

STANDARDIZED EXCLUSION: A THEORY OF BARRIER LOCK-IN

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ABSTRACT

The United States has relaxed antitrust scrutiny of private standard-setting organizations in recognition of their potential procompetitive benefits. In the meantime, however, the growing importance of network industries—and the coinciding move toward vendor-led standards consortia—has welcomed new, insidious anticompetitive risks. This Note proffers one such risk: barrier lock-in. A theory of barrier lock-in recognizes that dominant vendors can capture and control standards consortia to keep standardized equipment complex and costly. These practices are exclusionary. This Note situates barrier lock-in within the existing antitrust literature and jurisprudence, provides a potential example of barrier lock-in in the 5G network equipment standardization process, and proposes two solutions for future legislative, executive, and judicial action against misbehaving standard-setters.

INTRODUCTION

We live in a standardized world. What we eat and drink, how we move from place to place, how we do our jobs and what we use to do them—almost every facet of modern society involves (indeed requires) some degree of underlying uniformity, created and maintained either by the market or by standard-setting bodies. Standardization affects no less than 80 percent of the products moved daily in international trade.¹

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1. See MAUREEN A. BREITENBERG, NAT'L INST. OF STANDARDS & TECH., THE ABC'S OF STANDARDS ACTIVITIES 2 (2009), <https://www.nist.gov/document/abcs-standards-activities> [<https://perma.cc/YQ4V-W39Q>] (“Today, an estimated 80 percent of world merchandise trade is affected by standards or regulations that reference or incorporate standards.”). Some estimates exceed 90 percent. See JEFF OKUN KOZLOWICKI, U.S. DEP'T OF COM., STANDARDS AND

Without standards, complex, everyday technologies like the cellphone and the internet could never exist.² Indeed, some experts approximate that fifteen-to-twenty-thousand standards are a *prerequisite* for highly industrialized societies.³ Over one hundred thousand people regularly attend standard-setting meetings,⁴ where standard-setting groups promulgate tens of thousands of standards impacting tens of millions of people.⁵

But what exactly *is* a standard? Put simply, a standard describes “an agreed-upon way of doing something.”⁶ What that something is can vary widely.⁷ The width at which to set railroad tracks is a standard.⁸ So is the permissible number of bug parts in peanut butter (thirty fragments per 100 grams)⁹ or the best method for making a dry

REGULATIONS: MEASURING THE LINK TO GOODS TRADE 3 (2016) (“[A]round . . . 93 percent of global exports [between 2006–15] were potentially linked to technical regulations.”).

2. See JOANNE YATES & CRAIG N. MURPHY, *ENGINEERING RULES: GLOBAL STANDARD SETTING SINCE 1880*, at 241–92 (2019) (outlining the pivotal roles of the IETF and W3C with regard to the Internet); *Standards Are on Call as the Mobile Phone Rings in Its 40th Anniversary*, AM. NAT’L STANDARDS INST. (Apr. 18, 2013), <https://www.ansi.org/news/standards-news/all-news/2013/04/standards-are-on-call-as-the-mobile-phone-rings-in-its-40th-anniversary-18> [<https://perma.cc/T8BJ-8KFX>] (describing role of ANSI standards in cell phone development).

3. See, e.g., *id.* at 113 (proffering estimate).

4. Joseph Farrell & Garth Saloner, *Coordination Through Committees and Markets*, 19 RAND J. ECON. 235, 235 (1988).

5. See AM. NAT’L STANDARDS INST., *ANNUAL REPORT: 2020–2021*, at 51, https://share.ansi.org/Shared%20Documents/News%20and%20Publications/Brochures/Annual%20Report%20Archive/ANSI_2020-2021_Annual_Report.pdf [<https://perma.cc/WDG2-RDNS>] (noting that ANSI alone represents the interest of more than 30 million professionals). The International Organization of Standardization (“ISO”) has promulgated more than twenty-four thousand standards. *ISO in Figures*, INT’L ORG. STANDARDIZATION, <https://www.iso.org/iso-in-figures.html> [<https://perma.cc/8K2D-7YAV>], (last updated Dec. 31, 2021) (reporting 24,121 promulgated standards as of December 31, 2021).

6. AM. NAT’L STANDARDS INST., *STANDARDS 101*, https://share.ansi.org/shared%20documents/Education%20and%20Training/Committee%20on%20Education/2014_USA_Science_Engineering_Festival/Standards%20101%20flyer.pdf [<https://perma.cc/EJX4-9ENR>]; see also *Standards*, INT’L ORG. FOR STANDARDIZATION, <https://www.iso.org/standards.html> [<https://perma.cc/Y7UJ-SVH3>] (defining “standards” as “the distilled wisdom” of subject matter experts and offering examples).

7. For example, the International Organization of Standardization has defined “eight common types of standards based on purpose.” BREITENBERG, *supra* note 1, at 5–6.

8. See Douglas J. Puffert, *The Standardization of Track Gauge on North American Railways, 1830–1890*, 60 J. ECON. HIST. 933, 950 (2000) (attributing industry coalescence around the 4’8.5” railroad gauge standard to patterns of traffic demand).

9. *Food Defect Levels Handbook*, U.S. FOOD & DRUG ADMIN., <https://www.fda.gov/food/ingredients-additives-gras-packaging-guidance-documents-regulatory-information/food-defect-levels-handbook> [<https://perma.cc/A8AY-JADR>], (last updated Sept. 7, 2018).

martini.¹⁰ Crucially, standards can also enable interoperability between multiple different products or between components of a final product. Consider, for example, the universal serial bus (“USB”) standard, the use of which the European Union has mandated in the charging ports of consumer electronics.¹¹

Today, many standards are set by standards consortia—groups of competitors who meet to agree on the best way of producing their industry’s product.¹² Such competitor-driven standardization is common in the wireless telecommunications industry, where, as discussed later in this Note, competing equipment vendors set and adhere to detailed specifications for how that equipment should operate and interoperate.¹³ This arrangement makes sense. After all, who knows more about wireless equipment than the experts that make it? The U.S. government certainly holds this sentiment, and it has shown favoritism toward such standard-setting.¹⁴

Regardless, this Note argues for more skepticism of this competitor-driven standard-setting. Market participants may be most knowledgeable about the technology underlying their products, but when conformance with standards is vital to competing in a marketplace, letting the incumbent, dominant companies set those standards will make the standardized products more expensive and less innovative.¹⁵ Companies with power want to maintain it. Standards are a tool for maintaining that power, particularly when they make the resulting products costly or difficult for the dominant firms’ rivals or

10. The dry martini standard is a well-known novelty joke among standard setters (and presumably ill known outside of the industry). See, e.g., Todd Carpenter, *American National Standard Safety Requirements for Dry Martinis ANSI K100.1-1974*, NAT’L INFO. STANDARDS ORG. (Apr. 2011), <http://www.niso.org/niso-io/2011/04/american-national-standard-safety-requirements-dry-martinis-ansi-k1001-1974> [<https://perma.cc/N6AS-DYHQ>] (describing the dry martini standard as if consistency in the “nomenclature, size, ingredients, proportions, [and] mixing methods” of dry martinis were critical to the public welfare—whether similar concerns arise for gin and tonics is not clear (quoting AM. NAT’L STANDARDS. INST., K100.1-1974 SAFETY CODE AND REQUIREMENTS FOR DRY MARTINIS (1974))).

11. European Parliament, Internal Market and Consumer Protection Press Release, Deal on Common Charger: Reducing Hassle for Consumers and Curbing e-Waste (July 6, 2022), <https://www.europarl.europa.eu/news/en/press-room/20220603IPR32196/deal-on-common-charger-reducing-hassle-for-consumers-and-curbing-e-waste> [<https://perma.cc/J95S-RYBE>]. The EU estimates that this rule will save consumers hundreds of millions of euros annually. *Id.*

12. See *infra* Part I.B.

13. See *infra* Part IV.

14. See *infra* Part II.

15. See *infra* Part II.

potential rivals to produce. Economists call the high expense or expertise necessary to meet these standards a barrier to entry.¹⁶ Throughout this Note, this Author will refer to the use of standardization to create, raise, or maintain artificial entry barriers as “barrier lock-in.”

This is not just a theoretical problem—evidence suggests that barrier lock-in accompanied the recent development of 5G network equipment standards.¹⁷ Almost all wireless networks globally operate under standards set by the Third Generation Partnership Project (“3GPP”), wherein numerous wireless companies develop technical specifications for how new equipment will operate and interoperate.¹⁸ As 5G development began, early buzz surrounded the arrival of an advanced new technology that would dramatically reduce the barriers to entering the 5G equipment market.¹⁹ However, 5G standardization was largely controlled by five dominant equipment vendors, and when 3GPP released its 5G standards, this new technology was largely absent.²⁰ Perhaps as a consequence, those five vendors have led early 5G equipment sales.²¹

This Note proffers two potential solutions to minimize barrier lock-in. Although courts may lack the institutional capacity to review the reasonableness of the standards themselves,²² renewed attention can and should be given to the structure of the marketplace and the procedures with which standards are adopted.

This Note proceeds as follows. Part I provides necessary background on the importance of standard-setting and on different standard-setting processes. This background information is important for understanding the tradeoffs between the pro and anticompetitive aspects of standard-setting. Part II of this Note reviews interactions between U.S. antitrust law and standard-setting bodies, including the imposition of Congress and the president. In Part III, the Note turns to the “barrier lock-in” theory. It defines barrier lock-in and situates the theory within existing U.S. antitrust law, showing its consistency with general antitrust principles. Part IV provides an example of potential

16. See, e.g., Daniel E. Lazaroff, *Entry Barriers and Contemporary Antitrust Litigation*, 7 U.C. DAVIS BUS. L.J. 1, 2–4 (2006) (proffering several influential definitions of entry barriers).

17. See *infra* Part IV.

18. See *infra* Part IV.

19. See *infra* Part IV.

20. See *infra* Part IV.

21. See *infra* Part IV.

22. See *infra* Part V.

barrier lock-in in one of the most vital standard-setting processes of the last decade: the creation of technical specifications for 5G networks. Finally, Part V concludes by proposing two courses of action that agencies and courts can take to recognize and respond to barrier lock-in.

I. STANDARDIZATION

At its core, a standard is a consensus. Markets devote an incredible amount of time, energy, and money to reaching these consensuses. This Part explores why. It first outlines the benefits of standardization, making the case for why standard-setting is so ubiquitous today. It next outlines the three main ways that standards are set.

A. *Why Do We Set Standards?*

Standardization is a major part of the modern economy. As noted above, almost all of the goods exchanged daily through international trade are touched by some standardization process.²³ A deliberate focus on developing standards traces back to the Industrial Revolution, when, as goods became more complex, agreed-upon designs or interfaces aided mass production and the development of more complex products and systems.²⁴

And standardization can have enormous benefits. Common standards make it easier for manufacturers to design like products and for customers to replace like items.²⁵ Standardization reduces undesirable deviations from an optimal design, which allows consumers to easily switch between different products produced by different manufacturers. Imagine a world without standardized plugs and sockets. Toasters, refrigerators, and any number of consumer electronics would need to be professionally installed, or perhaps designed with fifty plugs that fit many different types of sockets. This compatibility also has spillover effects. Standardization often decreases

23. See *supra* note 1 and accompanying text.

24. See YATES & MURPHY, *supra* note 2, at 19 (describing the rise of private standard-setting at the end of the nineteenth century); Manveen Singh, *Tracing the Evolution of Standards and Standard-Setting Organizations in the ICT Era*, 24 MARQ. INTELL. PROP. L. REV. 217, 219–22, (2020) (describing genesis of private standard-setting).

25. See David A. Balto, Speech Before Cutting Edge Antitrust Law Seminars International: Standard Setting in a Network Economy (Feb. 17, 2000), <https://www.ftc.gov/news-events/news/speeches/standard-setting-network-economy> [<https://perma.cc/E6FL-U6P8>] (describing the procompetitive benefits of standard setting).

the production costs of products, which in turn increases the number of firms that can compete in the market and, consequently, expands consumer choice.²⁶ New entrants, enticed by lower production costs, can also facilitate price competition, ultimately bringing products within the consumption bundle of more consumers.²⁷

Standardization is particularly valuable in network industries. Network industries, which include some of the most dynamic industries in the world (for example, mobile communications and the internet), are characterized by their large network effects.²⁸ Products with network effects increase in value to each user as more total people use them.²⁹ The classic example of a network product is the railroad. A railroad that runs between Atlanta and Nashville is valuable to passengers in those two cities. If the railroad adds a third stop in Birmingham, the railroad now becomes much more valuable for the citizens of Birmingham. But it *also* becomes more valuable to people in Atlanta and Nashville, who can now reach a new city.³⁰ Consequently, a railroad may need to reach some minimum number of stops before its total value exceeds its cost.

Of course, as the railroad expands, it necessarily becomes more complex and unwieldy to coordinate and operate. Standardization ensures all parts of the network work together.³¹ For example, a standardized width for railroad tracks permits one type of train to

26. See Herbert Hovenkamp, *Standards Ownership and Competition Policy*, 48 B.C. L. REV. 87, 90 (2007) [hereinafter Hovenkamp, *Standards Ownership*] (“Standards also can reduce consumer search costs, . . . significantly reduce the costs of input suppliers, make networking possible or at least much more efficient, or facilitate the achievement of scale economies.”).

27. See Balto, *supra* note 25 (listing increased price competition as a procompetitive benefit of standard setting).

28. Singh, *supra* note 24, at 218, 226; see Balto, *supra* note 25 (“Network industries are the central nervous system of the Twenty-First Century economy.”).

29. See Balto, *supra* note 25 (“The more consumers who are connected to the network, the more valuable the network becomes to each consumer.”); see also James J. Anton & Dennis A. Yao, *Standard-Setting Consortia, Antitrust, and High-Technology Industries*, 64 ANTITRUST L.J. 247, 249 (1995) (“In [network industries] the benefit an individual buyer derives from the product is greater when other buyers also use the product. In turn, this economy of scale . . . implies that benefits to society as a whole are greater when standardization allows for product compatibility among all users.”).

30. See Balto, *supra* note 25 (describing railroads as a network industry).

31. U.S. DEP’T OF JUST. & U.S. FED. TRADE COMM’N, *ANTITRUST ENFORCEMENT AND INTELLECTUAL PROPERTY RIGHTS: PROMOTING INNOVATION AND COMPETITION* 33 (2007) [hereinafter FTC/DOJ IP REPORT].

travel across many different routes.³² Similarly, the development of standardized time zones is often attributed to the need for a railroad to have consistent time schedules.³³

Standardization is also necessary for the existence of modern, more complex networks like the internet. Without standardization, the internet's seamless exchange of data among all of the computers in the world seems an impossible feat.³⁴ Specifically, in order for computers to "talk" to each other across space, they must share a common language. The internet uses the TCP/IP suite of protocols to standardize the format of communications so that the guts of the internet can properly route data requests no matter the device.³⁵ Additionally, to make the internet usable for laypeople, the internet uses standardized domain names (for example, www.jstor.org) as proxies for the numerically-identified locations of webpages.³⁶

B. *How Do We Set Standards?*

Historically, standards have been set in three different ways.³⁷ First, standards can be set by the market.³⁸ These are called de facto standards.³⁹ No one person, organization, or government sets these standards; they just become the default through wide public support.⁴⁰ In network industries like the railroad, de facto standardization is often

32. See *supra* note 8 and accompanying text.

33. See, e.g., *History of Time Zones*, U.S. DEP'T OF TRANSP., BUREAU OF TRANSP. STAT. (Feb. 21, 2021), <https://www.bts.gov/geospatial/time-zones> [<https://perma.cc/KZ6N-RMP5>] (noting that before time standardization, trains "on the same tracks often could not be coordinated, resulting in collisions[,] resulting in "[t]he major railroad companies . . . operat[ing] on a coordinated system of four time zones starting in 1883").

34. See YATES & MURPHY, *supra* note 2 (outlining the pivotal roles of the IETF and W3C with regard to the Internet).

35. See *TCP/IP Protocols*, IBM, <https://www.ibm.com/docs/en/aix/7.1?topic=protocol-tcpip-protocols> [<https://perma.cc/VZ98-M2GV>], (last updated Oct. 17, 2022) (describing the TCP/IP protocols).

36. See *What Is DNS?*, AMAZON WEB SERVS., <https://aws.amazon.com/route53/what-is-dns> [<https://perma.cc/HL2G-55EV>] ("DNS, or the Domain Name System, translates human readable domain names (for example, www.amazon.com) to machine readable IP addresses (for example, 192.0.2.44).").

37. See Mark A. Lemley, *Standardizing Government Standard-Setting Policy for Electronic Commerce*, 14 BERKELEY TECH. L.J. 745, 747 (1999) (recognizing de facto standardization, government mandate, and standard-setting organizations as the three "basic ways" to produce standards).

38. *Id.*

39. *Id.*

40. Singh, *supra* note 24, at 223.

inevitable.⁴¹ As more users begin using the product, the product will gain value until it eventually “tips” and becomes entrenched as the standard.⁴² The classic example of a de facto standard is the QWERTY keyboard (have you seen any other key configuration?).⁴³

Second, standards can be set by the government.⁴⁴ These are called de jure standards.⁴⁵ Many early standards were de jure.⁴⁶ For example, King Henry I set a standard unit of length equal to the length of his own forearm in England in 1120.⁴⁷ Much of the U.S. regulatory state is a series of de jure performance standards that determine what it means to be high in fiber,⁴⁸ the minimum number of people in a carpool,⁴⁹ or any number of other attributes of daily life.

Finally, standards can be set by private organizations.⁵⁰ This Note focuses on this type of standard-setting. In the grand scheme of standardization, private standard-setting is relatively new. Early private standard-setting arose alongside industrialization in the second

41. See Lemley, *supra* note 37 (“[I]f the economic incentives for standardization are strong enough, no one needs to ‘choose’ a standard at all: the market will ‘tip’ to favor one particular product (a new, de facto standard) at the expense of competing products.”).

42. *Id.*; see Christopher S. Gibson, *Globalization and the Technology Standards Game: Balancing Concerns of Protectionism and Intellectual Property in International Standards*, 22 BERKELEY TECH. L.J. 1403, 1417 (2007) (“[N]etwork industries . . . ‘have a tendency to tipping—that is, when a certain technology has reached a critical mass it tends to dominate the whole market.’ Firms owning different technologies may engage in fierce competition . . . to persuade a sufficiently large number of consumers to choose their product.” (quoting WORLD TRADE ORG., WORLD TRADE REPORT 2005—EXPLORING LINKS BETWEEN TRADE, STANDARDS AND THE WTO, at xxvi (2005))).

43. See, e.g., Singh, *supra* note 24, at 224; Jimmy Stamp, *Fact of Fiction? The Legend of the QWERTY Keyboard*, SMITHSONIAN MAG. (May 3, 2013), <https://www.smithsonianmag.com/arts-culture/fact-of-fiction-the-legend-of-the-qwerty-keyboard-49863249> [<https://perma.cc/N999-8PQK>] (“The fate of the keyboard was decided in 1893 when the five largest typewriter manufacturers . . . merged to form the Union Typewriter Company and agreed to adopt QWERTY as the *de facto* standard . . .”).

44. Lemley, *supra* note 37.

45. Singh, *supra* note 24, at 223.

46. See, e.g., BREITENBERG, *supra* note 1, at 3 (describing early standard-setting from Boston government and other leaders); YATES & MURPHY, *supra* note 2, at 4 (noting that early demands of the French Revolution and U.S. President George Washington called for de jure standardization of weights and measures).

47. BREITENBERG, *supra* note 1, at 3.

48. See 21 C.F.R. § 101.54(b), (d) (2021) (describing labeling standards for foods with a certain amount of fiber).

49. It’s two. 10 C.F.R. § 420.2 (2021).

50. Lemley, *supra* note 37.

half of the nineteenth century.⁵¹ These early standard-setters were generally diverse groups of experts in a particular industry coming together to overcome coordination problems.⁵² Proliferation of these traditional standard-setting bodies accelerated after the Second World War,⁵³ and they became staple parts of the economy.⁵⁴

Traditional standard-setting organizations are typified by a focus on broad stakeholder contribution and strict bureaucratic oversight.⁵⁵ The American National Standards Institute (“ANSI”) is one such group.⁵⁶ It furthers these goals by bringing together stakeholders from across the public and private sectors to develop standards in myriad industries.⁵⁷ For example, when ANSI recently produced standards for the operation of drones, it compiled feedback from the government, private manufacturers, lawyers, consultants, and potential customers.⁵⁸

In the last fifty years, a new type of private standard-setting group has emerged: the standards consortium.⁵⁹ Standards consortia are like traditional standard-setting organizations, with one important distinction: they lack broad stakeholder participation.⁶⁰ Instead of including and foregrounding customers and other industry participants, standards consortia are dominated by the manufacturers of the standardized products. The smaller and less diverse membership of standards consortia makes them nimbler—instead of waiting for a broad consensus from a diverse group of stakeholders, the major

51. See YATES & MURPHY, *supra* note 2, at 19 (“Nineteenth-century developments in engineering led to the first organized attempts at private standard setting within professional associations of engineers before the century’s end.”).

52. See *id.* (describing the collaboration of engineers, industrialists, and diplomats).

53. See *id.* at 127 (describing the post-World War II “peak of a new international network of [standard-setting] organizations, with national organizations feeding into it”).

54. See *id.* at 158 (“The formation of the International Organization for Standardization launched the second wave of institutional innovation in voluntary standard setting. From the 1960s through the 1980s . . . standardizers . . . shifted focus . . . to setting international standards that facilitated commerce more broadly.”).

55. See *id.* at 255 (contrasting standards consortia with the “time-consuming process of traditional multi-stakeholder standard setting”).

56. About ANSI, ANSI, <https://www.ansi.org/about/introduction> [<https://perma.cc/K69H-MUGQ>].

57. *Id.*

58. See generally ANSI, STANDARDIZATION ROADMAP FOR UNMANNED AIRCRAFT SYSTEMS, VERSION 2.0 (2020) (describing the findings of ANSI’s Unmanned Aircraft Systems Standardization Collaborative).

59. Singh, *supra* note 24, at 228.

60. See YATES & MURPHY, *supra* note 2, at 255 (defining a standards consortium).

vendors in an industry (whose interests are often aligned) can act unilaterally.⁶¹ Thus, these consortia are ubiquitous in rapidly innovating industries that would otherwise be stifled by the slow pace of traditional standard-setting organizations.⁶² Given the current lightning pace of technological progress, standards consortia have become almost necessary.

II. U.S. ANTITRUST SCRUTINY OF STANDARD-SETTING ORGANIZATIONS

Despite their importance in modern high-tech industries, standards consortia are particularly susceptible to anticompetitive action. After all, at their core, these consortia are just organizations of competitors that come together to set rules for how their industry operates.⁶³ That dynamic blurs the line between competition and collusion.⁶⁴ Indeed, while participants in early standard-setting organizations used high-minded rhetoric to describe the noble work of participating industry professionals,⁶⁵ one cannot ignore that most participants in modern standards consortia are *employees of active market participants*.⁶⁶ This Note does not suggest that these employees frequently place personal benefit over producing the best standards for the industry. However, to suggest that affiliation with a company does

61. See *id.* (contrasting standards consortia with the “time-consuming process” used by traditional standard-setting organizations).

62. See Singh, *supra* note 24, at 228 (attributing the rise of consortia to the slow pace of traditional organizations).

63. See ORG. FOR ECON. CO-OP. AND DEV., POLICY ROUNDTABLE: STANDARD SETTING 10 (2010), <https://www.oecd.org/daf/competition/47381304.pdf> [<https://perma.cc/5MZ6-X9SL>] (“At its heart, standard setting involves coordinated action between many interested parties in an industry, including potential competitors, the very conditions with which competition law is usually concerned. The potential for collusion in such a setting cannot be ignored.”).

64. As the Department of Justice and FTC report,

Firms that choose to work through an SSO to develop and adopt standards may be competitors within their particular industry. Thus, agreement among competitors about which standard is best suited for them replaces consumer choice and the competition that otherwise would have occurred in the market to make their product the consumer-chosen standard.

2007 FTC/DOJ IP REPORT, *supra* note 31, at 34.

65. See, e.g., YATES & MURPHY, *supra* note 2, at 90–93 (highlighting the high-minded rhetoric of early standard-setters).

66. See Farrell & Saloner, *supra* note 4, at 237 (“Often, by the time a [standard-setting] committee is convened, participants have vested interests in incompatible positions . . .”).

not affect the actions of participants is naïve.⁶⁷ Even Adam Smith, a father of modern economics, recognized that “[p]eople of the same trade seldom meet together, even for merriment and diversion, but the conversation ends in a conspiracy against the public, or in some contrivance to raise prices.”⁶⁸ Yet the U.S. government has openly endorsed private standard-setting and relaxed scrutiny of the anticompetitive potential of standards consortia. This Part reviews the U.S. courts’ and the legislature’s policies toward standard-setting bodies over time.

A. *Enforcement Under the Traditional Antitrust Laws Has Waned*

Given the vague nature of the antitrust laws, their scope is largely determined by the courts.⁶⁹ In the first decades of antitrust enforcement, courts implementing these laws quickly recognized the capacity of standard-setting organizations to restrain trade.⁷⁰ They assessed liability to standard-setting organizations for setting prices or output,⁷¹ facilitating more tacit collusion,⁷² and excluding competitors.⁷³

In recent years, however, antitrust enforcement has shifted away from concerns with multiparty price-fixing, facilitating practices, or exclusionary behavior by standard-setting bodies. Remarkably, the

67. *See, e.g.,* Am. Soc’y of Mech. Eng’rs, Inc. v. Hydrolevel Corp., 456 U.S. 556, 556 n.8 (1982) (quoting performance review of a company whose employee manipulated a standard setting body, which noted that “[a] major reason for the continued success [of the company] is a result of [the employee’s] efforts and skill in influencing the various code making bodies to ‘legislate’ in favor of [our] products”).

68. 1 ADAM SMITH, AN INQUIRY INTO THE NATURE AND CAUSES OF THE WEALTH OF NATIONS 177 (London, W. Heney 1812) (1776).

69. Sanjukta Paul, *Recovering the Moral Economy Foundations of the Sherman Act*, 131 YALE L.J. 175, 180 (2021) (“The widely held conventional wisdom is that the Sherman Act is the paradigmatic ‘common-law statute,’ entailing a delegation of lawmaking power by Congress to the courts that spans the field of antitrust.”).

70. *See infra* Part III.B.

71. *See, e.g.,* United States v. Trans-Mo. Freight Ass’n, 166 U.S. 290, 341–42 (1897) (invalidating a railroad rate-fixing agreement); John M. Connor, *Lysine: A Case Study in International Price-Fixing*, 13 CHOICES 13, 15 (1998) (highlighting the “lysine association,” a group of a few chemical companies that engaged in price-fixing and became embroiled in an FBI investigation and litigation).

72. *See* C-O-Two Fire Equip. Co. v. United States, 197 F.2d 489, 497 (9th Cir. 1952) (“Here, however, we have in addition to price uniformity, the other so-called plus factors hereinbefore treated. They include . . . an artificial standardization of product . . .”); Milk & Ice Cream Can Inst. v. Fed. Trade Comm’n, 152 F.2d 478, 482 (7th Cir. 1946) (finding petitioners’ artificial standardization of their product anticompetitive).

73. *See infra* Part III.B.1.

Antitrust Division and Federal Trade Commission's ("FTC's") 2000 Guidelines on antitrust liability for "collaborations among competitors" relegated concerns with standard-setting bodies to a two-sentence footnote.⁷⁴ One wonders how intently agencies feel the desire to police standard-setting outside of naked price-fixing. Where the agencies do scrutinize standard-setting bodies, they have shifted their focus toward the conduct of *individual* member firms—more particularly their manipulation of intellectual property rights.⁷⁵ And while private parties may themselves theoretically sue standard setters,⁷⁶ no recent district courts have found these claims viable.⁷⁷

74. See U.S. DEP'T OF JUSTICE & U.S. FED. TRADE COMM'N, ANTITRUST GUIDELINES FOR COLLABORATIONS AMONG COMPETITORS 2 n.5 (2000) (recognizing *no* consideration of the anticompetitive effects of standard-setting in guidelines about competitor collaborations).

75. See, e.g., Alexander Okuliar, Deputy Assistant Att'y Gen., Antitrust Div., U.S. Dep't of Just., Speech Before the Intellectual Property Rights Policy Advisory Group of the American National Standards Institute: Ensuring the Proper Application of Antitrust Law to Standards Development (May 28, 2020) (mentioning only IP concerns in speech purportedly about antitrust law and standards development more broadly); Transcript, U.S. Fed. Trade Comm'n, Tools To Prevent Patent "Hold-Up" 7 (June 21, 2011), https://www.ftc.gov/sites/default/files/documents/public_events/tools-prevent-patent-hold-ip-rights-standard-setting/transcript.pdf [<https://perma.cc/F5J6-LC22>] (briefly referencing collusive risk). Unfortunately, efforts to establish intellectual property-based theories of anticompetitive action recently faced a setback in the courts, and current or former high-ranking authorities at both the Antitrust Division and the FTC have expressed reservations about bringing these types of cases in the future. See, e.g., Rambus Inc. v. Infineon Techs. AG, 318 F.3d 1081, 1105 (Fed. Cir. 2003) (rejecting liability in patent hold-up case); Fed. Trade Comm'n v. Qualcomm Inc., 969 F.3d 974, 1005 (9th Cir. 2020) (refusing to address Qualcomm's potential liability under antitrust laws for renegeing on FRAND commitments); Maureen K. Ohlhausen, *The Elusive Role of Competition in the Standard-Setting Antitrust Debate*, 20 STAN. TECH. L. REV. 93, 93 (2017) (questioning the FTC's reliance on section 5 of the FTC Act to prosecute conduct that does not impede competition and is beyond the Sherman Act); Makan Delrahim, Assistant Att'y Gen., Antitrust Div., U.S. Dep't of Just., Remarks as Prepared for Delivery at USC Gould School of Law: Take It to the Limit: Respecting Innovation Incentives in the Application of Antitrust Law (Nov. 10, 2017), <https://www.justice.gov/opa/speech/assistant-attorney-general-makan-delrahim-delivers-remarks-usc-gould-school-laws-center> [<https://perma.cc/ENP6-3ZMD>] (positing that "Antitrust Law Should Not Police FRAND Commitments to SSOs").

76. See James H. Watz, *Section 7 of the Clayton Act: The Private Plaintiff's Remedies*, 7 B.C. L. REV. 333, 333 (1966) ("The right of a private party, who is injured in his business or property by reason of a violation of federal antitrust law, to sue for treble damages is as old as federal antitrust law itself.").

77. See, e.g., U.S. Bd. of Oral Implantology v. Am. Bd. of Dental Specialties, 390 F. Supp. 3d 892, 902–05 (N.D. Ill. 2019) (holding that conspiracy to restrain trade was not plausibly alleged and finding insufficient evidence of concerted action); *In re* Dynamic Random Access Memory Indirect Purchaser Litig., No. 4:18-CV-2518, 2020 WL 8459279, at *10 (N.D. Cal. Nov. 24, 2020) (recognizing that courts are "loathe" to find trade associations guilty of conspiracy); Conn. Ironworkers Emps.' Ass'n v. New Eng. Reg'l Council of Carpenters, 324 F. Supp. 3d 293, 305 (D. Conn. 2018) (refusing to find concerted action in trade association).

B. The Legislative and Executive Branches Have Restricted Enforcement

Meanwhile, Congress and the executive branch have openly endorsed private standard-setting bodies. In 1980, the Office of Management and Budget (“OMB”) issued guidance to agencies directing them to use voluntary private standards instead of developing their own.⁷⁸ OMB intended this guidance—widely known as Circular A-119—to reduce the cost to agencies of promulgating new regulations that incorporated standards.⁷⁹

When OMB revised Circular A-119 in 1982, commenters expressed concerns about such explicit promotion of private standard-setters, given their potential for anticompetitive action.⁸⁰ These commenters wanted the government to impose procedural requirements on private standard-setting bodies that must be met for the inclusion of their standards in regulation.⁸¹ OMB refused to impose these requirements, opting instead simply to provide a warning to agencies about these risks.⁸² Congress codified Circular A-119 into law with the National Technology Transfer and Advancement Act of 1995 (“NTTAA”).⁸³ Touting the procompetitive benefits of standard-setting organizations,⁸⁴ Congress passed the Standards Development Organization Advancement Act (“SDOAA”) nine years later, which

78. Federal Participation in the Development and Use of Voluntary Standards; Final Issuance, 45 Fed. Reg. 4326, 4326–27 (Jan. 21, 1980).

79. *See id.* at 4326 (“Federal use of voluntary standards, whenever practicable and appropriate, reduces the cost of developing and using standards and, thereby, serves the public interest.”).

80. Issuance of Circular No. A-119, “Federal Participation in the Development and Use of Voluntary Standards,” 47 Fed. Reg. 49496, 49496 (Nov. 1, 1982).

81. *Id.*

82. *Id.* The OMB later included this language directly into Circular A-119. *See* OMB Circular A-119; Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities, 63 Fed. Reg. 8546, 8555 (Feb. 19, 1998) (“Your agency should also recognize that use of standards, if improperly conducted, can suppress free and fair competition; impede innovation and technical progress; exclude safer or less expensive products; or otherwise adversely affect trade, commerce, health, or safety.”).

83. National Technology Transfer and Advancement Act of 1995, Pub. L. No. 104-113, 110 Stat. 775 (1996) (codified as amended in scattered sections of 15 U.S.C.); *see* H.R. Rep. No. 104-390, at 15 (1995) (noting that the Act “[c]odifies OMB Circular A-119 requiring federal agencies to adopt and use standards developed by voluntary consensus standards bodies and to work closely with those organizations to ensure that the developed standards are consistent with agency needs”).

84. Standards Development Organization Advancement Act of 2004, Pub. L. No. 108-237, § 102, 118 Stat. 661, 661.

went even further, enshrining a more deferential standard of review for antitrust scrutiny of standards development organizations.⁸⁵ All told, the long arc of twentieth century antitrust policy, both judicially and legislatively, has bent towards private standard-setting.

III. BARRIER LOCK-IN

The preceding Parts provide the case for standards consortia. This Part provides the case against them—or, at least, the case for greater skepticism. As standards become more important, they grant more power to whoever controls them.⁸⁶ Thus, ceding control over an industry's vital standards to the very vendors who produce and sell the industry's products opens the market to abuse. This Note's fear is that vendors will use this power to set the standards that are best for them, instead of the standards that are best for the market as a whole.

At an extreme, whoever controls the standards could simply withhold them from other potential competitors. For example, interoperability standards define the way that different components of some products interact with each other.⁸⁷ By refusing to share with rivals these crucial interfaces, dominant component manufacturers can effectively eliminate them from the market.⁸⁸ As this Part discusses later, U.S. courts have recognized antitrust liability for standard-setters that have excluded competitors in this way and similar ways.

This Note points to a different type of exclusionary standard-setting conduct. Instead of baldly excluding competitors from the standard-setting process, dominant companies in standards consortia could simply exert control over the content of the standard, making it

85. *Id.* § 104 (codified at 15 U.S.C. § 4302). That new standard was the rule of reason. *Id.* This standard is more deferential than the *per se illegality* rule. *See* Jefferson Par. Hosp. Dist. No. 2 v. Hyde, 466 U.S. 2, 34–35 (1984) (O'Connor, J., concurring) (contrasting existing *per se illegality* rule for tying arrangements with a rule of reason less likely to find illegality). Thankfully, Congress did not expand relaxed scrutiny to all companies involved in standard-setting. *See id.* § 108(1) (limiting standard of review only for organizations). Congress also specifically excluded exchanges, price, cost, and other information, market division, or price-fixing from the relaxed standard of review. *See id.* § 103(2) (codified at 15 U.S.C. § 4301) (excluding these activities from the definition of “standards development activity”).

86. *See* Balto, *supra* note 25 (“Network industries are the central nervous system of the Twenty-First Century economy.”).

87. *Id.* (“Network products such as modems and cellular phones are heavily dependent on interoperability standards. Interoperability standards also play a critical role in overcoming the concerns of stranding and the expectations of those which produce complementary products.”).

88. *See id.* (“The firm or group could restrict the standard setting process restricted to a subgroup of less than all competitors, and this would usually lead to restricted access to the completed standard.”).

more difficult or expensive for new competitors to comply with. By creating technical standards that require larger capital outlays or more specialized knowledge, dominant incumbent firms can raise costs for potential new entrants, shutting them out from the market. Similarly (as Part IV of this Note describes in detail), a standards consortium could refuse to explore new technological innovations that could lower overall costs and encourage entry. By maintaining standards that discourage the rise of new firms, the dominant firms in a standards consortium can maintain their existing market power, which can lead to artificially inflated prices and diminished innovation. This Note coins the term “barrier lock-in” to refer to this conduct.

While it may sound conspiratorial, the notion that participants in a standards consortium can band together to steer the standardization process is not a fringe idea. Herbert Hovenkamp, one of the leading voices in modern antitrust law, has recognized the susceptibility of private standard-setting groups to “capture” by dominant companies.⁸⁹ Recently, an Assistant Attorney General at the Antitrust Division of the U.S. Department of Justice (“DOJ”) acknowledged that vendors in a standard-setting organization “can shut down a potential new technology in favor of the status quo, all to the detriment of consumers.”⁹⁰

Ceding such enormous power to incumbent, dominant firms is dangerous and is likely to harm consumers and other potential market participants. Despite these possible consequences, federal courts have not even *considered* imposing liability on a standard-setting organization for these actions.⁹¹ This Part provides courts with a

89. See 2 HERBERT HOVENKAMP, MARK D. JANIS, MARK A. LEMLEY & CHRISTOPHER R. LESLIE, *IP AND ANTITRUST: AN ANALYSIS OF ANTITRUST PRINCIPLES APPLIED TO INTELLECTUAL PROPERTY LAW* § 35.02[D][3], at 35-17 (3d ed. 2020) (“Private [standards development] groups are not immune from capture, particularly where the standard to be set excludes rather than includes competitors.”); see also *Regulatory Capture*, BLACK’S LAW DICTIONARY (11th ed. 2019) (“The process by which a regulatory agency created to protect public interests becomes dominated by the industry it was created to regulate and comes to favor the industry rather than serving as a watchdog for the public interest.”).

90. Delrahim, *supra* note 75, at 10.

91. A targeted search for reported federal antitrust cases involving standard-setting bodies and the creation, maintenance, or raising of artificial barriers to entry returned thirty-three cases, none of which concerned barrier lock-in. Some focused on fraudulent behavior in setting standards. See, e.g., *Fed. Trade Comm’n v. Qualcomm Inc.*, 969 F.3d 974, 982 (9th Cir. 2020) (examining anticompetitive versus hypercompetitive behavior). Others were individual tying cases. See, e.g., *In re Wireless Tel. Servs. Antitrust Litig.*, 385 F. Supp. 2d 403, 405 (S.D.N.Y. 2005) (determining whether “the five largest carriers of wireless telephone services in the U.S.” were

blueprint for considering theories of barrier lock-in. It proceeds as follows. First, it describes both the incentive for and ability of standards consortia to raise entry barriers through the standardization process. This “incentive and ability” framework is common in other parts of antitrust law, particularly in vertical mergers.⁹² Second, this Part reviews U.S. case law, pointing to precedents on which barrier lock-in theories rest. Namely, while U.S. courts have never directly imposed liability under a barrier lock-in theory, courts have proscribed both (i) exclusionary conduct by standard-setters and (ii) artificial raising of entry barriers. The intersection of these two types of conduct should also invite scrutiny.

A. In Markets With Network Effects, Standards Consortia Have the Incentive and the Ability to Select Standards with High Entry Barriers

The “incentive and ability” framework provides a useful proxy for potential anticompetitive action. Because it behooves standards consortia to raise entry barriers, and because they *can* raise them, it is likely that they will do so.

1. *Consortia Have the Incentive To Set the Standards That Are Best for Its Members.* A firm has the incentive to take an action when that action is profitable. For example, a firm has the incentive to raise prices when the increased revenue from higher prices exceeds the decreased revenue from lost sales. In the case of standard-setting, dominant incumbent firms have the incentive to raise entry barriers when the benefits accrued by maintaining market power outweigh the potential downsides of setting exclusionary standards.

An entry barrier is any factor that deters new companies from entering the market.⁹³ High entry barriers are often bad for consumers, because they insulate incumbent firms from competition that would

part of “an unlawful tying arrangement”). Some cases simply did not involve standard setting. *See, e.g., Phoenix Elec. Co. v. Nat’l Elec. Contractors Ass’n, Inc.*, 867 F. Supp. 925, 928 (D. Or. 1994) (deciding claims under Sections 1 and 2 of the Sherman Act).

92. *See* U.S. DEP’T OF JUST. & U.S. FED. TRADE COMM’N, VERTICAL MERGER GUIDELINES 2 (2020), https://www.ftc.gov/system/files/documents/reports/us-department-justice-federal-trade-commission-vertical-merger-guidelines/vertical_merger_guidelines_6-30-20.pdf [https://perma.cc/RNQ9-JUTX] (“Therefore, the Agencies focus on competitive outcomes caused by conduct that would be compatible with firms’ abilities and incentives following a vertical merger, but would not be in the absence of the merger.”).

93. *See* Lazaroff, *supra* note 16, at 2 (defining “entry barriers”).

lower prices and spur innovation.⁹⁴ Potential entry is often seen as a check against collusive action⁹⁵ or monopolistic pricing.⁹⁶ Antitrust regulators frequently look at entry barriers to judge the extent of market power that incumbent firms hold.⁹⁷

Entry barriers are, therefore, incredibly desirable for dominant incumbent firms.⁹⁸ Most saliently, they preserve incumbent firms' market power, insulating them from competition that might force them to lower their prices or devote research and development costs toward improving their product.⁹⁹ Moreover, when fewer companies compete in the market, a greater share is available to each firm. And shutting new, smaller companies out of the marketplace reduces the likelihood of disruptive entry. Thus, in a choice between two standards, indistinguishable outside of their entry barriers, a company would prefer the standard with the higher barriers to entry.

Entry barriers are particularly relevant in network industries. As discussed above, network industries tend toward a smaller number of sellers, because economies of scale dictate increased value as those sellers expand.¹⁰⁰ For example, social media companies recognize that, because social media apps become more valuable to users as more

94. See, e.g., U.S. DEP'T OF JUST. & U.S. FED. TRADE COMM'N, ANTITRUST GUIDELINES FOR COLLABORATIONS AMONG COMPETITORS § 3.35, at 21–23 (2000) (“Easy entry may deter or prevent profitably maintaining price above, or output, quality, service or innovation below, what likely would prevail in the absence of the relevant agreement.”).

95. See L. Rune Stenbacka, *Collusion in Dynamic Oligopolies in the Presence of Entry Threats*, 39 J. INDUS. ECON. 147, 147 (1990) (describing the impact of potential entry on collusion).

96. Courts have ruled against merger challenges based on the potential for actual or threatened entry. Gregory J. Werden, *Network Effects and Conditions of Entry: Lessons from the Microsoft Case*, 69 ANTITRUST L.J. 87, 87 n.2 (2001) (citing, among other cases, *United States v. Baker Hughes Inc.*, 908 F.2d 981, 987–89 (D.C. Cir. 1990); *United States v. Waste Mgmt., Inc.*, 743 F.2d 976, 981–84 (2d. Cir. 1984)).

97. See U.S. DEP'T OF JUST. & U.S. FED. TRADE COMM'N, HORIZONTAL MERGER GUIDELINES 27–28 (2010) [hereinafter HORIZONTAL MERGER GUIDELINES], <https://www.justice.gov/sites/default/files/atr/legacy/2010/08/19/hmg-2010.pdf> [<https://perma.cc/7S7E-5FFN>] (discussing role of entry in horizontal merger review).

98. See Hovenkamp, *Standards Ownership*, *supra* note 26, at 96 (recognizing that firms must exclude entry to charge supracompetitive prices); *Allied Tube & Conduit Corp. v. Indian Head, Inc.*, 486 U.S. 492, 500 (1988) (“There is no doubt that the members of [private standard-setting] associations often have economic incentives to restrain competition and that the product standards set by such associations have a serious potential for anticompetitive harm.”).

99. See generally Philippe Aghion, Stefan Bechtold, Lea Cassar & Holger Herz, *The Causal Effects of Competition on Innovation: Experimental Evidence* (Nat'l Bureau of Econ. Rsch., Working Paper No. 19987, 2014), <https://www.nber.org/papers/w19987> [<https://perma.cc/C95X-YAZ9>] (quantifying the positive effect of competition on innovation).

100. See *supra* notes 28–31 and accompanying text.

people join them, the market will only support a limited number of apps.¹⁰¹ So, as a new app pulls users away from incumbents, those incumbents' apps lose significant value, like MySpace did as other social media platforms became more popular.¹⁰² This dynamic increases the stakes of potential entry. As an incumbent company begins to lose market share, it is easier for it to ultimately be pushed from the market entirely, as was the case in the fight between VHS and Betamax.¹⁰³

Taking as true firms' incentives to raise entry barriers, the question remains: are firms incentivized to raise entry barriers through *standardization*? Standards are certainly a straightforward way of setting entry barriers. Standardization is one of few places where U.S. antitrust laws permit direct coordination between multiple different market participants, who otherwise may not agree on the particulars of how they compete.¹⁰⁴ However, using standards to raise entry barriers may be disadvantageous if those standards are subpar and push consumers away from the standardized product. Below, this Note walks through several disciplining factors that could theoretically constrain dominant consortia from effecting barrier lock-in, showing that those factors are rarely present.

One factor is ease of entry for new competing consortia. As entry becomes easier, the dominant consortium cannot set whatever standards it pleases; if it does so, and the dominant consortium's standard is undesirable to consumers, a new standard-setting group will arise and attract consumers to its standard. However, developing a new consortium is not easy, and therefore, such entry is unlikely.¹⁰⁵

101. See, e.g., Complaint at 22, Fed. Trade Comm'n v. Facebook, Inc., 581 F. Supp. 3d 34 (D.D.C. 2021) (No. 1:20-cv-03590) (quoting Mark Zuckerberg recognizing that the market will only support a "finite" number of social media apps).

102. See Esteban Ortiz-Ospina, *The Rise of Social Media*, OUR WORLD IN DATA (Sept. 18, 2019), <https://ourworldindata.org/rise-of-social-media> [<https://perma.cc/MC9X-Y3GW>] (documenting the decline in MySpace's market share as other social networks became popular).

103. See Brad Kelechava, *VHS vs Betamax: Standard Format War*, ANSI (May 5, 2016), <https://blog.ansi.org/2016/05/vhs-vs-betamax-standard-format-war> [<https://perma.cc/2SNA-FF8U>] (documenting the VHS-Betamax struggle for supremacy, VHS's ultimate victory, and the role of network effects).

104. See Sherman Antitrust Act of 1890, 15 U.S.C. § 1 ("Every contract, combination in the form of trust or otherwise, or conspiracy, in restraint of trade or commerce among the several States, or with foreign nations, is declared to be illegal.").

105. The consortium needs bylaws and procedures. It likely needs a broad base of common specifications off of which to work. More importantly, it needs companies to come and staff it. To be adopted as the industry-wide standard, the consortium must show that a sufficient number of

Moreover, once a set of standards becomes a default throughout the marketplace, the costs of switching standards increase. Not only must consumers face the monetary costs of switching, but they must devote time and energy to learning the new standard (or, in the case of standardized component parts, ensuring that the new standard interoperates with all other component parts).¹⁰⁶ Consider, for example, how long it would take to relearn to type on a non-QWERTY keyboard. Thus, once a consortium sets a standard, it is often durable.¹⁰⁷ Indeed, courts have recognized that a dominant standard in a network industry is often displaced only by a change in technology.¹⁰⁸

Another factor is the close substitutability of other products. If a standardized product has close substitutes and the dominant firms in a standards consortium set suboptimal standards, consumers can just switch to the substitute product. For example, terrible standards in the cellphone industry could technically shift consumers toward the postal service or toward their landlines. Of course, the willingness of cellphone users to switch to the postal service is likely low. By definition, close substitutability is unlikely in network industries due to the structure of markets with network effects—these markets tend towards monopolization.¹⁰⁹

Altogether, whether a standards consortium holds the incentive to use its power over the market to artificially inflate entry barriers will

vendors will produce standards-compliant equipment to meet the full scope of demand. But established companies are unlikely to join this nascent standard-setting group; they already have power through the incumbent consortium. It is unlikely that small firms, acting alone, can credibly commit to meeting such massive market-wide demand.

106. See Balto, *supra* note 25 (describing several ways that standard setting impacts network industries).

107. See David A. Heiner, *Five Suggestions for Promoting Competition Through Standards*, 7 COMPETITION L. INT'L 20, 22 (2011) (“[S]tandards that are widely adopted – and thus provide the benefits of broad interoperability – may tend to become ‘locked in’ over time.”); see also Hovenkamp, *Standards Ownership*, *supra* note 26, at 88 (recognizing that standards are “path dependent,” such that existing choices in standards constrain later choice sets).

108. See *United States v. Microsoft Corp.*, 253 F.3d 34, 49–50 (D.C. Cir. 2001) (describing “Schumpeterian,” meaning sequential over time, competition in network industries); accord *New York v. Deutsche Telekom AG*, 439 F. Supp. 3d 179, 241–42 (S.D.N.Y. 2020) (applying the *Microsoft* court’s holding that firms “compete through innovation for temporary market dominance” in analysis of the wireless telecommunications market).

109. See Carl Shapiro, Deputy Assistant Att’y Gen., Antitrust Div., U.S. Dep’t of Just., Address Before the American Law Institute and American Bar Association: Antitrust in Network Industries 1, 6 (Jan. 25, 1996), <https://www.justice.gov/atr/public/speeches/0593.pdf> [<https://perma.cc/DX2Y-JCSM>] (noting that “networks tend to exhibit *positive feedback*,” such that “monopolization may be accomplished swiftly”).

depend in some part on that market's structure. Nevertheless, as described above, disappointingly few factors discipline standards consortia against such exclusionary conduct, and even where those factors are present, they may not outweigh the benefits of exclusion.

2. Consortia Have the Ability To Set the Standards That Are Best for Their Members. Dominant firms' ability to raise entry barriers through standardization largely depends on the ability of other actors—including customers, competitors, or the market as a whole—to discipline such exclusionary conduct. This Subpart walks through each of these potential disciplining forces. While each of these forces *could* apply, for the below-stated reasons, they often will not.

First, customers could constrain dominant firms' ability to effect barrier lock-in. In traditional standard-setting organizations, customers are often active in the standard-setting process, which allows them to impress their will on the group directly. Of course, standards consortia have removed this check.¹¹⁰ Customers could alternatively refuse to comply with a standard designed to increase entry barriers. To have any meaningful impact, however, an appreciable share of customers must act together in boycotting these standards. This concerted action is unlikely, given collective action problems faced by a diffuse customer base.¹¹¹ Moreover, *some* standardization is necessary for the continued existence of many network products and systems.¹¹² And when an industry has already cohered to one set of standards, switching is incredibly difficult. This entrenches the dominant firms.

Second, competitors could constrain the dominant firms' ability to effect barrier lock-in. The consortium itself can have internal rules that force participating companies to choose the best standards.¹¹³ Unfortunately, standards consortia have largely rejected these kinds of safeguards—like broad stakeholder participation—in favor of speed.¹¹⁴

110. See *supra* notes 59–62 and accompanying text (discussing the lack of stakeholder participation in standards consortia and the resulting ability for major vendors to act unilaterally).

111. See generally Philippe Delacote, *On the Sources of Consumer Boycotts Ineffectiveness*, 18 J. ENV'T & DEV. 306 (2009) (discussing several reasons why consumer boycotts fail, including collective action and coordination problems).

112. See Balto, *supra* note 25 (“[C]ompatibility standards are crucial for industries subject to network economics.”).

113. See *infra* Part V.B (discussing DOJ's proposed changes to GSMA's procedures).

114. See YATES & MURPHY, *supra* note 2, at 255–56 (describing inefficiencies in multi-stakeholder standard setting processes as one factor that drove the rise of standards consortia).

Even where there is strong stakeholder participation, the expertise gap between vendors and customers in highly technical areas ensures that vendors still have significant control.¹¹⁵

Third, the market could constrain the power of dominant firms if those firms' standards compete with some other set of standards. In markets with multiple standards consortia, all consortia will develop their own set of standards, they will produce products compliant with those standards; they will send those products to the market; and customers will pick the standard they like best.¹¹⁶ This is what used to happen in cellular network equipment. There were two 4G standards: the 3GPP-developed LTE standard and the Institute-of-Electrical-and-Electronics-Engineers-developed WiMAX standard.¹¹⁷ Both consortia attracted vendors who produced equipment fitting that standard.¹¹⁸ Telefonaktiebolaget LM Ericsson ("Ericsson"), for example, produced LTE equipment,¹¹⁹ while Motorola produced WiMAX equipment.¹²⁰ Operators (the customers in this market) overwhelmingly preferred LTE equipment, and LTE became the standard.¹²¹ But, as noted in Part III.A.1 above, multiple consortia are often costly, not to mention duplicative, and thus rare.

To summarize, dominant firms have every incentive to raise entry barriers to preserve market power. And the modern standards consortium provides these firms with a tool to do so. The structure of these consortia—which eliminates potential checks from customers and competitors—facilitates barrier lock-in by granting dominant companies *carte blanche* over the resultant standards. Given the incentive and ability to lock out competitors through the contents of standards, the question of dominant firms using this power becomes

115. A perfect example is the 3GPP 5G standardization, discussed *infra* in Part IV.

116. See Balto, *supra* note 25 (noting benefits of competing standard setting bodies over single standard-setters).

117. Zakhia Abichar, J. Morris Chang & Chau-Yun Hsu, *WiMAX vs. LTE: Who Will Lead the Broadband Mobile Internet?*, IT PRO., May–June 2010, at 26, 26.

118. *Id.* at 26–27.

119. *Id.* at 27.

120. See *Motorola WiMAX Products*, WiMAX INDUS., <http://www.wimax-industry.com/sp/htn/htnmt01.htm> [<https://perma.cc/TC6F-Y38L>] (displaying Motorola WiMAX products).

121. See Craig Mathias, *WiMAX Is Dead*, NETWORK WORLD (Aug. 9, 2011), <https://www.networkworld.com/article/2220370/wimax-is-dead.html> [<https://perma.cc/42ZS-H4GQ>] (describing Clearwire's decision to use LTE over WiMAX as further evidence of WiMAX's impending demise and, conversely, LTE's dominance).

when, not if. The resultant standards will benefit dominant firms, but likely to the detriment of consumers.¹²²

B. Courts Have Recognized Component Parts of Barrier Lock-in

This Note argues that antitrust liability under a theory of barrier lock-in finds analogy in two already-existing components of antitrust law. First, barrier lock-in recognizes that companies act anticompetitively by using standard-setting bodies to intentionally exclude competitors, which courts have long proscribed under the Sherman and FTC Acts. Second, barrier lock-in presumes that setting a standard with a high entry barrier is an anticompetitive action. This Subpart explores federal case law to support both propositions.

1. *Courts Recognize the Exclusionary Power of Standard-setting Organizations.* The Supreme Court has recognized liability when standard-setting bodies exclude competitors. While many early cases against standard-setting bodies focused on their facilitation of price-fixing,¹²³ recent antitrust scrutiny has not been so limited in scope. Indeed, the Supreme Court has consistently recognized that when a standard-setting organization wields power over a market, dominant firms therein can use it as a tool for excluding competitors.¹²⁴

One way that standard-setting bodies can exclude competitors is by refusing to include their products in the standard. For example, in *Radiant Burners v. Peoples Gas Light & Coke*,¹²⁵ the Supreme Court held that the refusal of the American Gas Association—a trade organization that set “voluntary” safety standards for gas burners¹²⁶—to certify the safety of Radiant Burner’s gas burner constituted illegal exclusion of a competitor.¹²⁷ In holding for *Radiant Burners*, the Court made two key observations. First, the Court emphasized the power of the Association in setting standards for the market; indeed, the

122. See *supra* notes 91–101 and accompanying text.

123. See CAROL CHAPMAN RAWIE, A GUIDE TO PAPERS CITING ANTITRUST CASES INVOLVING STANDARDS OR CERTIFICATION 6–9 (U.S. Dep’t of Com., Office of Eng’g Standards ed., 1979) (compiling early antitrust cases and noting that many early cases dealt with price-fixing).

124. See *infra* notes 125–139 and accompanying text.

125. *Radiant Burners, Inc. v. Peoples Gas Light & Coke Co.*, 364 U.S. 656 (1961).

126. Brief for Petitioner at 5, *Radiant Burners*, 364 U.S. 656 (No. 73), 1960 WL 99154, at *5.

127. *Radiant Burners*, 364 U.S. at 659–60.

Association called these standards “requirements.”¹²⁸ Second, the Court recognized that Radiant Burners’ product was safer, more efficient, and just as durable as other certified burners on the market.¹²⁹ That is to say, this burner was a viable competitor to existing gas burner companies and posed a threat to members of the governing body of the Association.

Similarly, in *American Society of Mechanical Engineers, Inc. v. Hydrolevel Corp.*,¹³⁰ the Court upheld antitrust liability for a different standard-setting body.¹³¹ It found that the chairman of a subcommittee that oversaw low water fuel cutoff standards—himself an employee of a manufacturer of low water fuel cutoffs—issued a guidance letter explicitly designed to exclude a potential new competitor. The Court ruled that perceived compliance with these safety standards was imperative to competing in the marketplace, so this action effectively barred the Hydrolevel from the market.¹³² Just six years later, the Court again considered bad-faith manipulation of the standard-setting process, this time in *Allied Tube & Conduit Corp. v. Indian Head, Inc.*¹³³ The standard-setting body involved in this controversy was the National Fire Protection Association, which set voluntary standards on fire protection, including on the conduits that carry electrical wires.¹³⁴ These conduits were historically made of steel, but Allied Tube began offering cheaper and more flexible PVC conduits instead, and Allied Tube petitioned for the inclusion of these materials in the National Fire Protection Association’s standards.¹³⁵ Unfortunately for Allied Tube, the proposal failed.¹³⁶ However, the Court found concerted action by steel conduit manufacturers, who bribed other members to vote against the proposal.¹³⁷

In these three cases, the Supreme Court established a template for analyzing exclusionary conduct in standard-setting organizations. The Court expressed consistent concern for the power that standard-setting

128. Brief for Petitioner at 5, *Radiant Burners*, 364 U.S. 656 (No. 73).

129. *Radiant Burners*, 364 U.S. at 658.

130. *Am. Soc’y of Mech. Engineers, Inc. v. Hydrolevel Corp.*, 456 U.S. 556 (1982).

131. *Id.* at 558–59.

132. *Id.* at 560–62.

133. *Allied Tube & Conduit Corp. v. Indian Head, Inc.*, 486 U.S. 492, 497 (1988).

134. *Id.* at 495–96.

135. *Id.* at 496.

136. *Id.* at 496–97.

137. *Id.*

organizations hold in some marketplaces.¹³⁸ While these concerns were salient in the 1980s, they are all the more so now, as network industries expand and the government increasingly adopts private standards in regulations. Additionally, while the Court considered, at least in part, the technical merits of each standard-setting body's decision, it did not dive into great depth, focusing instead on extrinsic evidence showing that the organization was not deciding each standard on its merits.¹³⁹ Regardless, these decisions show that the Supreme Court has long recognized the potential for market participants to use their positions in standard-setting organizations to exclude competitors.

2. *Courts Recognize That Raising Entry Barriers Can Be Anti-Competitive.* The Supreme Court has similarly recognized that the imposition and maintenance of high entry barriers can be anticompetitive. In a 1911 case against a cartel of tobacco companies,¹⁴⁰ the Court condemned the cartel's actions as anticompetitive because they “serv[ed] as perpetual barriers to the entry of others into the tobacco trade.”¹⁴¹ Note here that the Court ascribed these entry barriers to the deliberate actions of the defendants.¹⁴²

Raising artificial entry barriers, by this telling, is illegal. Even Robert Bork, famously dismissive of the competitive impact of entry barriers, embraced antitrust liability for artificially created barriers to entry.¹⁴³ So has the Second Circuit. In *North American Soccer League, LLC v. United States Soccer Federation*,¹⁴⁴ the Second Circuit recently noted that antitrust liability requires demonstrating that the challenged behavior can have “an adverse effect on competition.”¹⁴⁵ The court then acknowledged that evidence of market power, combined with

138. See, e.g., *Am. Soc’y of Mech. Engineers, Inc. v. Hydrolevel Corp.*, 456 U.S. 556, 570 (1982) (noting that “ASME wields great power in the Nation’s economy”).

139. Indeed, in *Allied Tube*, the Court recognized record evidence that PVC pipe may actually have safety concerns. See *Allied Tube*, 486 U.S. at 496 (“In 1980, however, there was also a scientific basis for concern that, during fires in high-rise buildings, polyvinyl chloride conduit might burn and emit toxic fumes.”).

140. *United States v. Am. Tobacco Co.*, 221 U.S. 106, 143–49 (1911).

141. *Id.* at 183 (emphasis added).

142. Lazaroff, *supra* note 16, at 7.

143. See ROBERT H. BORK, *THE ANTITRUST PARADOX: A POLICY AT WAR WITH ITSELF* 311 (1978) (suggesting that antitrust law should act against “artificial” barriers to entry).

144. *N. Am. Soccer League, LLC v. U.S. Soccer Fed’n, Inc.*, 883 F.3d 32 (2d Cir. 2018).

145. *Id.* at 42.

evidence of conduct that raises entry barriers, is sufficient to meet these thresholds.¹⁴⁶

Other areas of antitrust law are also deeply mistrustful of the artificial imposition of entry barriers. Prohibitively high barriers to entry can enhance the competitive concerns of a merger.¹⁴⁷ One line of merger cases even moves beyond concerns with static entry barriers, challenging mergers on the grounds that they *raise* entry barriers.¹⁴⁸ The raising of entry barriers is also one of the recognized anticompetitive effects of tying practices.¹⁴⁹

In sum, it is no great leap for courts to recognize barrier lock-in as a violation of the antitrust laws. Modern consortia are excluding competitors, which the *Radiant Burners*, *Hydrolevel*, and *Allied Tube* courts openly recognized as violations. They do so by raising entry barriers, which courts have recognized as anticompetitive conduct proscribed by the Sherman and Clayton Acts. Notably, the Antitrust Division expressed concern about very similar conduct in 2019.¹⁵⁰ Regulators like the DOJ should expand their recognition of the harms of barrier lock-in, and courts should be amenable to the theory when assessing liability.

IV. BARRIER LOCK-IN IN PRACTICE: STANDARD-SETTING IN THE 5G RADIO ACCESS NETWORK EQUIPMENT MARKET

From outside a standard-setting body, proving barrier lock-in seems tricky. After all, it is incredibly difficult for a layperson to separate legitimate reasons for choosing a standard from illegitimate

146. *Id.*

147. See HORIZONTAL MERGER GUIDELINES, *supra* note 97, at 28 (“A merger is not likely to enhance market power if entry into the market is so easy that the merged firm and its remaining rivals . . . could not profitably raise price or otherwise reduce competition . . .”).

148. See, e.g., Fed. Trade Comm’n v. Procter & Gamble Co., 386 U.S. 568, 578 (1967) (“[T]he substitution of the powerful acquiring firm for the smaller, but already dominant, firm may substantially reduce the competitive structure of the industry by raising entry barriers and by dissuading the smaller firms from aggressively competing . . .”); Gen. Foods Corp. v. Fed. Trade Comm’n, 386 F.2d 936, 945 (3d Cir. 1967) (holding that the FTC could reasonably find that merger substantially heightened “factual and psychological barriers to entry”).

149. See, e.g., Jefferson Par. Hosp. Dist. No. 2 v. Hyde, 466 U.S. 2, 14 (1984) (“This impairment could . . . harm existing competitors or create barriers to entry of new competitors in the market for the tied product . . .”).

150. See Letter from Makan Delrahim, Assistant Att’y Gen., U.S. Dep’t of Just., Antitrust Div., to Timothy Cornell, Clifford Chance US LLP 1 (Nov. 27, 2019) [hereinafter GSMA Letter], <https://www.justice.gov/atr/page/file/1221321/download> [<https://perma.cc/K83K-FL67>] (describing “significant concerns” by the Department of Justice that GSMA allowed a “single interest group to exercise undue influence in the standard-setting process”).

ones. Luckily, the discovery mechanisms, adversity, and intense fact-finding of the U.S. legal system can help unveil the true meaning behind these actions. Still, even publicly available information can reveal troubling trends in standard-setting that suggest barrier lock-in. This Part explores public information in the development of 5G standards for radio access network (“RAN”) equipment and the sidelining of open standards that would have facilitated entry. It begins by providing background on cellular network equipment and the role of standardization therein, before turning to the recent 5G RAN standardization process. It concludes by detailing the outsized influence of major RAN vendors in the standardization process and highlighting the potential anticompetitive impacts of that power.

A. *What Is Radio Access Network Equipment?*

At the time of this writing, as they do every decade or so,¹⁵¹ mobile network operators like AT&T and T-Mobile are deploying the next generation of mobile wireless networks (“5G”).¹⁵² These networks are incredibly complicated, comprising hundreds of thousands of pieces of incredibly sophisticated equipment.¹⁵³ Mobile operators do not manufacture this equipment themselves. Instead, they purchase it from

151. See QUALCOMM, WHAT’S IN THE FUTURE OF 5G? 10 (2019) (describing cellular generations that occur about every ten years).

152. Global 5G coverage hit 17 percent in 2020. GSMA, THE STATE OF MOBILE INTERNET CONNECTIVITY 2021, at 8, <https://www.gsma.com/tr/wp-content/uploads/2021/09/The-State-of-Mobile-Internet-Connectivity-Report-2021.pdf> [<https://perma.cc/7QG4-YWR3>]. To date, 5G rollout largely concentrates in North America (76 percent coverage, as opposed to the less than 30 percent in all other regions). *Id.* at 48.

153. See FCC, FCC 20-188, 2020 COMMUNICATIONS MARKETPLACE REPORT 25–26, 26 fig.II.A.16 (2020) (identifying 395,562 cell sites in 2019); Eleni Theodoropoulou, Ioanna Mesogiti, George Lyberopoulos, George Kalfas, Christos Vagionas, Nikos Pleros, Annachiara Pagano, Mauro Agus, Luiz Anet Neto, Nikos Psaromanolakis & Athina Ropodi, *A Framework To Support the 5G Densification*, in 2020 ARTIFICIAL INTELLIGENCE APPLICATIONS AND INNOVATIONS, INTERNATIONAL WORKSHOPS 3, 3 (Ilias Maglogiannis, Lazaros Iliadis & Elias Pimenidis eds., 2020) (predicting tenfold network densification under 5G networks); Larry Peterson & Ouz Sunay, *Basic Architecture*, in 5G MOBILE NETWORKS: A SYSTEMS APPROACH (2020), <https://5g.systemsapproach.org/arch.html> [<https://perma.cc/NVF3-7T7Q>] (identifying multiple pieces of equipment at each cell site and other equipment in core network); see also, e.g., RYSAVY RSCH. & 5G AMS., GLOBAL 5G: IMPLICATIONS OF A TRANSFORMATIONAL TECHNOLOGY 36, 42–44 (2019) (describing several complex parts of new 5G networks); ERICSSON, 5 KEY FACTS ABOUT 5G RADIO ACCESS NETWORKS: MOBILE RADIO ACCESS NETWORKS AND 5G EVOLUTION 4 (2020), <https://www.ericsson.com/495922/assets/local/policy-makers-and-regulators/5-key-facts-about-5g-radio-access-networks.pdf> [<https://perma.cc/7TKY-VTEP>] (“In fact, the software complexity of RAN in a baseband exceeds that of Boeing 787 aircraft.”).

specialized vendors.¹⁵⁴ Experts traditionally group these vendors into two groups representing the two parts of a cellular network: the radio access network (“RAN”) and the core network.¹⁵⁵

The RAN is the visible part of the cellular network. It is the cell towers and antennae that dot highways and pepper the roofs of buildings and the tops of utility poles.¹⁵⁶ The RAN “listens” for signals from users’ devices.¹⁵⁷ Cellular users transmit these signals whenever they try to start a call or use an app.¹⁵⁸ The RAN’s antennae capture the signal, and its computers translate it, determine where it needs to go, and send it off into the rest of the network.¹⁵⁹ The cost of buying RAN equipment typically comprises up to 80 percent of the cost of

154. See, e.g., T-Mobile, 2020 Annual Report (Form 10-K) 16 (Feb. 23, 2021) (“Many of the products and services we use are available through multiple sources and suppliers. However, there are a limited number of suppliers who can support or provide . . . wireless or wireline network infrastructure [and] equipment . . .”); AT&T, 2020 Annual Report (Form 10-K) 48 (Feb. 8, 2021) (“We depend on suppliers to provide us, directly or through other suppliers, with items such as network equipment . . .”).

155. See SECRETARY OF STATE FOR DIGITAL, CULTURE, MEDIA AND SPORT, 5G SUPPLY CHAIN DIVERSIFICATION STRATEGY, 2020, Cm. 342, at 41–43 (UK) (recognizing RAN and core networks as key separate components and acknowledging the existence of a separate RAN market). Compare Press Release, Dell’Oro Grp., RAN Growth Slows in 4Q 2021 – Still Grows More Than 10 Percent in 2021, According to Dell’Oro Group (Feb. 23, 2022), <https://www.delloro.com/news/ran-growth-slows-in-4q-2021-still-grows-more-than-10-percent-in-2021> [<https://perma.cc/DUX7-866T>], with Press Release, Dell’Oro Grp., Mobile Core Network Stagnant in 2021, Poised for Growth in 2022, According to Dell’Oro Group (Feb. 24, 2022), <https://www.delloro.com/news/mobile-core-network-stagnant-in-2021-poised-for-growth-in-2022> [<https://perma.cc/TVK5-A9NH>] (showing differences in the key vendors in the RAN and core markets).

156. See Anderson Sullivan, *What Is a Small Cell? A Brief Explainer*, CTIA (Mar. 27, 2018), <https://www.ctia.org/news/what-is-a-small-cell> [<https://perma.cc/W46X-28EU>] (describing small and macro cells as radio equipment and antennas); *About Small Cells*, SMALL CELL FORUM, <https://www.smallcellforum.org/small-cells> [<https://perma.cc/6UJT-RV74>] (defining small cells as a type of radio access).

157. See *Open RAN Explained*, NOKIA (Oct. 2020), <https://www.nokia.com/about-us/newsroom/articles/open-ran-explained> [<https://perma.cc/4J6N-YUFF>] (“The RAN is the final link between the network and the phone.”).

158. See Jason Johnson, *It Can’t Be Magic: How Cellphones Work*, CTIA (Mar. 7, 2018), <https://www.ctia.org/news/it-can-t-be-magic-how-do-cellphones-work> [<https://perma.cc/984N-QMDE>] (describing the “life cycle” of a video call); *How Wireless Works*, CTIA, <https://howwirelessworks.ctia.org> [<https://perma.cc/4SVD-RYDT>] (explaining how wireless networks work).

159. See *Open RAN Explained*, *supra* note 157 (“When we make a call or connect to a remote server e.g., to watch a YouTube video, the antenna transmits and receives signals to and from our phones or other hand-held devices. The signal is then digitalized in the RAN base station and connected to the network.”).

building a network.¹⁶⁰ And because vendors currently sell RAN equipment as end-to-end solutions,¹⁶¹ instead of mixing and matching equipment from different vendors to build a cell site, operators almost always purchase all of the equipment for any cell site from a single vendor.¹⁶²

Established operators have largely turned only to five vendors for 5G deployment: Huawei Technology Co., Ltd. (“Huawei”), Ericsson, Nokia Corporation (“Nokia”), Samsung Electronics Co., Ltd. (“Samsung”), and ZTE Corporation (“ZTE”).¹⁶³ Together, these vendors supply equipment to an overwhelming share of the market,¹⁶⁴ with just Huawei, Ericsson, and Nokia providing at least 85 percent of RAN equipment worldwide.¹⁶⁵ The barriers to entering this market are huge. Specifically, it is unclear if any other companies can supply the

160. HEWLETT PACKARD ENTER., BUSINESS CASE FOR OPEN VIRTUALIZED RAN 2 (2020). Operators then spend up to 60 percent of their operating costs on RAN. *Id.*

161. See Nat’l Telecomm’n & Info. Admin., Comments on Promoting the Deployment of 5G Open Radio Access Networks 2 (July 16, 2021) (“This end-to-end focus allows incumbent vendors to offer end-to-end solutions.”); see also HEWLETT PACKARD ENTER., *supra* note 160 (“Traditional RAN equipment are closed, proprietary appliances.”). The major RAN vendors promote end-to-end products. See, e.g., HUAWEI INVEST. & HOLDING CO., 2020 ANNUAL REPORT 20 (2021) (describing Huawei RAN offerings); Nokia Corporation, Annual Report (Form 20-F) 10 (2021) (describing Nokia RAN offerings).

162. See Colby Harper & Sasha Sirotkin, *NG-RAN Architecture*, in 5G RADIO ACCESS NETWORK ARCHITECTURE: THE DARK SIDE OF 5G 123, 123 (Sasha Sirotkin ed., 2021) (describing mixing-and-matching practices of vendors).

163. Press Release, Dell’Oro Grp., Huawei Leads Market, Ericsson and Samsung Gaining Share Outside China (Feb. 23, 2022), <https://www.delloro.com/news/ran-growth-slows-in-4q-2021-still-grows-more-than-10-percent-in-2021> [<https://perma.cc/87M9-GTLV>].

164. Estimates of the market shares of these five companies vary. One estimate places their combined 2021 global RAN share at 91.7 percent. Press Release, Mobile Experts, Ericsson Snags #1 Position in the RAN Market According to Total Year Review for 2021 from Mobile Experts, <https://www.prnewswire.com/news-releases/ericsson-snags-1-position-in-the-ran-market-according-to-total-year-review-for-2021-from-mobile-experts-301466707.html> [<https://perma.cc/6HGW-MX6D>].

165. See Monica Allevan, *RAN Market Smashes Expectations in 2020: Dell’Oro*, FIERCE WIRELESS (Feb. 19, 2021, 2:25 PM), <https://www.fiercewireless.com/tech/ran-market-smashes-expectations-2020-dell-oro> [<https://perma.cc/8XQ6-MMU9>] (“Both [Ericsson and Nokia] improved their RAN revenue shares . . . [to] 35% to 40% and 25% to 30% of the overall RAN market, respectively Despite being shut out of some geographies due to security concerns, Huawei maintained its No. 1 ranking for the global RAN market”). Because Huawei has at least 30 percent of the market, Huawei, Nokia, and Ericsson must combine for at least 85 percent of the market.

volume of equipment that large operators need.¹⁶⁶ Similarly, it is unclear if any companies besides Huawei are capable of supplying the affordable equipment that smaller operators need.¹⁶⁷ Thus, without sea changes in the underlying technology, the market power of these companies is pretty durable.

B. How Are Telecommunications Network Equipment Standards Set?

Wireless cellular networks are generally grouped into “generations,” with the first generation of wireless networks called 1G, and the most recent generation, 5G.¹⁶⁸ While there are technical differences between different wireless generations, the true distinction is in performance. As anyone whose phone has switched from a 3G to a 4G connection can attest, there are meaningful distinctions in the speed and reliability of service.¹⁶⁹

166. See Nat’l Telecomm’n & Info. Admin., *supra* note 161 (“The problem is that new entrants must develop the entire RAN and some components require expertise that is difficult to obtain.”).

167. See, e.g., Competitive Carriers Ass’n, Comment Letter on Proposed Rule To Protect Against National Security Threats to the Communications Supply Chain, app., declaration of Michael Beehn 2 (June 1, 2018), <https://www.fcc.gov/ecfs/document/1060139338545/1> [<https://perma.cc/3GXQ-CPKD>] (“SI Wireless chose Huawei because it delivered excellent quality and was the most cost-effective option . . .”); *id.* app., declaration of James Groft 1 (“JVT chose Huawei because it was . . . a 40% savings versus the 2nd most cost-effective option.”). The only recent entrant into the market is Samsung. See Supantha Mukherjee, *Nokia Takes a Hit as Samsung Secures Verizon 5G Deal*, REUTERS (Sept. 15, 2020, 5:01 PM), <https://www.reuters.com/article/samsung-elec-verizon-nokia/nokia-takes-a-hit-as-samsung-secures-verizon-5g-deal-idUSKBN25Y13J> [<https://perma.cc/E9AS-YUHZ>] (“With this \$6.64 billion contract win, Samsung has reinforced its position as a challenger to the dominance of Nokia and its Nordic rival Ericsson . . .”). However, Samsung lacks some of the traditional barriers to entering the RAN market. Samsung is one of the fifteen largest companies in the world and reported \$19 billion R&D spending in 2021. See *Global 500*, FORTUNE (2021), <https://fortune.com/global500/2021/search> [<https://perma.cc/JT6U-2UGK>] (listing Samsung as the fifteenth largest company); CONSOLIDATED FINANCIAL STATEMENTS OF SAMSUNG ELECTRONICS CO., LTD., AND ITS SUBSIDIARIES 71 (2021) (reporting 2021 R&D spending of 22.4 trillion Korean won); *South Korean Won to U.S. Dollar Spot Exchange Rate*, FED. RSRV. BANK OF ST. LOUIS, <https://fred.stlouisfed.org/series/DEXKOUS> [<https://perma.cc/55U4-2QQP>] (reporting a 2021 year-end won to dollar exchange rate of 1,188.59).

168. See Mark Lowenstein, *Here Comes 5G — but First, a Reality Check*, VOX (July 25, 2016, 10:00 AM), <https://www.vox.com/2016/7/25/12266072/5g-wireless-broadband-spectrum-reality-check-fcc-internet-of-things> [<https://perma.cc/7NX6-GAPU>] (describing generations).

169. See *What Is the Difference Between 3G, 4G and 5G?*, VERIZON COMM’NS, <https://www.verizon.com/about/our-company/5g/difference-between-3g-4g-5g> [<https://perma.cc/6F6S-74DK>] (outlining quality differences across generations).

The United Nations sets the performance standard for a new generation through its oldest arm¹⁷⁰: the International Telecommunications Union (“ITU”).¹⁷¹ The ITU produces voluntary performance standards for wireless networks, which its member countries and institutions widely adopt.¹⁷² In 2015, the ITU released a new “vision recommendation,” which outlined certain benchmarks that 5G networks should meet, including 1,000 percent improvements in user speed and latency over previous standards.¹⁷³ Once the ITU sets performance standards, its job is done. It leaves the development of technical specifications to other bodies.¹⁷⁴

In the early days of wireless networks, different companies or countries deployed their networks using different technologies.¹⁷⁵ Over successive generations, however, the benefits of coalescing around a single standard became hard to ignore. Wireless networks are (tautologically) a network industry, and coalescing around one standard prevents market fragmentation and provides the benefits

170. *As International Telecommunication Union Turns 150, Ban Hails ‘Resilience’ of Oldest UN Agency*, UNITED NATIONS (May 17, 2015), <https://news.un.org/en/story/2015/05/498942-international-telecommunication-union-turns-150-ban-hails-resilience-oldest-un> [<https://perma.cc/JL47-HJ9>].

171. See Raúl Chávez-Santiago, Michał Szydelko, Adrian Kliks, Fotis Foukalas, Yoram Haddad, Keith E. Nolan, Mark Y. Kelly, Moshe T. Masonta & Ilangko Balasingham, *5G: The Convergence of Wireless Communications*, 83 WIRELESS PERSONAL COMM’N 1617, 1618 (“Wireless communication generations typically refer to non-backwards-compatible standards following requirements specified by the International Telecommunication Union-Radiocommunication Sector (ITU-R).”).

172. See *ITU-T Recommendations*, INT’L TELECOMM’N UNION, <https://www.itu.int/en/ITU-T/publications/Pages/recs.aspx> [<https://perma.cc/L8YG-Z57Q>] (“The main products of ITU-T are Recommendations (ITU-T Recs) . . . ITU-T Recs have non-mandatory status until they are adopted The level of compliance is nonetheless high”).

173. INT’L TELECOMM’N UNION, RECOMMENDATION ITU-R M.2083-0, IMT VISION – FRAMEWORK AND OVERALL OBJECTIVES OF THE FUTURE DEVELOPMENT OF IMT FOR 2020 AND BEYOND 12–14, 14 fig.3 (2015).

174. See *IMT-2020 Towards “Beyond,” 3RD GENERATION P’SHIP PROJECT*, https://www.3gpp.org/news-events/partners-news/2212-itu-r_imt2020 [<https://perma.cc/TS53-9MXN>] (“The ‘ITU-R Vision’, set out for each IMT process, states what is needed to be accomplished. The standardisation body must define and develop a fitting functional technology. In 3GPP’s case, the technology is described in technical specifications”).

175. See Kathleen M.H. Wallman, *The Role of Government in Telecommunications Standard-Setting*, 8 COMM’LAW CONSP’CTUS 235, 246 (2000) (describing three 2G and four 3G standards in the United States and separate standards in Europe).

outlined in Part I.A.¹⁷⁶ Today, technical specifications for almost every wireless network in the world are set by 3GPP.¹⁷⁷ 3GPP is a partnership of seven regional, standard-setting organizations.¹⁷⁸ It takes the ITU's performance standards and designs specifications for technologies that meet those standards.¹⁷⁹ While these specifications do not have any independent weight or force, the regional standard-setting organizations that comprise 3GPP generally rubber stamp them as accredited standards.¹⁸⁰ Moreover, once 3GPP completes work on its technical specifications, it submits them to the ITU for certification that they conform to that generation's standards.¹⁸¹ The ITU certified 3GPP's technological standards as 5G in late 2020.¹⁸²

C. *The 5G Standard-Setting Process Excluded Low-Entry-Barrier Technology*

As noted above, vendors typically sell “end-to-end” RAN equipment, so that all the equipment necessary for a cell site is supplied by one vendor.¹⁸³ There was an early belief that 5G RAN standards would radically change this structure.¹⁸⁴ The exact mechanics of this

176. See *supra* Part I.A.; see also Reza Arefi & Sasha Sirotkin, *Market Drivers, in 5G RADIO ACCESS NETWORK ARCHITECTURE: THE DARK SIDE OF 5G*, *supra* note 162, at 5, 8, 25–26 (describing benefits of cellular standardization).

177. Arefi & Sirotkin, *supra* note 176, at 25–27; see also *About 3GPP*, 3RD GENERATION P'SHIP PROJECT, <https://www.3gpp.org/about-3gpp> [<https://perma.cc/PWZ7-CKEB>] (“With LTE and 5G work, 3GPP has become the focal point for the vast majority of mobile systems beyond 3G.”).

178. See *Partners*, 3RD GENERATION P'SHIP PROJECT, <https://www.3gpp.org/about-3gpp/partners> [<https://perma.cc/4FQH-Y49N>] (“The seven 3GPP Organizational Partners - from Asia, Europe and North America - determine the general policy and strategy of 3GPP . . .”).

179. ERIK GUTTMAN, *5G STANDARDIZATION IN 3GPP* (2018), https://www.itu.int/en/ITU-T/Workshops-and-Seminars/201807/Documents/3_Erik_Guttman.pdf [<https://perma.cc/N9HZ-D9U5>] (describing ITU/3GPP relationship).

180. See *Partners*, *supra* note 178 (“3GPP produces Technical Specifications, to be transposed by relevant Standardization Bodies (Organizational Partners) into appropriate deliverables (e.g., standards).”).

181. See, e.g., Press Release, Int'l Telecomm'n Union, ITU Completes Evaluation for Global Affirmation of IMT-2020 Technologies (Nov. 26, 2020), <https://www.itu.int/en/mediacentre/Pages/pr26-2020-evaluation-global-affirmation-int-2020-5g.aspx> [<https://perma.cc/6YZG-5WY8>] (certifying 3GPP's specifications as 5G).

182. *Id.*

183. See *supra* notes 161–162 and accompanying text.

184. See Jeffrey G. Andrews, Stefano Buzzi, Wan Choi, Stephen Hanly, Angel Lozano, Anthony C.K. Soong & Jianzhong Charlie Zhang, *What Will 5G Be?*, 2014 IEEE J. SELECTED AREAS IN COMM'NS 1, 9 (“As virtualization of the communication network gains traction in the industry, an old concept, dating back to the 1990s, will emerge: the provision of user-controlled

change are incredibly technical and far beyond the scope of this Note (or its Author's expertise). However, one aspect of this change would be the separation of RAN's hardware and software. End-to-end RAN equipment has proprietary software designed for and preinstalled on the hardware.¹⁸⁵ This anticipated 5G RAN innovation would permit any vendor to design software to run on standardized, commercial, off-the-shelf-hardware, so that operators could "upgrade" their equipment (like an iPhone installs a new iOS 14.1.1 update) or install a new feature (like a computer downloading a new word processor).¹⁸⁶ Separating the software from the hardware also allows operators to "split" different RAN functions, and therefore, RAN markets, into several different components (such as translating a signal and routing that signal).¹⁸⁷

However, in order for separate vendors to provide each of these different components, standard-setters must create open, common, standardized interfaces between the hardware and the software.¹⁸⁸

management in network elements."); *see also* Press Release, AT&T, AT&T Unveils 5G Roadmap Including Trials in 2016 (Feb. 11, 2016), https://about.att.com/story/unveils_5g_roadmap_including_trials.html [<https://perma.cc/QHD4-PMH9>] (committing to producing open source software alongside network virtualization).

185. *See* HEWLETT PACKARD ENTER., *supra* note 160 ("Traditional RAN equipment are closed, proprietary appliances.").

186. This change is called "virtualized" or "vRAN." *See Virtualized RAN, Cloud RAN, and Open RAN: Making Sense of the 5G RAN Alphabet Soup*, WILSON CTR., <https://www.wilsoncenter.org/video/virtualized-ran-cloud-ran-and-open-ran-making-sense-5g-ran-alphabet-soup> [<https://perma.cc/45KW-LUYT>]. Virtualized RAN is a part of, or at least compatible with, 3GPP standards. Larry Peterson & Ouz Sunay, *RAN Internals, in 5G MOBILE NETWORKS: A SYSTEMS APPROACH* §§ 4.2–4.3 (2020), <https://5g.systemsapproach.org/ran.html> [<https://perma.cc/6YFG-9EDW>].

187. *See* CAROLINE GABRIEL, ANALYSYS MASON, WHAT IS THE vRAN? 2–3 (2021) (identifying various functional splits in 5G networks). Functional splits and virtualization *are* parts of 3GPP's 5G standards. Peterson & Sunay, *supra* note 186, § 4.2. Indeed, they are key parts of 5G RAN rollout. *Id.* However, open interfaces between all hardware and software are *not* part of 5G standards, so that current deployments permit software updates, but not from any software vendor on any interface. *See Why We Need the Open RAN Movement Even Though 3GPP Interfaces Are Already Open*, PARALLEL WIRELESS (June 29, 2020), <https://www.parallelwireless.com/blog/why-we-need-the-open-ran-movement-even-though-3gpp-interfaces-are-already-open> [<https://perma.cc/X4CM-J3KW>] (recognizing 3GPP failed to open key interfaces that locked networks into their 4G vendors); *Open RAN, 3RD GENERATION P'SHIP PROJECT* (Jan. 20, 2021), https://www.3gpp.org/news-events/2150-open_ran [<https://perma.cc/PX3C-CVBL>] (highlighting functional splits in open RAN).

188. *See Update: Open RAN Explained*, NOKIA CORP. (Mar. 30, 2020), <https://www.nokia.com/about-us/newsroom/articles/open-ran-explained> [<https://perma.cc/2AW9-PKJD>] ("The key concept of Open RAN is 'opening' the protocols and interfaces between these various building blocks (radios, hardware, and software) in the RAN. . . . An open environment expands the

With open interfaces, instead of purchasing one large cell site from an established RAN vendor, mobile operators could mix and match the best component products from a variety of different companies, creating cheaper and more innovative networks.¹⁸⁹

This disaggregation of RAN products and the standardization of open interfaces between them is typically called Open RAN.¹⁹⁰ Many experts see incredible benefits from Open RAN.¹⁹¹ Most notably, the markets for smaller, disaggregated network components have far lower barriers to entry.¹⁹² Indeed, several companies around the world have already sprung up to meet just the *expected* demand for component RAN products.¹⁹³ Thus, Open RAN promises to erode much of the incumbent control over the RAN market.¹⁹⁴

But Open RAN has yet to arrive. While Open RAN standards had considerable support within 3GPP, they were not included in final 5G standards due to what one expert calls “largely political reasons.”¹⁹⁵ At this point, most worldwide deployments of 5G have eschewed Open RAN,¹⁹⁶ though there are a couple of isolated Open RAN

ecosystem, and with more vendors providing the building blocks, there is more innovation and more options for the Operators.”); *see also infra* notes 198–201 (discussing Open RAN standards).

189. *See* PEDRO TAVARES & PEDRO SANGUINHO, DELOITTE, *THE OPEN FUTURE OF RADIO ACCESS NETWORKS* 4, 10 (describing benefits of Open RAN, including “increase[d] vendor diversity”).

190. *See Virtualized RAN, Cloud RAN, and Open RAN, supra* note 186 (defining Open RAN).

191. *See generally* Naima Hoque Essing, Kevin Westcott, Craig Wigginton & Jeff Loucks, *The Next-Generation Radio Access Network: Open and Virtualized RANs Are the Future of Mobile Networks*, DELOITTE INSIGHTS (Dec. 7, 2020), <https://www2.deloitte.com/xs/en/insights/industry/technology/technology-media-and-telecom-predictions/2021/radio-access-networks.html> [<https://perma.cc/2RDQ-U3T8>] (outlining many benefits of Open RAN).

192. *Id.* (“Suppliers also benefit from open RAN because it opens up market participation and lowers barriers to entry. Because of interoperability, vendors can develop products and solutions for use by multiple operators instead of having to create unique one-offs for a specific operator.”).

193. *See, e.g., id.* (identifying Altiostar, Mavenir, and Parallel Networks as “open RAN startups”).

194. *See Virtualized RAN, Cloud RAN, and Open RAN, supra* note 186 (describing how Open RAN allows telecom operators to disaggregate RAN and purchase components from a variety of vendors).

195. *See* Arefi & Sirotkin, *supra* note 176, at 28 (acknowledging that Open RAN’s exclusion from 3GPP standards was largely political in nature).

196. *See generally* MICHELA VENTURELLI, ANALYSYS MASON, *5G DEPLOYMENT NUMBERS ARE ACCELERATING AND OPERATORS ARE FOCUSING ON STANDALONE ARCHITECTURE* (2022) (separating Open RAN experimentation by a “few operators” from discussion of broader 5G deployments in North America, Europe, and Australia).

deployments.¹⁹⁷ That is not to say that Open RAN standards do not exist. Groups outside of 3GPP are developing the open interfaces that are necessary for Open RAN to be viable, which work on top of 3GPP standards.¹⁹⁸ However, the established major vendors—Huawei, Nokia, and Ericsson—have expressed hesitation about these interfaces. Huawei actively refuses to participate in open interface standards consortia.¹⁹⁹ Nokia and Ericsson participate cautiously yet have shown a willingness to withdraw at the slightest cause for concern.²⁰⁰ Meanwhile, their 5G network deployments around the world do not support open interfaces.²⁰¹

Of course, Open RAN may not be a viable technology. Early deployments have been somewhat successful,²⁰² but signs show that open networks may be too expensive if deployed on top of existing networks and too complex when deployed by unsophisticated entrants.²⁰³ Still, the counterfactual where 3GPP fully devotes itself to Open RAN for 5G development is unobservable, and it is worth asking whether 3GPP's structure has permitted dominant firms to stifle the growth of this innovative technology and to lock in end-to-end technology with higher barriers to entry. 3GPP's equipment vendors

197. See TAVARES & SANGUINHO, *supra* note 189, at 9 (providing the state of Open RAN deployment). Dish plans to deploy an Open RAN network in the United States. Press Release, Dell Techs., DISH and Dell Technologies Will Build the Nation's First Open RAN 5G Edge Infrastructure (June 17, 2021), <https://www.dell.com/en-us/dt/corporate/newsroom/announcements/detailpage.press-releases-usa~2021~06~20210617-dish-and-dell-technologies-will-build-the-nations-first-open-ran-5g-edge-infrastructure.htm> [<https://perma.cc/MA4W-QM3U>].

198. See Arefi & Sirotkin, *supra* note 176, at 8 (“Furthermore, there are still many Standards Developing Organizations (SDOs) and industry fora working on technologies that may . . . complement 3GPP standards (e.g. Broadband Forum [BBF], Open Radio Access Network [O-RAN], Small Cell Forum, etc.)”).

199. See Matt Kapko, *Huawei CTO Disses Virtualized, Open RAN*, SDXCENT. (Sept. 9, 2021, 5:42 PM), <https://www.sdxcentral.com/articles/news/huawei-cto-disses-virtualized-open-ran/2021/09> [<https://perma.cc/2VPQ-ND6R>] (expressing Huawei's disapproval of Open RAN architecture).

200. See Mike Dano, *Ericsson, Nokia Pay Open RAN Lip Service, but Not Much Else*, LIGHTREADING (June 2, 2021), <https://www.lightreading.com/open-ran/ericsson-nokia-pay-open-ran-lip-service-but-not-much-else/d/d-id/769916> [<https://perma.cc/B8VM-GAH3>] (reporting Ericsson and Nokia's support but noting their “endorsements ended abruptly at the first hint of any government mandates or other requirements in support of open RAN”).

201. Other industry participants have noticed. See Michael Koziol, *The Cellular Industry's Clash over the Movement To Remake Networks*, IEEE SPECTRUM (Apr. 23, 2021), <https://spectrum.ieee.org/the-cellular-industrys-clash-over-the-movement-to-remake-networks> [<https://perma.cc/4A72-8LPZ>] (noting industry recognition of Ericsson and Nokia's closed interfaces).

202. See TAVARES & SANGUINHO, *supra* note 189, at 9 (recognizing early successful deployments of Open RAN).

203. See *id.* at 11 (recognizing drawbacks of Open RAN).

have been accused of conspiring to exclude a competitor's technologies before.²⁰⁴

D. Five RAN Vendors Controlled the 5G Standard-Setting Process

So we arrive at the operative question: whether the structure of 3GPP provides large companies like Huawei, Nokia, Ericsson, Samsung, and ZTE the ability to foreclose potential technological paths that could lower entry barriers and increase competition. On a theoretical level, the power of these major firms can certainly be constrained.²⁰⁵ On a practical level, however, the pervasiveness of large firms in RAN standard development is clear. As with *Hydrolevel*, look first at the leadership.²⁰⁶ At the time of this writing, Samsung, ZTE, and Huawei hold three of the five chairmanships for RAN working groups.²⁰⁷ Huawei, ZTE, Nokia, Ericsson, and Samsung each hold one of the ten vice chairmanships as well.²⁰⁸ To put these numbers in context, consider the scope of 3GPP membership. Six hundred sixty-three individual companies attended a May 2019 vote in the RAN

204. See, e.g., *TruePosition, Inc. v. LM Ericsson Tel. Co.*, 899 F. Supp. 2d 356, 358 (E.D. Pa. 2012) (“TruePosition alleges that [Ericsson, Qualcomm, and Alcatel-Lucent] abused their positions of authority within 3GPP by violating its rules and procedures in order to conspire to exclude TruePosition’s positioning technology . . .”).

205. Operators and smaller competitors ultimately vote on contributions. See Justus Baron & Kirti Gupta, *Unpacking 3GPP Standards* § 4.3 (Nw. L. & Econ., Rsch. Paper No. 18-09, 2018), https://papers.ssrn.com/abstract_id=3119112 [<https://perma.cc/7J89-XSHH>] (describing process of approving contributions). Operators and smaller competitors also help test and develop contributions into final specifications. See Lorenzo Casaccia, *Understanding 3GPP – Starting with the Basics*, QUALCOMM (Aug. 1, 2017), <https://www.qualcomm.com/news/onq/2017/08/02/understanding-3gpp-starting-basics> [<https://perma.cc/EK7X-LD59>] (“The agreed-upon concepts and implementation details instead come from a collaborative effort that involves iteration and negotiation between 3GPP members.”).

206. See *supra* notes 130–132 and accompanying text.

207. See *3GPP Officials for Group: 3GPP RAN 1 (“R1”)*, 3RD GENERATION P’S HIP PROJECT [hereinafter *RAN 1 Officials*], <https://www.3gpp.org/DynaReport/TSG-WG-R1-officials.htm> [<https://perma.cc/7SAX-NUNJ>] (noting that Samsung is the Chair); *3GPP Officials for Group: 3GPP RAN 3 (“R3”)*, 3RD GENERATION P’S HIP PROJECT [hereinafter *RAN 3 Officials*], <https://www.3gpp.org/DynaReport/TSG-WG-R3-officials.htm> [<https://perma.cc/6TS4-3EPH>] (noting that ZTE is the Chair); *3GPP Officials for Group: 3GPP RAN 4 (“R4”)*, 3RD GENERATION P’S HIP PROJECT [hereinafter *RAN 4 Officials*], <https://www.3gpp.org/DynaReport/TSG-WG-R4-officials.htm> [<https://perma.cc/B2JB-8ZXX>] (noting that Huawei is the Chair).

208. See *RAN 1 Officials, supra* note 207 (listing Huawei as a Vice Chair); *3GPP Officials for Group: 3GPP RAN 2 (“R2”)*, 3RD GENERATION P’S HIP PROJECT, <https://www.3gpp.org/DynaReport/TSG-WG-R2-officials.htm> [<https://perma.cc/8G2W-5LN7>] (listing ZTE and Nokia as Vice Chairs); *RAN 3 Officials, supra* note 207 (listing Ericsson as a Vice Chair); *RAN 4 Officials, supra* note 207 (listing Samsung as a Vice Chair).

technical specification group, of which over three hundred were so active in attending meetings that they were eligible to vote.²⁰⁹

Of course, while working group leaders can direct the overall operations of 3GPP groups, individual companies still create the contributions that will underlie future specifications through their own research and development.²¹⁰ A 2020 Strategy Analytics study reviewed 5G contributions across all working groups, not just RAN.²¹¹ Focusing on thirteen companies that produced over 78 percent of the submitted and approved 5G contributions, analysts showed Huawei, Ericsson, and Nokia as the clear leaders in contributions.²¹² Samsung and ZTE were not far behind, along with chipmakers Qualcomm and Intel.²¹³ Intellectual property analyst IPlytics reached similar findings in late 2021. Together, the big five RAN vendors were responsible for over 61 percent of 5G technical contributions.²¹⁴ Similarly, they introduced over two-thirds of approved 5G technical contributions.²¹⁵

209. See *Voting List for TSG RAN WG Meeting #84, 3RD GENERATION P'SHIP PROJECT* (May 28, 2019), https://www.3gpp.org/ftp/webExtensions/elections/RAN/Technical_vote/RP_84/voting_List_RAN_mtg-84.htm [<https://perma.cc/4VGX-F74Y>] (listing attending companies and those eligible to vote).

210. See Justus Baron & Tim Pohlmann, *Who Cooperates in Standards Consortia — Rivals or Complementors?*, 9 J. COMPETITION L. & ECON. 905, 911 (2013) (explaining how companies can impact future standards through individual research and development projects).

211. GUANG YANG, STRATEGY ANALYTICS, WHO ARE THE LEADING PLAYERS IN 5G STANDARDIZATION? AN ASSESSMENT FOR 3GPP 5G ACTIVITIES 4 (2020).

212. *Id.* at 12 ex. 9.

213. *Id.*

214. See *supra* note 163 and accompanying text (listing the “big five” RAN vendors); TIM POHLMANN & MAGNUS BUGGENHAGAN, WHO LEADS THE 5G PATENT RACE NOVEMBER 2021?, at 6 (IPlytics ed., 2021) (listing the technical contributions of Huawei, Samsung, ZTE, Nokia, and Ericsson, which equal 61.61 percent).

215. See *id.* (listing the approved technical contributions of Huawei, Samsung, ZTE, Nokia, and Ericsson, which equal 67.99 percent). As a note of caution, counting contributions is never perfect. Contributions can be of drastically different quality or importance to the final specification, yet they count the same in these measurements. Lorenzo Casaccia, *Top 5 Drawbacks of “Contribution Counting” in 3GPP. (Don’t Count on It!)*, QUALCOMM (Aug. 1, 2017), <https://www.qualcomm.com/news/onq/2017/08/02/top-5-drawbacks-contribution-counting-3gpp-dont-count-it> [<https://perma.cc/BQ7E-4JA5>]. Some companies may aggregate multiple proposals into one contribution or disaggregate one proposal into many contributions. *Id.* Moreover, by the final specification, the iterative process of 3GPP specification development may fundamentally alter a contribution. See *supra* note 205 and accompanying text. Still, they can be a useful guide for the activity of companies within 3GPP. And incredibly significant overcounting would be required to negate the fact that five vendors were responsible for an overwhelming share of approved 5G technical contributions.

Taken together, the dominance of the major firms in setting 3GPP technical standards is undeniable. And it is not difficult to see how this power manifests in major RAN vendors steering the overall direction of standards development through their dominance in leadership positions. As the companies devoting the most research and development toward RAN contributions, they ensure that more often than not, the contributions before RAN working groups are their own. Major RAN vendors then get a vote on their own standards. And evidence from contributions, approved contributions, and declared patents shows that major RAN vendors are successful at steering standards development their way. By steering development away from Open RAN, these vendors can maintain high entry barriers, forestalling potential new competition until a later generation.

V. PROPOSED SOLUTIONS

This Note does not suggest that U.S. courts or lawmakers can or should tell major companies like Huawei, Nokia, and Ericsson where they should focus their research and development investment. Such stringent regulation of private (and in this case, foreign) companies is anathema to U.S. economic regulation; regulation is not the job of courts.²¹⁶ Indeed, the Supreme Court has recognized its scant ability to judge the wisdom of private, *ex ante* business decisions.²¹⁷ Courts would likely be even worse at assessing the incredibly technical questions underlying a company's choice to invest in one specification over another in technical standard-setting bodies.²¹⁸ It is almost comical to imagine a Supreme Court case considering, for example, whether “the complexity of the intra-PHY low-level split, its sensitivity to network interface latency, and stringent requirements on timing synchronization, compared with, for example, the high-level CU/DU split” are sufficient reasons to avoid open RAN functional splits.²¹⁹

But courts and lawmakers can intervene in other ways. Most simply, courts could just apply new standards of review that are more

216. *See Verizon Commc'ns Inc. v. L. Offs. of Curtis V. Trinko, LLP*, 540 U.S. 398, 411–12 (2004) (contrasting legislative with judicial regulation of complex industries).

217. *See id.* at 415 (“We think that Professor Areeda got it exactly right: ‘No court should impose a duty to deal that it cannot explain or adequately and reasonably supervise.’”).

218. Hovenkamp, *Standards Ownership*, *supra* note 26, at 90–91.

219. Harper & Sirotkin, *supra* note 162, at 193.

discerning of standards consortia.²²⁰ This Note offers several additional interventions. First, the government can incentivize the development of multiple standard-setting groups, which can discipline each other's actions. Alternatively, courts and antitrust agencies can more closely scrutinize the procedures of standard-setting groups.

A. *Incentivize the Growth of Competitive or Auxiliary Standard-Setting Bodies*

One way the government can counter barrier lock-in is by encouraging the development and growth of additional standard-setting bodies in particularly vulnerable industries. This support can be either direct or indirect, and these additional standard setters can either compete with the dominant standards consortium or operate alongside it. This Subpart describes both the type of support the government can provide and the impact of supporting multiple standard setters.

First, the U.S. government can help directly facilitate the development of additional standard-setters by providing them with technical, administrative, or even direct financial support.²²¹ For example, over seventy government agencies are members of ANSI, where government members pay dues that sometimes exceed \$38,000 per year.²²² The ANSI drone standardization process, discussed above, includes many members of the Federal Aviation Administration, the Federal Communications Commission, and NASA, among others.²²³ Circular A-119 recognizes that support may be given to endeavors that further agency priorities.²²⁴ One such priority is fostering competition

220. Such a move would require reform of the SDOAA, necessitating Congressional action. *See supra* notes 91–92 and accompanying text.

221. *See* OFF. OF MGMT. & BUDGET CIRCULAR NO. A-119, FEDERAL PARTICIPATION IN THE DEVELOPMENT AND USE OF VOLUNTARY CONSENSUS STANDARDS AND IN CONFORMITY ASSESSMENT ACTIVITIES 28 (2016), http://www.whitehouse.gov/wp-content/uploads/2020/07/revised_circular_a-119_as_of_1_22.pdf [<https://perma.cc/P69T-29L5>] (listing forms of acceptable support to standard-setting bodies).

222. *Federal Engagement in Standards-Related Activities*, ANSI, <https://www.ansi.org/outreach/government/federal-engagement> [<https://perma.cc/37H5-HY6B>]; *Member Categories & Dues*, ANSI, <https://www.ansi.org/membership/member-categories-rosters> [<https://perma.cc/U5CF-7VZU>].

223. ANSI, *supra* note 58, at 9–18 (2020).

224. OFF. OF MGMT. & BUDGET, *supra* note 221, at 27 (“[A]gencies must . . . participate with such bodies in the development of standards when consultation and participation is in the public interest and is compatible with their missions, authorities, priorities, and budgetary resources.”).

and innovation.²²⁵ Indeed, the Circular directly recognizes that the use of multiple standards can “enhance competition in the marketplace, provide greater choice to consumers, and enable new innovative solutions to be developed.”²²⁶

The existence of multiple standard-setters enhances competition by constraining the dominant standards consortium’s ability to alienate customers, competitors, and adjacent industry participants. When one consortium sets the standards that underlie the entire market, deviation from those standards becomes far more difficult. For example, Frigidaire could theoretically design its refrigerators to connect to the electrical grid through nonstandard plugs. To do so, however, would be corporate suicide—Frigidaire’s customers would likely be incredibly irritated at their need to rewire their houses with new sockets. Thus, a single standard-setter has dampened incentives to produce the best standards for consumers. The market adopts whatever standards the members elect.

By contrast, when a market has more than one set of standards, each standard-setting body has far less power. A dominant company or group of companies in one standards consortium must fear the defection of competitors or customers to the alternative standard. Losing market share in one’s standard is a problem for companies—having one’s standard lose favor in the marketplace is catastrophic. Consider the development of 4G networks, discussed above. Two major consortia developed standards: 3GPP and the IEEE.²²⁷ Ultimately, the world coalesced around the 3GPP standard.²²⁸ Companies that produced equipment based on IEEE’s WiMAX standard, like Motorola, faced enormous sunk costs on a now defunct technology.²²⁹ Fear of becoming the “next WiMAX” can discipline dominant firms’ exclusionary conduct, at least through the standard-setting process.

225. *Id.* at 15.

226. *Id.* at 25.

227. *See supra* Part III.A.2.

228. *See supra* Part III.A.2.

229. *See, for example,* the history of Sprint-owned Clearwire, which originally adopted the WiMAX standard. Stephen Lawson, *Clearwire Stayed Ahead in Big Year for WiMax*, COMPUTERWORLD (Dec. 31, 2009, 11:40 AM), <https://www.computerworld.com/article/2522434/clearwire-stayed-ahead-in-big-year-for-wimax.html> [<https://perma.cc/5FGD-6H66>]. Clearwire eventually switched to LTE, to the tune of \$600 million in added costs. Paul Taylor, *Clearwire in Shift from WiMax Technology*, FIN. TIMES (Aug. 3, 2011), <https://www.ft.com/content/eebc4628-be22-11e0-bee9-00144feabdc0> [<https://perma.cc/7NMS-63HQ>].

Second, the government could offer indirect support, including the recognition or promotion of an additional standard-setting group. For example, the FCC has thrown considerable support behind two groups: the O-RAN Alliance and Open RAN.²³⁰ These are standard-setting groups devoted to developing open 5G RAN standards.²³¹ However, they are not competitors to 3GPP, and they do not attempt to provide conflicting standards. Instead, their specifications are specifically designed to work *within* existing 3GPP 5G standards.²³² As such, these specifications provide potential entrants and equipment buyers with common references that *can* be used if desired.²³³ Early successes on the fringe of the market could show the viability of Open RAN to other operators.

The FCC's main contribution to the O-RAN Alliance and Open RAN has been legitimizing the groups, rather than lending monetary support. The FCC, facing pressure from O-RAN Alliance members, recently lowered its estimates of the cost of Open RAN equipment.²³⁴ This change dropped cost estimates from above to below the cost of traditional RAN equipment—a significant win for Open RAN proponents.²³⁵ Additionally, the FCC has hosted two events centered on Open RAN development in the past two years,²³⁶ and in March 2021, the FCC adopted a Notice of Inquiry seeking “input on what steps should be taken by the FCC, federal partners, industry, academia,

230. See *infra* notes 231–234 and accompanying text.

231. E.g., *About O-RAN Alliance*, O-RAN ALL., <https://www.o-ran.org/about> [<https://perma.cc/J2YS-PXA9>]; *OpenRAN*, TELECOM INFRA PROJECT, <https://telecominfraproject.com/openran> [<https://perma.cc/H95D-VHVS>].

232. See, e.g., *O-RAN ALLIANCE Is Transforming Radio Access Networks Towards Open, Intelligent, Virtualized and Fully Interoperable RAN*, O-RAN ALL., <http://o-ran-org.square-space.com> [<https://perma.cc/G2L5-44VX>] (“O-RAN specification effort builds on common standards and cares about alignment with other industry bodies to ensure compatibility and to avoid duplication of work.”).

233. See, e.g., Bevin Fletcher, *Rakuten Mobile Signs on to O-RAN Alliance, Unveils Fee Cuts*, FIERCE WIRELESS (Nov. 4, 2020, 11:25 AM), <https://www.fiercewireless.com/financial/rakuten-mobile-signs-to-o-ran-alliance-unveils-fee-cuts> [<https://perma.cc/2HKS-VA2Z>] (describing the significance of O-RAN Alliance standards to nascent Rakuten Open RAN network).

234. Mike Dano, *FCC Acknowledges Open RAN Is Cheaper, Albeit with Reservations*, LIGHTREADING (Aug. 12, 2021), <https://www.lightreading.com/open-ran/fcc-acknowledges-open-ran-is-cheaper-albeit-with-reservations/d/d-id/771467> [<https://perma.cc/DY9D-P3AG>].

235. *Id.*

236. *Open RAN Solutions Showcase – Day 1*, FCC (July 14, 2021), <https://www.fcc.gov/news-events/events/2021/07/open-ran-solutions-showcase-day-1> [<https://perma.cc/CZP6-BXUC>]; *Forum on 5G Open Radio Access Networks*, FCC (Sept. 14, 2020), <https://www.fcc.gov/news-events/events/forum-5g-virtual-radio-access-networks> [<https://perma.cc/DF9B-26QR>].

and others to accelerate the timeline for Open RAN standards development.”²³⁷ These activities attract new members and attention to open standards.

B. More Closely Scrutinize Internal Procedures

While the government is often ill-suited to evaluate technology and business decisions, it is much better at reviewing whether procedures are pro or anticompetitive. Indeed, the Court’s analyses in *Radiant Burners*, *Hydrolevel*, and *Allied Tube* showed that judges can cast a keen, discerning eye towards anticompetitive procedures even in highly technical fields.²³⁸ By reviewing the *processes* by which consortia set standards, courts and antitrust regulators can ensure that others can have their voices heard in a balanced and fair manner. The government can provide oversight to standard-setting groups through its review letter process, which permits the DOJ to review an organization’s practices for potential liability.²³⁹

The Antitrust Division flexed this muscle in a recent business review letter to GSMA.²⁴⁰ GSMA is a trade association of mobile network operators.²⁴¹ It sets technical standards for SIM technology, device charging, data exchange, and mobile roaming.²⁴² GSMA’s process for setting technical standards for eSIM technology invited the scrutiny of the Antitrust Division.²⁴³ As in *Hydrolevel* and *Allied Tube*, the lack of any viable competitor made GSMA’s chosen standard the default. While GSMA permitted many stakeholders (in other words, not just mobile network operators) to join the Association, the

237. Press Release, FCC, FCC Seeks Comment on Open Radio Access Networks (Mar. 17, 2021), <https://docs.fcc.gov/public/attachments/DOC-370868A1.pdf> [<https://perma.cc/4Z2E-L3TW>].

238. See *supra* Part III.B.1.

239. 28 C.F.R. § 50.6 (2021).

240. See generally GSMA Letter, *supra* note 150 (demonstrating DOJ’s ability to direct organizational behavior through responses to business letters).

241. *Id.* at 3.

242. See *Working Groups*, GSMA, <https://www.gsma.com/aboutus/workinggroups> [<https://perma.cc/4WC2-BL8M>] (describing roles of working groups); *Discover the Working Groups*, GSMA, <https://www.gsma.com/aboutus/workinggroups/discover-the-working-groups> [<https://perma.cc/J6FE-TC8Z>] (providing description of specification development areas); GSMA Letter, *supra* note 150, at 3 (describing GSMA’s development of technical standards).

243. See GSMA Letter, *supra* note 150 (recounting DOJ’s “extensive investigation into the process GSMA used previously in the development” of standards for eSIM technology). Instead of needing to physically acquire and swap SIM cards to access a new network, eSIM technology permits consumers to download an operator’s profile through the internet. *Id.* at 3.

structure of specification development gave mobile network operators the opportunity to “exercise undue influence in the standard-setting process.”²⁴⁴ The Antitrust Division found that this structure invited collusion. It expressed “concerns about potential abuses of the standard-setting process—particularly when conducted within trade associations controlled by a single constituency of competitors—to dampen the potential of new technologies to disrupt the status quo and ultimately discourage companies from competing through innovation.”²⁴⁵

So, to reduce antitrust scrutiny, GSMA changed the way it set standards. These procedural changes decreased the power of operators in the standard-setting process. First, GSMA separated the standard-setting process into two stages run by two different bodies: a standards creation group and a standards approval group.²⁴⁶ Second, GSMA opened both groups to nonoperators and limited leadership positions for operators in each group.²⁴⁷ Third, GSMA changed standards approval from a simple majority to a minimum of 71 percent approval from group members.²⁴⁸ Finally, GSMA improved due process for members, creating an independent appeals board for grievances at any stage in the standard-setting process.²⁴⁹

Of course, this example does not prove that the Antitrust Division could unilaterally improve each standards consortium. The Division’s resources are limited. Moreover, business review letters are prompted only by request letters from the industry,²⁵⁰ so the refusal of standard-setting organizations to request Antitrust Division review can stifle this process. However, if the Antitrust Division expressed its preference for receiving them, reticence to use this process is unlikely; standard-setting organizations are *incredibly* cautious about antitrust laws. 3GPP, for example, begins specification group meetings with the recitation of an antitrust warning.²⁵¹

244. *Id.* at 1.

245. *Id.* at 2.

246. *Id.* at 10.

247. *Id.* at 10–11.

248. *Id.* at 6, 11.

249. *Id.* at 11.

250. See 28 C.F.R. § 50.6 (1977) (describing the business review process).

251. See, e.g., THIRD GENERATION P’SHP PROJECT, WORKING PROCEDURES art. 23 (2022) (“At the commencement of each meeting . . . the group shall be reminded that: (i) compliance with all applicable antitrust and competition laws is required . . .”).

There is room for the growth of business review letters. Between 2016 and 2019, the Antitrust Division published only three business review letters.²⁵² Despite issuing far more letters in 2020 and 2021, these letters focused on other topics, with none concerning standard-setting organizations.²⁵³ And if standard-setting groups fail to send inquiry letters, the DOJ can always initiate actions for Sherman Act violations.²⁵⁴ The FTC can exercise similar authority under the FTC Act.²⁵⁵ Once the letters are before a court, judges could use a standards consortium's membership and structure as an indicator of potentially collusive action. Overall, renewed scrutiny of the process through which consortia set standards is not only advisable, but feasible using the antitrust agencies' existing tools. Encouraging and using business review letters permits quick, *ex ante* responses to potential anticompetitive issues.

Now, some of these safeguards are in place at 3GPP. For example, specification approval requires a 71 percent vote.²⁵⁶ 3GPP permits RAN customers like AT&T and Vodafone to vote on technical contributions.²⁵⁷ But focusing on GSMA's specific safeguards misses the forest for the trees. The spirit of standard-setting organizations, back to the earliest days of private standard-setting, has been the broad participation of *all* relevant stakeholders—vendors *and* customers—in the standard-setting process.²⁵⁸ The lopsided nature of specification development outlined in Part IV.D and the sidelining of Open RAN

252. *Business Review Letters and Request Letters*, U.S. DEP'T OF JUST., <https://www.justice.gov/atr/business-review-letters-and-request-letters> [<https://perma.cc/WT4Q-XUCE>].

253. *See id.* (listing twelve letters from 2020–21); *see, e.g.*, Letter from Makan Delrahim, Assistant Att'y Gen., U.S. Dep't of Just., Antitrust Div., to Thomas O. Barnett, Covington & Burling (July 23, 2020), <https://www.justice.gov/atr/page/file/1297161/download> [<https://perma.cc/QY99-DVVA>] (discussing antitrust enforcement intentions about exchanging information regarding COVID-19 treatments).

254. 15 U.S.C. § 1.

255. *See Fed. Trade Comm'n v. Motion Picture Advert. Serv. Co., Inc.*, 344 U.S. 392, 394–95 (1953) (asserting that the FTC Act “was designed to supplement and bolster the Sherman Act and the Clayton Act—to stop in their incipency acts and practices which, when full blown, would violate those Acts” (citation omitted)).

256. GSMA Letter, *supra* note 150, at 11.

257. *See Baron & Gupta, supra* note 205, § 4.3 (noting that individual participants can get voting rights); *see also 3GPP Membership*, ETSI, <https://webapp.etsi.org/3gppmembership/QueryForm.asp> [<https://perma.cc/C2SB-J2QN>].

258. YATES & MURPHY, *supra* note 2, at 9 (describing democratic history of standard setters); *see also id.* at 60–62 (outlining eight guiding principles of standard-setting bodies).

solutions for which a demand clearly existed is strong evidence that this spirit is not alive in 3GPP.

CONCLUSION

Standard-setting bodies are a bedrock of the modern economy, and their benefits remain. However, as network industries and standards consortia become a more central component of the global economy, the risk of barrier lock-in increases. Failure to police barrier lock-in can have real, economic effects on consumers. For example, by one estimate, 3GPP's choice of proprietary RAN technologies over Open RAN may have increased the cost of RAN deployment by over 40 percent and stifled new innovative technologies.²⁵⁹ Antitrust has long prized the ability of competition to lower prices and spur new research and development. When the government permits dominant companies—and not competition—to steer the direction of the marketplace, it abdicates its crucial role under the antitrust laws, and it ultimately harms consumers. Incentivizing the existence of multiple standard-setters and scrutinizing their internal processes walks a happy middle ground between chilling the important role of standard-setting and permitting dominant companies to entrench their monopolies.

259. See PETER FETTEROLF, ACG RSCH., *THE ECONOMIC BENEFITS OF OPEN RAN TECHNOLOGY* 6–7 (2021) (recognizing that open RAN equipment would be 30 percent less expensive).