patent royalty rates is discouraged,[93] working group members are advised to consider the potential impact of disclosed patents and proposed licensing terms on the usefulness of a technology under consideration for standardization.[94] In practice, IETF working group participants have exhibited a keen awareness of which technical proposals are burdened by potential patent royalties and take this information into account when designing standards.[95]

c. Voluntary Licensing Disclosures

Decisions regarding the inclusion of patented technologies in IETF standards are facilitated by voluntary disclosures that SEP holders may make regarding their licensing intentions. Thus, while patent disclosures at IETF must contain certain key information such as patent numbers, affected standards, and the like, IETF also permits the disclosure of additional relevant information regarding patents. Accordingly, many IETF participants make express licensing commitments in their patent disclosures.[96] These can include commitments to license the disclosed SEPs on RAND or RF terms as well as broad commitments not to assert patents in particular contexts.

Not surprisingly, given IETF's stated preferences, many voluntary licensing commitments indicate that RF licensing of SEPs will be offered. In a study covering the period between 2007–2010, I analyzed 481 patent disclosures made at IETF covering a total of 594 different stand-

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93. Potential antitrust concerns arise in the context of such group negotiations. Non-lawyer IETF working group leaders do a good job of curbing these discussions. For example, the 2009 e-mail list discussion of the Robust Header Compression standard, in which a working group leader writes, in typical tongue-in-cheek IETF fashion, "please do *not* discuss specific patents/patent claims on the mailinglist [sic], as such a discussion might require a number of contributors tounsubscribe [sic] and stop contributing. (It might also cause you or your employer to become liable for damages in interesting ways.) . . . . If you want to discuss this, meet in a hallway and make sure nomicrophones [sic] are nearby." *See* E-mail Archive for Robust Header Compression (ROHC) (Apr. 30, 2009), http://www.ietf.org/mail-archive/web/rohc/current/msg05691.

94. *See* Memorandum from Scott Brim, *supra* note 92, at 12–13.

95. There are multiple examples of potential patent issues considered by IETF working groups. *See id.* § 4 (detailing patent issues arising in connection with standardization efforts for IPS, PEM and PKI, VRRP and SecSH).

96. The enforceability of such commitments in the absence of a formal contractual framework is discussed in Jorge L. Contreras, *A Market Reliance Theory for FRAND Commitments and Other Patent Pledges*, 2015 UTAH L. REV 479.

ards documents. Of these disclosures, 283 (59%) contained voluntary commitments to license the disclosed SEPs on royalty-free terms or the equivalent. These data reveal strong community alignment behind a patent policy that outwardly disadvantages patent holders.

The strength of IETF's community norms around royalty-free patent licensing is further exemplified by the agreement—even of IETF participants with well-known patent monetizing programs—not to assert their SEPs under certain circumstances.[97]

IV. THE WORLDWIDE WEB CONSORTIUM (W3C)

A. The Origins of W3C

By the late 1980s, the European Organization for Nuclear Research (CERN) was a key European Internet node.[98] Around 1989 a young software engineer at CERN named Tim Berners-Lee began work on improving the Internet's user interface to facilitate scientific collaboration and data exchange both within CERN and with external collaborators. In doing so he developed the hypertext transfer protocol (HTTP) and hypertext markup language (HTML),[99] which became the foundational protocols for the World Wide Web. Berners-Lee, heavily influenced by the open source software movement, released his code online in 1991.[100]

The graphically oriented World Wide Web was a significant improvement over existing text and directory-based file sharing systems such as Gopher and FTP. Enthusiasm for the Web grew rapidly among academic researchers. Berners-Lee, aware that researchers were likely to tinker with and improve his original Web protocols, recognized the need to standardize the technology to avoid fragmentation and proliferation of incompatible versions. His first efforts at publishing the Web protocols as standards were made at IETF.[101] He was discouraged, however, by the slow and contentious deliberations at IETF and decided that the Web would best be served by a new and more flexible standardization body.[102]

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97. *See QUALCOMM Incorporated's Statement About IPR Related to RFC 6330*, IETF DATATRACKER (Mar. 19, 2015), https://datatracker.ietf.org/ipr/2554/. Qualcomm committed to not assert SEPs against implementers of IETF RFC 6330 so long as the standard was not implemented in a device that uses a wireless wide-area standard (e.g., a mobile phone).

98. DENARDIS, *supra* note 69, at 74.

99. Memorandum from Tim Berners-Lee, Dir., W3 Consortium, & Daniel Connolly, Research Tech. Staff, W3 Consortium, on Hypertext Markup Language - 2.0, RFC 1866, § 1.1, at 1, 3 (Nov. 1995), https://www.rfc-editor.org/rfc/rfc1866.txt. ("HTML is an application of ISO Standard 8879: 1986 Information Processing Text and Office Systems; Standard Generalized Markup Language (SGML).").

100. Andrew L. Russell, *Constructing Legitimacy: The W3C's Patent Policy*, *in* OPENING STANDARDS 159, 162–64 (Laura DeNardis ed., 2011).

101. Berners-Lee submitted a version of HTML for standardization to IETF in June 1993. *See* Memorandum from Tim Berners-Lee & Daniel Connolly, *supra* note 99. The standard was published by IETF as RFC 1866 in November 1995. *Id.*

102. Russell, *supra* note 100, at 163–64. It has also been alleged that Berners-Lee preferred a standardization process over which he exerted more direct control. In this regard, W3C has been

In 1994 Berners-Lee left CERN for MIT, which became the home of a new SDO devoted to Web standards—the World Wide Web Consortium (W3C). Berners-Lee brought the page descriptor language HTML to W3C, while leaving HTTP at IETF, where it continues to be maintained.

Soon after MIT became the base for W3C, several other universities in Europe and Asia joined W3C as organizational hosts. W3C received early funding from DARPA and the European Union but soon shifted to a self-sufficient member fee funding model.[103]

B. Patents and W3C

1. The Increasing Relevance of Patents to the Web

The open source movement was, to a large extent, a reaction to increases in intellectual property protection for computer software. As noted above, by the late 1980s and 1990s, an increasing number of software-related patents were being issued in the United States. In addition, patents purporting to cover broad categories of Internet technology, including British Telecom's 1989 patent that allegedly covered all hyperlinks,[104] drew increasing press coverage and public concern, along with a degree of scorn and ridicule from the technical community.[105] According to Richard Stallman, one of the founders of the "free" software movement, "the worst threat we face comes from software patents."[106]

In 1993, the University of Minnesota, which developed the popular Gopher Internet file sharing system, announced that it would begin to charge commercial users to use Gopher.[107] This announcement caused concern among many Internet users and prompted Berners-Lee to seek assurances from his own employer (CERN) that it would not do the same.[108] Later that year, CERN agreed to contribute its intellectual property rights in the code underlying the Web to the public domain to "fur-

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referred to as a "benevolent dictatorship," one in which the ultimate authority lies in the organization's director. *See* TINKEKE M. EGYEDI, BEYOND CONSORTIA, BEYOND STANDARDISATION?: NEW CASE MATERIAL AND POLICY THREADS 40–41 (2001), http://www.tbm.tudelft.nl/fileadmin/Faculteit/TBM/Over_de_Faculteit/Afdelingen/Afdeling_Infrastructu-
tu-
re_Systems_and_Services/Sectie_Informatie_en_Communicatie_Technologie/medewerkers/tineke_egeydi/publications/doc/Report_EU_Beyond_Stand.pdf.

103. DENARDIS, *supra* note 69, at 74–75.

104. *See* British Telecomms. PLC v. Prodigy Commc'ns Corp., 189 F. Supp. 2d 101, 106–07 (S.D.N.Y. 2002).

105. *See, e.g.*, Rob Pegoraro, *Patently Ridiculous Claims*, WASH. POST, Feb. 9, 2001, at E-1; *BT Pushes Hyperlink Patent*, GEEK (Dec. 15, 2000, 1:55 PM), http://www.geek.com/news/bt-pushes-hyperlink-patent-542562/15 ("If BT keeps pushing this 'we own hyperlinks' nonsense it's going to take an image beating without precedent . . . .").

106. Richard Stallman, *The GNU Operating System and the Free Software Movement*, *in* OPEN SOURCES: VOICES FROM THE OPEN SOURCE REVOLUTION 53, 67 (Chris DiBona et al. eds., 1999); *see also* Weitzner, *supra* note 84, at Part II.

107. Russell, *supra* note 100, at 162.

108. *Id.*

ther compatibility, common practices, and standards in networking and computer supported collaboration."[109]

Given W3C's origins in the scientific research community, the first five years of its existence were relatively free from patent-related controversy. As Berners-Lee observed of that period:

> Many participants in the original development of the Web knew that they might have sought patents on the work they contributed to W3C, and that they might have tried to secure exclusive access to these innovations or charge licensing fees for their use. However, those who contributed to building the Web in its first decade made the business decision that they, and the entire world, would benefit most by contributing to standards that could be implemented ubiquitously, without royalty payments.[110]

However, as noted in the Introduction, throughout the 1990s patents were becoming an increasingly important force in the commercial world. Patent concerns finally reached W3C in 1999. That year, Microsoft and Sun Microsystems disclosed patents covering W3C's CSS and XLink technical proposals, respectively, and a small firm called Intermind obtained a patent claiming key aspects of W3C's Platform for Privacy Preferences (P3P) standard.[111] W3C feared that Intermind's royalty demands would chill adoption of the P3P standard. As a result, W3C engaged the prestigious New York law firm Pennie & Edmonds to opine that P3P did not infringe Intermind's patent. Eventually, Intermind backed down and P3P was released without the threat of patent infringement. Nevertheless, the Intermind incident caused W3C to re-evaluate its informal "gentlemen's agreement" whereby participants would not seek to patent W3C standards.

2. W3C's Royalty-Free Patent Policy

In 1999 W3C began the arduous task of developing a formal patent policy. Daniel Weitzner, one of the organization's early leaders, offers a detailed account of this difficult and contentious multi-year process.[112] The first policy that W3C's drafting group developed included requirements relating both to patent disclosure and patent licensing. The patent licensing provisions were the most controversial because they would have required W3C members to license SEPs to all implementers of

109. W. Hoogland, Dir. Research, & H. Weber, Dir. Admin., Declaration at the European Organization for Nuclear Research (CERN) Concerning CERN W3 Software Release into Public Domain 2 (Apr. 30, 1993), https://tenyears-www.web.cern.ch/tenyears-www/Declaration/Page2.html.

110. Tim Berners-Lee, *Director's Decision, W3C Patent Policy*, W3C (May 20, 2003, 7:50 AM), https://www.w3.org/2003/05/12-director-patent-decision-public.html.

111. *See* Russell, *supra* note 101, at 165–66; Weitzner, *supra* note 84, Parts II–IV.

112. Weitzner, *supra* note 84, Section III.A.

W3C standards on royalty-free or royalty-bearing RAND terms.[113] The possibility that monetary royalties could be charged on W3C standards alarmed some W3C participants and members of the public particularly the Open Source Initiative (OSI) and other open source software developers and advocates.[114] They claimed that large corporate interests within W3C were attempting to "hijack" the organization and subvert its historically open tradition. W3C received nearly 2,500 public comments on the draft policy, most of which opposed it.[115]

This reaction from the open source community sent W3C back to the drawing board. In 2002, after extensive internal discussions and debate, W3C proposed a new patent policy, this time requiring royalty-free licensing by all members of the working group that developed a standard. Berners-Lee justified the move to a royalty-free model as follows:

> The open platform of royalty-free standards enabled software companies to profit by selling new products with powerful features, enabled e-commerce companies to profit from services that on this foundation, and brought social benefits in the non-commercial realm beyond simple economic valuation. By adopting this Patent Policy with its commitment to royalty-free standards for the future, we are laying the foundation for another decade of technical innovation, economic growth, and social advancement.[116]

To accommodate the concerns of some of its corporate members, the W3C included an exception in its policy that allowed the inclusion of patented technologies in W3C standards, but only after a "Patent Advisory Group" (PAG) comprising representatives of all working group members and the Chair of W3C determined that the patented technology was essential to the standard and could not be worked around. The new version of the patent policy was approved and went into effect in 2004, the tenth anniversary of the W3C's formation. The policy remains in effect today with only minor revisions.[117]

The new W3C patent policy was not universally applauded by W3C members, and it has been reported that the royalty-free requirement caused large patent holders such as IBM, SAP, and Microsoft to bring standardization proposals to SDOs with more patent-friendly policies.[118]

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113. *Id.*; Mark Cutler, *W3C Working Group on Patent Policy Weighing Royalties for Patented Contributions*, 2 Computer Tech. L. Rep. (BNA) 446 (2001).

114. E-mail from Brett Serkez, Techie, to OpenSource.org (Nov. 13, 2001), https://lists.w3.org/Archives/Public/www-voice/2001OctDec/0037.html.

115. Nickerson & zur Muehlen, *supra* note 72, at 477.

116. Berners-Lee, *supra* note 110.

117. *See W3C Patent Policy*, W3C (Feb. 5, 2004), https://www.w3.org/Consortium/Patent-Policy-20040205/.

118. Paul Festa, *W3C Makes Patent Ban Final*, CNET (May 22, 2003, 5:13 AM), http://www.cnet.com/news/w3c-makes-patent-ban-final/; Russell, *supra* note 100, at 166–67. SDOs face the risk that members will depart with any controversial policy change. Such fears arose in 2007 when the small SDO VITA amended its patent policy to require members holding SEPs to disclose

Nevertheless, some of these firms eventually expressed support for the policy acknowledging the growing importance of open source software to the Web ecosystem.

Since the W3C's royalty-free policy went into effect, there have been relatively few invocations of the PAG process. One of the first arose in 2003, when a PAG was formed to assess the potential impact of four patents on W3C's draft VoiceXML standard.[119] The PAG approached the owners of the four patents and received a commitment of royalty-free licensing with respect to two of them and an assurance that the owner of the third did not consider the patent to be essential to the standard. But Rutgers University, the owner of the fourth patent, did not make any commitment regarding the patent and seemingly reserved its right to seek royalties against implementers of the standard. The W3C proceeded to adopt the standard in the face of this threat, and it appears that Rutgers did not actively seek to license the patent.

A more contentious incident arose, also in 2003, with respect to a patent held by a small firm called Eolas, which allegedly covered a key aspect of the HTML standard.[120] After Eolas obtained a $521 million infringement verdict against Microsoft's Internet Explorer browser, W3C convened a PAG to assess the potential impact of the Eolas patent on HTML.[121] As a result of the PAG, W3C petitioned the PTO to reexamine the Eolas patent. In one letter to the PTO, Berners-Lee potently expressed the concerns of the PAG and the broader Web community:

> The barriers imposed on the information technology industry by the [Eolas] '906 patent are of such concern because they cause fragmentation in the basic standards that weave the Web together. Denial of access to any particular technology is a problem that engineers can successfully address, provided they have knowledge of the barrier before it becomes part of a standard. However, as the '906 patent threatens widely deployed, standard technology, the damage is magnified. If the '906 patent remains in force, Web page designers and software developers will face a dangerous dilemma. They may com-

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their maximum royalty rates prior to approval of a standard. Jorge L. Contreras, *Technical Standards and* Ex Ante *Disclosure: Results and Analysis of an Empirical Study*, 53 JURIMETRICS J. 163, 193–94 (2013). Despite vigorous opposition, only one member, Motorola, actually withdrew from VITA as a result of the policy change. *Id.* at 193–94. Similar concerns have been raised in the wake of recent policy amendments by IEEE. *See, e.g.*, Susan Decker & Ian King, *Qualcomm Says It Won't Follow New Wi-Fi Rules on Patents*, BLOOMBERG TECH. (Feb. 11, 2015, 9:23 AM), http://www.bloomberg.com/news/articles/2015-02-11/qualcomm-says-new-wi-fi-standard-rules-unfair-may-not-take-part; Ron D. Katznelson, IEEE-USA Comm., Presentation: Will New IEEE Standards Incorporate Patented Technologies Under the Proposed Patent Policy? 12 (Dec. 23, 2014), http://s3.amazonaws.com/sdieee/1824-1806-SD%2BSection-IEEE-Standards-Patent%2BPolicy%2BDec-23-2014v2.pdf (first quoting Letter from Nokia to IEEE (Nov. 18, 2014); and then quoting Letter from Ericsson to IEEE (November 7, 2014)).

119. W3C, VOICE BROWSER PAG REPORT (2003), http://www.w3.org/2003/06/VBPAG-Report.html.

120. Weitzner, *supra* note 84.

121. *Id.*

> ply with globally-recognized Web standards resulting in an inadequate user experience of their content. Or, they may attempt to design to the various work-arounds chosen by different browser developers and face the uncertainly of not knowing who will be able to use their content or applications properly. W3C's development and the industry's acceptance of a single common base of standards for Web infrastructure arose out of a need to avoid just this sort of dilemma. The '906 patent is a substantial setback for global interoperability and the success of the open Web.[122]

The Eolas patent was subsequently invalidated by the PTO on the basis of the prior art presented by W3C.[123]

Despite these relatively high-profile incidents and the large number of standards published by W3C, only a handful of PAGs have been formed to investigate patents not subject to royalty-free licensing commitments. During the first ten years of the royalty-free patent policy, a mere twelve PAGs were formed, all of which resolved the relevant issues without serious disruption of W3C's standardization activities.[124] It thus appears that the RF policy at W3C has largely been a success.

VII. CONCLUSION: THE LOGIC OF ROYALTY-FREE

As this Article shows, the primary SDOs responsible for Internet standards, IETF and W3C, have evolved strong policies and norms favoring royalty-free standards. Many of the resulting standards have taken on the character of public goods "free for everyone to use without restrictions."[125] This approach has likely contributed to the relatively low level of patent litigation relating to Internet standards in comparison with Network standards.

The preference for RF standards at IETF and W3C can be traced, in part, to the historical origins of these groups in academia and government and their ties to the open source movement. Suzanne Scotchmer called the circumstances resulting in the open Internet "one of the most fortunate accidents in industrial history."[126]

Today, however, IETF and W3C are dominated by private firms that are as motivated by profit as their counterparts in the Network space. Their reasons for favoring RF models are not entirely ideological or altruistic. As I have written elsewhere, a range of commercial considerations motivate firms to relinquish potentially profitable exploitation of

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122. Letter from Tim Berners-Lee, Dir., World Wide Web Consortium, to Hon. James E. Rogan, Dir., USPTO (Oct. 28, 2003), http://www.w3.org/2003/10/27-rogan.html (emphasis omitted).

123. Weitzner, *supra* note 84.

124. *W3C Patent and Standards Interest Group: Continued Maintenance of W3C's Patent Policy*, W3C, http://www.w3.org/2004/pp/psig/ (last updated May 3, 2016).

125. Whitt, *supra* note 78, at 722.

126. SCOTCHMER, *supra* note 26, at 307.

their patent rights in the service of broader commercial goals, such as the seeding of new markets, the establishment of technological leadership, and the desire to achieve industry-wide interoperability.[127]

Whatever the reasons for its development, the royalty-free patent landscape of the Internet has yielded significant benefits. It has enabled substantial innovation and experimentation, it has yielded entirely new industries such as social media, and it has facilitated virtually unrestricted market entry and competition.[128] It has also influenced groups developing other important standards, such as USB (uniform serial bus) and Bluetooth, to adopt royalty-free licensing requirements.[129] Finally, groups such as IETF and W3C have demonstrated that technical standards are not incompatible with open source software projects, which continue to increase in importance.[130]

Defendants of patent monetization argue that a financial return on patents is necessary to fuel innovation and product development in complex and rapidly advancing technologies. There is clearly some truth to this assertion—and a recognition in no less than the U.S. Constitution that patents are intended to promote innovation. However, proponents of strongly-monetized patent structures may lose sight of the innovation that could potentially be enabled by lowering barriers to technology markets.[131]

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127. Jorge L. Contreras, *Patent Pledges*, 47 ARIZ. ST. L.J. 543, 572–73 (2015). *See also* Microsoft Corp. v. Motorola, Inc., No. C10-1823JLR, 2013 U.S. Dist. LEXIS 60233, ¶ 15 (W.D. Wash. Apr. 25, 2013) ("Industry participants in the standard-setting process enjoy significant potential benefits to having their technology incorporated into a standard independent of potential royalty income from licensing patents they own. These non-income benefits can include increased demand for participants' products, advantages flowing from familiarity with the contributed technology potentially leading to shorter development lead times, and improved compatibility with proprietary products using the standard.").

128. DENARDIS, *supra* note 69, at 75–76.

129. *See* Bluetooth Patent/Copyright License Agreement, https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwilvZnRhLvOA-hUQ62MKHWWmDlEQFghBMAA&url=https%3A%2F%2Fwww.bluetooth.org%2FDocMan%2Fhan-dlers%2FDownloadDoc.ashx%3Fdoc_id%3D67&usg=AFQjCNHStPDik6Pn7aXj3nr5F0SbH_uAfg&sig2=7eWxYkJfmL-0r9WyhU0G4Q; USB 3.0 Adopters Agreement, http://www.usb.org/developers/docs/USB_3_0_Adopters_Agreement_Final_020411.pdf.

130. *See* Jorge L. Contreras & Andrew Updegrove, *A Primer on Intellectual Property Policies of Standards Bodies*, *in* EFFECTIVE STANDARDIZATION MANAGEMENT IN CORPORATE SETTINGS 220–21 (Kai Jakobs ed., 2016).

131. In a way, today's patent monetization justifications echo those made by AT&T in the heyday of the telephony monopoly. As Tim Wu has described it, AT&T justified its state-sanctioned monopoly, in part, by arguing that the resulting rents were plowed back into research and development at facilities like Bell Laboratories, where no fewer than seven Nobel laureates hung their hats and to which we owe the transistor and many other technological marvels. Yet in hindsight, Wu points out these arguments ring hollow. After all the basic residential telephone unit remained essentially unchanged for forty years notwithstanding the brain trust at Bell Labs. What's more, AT&T imposed a daunting array of intellectual property, regulatory and commercial barriers to block any innovator who sought to improve telephony in the slightest degree (culminating in the notorious "Hush-a-Phone" debacle). When the FCC finally grew skeptical of the monopoly's virtue and or-

Today's debate over SEPs and patent monetization is really just one skirmish in a much larger war over openness and closure in technology networks. Scholars including Larry Lessig,[132] Jonathan Zittrain,[133] Milton Mueller,[134] Tim Wu,[135] and Laura DeNardis[136] have warned about the consequences of over-regulating, closing, and monetizing the Internet. The open and royalty-free nature of the Internet was not pre-ordained and it may not last forever. Slight changes in history could have sent the Internet off in very different directions. Just as a single meteor or climatic event can shift the course of biological evolution, so can a single judicial decision or regulatory pronouncement change the course of a technology field. I doubt that many today would prefer to live in a world in which most content is meted out by commercial networks, as it was in the 1980s under pay services like American Online (AOL), Compuserve, and Prodigy. Could the proliferation of patents on fundamental interoperability standards nudge us back in this direction?

Rapid technical change will occur in the near future with the advent of the Internet of Things, the Smart Grid,[137] wearable devices, and other technological advances, as well as the continuing convergence of computing, networking and telecommunications technologies.[138] Each of these developments will require new standards and common protocols that build on top of the existing Internet infrastructure. Let us hope that these new technologies remain as open to future innovation and competition as the Internet is today.[139]

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dered the standardization of telephone jacks via the now-ubiquitous RJ-11 connector, an explosion of innovation occurred leading to the introduction of connected devices including fax machines, answering machines, and speakerphones. WU, *supra* note 58, at 9, 307–08.

132. *See generally* LAWRENCE LESSIG, CODE: VERSION 2.0, at 4 (2006); LESSIG, *supra* note 78.

133. *See generally* ZITTRAIN, *supra* note 56, at 246.

134. *See generally* MILTON L. MUELLER, RULING THE ROOT: INTERNET GOVERNANCE AND THE TAMING OF CYBERSPACE 7–10 (2002).

135. *See generally* WU, *supra* note 58, at 317–19.

136. *See generally* LAURA DENARDIS, PROTOCOL POLITICS: THE GLOBALIZATION OF INTERNET GOVERNANCE (2014); DENARDIS, *supra* note 69.

137. For example, I describe the influence of telecommunications and electronics patent holders on discussions of Smart Grid standardization. Jorge L. Contreras, *Standards, Patents and the National Smart Grid*, 32 PACE L. REV. 641, 642–43 (2012).

138. Weitzner observed the influence of telecommunications and computing technology on the increasing prominence of patents in Internet standards as early as 2004. Weitzner, *supra* note 84 ("[A]s the Web comes into contact with the telecommunications, broadcast media and consumer electronics industries, there is pressure to change the traditional role patents have played in Web standards.").

139. A group of SDOs led by IETF, W3C, and IEEE took a tentative step toward formalizing this ethos in 2012 with the publication of the OpenStand *Modern Paradigm for Standards*. *See Principles*, OPENSTAND, https://open-stand.org/about-us/principles/ (last visited May 30, 2016). The principles espoused by OpenStand include laudable ideals such as cooperation, due process, transparency, and consensus. *Id.* The OpenStand position regarding patents, however, does little other than accept both RF and FRAND licensing models for patented standards.

APPENDIX 1

PATENT CASES INVOLVING IETF STANDARDS

Year[140]	**Case/Court**	**Type**[141]	**IETF Standards**
2003	*Cisco Sys., Inc. v. Huawei Techs., Co.*, 266 F. Supp. 2d 551, 552 (E.D. Tex. 2003).	1	RFC 2281 - Hot Standby Router Protocol ("HSRP") RFC 3768 - Virtual Router Redundancy Protocol ("VRRP")
2004	Amended Complaint at 6, *Foundry Networks, Inc. v. Lucent Techs. Inc.*, No. 2:04CV–40, 2004 WL 3357181 (E.D. Tex. Feb. 9, 2004).	2	RFC 1866 et seq. - Hypertext Markup Language – 2.0 (HTML) RFC 2616 - Hypertext Transfer Protocol (HTTP)

140. Indicates year in which request for document authentication was made.

141. Indicates the role of IETF standards in the case:
1 – Commercial dispute
2 – Patent holder alleges that standards-compliant products infringe patents
3 – Unknown
4 – Challenge to patent validity/Use of IETF documents to establish patent invalidity

Year [140]	**Case/Court**	**Type** [141]	**IETF Standards**
2005	Complaint at 11, *Fenner Investments, LTD. v. Juniper Networks, Inc.*, No. 2–05CV–05, 2005 WL 320552 (E.D. Tex. Jan. 6, 2005).	2	RFC 2002 - IP Mobility Support RFC 2003 - IP Encapsulation within IP RFC 2004 - Minimal Encapsulation within IP RFC 2006 - The Definitions of Managed Objects for IP Mobility Support using SMIv2 RFC 2344 - Reverse Tunneling for Mobile IP RFC 2794 - Mobile IP Network Access Identifier Extension for IPv4 RFC 3012 - Mobile IPv4 Challenge/Response Extensions
2005	*Connectel, LLC v. Cisco Sys., Inc.*, 391 F. Supp. 2d 526, 527 (E.D. Tex. 2005).	2	RFC 1479 – Inter-Domain Policy Routing Protocol Specification: Version 1 RFC 1771 – A Border Gateway Protocol 4 (BGP-4) RFC 1772 – Application of the Border Gateway Protocol in the Internet RFC 1773 – Experience with the BGP-4 protocol RFC 1774 – BGP-4 Protocol Analysis RFC 1775 – To Be "On" the Internet

Year[140]	Case/Court	Type[141]	IETF Standards
2007	*Akamai Techs., Inc. v. Limelight Networks, Inc.*, 494 F. Supp. 2d 34, 49 (D. Mass. 2007).	4	RFC 882 – Domain names: Concepts and facilities RFC 883 – Domain names: Implementation specification RFC 973 – Domain system changes and observations RFC 1001 – Protocol standard for a NetBIOS service on a TCP/UDP transport: Concepts and methods RFC 1002 – Protocol standard for a NetBIOS service on a TCP/UDP transport: Detailed specifications RFC 1034 – Domain names - concepts and facilities RFC 1035 – Domain names - implementation and specification RFC 1105 – Border Gateway Protocol (BGP) RFC 1163 – Border Gateway Protocol (BGP) RFC 1164 – Application of the Border Gateway Protocol in the Internet RFC 1546 – Host Anycasting Service RFC 1794 - DNS Support for Load Balancing
2008	*Alcatel USA Res. Inc. v. Microsoft Corp.*, No. 6:06–CV–500, 2008 WL 2625852, at *1 (E.D. Tex. June 27, 2008).	3	Middlebox Communications (midcom)

Year[140]	Case/Court	Type[141]	IETF Standards
2009	*UTStarcom, Inc. v. Starent Networks, Corp.*, 675 F. Supp. 2d 854, 870 (N.D. Ill. 2009).	4	Draft proposals re. Virtual Tunneling Protocol and Tunnel Establishment Protocol
2009	Answer and Counterclaims at 25, *Valueclick, Inc. v. Netscape Comm. Corp.*, No. 209–CV–02352, 2009 WL 3059251 (C.D. Cal. May 12, 2009).	4	RFC 2109 – HTTP State Management Mechanism RFC 2965 – HTTP State Management Mechanism
2009	Brief of Defendant at *2–6, *Voxpath Networks, Inc. v. Verizon Bus. Network Servs. Inc.*, No. 4:08–cv–127–RAS, 2009 WL 2335552 (E.D. Tex. May 8, 2009).	4	Draft proposals relating to Media Gateway Control Protocol (MGCP), Session Description Protocol (SDP), and Session Initiation Protocol (SIP), Telephony Routing Information Protocol (TRIP), IP Network Address Translator (NAT) and Megaco Protocol
2009	Amended Complaint & Demand for Jury Trial at 13, 16, *Cheetah Omni LLC v. Verizon Bus. Network Servs. Inc.*, No. 609–CV–260, 2009 WL 3189129 (E.D. Tex. Aug. 20, 2009).	2	RFC 3031 – Multiprotocol Label Switching Architecture RFC 3471 – Generalized Multi-Protocol Label Switching (GMPLS) Signaling Functional Description

Year [140]	**Case/Court**	**Type** [141]	**IETF Standards**
2012	*Apple, Inc. v. Motorola Mobility, Inc.*, 886 F. Supp. 2d 1061, 1073 (W.D. Wis. 2012).	4	RFC 791 – Internet Protocol
2011	*SSL Servs., LLC v. Citrix Sys., Inc.*, 816 F. Supp. 2d 364, 366–67 (E.D. Tex. 2011).	3	RFC 1508 – Generic Security Service Application Program Interface
2012	*VirnetX v. Mitel Networks Corp.*, No. 6:11-cv-00018-LED, 2012 WL 2091332 (E.D. Tex. Apr. 4, 2012).	2	Large number of documents relating to L2TP, SSL, SMTP, DNS and more
2012	*Nomadix v. Hewlett-Packard Co.*, No. 209CV08441, 2010 WL 3013123 (C.D. Cal. May 21, 2010).	2	23 different RFCs
2012	*Summit Data Sys. v. EMC Corp.*, No. 10CV00749, 2010 WL 3555604 (D. Del. Sept. 1, 2010).	4	All documents relating to Internet Small Computer Systems Interface (iSCSI)

Year 140	**Case/Court**	**Type** 141	**IETF Standards**
2012	*Realtime Data, LLC v. Thomson Reuters Corp.*, No. 11CV06703, 2011 WL 4576896 (S.D.N.Y. Sept. 27, 2011).	4	RFC 1144 - Compressing TCP/IP Headers for Low-Speed Serial Links RFC 1332 - The PPP Internet Protocol Control Protocol (IPCP) RFC 1661 - The Point-to-Point Protocol RFC 1662 - PPP in HDLC-like Framing RFC 1962 - The PPP Compression Control Protocol (CCP) RFC 2395 - IP Payload Compression Using LZS RFC 2507 - IP Header Compression RFC 2509 - IP Header Compression over PPP
2012	*Alberta Telecomm. Research Centre v. AT&T Corp.*, No. 09CV03883, 2010 WL 6368146 (D.N.J. Nov. 18, 2010).	3	Numerous draft documents relating to MPLS

Year[140]	Case/Court	Type[141]	IETF Standards
2012	*British Telecomms. v. Cox-Com, Inc.*, No. 10CV00658, 2011 WL 4466026 (D. Del. Sept. 6, 2011).	2	RFC 741 - Specifications for the Network Voice Protocol (NVP) RFC 1633 - Integrated Services in the Internet Architecture: an Overview RFC 1190 - Experimental Internet Stream Protocol: Version 2 (ST-II) RFC 1889 - RTP: A Transport Protocol for Real-Time Applications RFC 1890 - RTP Profile for Audio and Video Conferences with Minimal Control RFC 2205 - Resource ReSerVation Protocol (RSVP) -- Version 1 Functional Specification RFC 2210 - The Use of RSVP with IETF Integrated Services RFC 2211 - Specification of the Controlled-Load Network Element Service RFC 2212 - Specification of Guaranteed Quality of Service RFC 2216 - Network Element Service Specification Template
2012	*Innova Patent Licensing, LLC v. Alcatel-Lucent Holding, Inc.*, No. 10CV00251, 2011 WL 2198945 (E.D. Tex. Mar. 21, 2011).	2	8 RFCs relating to DomainKeys Identified Mail (DKIM)

Year [140]	Case/Court	Type [141]	IETF Standards
2012	*Certain Elec. Imaging Devices*, Inv. No. 337-TA-850, 2012 WL 7783003 (USITC Nov. 2, 2012).	4	All documents relating to HTML 2.0, Multipurpose Internet Mail Extensions (MIME) and others
2012	*Certain Devices with Secure Commc'n Capabilities*, Inv. No. 337-TA-858, 2012 WL 5883570 (USITC Sept. 18, 2012).	4	Numerous drafts and standards
2013	*Smartphone Tech. LLC v. Huawei Devices USA Inc.*, No. 6:12-cv-245-LED, 2013 WL 9639266 (E.D. Tex. Sept. 30, 2013).	4	RFC 977 - Network News Transfer Protocol RFC 1738 - Uniform Resource Locators (URL) RFC 1941 - Frequently Asked Questions for Schools RFC 1392 - Internet Users' Glossary RFC 1630 - Universal Resource Identifiers in WWW: A Unifying Syntax for the Expression of Names and Addresses of Objects on the Network as used in the World-Wide Web RFC 2806 – URLs for Telephone Calls
2013	*Emblaze Ltd. v. Apple Inc.*, No. 4:11-cv-01079-SBA, 2012 WL 8145854 (N.D. Cal. Dec. 18, 2012).	4	Draft re HTTP Live Streaming

Year[140]	Case/Court	Type[141]	IETF Standards
2013	*Brixham Sols. Ltd. v. Juniper Networks*, No. C 13 0616 JCS, 2013 WL 664425 (N.D. Cal. Feb. 12, 2013).	4	RFC 2663 – IP Network Address Translator (NAT) Terminology and Considerations RFC 3209 – RSVP – TE: Extensions to RSVP for LSP Tunnels RFC 3386 – Network Hierarchy and Multilayer Survivability RFC 4762 – Virtual Private LAN Services over MPLS RFC RFC 4090 – Fast Reroute Extensions to RSVP-TE for LSP Tunnels
2014	*Prism Techs. LLC v. T-Mobile USA, Inc.*, No. 8:12CV125, 2014 WL 4705403, at *1 (D. Neb. Sept. 22, 2014).	4	RFC 2138 – Remote Authentication Dial In User Service (RADIUS)
2014	*Datascape, Inc. v. Spring Spectrum, L.P.*, No. 1:07-CV-0640-CC (N.D. Ga. Mar. 31, 2014).	4	RFC 1055 – Nonstandard for transmission of IP datagrams over serial lines: SLIP RFC 1945 – Hypertext Transfer Protocol -- HTTP/1.0 RFC 1980 – A Proposed Extension to HTML: Client-Side Image Maps

Year 140	**Case/Court**	**Type** 141	**IETF Standards**
2014	*Samsung Elecs. Co., Ltd. v. Affinity Labs of Tex.*, No. IPR2014-00408, 2014 WL 3668013 (P.T.A.B. July 21, 2014); *Samsung Elecs. Co., Ltd. v. Affinity Labs of Tex.*, No. IPR2014-00209, 2014 WL 2121216 (P.T.A.B. May 20, 2014).	4	RFC 1866 - Hypertext Markup Language (HTML)
2014	*Straight Path IP Grp. v. Samsung* (E.D. Tex. 2014).	4	RFC 791 - Internet Protocol, RFC 793 - Transmission Control Protocol, RFC 1541 - Dynamic Host Configuration Protocol
2014	*Ericsson Inc. v. Intellectual Ventures I, LLC*, No. IPR2014-00527, 2014 WL 3885902 (P.T.A.B. Aug. 6, 2014).	4	RFC 2341 - Cisco Layer Two Forwarding (Protocol) "L2F" RFC 2661 - Layer Two Tunneling Protocol "L2TP" RFC 827 - IP Encapsulating Security Payload (ESP) RFC 2784 - Generic Routing Encapsulation (GRE)

Year[140]	Case/Court	Type[141]	IETF Standards
2015	*Genband USA LLC v. Metaswitch Networks Ltd.*, No. 2:14–CV–33–JRG–RSP, 2015 WL 1518007, at *17–18, *30–31 (E.D. Tex. Apr. 1, 2015).	4	RFC 792 – Internet Control Message Protocol RFC 2661 – Layer Two Tunneling Protocol L2TP RFC 2543 – SIP: Session Initiation Protocol RFC 3261 - SIP: Session Initiation Protocol RFC 5806 – Diversion Indication in SIP RFC 3891 – The Session Initiation Protocol (SIP) "Replaces" Header RFC 5359 - Session Initiation Protocol Service Examples
2015	PTAB *Inter partes* review of U.S. Patent No. 7,224,668 (Cisco).	4	RFC 792 – Internet Control Message Protocol RFC 2661 – Layer Two Tunneling Protocol L2TP
2015	*Arista Networks, Inc. v. Cisco Sys., Inc.*, No. IPR2015-00975, 2015 WL 5895790 (P.T.A.B. Oct. 6, 2015).	4	RFC 2401 - Security Architecture for the Internet Protocol

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2015	PTAB *Inter partes* review of U.S. Patent No. 7,162,537 (Cisco).	4	RFC 1098 – Simple Network Management Protocol (SNMP) RFC 2257 – Combined User and Infrastructure ENUM in the e164.arpa Tree RFC 2570 – Introduction to Version 3 of the Internet-standard Network Management Framework RFC 2571 - An Architecture for Describing SNMP Management Frameworks RFC 2742 - Definitions of Managed Objects for Extensible SNMP Agents

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2015	*Intellectual Ventures I, LLC v. AT&T Mobility LLC*, No. 12–193–LPS, 2015 WL 1393386, at *4–5, *8, *13–16, *18–19, *22, *27 (D. Del. Mar. 24, 2015).	4	RFC 2305 - A Simple Mode of Facsimile Using Internet Mail RFC 2532 - Extended Facsimile Using Internet Mail RFC 2542 - Terminology and Goals for Internet Fax RFC 1530 - Principles of Operation for the TPC.INT Subdomain: General Principles and Policy RFC 791 – Internet Protocol RFC 1825 - Security Architecture for the Internet Protocol RFC 1826 - IP Authentication Header RFC 1827 - IP Encapsulating Security Payload (ESP) RFC 2401 - Security Architecture for the Internet Protocol RFC 2402 - IP Authentication Header RFC 2403 - The Use of HMAC-MD5-96 within ESP and AH RFC 2405 - The ESP DES-CBC Cipher Algorithm With Explicit IV RFC 2406 - IP Encapsulating Security Payload (ESP) RFC 2407 - The Internet IP Security Domain of Interpretation for ISAKMP RFC 1341 - MIME (Multipurpose Internet Mail Extensions): Mechanisms for Specifying and Describing the Format of Internet Message Bodies

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2015	*Maxmind, Inc. v. Fraud Control Sys.com Corp.*, No. CBM2015-00094, 2015 WL 5440812 (P.T.A.B. Sept. 11, 2015).	4	RFC 1122 - Requirements for Internet Hosts: Communications Layers RFC 1366 - Guidelines for Management of IP Address Space RFC 1531 - Dynamic Host Configuration Protocol