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Internet of Infringing Things: The Effect of Computer Interface Copyrights on Technology Standards

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INTERNET OF INFRINGING THINGS: THE EFFECT OF COMPUTER INTERFACE COPYRIGHTS ON TECHNOLOGY STANDARDS

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I. INTRODUCTION

You connect to the Internet via your Wi-Fi access point. You surf the Web using a browser and send emails through your email server. You probably use some USB peripherals—say a mouse, keyboard, or printer. Maybe you even watch cable or broadcast television.

Under current case law, each of those computer systems and devices may very well be copyright-infringing contraband. This is through no fault of your own—you need not be pirating music or streaming illegal movies to infringe a copyright. The infringement simply exists, hard-wired within each of those devices and many more that you use, a result of the devices' basic operations: connecting to Wi-Fi, displaying web pages, sending email, connecting peripherals, or receiving broadcasts.

The root of this unexpected situation is an obscure corner of copyright law: copyright in computer interfaces. This issue has been hotly debated for decades,[1] but has come to particular attention in view of several recent decisions in the *Oracle v. Google* litigation.[2] Much attention has been paid to the implications of those decisions for software programmers and particular computer systems.[3] But the connection of that case to ordinary, everyday technologies does not appear to have been made in detail—perhaps because the complexity of the technological issues, in combination with the obscurity of the copyright doctrines, have rendered it difficult to shine light upon the issue.[4]

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[1] *See generally* JONATHAN BAND & MASANOBU KATOH, INTERFACES ON TRIAL 2.0, 10–18, 21–52 (2011) (discussing history of judicial decisions on copyright in interfaces).

[2] *See generally* Oracle America, Inc. v. Google Inc., 750 F.3d 1339 (Fed. Cir. 2014); Oracle America, Inc. v. Google LLC, 886 F.3d 1179 (Fed. Cir. 2018).

[3] *See* Klint Finley, *The Oracle-Google Case Will Decide the Future of Software*, WIRED (May 23, 2016, 7:00 AM), https://www.wired.com/2016/05/oracle-google-case-will-decide-future-software/; *see also* Quentin Hardy, *Oracle-Google Dispute Goes to Heart of Open-Source Software*, N.Y. TIMES (May 19, 2016), https://www.nytimes.com/2016/05/20/technology/oracle-google-dispute-goes-to-heart-of-open-source-software.html.

[4] *See* Sarah Jeong, *Why the Very Silly Oracle v. Google Trial Actually Matters*, VICE: MOTHERBOARD (May 25, 2016, 5:10 PM),

This article aims to fill that gap and explain how copyright in computer interfaces implicates the operation of common technologies. An interface, as used in industry and in this article, is a means by which a computer system communicates with other entities, either human programmers or other computers, to transmit information and receive instructions. All the technologies discussed above—Wi-Fi, web pages, email, USB, digital TV—are thus interfaces under this definition. Accordingly, if it is copyright infringement to implement an interface (a technical term referring to using the interface in its expected manner), then all of those common technologies infringe copyright.

Intuitively it seems unbelievable that all sorts of common computer technologies are copyright infringements, and this article confirms that intuition at least with respect to the views of the computer industry that developed those technologies. Generally speaking, the proof is as follows. Technological interfaces are specified in standards documents—IEEE 802.11 for Wi-Fi, SMTP for email, USB for USB—that are prepared by standard-setting organizations, which are large consortia made up of industry members large and small. Those organizations are keenly aware that use of their standards implicates at least one form of intellectual property, namely patents, and set up elaborate licensing systems to deal with the possibility that implementing a standard could infringe a patent.

If the organizations believed that implementing a standard could infringe copyrights, one would expect them to maintain copyright licensing arrangements on par with their patent licensing arrangements. Yet this article reviews the policies of several of the most prominent standard-setting organizations, and not one has a

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https://motherboard.vice.com/en_us/article/8q88bz/why-the-very-silly-oracle-v-google-trial-actually-matters (describing the multiplicity of analogies used to explain interfaces in the *Oracle v. Google LLC* litigation); *cf.* Peter Bright, *The Google/Oracle Decision Was Bad for Copyright and Bad for Software*, ARS TECHNICA (June 2, 2016, 2:00 PM), https://arstechnica.com/information-technology/2016/06/the-googleoracle-decision-was-bad-for-copyright-and-bad-for-software/ ("Large-scale replication of other people's [interfaces] is a relatively unusual phenomenon."). *But see* discussion *infra* Part III (explaining that replication of others' interfaces is in fact common).

copyright policy even approaching the simplest patent policy—indeed, many organizations have no copyright policy at all. The absence of copyright licensing policies suggests that, at least in the eyes of standard-setting organizations and by extension in the eyes of technology industry members, implementation of computer interfaces is not an infringement of copyright.

The apparent discrepancy between current law and industry expectation raises the question of how courts should react to this discrepancy. Intellectual property law has generally sought to track industry expectations and promote rather than subvert them, and courts in particular have tried to advance the work of standard-setting organizations through a number of doctrines of patent law. It would be good policy for courts to apply the same rationale to copyright law, recognizing that it would be better for copyright in computer interfaces to track the expectations of standard-setting organizations rather than upending those expectations and leaving the copyright infringement status of all sorts of modern technologies in limbo.

The remainder of this article proceeds as follows. Section II defines computer interfaces and what it means to implement one, and discusses the law of copyright in interfaces.[5] Section III reviews several common technologies, including Wi-Fi, web pages, email, and others, and explains how those technologies are in fact interfaces such that implementation could constitute copyright infringement.[6] Section IV demonstrates, by comparison of their patent and copyright policies, that standard-setting organizations do not expect implementation of computer interfaces to constitute copyright infringement.[7] Finally, Section V considers how courts should react to the divergent views on copyright in interfaces.[8]

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[5] *See infra* Section II.
[6] *See infra* Section III.
[7] *See infra* Section IV.
[8] *See infra* Section V.

II. THE DISPUTE OVER COPYRIGHT IN COMPUTER INTERFACES

The ongoing legal dispute addressed in this paper is the question of whether computer interfaces may be protected by a copyright, such that implementing the interface constitutes an act of copyright infringement. This section first defines the terms *interface* and *implementation*, and then reviews the relevant case law.

A. WHAT IS AN INTERFACE?[9]

Though some have described it as a "verbal chameleon,"[10] the term *interface* is in fact a straightforward concept. An interface is a means by which an entity, either human or computer, can interact with a computer to receive information or provide instructions. Technical dictionaries define the term as a "connection between two systems through which information is exchanged," and in particular with regard to software as "a standard format for exchanging data."[11] This definition should not sound foreign, because the concept of an "interface" is well known from many fields. A "user interface" includes the windows, icons, and other graphical elements by which people communicate with computers. The Ninth Circuit described the "graphical user interface" as the "way for ordinary mortals to communicate with the Apple computer."[12] Outside the computer

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[9] *See* Brief of *Amicus Curiae* Public Knowledge in Support of the Petition 5–8, Google, Inc. v. Oracle America, Inc. No. 14-410 (U.S. Nov. 7, 2014), https://www.publicknowledge.org/documents/amicus-curiae-brief-in-oracle-v-google.

[10] Opening Brief and Addendum of Plaintiff-Appellant at 9, Oracle America Inc. v. Google Inc., 750 F.3d 1339 (Fed. Cir. Feb. 11, 2013) (No. 13-1021) [hereinafter Oracle Brief].

[11] DOUGLAS DOWNING ET AL., DICTIONARY OF COMPUTER AND INTERNET TERMS 255 (10th ed. 2009); *see* AMERICAN HERITAGE, DICTIONARY OF COMPUTER AND INTERNET WORDS 141 (3d ed. 2001), https://archive.org/details/dictionaryofcomp00bost ("The devices, graphics, commands, and prompts that enable a computer to communicate with any other entity, such as a printer or the user.").

[12] Apple Computer, Inc. v. Microsoft Corp., 35 F.3d 1435, 1438 (9th Cir. 1994) (describing the Apple Macintosh user interface as "a user-friendly way for ordinary mortals to communicate with the Apple computer"); Andries van Dam,

context, "interface" can mean "communication or interaction," or "a thing or circumstance that enables separate and sometimes incompatible elements to coordinate effectively."[13]

Interfaces take on many forms, and particular types of interfaces are given specific names. An application programming interface, or API, is an interface made up of words and syntax used for controlling (i.e., programming) a piece of computer software (i.e., an application).[14] A protocol is an interface used between two systems communicating over a network connection such as the Internet.[15] The Federal Circuit has used the term "declaring code."[16]

An interface is thus a generalized mechanism of communication—a type of language. Indeed, language is an

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Post-WIMP User Interfaces, COMM. OF THE ACM, Feb. 1997, at 63, *available at* http://citeseer.ist.psu.edu/viewdoc/summary?doi=10.1.1.46.6390 (referring to an abbreviation for "windows, icons, menus, and a pointing device, typically a mouse").

[13] RANDOM HOUSE UNABRIDGED DICTIONARY 993 (2d ed. 1987); *see* Rios v. Colon, 819 F.2d 319, 328 (1st Cir. 1987) (describing government official as "a kind of cultural interface" because duties included acting as "a public liaison between the government and the artistic community"); *see also* Trans-Lux Corp. v. U.S., 696 F.2d 963, 964 (Fed. Cir. 1982) (calling a device designed to enable communication between a Telex network and a user terminal an "interface between" the two).

[14] *See* A DICTIONARY OF COMPUTING 19 (6th ed. 2008) (defining API as "a set of functions and procedures [that] enables a program to gain access to facilities within an application"); *see also* U.S. v. Microsoft Corp., 253 F.3d 34, 53 (D.C. Cir. 2001) (defining API as "routines or protocols that perform certain widely-used functions" that are "expos[ed]—i.e., ma[de] available to software developers").

[15] *See* AMERICAN HERITAGE, *supra* note 11, at 54 ("A standard that defines the way in which data is passed between two or more pieces of computer equipment over a telephone line or other communications link.").

[16] *See Oracle America, Inc.*, 750 F.3d at 1347, 1356. Oracle, for its part, has used the term API confusingly. Oracle uses "Java API" to refer to an entire bundle of computer programs, not just declaring code. Oracle Brief, *supra* note 10, at 9. This does not conform with the general understanding of the term "API," but Oracle repeatedly insists on conflating its own mistaken definition with the correct one. *See* Response and Reply Brief of Plaintiff-Appellant at 5, 750 F.3d 1339 (July 3, 2013) (No. 13-1021). Oracle does in fact admit the correct definition, *see* Oracle Brief, *supra* note 10, at 9 (API can describe a "communication protocol to pass information between programs"), and then invents the term "declaring code" to mean "API," *see id.* at 10 (declaring code is "code that the programmer declares in order to invoke the prewritten program"). It is thus worth reading the company's briefs with a grain of salt as to these terms.

interface between humans, a means by which a person receives information from or instructs another.[17] Importantly, this means that an interface is an abstract concept. It may be embodied in a work using it or a dictionary enumerating its vocabulary.[18] But standing alone, it is merely abstract knowledge, enabling two parties to understand and perform the wishes of each other.

To make this abstract concept more concrete, though, consider a familiar computer interface for controlling the playing of music. The interface is made up of commands such as "Play," "Pause," "Next Song," and "Previous Song." Each of those commands is used to instruct the computer on what music to play. In general, interfaces may be thought of as collections of commands.

To *implement* an interface means to develop a device or system that carries out commands and provides information and responses consistent with the interface; that is, to make something that "understands the language" specified by the interface. To implement the music-playing interface described above, for example, one would write a computer program that turned the music on upon the command "Play," stopped it upon "Pause," and so on. Consistency is the expectation: A program that fast-forwarded upon receiving the command "Play" would not be a useful implementation of this interface.

B. DEVELOPMENT OF THE LAW ON INTERFACE COPYRIGHTS

Is implementation of an interface an infringement of copyright? Other commentators have extensively considered this issue,[19] so this

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[17] *See* Charles Duan, *Can Copyright Protect a Language?*, SLATE (June 3, 2015, 10:08 AM), http://www.slate.com/articles/technology/future_tense/2015/06/oracle_v_google_klingon_and_copyrighting_language.html.

[18] *See* JAMES GOSLING & FRANK YELLIN, THE JAVA APPLICATION PROGRAMMING INTERFACE (1996).

[19] *See, e.g.*, Pamela Samuelson, *Functionality and Expression in Computer Programs: Refining the Tests for Software Copyright Infringement*, 31 BERKELEY TECH. L.J. 1215, 1220–22 (2017); Peter S. Menell, *API Copyrightability Bleak House: Unraveling and Repairing the Oracle v. Google Jurisdictional Mess*, 31 BERKELEY TECH. L.J. 1515, 1523–32 (2016).

section provides a brief summary of the development of the law on this question. In short, interfaces were historically not considered subject to copyright protection, such that implementation of an interface was not an infringement.[20] That changed with the Federal Circuit's recent decisions in *Oracle America, Inc. v. Google Inc.* ("*Oracle I*")[21] and *Oracle America, Inc. v. Google LLC* ("*Oracle II*"),[22] which effectively reversed course and deemed implementations of interfaces to be very likely infringements of copyright. Because of the nature of the Federal Circuit's appellate jurisdiction, any interface creator can force a copyright case into the Federal Circuit, effectively making that court's holding favoring copyright in interfaces into the law of the land.

Because the facts of the *Oracle* cases will be central to the arguments in the remainder of this article, the focus of the discussion below is on those cases and their facts. The material in dispute was the so-called "declaring code" of certain parts of the Java programming language system.[23] The Java system includes a variety of prewritten functions to perform various jobs such as math calculations, and programmers using Java who wished to use those prewritten functions need a way to instruct the Java system to execute those functions.[24] The declaring code, as the Federal Circuit explained, "is the expression that identifies the prewritten function" and thereby allows programmers to call those functions.[25] In that sense, the declaring code is an interface: the means by which a programmer commands the Java system to execute its prewritten functions.

Google's Android operating system similarly contains prewritten

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[20] *See* Lotus Dev. Corp. v. Borland Int'l, Inc., 49 F.3d 807, 815, 817 (1st Cir. 1995) (holding that a "menu command hierarchy is a method of operation" not copyrightable under 17 U.S.C. § 102(b) because implementations "depend[] for its operation on use of the precise command terms that make up the . . . command hierarchy"), *aff'd by an equally divided Court*, 516 U.S. 233 (1996) (per curiam); *see also* BAND & KATOH, *supra* note 1, at 21 ("[T]he unprotectability of interface specifications . . . [is] well established in U.S. copyright law.").

[21] *Oracle America, Inc.*, 750 F.3d at 1354.

[22] *Oracle America, Inc.*, 886 F.3d at 1179.

[23] *See Oracle America, Inc.*, 750 F.3d at 1348–49.

[24] *See id.* at 1349.

[25] *Id.*

functions, and thus includes declaring code for accessing those Android functions.[26] Some (but not all) of the Android declaring code was made to be the same as portions of the Java declaring code, so that the commands that a programmer would use to instruct the Java system would be the same as the commands used to instruct the Android system.[27] Thus, for at least the overlapping portions of declaring code, Android is an implementation of the Java interface—a system that carries out the same commands as the Java system. Oracle, which acquired the copyrights to Java, sued Google for copyright infringement based on the Android implementation of the Java declaring code. In *Oracle I*, the Federal Circuit held that Oracle held a copyright in the declaring code that Google may have infringed by implementing it.[28] In large part, the court's decision turned on its view that the commands of the declaring code could have been named differently, so the specific choice of names was sufficiently creative to warrant copyright protection.[29] Software, including interfaces, "is entitled to copyright protection as long as the author had multiple ways to express the underlying idea," according to the court.[30] Because "Google could have structured Android differently and could have chosen different ways to express and implement the functionality that it copied," by naming commands differently for example, the Federal Circuit concluded that Google's choice to use the same command names—that is, to implement the Java interface rather than create a new interface from scratch—constituted copyright infringement.[31]

Oracle I left open the question of whether Google's implementation of Java was fair use, but the Federal Circuit

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[26]*See id.* at 1350.

[27]*See id.* at 1350–51.

[28]*See id.* at 1359.

[29]*See id.* at 1361 (rejecting merger defense on this ground); *id.* at 1363 (rejecting short phrases defense because "Oracle 'exercised creativity in the selection and arrangement' of the method declarations when it created the API packages and wrote the relevant declaring code") (quoting Atari Games Corp. v. Nintendo of America, Inc., 975 F.2d 832, 840 (Fed. Cir. 1992)); *id.* at 1364 (rejecting scènes à faire defense due to lack of "external factors that dictated Sun's selection of" declaring code).

[30]*Id.* at 1367.

[31]*Id.* at 1368.

subsequently decided that it was "not fair as a matter of law" in *Oracle II*.[32] Importantly, the court's decision leaves little room for any other implementation of an interface to be fair use. The court found Google's implementation "not transformative as a matter of law" because it served the same purpose as the Java system.[33] That will be the case for any implementation of another's interface, since the expectation is that every implementation of an interface will behave identically. Furthermore, the court reasoned that "the fourth factor weighs heavily" against fair use because Android undercut a potential commercial opportunity for Oracle.[34] Computer interfaces will generally have commercial applications, so this reasoning again will likely apply to other interfaces.

As a result, under the two *Oracle* decisions, it is likely that the Federal Circuit would find any implementation of an interface to be an infringement of copyright and not fair use. It is true, of course, that copyright law is a matter for regional circuit courts, so one may wonder what precedential effect a Federal Circuit copyright decision might have. The answer is a lot, because a copyright owner wanting to fall within the Federal Circuit's jurisdiction need only attach a patent cause of action (which need not be pursued) to the complaint.[35] As a result, *Oracle* "now motivates software intellectual property owners to bundle patent and copyright claims in order to take advantage of the Federal Circuit's expansive interpretation of software copyright protection," and subsequent litigants have already used that same strategy.[36] Though the *Oracle* cases are not binding law on any circuit, they are effectively controlling law for any future cases involving copyright over interfaces, at least for the time being.

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[32] *Oracle America, Inc.*, 886 F.3d at 1186.
[33] *Id.* at 1199.
[34] *Id.* at 1210.
[35] *See* Menell, *supra* note 19, at 1518.
[36] *Id.* at 1581.

III. TECHNICAL STANDARDS: UBIQUITOUS COPYRIGHT INFRINGEMENT?

Given that the *Oracle* decisions opened the door to copyright infringement by implementation of interfaces, the question is whether this sort of infringement is common or limited to unusual situations. This section argues that copyright infringement by interface implementation is common to the point of ubiquity, because (1) technical standards for computer interoperability are prevalent across all modern technology, and (2) technical standards are computer interfaces, on par with the declaring code involved in *Oracle*.

A. MODERN TECHNOLOGY'S DEPENDENCE ON TECHNICAL STANDARDS

Computers and other electronic devices communicate with each other, and their ability to communicate depends on technical standards. As a result, most modern technologies are based on technical standards.

Technical standards are "specifications that ensure that a variety of products from different manufacturers operate compatibly."[37] Especially relevant today are standards of electronic communication that define the protocols, or languages, that "enable products designed and produced by different companies to operate and communicate with one another."[38] Standards underlie key technologies and enormous economic industries. They allow us to "connect to WiFi in a coffee shop, plug a hairdryer into an outlet, or place a phone call."[39] Information technologies in particular, such as email, television, and the Internet, all operate based on technical standards.[40] According to the National Academy of Sciences: "The

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[37]Microsoft Corp. v. Motorola, Inc., 795 F.3d 1024, 1030 (9th Cir. 2015).

[38]NAT'L RESEARCH COUNCIL OF THE NAT'L ACADEMIES, PATENT CHALLENGES FOR STANDARD-SETTING IN THE GLOBAL ECONOMY: LESSONS FROM INFORMATION AND COMMUNICATIONS TECHNOLOGY 16 (Keith Maskus & Stephen A. Merrill eds., 2013).

[39]*Microsoft*, 795 F.3d at 1030.

[40]*See infra* Section III (B) (for review of these standards).

technologies embodied in today's complex microelectronic products, such as a smartphone, are governed by hundreds of standards," and generally "the Internet and cellular networks rely heavily on interoperability standards"; those standards-dependent industries generate "aggregate economic activity approaching $2 trillion per year."[41]

Technical standards are arguably the driving force behind the success of computers and the Internet. Microsoft Windows famously maintained a consistent application programming interface for many years, allowing for the creation of numerous Windows software programs.[42] Furthermore, the success of the Internet has been credited to its "use of a common protocol," a single language with which all contemporary computers can communicate.[43] Every web page owes its existence to the HyperText Transport Protocol by which computers obtain web pages.[44] Each of these interfaces—Windows, the Internet, HTTP—served as a springboard for enormous further advancement of technology.

Without this standardization, modern technology almost certainly would not have progressed as quickly as it has. In the context of Global Positioning System (GPS) technology, for example, the lack of a standard for a particular locator interface resulted in "a proliferation of proprietary interfaces," leading an expert to complain about the resulting complexity and call for standardization.[45] Without technical standards, the Internet could have devolved from a universal information resource into a Tower of Babel, every website speaking a different API language.

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[41] NAT'L RESEARCH COUNCIL OF THE NAT'L ACADEMIES, *supra* note 38, at 26.

[42] *See* Joel Splosky, *How Microsoft Lost the API War, JOEL ON SOFTWARE (June 13, 2004),* https://www.joelonsoftware.com/2004/06/13/how-microsoft-lost-the-api-war/.

[43] PAUL E. CERUZZI, A HISTORY OF MODERN COMPUTING 295–96 (2d ed. 2003).

[44] *See* T. BERNERS-LEE ET AL., *HYPERTEXT TRANSFER PROTOCOL—HTTP/1.0*, NETWORK WORKING GROUP (May 1996), https://tools.ietf.org/html/rfc1945.

[45] NEIL HARPER & DANIEL SCHUTZER, SERVER-SIDE GPS AND ASSISTED GPS IN JAVA 69–70 (2010).

B. TECHNICAL STANDARDS ARE COMPUTER INTERFACES

Implementing a standard almost inevitably requires an act akin to what *Oracle I* declared to be a potential copyright infringement. That is because information technology standards include compilations of commands that a computer system uses to communicate information or receive instructions, thereby making them interfaces. Implementing a standard requires developing a system that responds to the command compilation specified in the standard. As a result, technical standards are interfaces on par with the Java declaring code, and implementing a standard is an act on par with Google's reimplementation of Oracle's declaring code.[46] It would be obviously infeasible to review every single technical standard in use today or that might be created in the future. Thus, this section reviews a diverse range of several well-known exemplary technical standards, representative of the many in current use, in order to demonstrate a pattern that likely holds across other standards.

Web page formatting. The fonts, colors, arrangement, and other aspects of laying out a web page are specified according to a standard called Cascading Style Sheets, or CSS.[47] According to the standard, a web page creator writes "declarations" that define how portions of the page should be presented.[48]

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[46]At the outset, it may be wondered whether technical standards are distinguishable from the Java declaring code simply because they are adopted interoperability standards, unlike Java. But *Oracle America, Inc. v. Google Inc.* explicitly rejects the notion that standardization affects copyright protection: "Google's industry standard argument has no bearing on the copyrightability of Oracle's work." 750 F.3d at 1372.

[47]*See CASCADING STYLE SHEETS LEVEL 2 REVISION 1 (CSS 2.1) SPECIFICATION*, W3C (June 7, 2011), https://www.w3.org/TR/2011/REC-CSS2-20110607/ [hereinafter CSS 2.1 SPECIFICATION].

[48]*See id.* § 4.1.7–.8.

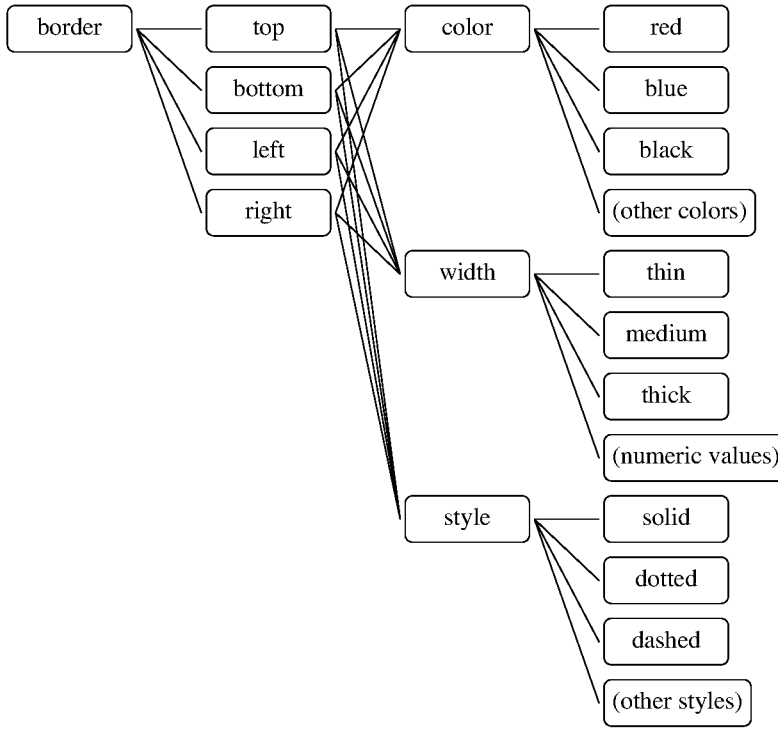

Figure 1: A partial hierarchy of CSS commands for drawing borders on portions of web pages. Each left-to-right path represents a multi-word command, with punctuation between words omitted.

CSS declarations are interfaces much like the Java declaring code. Figure 1 provides one such hierarchy, for drawing borders around text. To draw a red border line under some text on a web page, for instance, one would write "border-bottom-color: red."[49] The CSS specification lists over 350 declarations, not including numeric values or more complex combinations of words (which permit for infinite variation).[50]

Several features of CSS are remarkably similar to the features of

[49] *See id.* § 8.5.
[50] *See id.* App. F.

the Java declaring code upon which the Federal Circuit relied to find copyrightability. In *Oracle I*, the Federal Circuit remarked several times upon the "creative process" of creating the declaring code and the "vast range of options for the structure and organization."[51] There is also plenty of evidence that the design of CSS involved a creative process of selecting among a vast range of options. For example, the creator of CSS opted to use hyphens rather than dots between command words (font-size rather than font.size) to make CSS "look more like written English."[52] The CSS specification itself explains that commands are "declarations" written to be "human readable and writable."[53] Indeed, the Federal Circuit specifically held that declaring code "is entitled to copyright protection as long as the author had multiple ways to express the underlying idea";[54] the CSS developers also had multiple ways to express their command ideas, as demonstrated by the fact that they changed the names and structure of several commands during development of the standard.[55] Insofar as these features were determinative of the Java declaring code's copyrightability, it is hard to see why CSS would not be eligible for copyright under the same reasoning.

Implementing a web browser that understands CSS (as every major web browser does today) requires the same act of copying of which Oracle accused Google. There, "Google copied the elaborately organized taxonomy of all the names of methods,

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[51] *Oracle America, Inc.*, 750 F.3d at 1356, 1361 ("The evidence showed that Oracle had 'unlimited options as to the selection and arrangement of the 7000 lines Google copied.'").

[52] Bruce Lawson, *CSS: It Was Twenty Years Ago Today—An Interview with Håkon Wium Lie*, DEV.OPERA (Oct. 10, 2014), https://dev.opera.com/articles/css-twenty-years-hakon/.

[53] CSS 2.1 SPECIFICATION, *supra* note 47, § 2.4.

[54] *Oracle America, Inc.*, 750 F.3d at 1361, 1367 (explaining how Java developers could have called the java.lang.Math.max declaration "any number of things, including 'Math.maximum' or 'Arith.larger'").

[55] The grid-layout portion of the CSS standard, for example, originally had commands "grid-row-align: start" and "grid-column-align: center" but were later changed to "align-self: start" and "justify-self: center." *Compare Grid Layout, W3C* (Apr. 7, 2011), https://www.w3.org/TR/2011/WD-css3-grid-layout-20110407/ *with CSS Grid Layout*, W3C (Dec. 14, 2017), https://www.w3.org/TR/2017/CR-css-grid-1-20171214/ (§ 10.3–10.4).

classes, interfaces, and packages," but "wrote its own implementing code" in relevant part.[56] Similarly, a web browser would have to copy the entire "elaborately organized taxonomy" of CSS commands in order for the browser to understand CSS declarations used on the Internet. Just as Google could have "chosen different ways to express and implement the functionality that it copied,"[57] a web browser could use different commands to express and implement the same functionality as CSS—the browser could use dots rather than hyphens, for example. A web browser developer copies the CSS command set rather than inventing a new set of commands in order to ensure interoperability with websites—a rationale that *Oracle I* rejected as irrelevant to copyright eligibility[58] and that *Oracle II* rejected as irrelevant to fair use.[59] If implementing the Android operating system to understand Java declaring code commands was an infringement of a valid copyright, then it is hard to see why implementing a web browser to understand CSS commands would receive any different treatment.

Email. The standard for sending email messages is called the Simple Mail Transfer Protocol, or SMTP. It is specified in standards documents called "Requests for Comment" or RFCs.[60] While in early years RFCs were genuine requests for peer review, today "they are published only after a lot of vetting" and industry treats them as accepted standards.[61]

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[56] *Oracle America, Inc.*, 750 F.3d at 1351, 1377-79 (finding of Google copying implementing code, but this was not relevant to the court's decision on the copyrightability of the declaring code).

[57] *Id.* at 1368.

[58] *See id.* at 1371 ("Whether Google's software is 'interoperable' in some sense with any aspect of the Java platform . . . has no bearing on the threshold question of whether Oracle's software is copyrightable.").

[59] *See Oracle America, Inc.*, 886 F.3d at 1207 ("Taking those aspects of the copyrighted material that were familiar to software developers to create a similar work designed to be popular with those same developers is not fair use.").

[60] *See* J. Klensin, *SIMPLE MAIL TRANSFER PROTOCOL*, NETWORK WORKING GROUP (Oct. 2008), https://tools.ietf.org/html/rfc5321.

[61] Stephen D. Crocker, *How the Internet Got Its Rules*, N.Y. TIMES (Apr. 6, 2009), http://www.nytimes.com/2009/04/07/opinion/07crocker.html.

Data sent/received	Explanation of command
Server: `220 smtp.example.com`	
Client: `HELO 203.0.113.1`	*Introduce client*
Server: `250 smtp.example.com`	
Client: `MAIL FROM:<bob@example.com>`	*Send an email*
Server: `250 Ok`	
Client: `RCPT TO:<alice@example.com>`	*Provide email recipient*
Server: `250 Ok`	
Client: `DATA`	*Provide message content*
Server: `354 End data with .`	
...Content of email is transmitted here...	
Client: `.`	
Server: `250 Ok: queued as 12345`	
Client: `QUIT`	
Server: `221 Bye`	

Figure 2: Example communication according to the SMTP standard. The client is the computer seeking to send an email to the server.

To send email according to the SMTP standard, a computer issues commands to an email server, as illustrated in Figure 2. The commands are English-derived words, such as "MAIL FROM" and "RCPT TO."[62] The SMTP standard defines eleven basic commands,[63] and "Extended SMTP" adds further commands for features such as encryption, authentication, and international character encodings.[64]

Much like CSS and the Java declaring code, SMTP commands and command structures reflect choices among many possible options. SMTP commands are generally four-letter sequences resembling English words; any person can open a terminal window on a computer, enter "telnet gmail-smtp-in.l.google.com 25" and

[62] *See* Klensin, *supra* note 60, at 19.

[63] *See id.* at 32–40.

[64] *See* P. HOFFMAN, *SMTP SERVICE EXTENSION FOR SECURE SMTP OVER TRANSPORT LAYER SECURITY*, INTERNET ENGINEERING TASK FORCE (Feb. 2002), https://www.ietf.org/rfc/rfc3207.txt; R. Siemborski et al., *SMTP SERVICE EXTENSION FOR AUTHENTICATION*, INTERNET ENGINEERING TASK FORCE (July 2007) [hereinafter RFC 4954], https://tools.ietf.org/html/rfc4954; J. Yao & W. Mao, *SMTP EXTENSION FOR INTERNATIONALIZED EMAIL*, INTERNET ENGINEERING TASK FORCE (Feb. 2012), https://tools.ietf.org/html/rfc6531.

proceed to send email by typing commands.[65] Indeed, aesthetics were a component of the design of SMTP: The early Internet community considered SMTP's predecessor, the Mail Transfer Protocol, to be "an ugly protocol" and overly complex; SMTP was designed in response to be "a simpler protocol" that was more elegant in its command structure.[66]

An email server that implements SMTP must copy the collection of SMTP commands, in the same way that a web browser copies CSS declarations or Android copies Java declaring code. The email server must be programmed to understand commands from email senders, such as MAIL FROM and RCPT TO in order to receive emails, and the server must produce response codes identical to the SMTP standard in order for email senders to understand whether their emails have been transmitted or not. The email server could of course express the same functionality with different commands—MESG FROM and SEND TO, for example. The exact SMTP wording is necessary only to maintain interoperability with existing email senders.

Wi-Fi. Laptops and mobile devices usually connect wirelessly to the Internet via a standard called 802.11, colloquially "Wi-Fi."[67] According to that standard, data is transferred in the form of structured chunks called "frames."[68] Each frame begins with a header comprising several numeric codes, which act as command words that instruct the recipient on how to process the frame.[69]

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[65]The message will almost certainly bounce unless it complies with standards such as MIME, DKIM, SPF, and DMARC—all of which contain further commands which email systems must implement.

[66]Craig Partridge, *The Technical Development of Internet Email*, IEEE ANNALS OF THE HIST. OF COMPUTING, 3, 17-18 (2008), https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4544553 (praising features of SMTP design such as reply codes and simple list of basic commands).

[67]*See* IEEE, *802.11-2016 – IEEE Standard For Information Technology – Telecommunications and Information Exchange Between Systems Local and Metropolitan Area Networks—Specific Requirements – Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications* 122, IEEE (Dec. 14 2016), https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7786995.

[68]*See id.* at 636.

[69]*See id.* at 638.

Figure 3 shows a sample of 2–3 word Wi-Fi frame header commands. The sequence "01 0110 1000," for example, transmits the "sector sweep" command.[70] Commands in Wi-Fi frame headers are only the basics; other features specified in the standard, such as authentication, involve further commands.[71]

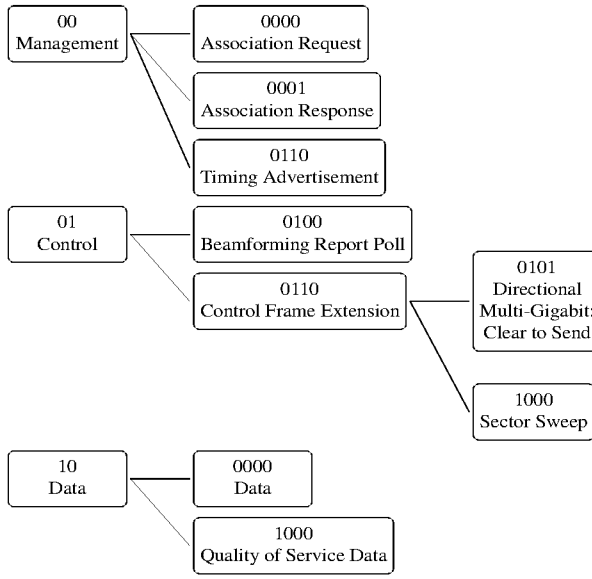

Figure 3: Some command words defined in the 802.11 Wi-Fi standard. The binary numbers are the actual words transmitted; the text describes each command word's meaning.

[70] *See id.* at 639-40.
[71] *See id.* at 1923-2088.

Certainly, these are words spelled with digits rather than alphabetic characters, but it is difficult to see a reason to distinguish the two. Indeed, binary numbers used in standards can reflect a degree of aesthetic judgment.[72]

Again, a Wi-Fi access point that complies with the standard must copy the command words in the standard in order to be interoperable with other Wi-Fi devices, such as laptops and mobile tablets. (This point will remain true for the remaining standards discussed, so it will not be repeated.)

Peripheral devices. Most external computer peripherals (keyboards, mice, and printers, for example) connect by USB port. USB stands for Universal Serial Bus, which specifies not just a plug shape but also an extensive language by which peripherals communicate with computers.

When a USB device connects to a computer, the computer may issue one or more commands, called "device requests," to collect information from the device or adjust the device's settings. Implementing a USB device requires implementing responses to these commands.[73] The commands are structured as a hierarchy of phrases of at least three binary words: a request type, a request, and a value.[74]

Multimedia. Television and online video are generally stored and transmitted according to the H.264 video encoding standard, one that includes numerous command words.[75] If that video is shown on a recent television or computer monitor, it is likely sent via the

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[72] *See* E. FLEISCHMAN, WAVE AND AVI CODEC REGISTRIES 3 (June 1998), https://tools.ietf.org/html/rfc2361 (standard that assigns 32-bit integers for identifying audiovisual codecs, with the integers selected to resemble four-letter mnemonics).

[73] *See* APPLE INC. ET AL., UNIVERSAL SERIAL BUS 3.2 SPECIFICATION 329 (Sept. 22, 2017), http://www.usb.org/developers/docs/.

[74] *See id.* § 9.4, tbls. 4–6, at 330–31.

[75] *See, e.g.*, *ADVANCED VIDEO CODING FOR GENERIC AUDIOVISUAL SERVICES* 62–64, INT'L TELECOMM. UNION (APR. 2017), http://www.itu.int/rec/T-REC-H.264-201704-I (describing "NAL units," commands that "provide header information in a manner appropriate for conveyance on a variety of communication channels or storage media").

High-Definition Multimedia Interface standard, or HDMI, which incorporates compilations of command words.[76] If it is broadcast over air, cable, or satellite, the video signal likely conforms to standards adopted by the Advanced Television Systems Committee; those standards include further command compilations for features such as closed captioning.[77]

The foregoing examples show that technical standards, of the kind that underlie all kinds of information technology today, regularly include commands for communicating with computer systems, making those standards interfaces. For those standards to be used, they must be implemented, just like the Java declaring code. Insofar as Google's implementation of the declaring code was deemed to have infringed Oracle's copyrights, implementation of a technical standard would appear to be an infringement of the copyright in the standard, too.

IV. INDUSTRY EXPECTATIONS REGARDING INTERFACE COPYRIGHTS

Having established that the implementation of technical standards would likely constitute an act of copyright infringement, it may be asked whether this is the result that the technology industry expected. Unsurprisingly, it is not especially useful to ask industry members directly, since they naturally answer the question in line with their personal or corporate interests.[78] A better approach is to discern the expectations of industry based on its historical actions and decisions.

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[76] *See* *HIGH-BANDWIDTH DIGITAL CONTENT PROTECTION SYSTEM: MAPPING HDCP TO HDMI*, DIGITAL CONTENT PROT. LLC, (Feb. 13, 2013), https://www.digital-cp.com/hdcp-specifications (Follow "HDCP 2.2 on HDMI Specification (823k, PDF – February 13, 2013)" hyperlink; then proceed to pages 57-62) (describing "authentication protocol messages") (The HDMI standard itself is not public, but it incorporates HDCP).

[77] *See* ATSC STANDARD: CAPTIONS AND SUBTITLES (A/343), ADVANCED TELEVISION SYS. COMM. (Sept. 18, 2017) [hereinafter ADVANCED TELEVISION SYS. COMM.], https://www.atsc.org/wp-content/uploads/2016/12/A343-2017-Captions-and-Subtitles-1.pdf (incorporating XML commands of another standard).

[78] *See* Jeong, *supra* note 4 (describing competing views of industry expectations proffered by Oracle and Google).

In line with this methodology, this article discerns the expectations of the technology industry by observing the practices of *standard-setting organizations*, those private entities that coordinate the development of technical standards.[79] Standard-setting organizations are generally large consortia of industry members, either individual engineers or corporate firms,[80] suggesting that their actions will be representative of the industry overall. The organizations reviewed in this article are listed in Figure 4. The list includes the sponsors of each of the standards discussed in Section B, plus ANSI, which sets procedural guidelines for and accredits other standard-setting organizations.

[79] *See* Mark A. Lemley, *Intellectual Property Rights and Standard-Setting Organizations*, 90 CAL. L. REV. 1889, 1896–901 (2002) (for an overview of standard-setting organizations).

[80] *See, e.g.,* Brief for the Institute of Electrical and Electronics Engineers Inc. as *Amici Curiae* in support of no party, Ericsson, Inc. v. D-Link Sys., Inc., 773 F.3d 1201 (Fed. Cir. 2013) (No. 13-1625) [hereinafter IEEE Brief] (describing one standard-setting organization's "technical diversity of its 20,000-plus participants, consisting of technology experts and interested parties from around the globe, [which] includes individuals affiliated with corporations, universities, government agencies, and other organizations").

Abbr.	Standard-Setting Org.	Standards Developed
IEEE	Institute of Electrical and Electronics Engineers	802.11 Wi-Fi standard
IETF	Internet Engineering Task Force	SMTP standard and other RFCs
W3C	World Wide Web Consortium	Web pages, CSS standard
ATSC	Advanced Television Systems Committee	Digital television standards
ITU, ISO, IEC	International Telecommunication Union, International Organization for Standardization, International Electrotechnical Commission	Multimedia formats such as H.264 video
ANSI	American National Standards Institute	Accredits other standard-setting organizations
USB	Universal Serial Bus Implementers Forum	Computer peripherals
HDMI	High Definition Multimedia Interface Forum	Audiovisual signals for televisions, computer monitors, and sound systems

Figure 4: Standard-setting organizations whose patent and copyright policies are reviewed in this article.

The practices of standard-setting organizations demonstrate that the technology industry does not believe that implementation of interfaces is an infringement of copyright for the following reasons. In developing a technical standard, third parties contribute to the standard-setting organization various ideas for technological features of the standard, and those contributions often include patentable inventions.[81] If a patented third-party contribution is ultimately incorporated into the standard, then theoretically every implementer of the standard will infringe the patent. As a result, standard-setting organizations go to great lengths to develop patent arrangements that simplify downstream licensing for implementers.[82]

[81] *See id.* at 12; Lemley, *supra* note 79, at 1901–03.
[82] *See infra* Section IV.A.

Third-party contributions to standards also often contain interfaces, such as collections of commands to be incorporated into the standard.[83] If standard-setting organizations believed that implementing an interface could constitute copyright infringement, then they ought to make equal arrangements for copyrights to simplify downstream licensing for implementers. But standard-setting organizations almost uniformly make no such arrangements.[84] The lack of attention to copyright licensing strongly suggests that standard-setting organizations, and by extension the technology industry, do not believe that implementation of interfaces constitutes copyright infringement.

A. PATENT POLICIES TO DEAL WITH CONTRIBUTIONS OF PATENTED INVENTIONS TO TECHNICAL STANDARDS

Standard-setting organizations receive third-party contributions of ideas to include in a standard being developed. Those contributions may include patentable inventions.[85] Thus, as will be shown below, standard-setting organizations maintain extensive patent policies to assist implementers of technical standards who would otherwise face patent infringement issues.

The process of developing a standard within a standard-setting organization is described in *Ericsson, Inc. v. D-Link Systems, Inc.* and in IEEE's comprehensive *amicus* brief in that case.[86] Briefly, the process is as follows. A standard-setting organization, such as IEEE, will form a working group to draft a standard for a particular technological subject, such as Wi-Fi. In most cases, the working groups "strive for broad representation of all interested parties" and are "open to participation by anyone."[87] Working group members contribute proposals to the group, which are put to discussions,

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[83] *See infra* Section IV.B.

[84] *See infra* Section IV.C.

[85] *See, e.g.,* NAT'L RESEARCH COUNCIL OF THE NAT'L ACADEMIES, *supra* note 38, at 16.

[86] *See* Ericsson, Inc. v. D-Link Sys., Inc., 773 F.3d 1201, 1208–09 (Fed. Cir. 2014); IEEE Brief, *supra* note 80, at 5–12.

[87] IEEE Brief, *supra* note 80, at 8.

votes, and various levels of approval.[88]

The key point is that standard-setting organizations are not the sole authors; standards are written based on the "cooperation of a number of interested parties."[89] Promulgated standards incorporate these third-party contributions.

Anyone who accepts third-party contributions of ideas ought to be concerned with intellectual property rights, and standard-setting organizations are no exception. Intellectual property rights on technology incorporated into a standard can cause *holdup*, which the Federal Circuit described as the situation where a holder of intellectual property essential to a technical standard "demands excessive royalties after companies are locked into using a standard."[90]

Holdup can discourage implementation of a standard, so standard-setting organizations ought to take measures to avoid it. With regard to patents, that is exactly what happens: Every standard-setting organization appears to have a detailed policy on patent licensing designed to prevent holdup.[91]

Patent policies differ across organizations but largely seek to accomplish three goals. First, standard-setting organizations generally require disclosure of *standard-essential patents*, namely those covering technology that implementers of the standard must use; working groups issue "calls for patents" to obtain those disclosures.[92] Second, the organizations require holders of standard-

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[88]IEEE Brief, *supra* note 80, at 9–11.

[89]*Ericsson*, 773 F.3d at 1209.

[90]*Id.* (citing IEEE Brief, *supra* note 81, at 16–18); *see also* U.S. DEP'T OF JUSTICE & FED. TRADE COMM'N, ANTITRUST ENFORCEMENT AND INTELLECTUAL PROPERTY RIGHTS: PROMOTING INNOVATION AND COMPETITION 35 (2007) [hereinafter FTC-DOJ REPORT], *available at* http://www.usdoj.gov/atr/public/hearings/ip/222655.pdf.

[91]*See generally* NAT'L RESEARCH COUNCIL OF THE NAT'L ACADEMIES, *supra* note 38, at 64 (reviewing patent policies of standard-setting organizations).

[92]*See* IEEE-SA STANDARDS BOARD OPERATIONS MANUAL 37 (June 2018), http://standards.ieee.org/develop/policies/opman/sb_om.pdf; IEEE-SA STANDARDS BOARD BYLAWS 19 (Dec. 2017) [hereinafter IEEE BYLAWS], https://standards.ieee.org/develop/policies/bylaws/sb_bylaws.pdf; INT'L TELECOMM., UNION UNDERSTANDING PATENTS, COMPETITION & STANDARDIZATION IN AN INTERCONNECTED WORLD 88 (2014) [hereinafter ITU PATENT],

essential patents to provide assurances that they will grant licenses on a royalty-free or "fair, reasonable, and non-discriminatory" (FRAND) basis; failure to do so may result in disqualification from the organization or selection of alternate, non-infringing technology for the standard.[93] Finally, to avoid the possibility that licensing assurances become ineffective if the patent is assigned to a third party,[94] the organizations generally characterize licensing assurances as encumbrances that travel with the patent.[95]

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http://www.itu.int/en/ITU-T/Documents/Manual_Patents_Final_E.pdf; S. BRADNER & J. CONTRERAS, INTELLECTUAL PROPERTY RIGHTS IN IETF TECHNOLOGY 10 (May 2017) [hereinafter RFC 8179], https://tools.ietf.org/html/rfc8179; WORLD WIDE WEB CONSORTIUM PATENT POLICY (Aug. 1, 2017) [hereinafter W3C PATENT POLICY], https://www.w3.org/Consortium/Patent-Policy-20170801/; ADVANCED TELEVISION SYS. COMM. INC. PATENT POLICY (Dec. 13, 2007) [hereinafter ATSC PATENT POLICY], https://www.atsc.org/wp-content/uploads/2016/06/B-4-2007-12-13_patent_policy_form_editable.pdf. ANSI directs that participants are "encouraged" to disclose standard-essential patents. *See* ESSENTIAL REQUIREMENTS: DUE PROCESS REQUIREMENTS FOR AM. NAT'L STANDARDS 10 (Jan. 2017) [hereinafter ANSI REQUIREMENTS], https://www.ansi.org/essentialrequirements/. The USB and HDMI forums have no disclosure requirement because contributors must offer a blanket license to all essential patents.

[93] *See* W3C PATENT POLICY, *supra* note 92; Lotes Co. v. Hon Hai Precision Indus. Co., 753 F.3d 395, 401 (2d Cir. 2014) (USB 3.0 Contributors Agreement requires "RAND-Zero" licenses); BYLAWS OF HDMI FORUM, INC., ANNEX C, § 1 (Oct. 25, 2011) [hereinafter HDMI BYLAWS], http://hdmiforum.org/wp-content/uploads/2016/11/HDMI-Forum-Inc-Bylaws_Final_20111025.pdf (royalty-free licenses required); IEEE BYLAWS, *supra* note 92, at 16–17 (FRAND licenses required); RFC 8179, *supra* note 92; ATSC PATENT POLICY, *supra* note 92, at 1 (standardization of patented technology without FRAND agreement requires board-approved "exception" to general policy); AM. NAT'L STANDARDS INST., GUIDELINES FOR IMPLEMENTATION OF THE ANSI PATENT POLICY 8–9 (Jan. 2016), https://share.ansi.org/Shared%20Documents/Standards%20Activities/American%20National%20Standards/Procedures,%20Guides,%20and%20Forms/ANSI%20Patent%20Policy%20Guidelines%202016.pdf (ANSI-certified standards require FRAND agreement); ITU PATENT, *supra* note 92, at 90.

[94] *See* NAT'L RESEARCH COUNCIL OF THE NAT'L ACADEMIES, *SUPRA* NOTE 38, AT 81; FTC-DOJ REPORT, *supra* note 90, at 6 (assignment of a patent to evade FRAND obligations may violate unfair competition law); Complaint at ¶ 38, *In re* Negotiated Data Solutions LLC, No. C-4234 (Fed. Trade Comm'n Sept. 22, 2008); *In re* Motorola Mobility LLC, 156 F.T.C. 147, ¶ 28, at 154 (July 23, 2013).

[95] *See* IEEE BYLAWS, *supra* note 92, § 6.2, at 17; RFC 8179, *supra* note 93, § 5.5(C), at 15; W3C PATENT POLICY, *supra* note 92, § 3.1 ("licensing obligations . . . encumber the patents"); ITU PATENT, *supra* note 92, at 91; ANSI

Patent policies of standard-setting organizations further contain specific provisions such as timing of patent disclosures,[96] permissibility of seeking injunctive relief,[97] reciprocity in patent licensing,[98] committees for negotiating for licenses with non-participants,[99] and obligations arising from oral contributions to a standard.[100] This attention to detail demonstrates that when intellectual property rights affect implementation of a standard, the organizations make dedicated and extensive efforts toward private ordering of those rights.

B. THIRD-PARTY CONTRIBUTIONS OF INTERFACES

It is not only patented or patentable inventions that are contributed to technical standards, however. Interfaces are frequently contributed too. Indeed, this section will review many of the standards discussed previously in Section B to show that third parties contributed substantial interfaces to those standards.[101]

REQUIREMENTS, *supra* note 92, § 3.1.1(b) (assignor shall "ensure that the commitments in the assurance are binding on the transferee"); USB 3.0 CONTRIBUTORS AGREEMENT § 3.5 (n.d.), *reprinted in* First Amended Complaint at Exh. A, Lotes Co. v. Hon Hai Precision Indus. Co., No. 1:12-cv-7465 (S.D.N.Y. Dec. 21, 2012); HDMI BYLAWS, *supra* note 93, annex C, § 1, at 2 (patent transfer "shall be subject to the terms and conditions of this IPR Policy").

[96]*See, e.g.,* ATSC PATENT POLICY, *supra* note 92, § 5, at 2.

[97]*See, e.g.,* IEEE BYLAWS, *supra* note 92, § 6.2 at 17 ("reasonable terms and conditions" of FRAND license "precludes seeking, or seeking to enforce, a Prohibitive Order" generally); NAT'L RESEARCH COUNCIL OF THE NAT'L ACADEMIES *supra* note 38, at 111–12.

[98]*See, e.g.,* USB 3.0 CONTRIBUTORS AGREEMENT, *supra* note 95, § 3.4.

[99]*See, e.g.,* W3C PATENT POLICY, *supra* note 92, § 7.1.

[100]*See* RFC 8179, *supra* note 92, § 5.7, at 15.

[101]Some of those standards are not discussed here, because their contribution processes were not publicly accessible or too voluminous to review.

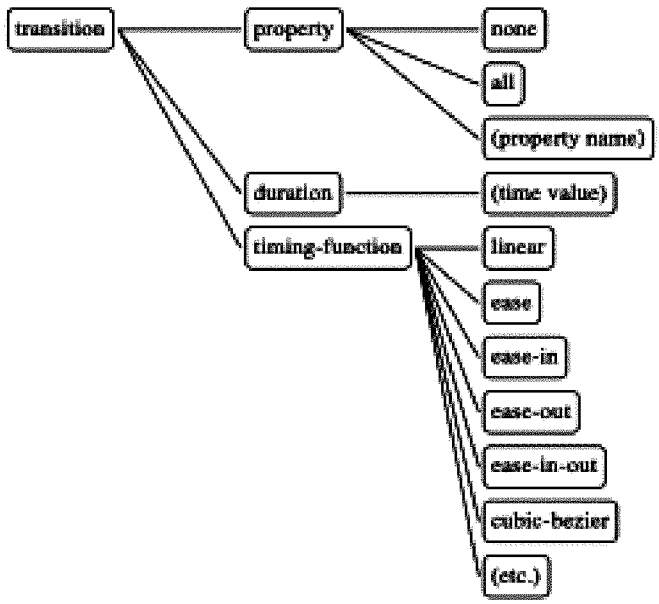

Figure 5: CSS commands for transitions (animations), as created by Apple and contributed to the CSS standard.

CSS. Third parties have contributed many subsets of CSS commands. For example, portions of a web page can be animated (text can move, change size, or disappear), and those animations are controlled by a set of transition commands, some of which are described in Figure 5.[102] The command words were developed by Apple in 2007 and contributed to the CSS standard in 2009.[103]

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[102] *See* L. DAVID BARON ET AL., *CSS TRANSITIONS* (Nov. 30, 2017) (unnumbered working paper) (found at https://www.w3.org/TR/2017/WD-css-transitions-1-20171130/).

[103] *See* Dave Hyatt (@hyatt_dave), *CSS Animation*, APPLE WEBKIT BLOG (Oct. 31, 2007), https://webkit.org/blog/138/css-animation/; *CSS Animations Module Level 3, W3C* (Mar. 20, 2009), https://www.w3.org/TR/2009/WD-css3-animations-20090320/.

SMTP. Third-party companies have contributed commands to the SMTP[104] standard to add new functionalities. For example, to prevent spam many SMTP email servers require authentication based on standards authored by engineers at companies such as Netscape, Lucent, Google, and Isode.[105] Some of these authentication commands are illustrated in Figure 6.[106]

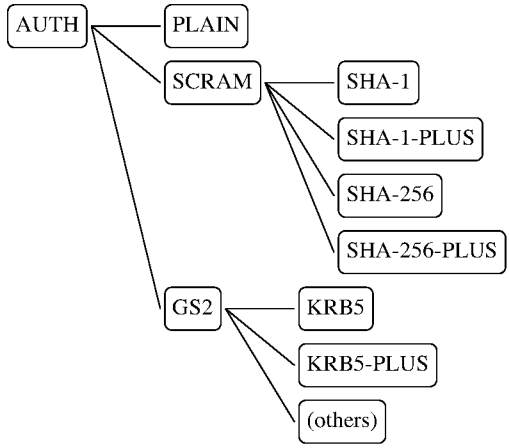

Figure 6: Partial command hierarchy for SMTP authentication, based on RFC 4954 and other standards.

[104]More accurately, Extended SMTP or ESMTP.

[105]*See* RFC 4954, *supra* note 64, at 19; *see also* S. JOSEFSSON & N. WILLIAMS, USING GENERIC SECURITY SERVICE APPLICATION PROGRAM INTERFACE (GSS-API) MECHANISMS IN SIMPLE AUTHENTICATION AND SECURITY LAYER (SASL) (Jul. 2010), https://tools.ietf.org/html/rfc5801; C. NEWMAN ET AL., SALTED CHALLENGE RESPONSE AUTHENTICATION MECHANISM, 9 (July 2010), https://tools.ietf.org/html/rfc5802; T. HANSEN, SCRAM-SHA-256 AND SCRAM-SHA-256-PLUS SIMPLE AUTHENTICATION AND SECURITY LAYER (SASL) MECHANISMS (Nov. 2015), https://tools.ietf.org/html/rfc7677.

[106]*See* RFC 4954, *supra* note 64, at 3–7.

USB. Computer peripherals meeting the USB standard are divided into classes of device types, such as audio devices, billboards, mass storage devices (such as flash drives), printers, and smart cards. Each class of devices implements both the general USB standard and a class-specific standard, the latter of which may add additional commands specific to the device type. For example, the USB audio class standard adds commands for controlling the volume level, muting the device, and adjusting the bass and treble output, among many other commands.[107]

The class-specific standards are third-party contributions to USB. The audio standard, for example, appears to have originated from an engineer at Philips and now has contributors from IBM, Microsoft, Altec Lansing, Dolby, and Logitech.[108]

Television. ATSC's standard for closed captions and subtitles incorporates other standards by reference, such as SMPTE Timed Text (a standard by the Society of Motion Picture and Television Engineers), and Timed Text Markup Language.[109] Each of these standards contributes words to the complete command set of the ATSC closed captioning standard.

The above examples show that the interfaces of technical standards often originate from third-party contributors, meaning that those contributors hold any copyright in the interfaces they contributed. Insofar as implementing an interface can be copyright infringement, then, implementing any of the above technical standards may infringe those third-party contributors' copyrights, unless the standard-setting organization has enacted some copyright policy akin to the patent FRAND policies that those organizations all appear to maintain.

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[107] *See* GAL ASHOUR ET AL., UNIVERSAL SERIAL BUS DEVICE CLASS DEFINITION FOR AUDIO DEVICES 1.0, 75–80 (Mar. 18, 1998), https://www.usb.org/sites/default/files/audio10.pdf.

[108] *See id.* at ii.

[109] *See* ADVANCED TELEVISION SYS. COMM., *supra* note 77, at 4.

C. COPYRIGHT POLICIES—OR LACK THEREOF—TO DEAL WITH CONTRIBUTIONS OF INTERFACES

If contributors to a standard had a copyright interest in the command interfaces they contributed, one would expect standard-setting organizations to set forth at least reasonably detailed copyright licensing policies to protect implementers who must use those command word compilations. But standard-setting organizations almost uniformly lack copyright licensing policies: "As a generality, the issue of what might be referred to as 'essential copyrights' is rarely dealt in an effective way in IPR policies."[110] Most standard-setting organizations examined here have no relevant copyright policy at all. To the extent that a copyright license is sought from contributors to standards, the license is solely directed to distributing the text of the standard itself. This suggests that copyright is simply not an issue with regard to implementing interfaces.

Organization	Patent Policy	Copyright Policy
IEEE	Yes	No
IETF	Yes	Only as of 2008; questionable
W3C	Yes	Only as of 2015
ATSC	Yes	No
ITU	Yes	Only for "software"
ISO, IEC	Yes	No
ANSI	Yes	Only for "normative software"
USB	Yes	No
HDMI	Yes	No

Figure 7: Standard-setting organizations' copyright policies with respect to implementation of standards.

For example, ATSC requires contributors to its standards to grant the organization a license to "incorporate the Contribution into

[110] RUDI BEKKERS & ANDREW UPDEGROVE, A STUDY OF IPR POLICIES AND PRACTICES OF A REPRESENTATIVE GROUP OF STANDARDS SETTING ORGANIZATIONS WORLDWIDE, at 36 (Sept. 17, 2012) (commissioned paper preparatory to NAT'L RESEARCH COUNCIL OF THE NAT'L ACADEMIES., *supra* note 38).

the Standard" and to copy the contribution as part of the standard, but ATSC demands no copyright license for implementation.[111] IEEE similarly requires no copyright license relevant to implementers.[112] Since the standards promulgated by these organizations all include interfaces,[113] the lack of policies addressing copyright licensing suggests that the organizations did not believe that implementation of those interfaces implicated copyright. The copyright license agreements of the USB and HDMI forums are especially notable. Both require contributors to grant a copyright license to "prepare derivative works . . . in order to develop" drafts of the standard but omit a derivative works license once the standard is final.[114] If implementation of a standard requires any copyright license at all, it must be a license to make derivative works. Inclusion of a derivative works license for drafting the standard but exclusion of a derivation license for using the final standard indicates, *expressio unius est exclusio alterius*,[115] that contributors to USB and HDMI grant no copyright license applicable to implementation of final standards. Presumably no copyright license is sought because none is believed necessary.

ITU and ANSI. Some standard-setting organizations do request copyright licenses permitting use of literal software code included in standards, but those licenses are inapplicable to interface command words. ITU (but not ISO and IEC) requires contributors of "Software," defined as instructions executable on a computer, to

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[111] ADVANCED TELEVISION SYS. COMM., INC., DOC. B/03, OPERATIONAL PROCEDURES FOR TECHNOLOGY GROUPS AND SUBCOMMITTEES § 15.1.1(i)–(ii), at 12 (Mar. 24, 2015), https://www.atsc.org/wp-content/uploads/2017/01/B-3-2015-03-24_Procedures.pdf.

[112] *See* IEEE BYLAWS, *supra* note 92, § 7.2.1–.2.

[113] *See* Section B *supra* p. 15.

[114] HDMI BYLAWS, *supra* note 93, annex C, § 2; *see also* USB 3.0 CONTRIBUTORS AGREEMENT, *supra* note 95, § 3.2–3.5.

[115] *See* Clifton Williams, *Expressio Unius Est Exclusio Alterius*, 15 MARQ. L. REV. 191, 191 (1931) ("[T]he expression of one subject, object, or idea is the exclusion of other subjects, objects, or ideas.").

grant a copyright license on royalty-free or FRAND terms.[116] ANSI "strongly recommends" (but does not require) that accredited standard-setting organizations obtain copyright permissions "sufficient to ensure that there will be no legal impediment" to implementation of any standard that includes "normative software."[117]

Command words in interfaces are not "software" for several reasons. First, both ANSI and ITU recommend developing standards "written around copyrighted material using performance-based requirements" rather than incorporating copyrighted software directly.[118] But interface command words cannot be "written around"; exact wording of commands is the very essence of a standard.

Second, ITU distinguishes between executable software, which requires a license, and "data structures, data streams, [and] formal description techniques," for which, according to ITU, "no specific license is required."[119] Because interfaces are more akin to the latter category,[120] ITU likely interprets "software" not to include interfaces or their commands.

Third, ANSI specifically expresses concern with the notion that use of a copyrighted work could be essential to a standard. Its copyright policy explains, "[i]f a standard requires that all implementers of the standard copy a specific copyrighted work, then by being endorsed as a standard, the copyright right has taken on a

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[116]*See ITU SOFTWARE COPYRIGHT GUIDELINES*, INT'L TELECOMM. UNION, § 2.1, at 3 (3d ed. Dec. 7, 2011) [hereinafter ITU COPYRIGHT], https://www.itu.int/oth/T0404000004/en; *see also id.* Annex A, at 9.

[117]*ANSI GUIDELINES ON SOFTWARE IN STANDARDS*, AM. NAT'L STANDARDS INST., 3–4 (2008) [hereinafter ANSI SOFTWARE GUIDELINES], https://share.ansi.org/Shared%20Documents/Standards%20Activities/American%20National%20Standards/Procedures,%20Guides,%20and%20Forms/ANSI%20Guidelines%20on%20Software%20in%20Standards.pdf.

[118]ITU COPYRIGHT, *supra* note 116, § 2.1, at 3; *accord* ANSI SOFTWARE GUIDELINES, *supra* note 117, at 4.

[119]ITU COPYRIGHT, *supra* note 116, § 2.2.2, at 5.

[120]Command hierarchies in interfaces are sometimes presented using formal description techniques such as Backus–Naur form. *See* D. CROCKER & P. OVERELL, AUGMENTED BNF FOR SYNTAX SPECIFICATIONS: ABNF (Jan. 2008), https://tools.ietf.org/html/rfc5234.

significance far beyond that which the original copyright right provided."[121]

If implementing an interface in a standard constitutes infringement of copyright, then every standard that contains an interface would require "that all implementers of the standard copy a specific copyrighted work," namely the interface. In such a case, copyright in interfaces will take on a significance far beyond what ANSI or other standard-setting organizations ever expected.

W3C and IETF. Two standard-setting organizations require contributors to provide a copyright license that arguably encompasses implementation of interfaces. Both demonstrate the limited effectiveness of this approach.

W3C requires participants in its standard-setting processes to grant a copyright license such that "anyone may prepare and distribute derivative works . . . in software."[122] However, W3C's policy is only effective as of February 2015; prior to then it had no copyright policy for implementers at all.[123] Prior contributions to W3C standards, including Apple's contribution of an animation interface to the CSS standard,[124] would have no attached copyright license for implementation.

IETF's policy is even less certain. The organization does require contributors to grant IETF a copyright license "to modify or prepare

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[121] ANSI SOFTWARE GUIDELINES, *supra* note 117, at 4.

[122] World Wide Web Consortium, *W3C DOCUMENT* LICENSE, W3C (Feb. 1, 2015), https://www.w3.org/Consortium/Legal/2015/doc-license. (W3C's license granted to implementers, participants in W3C processes "must agree" that their submissions "will be subject to the W3C Document License."); *accord* WORLD WIDE WEB CONSORTIUM, *PROCESS DOCUMENT § 10.1.2*, W3C (Mar. 1, 2017), https://www.w3.org/2017/Process-20170301/.

[123] *See* WORLD WIDE WEB CONSORTIUM, *W3C DOCUMENT LICENSE*, W3C (Dec. 31, 2002), https://www.w3.org/Consortium/Legal/2002/copyright-documents-20021231; *see also* Wendy Seltzer, *W3C Updates General Document License*, W3C BLOG (Feb. 6, 2015), https://www.w3.org/blog/2015/02/w3c-updates-general-document-license/ (noting that updated W3C document license newly grants permissions for "implementing specifications").

[124] *See supra* notes 102–03 and accompanying text.

derivative works," which IETF could sublicense to implementers.[125] But the intent of that derivation license is not to protect implementers; it is to enable IETF to promulgate updated standards.[126]

Indeed, IETF currently does not use its sublicensing ability to grant implementers any copyright license, except for a limited license on "Code Components" akin to the software licenses of ANSI and ITU.[127] And in any event, IETF's policy is only effective as of 2008, and IETF recognizes that no derivation license was granted for pre-2008 contributions.[128] Again, the SMTP authentication interfaces described previously[129] were contributed in 2007 and have no attendant copyright license for implementation. Every standard-setting organization reviewed above has a strong patent policy that stabilizes the obligations of implementers of standards. Not one has a comprehensive copyright policy protecting implementers in their use of interfaces in standards. The best inference from this discrepancy in treatment of intellectual property rights is that the technology community, which makes up these standard-setting organizations, does not believe that copyright licenses are necessary for implementing interfaces—because those interfaces are not protected by copyright.[130]

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[125]NETWORK WORKING GROUP, RIGHTS CONTRIBUTORS PROVIDE TO THE IETF TRUST § 5.3(c), at 10 (S. Bradner & J. Contreras eds. 2008), https://tools.ietf.org/html/rfc5378.

[126]*See id.* § 3.3, at 6–7.

[127]IETF TR., LEGAL PROVISIONS RELATING TO IETF DOCUMENTS § 4(c) (5th ed. Mar. 25, 2015), https://trustee.ietf.org/documents/IETF-TLP-5_001.pdf; *cf. id.* § 3(d)(i) ("license to modify IETF Contributions or IETF Documents" is "*not* granted").

[128]*See id.* at § 6(c).

[129]*See* C. NEWMAN ET AL., *supra* note 105, at 24

[130]An alternative explanation might be that the standard-setting organizations assumed that the third-party contributors had implicitly authorized use of their copyrights, giving rise to a sort of implied license. *See* Bright, *supra* note 4 ("With copyright protection of APIs, the specifications themselves implicitly authorize re-implementations, thanks to their extensive discussion of what those implementations should do."). But this seems highly unlikely for at least three reasons. First, the standard-setting organizations could also have relied on an implied license theory for patent rights, but did not. Second, unlike cases where courts have found im-

V. HANDLING THE DISCREPANCY BETWEEN LAW AND INDUSTRY EXPECTATIONS

The previous discussion showed that current law and industry expectations diverge: The Federal Circuit holds that computer interfaces may be subject to copyright and infringed by implementation, while the practices of standard-setting organizations suggest that they do not believe implementation to implicate copyright. How should this tension be resolved?

There is good reason to believe that it would be a positive development for courts to align copyright law with industry expectations and in particular with the expectations of standard-setting organizations. Courts have repeatedly recognized that technical standard-setting is a critical component of technological innovation, drawing doctrines of patent law to be consistent with expectations of standard-setting organizations. Industry expectations ought to be taken into account in deciding the copyright status of computer interfaces, especially given the uncertainty and risk to innovation that could result from continued rulings contrary to industry expectations.

Because they elicit product interoperability, positive network effects, and incentives for innovation, technical standards have "decidedly procompetitive effects."[131] Courts—including the Federal

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plied licenses, there is no privity between the third-party contributors to a standard and the implementers of that standard. *See* Monika Isia Jasiewicz, Comment, *Copyright Protection in an Opt-Out World: Implied License Doctrine and News Aggregators*, 122 YALE L.J. 837, 845 (2012) ("Historically, implied licenses have only been found in copyright cases when there is direct dealing between just a few parties."). Third, the implied license doctrine is poorly developed, with a leading case being an unappealed district court decision that gave the implied license doctrine less than a page of discussion. *See* Field v. Google Inc., 412 F. Supp. 2d 1106, 1115–16 (D. Nev. 2006); Orit Fischman Afori, *Implied License: An Emerging New Standard in Copyright Law*, 25 SANTA CLARA HIGH TECH. L.J. 275, 281 (2008) (explaining how the implied license doctrine "ultimately failed to continue developing in response to the dynamic environment of the copyright world"). It is difficult to believe that standard-setting organizations, obviously well-versed in intellectual property matters given their patent rules, would be complacent to rely on an implied license theory for copyright.

[131] Princo Corp. v. Int'l Trade Comm'n, 616 F.3d 1318, 1335 (Fed. Cir. 2010).

Circuit—have drawn multiple doctrines of intellectual property law to advance the arrangements of standard-setting organizations.

Damages. *Ericsson*, for example, directed courts assessing reasonable royalties to perform a special apportionment analysis for FRAND-encumbered patents in order to avoid excessively high royalty awards that could cause holdup and thus "inhibit widespread adoption" of standards.[132] Indeed, to further protect adoption of standards, the Federal Circuit later applied *Ericsson*'s apportionment analysis to all standard-essential patents, even those not under a FRAND obligation.[133]

Unenforceability. To ensure that standard-setting organizations' patent disclosure requirements are fulfilled, the Federal Circuit has several times held that failure to disclose a relevant patent in the standard-setting process can constitute fraud potentially sanctionable by partial unenforceability of the patent.[134] Manifesting concern for preserving the expectations of standard-setting process members, the court specifically held in *Qualcomm Inc. v. Broadcom Corp.* that even an oral expectation among members may create an enforceable duty to disclose if "members treated it as imposing a disclosure duty."[135]

Injunctive Relief. Although an injunction is not *per se* unavailable for a FRAND-encumbered patent, *Apple Inc. v. Motorola, Inc.* observed that a patentee's "FRAND commitments are certainly criteria relevant to its entitlement to an injunction," because among other reasons "the public has an interest . . . in ensuring that SEPs

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[132]Ericsson, Inc. v. D-Link Sys., Inc., 773 F.3d 1201, 1209, 1230–34 (Fed. Cir. 2014).

[133]*See* Commonwealth Sci. & Indus. Research Org. v. Cisco Sys., Inc., 809 F.3d 1295, 1304–07 (Fed. Cir. 2015).

[134]*See* Hynix Semiconductor Inc. v. Rambus Inc., 645 F.3d 1336, 1348 (Fed. Cir. 2011); *see also* Qualcomm Inc. v. Broadcom Corp., 548 F.3d 1004, 1026 (Fed. Cir. 2008); *see also* Rambus Inc. v. Infineon Techs. AG, 318 F.3d 1081, 1098 (Fed. Cir. 2003).

[135]*Qualcomm Inc.*, 548 F.3d *at* 1016.

[standard-essential patents] are not overvalued."[136]
Patent law has been interpreted mindful of industry expectations regarding standard-setting. To interpret patent law otherwise could seriously upset a critical component of technological innovation. Copyright law should also be interpreted mindful of the same expectations for the same reason.

Standard-setting organizations generally lack copyright policies protecting implementers, as discussed above.[137] To hold that implementation of a computer interface is indeed an infringement would potentially mean that contributors to standards (such as Apple, Netscape, Philips, and others noted in Section B) may hold a "standard-essential copyright," infringed by all implementers and unencumbered by any licensing obligation. The potential results include holdup based on copyright assertion, discouragement of the adoption of existing standards, and ultimately a drag on standards-based innovation. It would be advisable, as a policy matter, for courts to avoid these problematic results by aligning copyright law with historical standard-setting practices.

VI. CONCLUSION

This article has considered the implications of the Federal Circuit's *Oracle I* and *Oracle II* decisions on common technical standards. The article finds that, under the reasoning of those cases, many common Internet and computer technologies would also trigger copyright infringement concerns because those technologies are implementations of technical standards, and the *Oracle* decisions effectively hold implementation of technical standards to be copyright infringement. Because the standard-setting organizations that developed those ubiquitous standards almost certainly do not believe that implementation of their standards constitutes copyright infringement, this article identifies an important discrepancy between industry perception and legal doctrine. Accordingly, the article recommends change to the legal doctrine in a direction that

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[136] *See* Apple Inc. v. Motorola, Inc., 757 F.3d 1286, 1331-32 (Fed. Cir. 2014).

[137] *See* BEKKERS & UPDEGROVE, *supra* note *110.*

renders the doctrine more consistent with industry expectations.

Until that doctrine is changed (if it ever is), what should standard-setting organizations and other industry members do in view of the current state of the law? A likely first step would be for them to adopt new copyright policies akin to their patent policies as a defensive measure against future assertions of copyright against implementers of standards. However, such actions will only have prospective effect; the many contributions made to technical standards in the past would still potentially be fair game for copyright assertion. A more important task, then, is for the standard-setting organizations to seek necessary legal changes to protect implementers of standards. As the linchpin of nearly all modern technologies, one would imagine that those organizations have substantial political weight to call for change. Given that one opportunistic copyright campaign could provoke an existential crisis for those organizations and their standards, one hopes that they are also motivated to sound that call.

VII. APPENDIX: TABLE OF ABBREVIATIONS

CSS: Cascading Style Sheets
DKIM: Domain Keys Identified Mail
DMARC: Domain-based Message Authentication, Reporting and Conformance
ESMTP: Extended SMTP
FRAND: Fair, Reasonable and Non-Discriminatory
HDCP: High-Definition Copy Protection
HDMI: High-Definition Multimedia Interface
IPR: Intellectual property rights
MIME: Multipart Internet Mail Extensions
RFC: Request for Comment
SEP: Standard-essential patent
SMPTE: Society of Motion Picture and Television Engineers
SMTP: Simple Mail Transfer Protocol
SPF: Sender Policy Framework
USB: Universal Serial Bus