Standardized Interdependence: Why Some Global Economic Networks Do Not Decouple

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Abstract How and when do tensions between an established power and rising power lead to geoeconomic fragmentation? A general expectation is that great power competition necessitates global economic bifurcation. In this vein, one set of studies argues that the rise of economic networks centered on key nodes — often controlled by the U.S. — will compel rivals to pursue alternatives. Another thread points out that specific features of China's economic model and technology policies threaten economic interdependence. Taking a different approach, this article argues that technical standards, which are essential for companies to develop and promote technologies at global scale, serve as a buffer against decoupling. This "standardized interdependence" depends on the legitimacy of the organizations that develop international standards such as the Internet Engineering Task Force. Assessing this argument with over 60 expert interviews as well as social network analysis of datasets that cover 10,000 standards documents, I leverage a medium-N analysis of twelve cases, including: the IETF and internet networks (2010-2024), the IEEE 802.11 working group and Wi-Fi ecosystems (2003-2025), 3GPP and mobile telecommunications (2015-2025), and SWIFT and financial messaging (2014-2024). My findings challenge the conventional wisdom that the U.S. and China are destined for decoupling and economic fragmentation.

Introduction

A new Cold War is in the air, and U.S.-China decoupling is all around. Growing choruses of scholars and pundits proclaim that critical technology networks are bifurcating. As the "splinternet" meme exemplifies, prominent voices and publications have continually predicted that the internet would bifurcate into two distinct networks, one led by the United States and the other led by China.[1] Henry Farrell and Abraham Newman's influential book *Underground Empire* depicts a global economy on the brink of rupture, "As the United States began to confront China, they were stranded in the no-man's-land between warring empires, one trying to retain its grasp on global

1. Gross and Murgia 2020; Kolodny 2018.

networks and the other struggling to displace it. . . We may be on the verge of a greater catastrophe still, brought about not by chance but by battles that tear apart the silken webs that weave the world economy together."[2]

How and when do tensions between an established power and rising power splinter global technology networks? Existing work presumes that great power competition makes economic fragmentation inevitable.[3] There exist two main sets of explanations. First, some studies argue that weaponized interdependence will entail U.S.-China decoupling. According to this logic, the rise of economic networks centered on key nodes, which the U.S. and other select states can use to coerce others, forces rivals to develop alternative networks.[4] Second, other scholars argue that specific features of a rising power's economic model and technology policies threaten economic interdependence. Some studies, for example, attribute fragmentation to Chinese policies aimed at self-sufficiency as well as international backlash to the close ties between the Chinese party-state and its leading firms.[5]

Yet, across many global networks, interconnections between the U.S. and China have not only remained durable but even strengthened. The internet has not splintered, and experts observe that, in recent years, Chinese firms have become more accepting of and integrated with its established protocols.[6] Why?

This article argues that the puzzle's solution lies in technical standards: detailed requirements for developing technologies such that they can interface with other products and satisfy performance conditions. The Transmission Control Protocol (TCP), for example, is a core standard that governs data transfer and communications through the Internet. Checking in at 91 pages and over 30 acronyms, the TCP document can read as dull and unremarkable. To a casual observer, it is hard to get excited about this passage: "The procedures to establish connections utilize the synchronize (SYN) control flag and involves an exchange of three messages. This exchange has been termed a three-way hand shake."[7] Yet, these technicalities provide the foundation for a global technology ecosystem. That three-way handshake, by requiring three steps to confirm a stable connection between client and server, trades speed for reliability — an engineering decision that continues to preserve today's global Internet.[8]

Today's global economy is rooted in standards like TCP that are essential for companies to develop and promote network technologies at global scale (a phenomenon I call "*standardized interdependence*"). The wireless networking technology known as Wi-Fi, for example, is a universal standard. It connects devices in the same way in Shenzhen, or Cupertino, or Berlin; this claim still holds, if the device in question is a

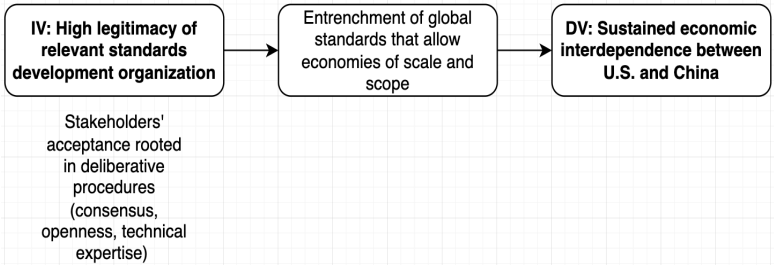
2. Farrell and Newman 2023, 14–15.
3. Drezner 2024; Mastanduno 2021; Chen and Evers 2023, 174, 203.
4. Drezner 2024; Mastanduno 2021; Farrell and Newman 2019.
5. Pearson, Rithmire, and Tsai 2022; Y. Tan et al. 2025.
6. Yoo and Mueller 2024.
7. Postel 1981, 12.
8. Johnson 2024.

Huawei laptop, an Apple tablet, or a Bosch sensor. In technologies characterized by network effects like wireless communication, firms collaborate on standards because greater interoperability increases the market size and scope of applications.

I argue that U.S.-China interdependence will persist in technological domains structured around global technical standards (Figure 1). Since stakeholders in both powers have grown invested in the technology ecosystems founded on these standards, their indispensability impedes the supposedly inexorable march toward decoupling and geoeconomic fragmentation (a phenomenon I call "standardized interdependence").

Standardized interdependence presents constraints on both the potential wielders of weaponized interdependence and the disruptors of established networks. The economies of scale and scope attached to global standards make it costly for the states that control key nodes to exclude rival states. As the case studies reveal, the U.S. government has considered compelling U.S.-based standards bodies to expel Chinese companies; however, it reversed course when confronted with the risks of fracturing global markets and damaging U.S. companies. As for a rising power that might be tempted to go-it-alone, it confronts high costs because its firms that are invested in global markets would have to develop one set of products that adhered to established protocols and another set of platforms based on divergent protocols. For instance, China's initiative to develop an alternative Wi-Fi standard failed in part because Chinese firms were already committed to internationally accepted standards.[9]

Figure 1: Standardized Interdependence argument map



Across various technologies, standardized interdependence rests on the legitimacy of the relevant standards development organizations (SDOs). To form protocols that companies cannot go without, an SDO must produce standards that function like infrastructure, providing spillover benefits that support the entire ecosystem — not just favored governments or firms. Of course, powerful private and governmental interests will seek to co-opt the standardization process, as the choice of standard A over standard B could confer enormous benefits to a firm with a head-start in developing products linked to A.[10] If industry stakeholders do not trust an SDO's

9. Bell and Feng 2007.

10. This builds on previous research on international standards: Büthe and Mattli 2011; Abbott and

deliberative practices, then its standards will resemble bridges to nowhere. To wit, the development of China's failed Wi-Fi standard was initially restricted to eleven Chinese companies, which prevented other engineers from debating its technical merits.

To prove to industry stakeholders that they are appropriate standards-makers, SDOs guard against undue intervention through deliberative rules and norms based on consensus, openness, and technical expertise.[11] Wi-Fi's ubiquity owes much to the 802.11 working group at the Institute of Electrical and Electronics Engineers (IEEE), which issued the original Wi-Fi standard in 1997.[12] During its initial years, a fierce debate between Harris and Lucent Technologies, two companies that had sponsored competing proposals, left the standards body "on the brink of being torn apart."[13] Ultimately, the group's consensus procedures forced the two camps to deliberate on an agreement that would benefit all in the long-term. Acknowledging that they had violated the working group's norms by voting on "party lines", instead of debating the proposals' technical merits, Harris and Lucent supporters compromised on a scheme that mixed in elements from both proposals.[14] As the case study will detail, the IEEE working group's deliberative principles gave it the standing to make Wi-Fi universal.

I test this argument with a medium-N analysis of twelve cases, including: the IETF and internet networks (2010-2024), the IEEE 802.11 working group and Wi-Fi ecosystems (2003-2025), 3GPP and mobile telecommunications (1999-2025), and SWIFT and financial messaging (2014-2024). The evidence draws from over 60 expert interviews as well as quantitative analysis of co-authorship networks from thousands of standards documents. Apart from digital TV, all the cases substantiate the expected relationship between the legitimacy of relevant standards development organizations and U.S.-China economic interdependence.

This article makes two main contributions. First and foremost, it demonstrates that U.S.-China interdependencies in technology networks are durable and resilient, provided that they are anchored in high-legitimacy standards development organizations. Why care about whether the global technology ecosystem is splintering into two spheres? The level and nature of U.S.-China economic interdependence directly bear on the risk of a conflict between two great powers, perhaps one of the most devastating outcomes in the international system. As a central variable in the international relations field, economic interdependence serves as an important explanatory factor in theories of international cooperation, democratization, nuclear proliferation, alliance strength, and global environmental governance.[15]

For policymakers who operate as if the Cold War era of separate economic

Snidal 2001; DeNardis 2014.

11. Steffek 2015.

12. Rikitianskaia 2024.

13. Lemstra, Hayes, and Groenewegen 2010, 75.

14. Lemstra, Hayes, and Groenewegen 2010.

15. See, respectively, Suzuki 1994; Genna and Hiroi 2014; Solingen 2009; Papayoanou 1999; Lenschow, Newig, and Challies 2016.

blocs has already returned, this article offers a rejoinder: across many significant technological domains, states must accept and contend with interdependent networks. In a world of standardized interdependence, attempts to pressure standards development organizations to support narrow, national interests — as both Chinese and U.S. policymakers have pursued — will either fail or weaken the infrastructure that supports broader technology ecosystems. Instead, a smarter approach would ensure standards organizations continue to favor the most collaborative and best-engineered technologies, through supporting participation in standardization by civil society groups and funding groups that develop open-source standards.[16]

Second, my findings also intervene in debates over China's challenge to the global order. Extending Stacie Goddard's work, a growing number of scholars classify China as a "bridging revisionist" power that seeks to radically transform the international order in a "rule-based revolution."[17] With high access to established institutional institutions and strong linkages to groups outside the existing order, China could leverage its network position to remake the international order in its own image. In the same vein, analysts warn of China's attempts to overturn the global standards architecture, pointing to its Belt and Road Initiative as an instrument to lock developing countries into Chinese standards.[18]

Yet, as Alastair Iain Johnston contends, careful assessments of China's encounter with international order require unpacking a singular liberal order into various "issue-specific orders."[19] This article shows that, at least within the technology governance order, China behaves more like an integrated revisionist that pursues engagement with established institutional networks. When organizations can legitimate their standards development process to attract international convergence, they gain the backing of globally-oriented Chinese firms. This dynamic has frustrated the Chinese government's efforts to gain undue influence over standardization through mobilizing alternative standards-setting forums and mandating technonational specifications.

The article proceeds as follows. The theory section differentiates my argument from the surrounding literature on great power competition and economic fragmentation. Next, I report the top-level findings from the twelve cases, before evaluating standardized interdependence across four detailed case studies. In each of these technological domains, I measure changes in integration over time, evaluate the extent to which the U.S. and China are invested in a common set of technical standards, and then analyze the legitimacy of key standards development organizations. I conclude with implications for scholars and policymakers.

16. Neahier et al. 2021.
17. Owen 2025; Goddard 2018, 793, 773–775.
18. Hoffmann, Lazanski, and Taylor 2020.
19. Johnston 2019.

II. Theory: Standardized Interdependence

What is the effect of intensified great power competition on global economic integration? Amidst a possible power transition, how and when do insecurities between an established power and rising power lead to geoeconomic fragmentation?

Discussions about great power competition's impact on the global economy deploy a variety of labels, including geoeconomic fragmentation, decoupling, and bifurcation. To clarify terms, my outcome of interest is the level of economic interdependence between a rising power and established power in a particular technology domain. Economic interdependence between two states reflects the costs of breaking off commercial interactions, after accounting for policy adjustments to engage alternative suppliers and collaborators. This is in line with Keohane and Nye's concept of vulnerability interdependence.[20] The empirical analysis measures U.S.-China interdependence across various sectors by collecting information to construct a counterfactual: what would be the costs to both countries if economic relations were interrupted?[21] If fragmentation or bifurcation has occurred in a domain, then these projected costs will have decreased.

Scholarly consensus: shrinking power gap makes global economic fragmentation inevitable

A general expectation is that, as a rising state nears parity with the dominant state, mutual insecurities engender global economic fragmentation. In the 1930s, for example, concerns about Japan's military buildup prompted the U.S. to block raw material exports; Japan also used its occupation of China to restrict U.S. business from access to the Chinese market.[22] Ling Chen and Miles Evers see such sequences as intrinsic to power transitions: both states are incentivized "to decouple from the global supply chains that connect their countries."[23] The established power seeks to prevent a challenger from achieving technological leadership, and the rising power pursues self-sufficiency in response. As Chen and Evers observe, the U.S.-China technology war is "dividing the world into competing blocs."[24]

The surrounding literature further expands on this thesis from the perspective of the dominant power and the rising power. First, consider how an established power's motivations and actions could shape the degree and nature of global economic interdependence. In their agenda-setting text on weaponized interdependence, Henry Farrell and Abraham Newman identified a crucial feature of globalization: the development of economic networks centered on key nodes, which a select group

20. Keohane and Nye 1977; Baldwin 1980.
21. Mansfield and Collins 2003.
22. Copeland 2015, 144–183.
23. Chen and Evers 2023, 174. One notable exception is Anglo-German economic relations before (and even during) World War I. See Kennedy 1980.
24. Chen and Evers 2023.

of states — the U.S. and Europe, principally — can leverage for coercive ends.[25] Extending the argument, some researchers assume that this new vector for economic coercion will lead to the fragmentation of the global technological system. In a 2024 *Annual Review of Political Science* article, Daniel Drezner asserts that the capacity for weaponized interdependence will contribute to "technological decoupling by attrition" and "geoeconomic fragmentation."[26]

Regarding the U.S.-China bifurcation of global technology networks, scholars posit that the U.S.'s expanding use of weaponized interdependence compels rival states to set up replacement systems. Michael Mastanduno claims that the first Trump administration employed economic weaponization more frequently than prior administrations.[27] Routine weaponization, he suggests, will provoke China and other rivals to break out from interdependent networks.[28] In their analysis, Farrell and Newman avoid predetermined judgements about rival states' reactions to the weaponization of interdependence.[29] They do, however, expect that, in response to the threat of weaponized interdependence, rising powers will insulate themselves from and eventually displace entrenched networks.[30]

To be very clear, I do not contest the core argument of weaponized interdependence: globalization has produced highly centralized economic networks which some states can leverage for strategic advantage. Rather, standardized interdependence takes issue with certain extensions to the weaponized interdependence argument: namely, the implication that the mere existence of highly asymmetric economic networks will necessarily bring about fragmentation and decoupling.[31]

A second set of explanations focuses on the rising power's incentives and characteristics. One account highlights the rising state's political economy and the attendant threats faced by other countries. In *International Security*, Margaret Pearson, Meg Rithmire, and Kellee Tsai argue that international backlash to China's economic model — in particular, the blurred lines between the Chinese party-state and private firms — could "constitute a lasting shift in the international order in terms of economic openness and interdependence."[32] Another study emphasizes the impact of knowledge shocks that reshape an emerging power's perception of the risks of technological interdependence, such as the Snowden leaks in 2013 (which revealed that U.S. technology firms had helped the U.S. government spy on adversaries) and U.S. sanctions on Chinese telecommunications giant ZTE in 2018. According to these scholars, the Chinese leadership's reassessment of its technology policy in the wake of these

25. Farrell and Newman 2019.
26. Drezner 2024, Specifically, Drezner writes, "Heightened concerns about weaponized interdependence are likely to ensure further fragmentation going forward."
27. Mastanduno 2021; Drezner 2024.
28. Mastanduno 2021.
29. Drezner, Farrell, and Newman 2021, 50–51.
30. Farrell and Newman 2019, 77; Drezner et al. 2021, 51-52.
31. Drezner 2024; Mastanduno 2021.
32. Pearson, Rithmire, and Tsai 2022.

revelations led to a "broader withdrawal of Chinese engagement with global networks in favor of a whole-of-nation system of self-reliance."[33]

My argument: standardized interdependence

By contrast, this article argues that technological rivalry between rising and dominant states does not necessitate international economic fragmentation. International standards development organizations encourage economic integration between rising challengers and established powers, as their firms collaborate on common standards to take advantage of economies of scale and scope. These investments in globally interoperable standards serve as a buffer against both the wielders of weaponized interdependence and the disruptors of global networks.

In information and communications technologies, the network effects generated by globally interoperable standards make them indispensable to firms that profit from economies of scale and scope. Compatibility standards encourage more users, developers of add-on products, and other industry actors to connect to a single network, which in turn makes the network more valuable for all participants.[34] Regarding returns to *scale*, a common standard allows companies to sell goods and services to global markets, which reduces per-unit costs and allows for R&D re-investment. These effects are especially strong in high-tech industries characterized by rapid innovation.[35] Because a standardized protocol enables firms to specialize in complementary modules, these firms can then leverage economies of scale in a narrower set of subcomponents.[36]

Convergent standards also allow firms to exploit economies of *scope* by developing a greater variety of core and complementary products. Since all these related outputs can draw on the same assets used to develop all goods connected to the standardized network, these companies can further reduce their per-unit costs.[37] In their study of new forms of industrial organization, Thun et al. characterize standards as "an essential infrastructure that allows modular ecosystems to form and scale."[38]

The ubiquity of Wi-Fi demonstrates the value of globally interoperability standards. Over the years, the systems supported by Wi-Fi have expanded from phones, laptops, and gaming consoles to automobiles, energy grids, and smart cities. Wi-Fi presently contributes to over $4 trillion in economic value and connects more than 21 billion devices around the world.[39] Crucially, IEEE standards helped unify the major market players around a common standard, instead of one type of Wi-FI for work environments and another for home, or one version for Apple and one for everyone else, or one

33. Y. Tan et al. 2025.
34. Kuerbis and Mueller 2019.
35. Montresor and Vezzani 2015, Returns to scale are less salient for low-tech and medium-tech industries such as electrical equipment, chemicals, automobiles and parts.
36. Thun et al. 2022.
37. Thun et al. 2022.
38. Thun et al. 2022.
39. Wi-Fi Alliance 2024.

protocol specific to China and another for everywhere else. Greg Ennis, longtime leader in Wi-Fi standards committees, recounts that, without these standardization efforts, the world would likely be working with "several different and non-interoperable networking systems."[40]

If the Wi-Fi ecosystem did splinter into two non-interoperable networks, firms would forfeit economies of scale and scope. Established players such as Chinese firm TP-Link would have to decide whether they would manufacture routers for both incompatible standards or prioritize one type. In either case, reduced global orders would increase per-unit costs and prices. These effects would be exacerbated by established firms reducing the variety of their product portfolio. The presence of incompatible standards would also raise barriers to new entrants into the Wi-Fi industry. One comparison point is the lack of standardization in electric plugs — 14 different types in use around the world — which decreases the quality of electronic devices and the number of electronics firms.[41] By one estimate, the adoption of a universal standard plug would increase global trade in electronic devices by 8 to 10 percent.[42]

Under standardized interdependence, the indispensability of global standards for information and communication technology mitigates the dominant and rising power's incentives for decoupling.[43] First, states that control central network nodes cannot exclude rival states without significant costs. If excluded states develop alternative networks structured around different standards, then the resulting market fragmentation means that the established network's core firms lose out on economies of scale and scope. Suppose, for instance, the U.S. sought to curtail other states from developing standards for a certain technology network. Other countries might question its commitment to the market-based, open standards development process, which would reduce that network's overall scale.[44]

As for potential network disruptors, they also face significant barriers to displacing entrenched standards. To establish a separate network, a state needs to not just build up a large scale of users and collaborators but also convince firms invested in the established network to switch over. A rising power's own firms will be increasingly committed to the established standards, serving as another barrier to going-it-alone. For example, in the early 2000s, China pushed its own wireless security standard; however, it failed to attract global reach in part because Chinese companies such as ZTE and China Network Communications Group Corporation already committed to the established international standard.[45]

40. Ennis 2023, 402.
41. Mei and Xu 2024.
42. Mei and Xu 2024.
43. Koremenos, Lipson, and Snidal 2001.
44. Kerry 2024.
45. Bell and Feng 2007.

Legitimacy of SDOs

Standardized interdependence prevails when a standards organization earns legitimacy: the belief from stakeholders that it is the appropriate intermediary to set common protocols in a particular domain.[46] High-legitimacy organizations have a proven track record of establishing standards that function as "essential infrastructure" — a public good that allows an entire ecosystem of contributors to benefit from network effects and economies of scale and scope.[47] To attain legitimacy, SDOs must adjudicate debates over which technical specifications provide more stable infrastructure, since the choice of standard A over standard B gives concentrated benefits to firms that have already developed products optimized for A or to governments that think A will help reduce foreign technology dependence.[48]

To settle standards contests in a way that serves the broader technology ecosystem, high-legitimacy SDOs must establish institutional rules and norms that foster deliberations based on consensus, openness, and technical expertise.[49] Historically, a standards organization's commitment to these procedural principles prevents vested private and governmental interests from co-opting the standardization process, thereby resulting in standards that achieve widespread adoption.[50] The International Electrotechnical Commission (IEC), one of the oldest and most respected international standards organizations, upholds a code of conduct that emphasizes a "consensus-based process" rooted in openness and transparency.[51] In Tim Büthe's account of how the IEC became the uncontested authority for electrical standards, the organization's "technical reasoning norm", which allows committees to dismiss arguments that lack a technical basis, functions as a key check against undue governmental influence.[52]

It is important to differentiate my argument from more idealized accounts of international standardization. Some accredit the legitimacy of standards organizations to a transnational engineering community that elevates technical rationality above all else. For instance, Thomas Loya and John Boli position standards experts "as impersonal technicians who must put the universalistic purposes of standardization first."[53] In their expansive history of global standard-setting, JoAnne Yates and Craig Murphy depict standard-setting as a "an entirely different realm with a very different logic from either commerce or politics," through which the standardization movement transcends interests to serve the public good.[54]

46. Hurd 2007.
47. Thun et al. 2022.
48. Drezner 2004.
49. Openness refers to both openness of participation and transparency of operations. Büthe and Mattli 2011, 55.
50. Yates and Murphy 2019.
51. International Electrotechnical Commission 2024.
52. Büthe 2010a, 30 fn 110.
53. Loya and Boli 1999, 177.
54. Yates and Murphy 2019, 13.

Standards development is not a politics-proof bubble. SDOs do not embody the idealized forms of participatory democracy ascribed to them by some promoters.[55] In many cases, engineers will push a certain standard over the objectively best standard because their employer owns patents that are essential to that standard's implementation. Larger companies sponsor membership and meeting registration costs for their standards representatives, whereas less-resourced organizations such as civil society groups face substantial obstacles to participation.[56] Instead, in my account, high-legitimacy SDOs are "satisficers" that develop good-enough standards.[57] Though they fall short of the ideals of participatory democracy or technocratic governance, their procedural guardrails provide adequate checks against powerful firms and governments.[58]

Take, for example, the Internet Engineering Task Force (IETF), which has remained the predominant Internet standards body for four decades. It is not without flaws: large companies dominate some standards discussions, and experts criticize the organization's lack of responsiveness to civil society demands.[59] Yet, as the case study will detail, the IETF's open and technically-informed consensus process has rebuffed the Chinese government's efforts to push centralized, top-down internet standards.[60] The IETF also curtails the dominance of powerful companies. When Google submitted a new Internet transport protocol named QUIC, for instance, the IETF community expressed concerns that all traffic that used this protocol flowed through Google servers.[61] Eventually, mobile network operators and other IETF participants "heavily negotiated" the protocol to allow other stakeholders to inspect QUIC traffic.[62] As one indication of how these deliberations limited undue influence by Google, the final QUIC standard document was co-authored by an engineer at Mozilla, a non-profit that is Google's longtime competitor in the web browser domain.[63]

Other groups lack legitimacy. For instance, many stakeholders do not recognize the International Telecommunications Union's Standardization Sector (ITU-T) as an effective standards developer. Only member states can vote on standards proposals, and draft ITU-T documents are only available to members, not the general public.[64] Since its institutional set-up allows powerful member states to push through standards without consensus on technical merits, Russia and China have turned to the ITU-T as a platform to develop internet-related standards that would not have passed the

55. Russell 2014, 231.
56. Weyrauch and Winzen 2021.
57. Abbott and Faude 2021.
58. Abbott and Faude 2021.
59. Cath 2021.
60. Yoo and Mueller 2024.
61. The QUIC protocol. Technically, QUIC is the name of the protocol, not the acronym. Originally, the name refers to a quick user datagram protocol.
62. Lazanski 2019, 370.
63. Iyengar and Thomson 2021.
64. Cory 2023.

IETF process (e.g., an alternative network for Internet of Things devices).[65] As evidence of the ITU-T's low legitimacy, many industry actors have stopped adhering to and contributing to its standards: the number of ITU-T sector members declined from from 650 in 2004 to just 188 in 2016.[66] One expert who has worked on international standards at a U.S. technology giant for twenty years remarked, "There are hundreds and hundreds of ITU standards that have been completed but have never been implemented."[67]

Theory summary

My argument departs from those who argue that standards development organizations simply help large markets and great powers capture network externalities. Beth Simmons finds that financial standardization reflects the interests of countries with large capital markets.[68] In his account of the rise of global internet protocols, Drezner argues that great powers delegate standard-setting to make use of a "less-public and more-effective pathway of ensuring control over the regime's governance structure."[69] In my account, delegation to a standards body with low legitimacy is ineffective. Furthermore, a highly legitimate organization binds great powers, sometimes against their will, to a shared economic infrastructure. In line with Büthe and Mattli's work, standardized interdependence theory underscores the agency and characteristics of the standards bodies themselves.[70]

How does an SDO become the legitimate authority of its domain? The deeper roots of why some standards-setters develop deliberative decision-making procedures are worthy of further excavation but outside this study's scope. Possibly, historical institutionalism provides a starting point. As Büthe's account of the International Electrotechnical Commission's rise shows, the timing of an SDO's initial creation matters. If the organization is established when distributional conflicts are low, it has more agency to pursue its organizational interests and institutionalize deliberative practices.[71]

While standardized interdependence's effects are most salient in the period since 1990 — when standards-setting activity intensified to manage Internet technologies[72] — this is a theory with old foundations. In fact, history's oldest surviving intergovernmental organization, the Central Commission for the Navigation of the Rhine, formed in 1815 as a standards body to manage the economic interdependence along one of

65. Lazanski 2019; Sheehan and Feldgoise 2019.
66. Lazanski 2019; Sheehan and Feldgoise 2019.
67. Interview with standards lead at U.S. technology company, April 16, 2021.
68. Simmons 2003.
69. Drezner 2004, 483.
70. Büthe and Mattli 2011; Cowhey 1990.
71. Büthe 2010b.
72. Yates and Murphy 2019.

Europe's longest rivers.[73] Composed of respected engineers from riparian countries, the body's Technical Commission set standards for the appropriate depth and width of the river.[74] During the late 19th century, these standards substantially improved the Rhine's navigability, serving as essential infrastructure that enmeshed Germany in global markets.

The significance of Rhine integration came to the fore in World War I. Average annual Rhine transport surged from 2.2 million tons during the period 1871-1875 to 31.9 million tons during the period 1911-1914; by 1913, 25 percent of German imports and 22 percent of German exports passed through the German-Dutch border by Rhine barge.[75] Historian Hein Klemann observes, "Mutual dependence between the Dutch economy and Western German industrial centres precluded hostile German actions against the Netherlands."[76] In the debates over economic interdependence and World War I, the Rhine Commission is largely neglected.[77] It would be wise to not also overlook the standards development organizations that tie today's global economy together.

III. Research Design

To test the relationship between the legitimacy of a focal standards development organization and global economic fragmentation, I analyze twelve cases that span a variety of information and communications technologies (Figure 2). In eight of the nine cases governed by a high-legitimacy SDO, U.S.-China interdependence persists. Since I only selected technologies that existing scholarship pinpoints as likely areas of U.S.-China decoupling — where China has pursued indigenous standards development or the U.S. has exercised leverage over central nodes — these tough tests provide especially convincing evidence for standardized interdependence.[78]

In line with guidance on medium-N designs,[79] additional case studies probe the bounds of standardized interdependence. In financial messaging, third-generation cellular networks, and server efficiency, weakened legitimacy of key standards organizations resulted in fragmentation. Developments in digital TV, as the only case in which a high-legitimacy SDO does not produce sustained interdependence, show that other factors can overwhelm standardized interdependence. Still, the idiosyncratic factors that explain this case's deviation from expectations would not apply to other domains.

73. Oneal and Russett 2001.
74. Schenk 2020.
75. Klemann and Schenk 2013.
76. Klemann 2017.
77. One exception is Oneal and Russett 2001.
78. The supplementary appendix includes details on scope conditions, the population of cases, and case selection strategy.
79. Goertz 2017, 232.

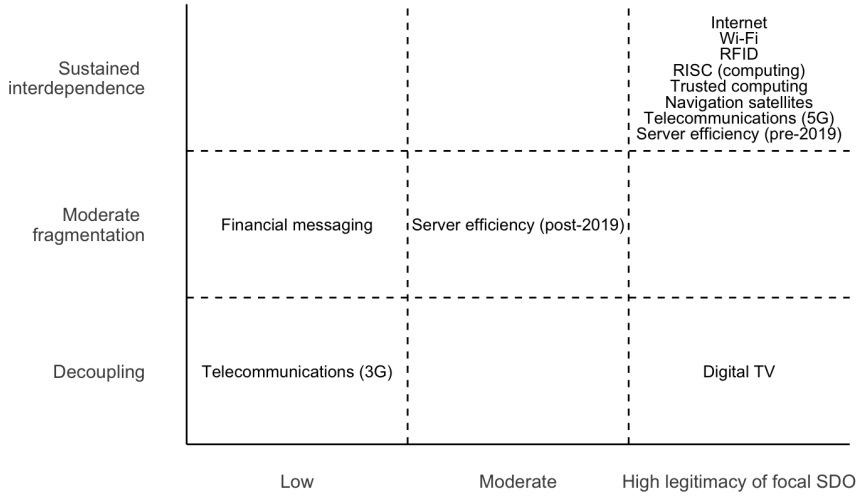


Figure 2: Selected Cases

The empirical evidence draws from a diversity of sources. Since the internal workings of standards meetings are often obscured, I conducted participant observation of the IETF's plenary meeting in Madrid, Spain, and 3GPP's technical specification group plenary meeting in Baltimore, United States. I also interviewed over 60 specialists, collected attendance records from past meeting minutes, and sorted through mailing list debates.[80] To quantitatively measure the interdependencies between U.S. and Chinese actors, I conducted social network analysis on datasets that encompass over 10,000 standards documents in total. The main text reports the findings from four domains: the Internet, Wi-Fi, telecommunications, and financial messaging. Tapping additional interviews and data analysis, the supplementary appendix analyzes eight other cases.

IV. Empirics

IETF and the Unsplintered Net (2010-2024)

If any global network is held up as the strongest candidate for decoupling, it is the Internet. In September 2018, former Google CEO Eric Schmidt predicted that the Internet would splinter into "two distinct Internets," with one led by the United States and the other led by China.[81] This "Splinternet" motif is pervasive. As a World

80. The supplementary appendix provides a complete list of interviews.
81. Kolodny 2018.

Economic Forum paper outlined in 2016, "A growing number of thought leaders in government, the private sector, the Internet technical community, civil society and academia have expressed concerns over the past two years that the Internet is in some danger of splintering or breaking up into loosely coupled islands of connectivity."[82] Some policymakers and scholars advocate for an "Internet Freedom League", which would create a Schengen Area-like zone for democratic countries that cuts off traffic with problematic actors in authoritarian regimes.[83]

For those who believe that the Internet is splintering at the basic layers, one oft-cited piece of evidence is Chinese telecommunications giant Huawei's push for alternative internet protocols labeled "New IP," which included security frameworks that could make it easier to trace illegal Internet traffic back to the responsible party. Starting in late 2019, Chinese delegations presented New IP to the International Telecommunications Union (ITU) and the Internet Engineering Task Force (IETF).[84] One widely-circulated *Financial Times* article declared that New IP would "splinter the global internet" and "bake authoritarianism into the architecture underpinning the web."[85]

International relations and cyber policy scholars both point to New IP as evidence that the Internet will bifurcate into Western-based and Chinese-based networks. In a *Journal of Cyber Policy* article, Oxford Information Labs researchers forecast that, if proposals like New IP succeed, the Internet will fragment into a "Western" system governed by multistakeholder forums like the IETF and an "Eastern" system reliant on Chinese national standards supported by multinational forums like the ITU.[86] Likewise, Newman and Farrell describe the New IP proposal as China's push for "a radical redesign of the underlying standards of the Internet at the ITU."[87]

Internet integration measures

The world wide web that weaves the global economy together has not torn apart. Enabled by the internet, trade in digital services has surged in recent years. In 2021, digital services made up 63 percent of all services exports, which represented a 40 percent increase from 2005; China's digital services exports more than doubled over this time span.[88] U.S.-China digital interdependence has also strengthened. One way to measure internet interdependence at the dyadic level is to track the number of data routing agreements between Autonomous Systems (ASes) — subnetworks managed by Internet service providers like Verizon or large technology companies such as

82. Drake, Vinton, and Kleinwächter 2016; Mueller 2017.
83. Clarke and Knake 2019.
84. Yoo and Mueller 2024.
85. Gross and Murgia 2020.
86. Hoffmann, Lazanski, and Taylor 2020.
87. Farrell and Newman 2021.
88. Weymouth 2023, 8.

Tencent — that operate in different countries.[89] In January 2010, there were 88 data exchange agreements between U.S-based ASes and China-based ASes. By November 2017, that figure climbed to 257 connections.[90]

Internet fragmentation conjures up many possible meanings, but the most serviceable definition is rooted in technical fragmentation: the extent to which information must travel through separate, non-interoperable "internets".[91] To be sure, the internet is differentiated at the regulatory level, as states censor certain Internet content. Most prominently, China's "Great Firewall" blocks its residents from accessing websites deemed to be illegal. One could interpret this as fragmentation, but China's heavily filtered Internet still communicates with the global Internet through common protocols. At the end of day, technical fragmentation, not regulatory fragmentation, is also what splinternet seers have in mind (After all, if domestic censorship counts as fragmentation, then the internet has always been fragmented). This is why they emphasized China's New IP proposal as a threat to the internet's technical architecture.[92]

Six years after the New IP scare, the global internet landscape has not splintered into a China-led system and a U.S.-led one. Specifically, New IP has not replaced the Transmission Control Protocol (TCP) and the Internet Protocol (IP), the common language through which Autonomous Systems communicate with each other. Ironically, internet governance experts worry more about overuse than fragmentation.[93] Enter IPv6, an upgraded version of the Internet Protocol that aims to resolve the impending depletion of IP address spaces. Initially proposed in 1998 and eventually standardized at the IETF in 2017, IPv6 has struggled to take root since all parties have become attached to its precursor.[94] In 2019, a leading internet infrastructure scientist called China "the last piece in a critical mass of IPv6 deployment that will propel the Internet's migration over the coming years."[95] Recently, China's transition to IPv6 has taken off, as it accounted for 22 percent of global IPv6 capability in April 2025.[96] In other words, when it comes to the real "New IP" (IPv6), China has become more deeply embedded in the global web.

Standardized interdependence in the internet

Why has intensified U.S.-China competition not fragmented the internet? If standardized interdependence holds up, the case evidence should reveal significant constraints

89. Oppenheimer 2025.
90. Author's calculations based on Oppenheimer 2025. Certainly, there are some cases that flow in the other direction. In 2020, the U.S. government blocked the construction of an undersea cable that would connect Los Angeles and Hong Kong.
91. Mueller 2017. There are other forms of fragmentation. DeNardis 2016; cited in Nanni 2024.
92. Gross and Murgia 2020; Hoffman et al. 2020.
93. Weyrauch and Winzen 2021; Mueller 2017.
94. Mueller 2017, 63-65.
95. Huston 2019.
96. Low 2025.

on China's ability to promote New IP as an alternative Internet architecture, as this would entail persuading a large scale of users and collaborators to switch from well-established standards. We should also observe that Chinese companies themselves are invested in the focal internet standards body, the IETF, which further restrains attempts to redesign fundamental internet protocols. Lastly, the essentiality of TCP/IP protocols should rest on the high legitimacy of the IETF.

While New IP-related proposals ultimately failed to move forward in the ITU, the project offers a valuable testing ground to better understand the costs China faces in developing standalone networks. First, in promoting New IP, China would have encountered difficult obstacles on the road from ITU approval to global acceptance. Let us assume some of the worst fears about New IP had materialized — that the ITU had established a New IP study group, that this group approved well-specified replacement standards for existing TCP/IP protocols, and that this standard included features that facilitated more centralized control over the Internet.[97] Even then, to institute an alternative network, New IP proponents would need a critical mass of operators to actually adopt the New IP standard. This would be extremely unlikely, given the dominance of TCP/IP protocols.[98]

Moreover, the IETF is the focal standards development organization in Internet protocols, not the ITU. Because they are developed in a transparent process with strong input from firms, IETF standards are much more likely to gain acceptance from market actors than ITU standards.[99] As exemplified by the Open Systems Interconnection protocol suite, the ITU's Telecommunications Standardization sector has promoted Internet standards that ultimately failed to achieve widespread adoption.[100] Put simply, all parties have too much to gain from the IETF standards that support a technically unified Internet. Milton Mueller, a leading scholar on internet governance, writes, "The global compatibility created by universal use of TCP/IP and related IETF standards such as DNS and a common global root are practically impossible to abandon without unacceptable sacrifices in compatibility."[101]

Second, as Chinese firms expand to global markets, they are disincentivized from creating standards detached from existing Internet communication protocols. If New IP created a network separate from the IP-based Internet, then Huawei would have to produce devices with two different protocols for different markets, losing out on economies of scale.[102] This would hurt not only firms at the infrastructural layer like Huawei but all Chinese firms in digital markets that operate on top of that architecture.[103] Undoubtedly, this point is complicated by the fact that Huawei

97. Each of these points have been contested. See Yoo and Mueller 2024.
98. Mueller 2020.
99. Yoo and Mueller 2024; Interview with Jason Matusow, April 16, 2021.
100. Tanenbaum and Wetherall 2011, 51–53.
101. Mueller 2020.
102. Nanni 2022.
103. Yoo and Mueller 2024.

researchers introduced New IP in the first place. Still, Huawei is a large organization, and three separate interviewees suggested that there was internal dissension about New IP.[104] In a lengthy discussion paper, Richard Li, chief scientist of Huawei's U.S.-based R&D lab, framed New IP as a protocol that complemented existing protocols and even noted that "the IETF would be the natural forum" to further investigate New IP use cases.[105]

Despite some tensions, the relationship between Chinese firms and the IETF has largely trended towards more engagement.[106] According to one network analysis of mailing list exchanges for three IETF working groups, from 2007 to 2019, "Chinese actors, particularly Huawei, have grown increasingly proactive within IETF working groups."[107] Since 2014, Huawei trails only Cisco in terms of their affiliates' contributions to Request for Comments (RFCs) — the IETF's primary outputs, which specify key Internet standards.[108] By one measure based on co-authorship of Requests for Comments, in 2018, Huawei was one of the six most central actors in the IETF network.[109] According to another analysis of 4,512 authors of IETF RFCs, 9.7 percent of contributors were affiliated with Huawei in 2018, which marked a dramatic increase from 2005 when Huawei employees first appeared in the dataset.[110]

RFC coauthorship networks reflect US-China interconnections

The balance of evidence suggests that Chinese firms have grown increasingly committed to the IETF. Standardization is a social process. Co-authorship of RFCs provides a useful window into the IETF as a social network, in which an individual's reputation is often tied to their technical contributions. I collected data on 3,555 RFCs published in the past fifteen years (2010-2024). The full dataset included 10,444 rows of information on RFC author attributes, including each author's organizational affiliation and the organization's country headquarters.[111] To better comprehend the integration of Chinese firms in the IETF over time, I split the network into two periods (Figure 3).

A series of network metrics demonstrate that Chinese-affiliated participants have become more integrated in standards development at the IETF.[112] I first analyzed the "edge betweenness" of ties (co-authorship relationships) between authors affiliated with Chinese firms and those affiliated with U.S. firms. Higher values of edge betweenness indicate that a particular co-authorship connection (edge) lies on more of the shortest

104. Interview with veteran participant at the Internet Research Task Force, Madrid, July 23, 2025; interview with data governance expert, Zoom, June 13, 2025. Interview with standards developer at Chinese firm, Zoom, September 4, 2025.
105. R. Li 2020.
106. Contreras 2014, See the disagreement over the Multi-Protocol Label Switching protocol.
107. Nanni 2022.
108. https://www.arkko.com/tools/docstats.html.
109. Weyrauch and Winzen 2020.
110. McQuistin, Karan, Khare, et al. 2021.
111. For details on the data collection and cleaning process, see supplementary appendix.
112. Hafner-Burton et al. 2009.

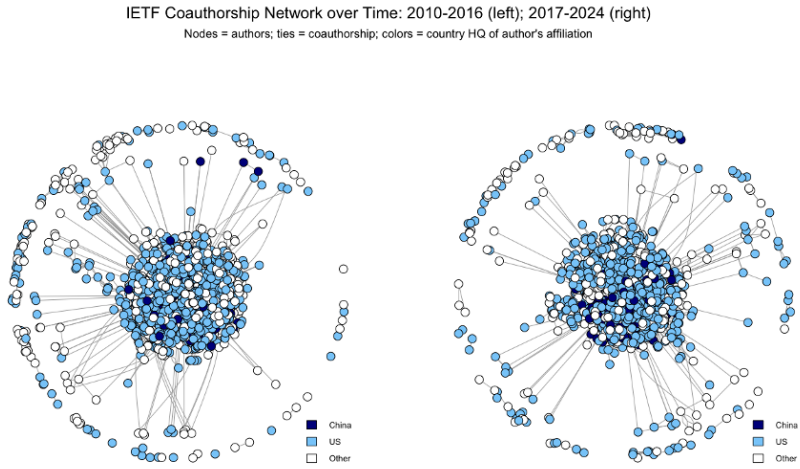


Figure 3

paths that connect various pairs of authors (nodes). In other words, co-authorship ties with high edge betweenness function as bridges that link separate clusters within the broader IETF network.[113] For the two periods, I calculated the edge betweenness of all co-authorship relationships between U.S.-affiliated authors and China-affiliated authors. In the 2010-2016 period, U.S.-China ties accounted for 8.3 percent of the network's total edge betweenness; from 2017 to 2024, that metric increased to 12.0 percent (Figure 4).

Over time, authors affiliated with Chinese firms have also become more *central* to the IETF standards development network. I calculated the average centrality of all authors affiliated with Chinese firms, operationalized by degree, betweenness, and eigenvector centrality. In this context, degree centrality simply measures an author's total number of co-authorship ties. Betweenness centrality is based on the number of shortest paths between various author pairs that go through a specific author. Lastly, eigenvector centrality gives greater weight to an author's connection to other influential nodes.[114] Overall, with the exception of the eigenvector centrality metric, the average centrality of Chinese company representatives in the RFC authorship network has increased over time (Figure 5).

In sum, as two internet governance scholars conclude, "China has grown increas-

113. Marsden and Campbell 2012.
114. Rawlings et al. 2023.

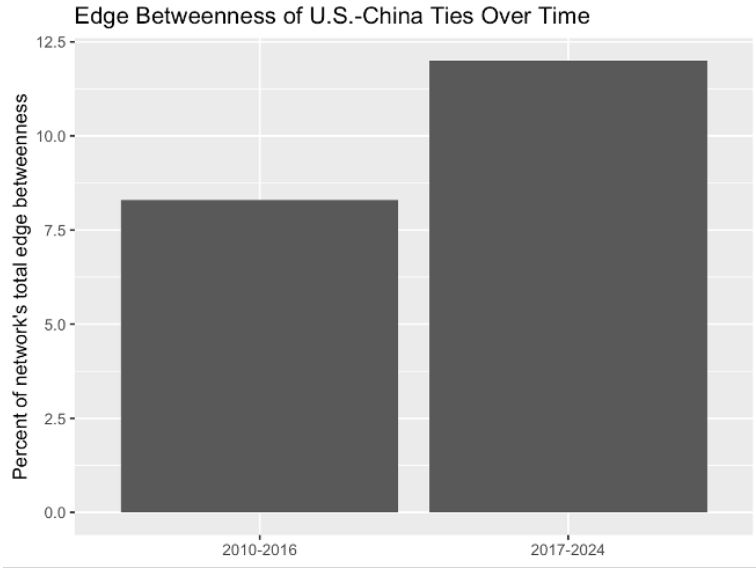


Figure 4

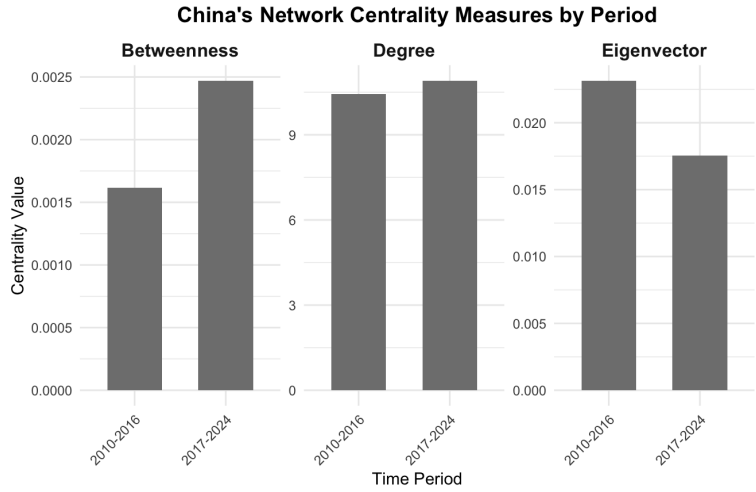


Figure 5

ingly accepting of the existing industry-led, bottom-up, incremental approach to shaping the Internet's architecture."[115]

IETF legitimacy: rough consensus and running code

Housed in Fremont, California, the IETF positions itself as a neutral broker of the best standards possible with the widest implementation. Its unofficial mantra is emblazoned on T-shirts: "We reject kings, presidents and voting. We believe in rough consensus and running code."[116] Though the group claims to stick to technical discussion and avoid policy questions, the leading standards-setter for a $40 billion networking infrastructure market cannot escape politics.[117] As discussed earlier, critics have highlighted the underrepresentation of women and as well as participation gaps between the largest companies and civil society groups.[118] A study by economist Timothy Simcoe found that rent-seeking behavior by commercial participants slowed down the IETF standards development process.[119]

Despite these shortcomings, the IETF maintains a reputation for producing reasonably good and widely-implemented standards. Per a community survey, nearly 90 percent of respondents said that the IETF often or almost always produces high-quality standards.[120] Around 70 percent of all respondents stated that the IETF is better or much better than other SDOs in relation to "independence of the standards process."[121]

Of course, companies prefer standards that favor technologies in which they hold a development head-start or intellectual property rights; however, the IETF's deliberative process eventually produce an outcome that is not beholden to a single company or government. At a recent IETF meeting in Madrid, Bryan Newbold, an engineer at Bluesky Social, discussed his team's tough decision to bring their decentralized social media protocol to the IETF. One of their main concerns was giving over control of the process. "Even the largest companies in the world don't get what they want here," Bryan said.[122] Recalling his team's rationale for formalizing their geospatial data specification at the IETF instead of the Open Geospatial Consortium, one developer relayed that they "wanted to protect it away from corporatist impulses."[123]

The IETF's legitimacy is grounded in a consensus decision-making process. For most of its history, IETF working group chairs gauged rough consensus based on

115. Yoo and Mueller 2024.
116. Russell 2014.
117. ten Oever 2021; DeNardis 2014.
118. Cath 2021; Weyrauch and Winzen 2021.
119. Simcoe 2012.
120. IETF Community Survey 2024. The supplementary appendix contains full references for all SDO technical documents, public comments on federal regulations, and company annual reports.
121. IETF Community Survey 2024.
122. Research and Analysis of Standard-Setting Processes Research Group meeting, IETF Madrid, July 23, 2025.
123. Interview with Howard Butler, Iowa City, July 7, 2025.

humming. Their reasoning is that humming functions as an anonymized way to give feedback, such that participants cannot corner individual dissenters. As IETF meetings have transitioned to a hybrid format, the humming mechanism has become an anonymous poll that allows remote participation, though the underlying concept remains unchanged: gauge rough consensus in a way that allows all voices to be heard.[124]

The IETF publishes open records of all public mailing lists and RFCs as well as video recordings of all meetings and working group sessions. Participants are also expected to be transparent about the intellectual property rights related to a particular standards draft, which is a "regular cause of working group awkwardness."[125] These disclosures provide checks against bad actors that try to manipulate a working group into adopting a standard in which they hold a key patent. Two experts in internet governance conclude, "While most of the other SDOs described above could be considered 'open' to varying degrees, the IETF is notoriously so."[126]

Finally, deference to technical expertise supports the acceptance of IETF standards. As Chinese firms have gained more leadership positions in standardization bodies like the IETF, some fear that the greater degree of coordination between the Chinese government and firms will lead to aligned groups that acquire undue influence. Yet, at the IETF, Huawei has recruited "seasoned IETF veterans" from other companies to build up its influence.[127] Since these engineers are committed to making the internet work better at a technical level, this limits China's ability to displace established network standards through co-option. As Baron and Whitaker point out, "The importance of individual experience and qualifications for appointments may at least partly shield the SDO (standard development organization) from outside influence, as companies cannot fill leadership positions at will, and must instead work with longstanding and respected members of an SDO's community."[128]

IEEE 802.11 and Wi-FI Ubiquity (2003-2025)

On May 16, 2019, determining that Huawei's violations of Iran sanctions contravened U.S. national security interests, the U.S. Department of Commerce placed the Chinese firm on its "Entity List", which severely restricted Huawei's access to

124. The author attended a working group meeting where an anonymous online poll was conducted; in-person attendees scanned a QR code to participate. After 22 yes votes and 7 no votes, the chair deemed it a rough consensus. Even after this vote, an open queue of debate continued (IETF Madrid, Standard Communication with Network Elements WG, July 22, 2025)

125. Leslie Daigle (Chief Internet Technology Officer at the Internet Society), IETF Madrid, New Participant Day, July 20, 2025.

126. Yoo and Mueller 2024.

127. Baron and Whitaker 2021.

128. Baron and Whitaker 2021.

U.S. technology.[129] While initial reactions viewed the move as a fatal blow because of the company's reliance on U.S. suppliers for components like Qualcomm chips or Google services, careful observers flagged an even more significant chokepoint: the Entity List's impact on Huawei's engagement with global standards development. For example, the Institute of Electrical and Electronics Engineers (IEEE), a New York-headquartered professional organization, and the Wi-Fi Alliance, a Texas-based industry association that certifies whether products meet IEEE wireless standards, both restricted Huawei's participation.[130]

These U.S.-based standards bodies functioned as potential chokepoints for the U.S. government to exercise weaponized interdependence against one of China's most important firms. To illustrate, consider the consequences for Huawei if it could no longer engage with the Bluetooth SIG, a certification body for IEEE standards which also initially revoked Huawei's membership. A mobile industry expert asserted that exclusion from the Bluetooth SIG would result in "the utter devastation of Huawei's phone business."[131] His characterization of the standards body essentially replicates the description of a central node under the weaponized interdependence framework:

> *"The Bluetooth SIG's unique position as a non-government entity through which basically every smartphone on the planet must pass arguably makes it even more important to Huawei's business than Google."*[132]

Based on the existing literature's presumptions, what should have happened next? In response to the threat of being cut off from central hubs, China should have broken out from interdependent wireless networks. As a matter of fact, there were some developments in that direction. The *Global Times*, a Chinese outlet known for its hawkish and nationalistic perspective, called for Chinese companies to unite and support Huawei's endeavors to develop new standards from scratch.[133] In September 2020, Chinese firms set up a NearLink alliance to coordinate standards on short-range wireless technologies. A *Wall Street Journal* report deemed the move, seen as a response to Huawei's exclusion from Bluetooth and Wi-Fi standards fora, as China's effort to displace foreign technology and "double down on efforts to achieve self-sufficiency."[134]

Wi-Fi integration measures

The fragmentation of wireless networks did not occur. Mere days after the Entity List action, on May 22, 2019, the Department of Commerce issued a temporary

129. Federal Register: RIN 0694–AH86.
130. Shepherd 2019.
131. Ruddock 2019.
132. Ruddock 2019.
133. Global Times 2019.
134. Jie and Purnell 2023.

general license that permitted U.S.-based organizations to engage with Huawei on a list of recognized standards bodies.[135] Shortly after, the Wi-Fi Alliance and the Bluetooth SIG restored Huawei's full membership in their organizations.[136] In an updated guidance published on June 2, IEEE clarified that employees of Entity List companies could participate in standards development.[137] On June 18, the Department of Commerce, under the first Trump administration, published an Interim Final Rule that granted safe harbor for all voluntary consensus standards bodies to work with Huawei. This *standards exemption* insulated wireless networks from decoupling. China's NearLink alliance struggled to attract an ecosystem, and its ambitions shifted toward co-existence with Wi-Fi networks.[138]

In the following years, the global Wi-Fi ecosystem experienced greater integration. China's domestic Wi-Fi adoption relies on international vendors. Due to convergent standards, Chinese Wi-Fi products and services are intertwined with components and technologies from many international companies. China's two leading Wi-Fi module vendors both partner with U.S. firms for key inputs such as NVIDIA systems or Amazon Web Services software.[139] International players such as Qualcomm, Broadcom, and Mediatek supply most of China's Wi-Fi chipsets, which "set the foundation for the ecosystem."[140]

In the years following the Entity List action, Chinese companies have become leading implementers of new Wi-FI standards. In 2019, the IEEE 802.11 released the Wi-Fi 6 standard, designed to meet the increased demands for speed and reliability posed by the higher number of Internet-linked devices. Using an innovative method to identify undeclared patents linked to Wi-Fi standards, LexisNexis experts found that Chinese companies have proactively incorporated the Wi-Fi 6 standard in their products by licensing these patents. In fact, China and the U.S. are home to the most Wi-Fi 6 implementing companies, collectively accounting for over 60 percent of the total number.[141]

Standardized interdependence in wireless

Why has the global wireless ecosystem become more integrated, even as U.S.-China competition has intensified? In a world of standardized interdependence, this is not a surprising outcome. If a standards body with high legitimacy like the IEEE 802.11 promotes interoperable protocols, then the dominant state faces significant barriers to excluding a rival power from technology networks. In particular, we should see

135. Federal Register: RIN 0694-AH86
136. Seaman 2020.
137. IEEE 2019. Interview with longtime participant in IEEE 802 working groups, Zoom, August 6, 2025.
138. Wu 2024, Some of these failures echoed China's previous attempt at an indigenous wireless standard, which is summarized in the supplementary appendix.
139. D. Tan et al. 2021.
140. Tan et al. 2021, 4.
141. Pohlmann and Buggenhagen 2024.

evidence that the U.S. refrained from wielding its potential leverage in this case because its firms would lose out on the economies of scale and scope associated with Wi-Fi standards.

Indeed, amidst debates over the Entity List order, the U.S. confronted the costs of weaponizing globally interoperable networks that offer economies of scale and scope. In June 2019, 26 standards-setting consortia, including groups that work closely with IEEE wireless standards such as the Ethernet Alliance, jointly petitioned the Department of Commerce to exempt them from Entity List requirements. Specifically, they argued that restrictions on Huawei would result in "the launch of competing standards, leading to lengthy and destructive 'standards wars'."[142] Speaking for the wireless industry, the Wi-Fi Alliance warned that Huawei's exclusion from accessing certification test schemes for wireless standards would lead to "the development of regional or fragmented certification programs, which will fracture the market and disadvantage consumers and other companies alike."[143]

In the end, based on continued industry input, a revised September 2022 rule not only confirmed the standards exemption but also expanded it in terms of technologies (beyond just information technology) and companies (to other firms on the Entity List).[144] Based on my analysis of 48 comments from the Regulations.gov portal, Table 1 traces how the final rule's language matched industry recommendations. Andy Updegrove, a lawyer who has advised SDOs for the past 25 years, typically represents 60 or so such groups at any one time. Regarding the deliberations over the standards exemption, Andy recalls, "I did not have one single client that did not want Huawei to continue to participate. As far as I can tell, American companies universally wanted Huawei in the room."[145]

US-China interdependency reflected in membership and contribution data

The U.S.'s reluctance to fracture the wireless market also owed much to the extensive ties between its firms and Chinese peers in Wi-Fi standards. According to their data on patents linked to the Wi-Fi 6 standard, LexisNexis experts find that Chinese companies own about 25 percent of Wi-Fi 6 patents, which is second only to U.S.-headquartered companies (about 40 percent) and represents an increase from Chinese patent ownership for earlier Wi-Fi standards.[146] Chinese companies also submitted the second-most contributions (a little over 10 percent of the total) to the IEEE 802.11ax standard, with Huawei and ZTE both ranking among the top ten firms on this metric.[147]

IEEE 802.11 membership data substantiates that U.S.-China interdependence in Wi-Fi has deepened. Based on my compilation of institutional affiliations of

142. Updegrove 2019.
143. Wi-Fi Alliance Comment (RIN 0694—AI06).
144. Updegrove 2022.
145. Interview with Andy Updegrove, January 9, 2025.
146. Pohlmann and Buggenhagen 2024.
147. Pohlmann and Buggenhagen 2024.

Table 1: Industry arguments about need for Chinese participation reflected in Entity List standards exemption

Main Requests	Examples of industry comments on June 18, 2020 request for information	Language in September 9, 2022 interim final rule
Expand exemption to all companies on Entity List (not just Huawei)	"Because the amendment authorizes the release of certain technology to Huawei but does not address release of the same such technology to other organizations on the Entity List that participate in standards organizations, the stated objective of the amendment is still undermined."— Intel, largest American chipmaker "The impact of the amendment being limited just to Huawei entities is not theoretical. Many standards organizations have or will likely have members that are on the Entity List." – Qualcomm, American tech giant	"BIS agrees with the commenters that the standards-related authorization should be applied to all entities on the Entity List."
Clarify that exemption covers software	"Clarify that the Final Rules Standards-Setting Exemption Applies to 'Technology and Software'" – Zigbee Alliance, represents over 500 member companies that work on low-cost wireless networking "The final rule should also clarify explicitly that all types of technology – ranging from hardware and chips to software and source code – are subject to the exemption for standards processes." – Consumer Technology Association, largest trade organization for North American technology companies	"In response to the public comments, BIS is revising the EAR (Export Administration Regulations) to expand the scope of the authorization to include "software" subject to the EAR."
Include standards-related activities such as conformity assessment	"BIS should explicitly confirm that certification programs, like those developed and administered by Wi-Fi Alliance, are included within the current definition of standards." – Wi-Fi Alliance "Recognize that standards development activities include any action taken by a standards development organization for the purpose of developing, promulgating, revising… or using such standard conformity assessment activities." – American National Standards Institute, premier body that accredits U.S. standards developers	"Standards-related activity" includes the development, adoption, or application of a standard…including but not limited to conformity assessment procedures."

Source: Comments on FR Doc #2020-13093; Bureau of Industry and Security 2022.

IEEE 802.11 voting members, in March 2019, just 13% of voting members were affiliated with Chinese institutions, and 52% of voting members were affiliated with U.S. institutions. By November 2024, the proportion of voting members affiliated with Chinese companies and universities had increased to 21%, and the corresponding proportion of U.S.-affiliated voting members had dropped to 38% (Figure 6).[148] At present, three Chinese companies rank among the top 15 companies in terms of voting members at IEEE 802.11, with Huawei at the very top.[149]

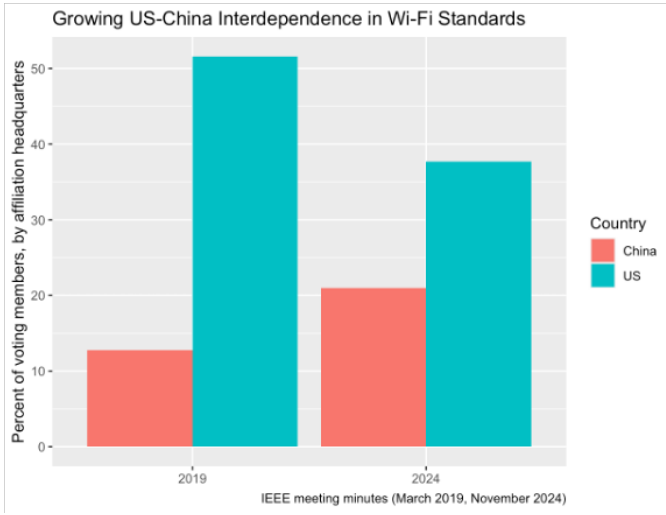


Figure 6

IEEE 802.11 legitimacy: tempered by trials

Formed in 1990, the IEEE 802.11 working group issued the original Wi-Fi standard (802.11b, or Wi-Fi 1) in 1997. One reason it outcompeted seven other SDOs in setting wireless standards is because the 802.11 working group could draw on the expertise of the IEEE 802 Standards Committee, which had previously standardized Ethernet.[150] "The worldwide acceptance of the standards it produces", according to an Engineering and Technology History Wiki entry, makes it "the premier LAN (local area network) standards development arena."[151]

This broad acceptance rests on the perception that decisions do not unduly favor one company or government. Interviewees acknowledged but also pushed back against

148. 802.11 meeting minutes (March 2019; November 2024).
149. 802.11 session report (March 2025).
150. Rikitianskaia 2024.
151. Engineering and Technology History Wiki 2024.

concerns that deep-pocketed companies like Huawei or strong governments dominate the process. Regarding the former, a longtime IEEE 802 veteran stated, "Huawei I must say is very cognizant of the fact that they should not be attempting to tilt the playing field."[152] As for the latter, another expert who has participated in 802 standards for multiple decades commented, "From the many years I've participated in, I've often wondered if the government would stick its finger in the pie, but it never did."[153]

In fact, after Huawei's Entity List designation, IEEE membership fought to preserve safeguards against U.S. government overreach. In a note sent to the 802 executive committee listserv, Geoff Thompson, former chair of the Ethernet working group, urged the IEEE to restore Huawei's access to standards development. "It is vitally important to our *standing* as a world-wide standards setting organization," he wrote.[154] A week later, after fielding significant pushback from its members and engaging with the U.S. government, the IEEE clarified that Huawei employees could continue participating in standards development and peer review.[155]

Deliberative procedures undergird the working group's legitimacy. The organization operates based on majority consensus, so a motion progresses if more than 50 percent of voting members support it.[156] As mentioned in the introduction, this decision-making rule was tested during a fierce dispute over the original Wi-Fi standard between Harris and Lucent Technologies. During one contested vote, 29 members voted for the proposal supported by Lucent representatives, 28 supported the Harris proposal, and one abstained. The close outcome sparked a debate about the consensus rule itself, as participants questioned whether the abstaining voter should have been included in the total. After the working group clarified that 29 out of 58 votes did not satisfy majority consensus, the two camps came to an agreement that would benefit both in the long-term, which was accepted at the next meeting.[157]

The 802.11 working group also ranks high on openness and transparency. Working group meetings are open to anyone, deliberations and meeting minutes are publicly available, and email listserv messages can be viewed by all.[158] From 2001 to 2024, Paul Nikolich served as chair of the IEEE 802 committee. On the transparency of the 802.11 process, he commented, "Everything is public. . . everything we do is heavily scrutinized, too. Because we subject all technical drafts to very thorough vetting, reviews, responses to comments, it's a very even playing field."[159]

An investigation into a special interest group DensiFi illustrates the working group's commitment to transparency in practice. In 2016, Graham Smith, a SR Technologies

152. Interview with longtime participant in IEEE 802 committee, Zoom, April 29, 2025.
153. Interview with experienced expert in IEEE 802 working groups, Zoom, August 6, 2025.
154. Emphasis mine. IEEE listserv thread 2019.
155. "IEEE Lifts Restrictions on Editorial and Peer Review Activities," 2019.
156. van de Kaa and de Bruijn 2015.
157. Lemstra et al. 2010, 76.
158. See public reflector: https://grouper.ieee.org/groups/802/11/Reflector.html.
159. Interview with Paul Nikolich, Zoom, April 29, 2025.

employee, submitted a complaint against DensiFi for violating the IEEE bylaws on "dominance", which refers to when members exercise undue influence in a way that excludes other views.[160] The resulting investigation found that DensiFi — organized by large tech companies including Apple, Broadcom, Cisco, Huawei, Samsung, ZTE, etc. — had covertly operated to shape the Wi-Fi 6 standard-setting process.[161] The investigation recommended that all members affiliated with DensiFI could only exercise one collective vote, ultimately bringing about the group's disbandment.

Lastly, technical merits play an influential, albeit not determinative, role in the working group's decision-making. According to one survey of individuals pivotal to the development of early IEEE 802.11 standards, almost all the active participants had engineering backgrounds, with titles like "system architect."[162] While the survey respondents conceded that the political influence of powerful companies factored into standards development, a proposal's technical viability still carried significant weight. In fact, some individuals became known for generally voting for the best technical specifications independent of their affiliation, which enhanced their reputation and influence in the working group.[163]

3GPP and unified 5G (2015-2025)

In 2020, as part of a Johns Hopkins University project that convened domain experts to assess U.S.-China interdependence in various industries, Paul Triolo envisioned a complete decoupling in telecommunications. "Over the next five years, a full bifurcation may take the industry back to the days of separate and competing national standards, problems with interoperability, and the end of a globalized value chain," he declared.[164] Written during the heights of the U.S.'s campaign to restrict Huawei's global 5G rollout, this forecast reflected a general expectation that the 5G landscape would fracture into separate Chinese and Western ecosystems.[165] Around that time, the U.S. and many allied countries banned the use of Huawei 5G equipment from core infrastructure; in turn, Chinese operators curbed their contracts with Western network equipment suppliers such as Ericsson and Nokia.[166]

In many ways, 5G is an ideal fit for the existing literature's presumptions regarding economic interdependence amidst an escalating U.S.-China rivalry. Concern that China could collect surveillance and intelligence benefits (panopticon effects) from Huawei's 5G networks drove the U.S.'s backlash. Adam Segal flagged U.S.-China competition over 5G as "perhaps the clearest illustration of the structure and processes

160. "IEEE SA Standards Board Bylaws."
161. Harcourt, Christou, and Simpson 2020.
162. Lemstra et al. 2010, p. 98-100.
163. Lemstra et al. 2010, p. 98-100.
164. Triolo 2020.
165. Morris 2021; Segal 2021.
166. Luong 2024; Morris 2025.

of weaponized interdependence."[167] Under a related perspective, the close ties between Chinese telecommunications firms and the Chinese Communist Party pushed the U.S. and other countries to break ties (e.g., the "Clean Network" initiative in 5G).[168] These circumstances should compel the bifurcation of the 5G ecosystem.

Standardized interdependence predicts a different outcome in 5G. In telecommunications, unified standards are essential for companies to reach a global market and specialize in certain components that can interact with a diversity of software and devices on different networks. A Samsung Galaxy 5G smartphone brings together technologies developed in China, the U.S., and European countries. That phone can transmit signals to a ZTE base station in Malaysia or an Ericsson base station in Texas, which were likely manufactured in Asia based on patented innovations largely developed in Europe and America.[169]

Global standards mean that the previous two sentences remain true, if the Samsung phone was replaced with an Apple iPhone, an autonomous vehicle, a smart home device, or any 5G-enabled technology and service. The Third Generation Partnership Project (3GPP), which formed in 1998 and started to standardize 5G in 2015, has established a proven track record in developing globally recognized standards for mobile telecommunications. These conditions should incentivize U.S. and Chinese companies to continue collaboration on 5G standards, functioning as a buffer against decoupling.

5G integration measures

Since 2019, has bifurcation occurred in the 5G industry? Undoubtedly, the U.S. has reduced its dependence on Huawei in core networks. The Secure and Trusted Communications Network Act authorized a "Rip and Replace" program to remove Huawei equipment from U.S. telecommunications networks. U.S. export controls have forced Huawei to find non-American suppliers of key components for 5G base stations. A 2023 teardown analysis of a Huawei small base station found that just 1 percent of components came from U.S. firms.[170] In recent years, Ericsson and Nokia have also bled market share in China.[171]

Nonetheless, this splintering only goes so far. Even after being placed on the Entity List in 2019, Huawei continued to source digital signal processing chips, power devices, and reprogrammable integrated circuit chips from U.S. firms like Broadcom, Onsemi, and Texas Instruments.[172] A similar teardown exercise for Huawei large base stations estimated that U.S. components accounted for almost 30 percent of the total

167. Segal 2021, 149.
168. Pearson, Rithmire, and Tsai 2022; Ryan and Burman 2024.
169. Boston Consulting Group 2015.
170. D. Li 2023.
171. Morris 2025.
172. Lee-Makiyama and Baker 2024.

value.[173]

Assessing US-China interdependence in 5G must account for Chinese firms other than Huawei, which have deepened their reliance on U.S. firms. Notably, another Chinese 5G vendor ZTE maintains close links with Lumentum, Qorvo, and other U.S. suppliers of integrated circuits, amplifiers, and optical modules.[174] In the transition from 4G to 5G devices, all three of China's leading smartphone firms now source a higher percentage of parts from U.S. partners.[175] This continued dependency is also reflected in Qualcomm's revenues. In 2018, before the U.S. government ramped up its campaign against Huawei's international 5G deployments, Qualcomm's revenues from China accounted for 67 percent of its total revenues. Six years later, according to its 2024 annual report, Qualcomm derived 66 percent of its revenues from China.[176]

Overall, under the surface of geopolitical tensions, a "peaceable kingdom" of intellectual property (IP) licensing still operates like normal.[177] Using a measure that incorporates a patent's competitive influence, LexisNexis ranked the top 50 owners of 5G-declared patent families. Of these leaders in 5G, fifteen firms are based in China, and nine are based in the United States. Together, therefore, these two countries' firms make up essentially half of the top 50 holders of standard essential patents (SEPs) in this domain.[178] Huawei, as the overall leader in 5G patent declarations, has signed lucrative cross-licensing deals with Qualcomm, Amazon, and many other U.S. companies.[179] In fact, these 5G licensing revenues have proved essential for Huawei to "stay afloat" and offset damages from U.S. technology restrictions.[180]

Standardized interdependence in telecommunications

Even amidst intensified geopolitical tensions, Chinese and U.S. firms continue to collaborate on 3GPP specifications. As one industry publication recently observed, 3GPP operates like "a sanctuary from the dogfights that have ripped through the sector."[181] Initially formed to produce specifications for third-generation cellular technology, 3GPP brings together over 800 companies and research institutions, which affiliate with one of seven organizational partners aligned with various regions (e.g., the Alliance for Telecommunications Industry Solutions [North America]).[182] While the ITU also develops some general standards in this domain, it essentially accepts the outputs from 3GPP, as industry actors are much more engaged in the latter.[183] Experts

173. Matsumoto and Watanabe 2020.
174. Triolo 2020. Morris 2021.
175. Yaku 2020.
176. Qualcomm annual reports (2018, 2024).
177. Saunders 2024.
178. Pohlmann et al. 2025, 21-23.
179. Hamblen 2020.
180. Ryan and Burman 2024, 361.
181. Morris 2025.
182. Baron, Bergallo, and Gamarra 2025.
183. Bruer and Brake 2021.

label 3GPP as the "keystone" SDO in mobile telecommunications.[184]

As an illustration of U.S.-Chinese cooperation in 3GPP, consider one change request to a technical specification that addresses 5G applications in satellite and drone systems. Over a one-year period beginning in December 2019, Chinese and U.S. companies engaged in discussions on this change request. Proposals from Chinese smartphone maker Oppo and Qualcomm were incorporated into the finalized change request; 24 different companies shared their views on the proposals, including vivo, Huawei, China Telecom, Apple, LG, Intel. Additionally, representatives of Huawei, China Mobile, ZTE, and AT&T participated as chair, vice-chairs, or moderators of discussions about the change request.[185]

Despite the geopolitical turmoils surrounding 5G, Chinese firms have increased their commitments to developing globally interoperable standards through the 3GPP process.[186] One indicator of a company's investment in the 5G standards is its number of technical contributions, which cover summary documents that identify points of consensus, change requests, and research and position papers. From 2015 to 2024, Chinese firms made up seven of the 15 firms that submitted the most 5G-related technical contributions to 3GPP.[187] From 2015 to 2019, the number of change requests that involved Chinese actors more than tripled.[188] At the 3GPP meeting attended by the author, one interviewee flagged a proposal co-sponsored by T-mobile and China Unicom, driven by their shared optimism about the use of AI in base stations: "Who would have thought that the leading U.S. and Chinese operators find each other and drive things together?"[189]

US-China co-investments: 3GPP Change Requests analysis

Has 3GPP's work been impeded by U.S. concerns about weaponized interdependence or China's ambitions to develop its own sphere of influence? Instead, network analysis of 3GPP collaborations shows that U.S. and Chinese firms have become more committed to unified, global standards. To quantitatively measure the integration of Chinese firms into telecommunication standards development, I analyzed 7,230 change requests from the 3GPP database.[190] Since change requests include information on all the contributing organizations, previous studies have used change request data to analyze collaboration patterns in 3GPP.[191]

Network centrality measures reveal that collaborations between U.S .and Chinese

184. Dallas and Shiu 2023.
185. Baron 2024.
186. Scott and Schaefer 2023.
187. Pohlmann, Richter, and Buggenhagen 2025; Casaccia 2018.
188. Schott and Schaefer 2023.
189. Interview with standards head at European firm, with experience in leadership positions at 3GPP. Technical document: RP-253524.
190. 3GPP CR Database. For detailed methodology, see supplementary analysis.
191. Johansson et al. 2019; Schott and Schaefer 2023.

organizations have become more pivotal to standards development at the 3GPP. First, I calculated the "edge betweenness" of collaborations between U.S. and Chinese firms on 3GPP change requests. Higher values of edge betweenness would suggest that a particular co-contribution tie between a U.S. and Chinese firm bridges many of the shortest paths that link various organizations — a proxy for the significance of some ties to the overall network's connectedness. From the 2012-2016 period to the 2021-2025 period, 3GPP relationships have become more dependent on U.S.-China ties (Figure 7 shows an increase from 4.7 to 7.0 percent in the sum of edge betweenness for all U.S.-China co-contributions).

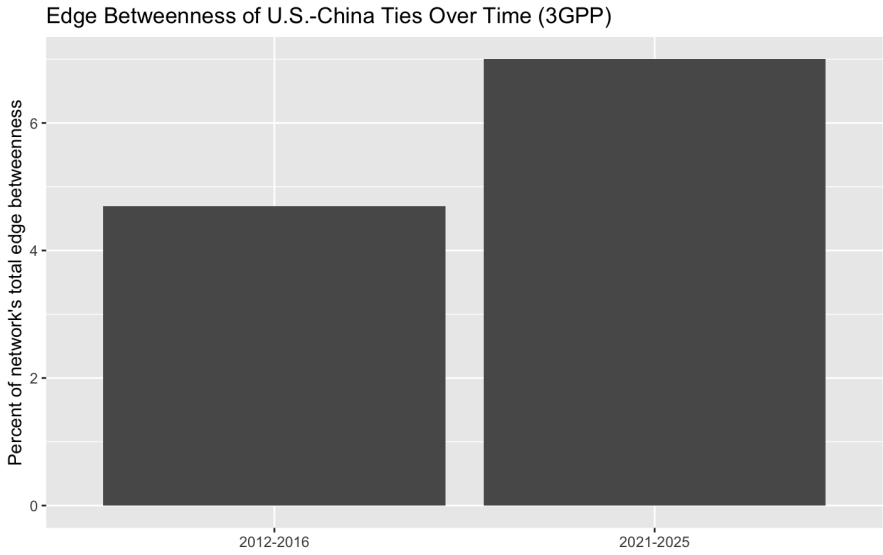


Figure 7

Over time, Chinese organizations have also become more *central* to the 3GPP standards development. I calculated the average degree, betweenness, and eigenvector centrality of Chinese firms. Across all three measures, the centrality of Chinese players has risen over the past decade (Figure 8).

3GPP legitimacy: nowhere to hide in terms of technical debates

How has 3GPP legitimized itself as the keystone body in telecommunication standards? As reflected in Article 25 of its working procedures, 3GPP encourages consensus-based decision-making on all issues.[192] Even the largest firms must negotiate with smaller

192. 3GPP Working Procedures 2026. In cases when consensus is not possible, the Chair can turn to a vote, which requires a 71% majority.

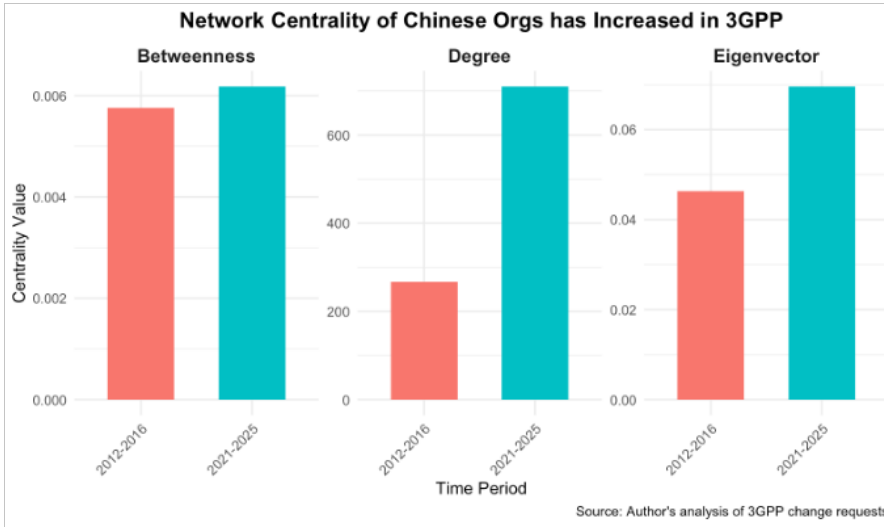


Figure 8

firms on the viability of particular technical specifications.[193] Any proposal for a novel feature must garner support from at least four members; on average, a new work item is proposed by about 10 firms.[194] Across discussions on more than thirty topics at a 3GPP meeting observed by the author, even for proposals which the meeting chair expressed eagerness to move on ("I think this is good enough. Can we move on from this?"), the discussion continued as long as one person kept raising their hand in disagreement.

The transparency of deliberations enables stakeholders to work towards practical technical solutions at 3GPP. All email distribution lists, meeting reports, and technical contributions are publicly available. Drawing on a decade of experience with 3GPP, one engineer from a U.S. company portrays how heated technical fights forge new ideas: "You make a proposal; for the first time, people laugh you out. Then you build it up and build alliances."[195] Another standards veteran attributes 3GPP's success to similar factors: "The rules are good in general. It's very transparent, and it comes with a real commitment to establish the best technical solutions. . . That leaves you nowhere to hide in terms of the technical debates."[196]

To be sure, 3GPP is not immune to the influence of large firms or powerful states.

193. Dallas and Shiu 2023.
194. Baron and Gupta 2018, 445.
195. Interview with experienced 3GPP representative for U.S. firm, Zoom, 11/20/25.
196. Interview with 30-year standards veteran, Zoom, 10/23/25.

Even though 3GPP boasts membership from over 550 organizations,[197] a concentrated group of companies exerts substantial influence. According to data on 3GPP activities from 2005 to 2013, nine firms submitted 60 percent of all technical contributions, including change requests, discussion documents, and technical studies.[198] Regarding opportunities for smaller players, one experienced 3GPP participant countered, "If you come in here with a commercial interest, it fits with the scope, you have a very good chance of influencing the work."[199] However, he also admitted that underfunded organizations usually had to partner with big companies to follow-through on their standards proposals.

Expert interviewees noted that participants must balance a dual loyalty to the standards organization and their company. At times, an engineer may edit a sentence in a technical specification to satisfy a company priority; other times, she may edit a sentence because it is the "technically right thing."[200] Of course, while 3GPP participants recognize the underlying business drivers, they also take pride in "ownership of the topic" and their own professional reputations.[201] The result is not a perfect standards body but rather, in the words of a specialist who has worked on mobile standards for three decades, "the most successful for making reasonable technical specifications that are sufficiently good."[202]

Due to space considerations, the supplementary appendix probes two extensions to 3GPP legitimacy. First, it examines the case of fractured 3G standards, when 3GPP's legitimacy was contested. Second, I tackle concerns about block voting practices employed by Chinese firms, which some analysts believe could undermine 3GPP's legitimacy.

SWIFT and financial fragmentation (2014-2024)

Diverging from the previous three domains, financial messaging networks have undergone modest fragmentation. Why? The U.S. government's influence over the Society for Worldwide Interbank Financial Telecommunication (SWIFT) has prompted rival states to develop alternative cross-border payments and messaging systems, but this explanation is incomplete. Crucially, SWIFT's dual role as a proprietary network operator and standards-setter undermines its efforts to promote global standardization

197. Casaccia, Petrovčič, and Vuong 2024.
198. Baron and Gupta 2018. One engineer argued that organizational concentration is higher in 3GPP than other standards bodies, where "Everyone is basically trying to satisfy Verizon and China Mobile." Interview with Greg Ennis, Zoom, 9/10/25.
199. Interview with standards head at European firm, Baltimore, USA, 12/9/25.
200. Interview with 30-year standards veteran, Zoom, 10/23/25.
201. Interview with experienced 3GPP representative for U.S. firm, Zoom, 11/20/25.
202. Interview with 30-year standards veteran, Zoom, 10/23/25. Using similar language, another source described the 3GPP process as working "reasonably well." Interview with standards head at European firm, Baltimore, USA, 12/9/25.

in financial messaging standards.

Interbank communications integration measures

Since 2014, when SWIFT faced pressure to (but ultimately did not) exclude Russian banks after Russia's annexation of Crimea, states have intensified their pursuit of alternative financial messaging services. In 2022, after Russia's invasion of Ukraine prompted SWIFT's cut-off of some Russian banks, Russia coordinated some cross-border payments through its own financial messaging service, called Systema Peredachi Finansovykh Soobshchenii (SPFS).[203] On balance, SPFS's network connections, at the global level, represent less than 5 percent of SWIFT's membership, which makes it a very limited alternative.[204]

China's Cross-Border Interbank Payments System (CIPS), launched in 2015, presents a more formidable challenge to SWIFT. Perceiving SWIFT sanctions as an economic weapon, Chinese scholars and policymakers see CIPS as a hedge against SWIFT's dominance.[205] By March 2024, CIPS had attracted 1,511 financial institutions as participants, a figure that has more than doubled over the past six years.[206] In 2024, CIPS processed daily transactions worth 652 billion RMB, which was 35 percent higher than the 2023 average daily volume.[207] Jing Wang, a New York University Shanghai academic, asserts, "The continued expansion of CIPS (Cross-Border Interbank Payment System) has created alternative channels for international payment and settlement, enabling China to reduce its reliance on Western-dominated financial infrastructures such as SWIFT."[208]

As currently designed, CIPS is neither a near-peer nor exact substitute to SWIFT. On average, SWIFT coordinates about 374 times more in daily transactions than CIPS.[209] By one estimate, 80 percent of CIPS payments use SWIFT messaging.[210] When making payments through CIPS, banks can use either the CIPS messaging system or SWIFT. Many banks choose the latter because of their familiarity with SWIFT and the difficulties of installing specific terminals to accommodate CIPS messaging.[211]

Still, the growth of CIPS has partially reduced China's dependence on SWIFT. A Council on Foreign Relations analysis notes that, over the past few years, RMB transactions over CIPS seem to substitute for the decline in the RMB share of SWIFT

203. Venkiteswaran 2023.
204. Rodeheffer 2024; Cipriani, Goldberg, and La Spada 2023.
205. Wang 2024.
206. The Economist 2024.
207. PBC 2024
208. J. Wang 2025.
209. The Economist 2024.
210. Eichengreen 2022.
211. Eichengreen 2022.

transactions.[212] From 2024 to the end of 2025, the number of CIPS direct participants (which can coordinate payments through CIPS messages) increased by almost 40 percent.[213] Additionally, some evidence shows that CIPS has filled in for SWIFT in connecting Russia with the rest of the banking world.[214]

In short, over the past decade or so, the world has seen a moderate, albeit bounded, degree of fragmentation in interbank messaging. As three Federal Reserve Bank economists conclude, "While currently limited in scope, over time these alternative systems could meaningfully reduce the effectiveness of restricting access to the existing infrastructure of cross-border payments based in the West."[215] In the language of interdependence, this fragmentation has dampened the economic damages of a potential breakdown in U.S.-China cross-border payments.

Unstandardized interdependence in cross-border payments

What is the state of standardization in cross-border payments? The closest thing to a global standard is ISO 20022, a financial messaging format. Compared to the previous SWIFT Message Types format, ISO 20022 enables banks to include more precise data in their communications, such as information on the initiating party and ultimate debtor, which speeds up and automates processing.

Thus far, ISO 20022 adoption has been fragmented and slow. A decade after SWIFT began pushing the standard in 2016, less than 40 percent of North American and European banks expressed high confidence about their capacity to upgrade to ISO 20022 format.[216] In October 2025, the Financial Stability Board announced that it would fall short of its 2027 targets for faster and cheaper international payments. According to a Reuters report on the announcement, to reach these goals, one major need is "for countries' payments plumbing. . . to use standardised language so that moving money between countries and weeding out fraud and sanctions infringements is easier."[217]

The lack of implementation guidance for ISO 20022, which only offers a high-level roadmap, has hindered adoption.[218] As a result, even among two ISO 20022 adopters, their respective implementations may meaningfully diverge, which raises the costs for parties to accommodate both methods.[219] Take, as an example, the Committee on Payments and Market Infrastructure data requirements published in October 2023,

212. Interview with sanctions compliance manager at a multinational financial services company, Zoom, May 5, 2026. According to this manager, since Chinese banks had been using SWIFT to process domestic transactions, this apparent substitution effect could be explained by CIPS replacing SWIFT for coordinating domestic transactions, as opposed to cross-border payments. Stell and Schuster 2026.
213. Stell and Schuster 2026
214. The Economist 2024; Lipsky and Kumar 2023
215. Cipriani et al. 2023, 50; Nölke 2025, 259.
216. Adams 2024.
217. Jones and Seers 2025.
218. Tagai 2025.
219. Kamel 2025.

which aimed to ensure various implementations of the ISO 20022 standard supported consistent codes and identifiers. While China's CIPS and U.S. payments systems have endorsed ISO 20022 in principle, their specific implementations do not confirm with the committee's data requirements.[220] The lack of standardized implementations of messaging formats has pushed major banks to develop their own proprietary alternatives, such as blockchain-based infrastructure.

The lack of a high-legitimacy SDO in cross-border payments

The use of SWIFT as a tool for surveillance and sanctions has undermined its legitimacy as a neutral standards development organization. Specifically, U.S. leverage over SWIFT, as demonstrated by exclusion of Iranian financial institutions and access to network data to track suspected terrorist funds, has stirred controversy.[221] Wang Yongli, a former Vice President of Bank of China who previously served as a SWIFT board member, expressed his concerns in a recent blogpost: "This evolution of SWIFT into a US-EU policy instrument has marked a significant departure from its founding principles of neutrality, triggering high degrees of concern and vigilance from the international community."[222]

Ultimately, though, fragmentation in cross-border payments stems from the absence of a highly legitimate standards development organization. For many years, SWIFT was the only body that set cross-border payment rules. Even now, after ISO 20022 attempted to transition from previous processes "generally dominated" by SWIFT towards a "broader global governance model through cooperation and voluntary consensus,"[223] SWIFT still plays an essential role as the authority that reviews whether new messaging systems are compliant. Yet, SWIFT differs from the IETF and the IEEE standards working groups in one crucial aspect: it is not just a standardization body but also the operator of a proprietary network for financial message services. This role conflict has detrimental effects on its legitimacy.

Indeed, closed messaging standards developed by SWIFT have struggled to realize interoperability. For example, based on proprietary SWIFT syntax, the ISO standard 7775 for securities messages did not attain universal adoption in the 1990s. One obstacle was that the SWIFT standards development process was not open to securities firms, asset managers, and other key implementers, which left them "unconvinced that they should adopt a proprietary standard developed by a private cooperative."[224] A former managing director of J.P. Morgan's payments business concludes, "We don't have a 'real standards body' like ISDA [the International Swaps and Derivatives Association]...Compared to derivatives, the payments market does not have such an

220. Chang 2024, 477.
221. Scott and Zachariadis 2014.
222. Y. Wang 2024, See also Nölke 2022, 9.
223. Scott and Zachariadis 2014, 76.
224. Scott and Zachariadis 2014, 69.

overarching rule-making standards body that governs the practice of payments."[225]

V. Conclusion

Does great power competition compel decoupling? "[I]t becomes harder to imagine a future where the U.S. and China collaborate on any form of technology," writes a senior researcher at the Australian Strategic Policy Institute, which regularly influences U.S. technology policy.[226] The claim seems bold, yet it is not out of step with popular beliefs and important threads of international relations scholarship.

This article presents a rejoinder. Globally interoperable standards form the essential infrastructure for high-tech industries, enabling firms to specialize in a broad range of core and complementary products and weaving a complex web of cross-border interdependencies. Since firms consider these standards — and the attendant network effects — as indispensable, they constrain the dominant state's attempts to exclude rivals from global technology chains as well as the rising state's efforts to displace existing networks. This bulwark's effectiveness hinges on the legitimacy of a focal standards development organization, rooted in deliberative procedures that check undue influence from powerful governments and firms. In these domains, economic interdependence between great powers is standardized, which makes it very hard to break apart.

I test this argument across twelve different technology domains, which vary in SDO legitimacy and U.S.-China economic integration. The evidence includes social network analysis of datasets that cover 10,000 standards documents as well as over 60 expert interviews. To trace U.S. and Chinese interactions in SDOs, I attended IETF and 3GPP deliberations as a new member and guest member, respectively. My findings undermine the presumption that great power competition necessitates global economic fragmentation. In technology domains governed by a high-legitimacy SDO, U.S.-China economic interdependence has not only endured but even strengthened.

This paper points to several directions for future research. First, while the argument is scoped to information and communication technologies, further work should explore whether the findings travel to other industries, especially as software becomes integrated in most, if not all, value chains. The growing significance of technical standards to lower-tech industries such as machine tools (e.g., the MTConnect Protocol) suggests that this line of inquiry is worthwhile. Second, why do some standards-setters develop deliberative practices that support universal standards? Historical timing matters, and this paper likely underplays the import of civil society actors.[227]

In all these efforts, my hope is to reset the research agenda on U.S.-China

225. Interview with Mike Tagai, Zoom, December 8, 2025.
226. Hammond-Errey 2024.
227. DeNardis 2014; Harcourt et al. 2020.

technological competition, which often centers on the grand narratives circulating around the West Wing of the White House and Politburo sessions in Zhongnanhai. Who will win the AI race? In a world of separate technology blocs, which great power will get middle powers to swing their way? A standardized world suggests different queries. Can this organization prevent a company or country from dominating the underlying infrastructure behind AI development? What affects whether the U.S. and China co-invest in public goods that support the global economy? These questions ricochet back and forth in rooms with less decor and gold-plating: hotel conference settings with uncomfortable chairs where ordinary engineers discuss the nuts and bolts of technologies.

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