

# THE FOURTH WAVE OF TECHNOLOGY STANDARDIZATION: WHAT 5G’S HETEROGENEOUS NATURE MEANS FOR THE FUTURE OF TECHNOLOGY GOVERNANCE

Julien Crockett\*

CITE AS: 5 GEO. L. TECH. REV. 149 (2021)

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## I. INTRODUCTION

On May 5, 2020, a group of telecom system operators and network vendors including AT&T, Samsung, and Vodafone published a blog post announcing the formation of the Open Radio Access Network (RAN) Policy Coalition, a new coalition of companies that promotes “open and interoperable solutions” in RAN, the crucial back-end equipment that enables 5G.<sup>1</sup> The message was simple: beware of the telecom supply chain.

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\* University of California, Berkeley, School of Law, 2020. The author thanks Berkeley Law Professors Talha Syed and Mark Cohen for their thoughtful comments.

<sup>1</sup> *Open RAN Policy Coalition Launches to Advance Open and Interoperable Solutions to Expand the Global Advanced Wireless Supply Chain*, OPEN RAN POL’Y COALITION (May 6, 2020) [hereinafter OPEN RAN POL’Y COALITION], <https://www.openranpolicy.org/open-fan->

Listening to the hype, one may believe that 5G—the fifth generation of wireless technologies—promises to enable cutting-edge technologies like self-driving cars, the Internet of Things (IoT), and augmented reality.<sup>2</sup> 5G will achieve this through its “massive capacity,” or seemingly unlimited network bandwidth, and through “ultra-low latency,” or imperceptible lag time.<sup>3</sup> Thus, 5G will not be merely an evolution in wireless technology, but also a technological revolution—one that will transform health care, education, and finance—and will generate a huge economic windfall beyond the gains of 4G.<sup>4</sup>

But successful 5G deployment is far from certain. As has been well documented, the United States has fallen behind China, Hong Kong, Japan, Singapore, and South Korea in its 5G infrastructure capability, and it also faces a widening digital divide between rich and poor Americans, which disorganized 5G deployment will only exacerbate.<sup>5</sup> Less acknowledged, however, is the existential crisis facing 5G pre-deployment. Like its 3G and 4G predecessors, 5G is not an isolated technology built by an inventor and waiting to be deployed. Instead, 5G is a common protocol developed by well-established though largely invisible structures that have been doing the heavy lifting of setting global innovation agendas since the late 19th century: standard setting organizations (SSOs).<sup>6</sup>

SSOs are entities formed by collaborating industry participants that develop sets of technical standards for particular technologies. SSOs initially arose during the Industrial Revolution in British engineering societies.<sup>7</sup> They were organized in response to industrial capitalism to establish technical standards when governments and markets could not.<sup>8</sup> As a general consensus emerged around SSOs’ ability to create “network effects,” or increased value

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policy-coalition-launches-to-advance-open-and-interoperable-solutions-to-expand-the-global-advanced-wireless-supply-chain/ [https://perma.cc/QM7C-UNTK].

<sup>2</sup> See Wolfgang Bock, et al., *The Mobile Revolution: How Mobile Technologies Drive a Trillion-Dollar Impact*, BCG (Jan. 15, 2015), <https://www.bcg.com/publications/2015/telecommunications-technology-industries-the-mobile-revolution.aspx> [https://perma.cc/C7Q6-5KML]; Mae Anderson & Tali Arbel, *AP Explains: The Promise of 5G Wireless – Speed, Hype, Risk*, ASSOCIATED PRESS (Oct. 13, 2020), <https://apnews.com/article/5G-explained-wireless-smartphones-e922f2a48acc944eca777b8853d52f41> [https://perma.cc/U6XT-D62R].

<sup>3</sup> *5G Speed: How Fast is 5G?*, VERIZON (Aug. 3, 2020), <https://www.verizon.com/about/our-company/5g/5g-speed-how-fast-is-5g> [https://perma.cc/D7E5-NLLF].

<sup>4</sup> Bock, *supra* note 2.

<sup>5</sup> See, e.g., SUSAN CRAWFORD, *FIBER: THE COMING TECH REVOLUTION—AND WHY AMERICA MIGHT MISS IT* 8 (2018).

<sup>6</sup> *Id.* at 62.

<sup>7</sup> JOANNE YATES & CRAIG N. MURPHY, *ENGINEERING RULES: GLOBAL STANDARD SETTING SINCE 1880*, at 3 (2019).

<sup>8</sup> *Id.* at 101.

of a service through increased users,<sup>9</sup> the number of standards expanded. Today, there are more than 800,000 global standards for everything from paper sizes to the electrical impulses that create letters on electronic screens.<sup>10</sup> A typical laptop computer, for example, integrates more than 250 technical standards.<sup>11</sup> Moreover, the consequences of not having standards ensured by SSOs is tangible: travelers must buy adaptors for plugs<sup>12</sup> and electric vehicle owners must carefully plan trips around compatible fast-charging stations.<sup>13</sup> Therefore, harmonized standards are critical to communication networks because they are necessary for “the spread of compatible technologies and products—in short for ‘technological progress.’”<sup>14</sup>

SSOs first evolved from organizations that set national standards (the First Wave of SSOs) to organizations that set international standards (the Second Wave).<sup>15</sup> SSOs from both waves used deliberative, technocratic decision-making in private committees to develop standards.<sup>16</sup> In the 1980s, SSOs evolved yet again to quickly reach consensus when responding to computer networking and the rapid pace of technological change (the Third Wave).<sup>17</sup> With each of these evolutions, SSOs strived to counter the free-market threats of collusion and exclusion as technology became more pervasive in our lives.

However, the Open RAN Policy Coalition message signals distrust in the Third Wave’s ability to counteract these threats. Unlike older telecom coalitions like the O-RAN Alliance and the Telecom Infra Project where industry participants discuss vendor competition and innovation among each other, the Open RAN Policy Coalition is public-facing: the unusual blog post challenges U.S. lawmakers to start playing a more active role in encouraging

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<sup>9</sup> See Catherine Tucker, *Why Network Effects Matter Less Than They Used To*, HARV. BUS. REV. (Jun. 22, 2018), <https://hbr.org/2018/06/why-network-effects-matter-less-than-they-used-to> [<https://perma.cc/ETT9-YHZ7>].

<sup>10</sup> *Standard Setting Organizations and Standards List*, CONORTIUMINFO.ORG, <https://www.conortiuminfo.org/links/#.XqYXM1NKg6U> (last visited Dec. 20, 2020) [<https://perma.cc/AXU3-KFR8>]; *Learn How to Find Standards*, NAT’L INST. OF STANDARDS & TECH., <https://www.nist.gov/standardsgov/learn-how-find-standards> (last visited Dec. 20, 2020) [<https://perma.cc/EAV5-GTDT>].

<sup>11</sup> Peter S. Menell, *Economic Analysis of Network Effects and Intellectual Property*, in 1 RESEARCH HANDBOOK ON THE ECONOMICS OF INTELLECTUAL PROPERTY LAW 11 (Ben Depoorter & Peter S. Menell eds., 2019).

<sup>12</sup> See *The Parable of the Plug*, ECONOMIST, Feb. 6, 2020, at 32.

<sup>13</sup> *Cutting the Cord*, ECONOMIST, May 14, 2020, at 71.

<sup>14</sup> DAVID SINGH GREWAL, NETWORK POWER: THE SOCIAL DYNAMICS OF GLOBALIZATION 195 (2008).

<sup>15</sup> YATES & MURPHY, *supra* note 7, at 9, 13–14.

<sup>16</sup> *Id.*

<sup>17</sup> *Id.* at 239.

“open and interoperable solutions in the Radio Access Network”<sup>18</sup> within 3GPP, the SSO that sets most of the 5G standard. Without government intervention, the Open RAN Policy Coalition argues, 3GPP will continue to set standards for “fully integrated cell sites, where the radios, hardware and software [are] provided by a single manufacturer as a closed proprietary solution” and 5G will suffer from vendor lock-in and security concerns.<sup>19</sup> This cry for help, therefore, signals an alarming distrust in 3GPP’s ability to manage 5G standardization.

Two days after the blog post, thirty-five lawmakers from the U.S. House of Representatives published a bipartisan letter calling for emergency 5G funding to “support the development and deployment of open and interoperable wireless radio access networks . . . .”<sup>20</sup> The letter pushed many of the same themes as the Open RAN Policy Coalition blog post, including the need for “increasing supply chain diversity” and creating alternatives to “current state-backed equipment” such as Huawei, the Chinese telecom manufacturer.<sup>21</sup>

As evidenced by the Open RAN Policy Coalition’s blogpost, SSOs such as 3GPP are facing a legitimacy crisis. Notwithstanding the slew of concerns around 5G, including its security,<sup>22</sup> energy efficiency,<sup>23</sup> cost,<sup>24</sup> and unequal deployment,<sup>25</sup> one key aspect of 5G brings all of the aforementioned concerns together: the technologies that underlie 5G are far more heterogeneous than those that made up previous generations.<sup>26</sup> Thus, this

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<sup>18</sup> OPEN RAN POL’Y COALITION, *supra* note 1.

<sup>19</sup> *Id.*; Sean Kinney, *Open RAN Policy Coalition Launches to ‘Spur Competition’ in 5G*, RCR WIRELESS NEWS (May 5, 2020), <https://www.rcrwireless.com/20200505/policy/open-ran-policy-coalition-launches> [<https://perma.cc/ZR7Q-4QYP>].

<sup>20</sup> Letter from Doris Matsui et al., Representatives, U.S. House of Representatives, to Nancy Pelosi, Speaker of the House, U.S. House of Representatives, and Kevin McCarthy, Minority Leader, U.S. House of Representatives (May 7, 2020), [https://matsui.house.gov/uploadedfiles/20200507\\_-\\_open\\_ran.pdf](https://matsui.house.gov/uploadedfiles/20200507_-_open_ran.pdf) [<https://perma.cc/A5TY-4CSE>].

<sup>21</sup> *Id.*

<sup>22</sup> Ijaz Ahmad et al., *5G Security: Analysis of Threats and Solutions*, in 2017 IEEE CONFERENCE ON STANDARDS FOR COMMUNICATION AND NETWORKING 193, 193 (2017).

<sup>23</sup> Chih-Lin I et al., *Energy-Efficient 5G for a Greener Future*, 3 NATURE ELECTRONICA 182 (2020), <https://www.nature.com/articles/s41928-020-0404-1> [<https://perma.cc/W6E7-7UNV>].

<sup>24</sup> See L.S., *Why 5G May be Both Faster and Slower Than the Previous Wireless Generation*, ECONOMIST (Feb. 13, 2018), <https://www.economist.com/the-economist-explains/2018/02/13/why-5g-may-be-both-faster-and-slower-than-the-previous-wireless-generation> [<https://perma.cc/6S9S-UH97>].

<sup>25</sup> Crawford, *supra* note 5, at 8.

<sup>26</sup> See generally Sarah Brown, *5G, Explained*, MIT MGMT SLOAN SCH. (Feb. 13, 2020) <https://mitsloan.mit.edu/ideas-made-to-matter/5g-explained> (describing 1G technologies as

Note argues that SSOs must again evolve, creating a Fourth Wave, influenced by the implications of 5G's heterogeneity, technologically, economically, and politically. This Fourth Wave must embrace *coordination* among 5G stakeholders, industry groups, and SSOs or risk falling apart.<sup>27</sup>

This Note begins by introducing traditional and Third Wave approaches to standard setting. Next, this Note introduces 5G technology and explains why 5G standard setting is threatening existing standard-setting procedures. Finally, this Note describes what a "Fourth Wave" embodying *coordination* among 5G stakeholders, industry groups, and SSOs might look like. 5G has much promise—one scholar claimed that it "is as central to the next phase of human existence as electricity was a hundred years ago."<sup>28</sup> But ignoring 3GPP's existential crisis risks limiting its potential.

## II. SSOs AS SOCIAL INSTITUTIONS

SSOs are a form of institutional innovation. Historians describe the rise of SSOs as a movement, promising critical infrastructure for the global economy yet threatening "insidious authoritarian[ism]."<sup>29</sup> The Enlightenment era goal of creating common standards and finding best practices through widespread engagement among experts fueled the need for SSOs.<sup>30</sup> For example, SSOs first formed in the United Kingdom to harmonize standards for steam boilers.<sup>31</sup> In the U.S., SSOs emerged to set uniform standards for screw threads.<sup>32</sup>

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cellular phones, 2G as messaging, 3G as Internet access, and 4G as fast data download speeds) [<https://perma.cc/HF6Q-CABE>].

<sup>27</sup> The coordination problem is by no means new or exclusive to wireless technologies. *See, e.g.*, Mark Cohen & Philip Rogers, *A Techno-Globalist Approach to Intellectual Property and Supply Chain Disruption*, HINRICH FOUND. (Oct. 13, 2020) <https://www.hinrichfoundation.com/research/wp/tech/ip-strategy-techno-nationalism/> (describing global supply chain disruption and offering a "techno-globalist" solution) [<https://perma.cc/S9WJ-YBNT>]; Jorge Contreras, *The New Extraterritoriality: FRAND Royalties, Anti-Suit Injunctions and the Global Race to the Bottom in Disputes Over Standards-Essential Patents*, 25 B.U.J. SCI. & TECH. L. 251, 251 (2019), <https://www.bu.edu/jostl/files/2019/10/1.-Contreras.pdf> (describing domestic courts' use of extraterritorial anti-suit injunctions to establish global royalty rates) [<https://perma.cc/4B5L-H446>].

<sup>28</sup> Crawford, *supra* note 5, at 9.

<sup>29</sup> YATES & MURPHY, *supra* note 7, at 333.

<sup>30</sup> *Id.*

<sup>31</sup> *Id.* at 19 (noting that the first standards developed had revolved around scientific terminology and units).

<sup>32</sup> *See* James Surowiecki, *Turn of the Century*, WIRED (Jan. 1, 2002, 12:00 PM), <https://www.wired.com/2002/01/standards-2/> [<https://perma.cc/PKZ6-G38N>].

SSOs have proven to be particularly valuable because they reduce barriers to creating “network effects.” Network effects arise whenever the value that consumers place on a product or service depends on the number of other consumers using that product or service.<sup>33</sup> As the number of adopters increases, the benefits of being part of the network increase. Networks thus add value exponentially.<sup>34</sup> But there are significant barriers to creating network effects, including physical and intangible limits such as consumer familiarity, availability of alternatives, switching costs, and legal barriers like intellectual property protection and competition policy.<sup>35</sup> SSOs are institutional innovations that overcome many of these barriers.

Some claim that “without standardization there wouldn’t be a modern economy.”<sup>36</sup> Others question how obscure committees of technocrats may wield their social power.<sup>37</sup> However, the popularity of SSOs has been fueled by the recognition in the West that, with the proper structure and focus, they can outperform governments and markets in setting standards. Governments typically suffer from informational deficits, bureaucratic inertia, and regulatory capture, and markets suffer from private monopolies and interoperability issues.<sup>38</sup> With technical committees and broad, balanced participation, SSOs have the advantages of expertise and claims of legitimacy to promote orderly technical transitions.<sup>39</sup>

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<sup>33</sup> MENELL, *supra* note 11, at 7. *But see* DAVID SINGH GREWAL, NETWORK POWER: THE SOCIAL DYNAMICS OF GLOBALIZATION 5 (2008) (criticizing network power, another term for network effects, because they have the danger of stifling development and locking in technology at the expense of better options).

<sup>34</sup> *See* MENELL, *supra* note 11, at 7.

<sup>35</sup> *Id.* at 7–8 (“The magnitude of network effects depends on several considerations: interdependencies of consumer utility functions, range of complementary products or services, availability of alternative platforms, switching costs, business strategies, and legal limits on leveraging network markets (such as intellectual property protection and competition policy). In some cases, physical limitations govern network access—e.g., where a device must physically or digitally interoperate with other devices. In others, the network is not physically constrained, but instead driven by consumer familiarity or ease of use.”).

<sup>36</sup> *See* SUROWEICKI, *supra* note 28.

<sup>37</sup> *See* GREWAL, *supra* note 29, at 295 (arguing that “relations of sovereignty constitute our best hope for overcoming structural domination . . . as the power of today’s global networks becomes increasingly coercive—because increasingly universal . . .”).

<sup>38</sup> Jonathan Barnett, *Antitrust Overreach: Undoing Cooperative Standardization in the Digital Economy*, 25 MICH. TECH. L. REV. 163, 163, 181 (2019).

<sup>39</sup> *See e.g.*, YATES & MURPHY, *supra* note 7, at 101. *See generally* Brian Fung, *How China’s Huawei Took the Lead Over US Companies in 5G Technology*, WASH. POST (Apr. 10, 2019) <https://www.washingtonpost.com/technology/2019/04/10/us-spat-with-huawei-explained/> (describing the differing approaches taken in North America and Europe to developing common standards for wireless communications technology) / [<https://perma.cc/6WUV-SYG2>].

The history of SSOs can be understood as taking place in three waves—with a budding fourth, this Note argues, if we can manage it. As standard setting evolved from nationally-based standards (First Wave) to internationally-based standards (Second Wave), SSOs developed a traditional structure: standardization by private committee—a form of deliberative, technocratic decision-making.<sup>40</sup> During these first two waves, SSOs embodied the key democratic principles of consensus voting, such as including all stakeholders in discussion (e.g., producers, purchasers, and independent engineers) and voluntary adoption of the standards created.<sup>41</sup> This process, dominated by Western companies and Allied nations, was intended to reassure insiders as well as outsiders that SSO actors were transcending self-interest in favor of the public interest.<sup>42</sup>

However, the emergence of computer networking and the rapid pace of technological change in the late 1980s challenged SSOs to evolve from traditional structures to more diverse structures, creating the Third Wave.<sup>43</sup> While First and Second Wave SSOs maintained “the advantage of experience and authority,” with a clear hierarchy among SSOs, they were too slow to maintain relevance,<sup>44</sup> causing some commentators to argue for a return to the messy but creative market for fluid and flexible standard-making.<sup>45</sup> The Third Wave created a diversity of SSO structures. For example, the Third-Wave SSO Internet Engineering Task Force rejected “kings, presidents, and voting,”<sup>46</sup> had open participation, and believed in “rough consensus and running code.” The Third Wave also saw the proliferation of oligarchic “standards consortia,” SSOs comprised of a few like-minded firms that avoided the multi-stakeholder consensus process.<sup>47</sup> These new forms could more quickly come to consensus and were better placed to create anticipatory standards for specific technologies. However, what these new forms gained in speed, they gave up in uniformity and democratic principles.<sup>48</sup> Unlike First and Second Wave SSOs, which maintained clear separation between technologies and were hierarchically

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<sup>40</sup> YATES & MURPHY, *supra* note 7, at 13–14.

<sup>41</sup> *Id.*

<sup>42</sup> *Id.* at 14–15.

<sup>43</sup> *Id.*

<sup>44</sup> *Id.*

<sup>45</sup> See SUROWEICKI, *supra* note 28.

<sup>46</sup> YATES & MURPHY, *supra* note 7, at 250.

<sup>47</sup> *Id.*

<sup>48</sup> See, e.g., Mehmet Bilal Ünver, *Turning the Crossroad for a Connected World: Reshaping the European Prospect for the Internet of Things*, INT’L. J. OF LAW & INFO. TECH. 93 (2018) (documenting the difficulty varying SSO structures and rules create for IoT deployment); Justus Baron & Kirti Gupta, *Unpacking 3GPP Standards*, 27 J. ECON. & MGMT. STRATEGY 433 (2018) (documenting the large heterogeneity in the rules and procedures among SSOs).

ordered,<sup>49</sup> Third Wave SSOs were less unified and in fact overlapped, creating a “wild west” of standardization efforts.<sup>50</sup> And this lack of coordination—which was once seen as a strength in allowing Third Wave SSOs to move quickly—is, in fact, slowing them down.<sup>51</sup>

### III. WHAT IS 5G?

5G is the fifth generation of wireless communications technology.<sup>52</sup> Since 1980 with 1G, roughly every 10 years there has been a network evolution.<sup>53</sup> 1G enabled analog wireless cellular networks, which allowed mobile voice communications.<sup>54</sup> It was replaced around 1990 by 2G, which allowed Short Message Service (SMS).<sup>55</sup> In the early 2000s, 3G brought about various data services, including Internet access, video calls, and mobile television.<sup>56</sup> 4G/LTE in 2010 achieved high-speed mobile data transmission, spurring a data and connected-device explosion.<sup>57</sup> However, as could already be anticipated in 2010, the demands on wireless networks quickly overwhelmed 4G network capabilities.<sup>58</sup> 5G promises to meet this increased demand through higher data rates, ultra-low latency (or imperceptible lag time), efficiency, scalability, and high reliability.<sup>59</sup> Yet to meet these objectives, 5G cannot merely be an evolution of 4G. Intel’s Director of Wireless Communication Research, Vilda Ilderem, predicts something much grander: “[5G] requires major improvements over 4G throughput and capacity, and is the first wireless protocol to address the inclusion of the massive number of machines/things in the network.”<sup>60</sup> In short, because 5G

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<sup>49</sup> YATES & MURPHY, *supra* note 7, at 335.

<sup>50</sup> LAURA DENARDIS, *THE INTERNET IN EVERYTHING: FREEDOM AND SECURITY IN A WORLD WITH NO OFF SWITCH* 137 (2020).

<sup>51</sup> Timothy Simcoe, *Standard Setting Committees: Consensus Governance for Shared Technology Platforms*, 102 *AMERICAN ECON. REV.* 305-336 (2012).

<sup>52</sup> *High five*, 3 *NATURE ELECTRONICA* 1, 1 (2020).

<sup>53</sup> *Id.*

<sup>54</sup> *Id.*

<sup>55</sup> *Id.*

<sup>56</sup> See *What is the Difference Between 3G, 4G and 5G?*, VERIZON (Nov. 18, 2019), <https://www.verizon.com/about/our-company/5g/difference-between-3g-4g-5g> [<https://perma.cc/3TB9-D7HE>].

<sup>57</sup> See *id.*

<sup>58</sup> See *id.*

<sup>59</sup> See *id.*

<sup>60</sup> Vilda Ilderem, *The Technology Underpinning 5G*, 3 *NATURE ELECTRONICA* 5–6 (2020).

integrates 4G, Wi-Fi, millimeter wave, and other wireless-access technologies, it is considered a “transformative ecosystem.”<sup>61</sup>

In practice, 5G is a suite of telecom technologies standardized by SSOs. Most of these technologies are standardized by 3GPP, which divides 5G technology into three groups: Radio Access Network (RAN), Service and System Aspects (SSA), and Core Network and Terminals (CNT).<sup>62</sup> From these three technology groups, 3GPP enables three usage scenarios in communication services, as illustrated in Figure 1: (1) enhanced mobile broadband (emBB), (2) massive machine-type communication (mMTC), and (3) ultra-reliable, low-latency communications (URLLC).<sup>63</sup>

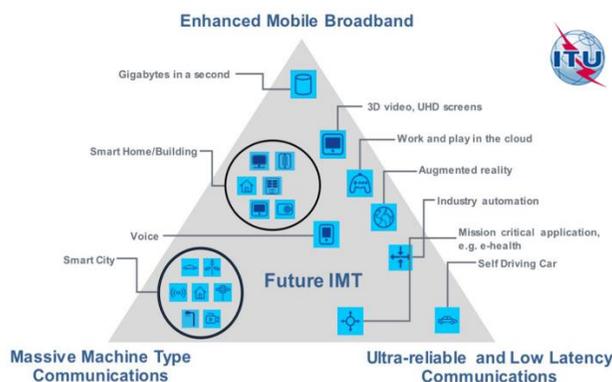


Fig 1: 5G trends.<sup>64</sup>

emBB is consumer device focused and designed to improve user experiences by aiming for higher throughput and lower latency.<sup>65</sup> mMTC pertains to IoT use cases, thus sporadically connecting low-power, low-complexity devices such as smart meters and environment sensors with data.<sup>66</sup> URLLC pertains to “mission-critical communications” with strict requirements on latency and reliability such as vehicle-to-vehicle communication and remote surgery.<sup>67</sup>

<sup>61</sup> Darrell M. West, *How 5G Technology Enables the Health Internet of Things*, CTR. FOR TECH. INNOVATION AT BROOKINGS (2016), <https://www.brookings.edu/research/how-5g-technology-enables-the-health-internet-of-things/> [<https://perma.cc/8TRH-YP6Y>].

<sup>62</sup> *Specifications Groups*, 3GPP, <https://www.3gpp.org/specifications-groups> (last visited Nov. 10, 2020) [<https://perma.cc/44Z3-KVBJ>].

<sup>63</sup> *IMT Vision – Framework and Overall Objectives of the Future Development of IMT for 2020 and Beyond*, INT’L TELECOMM. UNION (Sep. 2015), [https://www.itu.int/dms\\_pubrec/itu-r/rec/m/R-REC-M.2083-0-201509-I!!PDF-E.pdf](https://www.itu.int/dms_pubrec/itu-r/rec/m/R-REC-M.2083-0-201509-I!!PDF-E.pdf) [<https://perma.cc/F6SF-3R67>].

<sup>64</sup> *Id.*

<sup>65</sup> *Id.*

<sup>66</sup> *Id.*

<sup>67</sup> *Id.*

Given these different uses, 5G is sometimes termed a “unifying connectivity fabric.”<sup>68</sup> To achieve these ends, however, 5G is by design the first generation to integrate heterogeneous technologies, including traditional wireline connections, Wi-Fi access, communications between cars, IoT devices, and even satellite. 5G also supports both 3GPP and non-3GPP access technologies.<sup>69</sup> As demonstrated in Figure 2, one of these non-3GPP technologies is Wi-Fi, standards of which are set by the Institute of Electrical and Electronics Engineers (IEEE).

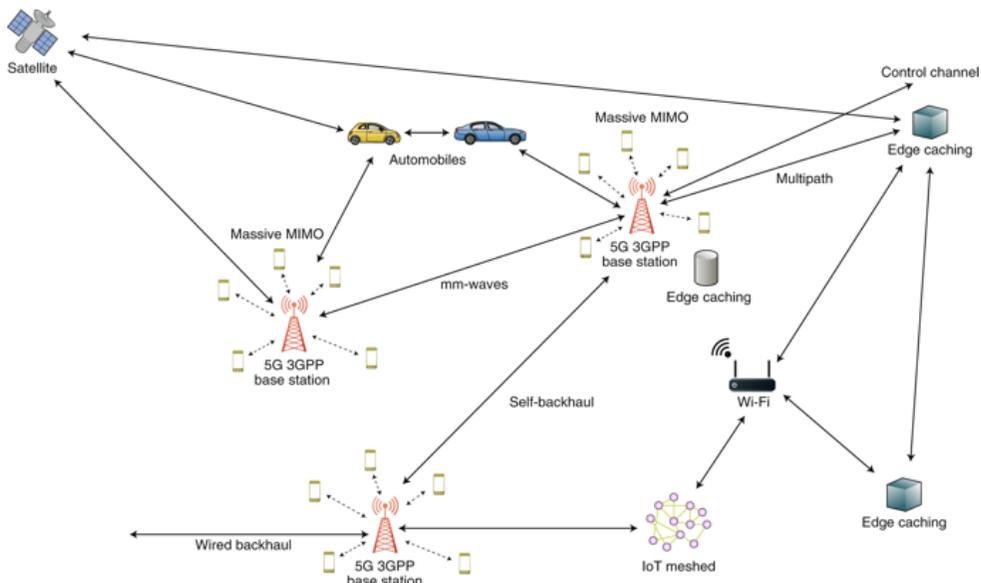


Fig 2: 5G's Heterogeneity<sup>70</sup>

Based on these technology improvements, 5G promises to finally enable cutting-edge technologies like self-driving cars, the IoT, and augmented reality.<sup>71</sup> With these improvements will come a huge economic windfall, beyond the gains of 4G.<sup>72</sup> Further, 5G's deployment seems to have

<sup>68</sup> *How can the Fabric of a Simple Dress be Part of our 5G Vision?*, QUALCOMM (Aug. 1, 2018), <https://www.qualcomm.com/news/onq/2018/08/01/how-can-fabric-simple-dress-be-part-our-5g-vision> [<https://perma.cc/Z9XV-GKGS>].

<sup>69</sup> Muriel Médard, *Is 5 Just What Comes After 4?*, 3 NATURE ELECTRONICS 2–4 (2020) (“3GPP technologies include those that are carried by base stations built by traditional telephone equipment manufacturers, whereas non-3GPP technologies include Wi-Fi, a wireless broadband technology standard.”).

<sup>70</sup> *Id.*

<sup>71</sup> Anderson and Arbel, *supra* note 2.

<sup>72</sup> *Id.*

become even more important with the coronavirus pandemic and increased remote work.<sup>73</sup>

As of December 2020, 5G has not yet been completely standardized. Its upcoming release is the subject of the largest dispute among 3GPP members because it deals with what is most revolutionary about 5G: replacing many of the hardware components of the network with software that “virtualizes” the network.<sup>74</sup> This revolution has “the potential to consume nearly all of the fragmented proprietary protocols that have historically defined telecommunications infrastructure.”<sup>75</sup> A virtualized network replaces hardware with software components, potentially creating a more open and general-purpose device that “eliminate[s] the need for specific technology protocols for specific functions.”<sup>76</sup>

It is this virtualization aspect of 5G—its replacement of hardware with software, thereby disassociating 5G technology from specific network vendors—that has led to the creation of non-3GPP groups like the above-mentioned Open RAN Policy Consortium, O-RAN Alliance, and Telecom Infra Project and to the growing interest from and ability for governments to influence the direction of the technology.

#### IV. TECHNOLOGY GOVERNANCE CONCERNS

These new trends raise three governance concerns that threaten the future of 5G and international standard making: technical, economic, and political. Each had an important role in the past but that role becomes glaringly more important with the advent of 5G.

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<sup>73</sup> See *Tech in a Time of Crisis*, 3 NATURE ELECTRONICA 181 (2020) (reporting that communications technology has taken on renewed significance helping us not only stay connected but also to try to control the spread of the virus.); see also Rana Foroohar, *US Society Needs a Broadband Big Dig to Get Out of its Hole*, FIN. TIMES (Apr. 5, 2020), <https://www.ft.com/content/731df4c6-758e-11ea-95fe-fcd274e920ca> [<https://perma.cc/ZGR7-XS75>]; John D. McKinnon & Ryan Tracy, *Pandemic Builds Momentum for Broadband Infrastructure Upgrade*, WALL ST. J. (Apr. 23, 2020), [https://www.wsj.com/articles/pandemic-builds-momentum-for-broadband-infrastructure-upgrade-11587461400?mod=hp\\_lead\\_pos10](https://www.wsj.com/articles/pandemic-builds-momentum-for-broadband-infrastructure-upgrade-11587461400?mod=hp_lead_pos10) [<https://perma.cc/L5KQ-3ZWL>]; *Let's be Thankful for a Billion Miles of IP*, IAM MEDIA (Apr. 22, 2020), <https://www.iam-media.com/coronavirus/billion-miles-of-ip> [<https://perma.cc/WFV4-55PY>].

<sup>74</sup> Tom Wheeler, *5G in Five (Not So) Easy Pieces*, BROOKINGS: GOVERNANCE STUD. (Jul. 9, 2019), <https://www.brookings.edu/research/5g-in-five-not-so-easy-pieces/> [hereinafter *Easy Pieces*] [<https://perma.cc/RRG2-SWKP>].

<sup>75</sup> Tom Wheeler, *Moving From 'Secret Sauce' to Open Standards for 5G*, BROOKINGS (Feb. 18, 2020), <https://www.brookings.edu/blog/techtank/2020/02/18/moving-from-secret-sauce-to-open-standards-for-5g/> [<https://perma.cc/M2MF-5BWH>].

<sup>76</sup> *Easy Pieces*, *supra* note 74.

### A. Technical Concerns: Fragmentation, Interoperability, and Security

The first major governance concern is technical, which includes issues of fragmentation, interoperability, and security. The competing and disjointed interests of new entrants in the 5G market create issues of fragmentation. While participation in 3GPP has historically been restricted to major established players like mobile telephone service providers and equipment manufacturers, the integration of 5G into the cyber-physical realm brings new entrants into the 5G market.<sup>77</sup> Makers of technologies that were not traditionally related to mobile telephone service providers and equipment manufacturers, like those in the satellite and automotive industries, currently participate in 3GPP. This raises new challenges around fragmentation of standard setting not only within 3GPP but also among SSOs, leading to disjointed and redundant development with “competing efforts by different stakeholders, industry groups, and established standards-setting institutions.”<sup>78</sup>

New entrants in the 5G market also create issues of interoperability, defined as “[t]he ability of two or more systems or components to exchange data and use information.”<sup>79</sup> Entities involved in fostering interoperability face a tension between cooperating with competitors to grow the potential market and competing with them for market share. Further, “the accelerating pace of innovation and economic incentive to be first to market does not comport with the slower pace of collaborative standards setting.”<sup>80</sup> In addition, “companies in the IoT space do not necessarily have a history of involvement in digital-standards-setting organizations.”<sup>81</sup> To deliver on its full potential as an enabler of global business, a 5G standard must be adopted globally, which is difficult to achieve in a non-collaborative competitive market.

Finally, the increasing number of connected devices raises security and user privacy concerns.<sup>82</sup> As Figure 3 demonstrates, the communications

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<sup>77</sup> Médard, *supra* note 69, at 2.

<sup>78</sup> DENARDIS, *supra* note 48, at 142.

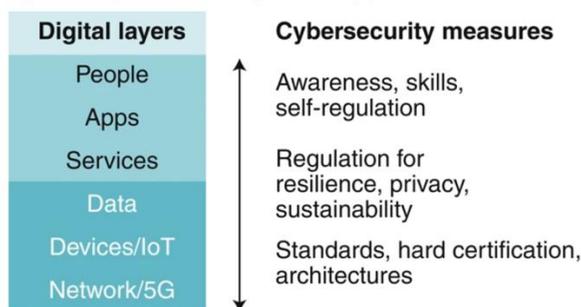
<sup>79</sup> LAURA DENARDIS, *OPENING STANDARDS: THE GLOBAL POLITICS OF INTEROPERABILITY* 215 (2011).

<sup>80</sup> DENARDIS, *supra* note 48, at 145.

<sup>81</sup> *Id.*

<sup>82</sup> See generally Ahmad et al., *supra* note 21, at 198; Dongfeng Fang & Yi Qian, *Security for 5G Mobile Wireless Networks*, 6 *IEEEACCESS* 4850 (2018).

network is just one layer of the digital “stack.” Security needs to be addressed in each layer.<sup>83</sup>



For security in the lower layers, hard regulatory measures tend to be used, whereas softer measures are used for the higher layers.

Fig 3: The digital stack and cybersecurity protection.<sup>84</sup>

### B. Economic Concerns: Incentives and Implementation

The second key challenge to governance pertains to the economics of 5G, both in terms of market participants’ incentives and in terms of implementing 5G. As noted above, there are more 5G players than in previous generations because of 5G’s design and because entities that were once standard adopters are becoming standard setters.<sup>85</sup> An increase in the number of players creates new challenges, including ownership disputes and disputes regarding varying economic interests.

One particularly contentious issue pertains to standard essential patents (SEPs), which cover inventions that must be used to implement a standard.<sup>86</sup> According to typical SSO rules, the inventor declares the SEP to be essential to implementing a standard and thereby the inventor is encumbered to license the patents on fair, reasonable, and non-discriminatory

<sup>83</sup> Paul Timmers, *There Will Be No Global 6G Unless We Resolve Sovereignty Concerns in 5G Governance*, 3 NATURE ELECTRONICA 10 (2020).

<sup>84</sup> *Id.*

<sup>85</sup> See, e.g., Kai Jakobs, *The (Future) Role of China in ICT Standardization – A European Perspective*, TELECOMM. POL’Y (2014); see also Raymond Zhong, *China’s Huawei Is at Center of Fight Over 5G’s Future*, N.Y. TIMES (Mar. 7, 2018), <https://www.nytimes.com/2018/03/07/technology/china-huawei-5g-standards.html?searchResultPosition=1> [<https://perma.cc/CQ7J-6HBZ>].

<sup>86</sup> Mark A. Lemley & Timothy Simcoe, *How Essential are Standard-Essential Patents?*, 104 CORNELL L. REV. 607, 507 (2019), <https://www-cdn.law.stanford.edu/wp-content/uploads/2019/07/104-Cornell-Law-Review-607-2019.pdf> [<https://perma.cc/BD5L-PR84>].

(FRAND) terms to licensees that wish to adopt the standard.<sup>87</sup> As such, they are typically infringed by the implementation of a standard.

Commentators have raised concerns and called for legislative reform<sup>88</sup> and antitrust intervention<sup>89</sup> regarding three kinds of risks that SEPs pose. First, the “patent thicket” risk in the SSO context occurs when a standard involves large numbers of SEPs—often of varying quality and relevance—and patents that have not been declared as essential to the standard but could be infringed by the standard and thus impede its implementation.<sup>90</sup> Second, the “patent hold-up” risk occurs in the SSO context after an SSO makes irreversible choices in which SEPs to use, thus presenting an opportunity for SEP owners to increase their royalty rates.<sup>91</sup> Third, the “overdisclosure” problem occurs when parties declare their own patents as “‘essential’ to a technology standard when, in reality, the claims of those patents would not be infringed by a standard-compliant product.”<sup>92</sup> This problem exists because of a persistent misalignment of economic incentives: SSOs have inconsistent policies regarding SEP declaration, harsh penalties for failing to disclose SEPs, and a lack of consequences for overdisclosure.<sup>93</sup> The problem of overdisclosure inflates and complicates royalty rates in license negotiations and skews courts’ reasonable-royalty analyses.<sup>94</sup>

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<sup>87</sup> See U.S. Dep’t of Justice & U.S. Patent & Trademark Office, Policy Statement on Remedies for Standards-Essential Patents Subject to Voluntary F/RAND Commitments 1 n.2 (2019) [hereinafter DOJ/PTO Policy Statement], <https://www.uspto.gov/sites/default/files/documents/SEP%20policy%20statement%20signed.pdf>; see also, Cody M. Akins, *Overdeclaration of Standard-Essential Patents*, 98 TEXAS L. REV. 579, 583 <https://texaslawreview.org/overdeclaration-of-standard-essential-patents/> (“The vast majority of SSOs have some form of disclosure requirement for standard-essential intellectual-property rights.”) [<https://perma.cc/87RV-JKNW>]. However, different SSOs have taken different approaches to determining FRAND licensing terms. See Rana Foroohar, *Let the 5G Battles Begin*, FIN. TIMES (Nov. 26, 2017), <https://www.ft.com/content/d8d615aef9c-11e7-b781-794ce08b24dc.pdf> [<https://perma.cc/D5LV-S49H>].

<sup>88</sup> See Mark Lemley, *Ten Things to Do About Patent Holdup of Standards (and One Not To)*, 48 B.C. L. REV. 149, 163 (2007).

<sup>89</sup> See George S. Cary, Mark W. Nelson, Steven J. Kaiser, & Alex R. Sistla, *The Case for Antitrust Law to Police the Patent Hold-Up Problem in Standard Setting*, 77 ANTITRUST L.J., 913, 913 (2011).

<sup>90</sup> Mark A. Lemley & Carl Shapiro, *Patent Holdup and Royalty Stacking*, 85 TEX. L. REV. 1991, 2009 (2006).

<sup>91</sup> *Id.*

<sup>92</sup> Akins, *supra* note 87.

<sup>93</sup> *Id.*

<sup>94</sup> *Id.*; Dieter Ernst, *China’s Standard-Essential Patents Challenge: From Latecomer to (Almost) Equal Player?*, CIGI (2017), <https://www.cigionline.org/sites/default/files/documents/China%27s%20Patents%20ChallengeWEB.pdf> [<https://perma.cc/7VWW-C3K4>].

Despite the differentiated effects of SEPs in standards and the role of SEPs in reducing the likelihood of standard replacement, SEPs incentivize innovation and increase the likelihood of standard upgrades.<sup>95</sup> Further, having an SEP declared as essential brings undeniable benefits. One scholar, for example, highlights an increase in the number of patent citations after a patent is declared an SEP.<sup>96</sup> Others note that declared SEPs contribute more to firm profits and market share than comparable non-SEP patents<sup>97</sup> and that an SSO's endorsement of a startup's technology standard increases its likelihood of an initial public offering or acquisition.<sup>98</sup> Because of the high value of SEPs, China has argued that patenting in standards constitute barriers to trade.<sup>99</sup> At the same time, the Chinese patent office has behaved preferentially in reviewing domestic SEPs compared to foreign SEPs, when the patent is declared as an SEP prior to examination.<sup>100</sup>

The participants may also have different economic interests beyond patents. For example, the Federal Communications Commission's Chief Technology Officer, Henning Schulzrinne, has noted that disputes between network manufacturers who want to lengthen product cycles and carriers who want to shorten them have raised questions on how many upgrades require a new "G" with 5G.<sup>101</sup> In addition, network costs will necessarily

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<sup>95</sup> See Justus Baron et al., *Essential Patents and Standard Dynamics*, 45 RES. POL'Y 1762, 1762–63 (2016).

<sup>96</sup> Marc Rysma & Timothy Simcoe, *Patents and the Performance of Voluntary Standard Setting Organizations*, 54 MGMT. SCI. 1920, 1929 (2008).

<sup>97</sup> Katrin Hussinger, & Franz Schwiebacher, *The Market Value of Technology Disclosures to Standard Setting Organizations*, 22 INDUS. & INNOVATION 321, 334 (2015).

<sup>98</sup> See David Wagespack & Lee Fleming, *Scanning the Commons? Evidence on the Benefits to Startups Participating in Open Standards Development*, 55 MGMT. SCI. 210, 211 (2009).

<sup>99</sup> See, e.g., Committee on Technical Barriers to Trade, *Intellectual Property Right (IPR) Issues in Standardization: Background Paper for Chinese Submission to WTO*, WTO Doc. G/TBT/W/251, G/TBT/W/251-Add.1, (November 9, 2006), Christopher S. Gibson, *Globalization and the Technology Standards Game: Balancing Concerns of Protectionism and Intellectual Property in International Standards*, 22 BERK. TECH. L. REV. 1403, 1406 ("China has responded that the mandatory adoption of international standards comes at a significant cost, particularly for developing countries. It has complained of unfair treatment when seeking to participate in the international standards system, suggesting that IP rights create obstacles for them and other developing countries by hindering access to new technologies and imposing significant costs in the form of royalty payments.").

<sup>100</sup> See GAETAN DE RASENFOSSE ET. AL., *DISCRIMINATION IN THE PATENT SYSTEM: EVIDENCE FROM STANDARD-ESSENTIAL PATENTS* 19–20 (2017), [https://www.oecd.org/site/stipatents/IPSDM17\\_6.4\\_bekkers-et-al.pdf](https://www.oecd.org/site/stipatents/IPSDM17_6.4_bekkers-et-al.pdf) [<https://perma.cc/U2QU-37BA>].

<sup>101</sup> Scott Fulton III, *How China, Brexit, and the US Derailed Global 5G Wireless*, ZDNET (Aug. 16, 2019), <https://www.zdnet.com/article/how-china-brexit-and-the-us-derailed-global-5g-wireless.pdf> [<https://perma.cc/96WC-YF6B>].

increase with 5G because, among other things, 5G frequencies “require more base stations—the sites that act as common connection points for local wireless networks”<sup>102</sup>—which will likely mean costly updates for network manufacturers.<sup>103</sup>

### C. Political Concerns: Past, Present, and Future

The third governance concern is the unprecedented politicization of the standardization process.<sup>104</sup> Standard setting has always been partisan in the sense that there are winners and losers, but the concern facing SSOs today have gone from “once-esoteric [to] geopolitical.”<sup>105</sup> Even SSOs like 3GPP<sup>106</sup> and ETSI<sup>107</sup> have warned of potential standardization bifurcation if American and Chinese entities refuse to cooperate because of political concerns.

Commentators have discussed recent politicization over standard setting in relation to the current “tech Cold War” between the U.S. and China,<sup>108</sup> but this discussion often overlooks the historical roots of the tension, as well as China’s other international activities. China challenged

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<sup>102</sup> River Davis, *Forget 5G for a Moment. Instead, Imagine 6G*, WALL ST. J. ONLINE (Apr. 12, 2020), [https://www.wsj.com/articles/forget-5g-for-a-moment-instead-imagine-6g11586743200?](https://www.wsj.com/articles/forget-5g-for-a-moment-instead-imagine-6g11586743200?mod=searchresults&page=1&pos=1.pdf)

<https://www.wsj.com/articles/forget-5g-for-a-moment-instead-imagine-6g11586743200?mod=searchresults&page=1&pos=1.pdf> [https://perma.cc/5A3P-B548].

<sup>103</sup> See Ferry Grijpink et al., *The Road to 5G: The Inevitable Growth of Infrastructure Cost*, MCKINSEY & CO. (Feb. 23, 2018), <https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-road-to-5g-the-inevitable-growth-of-infrastructure-cost#> [https://perma.cc/HAG3-RRRE].

<sup>104</sup> See Edwards, *supra* note 94; James Edwards, *Integrity, Quality and Secure IP Rights are Standard-Essential*, IPWATCHDOG (Aug. 12, 2019), <https://www.ipwatchdog.com/2019/08/12/integrity-quality-and-secure-ip-rights-are-standard-essential/id=112103.pdf> [https://perma.cc/D26E-D9G3].

<sup>105</sup> DENARDIS, *supra* note 45, at 324.

<sup>106</sup> Louise Lucas, *Standards Body Warns on US Blacklisting of Huawei*, FIN. TIMES (June 9, 2019), <https://www.ft.com/content/7e510cc0-88ea-11e9-97ea-05ac2431f453.pdf> [https://perma.cc/CM4C-WTBP].

<sup>107</sup> Monia Allevin, *Huawei Maintains Seat at Standards Table Despite Geopolitical Woes*, FIERCEWIRELESS (Feb. 28, 2019), <https://www.fiercewireless.com/wireless/huawei-maintains-seat-at-standards-table-despite-geopolitical-woes.pdf> [https://perma.cc/N3PA-S8ZR].

<sup>108</sup> *Open Standards, Not Sanctions, Are America’s Best Weapon Against Huawei*, ECONOMIST (Apr. 8, 2020), <https://www.economist.com/leaders/2020/04/08/open-standards-not-sanctions-are-americas-best-weapon-against-huawei> [https://perma.cc/9QYJ-EAXU].

U.S. standardization processes well before the Trump administration.<sup>109</sup> China has also subsidized participation in standardization activities and filed for patents overseas to enable it to play a leading role in standardization efforts.<sup>110</sup> These state-interventionist approaches are frequently admonished as incompatible with the private-rights orientation of SSOs.<sup>111</sup>

Today, realizing that China has increased its influence within SSOs,<sup>112</sup> the Trump administration has sought to cripple Chinese firms like telecom giant Huawei<sup>113</sup> through use of European-style industrial policies.<sup>114</sup> That strategy aimed to blacklist Chinese firms<sup>115</sup> and create a national 5G strategy,<sup>116</sup> including by proposing public, private, and public-private 5G

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<sup>109</sup> See e.g., Brian DeLacey et. al., *Government Intervention in Standardization: The Case of WAPI* (SSRN Working Paper Series No. 777, 2006) [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=930930](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=930930) (discussing China's behavior in the International Standard Organization in 2006 regarding the wireless security standard) [<https://perma.cc/P4VH-JNY3>]; Committee on Technical Barriers to Trade, *Intellectual Property Right (IPR) Issues in Standardization: Background Paper for Chinese Submission to WTO*, WTO Doc. G/TBT/W/251, G/TBT/W/251-Add.1, (November 9, 2006).

<sup>110</sup> DeLacey, *supra* note 110.

<sup>111</sup> *Id.*

<sup>112</sup> Elsa Kania, *China's Play for Global 5G Dominance—Standards and the 'Digital Silk Road'*, THE STRATEGIST (Jun. 27, 2018), <https://www.aspistrategist.org.au/chinas-play-for-global-5g-dominance-standards-and-the-digital-silk-road.pdf> [<https://perma.cc/8P8G-T3HR>]. But see Steven Erlanger, *Global Backlash Builds Against China Over Coronavirus*, N.Y. TIMES (May 3, 2020), <https://www.nytimes.com/2020/05/03/world/europe/backlash-china-coronavirus.html?action=click&module=Spotlight&pgtype=Homepage.pdf> [<https://perma.cc/95G7-K8HU>].

<sup>113</sup> The arguments for doing so often center on the threat Huawei poses to national security. See e.g., David McCabe, *F.C.C. Designates Huawei and ZTE as National Security Threats*, N.Y. TIMES (June 2020), <https://www.nytimes.com/2020/06/30/technology/fcc-huawei-zte-national-security.html> [<https://perma.cc/9YN6-AKN2>].

<sup>114</sup> See Mike Dano, *How Trump and the Coronavirus Could Impact 5G Standards*, LIGHTREADING (Apr. 6, 2020), <https://www.lightreading.com/5g/how-trump-and-the-coronavirus-could-impact-5g-standards/d/d-id/758711.pdf> [<https://perma.cc/RG6Y-37NJ>].

<sup>115</sup> Jeanne Whalen et al., *US Tech Firms Push Trump to Allow Sales to Huawei, Set Up White House Meeting Next Week*, WASH. POST (July 19, 2019), <https://www.washingtonpost.com/business/2019/07/19/us-tech-companies-push-trump-allow-some-sales-huawei.pdf> [<https://perma.cc/3FDQ-HZTE>].

<sup>116</sup> See, e.g., Don Clark & Cecilia Kang, *Why Companies and Countries are Battling for Ascendancy in 5G*, N.Y. TIMES (Mar. 6, 2018), <https://www.nytimes.com/2018/03/06/technology/companies-countries-battling-5g.html?searchResultPosition=2.pdf> (preventing a takeover of Qualcomm by Broadcom for national security reasons) [<https://perma.cc/45R4-HWZN>]; Brian Fung, *How 5G Became a Political Football in a Merger Attempt Involving Two of the World's Biggest Chip Makers*, WASH. POST (Mar. 7, 2018), <https://www.washingtonpost.com/news/the-switch/wp/2018/03/07/how-5g-became-a-political-football-in-a-merger-between-two-of-the-worlds-biggest-chip-makers.pdf> [<https://perma.cc/9ACL-9LXM>].

infrastructures.<sup>117</sup> It has also sought to use export controls to limit Huawei's access to standardization bodies.<sup>118</sup>

Some call for the U.S. and Europe to develop an alternative system to exclude Huawei's technology.<sup>119</sup> However, by forcing American firms to limit their interactions with Huawei, which plays a critical role in 5G standard setting, two unintended consequences emerge. First, American firms are sidelined from participating in international 5G standard setting, and second, standards bodies have threatened to leave the U.S. to avoid government interference.<sup>120</sup> Recognition of America's waning influence has prompted legislation requiring American officials to participate in the

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<sup>117</sup> See John Hendel & Margaret Harding McGill, *Trump Campaign Pushes Government Intervention on 5G*, POLITICO (Mar. 1, 2019), <https://www.politico.com/story/2019/03/01/trump-campaign-5g-1230276.pdf> [https://perma.cc/65HL-QT4V]; Kevin Werbach, *Trump's 5G Plan is More than a Gift to his Base*, N.Y. TIMES (Mar. 6, 2019), <https://www.nytimes.com/2019/03/06/opinion/trump-5g-wireless.html.pdf> [https://perma.cc/6ZYU-CXY6]; Tim Wu, *Should Trump Nationalize a 5G Network?*, N.Y. TIMES (Jan. 31, 2018), <https://www.nytimes.com/2018/01/31/opinion/nationalize-5g-network.html?action=click&module=RelatedLinks&pgtype=Article.pdf> [https://perma.cc/ZE98-5S98].

<sup>118</sup> See Mark Cohen, *Licensing Intellectual Property in a Changing Trade Environment*, IAM 102, 103 (2019), [https://chinaipr2.files.wordpress.com/2019/11/iam97\\_cfius-and-ip.pdf](https://chinaipr2.files.wordpress.com/2019/11/iam97_cfius-and-ip.pdf) [https://perma.cc/2P83-3VZJ].

<sup>119</sup> See Thomas J. Duesterberg, *There Is a Better Alternative to Huawei*, WALL ST. J. (Feb. 5, 2020), <https://www.wsj.com/articles/there-is-a-better-alternative-to-huawei-11580947530?mod=searchresults&page=1&pos=2.pdf> [https://perma.cc/LXA4-WQ5]; *America Does Not Want China to Dominate 5G Mobile networks*, ECONOMIST (Apr. 8, 2020), <https://www.economist.com/business/2020/04/08/america-does-not-want-china-to-dominate-5g-mobile-networks.pdf> [https://perma.cc/79MS-DKQ4]; *Open Standards, Not Sanctions, Are America's Best Weapon Against Huawei*, ECONOMIST (Apr. 8, 2020), <https://www.economist.com/leaders/2020/04/08/open-standards-not-sanctions-are-americas-best-weapon-against-huawei.pdf> [https://perma.cc/A7TX-WHTA].

<sup>120</sup> See Press Release, U.S. Dep't of Commerce, Commerce Clears Way for U.S. Companies to More Fully Engage in Tech Standards-Development Bodies (June 15, 2020), <https://www.commerce.gov/news/press-releases/2020/06/commerce-clears-way-us-companies-more-fully-engage-tech-standards> ("This action is meant to ensure Huawei's placement on the Entity List in May 2019 does not prevent American companies from contributing to important standards-developing activities despite Huawei's pervasive participation in standards-development organizations.") [https://perma.cc/FB8Z-MKPZ]; *The Fight with Huawei Means America Can't Shape Tech Rules*, ECONOMIST (Apr. 23, 2020), <https://www.economist.com/united-states/2020/04/23/the-fight-with-huawei-means-america-cant-shape-tech-rules.pdf> [https://perma.cc/289C-ZQBP]; Christian Shepherd, *Top Industry Standards Body Drops Huawei From Its Journals*, FIN. TIMES (May 29, 2019), <https://www.ft.com/content/6564035e-820d-11e9-b592-5fe435b57a3b.pdf> [https://perma.cc/STT3-8VVY].

development of 5G standards<sup>121</sup> and the release of a White House “national strategy to secure 5G” document outlining how to “promote responsible global development and deployment of 5G.”<sup>122</sup>

While governments are right to be concerned about 5G,<sup>123</sup> these nationalist disputes create great difficulty for SSOs. They fragment participation and decrease trust in institutions.<sup>124</sup> As governments fully realize the importance of technology governance and reassert control over key technologies, they risk fragmenting future technologies geographically through strategic-partnership approaches rather than through a global-common-good approach with risk management.<sup>125</sup> If 5G splits into two blocs centered around China and the EU/U.S., this could spell the end of SSOs such as 3GPP and risk limiting the potential of 5G and future technologies. A crucial question is how 3GPP and other global SSOs can adapt to these 5G governance concerns and demonstrate their legitimacy in creating international standards.

## V. FOURTH WAVE

To regain legitimacy, SSOs like 3GPP must evolve not only to withstand 5G’s heterogeneity but also to maintain the speed necessary to keep up with the rapidly evolving technology. This requires a Fourth Wave defined by *coordination* among stakeholders, industry groups, and SSOs. Although there are benefits to many minds freely seeking optimal solutions, the benefits of more coordinated exploration would help reduce unnecessary

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<sup>121</sup> See Secure 5G and Beyond Act of 2020, Pub. L. No. 116–129 (2020); Karen Freifeld & Chris Prentice, *US Drafts Rule to Allow Huawei and US Firms to Work Together on 5G Standards*, REUTERS (May 6, 2020), <https://uk.reuters.com/article/us-usa-china-huawei-tech-exclusive/exclusive-u-s-drafts-rule-to-allow-huawei-and-u-s-firms-to-work-together-on-5g-standards-sources-idUKKBN22I1ZY.pdf> [https://perma.cc/BLR5-TPLG].

<sup>122</sup> *National Strategy to Secure 5G of the United States of America*, THE WHITE HOUSE (Mar. 2020), <https://www.whitehouse.gov/wp-content/uploads/2020/03/National-Strategy-5G-Final.pdf> [https://perma.cc/SYW6-JCF6].

<sup>123</sup> See DENARDIS, *supra* note 45, at 3 (claiming that “transformation of the Internet from a communication network between people to a control network embedded directly into the physical world may be more consequential than the shift from an industrial society to a digital information society.”).

<sup>124</sup> See Anthony Rutkowski, *Keep Politics Out of 5G International Standardization* (March 10, 2021), CircleID, <https://www.circleid.com/posts/20210310-keep-politics-out-of-5g-international-standardization/>.

<sup>125</sup> Timmers, *supra* note 80, at 11.

competition that can lead to rushed deployment, duplication waste, and slower speeds with which organizations work.<sup>126</sup>

As discussed in Part III, 3GPP currently faces three key governance challenges: technical, economic, and political. Regarding the technical challenges of interoperability, fragmentation, and security, increased coordination would help lead to industry-specific segmentation rather than disorganized and overlapping standard setting. This would, in fact, increase safety and critical infrastructure security because “a lack of cross-industry interoperability can serve as a check on security problems.”<sup>127</sup> However, to facilitate the benefits of an interoperable digital economy, fragmentation must be coordinated. The safety of autonomous transportation, for example, relies upon data interoperability among connected cars made by different manufacturers.<sup>128</sup>

Economically and politically, the benefits of coordination are clear. Currently, SSOs use different rules for determining FRAND licensing terms, which can lead to forum shopping by industry actors.<sup>129</sup> Further, SSOs have different stances toward openness.<sup>130</sup> The IETF, for example, values open participation and open standards unencumbered by intellectual property rights.<sup>131</sup> The Zigbee Alliance offers tiered levels of participation with membership fees.<sup>132</sup> This lack of coordination between SSOs also leads to forum shopping and the risk of oligarchy. A coordinated effort to elevate consortium participation could enable small or resource-constrained firms to play a greater role. Further, governments are seeking to influence the

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<sup>126</sup> Tom Wheeler, *If 5G Is So Important, Why Isn't It Secure?*, N.Y. TIMES (Jan. 21, 2019), <https://www.nytimes.com/2019/01/21/opinion/5g-cybersecurity-china.html.pdf> [<https://perma.cc/5WN2-6GZD>]; Mike Dano, *Another Set of 5G Standards Was Just Released, But No One Really Cares*, LIGHTREADING (Apr. 5, 2019), <https://www.lightreading.com/mobile/5g/another-set-of-5g-standards-was-just-released-but-no-one-really-cares/d/d-id/750681.pdf> [<https://perma.cc/J24A-FPJJ>]; Sue Halpern, *The Terrifying Potential of the 5G Network*, THE NEW YORKER (Apr. 26, 2019), <https://www.newyorker.com/news/annals-of-communications/the-terrifying-potential-of-the-5g-network.pdf> [<https://perma.cc/7ES6-NSM8>].

<sup>127</sup> DENARDIS, *supra* note 45, at 144.

<sup>128</sup> *Id.*

<sup>129</sup> Joint Res. Ctr, *Fair, Reasonable and Non-Discriminatory (FRAND) Licensing Terms*, at 25 (2015), <https://publications.jrc.ec.europa.eu/repository/bitstream/JRC96258/jrc96258.pdf> [<https://perma.cc/WM9D-2Q8M>].

<sup>130</sup> DENARDIS, *supra* note 45, at 144.

<sup>131</sup> YATES & MURPHY, *supra* note 7, at 251.

<sup>132</sup> *Join the Zigbee Alliance*, Zigbee Alliance, <https://zigbeealliance.org/join.pdf> [<https://perma.cc/U3JC-6B7P>].

technology for geopolitical rather than technical excellence reasons.<sup>133</sup> SSOs must make a coordinated effort to deal with strategic partnerships between governments and industry. To do so, SSOs must reinforce their commitments to security and democratic participation. SSOs could also give governments a place to voice their concerns about unfair practices.<sup>134</sup>

## VI. CONCLUSION

As we move towards creating new standards, SSOs are proposing conflicting solutions and governments are refusing to delegate sovereignty decisions to industry. While governments are right to raise concerns regarding new technologies like 5G, SSOs can still be the appropriate place for global standard setting. To do so, however, they must again evolve, creating a Fourth Wave that embodies the principle of coordination. Only by embracing coordination will SSOs regain their legitimacy and be able to set trusted global standards that address the complex interplay of a technology's technical, economic, and political qualities.

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<sup>133</sup> See, e.g., Anja Manuel & Melanie Hart, *How the West Could Win a Technological 'Shadow War' with China*, LOS ANGELES TIMES (June 11, 2020) (describing how China “exerts tremendous influences in these standards-setting bodies by violating long-held norms without explicitly violating international law,” and offering the example of Lenovo, where after facing a backlash for having voted for an American-proposed standard at the ITU, Lenovo changed its vote because “Chinese companies should unite.”).

<sup>134</sup> Government entities such as the U.S. National Security Agency can participate in standard setting as technical contributors. See Anthony Rutkowski, *NSA Takes a Leadership Seat at the Global 5G Security Table*, CircleID, <https://www.circleid.com/posts/20210510-nsa-takes-a-leadership-seat-at-the-global-5g-security-table/>.