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The International Political Economy of Submarine Internet Cables: Analyzing Changes in US Cable Policies

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TABLE OF CONTENTS

LIST OF FIGURES

Introduction

I. Context and research question

The modern global economy rests for a large part on an intricate network of submarine fiber optic cables stretching for millions of kilometers under the oceans, connecting continental landmasses to one another. Although their existence is rarely acknowledged outside of technical communities, submarine cables quietly underpin the global information networks by transporting the near totality of the world's Internet traffic, providing the avenues for the light-speed flows of knowledge, finance, and entertainment content that characterize the modern era. Submarine cables are critical for the Internet's global reach and the Internet is critical for our globalized economy. Thus, submarine Internet cables can be rightly considered as «the out-of-sight arteries of globalization».[1] Despite its importance in sustaining the global economy, this crucial infrastructure network has not received much attention in international political economy literature.[2] This can arguably be reconducted to a general tendency of the discipline to neglect the study of infrastructure and technologies in their role as the physical backbone of global flows.[3] Aside from engineering and IT, submarine Internet cables have mostly been studied under the lens of security policy. Their nature as critical infrastructure, indeed, makes the protection of the physical integrity of these cables and the confidentiality of the data flowing through them a priority of the security community. However, interpreting submarine Internet cables as merely targets for espionage or sabotage undersells their importance in spatially structuring the Internet network, enhancing the centrality of certain actors within the digital economy, and shaping global information flows. It is my intention to contribute to broaden the perspective by focusing on a relevant political phenomenon that has only recently come to affect the submarine cable network.

The aim of this research is to understand the reasons for the sudden surge in the political attention toward submarine Internet cables on part of the government of the United States, which has brought a widely neglected, albeit crucial, infrastructure network to the fore of international competition. The US has traditionally been an attractive landing site for intercontinental submarine cables, facilitated by its general openness to private investments in infrastructure, including from foreign companies, its business-friendly environment, and a hands-off approach toward the cable industry. In general, US policies regarding submarine cables have been limited to establishing minimum criteria for granting cable landing licenses and setting penalties for those who intentionally or accidentally damage the systems. The management of the

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[1] Surabhi Ranganathan, "The Law of the Sea: 7 Essays on the Interfaces of Land and Sea", *Visualizing Climate and Loss*, January 2020. https://histecon.fas.harvard.edu/climate-loss/lawofthesea/arteries.html

[2] Notable exceptions include: Pierluigi De Rogatis, "The Political Economy of Submarine Cables: The Quantum Cable Project in the Mediterranean Sea", *The Square Insight* No. 18 (2022). https://ssrn.com/abstract=4144465 ; Lars Gjesvik, "Private Infrastructure in Weaponized Interdependence", *Review of International Political Economy* Vol. 30 No. 2 (2023): 722-746. https://doi.org/10.1080/09692290.2022.2069145 ; Edward J. Malecki, "The Economic Geography of the Internet's Infrastructure", *Economic Geography* Vol. 78 No. 4: 399-424. https://doi.org/10.2307/4140796

[3] Nick Bernards and Malcom Campbell-Verduyn, "Understanding Technological Change in Global Finance Through Infrastructures", *Review of International Political Economy* Vol. 26 No. 5 (2019): 773-789. https://doi.org/10.1080/09692290.2019.1625420

submarine network was delegated to the Federal Communications Commission (FCC), an independent agency that applied bureaucratic-technical screenings inevitably resulting in the approval of all cable landing applications. However, the beginning of the current decade has seen the US government adopt a newfound interventionism on the matter. In 2020, the White House formalized and expanded the competencies of the so-called "Team Telecom", a grouping of Executive agencies tasked with performing security screenings on cable landing applications submitted to the FCC. That same year, for the first time in history, Team Telecom recommended that the FCC deny the license for the Pacific Lights Cable Network, a project set to connect the US to China, on national security grounds. In the following months, Team Telecom's increasingly hostile stance against cables with any form of Chinese involvement led several other projects to be blocked or spontaneously withdrawn once it became clear they would also be rejected. These incidents came as a shock to the industry, as direct US-China connections had already been realized, most recently as of 2018. Moreover, during the same period the US launched a diplomatic offensive against the activities of Chinese cable supplier HMN, formerly Huawei Marine Networks, succeeding in ousting it from cable projects in foreign countries through the use of stick-and-carrot tactics. Finally, these efforts were complemented by the implementation or proposed introduction of numerous measures such as the institution of a semi-nationalized cable repair fleet, a protectionist Subsea Cable Control Act finalized at restricting Chinese companies' access to key components, and programs for providing funding to developing countries willing to invest only in "trusted" systems. The consistency of these policies, which all target Chinese companies, and the bipartisan support they enjoy signals these are not isolated incidents but rather a cohesive, more confrontational revised cable policy. This marks a drastic breakaway not only from submarine cables' usual invisibility, but also from several principles we have come to associate with the US, such as the avoidance of interferences with private markets. Moreover, it is significant that the US government now identifies the mere interconnection with China as a threat, as opposed to an opportunity to foster greater exchanges between the two nations.

Therefore, this dissertation aims at understanding the reasons for this policy shift. While this is clearly linked with China's rise as a global provider of ICT infrastructure through initiatives such as the Digital Silk Road, we still need a more comprehensive understanding of why submarine Internet cables have suddenly become politically sensitive artifacts requiring enhanced attention from governmental authorities. This question is relevant because it opens an opportunity to gain further insight into the dynamics affecting global infrastructure networks in a time of heightened international competition. What happens to infrastructures that exist to create stronger connections between countries as geopolitical tensions mount? In this sense, the submarine cable network provides an interesting case study for two reasons. First, like the Internet in general, it was conceived since the beginning as lying beyond the control of any individual state. Secondly, until recently, unlike the Internet's content layer – such as social media and applications – it has generally been considered as an apolitical matter of limited interest.

Furthermore, framing the new US policy towards submarine Internet cables in the broader context of global infrastructure networks enables us to broaden the view on the threat that the US associates with China's cable projects. Most commentators have focused solely on the potential exploitation of submarine cables for intelligence gathering purposes. However, this hyper-securitized perspective loses sight of other advantages associated with shaping infrastructure networks, which include the ability to influence their inner standards and regulations in accordance with an actor's own policy preferences. Interpreting infrastructure such as submarine Internet cables as vehicles for influencing the shape and dynamics of global flows can be the key to connect China's infrastructure investments with its intention to promote a revision of the current Internet model and, conversely, to visualize the new US cable policy as a struggle to preserve a digital ecosystem that has been largely influenced by Washington's policy choices.

II. Methodology

In order to analyze the shift in American submarine cable policies under an IPE lens, this research employs contributions from diverse academic fields to establish an effective theoretical framework capable of explaining the characteristics, dynamics, and tensions of global infrastructure networks. Given the niche nature of the topic, it will be necessary to draw contributions from various disciplines beyond economics, including international relations, sociology, security studies, and science and technology studies (STS). In particular, the research draws on the contributions of two seminal authors. One is sociologist Michael Mann, whose concept of infrastructural power provides an account of the intimate relationship between physical infrastructure and the implementation of state policy preferences.[4] The other is the matriarch of IPE, Susan Strange, whose notion of structural power emphasizes the advantages states draw from the ability to shape global structures, constraining the behavior of other actors.[5] These two concepts have an affinity that goes beyond semantics: indeed, they can be combined into a powerful lens explaining the interest of states in influencing the design and configuration of global infrastructure networks. This is further corroborated by STS accounts of the constraining effects and political qualities of technological standards and design choices.[6] Submarine Internet cables will be studied under this theoretical framework, highlighting the ways through which they can act as conduits of state influence. Moreover, the research will use a diachronic comparison between case studies set before and after the shift in US cable policies, which will serve to better understand the differences in Washington's approach toward cables in light of China's newfound prominence as well as its contradictions with some core tenets of US ideology. For what concerns technical information on cable systems, including relevant aspects such as ownership, geographical routes, landing points, and capacity, the research relies on the expertise of specialized websites, publications, and research institutions including *Telegeography*,[7] *Submarine Telecoms Forum*,[8] and *Submarine Cable Networks*.[9]

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[4] Michael Mann, "The Autonomous Power of the State: Its Origins, Mechanisms, and Results". *European Journal of Sociology* Vol. 25 No. 2 (1984): 185-213. https://www.jstor.org/stable/23999270
[5] Susan Strange, "The Persistent Myth of Lost Hegemony", *International Organization*, Vol. 41 No. 4 (Autumn, 1987): 551-574. https://www.jstor.org/stable/2706758
[6] Susan Leigh Star and Karen Ruhleder, "Steps Toward an Ecology of Infrastructure: Design and Access for Large Information Spaces", *Information Systems Research*, Vol. 7 No. 1 (March 1996): 111-134. https://doi.org/10.1287/ISRE.7.1.111
[7] https://www2.telegeography.com/
[8] https://subtelforum.com/
[9] https://www.submarinenetworks.com/en/

III. Structure

The research is divided into three chapters. The first chapter serves as the foundation, establishing the theoretical framework that will guide the rest of the analysis. It begins with a comprehensive literature review aimed at establishing a definition of the concept of infrastructure and an overview of its key characteristics and issues. The chapter then delves into an examination of the core dynamics of global infrastructure networks and the role played by the state within this context.

The second chapter applies the established framework first to the Internet's logical infrastructure and subsequently to its physical backbone, that is, to submarine cables. It emphasizes the influence of US values and preferences on the development of the Internet's logical standards and examines the factors that enabled certain states to acquire a central role within the submarine cable network. Furthermore, the chapter compares the relative status of the US and China within the submarine network and the cable industry, underscoring the enduring influence of the former as well as the increasing prominence of the latter.

The third and final chapter analyzes the shift in US cable policies. It commences with a series of case studies centered on the various dimensions of the new policy, including the tightened regime on cable landing licenses and the hindering action against HMN's activities abroad. These will be contrasted with the previous hands-off approach, thus providing insight into changes in Washington's attitude. It will also serve to gain a better understanding of the threat the US perceive in China's involvement within submarine cable investments. The chapter will then challenge the explanatory power of accounts centered solely on the securitization of cables, proposing an alternative interpretation rooted in the previously established theoretical framework.

Finally, in the concluding remarks, the study offers a comprehensive overview and synthesis of the findings, along with suggestions for potential further research.

Chapter 1:
General theories of infrastructure

1.1 Introduction

The aim of this research is to gain a better understanding of the reasons behind the shift in the United States' policy on submarine Internet cables, which brought a widely neglected, albeit crucial, infrastructure to the fore of political debates. In order to explore these issues, it will be necessary to conduct an overview of the most relevant theories on infrastructure, with the aim of constructing a theoretical framework in which to locate Washington's policy choices regarding submarine Internet cables.

Such a review should begin with a definition of infrastructure and its main characteristics. This is because we must first face a linguistic challenge. The submarine cables that are the focus of this research are identified as one of the most critical components of Internet infrastructure; however, the Internet itself is also considered an example of telecommunications infrastructure. This points to the fact that even our basic understanding of what infrastructure is may be limited or confused. Furthermore, it will be necessary to look into theories of infrastructure's contribution to a nation's economy to try to understand why infrastructure should provide an advantage to the state and its citizens. As the US policy contains significant implications on the interaction between the public and private sector, since it enticed several cases of the government blocking the initiatives of private firms in the name of the raison d'etat, it will also be important to look at the evolution of the debate on which should be the proper level of public involvement in the management of infrastructure. Finally, it will be important to try to understand what exactly the relationship between state power and infrastructure can be, if any. All of these issues are complicated by the intricacies determining the principles of global infrastructure networks, that is, aggregations of infrastructure spanning across the whole world, which lie beyond the jurisdiction of any single state and posit unique economic, legal, and political issues compared to national networks.

This section will explore all the aforementioned issues to create a general framework which, in the following chapters, will be then addressed in specific regard to the subsea cable network.

1.2 What is infrastructure?

1.2.1 The definition of infrastructure

Defining infrastructure can be surprisingly challenging. The term is used in a variety of contexts and applied to vastly different objects, which can be a source of confusion especially when trying to develop a common theoretical framework. What do our submarine cables have in common with such diverse items as a road, a power plant, and a hospital, that allow us to place them all under the same conceptual umbrella? Etymology might offer a first clarification. The word "infrastructure" (which is a relatively recent term: it originated in 19th century France and only entered English during World War II) combines the word "structure" with the Latin prefix *infra*, meaning "below, under".[10] This conveys the fundamental idea that infrastructure, rather than being useful per se, serves as a crucial underpinning and sustainment for other structures. It was originally applied to foundations, roadbeds, etc., as they literally supported other constructions from below. Today, the term refers to those structures that underpin the performance of socioeconomic activities, facilitating them or even making them possible altogether. For example, roads, railways, and other transportation infrastructure enable faster and more efficient travel and commerce, telecommunications infrastructure facilitates the exchange of information, hospitals enable the provision of public health, and so on. However, this core concept is still too vague for developing a coherent theory.

A good starting point for reaching a more precise understanding of infrastructure is Hirschman's laconic definition of it as «capital that provides public services».[11] As Fourie explains, this definition highlights two key elements: "capitalness" and "publicness". On the one hand, as capital, infrastructures represent durable, long-term investments whose finality, rather than consumption, is to facilitate the production of goods and services. On the other hand, infrastructural resources are public, in the sense that they are open for use to all members of a community and for a variety of different applications, thus, they benefit the whole of society rather than a single agent.[12] From this, we can deduce that public goods that do not factor into production functions, such as public benches or parks, do not qualify as infrastructure, and neither do systems that qualify as capital goods but whose benefits are entirely appropriated by a single actor, such as an 18th-century baker's watermill or a company's Intranet network. Nevertheless, both elements still require some caveats.

Beginning with the latter, for a resource to qualify as public, it must satisfy two conditions, that is, it must be both non-rivalrous and non-excludable. However, the services provided by a vast number of facilities that are universally recognized as infrastructures are, in fact, excludable, as anyone who ever forgot to pay their electric bill knows. Moreover, most infrastructures are rather *partially* nonrival resources, in the sense that they have a finite but renewable capacity.[13] Partial nonrivalry means infrastructures are shareable between multiple users at the same time but they can be subject to congestion (as in the case of a trafficked road). In this case, the marginal cost of an additional user will be zero up until a certain point where it becomes positive, which results in downgraded service until the congestion dissipates.[14] The problem of congestion can be solved by imposing tolls and/or by expanding capacity. Still, taken together, excludability and (partial) non-rivalry seem to imply that most infrastructures do not fit as public goods and instead belong

[10] "'Infrastructure': A New Word from Old Roots". *Merriam-Webster*, https://www.merriam-webster.com/wordplay/infrastructure-history-definition

[11] Albert O. Hirschman, *The Strategy of Economic Development* (New Haven: Yale University Press, 1958), cited in Johan Fourie, "Economic Infrastructure: A Review of Definitions, Theory and Empirics", *South African Journal of Economics*, Vol. 74 No. 3 (September 2006), 531. https://doi.org/10.1111/j.1813-6982.2006.00086.x

[12] Fourie, "Economic Infrastructure".

[13] Randall Bartlett, "Is Infrastructure a Public Good? No, Sort Of, and What Role for the Public and Private Sectors", Institute of Fiscal Studies and Democracy, 15 May 2017. https://www.ifsd.ca/en/blog/last-page-blog/infrastructure-public-good

[14] Brett M. Frischmann, "An Economic Theory of Infrastructure and Commons Management", *Minnesota Law Review*, Vol. 89 (2005), 951-954. https://ssrn.com/abstract=588424

to the category of club goods – which would also explain their tendency to create economies of scale and natural monopolies (see **paragraph 1.5**).[15] Regardless of classifications, the reason why Hirschman, and much of the literature with him, emphasize the public aspects of infrastructure is because they recognize that infrastructural resources have a disproportionate impact on society at large and, as a result, are heavily associated with a country's socioeconomic development. This disproportionate impact is due to two factors: first, because of its (partial) nonrivalry, infrastructure can be used to improve efficiency in a variety of different activities at once; second, it tends to generate large positive externalities, which often include the creation of pure public goods such as education, health, and mobility.[16] Importantly, it is not necessary for a resource to be publicly owned to qualify as infrastructure, that is, to have a beneficial effect on society at large. Indeed, this thesis deals with a type of infrastructure that is almost entirely privately owned. However, there are other issues that might make a form of governmental involvement socially desirable, if not as an owner, as a regulator, as we see in detail in **paragraph 1.5**. In sum, while the reference to "public services" is not unwarranted, it must be taken to mean "beneficial to the public" rather than "provided by the public sector".

Infrastructure's nature as capital similarly necessitates some clarification. Importantly, although we typically associate the term with physical objects and facilities such as pipelines, roads, and power plants, most authors agree that intangible assets can also qualify as infrastructures.[17] Institutions, human capital, knowledge, legislation, and other non-physical assets are categorized as "soft infrastructure", which is opposite to tangible or "hard" infrastructure.[18] Soft infrastructure, too, facilitates the production of goods and services in a generalized fashion. For example, in their research on national export performances, Portugal-Perez and Wilson find that trade is facilitated both by hard infrastructures, namely transportation and information systems, and soft ones, in particular border and transport efficiency and business regulation.[19] Moreover, some authors see a strong connection between hard and soft infrastructure. They conceptualize soft infrastructure as the facilitator of hard infrastructure's functions, noting that, without adequate regulation and human capital, hard infrastructures are unable to operate and interconnect smoothly.[20] This hints at a somewhat basic, but still relevant point: a country's stock of hard infrastructure cannot be a determinant of economic development unless it is complemented by proper regulation and management, which in turn require good human capital and an efficient political environment. Thus, the conceptualization of soft

[15] James M. Buchanan, "An Economic Theory of Clubs", *Economica*, Vol. 32 No. 125 (February 1965): 1-14 https://doi.org/10.2307/2552442 See also Mark Raymond, "Puncturing The Myth of The Internet As Commons", *Georgetown Journal of International Affairs*, International Engagement on Cyber III: State Building on a New Frontier (2013-14): 53-64. https://www.jstor.org/stable/43134322
[16] Frischmann, "An Economic Theory of Infrastructure".
[17] Colin Turner and Debra Johnson, *Global Infrastructure Networks. The Trans-national Strategy and Policy Interface* (Cheltenham: Edward Elgar Publishing, 2017), 2.
[18] William A. Niskanen, "The Soft Infrastructure of a Market Economy", *Cato Journal*, Vol. 1 No. 2 (Fall 1991): 233-238. https://www.cato.org/cato-journal/fall-1991
[19] Alberto Portugal-Perez and John. S. Wilson, "Export Performance and Trade Facilitation Reform: Hard and Soft Infrastructure", *World Development*, Vol. 40 No. 7 (2012): 1295-1307. https://doi.org/10.1016/j.worlddev.2011.12.002
[20] Turner and Johnson, *Global Infrastructure Networks*, 3.

infrastructure serves as a counterbalance to recipes for growth which see investment in hard infrastructure as an evergreen solution. Conversely, it could be argued that this concept is excessively flexible, to the point that we risk an "infrastructuralization" of every relevant economic variable. Unfortunately, such a discussion, though fascinating, is beyond the scope of this dissertation. Since the object of our analysis is a hard infrastructure, we will be content with accepting that soft assets are fundamental in shaping the way in which tangible assets operate.

Thus, from a seemingly basic definition, we have already encountered several considerations that pull into different directions of what exactly qualifies as infrastructure. Buhr tries to solve this problem with a broader definition: «infrastructure of an area is the sum of all relevant economic data such as rules, stocks and measures with the function of mobilizing the economic potentialities of economic agents».[21] This interpretation embraces both soft and hard infrastructure, emphasizing the core objective of realizing the full potential of each household, enterprise, and market – which is more general than the concept of public service although it retains the implications of openness and adaptability.[22]

Furthermore, it is worth noting that Buhr's definition adds a further dimension to our understanding of infrastructure. By specifying «of an area», he calls attention to infrastructure's spatial boundedness.[23] It is understood that material infrastructures – which typically have a very large scale – are usually fixed installations. However, some types of soft infrastructure such as institutions, regulations, and practices are also geographically bounded by their territorial authority or by their scope of application. Others, like human capital, are technically movable, yet it can be argued that when one is to consider their impact as infrastructure those must be necessarily seen as a stock value in a specific spatial and temporal frame. In general, since we have defined infrastructure based on its usefulness in mobilizing economic agents, it would make little sense to consider it without delimitating a geographical scale. Moreover, infrastructures are usually built with the intention to cover a specific area. The most typical geographical "container" of infrastructure is the nation-state – indeed, we have already referred to "a country's" infrastructure multiple times. However, most authors also conceptualize a subnational and an international category of infrastructures, both of which can be subject to further subdivisions, such as the local and municipal level for the former, and the regional and global level for the latter (see **paragraph 1.4.2** for further considerations).

Categorizations are, in fact, a fixed presence in infrastructure studies, often with significant variations between researchers. The same Buhr, for instance, subdivides soft infrastructure into two separate categories, institutional and personal infrastructure, with the former concerning institutions and regulations and the latter referring to human capital.[24] Fourie, on the other hand, distinguishes between "economic infrastructures", which facilitate productive activities, and "social infrastructures", such as hospitals and schools, whose

[21] Walter Buhr, "What Is Infrastructure?", *Volkswirtschaftliche Diskussionsbeiträge*, No. 107/03, 16. https://www.econstor.eu/handle/10419/83199
[22] Buhr, "What Is Infrastructure?", 14.
[23] Turner and Johnson, *Global Infrastructure Networks*.
[24] Buhr, "What Is Infrastructure?", 4-8.

function is to improve the quality of life, public health, education, etc.[25] As he admits, there is significant overlap between the two, to the point it becomes almost impossible to make a distinction. Finally, it is possible to divide infrastructures into several sectors depending on their function, such as transportation, communication, energy supply, financial services, etc. Moreover, infrastructures that are used in everyday domestic life (electricity, water, and gas) are generally referred to as "utilities".

By this point, it should be abundantly clear that the concept is extremely diversified. Consequently, developing a general theory of infrastructure requires great nuance and openness to various fields of knowledge. For the purposes of this section, however, I will mostly restrict my considerations to hard infrastructures and their contribution to economic activities. This is due to two reasons: first, this falls more in line with the ordinary understanding of infrastructure; second, submarine Internet cables belong to this category. However, we shall see that it is especially difficult to create a boundary between the economic and social effects of infrastructure and that overlaps are the norm.

1.2.2 Concepts of infrastructure beyond economics

Given its far-reaching impact, infrastructure has attracted the attention of many areas of study beyond economics. Contributions from the interdisciplinary field of science and technology studies (STS), which focuses on the development of technology and its transformative impact on society, are of special interest because they offer notable insight into the interaction between infrastructures and sociopolitical structures, providing an additional, important facet to our analysis.

Particularly, the works of Susan Leigh Star and Karen Ruhleder have enjoyed wide success because of their typification of the most salient features setting infrastructures apart from other resources. According to these authors, infrastructure is a «fundamentally relational concept», in the sense that an object or facility is recognized as such when it is used as a basic part of organized practices.[26] This is consistent with our previous definition: infrastructures gain meaning when inserted into economic activities. However, while economic approaches usually see infrastructures as simply means of production, in STS literature, the relationship between technology and socioeconomic processes is presented as two-sided: in the case of infrastructures, they are designed to accommodate social needs and practices, but their design and properties also contribute to shaping processes and dynamics. They act as «mediators inasmuch as they can modify the performativity of social actions»,[27] incentivizing the adoption of standardized practices and conventions; in

[25] Fourie, "Economic Infrastructure", 531.
[26] Susan Leigh Star and Karen Ruhleder, "Steps Toward an Ecology of Infrastructure: Design and Access for Large Information Spaces", *Information Systems Research*, Vol. 7 No. 1 (March 1996): 111-134. https://doi.org/10.1287/ISRE.7.1.111
[27] Francesca Musiani, "Science and Technology Studies Approaches to Internet Governance: Controversies and Infrastructures as Internet Politics", in Laura DeNardis, Derrick L. Cogburn, Nanette S. Levinson, and Francesca Musiani (Eds.), *Researching Internet Governance: Methods, Frameworks, Futures* (MIT Press, 2020), 87. https://doi.org/10.7551/mitpress/12400.003.0005

more economic terms, infrastructures inform «in-system behavior at the micro level by providing and shaping the available opportunities of many actors».[28]

Star and Ruhleder identify eight fundamental features of infrastructure: [29]

1) Embeddedness: infrastructures do not exist in a vacuum. Consistent with the "relational" conceptualization, they are integrated into broader structures, including socio-political arrangements and industry chains. Moreover, they tend to operate in conjunction with other infrastructure: for instance, the Internet depends on the electrical grid, and sanitation on water supply networks.[30]
2) Transparency: infrastructure does not need to be reinvented or reassembled for each task it supports, instead it is open to use for a variety of applications as-is. This contributes to its versatility.
3) Broad spatial and temporal reach: unlike most producer goods, which are confined in a single location and within a certain timeframe (i.e., working hours), infrastructure interconnects several sites and, in most cases, functions nonstop.
4) Learned as part of membership: individuals learn to interact with infrastructure in accordance with the professional, social, or cultural communities they belong to. This learning process is less of a conscious effort and more in line with, in Joanne Roberts' definition, "tacit knowledge", that is, non-codified knowledge acquired with the informal take-up of behaviors and procedures.[31] This type of learning leads to such a degree of familiarity and routinization that soon the interaction with infrastructure becomes natural and taken for granted, contributing to infrastructure's invisibility.
5) Linked with conventions of practice and other forms of routinized social action: related to the above, infrastructure simultaneously is shaped by and shapes conventions and habits. For instance, electricity has drastically changed day-night cycles, but the electrical grid is also designed to accommodate certain peak usage hours.
6) Embodies standards: its design and operations must be standardized to enable interaction between its own components, with other infrastructures, and with the users' facilities and their tools. As we see in **paragraph 1.4.3**, standards are crucial in determining how the infrastructure operates, which can have delicate implications.

[28] Christiaan Hogendorn and Brett M. Frischmann, "Infrastructure and General Purpose Technologies: A Technology Flow Framework", *European Journal of Law and Economics* No. 50, 472. https://doi.org/10.1007/s10657-020-09642-w
[29] Star and Ruhleder, "Steps Toward an Ecology", 113.
[30] Steve Jackson et al, "Understanding Infrastructure: History, Heuristics, and Cyberinfrastructure Policy". *First Monday*, Vol. 12 No. 6 (June 2007). https://firstmonday.org/ojs/index.php/fm/article/view/1904/1786
[31] Joanne Roberts, "From Know-How to Show-How? Questioning the Role of Information and Communication Technologies in Knowledge Transfer". *Technology Analysis & Strategic Management*, Vol. 12 No. 4 (2000): 429-443. https://doi.org/10.1080/713698499

7) Built on an already installed base: infrastructure is designed for durability, and newer infrastructures tend to be built on top of older ones (retrofit)[32] or to reuse the same routes and locations. For instance, as seen later, the maps for global submarine telegraph cables and modern fiber optic cables significantly overlap.
8) Becomes visible upon breakdown: since it so naturally fits into routine activities, infrastructure tends to be ignored unless it suddenly stops working. Normalcy is linked with invisibility: as noted by Edwards, infrastructures «are largely responsible for the feeling that things work, and will go on working, without the need for thought or action on the part of users beyond paying the monthly bills».[33] This invisibility, however, is cause for concern for experts in critical infrastructure (see **paragraph 1.5.3**).

To summarize, according to Star and Ruhleder, infrastructure's "ordinariness" leads users, but also researchers and policymakers, to lose sight of the complex issues surrounding them, such as the way they work and how they interact with other technologies, productive processes, and social practices. In keeping with the STS approach, the authors link technical and physical properties to key political and economic issues. Indeed, we will frequently refer to their typology when addressing various problems with infrastructure in general and submarine Internet cables in particular, both because it offers convenient terminology and because it has inspired several other authors.

Importantly, other researchers in the STS field and beyond have used these considerations as a springboard to develop more politically focused analyses. As previously stated, STS literature sees infrastructure's technical features as capable of transforming society. In this view, then, infrastructures possess their own *agency*, that is, an ability to influence society, which also means that they are not politically neutral.[34] Infrastructure's invisibility, then, becomes an opportunity to discreetly reproduce power relations through seemingly innocuous technical choices. We will further develop this topic in **paragraph 1.4**.

1.3 The economic impact of infrastructure

In the previous paragraphs, we have stressed multiple times that infrastructure's core contribution to the economy is that it is able to facilitate nearly every economic activity under conditions of nonrivalry or partial nonrivalry, which means that it generates a generalized, cross-sectoral improvement in efficiency and productivity. Diamond writes that infrastructures are a "collective" input into production, as they are shared between a large number of actors and used for very diverse applications.[35] However, he also adds that they

[32] Cymene Howe et al, "Paradoxical Infrastructures: Ruins, Retrofit, and Risk". *Science, Technology, & Human Values*, Vol. 42 No. 3 (2016), 553-554. https://doi.org/10.1177/0162243915620017
[33] Paul N. Edwards, "Infrastructure and Modernity: Force, Time, and Social Organization in the History of Sociotechnical Systems", in Thomas J. Misa, Philip Brey, and Andrew Feenberg (Eds.), *Modernity and Technology*, MIT Press (2002): 188. https://doi.org/10.7551/mitpress/4729.003.0011
[34] Marieke De Goede, "Finance/Security Infrastructures", *Review of International Political Economy*, Vol. 28 No. 2 (2021): 351-368. https://doi.org/10.1080/09692290.2020.1830832
[35] Frischmann, "An Economic Theory of Infrastructure", 919.

are "integrative", in the sense that they link together economic actors, allowing faster and more efficient exchange of goods, services, and information (what Star and Ruhleder refer to as "reach"). Improved connectivity expands an actor's opportunities – for instance, by enlarging the potential customer base – and drives down production costs, which in turn enables the expansion of markets and can often result in economies of scale.[36] Fourie explains that infrastructure has a three-pronged impact on economic growth. First, it has a direct effect, which amounts to a reduction in the cost of input factors, as previously described. Secondly, it has an indirect effect on the productivity of other input factors, such as labor: for example, workers are more productive if they can use electrical tools. Finally, investments in infrastructures can have a temporary effect on employment rates and can act as stimuli to the general economy.[37] The latter, being only a short-term effect, should arguably be considered less relevant compared to the other two; however, since it has significant political appeal as a supposedly quick, fix-it-all solution, it can lead governments to overinvest in types of infrastructure that are not needed, misallocating resources that would be better spent elsewhere.[38]

Nevertheless, a modern market economy cannot exist without a sufficiently developed infrastructure network. For this reason, most research on developing countries emphasizes the need for more efficient infrastructure to enhance growth, and international organizations and development banks are frequently engaged in financing such projects. Furthermore, infrastructure's "reach" extends beyond the country's national boundaries. Since national infrastructure networks interconnect with one another to carry global flows, as seen in more detail below, updated infrastructures are necessary for a country to connect to the world economy,[39] and indeed several economic historians note that the process of globalization has been guided by developments in certain types of infrastructures, notably telecommunications and information technology. However, while it is clear that a certain level of infrastructure is needed, it is less obvious whether investing further infrastructure capital in an already developed country is productive, and if so, to what degree this additional investment can improve productivity.

This is a highly debated topic in macroeconomics, which gained traction in the late 1980s, in the wake of a paper by David Aschauer. Aschauer calculated the rate of return of public capital investment in the US at 60% per annum, which led him to establish a direct causation link between the slowdown in US productivity

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[36] Vijaya G. Duggal, Cynthia Saltzman, and Lawrence R. Klein, "Infrastructure and Productivity: A Nonlinear Approach", *Journal of Econometrics* Vol. 92 No. 1 (September 1999), 50. https://doi.org/10.1016/S0304-4076(98)00085-2

[37] Fourie, "Economic Infrastructure", 539-540.

[38] Shantayanan Devarajan, Vinaya Swaroop, and Heng-fu Zou, "The Composition of Public Expenditure and Economic Growth", *Journal of Monetary Economics* Vol. 37 No. 2 (April 1996): 313-344. https://doi.org/10.1016/S0304-3932(96)90039-2 See also: David Canning and Peter Pedroni, "Infrastructure, Long-Run Economic Growth and Casuality Tests for Cointegrated Panels". *The Manchester School*, Vol. 76, No. 5, Special Issue 2008: 504-527. https://doi.org/10.1111/j.1467-9957.2008.01073.x

[39] Timo Henckel and Warwick McKibbin, "The Economics of Infrastructure in a Globalized World: Issues, Lessons and Future Challenges", *Journal of Infrastructure, Policy and Development* Vol. 1 No. 2 (2017): 254-271. http://doi.org/10.24294/jipd.v1i2.55

in the 1970s and 1980s and the decline in public infrastructure investment.[40] Several authors were skeptical of this abnormally high figure and proceeded to devise their own formulas, which, in general, resulted in significantly lesser, albeit still positive, estimates.[41] Part of the controversies can be explained by the fact that the debate on infrastructure is politically charged, and it was especially so in the 80s-90s, as public expenditure became a divisive topic among economists.[42] Note that Aschauer considered only *public* investments in infrastructure: the increasing relevance of private investments in the following decades has somewhat shifted the terms of the debate. Still, it can be argued that the issue remains relevant since, if an infrastructure undersupply is detected then this means that, for whatever reason, private markets are failing to deliver the socially preferred levels and the state will have to intervene through public investments. The issue of public versus private ownership is further analyzed in **paragraph 1.5**.

1.3.1 Infrastructure and externalities

Moreover, infrastructure's impact on overall national productivity might be very difficult to measure because of its tendency, already cited in **paragraph 1.2**, to generate large positive externalities, that is, it creates benefits that extend even to those who are not directly using the resource.[43] For instance, the construction of a new train line between two cities, in addition to improving the situation of commuters, may also benefit those who travel by car since they will find a less congested road, but also society as a whole thanks to a reduction in carbon emissions and car accidents. These externalities might be "invisible", to use Star and Ruhleder's terminology, or at the very least less readily identifiable, and thus complicate attempts at quantifying infrastructure's impact.

Furthermore, a relevant effect of positive externalities is that the supplier cannot appropriate them through pricing, which we used in **paragraph 1.2.1** to justify the application of the "public" label even to privately owned infrastructure. As Steinmueller writes,

> the traditional idea of infrastructure was derived from the observation that the private gains from the construction and extension of transportation and communication networks, while very large, were also accompanied by additional large social gains. Thus, society as a whole had an interest in promoting these networks because they created new opportunities for economic choice and growth through spillovers that were involuntary in the sense

[40] David A. Aschauer, "Is Public Infrastructure Productive?". *Journal of Monetary Economics* Vol. 23 No. 2(March 1989): 177–200. https://doi.org/10.1016/0304-3932(89)90047-0

[41] Spiros Bougheas, Panicos O. Demetriades, and Edgar L.W. Morgenroth, "International Aspects of Public Infrastructure Investment", *Canadian Journal of Economics*, Vol. 36, No. 4 (November 2003), 885. https://www.jstor.org/stable/3131805

[42] Alicia H. Munnell, "Policy Watch: Infrastructure Investment and Economic Growth", *Journal of Economic Perspectives*, Vol. 6 No. 4 (Fall 1992): 189-198**.** http://doi.org/10.1257/jep.6.4.189

[43] Frischmann, "An Economic Theory of Infrastructure", 965-970; Fourie, "Economic Infrastructure", 533-534.

that they could neither be avoided nor entirely captured by the creators of transportation and communication networks.[44]

In other words, Steinmueller directly links positive externalities with the arguments in favor of public involvement in the provision of infrastructure since the utility for the community might exceed the incentives for private markets to provide the good. This question is further explored below.

Of course, infrastructures can also generate negative externalities, such as pollution, noise, or ruined landscapes.[45] These negative effects – which might also be irrationally exaggerated, as recently seen with the conspiracy theories on 5G infrastructure[46] – can create strong opposition to new infrastructure projects from people who live in the designated areas even when social benefits seem to outweigh costs (the so-called "not in my backyard" syndrome, where, while the construction of a certain infrastructure is acknowledged as useful, it is difficult to find an area that is willing to host it).[47]

1.3.2 Infrastructures as general purpose technologies

A final observation to be made is that, as we have seen, several authors emphasize infrastructure's transformative impact on the economy and society at large, which is, once again, a result of its many applications. Hogendorn and Frischmann note that this oversized impact also sits at the core of theories on general-purpose technologies (GPTs).[48] Breshnan and Trajtenberg, who invented the concept, define GPTs as technologies possessing three features:

1) pervasiveness, meaning that they can be used as inputs by nearly every downstream sector,
2) dynamism, in the sense that they have an inherent potential for technical improvements, and
3) innovational complementarities, that is, they cause an improvement in the productivity of research and development sectors in a variety of industries, which generates a further cascade of innovations (yet another example of positive externality).[49]

These criteria, especially that of pervasiveness, seem to apply very well to infrastructures. Indeed, there is frequently an overlap between lists of GPTs and infrastructures: for instance, railways, electricity (or to be more precise, the infrastructure used for the generation and distribution of electrical energy), and telecommunications apparel are universally featured in both.

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[44] W. Edward Steinmueller, "Technological Infrastructure in Information Technology Industries", in Morris Teubal et al (Eds.), *Technological Infrastructure Policy: An International Perspective* (Dordrecht: Springer, 1996), 117. https://doi.org/10.1007/978-94-015-8739-6_5
[45] Fourie, "Economic Infrastructure", 534.
[46] Thomas M. Johnson Jr., "5G Conspiracy Theories Threaten the U.S. Recovery". *Washington Post*, 4 June 2020. https://www.washingtonpost.com/opinions/2020/06/04/5g-conspiracy-theories-threaten-us-recovery/
[47] See Michael Dear, "Understanding and Overcoming the NIMBY Syndrome", *Journal of the American Planning Association* Vol. 58 No. 3 (1992): 288-300. https://doi.org/10.1080/01944369208975808
[48] Hogendorn and Frischmann, "Infrastructure and General Purpose Technologies".
[49] Timothy F. Breshnan and Manuel Trajtenberg, "General Purpose Technologies: 'Engines of Growth'?", *Journal of Econometrics* Vol. 65 No. 1 (January 1995): 83-108, https://doi.org/10.1016/0304-4076(94)01598-T ; Clifford Bekard, Kenneth Carlaw, and Richard Lipsey, "General Purpose Technologies in Theory, Application, and Controversy: A Review", *Journal of Evolutionary Economics* No. 28 (2018), 1012. https://doi.org/10.1007/s00191-017-0546-0

However, Hogendorn and Frischmann observe that to fit both concepts, a GPT must also be usable in a nonrival or partially nonrival way. Rival good GPTs such as the computer, the engine, or the wheel are not infrastructures.[50] They seem to imply that, while a GPT may or may not be an infrastructure, *all* infrastructures are GPTs: this idea could be debated, especially if we consider soft infrastructure, which are hardly "technologies" at all.[51] In any case, their research is important because it offers another angle on infrastructure's broad impact on economics: as they note, GPTs by definition are able to satisfy the demand for several types of goods. Furthermore, because of "innovational complementarities", they stimulate the introduction of new technologies, some of which could be GPTs themselves, fueling a virtuous cycle.

1.4 Infrastructure networks and the centrality of standards

1.4.1 Infrastructure as networks

As stated above, infrastructures usually have a large scale, a broad spatial reach, and an ability to interconnect different locations and users. Moreover, in the previous paragraphs, we have made several references to infrastructures as "networks". Indeed, although certain infrastructures, such as hospitals or schools, are single-point facilities, it is much more common for them to take the form of complex networks, that is, linkages between spatially separate nodes.[52] Networks are normally comprised of multiple complementary components. For instance, a telephone network will include lines, repeater cells, subscription cards, individual phone apparels, and so on. Usually, there are close substitutes for each component. Phone communications, for example, can run over copper wires, fiber optic cables, or satellites, although different combinations may result in different qualities of service.[53] For the purposes of this dissertation, it is important to note that in some cases, the term "infrastructure" can be applied both to the network as a whole and to one or more of its components. This is particularly true for the Internet, which is conceptualized as a layered network where the system as a whole, its core protocols, and its physical architecture (such as submarine cables) are all referred to as infrastructure. Aside from semantics, these components qualify fully as infrastructure because, as explained by Musiani, «they have an infrastructural function—because they help structure, shape, enable, or constrain our being together on and with the Internet».[54] We will go back to this in our explanation of how submarine Internet cables fit in the theoretical framework of infrastructure (see **paragraph 2.1**). It is also worth noting that this "composite" nature does not prevent from defining an

[50] Hogendorn and Frischmann, "Infrastructure and General Purpose Technologies", 480-481. To be more precise, the authors go on to explain that the *idea* of the computer is perfectly nonrival, which enables it to be used in vastly different applications, whereas a single, specific computer is a private, rival good. Infrastructures are somewhat special because they are nonrival not only as ideas but also as material objects.
[51] One could argue that governance, regulations, and norm-setting constitute a set of "political technologies" which do in fact affect the entirety of the economy and society, but this seems to be a conceptual stretch well beyond Breshnan and Trajtenberg's original intent.
[52] Buhr, "What Is Infrastructure?", 8.
[53] Nicolas Economides, "The Economics of Networks", *International Journal of Industrial Organization* No. 14 (1996), 673. https://doi.org/10.1016/0167-7187(96)01015-6
[54] Musiani, "Science and Technology Studies", 95.

infrastructure network as a GPT, since the term can refer to aggregates of multiple different technologies.[55] The implication is that, in such cases, the virtues and issues of infrastructure described here are magnified since they apply both to the total (the infrastructure network) and its parts (the infrastructures it comprises).

It is possible for nodes in the networks to have roughly the same number of connections or, instead, for some nodes to enjoy more connections than others. This measure is called "degree centrality" in network theory. Commonly, certain nodes in infrastructure networks will display a higher degree centrality than the rest, which is usually related to population size and the level of economic activity. For instance, transportation networks will tend to center around major cities. Another significant indicator of the importance of a node in the network is betweenness centrality, which characterizes those nodes that sit along the shortest path between two other nodes.[56] Both degree and betweenness centrality carry some important advantages: central nodes will benefit from greater flows of goods, people, or information, which creates relevant opportunities, especially at the international level, as we will see in **paragraph 1.7**. On the other hand, it also creates risks since a failure in a central node will have greater repercussions on the rest of the network.

Networks are of particular interest to economists because they create a specific type of externalities, called "network effects". In the presence of network effects, the value of being connected to the network increases with the number of connected users.[57] The classic example is the telephone, although the rationale easily applies to telecommunications in general. From the supplier's point of view, this means the network's value increases with its scale. The possible consequence is that suppliers who manage to attract a larger user base in the early stages, the so-called "first movers", will be rewarded with a dominant position since new users will be attracted to the larger network rather than its competitors, which could pave the way for monopolies or at least severely constrain competition. This, as will be seen in **paragraph 1.5**, can be used as an argument in favor of public ownership: however, refinements to the theory on network effects (in particular, the distinction between direct and indirect effects), as well as the downfall of several high-profile first movers in the Internet market, show that their impact on competition is less straightforward than assumed.[58] In any case, it is important to note that, on the one hand, not all networks create this type of network effect, on the other, networks can create other types of externalities, including negative ones. Congestion, which was already discussed in **paragraph 1.2.1**, is an example. Another negative effect is that a network's growth in scale is usually associated with an increase in complexity. From a technical point of

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[55] Bekar, Carlaw, and Lipsey, "General Purpose Technologies in Theory", 1010.
[56] Ulrik Brandes, "On Variants of Shortest-Path Betweenness Centrality and Their Generic Computation", *Social Networks*, Vol. 30 No. 2 (2008): 136-145. https://doi.org/10.1016/j.socnet.2007.11.001.
[57] Michael L. Katz and Carl Shapiro, "Systems Competition and Network Effects", *Journal of Economic Perspectives* Vol. 8 No. 2 (Spring 1994): 93-115. https://doi.org/10.1257/jep.8.2.93
[58] The telephone is an example of a direct network effect since all users are functionally identical. Indirect effects are present when users can be divided into different groups (for instance, buyers and sellers on e-commerce platforms), which means they derive different utility from the network's growth. See David S. Evans and Richard Schmalensee, "Debunking the 'Network Effects' Bogeyman", *Regulation*, Vol. 40 No. 4 (Winter 2017-2018). https://ssrn.com/abstract=3148121

view, complexity carries significant risks such as cascading failures that, originating from a single point (which might not be easily identifiable), are transmitted throughout the whole network.[59]

1.4.2 Networks of networks

The issue of complexity uniquely impacts infrastructure networks because, in addition to being comprised of multiple components, some of which, as previously stated, may also qualify as infrastructures themselves, they also tend to aggregate with each other to form larger infrastructure networks from several independently developed systems.[60] As noted in **paragraph 1.2.1**, the state level is the typical term of reference for infrastructure networks. However, the national networks distributing goods and services throughout a country's whole territory are, in most cases, an aggregation of local networks, independently or semi-independently built and managed. An immediate example is a country's road network, which comprises a variety of levels from national highways to municipal roads. Moreover, to accommodate international flows of people, goods, services, and information, national infrastructure networks must be linked with those of other countries to form international networks, for example, a road crossing the border. In other words, most infrastructure networks can be seen as "networks of networks", magnifying issues of compatibility and coordination.

The interconnection between networks creates a form of interdependence, which is especially noticeable at the international level. Keeping with the road example, each country will be responsible for managing its own national road network. However, the decisions it takes will affect the other country as well: if it expands its network, exporters or travelers from the neighboring country will be able to move more freely, if, on the other hand, it chooses to close down the interconnecting road, it will have the opposite effect. This effect is even stronger when multiple national infrastructure networks are linked to each other to form a regional network, as is the case with transportation networks in Europe,[61] an interregional one, or a global one – as is the case of submarine Internet cables. Here we see the key issue with the interconnection of formerly independent infrastructure networks: by creating interdependence between the networks, it takes them away from under the complete control of a single authority – be it its owner, local authorities, or the state – and embeds them in a complex web of interlinked decisional centers. It also means that problems such as system failures, or simple mismanagement, can propagate over the linkages and affect the interconnected networks in a cascade.

1.4.3 Gateways and standards

The process of linking together a network's various components, and then different networks with each other, can raise technical issues, as it is very rare for them to be inherently compatible. In most cases, it

[59] Turner and Johnson, *Global Infrastructure Networks*, 10-11.
[60] Paul N. Edwards et al, "Understanding Infrastructure: Dynamics, Tensions, and Design. Report on a Workshop on *History & Theory of Infrastructure: Lessons for New Scientific Cyberinfrastructures*", NSF (January 2007), 8-12. https://deepblue.lib.umich.edu/handle/2027.42/49353
[61] Bougheas, Demetriades, and Morgenroth, "International Aspects", 904.

is necessary to build gateways, that is, points of interconnection between the two nodes, and to set design standards to enable interconnectivity and interoperability.[62] Gateways are usually material points of contact, such as border passes, seaports, telephone switching boards, or Internet routers. Standards can involve physical configurations, such as the gauge between railway rotaries, or operational protocols, such as those that configure the flow of data through the Internet. They enable smooth, uninterrupted flows between networks, which is why Star and Ruhleder define them as a core feature of infrastructures.

Standards are somewhat similar to an inner law of infrastructures, determining *who* or *what* can connect to the network and *how*.[63] Consequently, although they might appear as a strictly technical issue, standards carry significant political and economic implications. The origin of this argument can be traced to Lewis Mumford's observation that technologies reproduce in their design the political ideology of the system where they are developed, although he declined it in an almost neo-Luddite sense.[64] However, his intuition has been picked up by other researchers. When STS scholars, as mentioned above, speak of the "agency" of infrastructure, they usually refer to standards and other design choices, which they claim can be used to privilege certain users at the expense of others. A frequently cited example is the story according to which Robert Moses, the chief urban planner of New York State in the 1920s, intentionally designed the Southern Parkway's overpasses to be too low for buses, in order to keep poor people out.[65] This anecdote prompts Winner to observe:

> To our accustomed way of thinking, technologies are seen as neutral tools that can be used well or poorly, for good, evil, or something in between. But we usually do not stop to inquire whether a given device might have been designed and built in such a way that it produces a set of consequences logically and temporally prior to any of its professed uses.[66]

Perhaps the most influential contribution to this argument is Lawrence Lessig's theory of "architecture", according to which design choices act as constraints for actors, determining which behaviors are and are not possible, therefore, allowed. According to Lessig, this means that design acts as a form of law within structures – or infrastructures – influencing and shaping the agency of their users.[67] He also adds that while the power of design can be seen in the material world, citing as examples Moses' bridges as well as Baron Haussman's redesign of Paris' boulevards to prevent insurgents from barricading the streets,[68] it is significantly more pronounced in the Internet, where design standards are essentially the single determinant

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[62] Economides, "The Economics of Networks", 677.
[63] Star and Ruhleder, "Steps Toward an Ecology", 112; Edwards et al, "Understanding Infrastructure", 8-12.
[64] Lewis Mumford, "Authoritarian and Democratic Technics", *Technology and Culture*, Vol. 5 No. 1 (Winter 1964): 1-8. http://www.jstor.org/stable/3101118
[65] See Langdon Winner, "Do Artifacts Have Politics?", *Daedalus* Vol. 109 No. 1 (Winter 1980), 125. https://www.jstor.org/stable/20024652 The anecdote comes from Robert Caro's biography, *The Power Broker. Robert Moses and the Fall of New York* (New York: Knopf 1974), but modern historians tend to refute it. See Thomas J. Campanella, "Robert Moses and His Racist Parkway, Explained", *Bloomberg*, 9 July 2017, available at https://www.bloomberg.com/news/articles/2017-07-09/robert-moses-and-his-racist-parkway-explained
[66] Winner, "Do Artifacts Have Politics?", 125.
[67] Lawrence Lessig, *Code. Version 2.0* (New York: Basic Books, 2006).
[68] Lessig, *Code*, 127.

of the behavior of the infrastructure. We will see that the idea that standards shape the political character of infrastructure is heavily reflected in the frequently repeated argument that the Internet was designed to be free, openly accessible, and decentralized.

On another note, it should be added that a country's choice to interconnect its infrastructure networks with those of its neighbors is itself a political choice: while in most cases it will be seen as necessary for international trade, occasionally governments might prioritize other issues, such as security, and strategically pursue disconnection.[69] Similarly, standards can work as instruments of protectionism, as they can be used as non-tariff barriers to trade by artificially raising the costs of imported goods or outright banning them through technical means.[70] As an example, adopting different railway gauges from a neighboring country can discourage a military invasion, but it can also hinder the importation of consumer goods from the neighbor's freight cars, which would benefit local producers. In recent years, Mongolia experienced a heated debate over the choice of whether to introduce new train tracks with the same gauge as China's, thus increasing commercial exchanges with the powerful neighbor, or to preserve a "strategic" differentiation.[71]

From the previous considerations, it follows that the central issue with standards is: who should set them? This question is valid both for connecting components in an infrastructure network and for connecting a network with other ones. In both cases, solutions can be classified into centralized and decentralized arrangements.[72] At the national level, the epitome of centralization is the establishment of a national monopoly, usually under state ownership (see **paragraph 1.5**). If a monopolist owns the entirety of a network (such as national telecommunications), all firms producing specific types of components will inevitably have to conform to the monopolist's standards. The most decentralized solution, instead, is to allow market forces to land on standards through competition and voluntary agreements. Although, in this case, firms can choose against making networks or components compatible, they will be incentivized to do so by network effects and economies of scale. It should also be noted that, especially within highly innovational industries, standards can be patented, which can provide the firm with significant advantages if its standards, either through agreements or market effects, are adopted by the whole industry. Conversely, an innovator might choose not to patent the standards it develops out of a commitment to the advancement of the industry, as was the case with the early Internet standards (see **paragraph 2.3**).

At the international level, the issue is more complex. A truly centralized solution, absent a world government, is not possible: the closest approximation is for national governments to negotiate standardization agreements bilaterally or, more often, through ad-hoc international organizations, such as the general-purpose International Standardization Organization (ISO) and others operating in more specific

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[69] Jackson et al, "Understanding Infrastructure".
[70] Digby Gascoine, *Standards as Barriers to Trade* (Stockholm: SIDA, February 2004). https://cdn.sida.se/publications/files/sida3407en-standards-as-barriers-to-trade.pdf
[71] Stefano Pozzebon, "Mongolia Has to Change Its Railroads to Account for an 85 Millimeter Difference in Track Spacing", *Business Insider*, 1 October 2014. https://www.businessinsider.com/mongolia-extends-trans-border-railway-to-china-russia-2014-10?r=US&IR=T
[72] Paul A. David and W. Edward Steinmueller, "Standards, Trade and Competition in the Emerging Global Information Infrastructure Environment", *Telecommunications Policy*, Vol. 20 No. 10 (1996): 817-830. https://doi.org/10.1016/S0308-5961(96)00058-4

sectors, like the International Electrotechnical Commission (IEC) or the International Telecommunications Union (ITU).[73] However, an important role is also played by non-governmental international fora where private actors – firms or individuals – engage in decentralized, voluntary standard-making, most notably the Institute of Electronic and Electrical Engineers (IEEE) and the Internet Engineering Task Force (IETF). The interaction between standardization organizations with government-based representation and those with firm/individual-based membership can be challenging, due to differences in their internal balance of power and predominating vision. This can result in significantly different views on the best standards to adopt.

Of course, standardization arrangements can land at any point between the centralization and decentralization extremes: it is possible, in other words, to have some network standards set at the governmental level, through regulation, whereas others are left to be determined by market forces. The preference for market-driven solutions has grown in parallel to that for liberalized infrastructure networks, as explained in **paragraph 1.5**.

A further aspect of standards is that they have strong inertial qualities, making them subject to path dependence. Early choices tend to become permanent, even when there are objectively more efficient alternatives – a typically cited example is the enduring success of the QWERTY keyboard even after the development of the supposedly superior Dvorak layout.[74] There are several reasons why, once established, standards are difficult to overturn. First, given the scale of the networks, especially infrastructures, it might be exceedingly costly to do so, not only in terms of money but also of time, especially when the issue requires coordination between multiple stakeholders, such as firms or governments. Secondly, standards become engrained in what we previously called the users' tacit knowledge (see **paragraph 1.3**), thus, a radical change might be disorienting and could be met with resistance. Third, standards are reinforced by network effects since newcomers are more likely to adapt to the incumbents' standards. Again, these are not merely technical issues. When addressing the issues of Internet standards (see **paragraph 2.3**), we will see that path dependence tends to frustrate the attempts of certain countries to redesign it into a more centrally controlled network.

1.5 The state's involvement in infrastructure management

1.5.1 Public provision of infrastructure

As noted in **paragraph 1.2**, the notions of infrastructure and public capital are commonly conflated with one another. David Aschauer's work, which we credited with stimulating the debate on the economic impact of infrastructure, only considered public investment in his analyses, as did most of his critics and supporters. This is reflective of a time of transition, which can be dated between the second half of the 1970s and the first of the 1990s, which saw Western countries increasingly opt for the liberalization and privatization of several types of infrastructure networks, including telecommunications, transportation, and utilities.

[73] David and Steinmueller, "Standards, Trade and Competition", 819.
[74] Edwards et al, "Understanding Infrastructure", 17.

Arguments in favor of the public ownership of infrastructure rest on two characteristics that were highlighted above: on the one hand, its scale, on the other, its importance for society at large. This can be traced back to Adam Smith, who cites infrastructure provision as one of the chief economic duties of the government:

> The third and last duty of the sovereign or commonwealth is that of erecting and maintaining those public institutions and those public works, which, though they may be in the highest degree advantageous to a great society, are, however, of such a nature, that the profit could never repay the expense to any individual or small number of individuals, and which it therefore cannot be expected than any individual or small number of individuals should erect or maintain.[75]

Given its scale, infrastructure involves enormous early investments and maintenance costs, which can take very long or be outright impossible to recoup for a firm. This is especially true for non-excludable infrastructure resources, which enable users to freeride. At the same time, since infrastructure is crucial for the development and competitiveness of the national economy, it makes sense that, when private markets are unable or unwilling to invest in its provision, the state should bear this cost. Moreover, these high sunk costs may act as a barrier to entry and thus contribute to the creation of a natural monopoly, so that in cases where a private firm found it profitable to invest in infrastructure, it would then be able to exploit its monopoly to distort prices at the damage of customers – unless it was placed under public control.

Another argument from the customer's side is that, since infrastructures are indispensable not only for all production activities but also for ensuring a satisfying quality of everyday life, it follows that they should be managed as a single network under strict public scrutiny to provide universal and equitable access for all members of a community. Infrastructure studies call this normative principle the "modern infrastructural ideal" and link its development to that of mass democracy.[76] Market forces might not be able to satisfy this ideal for two reasons. For what concerns universal service, they would not have the incentives to connect remote, scarcely populated, and economically underdeveloped areas, as their investment would not be paid back, whereas they would prioritize highly dynamic areas.[77] As for equality, a private provider, if given the choice, would rather be able to perform price discrimination and provide premium services to those who are willing and able to pay extra for them, instead of granting equal access to all in the community.[78]

Thus, against private ownership, we have arguments centered both on the risk of infrastructure undersupply and others focused on natural monopolies and the subsequent danger of market power abuse. Consequently, common wisdom between the late 19th century and the 70s was that competitive markets could not manage infrastructure in a socially efficient manner. Accordingly, two models for publicly controlled

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[75] Adam Smith, *The Wealth of Nations*, Book V, Part III.

[76] Steve Graham and Simon Marvin, *Splintering Urbanism. Networked Infrastructures, Technological Mobilities and the Urban Condition* (New York: Routledge, 2001). It has been noted that, while the ideal has been more or less realized in developed countries, universal coverage is far from being attained in the Global South. See Katharyn Furlong, "STS Beyond the 'Modern Infrastructure Ideal'": Extending Theory by Engaging with Infrastructure Challenges in the South", *Technology in Society* Vol. 38 (August 2014): 139-147. https://doi.org/10.1016/j.techsoc.2014.04.001

[77] Graham and Marvin, *Splintering Urbanism*.

[78] Edwards et al, "Understanding Infrastructure", 11.

infrastructures emerged: in Europe, the predominant solution was to place the networks under state-owned monopolist enterprises; in the United States, instead, most infrastructure networks remained privately owned but each sector was put under strict oversight by ad-hoc public regulatory agencies,[79] all modeled after the Interstate Commerce Commission, which was created in 1887 to supervise the railroad industry.[80] In both cases, the state was heavily involved in constraining rates, financing infrastructure expansion in peripheral areas, and imposing common carrier obligations preventing discrimination between users.

1.5.2 Privatization and deregulation

However, this common wisdom came under challenge with the increasing influence of neoliberal scholarship, which contributed to shedding light on the structural inefficiencies of public infrastructure management. In general, it was argued that rate constraints acted as disincentives to investment, especially in research and development, which resulted in obsolete and/or degraded infrastructures – meaning that the services they provided were actually *overpriced* compared to their quality. State-owned enterprises were especially denounced as inefficient because of their propensity to bureaucratic failures, their lack of hard profit objectives and competitive pressure, and the overbearing influence of politics on investment strategies, which often led to uneconomic choices.[81] For instance, the Italian public TV network adopted color broadcasts a full decade later than the rest of Europe because of the government's internal quarrels over which standard to adopt between the German PAL and the French SECAM – a controversy based not on technical efficiency but on foreign policy considerations.[82] Another political risk associated with public infrastructure investment is the practice of "pork barreling", which can be defined as a betrayal of the modern infrastructural investment where certain politically sensitive constituencies, such as swing states, receive larger investments than necessary near elections.[83]

However, the oversight-based model was also found to be inefficient, if to a lesser degree. This was partly attributed to the accumulated weight of (frequently outdated) legislation and rules, sometimes described as the result of "clumsy" public authorities trying to steer the market in the direction they saw as more socially efficient.[84] Another issue, first identified by George Stigler in 1971, [85] is the phenomenon of

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[79] Matthew Titolo, *Privatization and Its Discontents. Infrastructure, Law, and American Democracy* (Cambridge: Cambridge University Press, 2023), 10-11. https://doi.org/10.1017/9781108683456

[80] Paul Stephen Dempsey, "The Rise and Fall of the Interstate Commerce Commission: The Tortuous Path from Regulation to Deregulation of America's Infrastructure", *Marquette Law Review* Vol. 95 No. 4 (Summer 2012): 1151-1189. http://scholarship.law.marquette.edu/mulr/vol95/iss4/7

[81] Henckel and McKibbin, "The Economics of Infrastructure in a Globalized World", 263-264; William L. Megginson and Jeffry M. Netter, "From State to Market: A Survey of Empirical Studies on Privatization", *Journal of Economic Literature*, Vol. 39 No. 2 (June 2001): 321-389. https://doi.org/10.1257/jel.39.2.321

[82] Enrico Negretti and Gualtiero Tramballi, "In Italia la TV a colori è gialla", *Epoca*, 29 June 1969. Available at https://www.leradiodisophie.it/Download-new/Epoca-1969-TVcolor.pdf

[83] Olivier Cadot, Lars-Hendrik Röller, and Andreas Stephan, "Contribution to Productivity or Pork Barrel? The Two Faces of Infrastructure Investment", *Journal of Public Economics* Vol. 90 No. 6-7 (August 2006): 1133-1153. https://doi.org/10.1016/j.jpubeco.2005.08.006

[84] Jerry A. Hausman and William E. Taylor, "Telecommunications Deregulation", *American Economic Review*, Vol. 102 No. 3 (2012): 386-390. http://dx.doi.org/10.1257/aer.102.3.386

regulatory capture, where the public agency establishes a close relationship with the firms it oversees, and, through practices such as lobbying, revolving door policies, and corruption, or merely because of informational asymmetries, tends to become conniving with the dominant firms and to pass regulation aimed at protecting the incumbents' market power rather than the consumer's interests.[86] Another observation was that state authorities, both when directly owning firms and regulating them, failed to consider that a natural monopoly's boundaries are not fixed and may change with technological innovation. For example, the introduction of fiber optic lines and integrated circuits in the telecommunications industry contributed to drastically driving down the costs of transmission and enabled the introduction of competing networks, yet for a time governments did not take action to dismantle the legal monopoly on the industry.[87]

In other words, infrastructure networks, too, were impacted by the global spreading of the so-called Washington Consensus, which resulted in a wave of monopoly breakdowns, deregulation, and privatizations, starting from the United States and the United Kingdom and then propagating to the whole world, partly through emulation of a model that was seen as successful and partly because of the influence of international institutions such as the International Monetary Fund and the World Bank, who began prescribing neoliberal reforms as a precondition for accessing loans.[88] This turn coincided with the end of the Cold War, the "unipolar moment" of the United States, and the process of economic globalization, which also meant that, as legal monopolies and barriers to entry were removed, it became possible for firms to invest in infrastructure projects abroad to a much larger extent than before, creating a truly global market for infrastructure provision. Although at the time many commentators believed it inevitable that the whole world would eventually adopt American socioeconomic principles, we now know this would not be the case. Several non-Western states retain full ownership of their infrastructure networks in a globalized world. In fact, as we will see later, China's state-owned firms have launched an aggressive campaign of FDIs in infrastructure, with the aim of emerging as a competitive alternative to the US model.

Nevertheless, even for countries that fell in line with the Washington Consensus, the process of liberalization, while certainly broad, should not be mistaken for a full switch to laissez-faire. Several of the previously cited concerns with the ownership and management of infrastructures currently remain in place. Although some authors lament a "splintering" of the modern infrastructural ideal – since the networks were divided between multiple private providers –[89] the principle of equitable access for all has lived on as a policy objective. In fact, it has possibly been expanded: as a notable example, access to the Internet is

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[85] George J. Stigler, "The Theory of Economic Regulation", *The Bell Journal of Economics and Management Science* Vol. 2 No.1 (Spring 1971): 3-21. https://doi.org/10.2307/3003160

[86] Ernesto Dal Bó, "Regulatory Capture: A Review", *Oxford Review of Economic Policy* Vol. 22 No. 2 (July 2006): 203-225. http://doi.org/10.1093/oxrep/grj013

[87] Paolo Saba, "Privatizing Network Industries: The Competition Policy Perspective", OECD Competition Law and Policy Division (September 1998), available at https://search.oecd.org/corporate/ca/corporategovernanceofstate-ownedenterprises/1929666.pdf ; Economides, "The Economics of Networks", 677-678.

[88] Witold J. Henisz, Bennet A. Zelner, and Mauro F. Guillén, "The Worldwide Diffusion of Market-Oriented Infrastructure Reform, 1977-1999", *American Sociological Review*, Vol. 70 No. 6 (December 2005): 871-897. https://www.jstor.org/stable/4145398

[89] Graham and Marvin, *Splintering Urbanism*.

increasingly portrayed as either a precondition for the full enjoyment of fundamental rights or as a right by itself.[90] One key difference with the pre-privatization era, however, is that the existence of a single public network is no longer considered a prerequisite for universal access to infrastructure and that competitive practices are not seen as hindering it.[91] Nevertheless, since covering remote areas remains unappealing for market forces, states are often forced to stimulate investments in those locations through either subsidies or public-private partnerships (PPPs).

Moreover, deregulation is not the same as "un-regulation". Although certain types of rules fell out of favor, particularly those enforcing pricing constraints, states continue to exert a strong oversight on infrastructure markets through regulatory agencies. Indeed, it is important to note that those countries that followed the European state-ownership model, after privatizing most of their infrastructure networks, had to create their own American-style monitoring authorities. The World Trade Organization's 1997 Basic Telecommunications Agreement, which established a common framework for the liberalization of the sector, was even accompanied by a Reference Paper recommending the creation of such agencies.[92] This is because, although most infrastructure networks are no longer considered to be natural monopolies, they nevertheless remain strongly conditioned by economies of scale and network effects, which favor concentration. Oversight is thus needed to ensure that oligopolistic competition does not turn into cartelization or other uncompetitive practices. Furthermore, several countries force private providers to ensure the equality of service between users, in another legacy of the modern infrastructural ideal. For the Internet, this takes the form of (highly debated) network neutrality obligations.[93]

1.5.3 Infrastructure and security: the concept of criticality

In the previous sub-paragraphs, we saw that there are relevant economic incentives compelling states to maintain a certain degree of involvement in the provision of infrastructure, even after the privatization of the networks. Here, we address other rationales for public scrutiny based on non-economic factors.

One reason is linked to security, the provision of which is, again according to Smith, the first duty of the sovereign. On the one hand, states must ensure that infrastructures are up to standard so that they do not endanger the citizens' well-being. Since several types of infrastructure can pose serious hazards if not maintained properly (think of a water dam, a nuclear plant, or even a single electric power pole), oversight bodies are tasked with setting safety regulations and ensuring their implementation to avoid disasters. On the other hand, however – which is more of interest for this dissertation – the state must also protect society from the harmful effects of infrastructural failures.

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[90] Oreste Pollicino, "The Right to Internet Access", in Andreas von Arnauld, Kerstin von der Decken, and Mart Susi (Eds.), *The Cambridge Handbook of New Human Rights. Recognition, Novelty, Rhetoric* (Cambridge: Cambridge University Press, 2020): 261-284. https://doi.org/10.1017/9781108676106
[91] Edwards et al, "Understanding Infrastructure", 11.
[92] Dwayne Winseck, "The Geopolitical Economy of the Global Internet Infrastructure", *Journal of Information Policy*, Vol. 7 (2017), 239-240. https://doi.org/10.5325/jinfopoli.7.2017.0228
[93] Edwards et al, "Understanding Infrastructure", 11.

In the previous discussion, we have amply stressed infrastructure's centrality in every economic and social activity and its ability to guarantee "normalcy". The flip side of this centrality is *criticality*. Because infrastructure underpins the ordinary socioeconomic life of a country, its breakdowns can have far-reaching disruptive effects. Particularly, states define critical infrastructures as those that are so pervasive in every aspect of everyday life that their incapacitation or destruction «would have a debilitating impact on security, national economic security, national public health or safety, or any combination of those matters».[94] Because of this centrality, critical infrastructures are an attractive target for hostile activities, which can come from both state and non-state actors and range in intensity, from small acts of sabotage (which often fall under plausible deniability) to direct attacks as an act of war. Moreover, criticality creates great concerns when paired with infrastructure's tendency to become invisible unless it breaks down, as described by Star and Ruhleder (see **paragraph 1.3**). Research on critical infrastructure protection has noted that this invisibility risks leading to subpar protection standards and failures in anticipating threats, which can have catastrophic consequences when a sudden infrastructural breakdown, accidental or otherwise, compromises all related downstream activities.[95]

The usual assumption is that governments, and, more specifically, the national security community, are more suited to assess dangers and devise countermeasures than the private sector. Thus, given the preponderance of privately owned infrastructures, governments frequently use regulations to enhance protection standards. In this regard, it is interesting to note that there can be a disconnect between economic rationale and critical infrastructure considerations, not only because compliance costs can be very high but also because of a difference in their fundamental logic. For example, while, as previously noted, the theory on regulatory capture sees the close relationship between regulators and firms as a potential cause of inefficiency, critical infrastructure studies call for even more symbiotic relations as a way to co-produce expertise and improve risk mitigation.[96] However, a strong relationship between public and private actors can also be used for more "proactive" forms of security, such as using infrastructure for espionage purposes (see **paragraphs 2.7.1** and **3.6**).

1.6 Infrastructures and state power

1.6.1 Mann's infrastructural power

At this point, it should be noted that all arguments for governmental involvement in infrastructure provision and regulation mentioned hitherto have been prescriptive. They emphasized issues such as market concentration, conditions of access, and security which call for a form of intervention to ensure the best possible result for the public interest, with different sensibilities as to the appropriate level of public involvement in the matter. However, there is a separate set of descriptive arguments, originating not from

[94] National Institute of Standards and Technology, "Guide for Conducting Risk Assessments", NIST SP 800-30 Rev. 1 (September 2012). https://doi.org/10.6028/NIST.SP.800-30r1
[95] Howe et al, "Paradoxical Infrastructures", 556.
[96] See, for instance, Rebecca Slayton and Aaron Clark-Ginsberg, "Beyond Regulatory Capture: Coproducing Expertise for Critical Infrastructure Protection", *Regulation & Governance* Vol. 12 No. 1 (March 2018): 115-130. https://doi.org/10.1111/rego.12168

economic literature, but from sociology, which is focused on the intimate relationship between state power and infrastructural resources. This school of thought can be traced back to Michael Mann's research on the roots of state power.

According to Mann, the key characteristic setting the state apart from other social actors is its territoriality, that is, the exclusive, centralized authority it exerts over a delimited territory. The state extracts its resources, such as finance, human capital, technical innovation, etc., from social agents such as households, firms, and civic organizations; in exchange, it provides services that require a centralized form of authority which the other agents lack, such as the enforcement of regulations, the protection of rights, and public security.[97] Territoriality is what makes the state useful. Mann goes on to explain that the modern state exerts its control over territory through what he dubs *infrastructural power*. Infrastructural power is «the capacity of the state to actually penetrate civil society and to implement logistically political decisions throughout the realm».[98] In other words, it is the ability to materially implement state policy in every corner of the territory claimed by the state and to maintain a constant presence in it.[99] Mann contrasts it with the more archaic *despotic power*, which is exerted through mere force. The main difference between the two lies in a concept we have already associated with infrastructure: its long reach (see **paragraph 1.2.2**). In ancient societies, sovereign power – though formally unlimited – was constrained in its application by logistical issues, as the government usually lacked the means to constantly ensure the application of its policies in its whole territory. On the other hand, the modern state has access to «logistical techniques» enabling it to discreetly «penetrate and centrally co-ordinate the activities of civil society through its own infrastructure».[100] We have already stated that infrastructures are deeply engrained in social and professional routines. In Mann's view, through infrastructure, the state, from its uniquely central position, can exploit this embeddedness to ensure its policies are implemented. He also stresses that this is a voluntary exchange that receives legitimation by the usefulness of state-provided infrastructure, rather than an imposition like with the exercise of despotic power. From the examples he provides, it is clear Mann thinks mainly of soft infrastructures, such as the bureaucratic organization of state apparatuses, literacy (which allows laws to be codified), and coinage and standards of measure (which allow goods to be exchanged under the state's guarantee of value). However, he also refers to hard infrastructure, notably, transportation and telecommunications networks and the financial system.[101]

Because Mann's focus is on state power, he tends to concentrate on the ability of the state to exercise control, particularly, the ability to collect large quantities of information on citizens and their activities. Other authors, however, used his work as inspiration for analyses centered more directly on the relationship

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[97] Michael Mann, "The Autonomous Power of the State: Its Origins, Mechanisms, and Results", *European Journal of Sociology* Vol. 25 No. 2 (1984), 198-199. https://www.jstor.org/stable/23999270
[98] Mann, "The Autonomous Power of the State", 189.
[99] Luciana Cingolani, "Infrastructural State Capacity in the Digital Age: What Drives the Performance of COVID-19 Tracing Apps?", *Governance* Vol. 36 No. 1 (January 2023), 276. https://doi.org/10.1111/gove.12666
[100] Mann, "The Autonomous Power of the State", 190.
[101] Mann, "The Autonomous Power of the State", 192.

between material infrastructure and the state's policy objectives, including positive obligations. Turner and Johnson, in particular, note that the state uses infrastructure not only to control its territory but also to foster integration, security, and development.[102] The previously cited modern infrastructural ideal (see **paragraph 1.5.1**), for instance, can be seen as a positive declination of infrastructural power where the state takes upon itself the obligation to ensure a baseline quality of life for all of its citizens. We have also mentioned how infrastructure ties the state's territory together, enabling, among other things, the creation of a single market. In fact, Turner and Johnson contend that infrastructure is what allows the state to transform a mere geographical space into a territory, «creating, forming, and sustaining the relationships between itself and all non-state agents located and operating within that space».[103] Moreover, since in Mann's view the state draws most of its capabilities from society, it makes sense that it would use infrastructure to allow social agents to express their full potential by facilitating their activities. In this sense, some researchers have proposed to divide infrastructural power into two separate components, "extractive power", or the capacity to draw on social resources with legitimacy and consent, and "transformative power", that is, the state's capacity to initiate and sponsor technological innovation by providing more efficient infrastructure and financing its development.[104] The core idea, however, remains that the configuration of infrastructure enables the state to push socio-economic activities in its desired direction.

Given that Mann's analysis is so state-centered, the idea of infrastructural power might seem outdated in a world where, as described above, infrastructures have become increasingly privatized. On the contrary, privatization is one of the trends that stimulated a resurgence of the concept in recent years. We can identify two broad tendencies in the literature. Some researchers worry that privatization has caused a transfer of infrastructural power from the state onto private actors, most notably, multinational corporations, a possibility Mann himself alluded to in his concluding remarks.[105] This argument is in line with Susan Strange's *Retreat of the State*, according to which corporations' increasing influence on a global scale disenfranchised them from territorial state control, turning them into "political institutions" that entertain direct political relations with civil society.[106] These firms' interests are not necessarily aligned with the political objectives of the state they are based in nor with those where they operate abroad. On the other hand, they might exploit their control of infrastructure to extract relevant resources. For example, several authors see the amount of data Internet platforms receive from their users as an exercise of "extractive power", since the users legitimize the companies to access their information (by accepting the conditions of

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[102] Turner and Johnson, *Global Infrastructure Networks*, 1.
[103] Turner and Johnson, *Global Infrastructure Networks*, 4.
[104] Maryanne Kelton et al, "Virtual Sovereignty? Private Internet Capital, Digital Platforms and Infrastructural Power in the United States", *International Affairs* Vol. 98 No. 6 (November 2022), 1977-78. https://doi.org/10.1093/ia/iiac226
[105] Mann, "The Autonomous Power of the State", 210.
[106] Susan Strange, *The Retreat of the State. The Diffusion of Power in the World Economy* (Cambridge: Cambridge University Press, 1996), 44-46. https://doi.org/10.1017/CBO9780511559143

use) which can then be applied to various purposes such as targeted advertising, profiling, and even ideological manipulation.[107]

Others, however, believe that the state remains capable of exercising its infrastructural power even in the face of market-led infrastructure. This argument is centered, once again, on territoriality. Infrastructure is inevitably built on state-controlled territory, meaning that the state retains the ultimate authority over it. It can intervene in infrastructure markets, partially through the measures we have described above, such as the oversight of regulatory agencies, the imposition of universal service obligations, and the development of public-private partnerships to pursue its policy goals.[108] In the worst-case scenario, it might even choose to nationalize the infrastructure, although, in a global market, this might be a double-edged sword capable of pushing investors out of the country.[109] These researchers also point out that a form of exchange and negotiation between the state and civic society was always at the heart of Mann's conception of infrastructural power.[110] Thus, the fact that in a liberalized market states must engage in structures of polycentric governance,[111] negotiating with corporations to ensure that infrastructure is provided and managed in accordance with their policy preferences, is a natural facet of a type of power that is exercised *with* society, rather than *over* society.

1.6.2 Strange's structural power

We have already referred to Susan Strange's work in connection to Mann-inspired research. Indeed, there is a significant proximity between Mann's concept of infrastructural power and Strange's definition of structural power – and not only in terms of semantics. In her famous article on the everlasting hegemony of the United States, Strange explains:

> Structural power is the power to choose and to shape the structures of the global political economy within which other states, their political institutions, their economic enterprises, and (not least) their professional people have to operate. This means more than the power to set the agenda of discussion or to design (in American phraseology) the international "regime" of rules and customs.[112]

She then identifies four interrelated areas of structural power: the control over security provision, control of the system of production of goods and services, the ability to shape the structure of finance and credit, and

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[107] Kelton et al, "Virtual Sovereignty?", 1982-1983. See also Joscha Abels and Hans-Jürgen Bieling, "Infrastructures of Globalisation. Shifts in Global Order and Europe's Strategic Choices", *Competition & Change* Vol. 27 No. 3-4 (2023), 520. https://doi.org/10.1177/10245294221130119
[108] Turner and Johnson, *Global Infrastructure Networks*, 11-33.
[109] Turner and Johnson, *Global Infrastructure Networks*, 140.
[110] Linda Weiss, "Infrastructural Power, Economic Transformation, and Globalization", in John A. Hall & Ralph Schroeder (Eds.), *An Anatomy of Power: The Social Theory of Michael Mann* (Cambridge: Cambridge University Press 2006), 167-168. https://doi.org/10.1017/CBO9780511488993.009
[111] Elinor Ostrom, "Beyond Markets and States: Polycentric Governance of Complex Economic Systems", *American Economic Review* Vol. 100, No. 3 (June 2010): 641-672. https://www.jstor.org/stable/27871226
[112] Susan Strange, "The Persistent Myth of Lost Hegemony", *International Organization*, Vol. 41 No. 4 (Autumn, 1987), 565. https://www.jstor.org/stable/2706758

the influence on the production and dissemination of knowledge.[113] The American primacy in all four areas at the international level turned the US into a global hegemon.

What is of particular relevance here is that Strange emphasizes structural power's ability to shape and constrain the room for the activity of other actors. Implicitly, the hegemon creates structures that suit its preferences: for example, the global financial system established at Bretton Woods was designed to ensure both the centrality of the dollar in the world economy and the diffusion of free market principles that were at the core of the US national ideology. To borrow from Mann, then, structural power is exercised through the creation of structures that penetrate (international) society and guide its activities in the hegemon's preferred direction. Another point in common is that both Mann and Strange characterize (infra)structural power as a form of pervasive influence legitimized by the usefulness of the services provided by the state/hegemon, distinct from the application of raw power. What is more, several of Strange's examples of structural power necessitate the establishment of some forms of global infrastructure to be implemented. Notably, the establishment of international commerce, finance, and information systems all require the construction of global infrastructure networks to enable the movement of large flows of money, goods, and information – in fact, in a separate work, Strange wrote on the importance of analyzing international transportation infrastructure for assessing a state's economic power.[114] Strange directly credits the United States with the creation of the conditions for the development of global infrastructure which, in turn, sustain its structural power. Referring to the financial opportunities created by the development of better, faster, and more reliable telecommunications technology, she observes:

> (…) it would be wrong to suppose that these opportunities opened up by chance. They were opened up by a combination of conscious policy decisions by governments, especially on the regulation of financial markets and banking institutions, and by a production structure – itself, in turn, the creation of politically determined laws and administrative decisions – which was predominantly 'capitalist' (i.e. pro-market) and which therefore was so organized as to encourage and reward technical innovation. The most significant of these policy decisions were taken by successive postwar governments of the United States.[115]

Structural power is strictly linked to the ability to foster the development of these infrastructures; in fact, Strange explains that even after Japan overtook the US as the world's major creditor country, it did not take over in terms of structural power, because it still moved inside and thrived on the structures established by the US.[116] These observations resonate with STS-inspired arguments emphasizing that infrastructure's design can discreetly shape, constrain, and influence the activities it supports (see **paragraphs 1.2.2** and **1.4.3**).[117] Indeed, Belli directly links the concept of structural power to Lessig's theory of regulation through design,

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[113] *Ibid*.
[114] Susan Strange, "Who Runs World Shipping?", *International Affairs*, Vol. 52 No. 3 (July 1976): 346-367. https://www.jstor.org/stable/2616550
[115] Susan Strange, "Finance, Information, and Power", *Review of International Studies*, Vol. 16, No. 3 (July 1990), 263. https://www.jstor.org/stable/20097226
[116] *Ibid*.
[117] Marieke De Goede and Carola Westermeier, "Infrastructural Geopolitics", *International Studies Quarterly*, Vol. 66, No. 3 (2022). https://doi.org/10.1093/isq/sqac033

noticing that during the Cold War technology was acknowledged as a source of structural power, a vector to spread the values that were embedded into it, such as the free flow of information and commerce.[118] This brings us back to the importance of setting technical standards. As noted in **paragraph 1.4.3**, standards, which are the cornerstone of interconnectivity within infrastructural networks, can act as discreet enactors of political preferences and strategies, creating advantages for the states or firms that manage to impose their vision of infrastructure's optimal functioning on the global industry. It is also interesting to note that Belli sees Internet giants as gaining structural power based on nearly the same premises which led his colleagues to claim these companies are developing their infrastructural power, showing that the two concepts largely overlap and can be integrated into a single analytical lens.

Furthermore, we should note that a key benefit of structural power, in Strange's explanation, is that the advantages it provides live on even after the hegemonic state starts declining in *relational power*, that is, in its economic/political performance. As stated above, Japan did not overtake the US as the world's chief economic player even though it performed better in certain areas. This argument fits very well with infrastructure's endurance, the difficulty in replacing it, and its tendency to path dependence (see **paragraphs 1.2.2** and **1.4.3**). Infrastructure is sticky, and its durability enhances the structural power of the actor who builds it.

It appears that the main difference between the two concepts is in their geographical scale, as Mann's work focused on the state level and Strange's on the global level, although it should be noted that Strange claims the concept of structural power applies to every human community, including households.[119] From an academic point of view, Mann's fortune has been mostly confined to the fields of urban planning and STS, whereas Strange's theory is a cornerstone of the school of international political economy and international relations in general. However, a combined reading of the two concepts can offer a powerful lens to interpret the close relationship between power and infrastructure. Together, they paint the design and provision of infrastructure as a key mechanism for shaping political, social, and economic relations in a way that fits an actor's preferences. This type of reading can be applied both to the national and international level and to public and private actors alike, from Robert Moses' low bridges to social media platforms' client profiling to the spatial configuration of global financial markets. It is also extremely useful at a time when infrastructure is increasingly the object of international competition.

Using this lens, in the following paragraph we shall proceed to explain the characteristics of global infrastructure, their role in international power plays, and the unique issues surrounding them.

1.7 Global infrastructure networks

In the previous paragraphs, we have seen that infrastructure is a multifaceted concept that is applied to a variety of systems and artifacts, both physical and non-material, linked together by the same basic function

[118] Luca Belli, "Structural Power as a Critical Element of Social Media Platforms' Private Sovereignty", in Edoardo Celeste, Amélie Heldt, and Clara Iglesias Keller (Eds.), *Constitutionalising Social Media* (Hart 2022), 6. https://ssrn.com/abstract=4569863
[119] Strange, "The Persistent Myth", 565.

of supporting nearly every productive activity and by the tendency to produce large positive externalities. They usually take the form of large-scale networks tying territories together and enabling the expansion of markets, and they are deeply connected to a sense of normalcy, which simultaneously makes them critical and invisible. Their importance for everyday activities makes a form of state involvement in their provision indispensable, although the proper extent of this involvement is the subject of debate. Finally, we have seen that their configuration and design can shape and constrain social and economic structures, meaning they can be wielded as instruments of power.

In this paragraph, these observations will be applied to the specific context of global infrastructure networks, that is, "networks of networks" connecting the entirety of the world within a single web of infrastructural resources.

1.7.1 The globalization of infrastructure

As mentioned in **paragraph 1.4.2**, global infrastructure networks originate from the interconnection of independently developed national networks. These are the pillars of globalization, the logistical basis for the enormous flows of goods and services, people, and information that characterize the contemporary age. Globalization and the expansion of infrastructure are two mutually reinforcing processes: on the one hand, economic globalization has been made possible by the introduction of more efficient modes of transportation and communication, on the other hand, the growing importance of being connected to the world economy has generated a strong pressure for states to improve their interconnectivity. From a practical perspective, the interconnection of infrastructure systems, much like at the national level, requires the establishment of gateways, to create a physical linkage between them, and the adoption of standards, to allow for interoperability (see **paragraph 1.4.3**). For what concerns global networks, gateways usually lie at a country's land or maritime border and act as a point of embarkation and disembarkation of sorts: for instance, ports and airports, the landing points of an international gas pipeline, or the landing stations of a submarine Internet cable. Furthermore, in several cases, global networks include large portions that are located in the global commons, that is, in spaces belonging to mankind as a whole rather than to the sovereignty of a particular state, such as outer space and the high seas.[120] This is the case for all submarine infrastructural networks connecting separate landmasses, including telecommunications cables but also electrical cables and pipelines. These portions, lying under the surface of inhabitable areas, are even more impacted by infrastructure's natural tendency towards "invisibility", which was described in **paragraph 1.2.2**.[121] Although, as noted in **paragraph 1.5.3**, this might lead to an underestimation of their importance and their security needs, it can also protect against some of the negative aspects of political exposure, such as pork barreling and the NIMBY syndrome: it is more difficult for politicians to gain the voters' support through projects that are not highly visible, or for citizens to mobilize against them.

[120] Turner and Johnson, *Global Infrastructure Networks*, 31-32.
[121] Christian Bueger and Tobias Liebetrau, "Protecting Hidden Infrastructure: The Security Politics of the Global Submarine Data Cable Network", *Contemporary Security Policy*, Vol. 42 No. 3 (2021): 391-413

It is also important to note that, while the process of globalization has increased the need for interconnecting national infrastructure networks, national networks have also been "globalized": since globalization coincided with the breakup of monopolies and the liberalization of the infrastructure market in most countries, private and state-owned firms became able to engage with foreign direct investments (FDIs) in infrastructure abroad, acquiring stakes in the infrastructural network of multiple countries. As shown in **Figure 1**, FDIs in infrastructure have remained consistently high in the past twenty years, although they exhibit a decidedly cyclical tendency as seen in the lull following the great financial crisis. It is also interesting to note that developed countries in Europe and America are not only the main source but also the main recipient of FDIs, perhaps reflecting their higher openness to foreign markets.

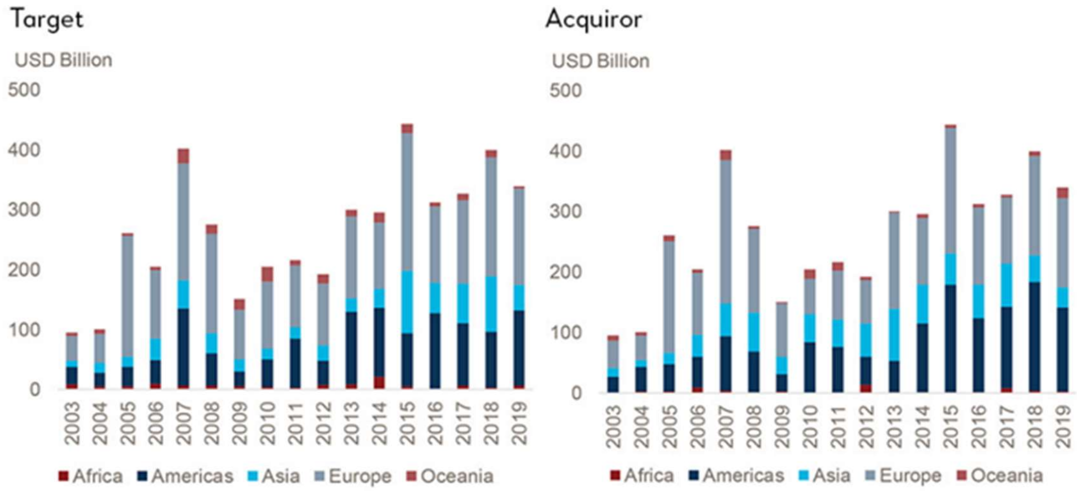

Figure 1. Regional distribution of inward FDI in infrastructure by deal value. Source: Asian Infrastructure Investment Bank, 27 October 2020. https://www.aiib.org/en/news-events/media-center/blog/2020/Recent-FDI-Trends-in-Infrastructure-and-Outlook.html

Of course, the world's stock of infrastructure is distributed unevenly, with some countries possessing more extensive and efficient national infrastructural networks and a greater degree of interlinkages with the rest of the world, which makes them crucial nodes in the global networks (see **paragraph 1.4.1**). Various factors contribute to this inequality, foremost among them being the level of economic development. Advanced economies tend to exhibit higher degree centrality in global infrastructure networks, reflecting their prominent status in the world economy. This centrality forms a self-reinforcing mechanism because, as seen in **paragraph 1.3**, superior infrastructure enhances economic performances and greatly facilitates international trade, which in turn solidifies these countries' privileged position within global flows of goods, capital, people, and information and improves their ability to forge newer infrastructural connections with other countries. Although the high costs of infrastructure investment might make it difficult for emerging economies to close the gap, the history of Southern and Eastern Asia shows it is possible to increase their centrality within the networks through shared infrastructural projects.[122] Moreover, it has been noted that

[122] C.T. Vidya and Farhad Taghizadeh-Hesary, "Does infrastructure facilitate trade connectivity? Evidence from the ASEAN", *Asia-Europe Journal* Vol. 19 (2021): 51-75. https://doi.org/10.1007/s10308-021-00614-6

developed economies have an incentive to assist emerging countries in developing their own infrastructure networks, through FDIs or international donor systems, as a way of opening those countries to more imports and exports.[123] However, according to Marxist-inspired literature, the resulting configuration of global infrastructure networks hardwires core-periphery relations, which can be seen in the general scarcity of connections between countries in the Global South and in the tendency for decolonized nations to depend on infrastructural linkages with their former colonizers.[124] Nevertheless, factors other than economic development are relevant in determining a country's status as a node. One of these is geography: for instance, countries located along the most direct shipping routes between landmasses, like the Suez Canal or the Luzon Strait, will be more attractive landing points for infrastructure networks compared to remote island nations or landlocked countries.

1.7.2 State-hindering effects of global infrastructure networks

From the physical point of view, there seems to be a significant correspondence in the dynamics of infrastructure networks at the national and global levels, with due consideration to the difference in scale. Even the unevenness in distribution mirrors the tendency for national infrastructures to concentrate around the most dynamic areas, and the commitment on the part of international agencies to assist underdeveloped countries in improving their infrastructures could be seen as a global-scale version of the infrastructural ideal described in **paragraph 1.5.1.** However, the area where we find significantly more complications is the one related to soft infrastructure, or, more broadly, the «rules» of the system.

In **paragraph 1.6**, we observed that the state's intimate relationship with infrastructure is rooted in its territoriality. Global infrastructure networks, however, are characterized exactly by their lying beyond the territory, and, consequently, the authority, of a single country. As global networks consist of an agglomeration of multiple national networks, the consequence is that control of the global infrastructure is divided among multiple state-level authorities. Each state can exert its authority and enforce regulations only over its national network, while it has no control over those of other countries. Moreover, portions located in the global commons are only subject to international law and to the oversight of international bodies, both of which are, in most cases, very tenuous.[125] Thus, from a state's perspective, the interconnection within global infrastructure networks can constrain its level of control over its own national networks. As we noted in **paragraph 1.4.2**, by connecting to the global network, the state accepts a form of interdependence where its own infrastructure's performance can be affected by decisions taken by other countries, or by accidents taking place in their national networks. Again, this conditioning effect is unevenly distributed among states: for instance, the decisions of countries exerting territorial control over strategically important routes, such as a strait, have a broader impact on the global network than those of more isolated nations. Similarly, countries that can rely on more diversified infrastructural connections will be more resilient to closures, breakdowns,

[123] Joseph Francois and Miriam Manchin, "Institutions, Infrastructure, and Trade", *World Development* Vol. 46 (June 2013): 165-175. https://doi.org/10.1016/j.worlddev.2013.02.009
[124] De Goede, "Finance/security Infrastructures".
[125] Turner and Johnson, *Global Infrastructure Networks*, 31-32.

or other unexpected interruptions of flows compared to those that are over-reliant on a smaller number of linkages. Furthermore, states are not the only actors able to influence global networks. We have seen in **paragraph 1.5.2** that as states liberalize their infrastructure market, they also find themselves negotiating with private firms, whose interests might diverge from those of the state. This applies at a global scale, too, and is further reinforced by the growing relevance of FDIs in the infrastructure sector. States are increasingly forced to negotiate with transnational corporations whose influence and bargaining power might occasionally surpass those of governments.

An important aspect of the state's diminished control over globalized infrastructure, beyond the risk of being affected by others' management choices, is the reduction in the state's ability to set the rules, standards, and regulations under which infrastructure operates. Again, as seen in **paragraph 1.4.3**, the state is the ultimate arbiter of infrastructure's inner rules at the national level. From a formal point of view, nothing prevents it from deciding to set its own standards independently of those of its neighbors. In fact, we have seen that a state could choose to insulate itself from the global networks by adopting divergent technical standards. However, such a choice implies the cost of being disconnected from the global economy, a price that few societies are willing to bear. It is worth mentioning here, in relation to an example made in **paragraph 1.5.2**, that Mongolia's authorities ultimately resolved to adopt China's standard track gauge for its new railways, having determined the advantages of facilitating exchanges with Beijing outweighed all other considerations.[126]

Furthermore, we already discussed (in **paragraph 1.4.3**) how standard setting, on a global scale, is frequently negotiated within international organizations and, increasingly, non-governmental fora. In the first case, the state's ability to influence standard-making activities depends on the organization's representation and voting rules; in the second case, it rests on the prominence of the state's companies within a particular industry, but also on the level of alignment of the state's views with those of its firms. Once again, a state that is discontent with the standards agreed upon by the appropriate organization might choose to adopt different ones for its national networks; nevertheless, if it wishes to participate in global commerce and exchanges, it often has no choice but to uniform itself to global standards. This, in Mann's terms, amounts to a loss of infrastructural power, because the state is no longer able to rely on material assets to ensure the enforcement of its policies; in fact, those same infrastructural assets force the state to accept choices taken elsewhere, such as within international standardization fora where it has little influence. This is the price to be paid for being part of the global economy.

However, globality does not automatically sound the death knell for state power. As noted above, the interconnection between networks requires gateways. Even in the case when the decision to build a new international infrastructure project comes entirely from the private sector and is entirely privately financed, and where the majority of the proposed infrastructural link lies in the global commons, the state retains the role of final arbiter through the power to approve or deny construction permits, at the very least, at the

[126] "Export Boost Expected from Mongolia – China Railway Opening", *Railway Gazette International*, 28 November 2022. https://www.railwaygazette.com/infrastructure/export-boost-expected-from-mongolia-china-railway-opening/63031.article

gateway point. We will see that this is the power used by the US government to hold at bay private cable projects it considers unfavorably. Indeed, national security provides a strong incentive for states to closely guard gateway points: although, in a globalized economy, the state is pressured into opening its borders to international flows, it must also monitor these flows to ensure it does not import threats.[127] This same principle applies to foreign investments in critical infrastructure. According to UNCTAD, at least 37 states have introduced legislation enabling them to screen foreign takeover proposals and, if necessary, to prevent them on national security grounds,[128] as is the case with the Italian government's so-called "Golden Power". Because of their criticality, infrastructure networks are subject to special attention in this regard. To this end, even after privatizing their state-owned infrastructure firms and breaking up their monopolies, several European countries have retained substantial stakes in those companies to maintain a degree of control over "strategic" infrastructural assets.[129]

These considerations, however, picture the state as being simply able to *react* to the state-hindering effects of being interconnected within a global infrastructure network: although they show that the state does not completely lose control of the arteries of global flows, they still paint it as weakened, forced to devise strategies to retain a minimum degree of authority over them. However, this portrait must be contrasted with accounts that focus on the state-augmenting effects of global infrastructures.

1.7.3 Global infrastructures as conduits for (infra)structural power

In the previous section, we described how partaking in global infrastructure networks constrains the state's control over its own infrastructure. This effect applies, in some measure, to all states in the network: interdependence inevitably implies a loss of autonomy. However, it also creates significant opportunities, not only in terms of improved commercial prowess but also in the ability to influence and shape the configuration of the world economy. As already seen in **paragraph 1.6**, global infrastructures can be seen as a material manifestation of Strange's structural power, that is, infrastructures have the potential to act as a discreet yet effective source of state influence in the international scene. States that actively engage in the provision of global infrastructure, by developing, promoting, and financing projects, can contribute to shaping the structure of global economic connections such as trade routes and supply chains to their favor, forging stronger relations with the rest of the world, attracting more commercial and information flows, and augmenting their centrality within the global networks.

Moreover, a state can increment its global projection of (infra)structural power by shaping standards which, as seen above, are both a source of commercial advantage and a tool for determining the inner laws of infrastructural networks. This influence is exerted in multiple ways. First, states that are responsible for the

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[127] Linda Weiss, "The State-Augmenting Effects of Globalisation", *New Political Economy*, Vol. 10 No. 3 (September 2005): 345-353. https://doi.org/10.1080/13563460500204233
[128] UNCTAD, "The Evolution of FDI Screening Mechanisms: Key Trends and Features". *Investment Policy Monitor* No. 25 (February 2023). https://unctad.org/system/files/official-document/diaepcbinf2023d2_en.pdf
[129] Paolo Castelnovo, Chiara F. Del Bo, and Massimo Florio, "Quality of Institutions and Productivity of State-Invested Enterprises: International Evidence from Major Telecom Companies", *European Journal of Political Economy*, Vol. 58 (June 2019): 102-117.

development of an infrastructural technology and its diffusion on the global scale are more likely to influence its basic rules because, as seen in **paragraph 1.4.3**, path dependence tends to crystallize early design choices and to ensure their persistence even as superior technical alternatives are devised. Secondly, by expanding infrastructures on a global scale, central states have the opportunity to reproduce their preferred standards in other countries and contribute to their diffusion as the global norm. Third, by virtue of their centrality in shaping infrastructures, the same states also have a stronger stake in establishing which are the most appropriate institutions for engaging in further standard setting. As we will see in **Chapter 2**, for instance, the greater relevance of non-governmental organizations vis-à-vis traditional international organizations in Internet governance directly reflects the belief of the United States that the private industry would be better equipped to perform such functions. Finally, market power can also play a role. Bradford famously noted that the European Union's prominent position within global trade creates a system of "involuntary incentives" where the rest of the world is frequently forced to adopt EU standards and regulations in order to remain compatible with such a large and developed market.[130] For what concerns more overt displays of control over the networks, according to Farrell and Newman, states can weaponize their position within global networks by chocking international flows to damage their rivals (for instance, Russia's attempts at leveraging Europe's dependency on its gas pipelines for intimidation, or the US' ability to cut off countries from the international payments system thanks to its influence over SWIFT).[131] Here, we can see another self-reinforcing tendency, which echoes Star and Ruhleder's notion that infrastructure simultaneously shapes and is shaped by conventions and practices (see **paragraph 1.3**): because of a combination of economic prowess, geographical advantage, and political characteristics, some states are in the position to influence the shape of global infrastructure networks, attracting more infrastructural connections and conditioning the adoption of their own standards as global ones; which, in turn, makes them better equipped to harness global flows, contributing to further enlarge their economic power.

To summarize, by shaping the distribution, design, governance, and overall functioning of global infrastructure networks, states exercise structural power in Strange's sense, because they create rules constraining the behavior of other actors on the international scene; and they expand their infrastructural power as conceptualized by Mann, as they hardwire their policy preferences within material infrastructure conditioning not only their territory, but also those of other states. This ability is closely associated with the concept of hegemony. The identification of Great Britain and the United States as the global economic hegemons, respectively, of the 19th and 20th-21st centuries is informed in most accounts by the centrality of their currencies, stock exchanges, and banking systems within the global financial infrastructure, which in turn enabled them to design the core rules of the international economy. The advantages provided by this centrality, and its ability to endure even against a relative decline in the hegemon's real economy are one of the most discussed themes in IPE scholarship. However, influence over other types of infrastructure

[130] Anu Bradford, *The Brussels Effect: How the European Union Rules the World* (Oxford University Press: New York, 2020).

[131] Henry Farrell and Abraham L. Newman, "Weaponized Interdependence. How Global Economic Networks Shape State Coercion", *International Security*, Vol. 44 No. 1: 42-79. https://doi.org/10.1162/ISEC_a_00351.

networks has also been acknowledged as a source of hegemonic power, including – which is most relevant for this dissertation – telecommunications networks.[132] Great Britain was able to extract considerable advantages from its centrality within global telegraph networks,[133] as has the United States from its unique role in the development of the Internet, as will be shown in the following chapter.

Of course, not all states can be hegemons; which also means that, at any given moment, only a handful of states have the appropriate combination of advantages enabling them to influence infrastructure networks in a meaningful way. The rest of the international community has little choice but to integrate themselves within the already existent networks, even if this means accepting less preferred rules. This can have serious implications when we consider Mumford's observation that infrastructure, like all artifacts, can hardwire political values. We expect, for instance, a liberal-capitalist state to shape infrastructure networks in a mostly decentralized way, emphasizing aspects such as freedom of movement and expression and the free circulation of goods, and leaving large space to private initiatives and competition; whereas autocratic countries would probably prefer more state-centric networks with clearer boundaries and stronger levels of control. For states that are broadly aligned with the hegemon's ideology, the issues of standards and infrastructural governance might translate into grievances concerning, for instance, divergent priorities given to environmental questions, or perceived unfair advantages for the hegemon's industry compared to their own. However, a state that does not share even the most basic political values that influence the configuration of global infrastructure finds itself in the unfortunate condition of having to adapt to a hostile network while trying to preserve its own national autonomy. Here, the strategies mentioned in the previous sub-paragraph, such as implementing stronger controls at national gateways, can serve as mitigation. However, we expect states that are profoundly dissatisfied with the status quo to attempt to change it, should their position in the global economy provide an opportunity to do so. This can be seen as a less violent version of a classic concept of international relations theory, that of a "revisionist power":[134] while the objective is ultimately the same – to change the status quo by rewriting international rules – in this framework revisionist states resort not to war but to economic means such as the promotion of infrastructural projects abroad, greater participation in standardization bodies and the attempt to create coalitions of likeminded states to oppose the status quo. Not by chance, in the view of most commentators, the moment that marked China's transition from a rapidly growing emerging country to a systemic rival to the US with a serious stake in world hegemony was the launch of the Belt and Road Initiative (BRI), which is, precisely, a massive project for the construction of global transportation, finance, and telecommunications networks offered as an alternative to the American-centric system, both in terms of routes and of ideological principles.

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[132] Among others: Strange, "Finance, Information and Power"; Winseck, "The Geopolitical Economy of the Global Internet Infrastructure"; Daniel R. Headrick, *The Invisible Weapon: Telecommunications and International Politics, 1851-1945* (London: Oxford University Press, 1991); Julia Bader, "To Sign or Not to Sign. Hegemony, Global Internet Governance, and the International Telecommunication Regulations", *Foreign Policy Analysis* No. 15 (2019): 244-262, https://doi.org/10.1093/fpa/ory016

[133] Daniel R. Headrick and Pascal Griset, "Submarine Telegraph Cables: Business and Politics, 1838-1939". *The Business History Review*, Vol. 75 No. 3 (2001): 543-578. https://www.jstor.org/stable/3116386

[134] See, for example, Randall L. Schweller, "Bandwagoning for Profit: Bringing the Revisionist State Back In", *International Security*, Vol. 19 No. 1 (Summer 1994): 72-107. https://doi.org/10.2307/2539149

As we see in the following chapters, the abundance of Internet-focused initiatives within the BRI as well as Beijing's increased activism within Internet governance bodies can be read as a "revisionist" push to radically alter the nature of the Internet.

1.7.4 The state within global networks: a final overview

To summarize, global infrastructure networks are inequal, not only because some countries can rely on better infrastructural connections than others, but also because some states wield influence over standards and configuration, whereas others have to navigate the constraints imposed by existing structures. Certain states face limitations due to historical legacies, economic constraints, or geopolitical circumstances that impede their ability to shape the trajectory of global infrastructure networks. Conversely, states with robust economies, technological prowess, and strategic geographical positioning possess the capacity to exert influence on a global scale. By actively participating in the formulation of international standards, engaging in projects abroad, and leveraging their economic strength, these states not only enhance their connectivity and competitiveness but also project their structural and infrastructural power throughout global infrastructure networks, shaping it under their political preferences. The rest find themselves unable to insulate from global networks, which would imply an enormous economic cost, but also hindered in the exercise of their infrastructural power, as they are forced to devise strategies to be able to continue enforcing their preferred policies in their own territory. We will apply this dynamic to the Internet in **Chapter 2**, to see that, although China was able to carve a significant role in the provision of global Internet infrastructure, it still has to follow standards and rules that were developed within the United States, and which are less ideologically compatible with its own policy preferences. States that are unwilling to cut themselves off from global flows but still feel the need to increase their degree of control within a framework that does not cater to their preferences are forced to react through the enhanced controls at gateways described above: as we will see, the Great Firewall of China is an example of such countermeasures.

Based on these considerations, it is possible to schematize the state's attitude toward global infrastructure networks. The basic assumption is that all states face strong pressures to open themselves to interconnection with the rest of the world, as interconnection is essential for a modern economy to thrive. Secondly, as there is a relationship between a country's degree of interconnection within networks and its role in the international economy, we expect states to try to maximize their linkages with global networks and to better enable goods, people, and information to flow to, from, and through their territory. At the same time, states must retain a degree of control over these flows to ensure they do not import threats within their territory: moreover, the concept of threat varies significantly depending on the state's political regime, with authoritarian states, in particular, being more likely to establish strong monitoring mechanisms against perceived dangers to their internal stability.

On the other hand, we have seen shaping global infrastructure can be the key to projecting power and enforcing a state's own preferences on the world economy. Thus, we expect states to aspire to actively shape infrastructural networks, influencing global standards and regulations to align them more closely to their policies. However, this capability, which requires a complex combination of factors, is only within reach for a small number of states, if not a single one. States that, due to a mixture of advantages, were able to shape the rules of global infrastructure networks are expected to try to preserve their status. In this, they are assisted by infrastructure's inclination toward inertia and path dependence, makes it likely that standards and rules set in the past will endure even in the face of alternative proposals coming from latecomers, as they will count on infrastructure's ability to shape conventions and practices to the point they feel as natural, that is, lacking an alternative. However, states that are hostile to the status quo, either because they feel marginalized by it or because they are radically opposed to the hegemonic state's vision for global infrastructure can be expected to seek opportunities to change current rules.

In the following chapters, these considerations will be applied to Internet infrastructure and, in particular, to submarine Internet cables, to frame these infrastructures within broader dynamics and to verify how closely the behavior of state actors aligns with expectations.

Chapter 2:
Understanding submarine Internet cables

2.1 Introduction

The previous chapter established the theoretical framework under which global infrastructure networks, and the actions of states within them, can be analyzed. In this chapter, the framework will be applied to the specific context of submarine Internet cables. Before embarking on a detailed examination of these cables, however, it is essential to frame the Internet itself within our theoretical lens. Understanding the broader context of the Internet's architecture, which includes both logical and physical infrastructure layers, is crucial for comprehending the importance of its physical backbone. Moreover, it is an essential prerequisite for understanding the ways in which (infra)structural power is exercised through the Internet and, conversely, the grievances certain states have with its current configuration. Thus, the chapter will first provide an overview of how the Internet is affected by the dynamics of infrastructure networks. Secondly, it will present a summary of the most salient features of the Internet's logical infrastructure, that is, the protocols and standards determining how data moves through the network. Finally, it will proceed to explain the relevance, dynamics, and development of the submarine cable network, highlighting how the pattern of its global expansion tends to gravitate around specific nodes.

2.2 The Internet as a global infrastructure

In the previous chapter, the Internet was already mentioned several times as an example of infrastructure. In light of the presented theoretical framework, the reasons why it fits the definition should be clear: the Internet is the most important telecommunications technology of the current age, able to support the seamless and nearly instantaneous exchange of data between people, businesses, and organizations around the world. Its impact on the economy is hard to quantify, given the enormous variety in its applications which have contributed to the "death of distance"[135] by driving down the costs of communication and coordination, facilitating access to and exchanges of information, and enabling a vast array of remote services. This also means that the Internet qualifies as perhaps the best example of a general purpose technology,[136] not only because of its ubiquitousness but also because of its effect in stimulating complementary innovations (see **paragraph 1.3.2**). Indeed, thanks to its status as an open platform with low entry costs, the Internet greatly enhances the potential for edge-based innovation, as seen in the ability of several newcomers to rise to the top of the Internet economy by inventing innovative applications and

[135] Frances Cairncross, *The Death of Distance: How the Communications Revolution Will Change Our Lives* (Harvard Business School Press, 1997).
[136] George R.G. Clarke, Christine Zhenwei Qiang, and Lixin Colin Xu, "The Internet as a General-Purpose Technology: Firm-Level Evidence from Around the World", *Economics Letters* Vol. 135 (2015): 24-27. https://doi.org/10.1016/j.econlet.2015.07.004

uses.[137] Furthermore, the Internet is also affected by the invisibility denounced by Star and Ruhleder (see **paragraph 1.2.2**). This affirmation might be contested, given that the impact of the Internet is regularly discussed within social, political, and cultural debates, frequently with an end-of-times sense of urgency related to the excessive power of Internet corporations, privacy issues, or the ease of spreading fake news in an environment where any end-user has the potential to provide their contribution. However, on closer inspection, there is a strong tendency, both within the general public and decision-makers, to focus on the *applications* that are supported by the Internet and on the *content* that is shared through it, such as browsers, websites, and social media, whereas the specifications of the infrastructure sustaining the exchange of data packets are limited within restricted circles of technicians.

Like most infrastructures, the Internet is a complex network of networks, resulting from the interconnection of billions of independent computers. The original goal behind the development of its precursor, the ARPANET, was precisely to enable the intercommunication between the US Department of Defense's various computers, which at the time were closed off from each other, incapable of directly exchanging data.[138] As the network expanded across the globe, and especially following the technology's release for civilian applications starting in the 1980s, it increasingly assumed a decentralized structure, comprising millions of smaller networks ranging from a local scale (such as a single office or building) to entire nations and continents, owned and independently administered by a plethora of subjects including private firms (ranging from small businesses to transnational corporations), local and national authorities, and research facilities. However, the term "decentralization", which is frequently invoked as a defining feature of the Internet, must be interpreted in light of networks' tendency to concentrate around certain nodes, described in **paragraphs 1.4** and **1.7**. It is true that the Internet has no single owner, nor a centralized form of control; moreover, every independent network has to rely on others to reach parts of the Internet it does not serve itself.[139] At the same time, a few tens of networks occupy central positions within the global Internet, handling the largest part of international traffic, and a similar concentration exists at the regional and national levels.[140] As we will see in **paragraph 2.5**, this is directly related to the distribution and capacity of the physical components of the global Internet architecture. Similarly, most services within the Internet economy, from the provision of physical infrastructure to that of multimedia content, are dominated by a small number of firms: although it is true that, as noted by Lehr et al, the absence of a single authority with central control over the Internet prevents the enforcement of strict gatekeeping, allowing new players to

[137] William Lehr et al, "Wither the Public Internet?", *Journal of Information Policy* Vol. 9 (2019), 9-10. https://dx.doi.org/10.2139/ssrn.3141969
[138] Barry M. Leiner et al, "Brief History of the Internet". Internet Society, 1997. https://www.internetsociety.org/resources/doc/2017/brief-history-internet/
[139] Paul Brodsky, "Measuring Provider Connectivity", *Telegeography*, 20 September 2022. https://blog.telegeography.com/measuring-provider-connectivity
[140] Ashwin J. Mathew, "The Myth of the Decentralised Internet", *Internet Policy Review* Vol. 5 No. 3 (2016), https://doi.org/10.14763/2016.3.425 ; Edward J. Malecki, "The Economic Geography of the Internet's Infrastructure", *Economic Geography*, Vol. 78 No. 4 (2002), 413-415. https://doi.org/10.2307/4140796

enter the competition with their innovations,[141] emerging as a late-comer can be extremely difficult in the face of giant firms amassing significant market power.[142]

Another aspect of Star and Ruhleder's typology that applies particularly well to the Internet is the embodiment of standards. Truthfully, the Internet encompasses this feature to a much more noticeable extent when compared to other infrastructures such as transportation or energy infrastructure. This is largely due to the fact that the Internet's core function is the transmission of immaterial data packets, rather than material goods. This does not mean that the Internet is entirely detached from the physical world: in fact, it is still rooted in tangible facilities such as routers, data centers, exchange points, and, of course, cables. However, these physical structures serve as conduits for a resource that is, in its bare essence, information translated into pulses of light, which would not convey anything meaningful nor be able to reach its intended destination if not for strict operational protocols defining how it must behave while traveling through the Internet. It would be completely impossible for computers to exchange coherent data without these commonly agreed-upon standards. In other words, the boundaries between hard and soft infrastructure (see **paragraph 1.2.1**) are considerably permeable for what concerns the Internet. Physical infrastructure and rules are equally crucial in determining its shape and structure; in fact, the Internet's hard infrastructure would be completely inert without standardized rules, and these rules would be meaningless without material conduits to transport data packets between locations.

As will be seen in this chapter, the development of the Internet's soft and hard infrastructure aligns with the previously established conceptual framework. In particular, the global expansion of both the Internet's logical and material infrastructures was conditioned by strong elements of path dependence which tend to increase the relative importance of the United States. This is due to the country's intimate association with the Internet's development, which contributed to the centrality of American actors within the global network. However, it is important to note that, although as previously stated Internet infrastructure is generally underrepresented within political debates, there still is a relative difference in the controversy attracted by the Internet's soft and hard infrastructure. Whereas Internet standards and governance have long been the object of contestation because of perceived imbalances of power, the Internet's physical layer has remained mostly in the background of political discussions, truer to Star and Ruhleder's expectations of invisibility, which is why the United States' sudden preoccupation with the management of submarine Internet cables is deserving of attention.

2.3 The Internet's logical infrastructure

2.3.1 The Internet's core standards

The core rules of the Internet are conceptualized as a protocol stack divided into several layers, standardizing each step of the networking process, from the interconnection of the physical infrastructure to the routing of data and, finally, to the service as it appears on the devices of the end-users. It is interesting to

141 Lehr et al, "Wither the Public Internet?", 9-10.
142 Philip Hanspach, "Internet Infrastructure and Competition in Digital Markets", 26 October 2023, available at SSRN: https://dx.doi.org/10.2139/ssrn.4262723

note that, although the Open Systems Interconnection (OSI) model is the officially recognized model of Internet layering, adopted by the International Organization for Standardization in 1984, it mostly serves as a theoretical reference for understanding individual network functions. From a practical point of view, the model of reference for solving networking problems is the Internet Protocol suite, better known as TCP/IP, that is, the set of rules and standards first developed within the US Department of Defense, which subsequently were accepted by the American industry and academia and, from there, by the global industry at large.[143] As seen in **Figure 2**, from a conceptual point of view the OSI and Internet Protocol models are mostly superimposable, although OSI is more detailed and precise; however, the key difference is that one offers mostly academic guidance, while the other contains the actual rules governing the movement of data packets throughout the Internet, the most important ones being the Transmission Control Protocol (TCP), the User Datagram Protocol (UDP) and the Internet Protocol (IP). These three protocols provide the logical foundation for the transmission of data packets between devices that are identified by their IP addresses. To be more precise, during the early days of the Internet's expansion, several alternative protocols to the TCP/IP suite were developed: for example, the OSI model included its own protocol suite, providing alternative connectivity means to the Internet protocol, such as CLNP and TP4. Despite gaining official recognition within ISO, these protocols failed to catch on and remained mostly confined to academic debates and scientific experiments.[144] A key reason for the TCP/IP's success was the choice of its creators, such as Vinton Cerf and Robert Kahn, to make its specifications publicly and freely available, with the explicit intention of facilitating its widespread adoption as well as enabling further innovation. In fact, in 1985, at the onset of Internet commercialization, the founders of ARPANET organized a conference reuniting hundreds of representatives from IT firms, in order to enhance knowledge of TCP/IP and convince them to abandon their own proprietary standards in favor of common solutions.[145] This enabled the definitive adoption of the suite as the industry standard. Tim Berners-Lee, the inventor of the World Wide Web, which he developed while working at Geneva's CERN, made the analogous choice to keep the HTTP protocol and

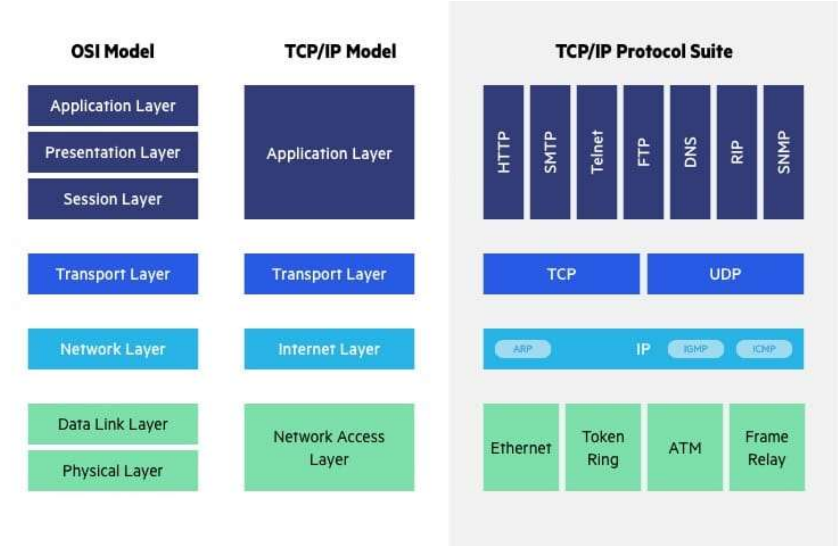

Figure 2. Comparison between layers in the OSI and TCP/IP models and the corresponding protocols. Source: Imperva, https://www.imperva.com/learn/application-security/osi-model/

[143] "TCP/IP vs. OSI: What's the Difference Between the Two Models?", *FS*, 29 September 2021. Available at https://community.fs.com/article/tcpip-vs-osi-whats-the-difference-between-the-two-models.html
[144] Ivan Pepelnjak, "Duty Calls: Technologies That Didn't: CLNS", *IP Space*, 27 September 2020. https://blog.ipspace.net/2020/09/worth-reading-clns-failure.html
[145] Leiner et al, "Brief History of the Internet", 15.

HTML language non-proprietary, enabling their emergence as the universally recognized pillar of Internet browsing.[146] Path dependence and network effects, which, as seen in **paragraphs 1.4** and **1.7**, tend to create a strong incentive to comply with solutions that are already well-established, ensured that proposed alternatives such as the OSI suite would remain on paper.[147] In the subsequent years, new standards have been developed, both public and patented, but they have almost exclusively been stacked on top of TCP/IP to refine the suite and address needs that could not be foreseen decades ago. Significant deviations from the standard remain confined to specialized networks, which are usually closed off from the public Internet. Furthermore, following the process described in **paragraph 1.2.2**, TCP/IP and the related protocols were assimilated within the users' tacit knowledge, as they now constitute the Internet's "natural" way of functioning – forgetting that they required multiple stakeholders to agree to their universal application. In fact, Berners-Lee once argued that the rules of the Internet should behave like the laws of physics, that is, universal constants that are applied in the same way in every part of the network, unchangeable, and untouchable by the interests of particular groups.[148]

Berners-Lee's comment is an example of a certain idealism shared by most of the Internet's fathers. Several authors have observed that this ideal of cyber-ecumenism, alongside the peculiar environment within which the Internet was developed, exerted an enduring influence on its configuration. The dynamics of the technical community that developed the new technology, working without a central coordination unit and under considerable freedom, contributed to its decentralized and open-access nature.[149] Mechanisms such as the first-come-first-served basis upon which domain names are allocated, which seemed only natural within the restricted community of Internet pioneers, have remained in force thanks to the power of path dependence, despite the scalability and trademarking issues they posit for a commercialized global-scale network.[150]

The effects of path dependence can be seen in the enduring application of the Border Gateway Protocol (BGP), another crucial standard responsible for guiding the routing of data packets between networks. The BGP was created as a short-term solution for routing: its authors did not intend for it to become a core feature of the Internet, nor did they take measures to anticipate possible issues once the BGP was translated on a global scale.[151] Devices connected to the Internet are identified by their IP addresses. Each IP address is located within a specific Autonomous System (AS), which roughly corresponds to a large-

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[146] Justyna Hofmokl, "The Internet Commons: Towards an Eclectic Theoretical Framework", *International Journal of the Commons* Vol. 4 No. 1, 235. https://www.jstor.org/stable/26523021
[147] Shane Greenstein, "The Basic Economics of Internet Infrastructure", *Journal of Economic Perspectives* Vol. 34 No. 2, 193. http://dx.doi.org/10.1257/jep.34.2.192
[148] Jonah F. Hill, "Internet Fragmentation. Highlighting the Major Technical, Governance and Diplomatic Challenges for U.S. Policy Makers", Berkman Center Research Paper, Harvard University (May 2012). https://ssrn.com/abstract=2439486
[149] Hofmokl, "The Internet Commons", 230-232; Ashwin J. Mathew, "Where in the World Is the Internet? Locating Political Power in Internet Infrastructure". PhD dissertation (University of California, 2014). https://escholarship.org/uc/item/13m8k8ns
[150] Hofmokl, *ibid*.
[151] Ashwin J. Mathew and Coye Cheshire, "The New Cartographers: Trust and Social Order Within the Internet Infrastructure", *TPRC 2010* (August 2010). https://ssrn.com/abstract=1988216

scale network controlled and managed by a single entity – typically, an Internet Service Provider (ISP), that is, a company selling access to the Internet to its clients. In order to enable communication between all devices connected to the Internet, ISPs exchange data with each other, either free of charge (what is called "peering") or at a fee. However, there is no central repository of addressing information on the Internet indicating which AS hosts which IP addresses. Instead, ISPs advertise to each other a list of the IP addresses they host on their routing tables. Thus, the BGP is essentially based on trust relationships between ISPs: based on the advertising from each ISP, the BGP pieces together a "map", calculates the best route in terms of speed and cost, and directs the data packets to their destination.[152] Anticipating the route data will take is a daunting challenge. As data travels through fiber optic cables at a speed of approximately 200,000 km/s, geographical distance, while not insignificant, is still a smaller concern compared to the availability of bandwidth, which depends both on the quality of the available physical infrastructure and on the level of congestion of a particular route at a given moment. In other words, data will most often hop onto multiple separate ASes before reaching its destination, and it might take routes that appear counter-intuitive from a human point of view. Most importantly, it will traverse different networks autonomously run by separate firms whose material infrastructure is located within the territories of different countries. This system reflects the reciprocal trust within a small community of professionals but also their vision of a borderless cyber-space where the main requirement is for data to move at a fast enough pace, without excessive security concerns.[153] However, it does not adapt as well to a world of sovereign states worried about the sensitivity of information entering or exiting their territory, and that might see an opportunity to extract data traversing through their national Internet networks for political purposes.[154] Although through the years several additions to the BGP have been implemented to prevent corrupt or malicious routing information from bleeding into the system, at its heart it remains based on mutual reliance, that is, highly vulnerable.[155] In 2008, the ISP Pakistan Telecom, on order of Islamabad's government, attempted to block Pakistani users' access to YouTube by redirecting them to a virtual dead-end. However, the incorrect routing information was accidentally advertised to a Hong Kong-based ISP, which, in turn, propagated it to other peers: thus, for a short time, Internet users from all around the world who attempted to access YouTube were instead sent to a black hole in Pakistan.[156] Although this incident was purely the result of human error, it highlights the ease of manipulating the protocol to hijack Internet data and route traffic along paths that allow surveillance.[157] However, from a more optimistic point of view, it also shows that authoritarian governments can struggle

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[152] Ashwin and Cheshire, "The New Cartographers".
[153] *Ibid.*
[154] Jack Goldsmith and Tim Wu, *Who Controls the Internet? Illusions of a Borderless World* (New York: Oxford University Press, 2006).
[155] Justin Sherman, *The Politics of Internet Security. Private Industry and the Future of the Web* (Washington, DC: Atlantic Council, 2020). https://www.atlanticcouncil.org/in-depth-research-reports/report/the-politics-of-internet-security-private-industry-and-the-future-of-the-web/
[156] Hari Balakrishnan, "How YouTube Was 'Hijacked'", Massachusetts Institute of Technology, May 2009. Available at https://web.mit.edu/6.02/www/s2012/handouts/youtube-pt.pdf
[157] William J. Drake, Vinton G. Cerf, and Wolfgang Kleinwächter, *Internet Fragmentation: An Overview*, World Economic Forum, January 2016, 22-23. Available at https://www3.weforum.org/docs/WEF_FII_Internet_Fragmentation_An_Overview_2016.pdf

with enforcing censorship on a technology that, to borrow Mumford's words as quoted in **paragraph 1.4.3**, reproduces the liberal-democratic ideology of the country where it was developed.

2.3.2 The influence of the United States on the Internet

Indeed, the Internet would likely have taken a different shape had its key features not been designed in the United States. While the research on networking was initiated as a government-funded project closely tied to defense policy, the US government left significant leeway to the DARPA engineers. An authoritarian government would have probably demanded the implementation of a more centralized network, enabling easier surveillance, which is indeed what happens with the national versions of the Internet in several such countries, including China (see **paragraphs 2.3.3** and **2.7.2**). Lessig notes that the Internet's standards – which, as "self-executing norms" in a virtual space, are automatically implemented by the system itself –[158] reproduce a distinctly American vision of the world, which places freedom of expression as a primary concern, transcending all other considerations. This prompts him to observe:

> Relative anonymity, decentralized distribution, multiple points of access, no necessary tie to geography, no simple system to identify content, tools of encryption – all these features and consequences of the Internet protocol make it difficult to control speech in cyberspace. The architecture of cyberspace is the real protector of speech there; it is the real "First Amendment in cyberspace," and this First Amendment is no local ordinance. Just think about what this means. For over 60 years the United States has been the exporter of a certain political ideology, at its core a conception of free speech. Many have criticized this conception: Some found it too extreme, others not extreme enough. (…) And yet, as if under cover of night, we have now wired these nations with an architecture of communications that builds within their borders a far stronger First Amendment than our ideology ever advanced (…) We have exported to the world, through the architecture of the Internet, a First Amendment more extreme in code than our own First Amendment in law.[159]

This reflects the previous considerations on global infrastructure's effect as a multiplier of (infra)structural power because of its ability to hardwire a state's political values in the arteries of globalization, forcing other states to come to terms with its implications on their autonomy.

At the same time, Washington's increasing commitment to the privatization and deregulation of the economy, in general, and infrastructures, in particular, paved the way for the Internet's rapid transition from a governmental project to a thriving commercial industry. Unlike previous telecommunications technology, which developed as state-owned monopolies, upon its commercialization the Internet immediately became dominated by private firms involved in all sectors, from the provision of material infrastructure to content creation and e-commerce. This private-led growth is reflected in the Internet's model of governance, the so-called multi-stakeholder model. In keeping with the network's decentralized structure, Internet standard-setting is not subject to the decisions of any single body but is collectively managed by a series of international fora, the most important of which are *not* government-based (see **paragraph 1.4.3**). These include: the already cited Internet Engineering Task Force (IETF), characterized by individual membership

[158] Belli, "Structural Power as a Critical Element", 4.
[159] Lessig, *Code*, 236.

and open to all those who feel they can make a contribution to the Internet's improvement; the World Wide Web Consortium (W3C), reuniting the main firms, governmental agencies, and research institutions within the IT ecosystem; and the Internet Society, established by the Internet's pioneers to preserve the network's core principles, which similarly includes individuals, firms, and institutions. Another crucial role is played by a non-profit organization, the Internet Corporation for Assigned Names and Numbers (ICANN), responsible for the allocation of domain names and IP addresses. This marks a stark contrast with older global telecommunications networks, namely the telegraph and telephone, whose interoperability and harmonization were guaranteed by the standardization body of the International Telecommunication Union (ITU-T), one of the world's oldest international organizations, now a specialized agency of the United Nations. Although ITU-T retains a stake in the standardization of Internet protocols, its role is largely marginal compared to the aforementioned organizations. The prevalence of private over public stakeholders can be explained by the general tendency to privatize infrastructure management described in **paragraph 1.5**; however, we should recall Susan Strange's observations from **paragraph 1.6.2** to note that this process, too, was not the product of chance but of conscious policy choices taken predominantly in the United States and reflecting the faith in capitalist competition characteristic of the Washington Consensus.[160]

The key role played by the US government in funding the Internet's development provided it with an undisputed advantage in shaping the rules that would govern it. In the words of Ira Magaziner, senior advisor of then-President Bill Clinton: «The United States paid for the Internet, the Net was created under its auspices, and most importantly everything Jon [Postel, one of the Internet's chief developers] and Networking Solutions [the company managing the first domain name system registry] did were pursuant to government contracts».[161] This does not mean the US government advocated for total control of the infrastructure; in fact, it used its overbearing influence – further reinforced by the post-Cold War "unipolar moment" – to promote private-led, deregulated, multi-stakeholder governance. This was based on the idea that the industry and the engineering communities were better equipped to discuss technical factors and to sustain incremental innovation,[162] but also on the conviction that, had the Internet's global expansion fallen under the supervision of international organizations with stricter decision-making procedures and opportunities for cross-vetoes, it would have been strangled by overregulation.[163] Another factor was the, at the time, widespread sentiment that the Internet's decentralized nature would have acted as a powerful stimulant for democratization even in authoritarian countries, bringing the world's remaining illiberal regimes over to the side of Western democracies.[164] This acted as a further incentive to promote an international governance structure that could not be influenced by state authorities.

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[160] Strange, "Finance, Information, and Power", 263.
[161] Quoted in Goldsmith and Wu, *Who Controls the Internet?*, 41.
[162] Madeline Carr, "Power Plays in Global Internet Governance", *Millennium: Journal of International Studies* Vol. 43 No. 2 (2015), 652. https://doi.org/10.1177/0305829814562655
[163] Goldsmith and Wu, *Who Controls the Internet?*, 39-42.
[164] Michael L. Best and Keegan W. Wade, "The Internet and Democracy. Global Catalyst or Democratic Dud?", *Bulletin of Science, Technology & Society* Vol. 29 No. 4 (August 2009): 255-271. https://doi.org/10.1177/0270467609336304

At the same time, the United States' unique role in shaping the Internet translated into a strong, enduring influence of US actors within its international governance bodies.[165] Two of the previously cited international fora, the W3C and the Internet Society, are both headquartered in the US, whereas the IETF originated as a US government-affiliated task force before evolving into an independent entity. American engineers have submitted the vast majority, about 75.4%, of the IETF's "Requests for Comments", technical documents that often lead to the development of new standards, as shown in **Figure 3**; moreover, this figure does not take into account the fact that earlier protocols, almost entirely developed within the US DoD, hold larger relative importance as they are new standards are stacked on top of those. Moreover, as the vast majority of the world's largest Internet companies are based in the US – itself a result of the nexus between government and private industry in the Internet's early development, which provided American firms with significant first-mover advantages – American companies and their employees tend to be overrepresented in these bodies.[166] For instance, CISCO employees have authored 6.8% of all IETF RFCs, more than double those of runner-up Huawei (see **Figure 4**). The latter's employees, it should be noted, submitted around two-thirds of their RFCs in the last 10 years, largely as a result of the Chinese government's efforts to promote Chinese-made standards (see **paragraph 3.6**).

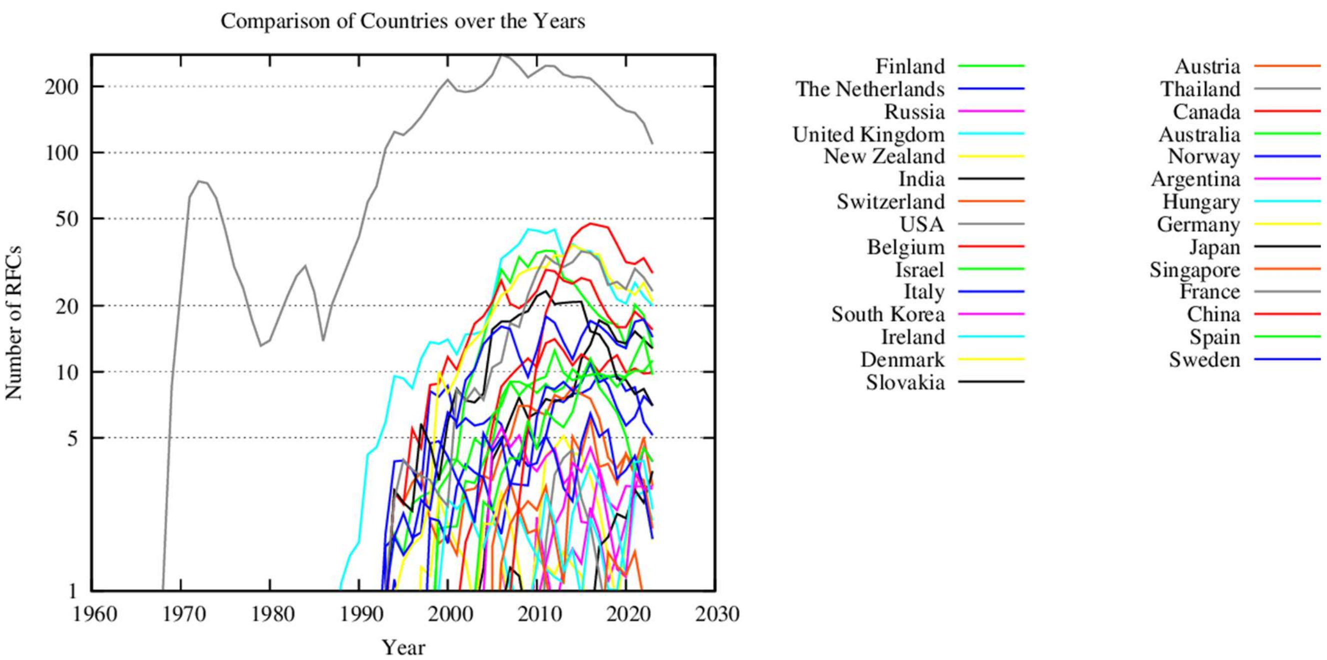

Figure 3. Yearly number of RFCs submitted by country of origin of the author. The grey line dominating the graph represents the US. Source: IETF, "Document Statistics", last accessed 21/01/2024. https://www.arkko.com/tools/docstats.html

[165] Hill, "Internet Fragmentation", 37.
[166] *Ibid.*

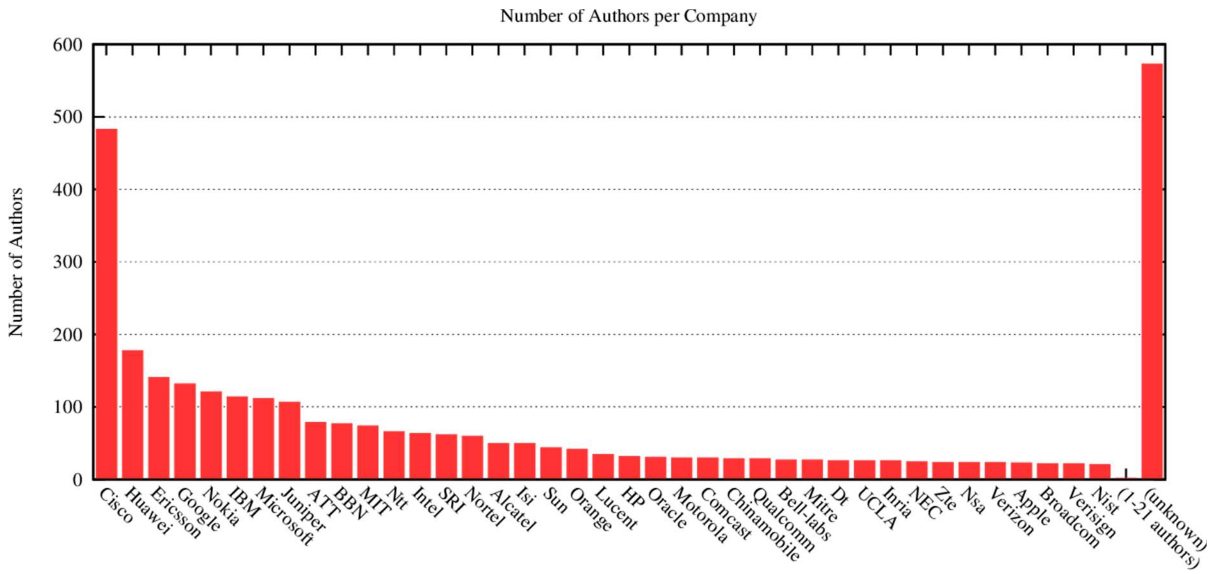

Figure 4. Number of RFC authors per company. Source: IETF, "Document Statistics", last accessed 21/01/2024. *https://www.arkko.com/tools/docstats.html*

US influence was even more evident in the evolution of ICANN. Originally, the root servers of the domain names system were managed by the Internet Assigned Numbers Authority (IANA), run almost singlehandedly by Jon Postel under a contract with the Department of Defense. As the Internet was commercialized, the decision was taken by the Department of Commerce to transfer IANA and its activities to a non-governmental, non-profit organization, which became ICANN. However, ICANN's management of IANA was still dependent on a contract with the US Department of Commerce, which retained ultimate authority and oversight over the DNS' infrastructure. Given the crucial implications of administering the DNS – as it involves, among other things, the allocation of commercially profitable domains and politically sensitive country-level domains identifying nations – ICANN's special relationship with the US government attracted strong criticism.[167] For instance, ICANN's seeming hesitation in introducing non-Roman alphabet versions of country-level domain names, even though the required technology had already been developed, attracted accusations of Western-centrism from China and other countries and pushed the former to experiment with a separate, Chinese-characters domain system.[168] In fact, threats from non-Western countries to break away from the supposedly US-dominated system and seek alternative models of governance contributed to the US government's decision, in 2006, to release ICANN from the Department of Commerce's oversight and fully transition its stewardship role to the global multistakeholder system. However, ICANN, from a juridical point of view, remains a Californian-incorporated entity, thus, the US government still retains more legal influence on it than any other nation.[169] Nevertheless, the actual extent of

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[167] Kathleen E. Fuller, "ICANN: The Debate Over Governing the Internet", *Duke Law & Technology Review* No. 2 (February 2001). https://scholarship.law.duke.edu/cgi/viewcontent.cgi?article=1000&context=dltr ; Jonathan G.S. Koppell, "Pathologies of Accountability: ICANN and the Challenge of 'Multiple Accountabilities Disorder'", *Public Administration Review* Vol. 65 No. 1 (January-February 2005), 102-103. https://www.jstor.org/stable/3542585

[168] Hill, "Internet Fragmentation", 17.

[169] Milton Mueller, "What 'Jurisdiction' Does ICANN Belong To?", *Internet Governance Project*, 7 November 2017. https://www.internetgovernance.org/2017/11/07/jurisdiction-icann-belong/

authority exerted by the US government over this critical body of Internet governance is not as important as the degree to which ICANN, and the multi-stakeholder model in general, reflects US policy preferences. Crucial Internet infrastructure and its governance bodies are designed to enable decentralized control, privatization, open access, competition, low regulation, freedom of expression, and, importantly, low governmental involvement, all principles that fall within the US' view of the liberal international order. At the same time, the circumstances of the Internet's development caused its governance and standardization bodies to naturally gravitate around US-based institutions and private companies, the latter of which were better positioned to acquire a dominant position in the Internet economy. Moreover, although these companies have in most cases a global reach and their interests cannot simply be subsumed with that of the US government, it is also true that they are regulated primarily by American laws, that their actions primarily reflect American norms, and that they are noticeably more responsive to US political pressures than other governments.[170]

It should be noted that, in the view of most United States officials, this enhanced stewardship is less of a means of control and more of a guarantee that the Internet remains true to its nature as a truly global network, insulated from excessive interferences from state entities that might result in a less efficient and more fragmented network.[171] However, this model is perceived as unequal by countries that feel excluded from the Internet's governance structures and would prefer more traditional, state-based institutions where voting rights are more evenly distributed but the decision-making process remains firmly within the hands of national governments.[172] Moreover, this perceived inequality makes it simpler for countries that do not share the Internet's liberalism-inspired foundational principles to criticize the status quo as Western-centric and advance proposals for technical revisions enabling, for instance, stricter governmental surveillance.[173]

2.3.3 National Internets and alternative visions for global governance

Here, however, it is necessary to clarify that the peculiar characteristics of global Internet governance are not necessarily reflected in *national* Internet governance. Despite the Internet's nature as a global network, it has never been an entirely unified, seamless system.[174] As noted in **paragraph 1.7**, global infrastructure networks originate from the aggregation of national networks. Thus, although the Internet as a global network is coordinated by the multi-stakeholder, non-state-centric model defined hereto, it is also broken down into several national versions, each falling under the jurisdiction of the respective state. Despite

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[170] Blayne Haggart, "American Internet, American Platforms, American Values", *CIGI*, 5 May 2021. https://www.cigionline.org/articles/american-internet-american-platforms-american-values/

[171] Goldberg and Wu, *Who Controls the Internet?,* ; Julia Pohle and Daniel Voelsen, "Centrality and Power. The Struggle Over the Techno-Political Configuration of the Internet and the Global Digital Order", *Policy & Internet* Vol. 14 No. 1 (2022), 17-18. https://doi.org/10.1002/poi3.296

[172] Daniel W. Drezner, "The Global Governance of the Internet: Bringing the State Back In", *Political Science Quarterly* Vol. 119 No. 3 (Fall 2004): 477-498, https://www.jstor.org/stable/20202392 ; William H. Dutton, "Multi-stakeholder Internet Governance?", *World Development Report 2016 Background Paper*, 16 May 2015, available at https://pubdocs.worldbank.org/en/591571452529901419/WDR16-BP-Multistakeholder-Dutton.pdf

[173] Carr, "Power Plays in Global Internet Governance".

[174] Hill, "Internet Fragmentation", 11.

the Internet founders' ideals of cyber-independentism and complete decentralization, national governments rapidly established means to control the Internet, which they were able to do because, although cyberspace as a concept is non-territorial, physical infrastructure, companies, and users are still geographically located within state borders.[175] This is not the sole prerogative of authoritarian countries: every government in the world, for example, prevents the circulation of illegal Internet content such as terrorist propaganda, illicit e-sales, or child pornography. Of course, non-democratic governments expand censorship to much greater extents, using filtering and deep-packet inspection (DPI) technologies to automatically ban politically charged discourse.[176]

However, these measures (both the light filtering adopted by liberal states and the more repressive restrictions) have to be implemented on top of the previously described Internet protocol stack, which, as shown above, does not lend itself as well to monitoring and censorship. For instance, although IP addresses can be traced back to devices and from there to individuals, this is not an instantaneous process, even for countries where ISPs closely cooperate with governmental agencies without the need for judicial authorizations; this is because the IP, at its core, was designed to identify locations in the network rather than in the real world, much less human beings. In Lessig's words, «while in real space (…) anonymity has to be created, in cyberspace anonymity is the given».[177] This is why since 2012 China has enforced a real-name system where ISPs and websites are required by law to collect their clients' ID information, allowing for a more immediate linkage between the IP address and the user's identity, which, however, imposes significant compliance costs and technical challenges on the firms.[178] Similarly, authorities need to place considerable efforts in keeping up with attempts to evade content restrictions through VPNs and other circumvention tactics.

In other words, centralized management of the Internet is possible on a national scale, but it requires significant technical efforts and expertise as it amounts to pulling in a different direction than the one solidified within global Internet standards. At the same time, even authoritarian states are forced to accept these decentralizing effects, as they value interconnectivity with the rest of the world. One of the early theories supporting the Internet's potential for democratization is the so-called "dictator's dilemma", according to which the economic value of being part of the global flows of information and harnessing the power of the Internet as a GPT is too great for authoritarian regimes to pursue disconnection, although this means opening their societies to potentially destabilizing information.[179] This theory certainly exaggerated the impact of the Internet on democracy, as it failed to take into account the technical opportunities for

[175] Goldsmith and Wu, *Who Controls the Internet?*, 89.
[176] Drezner, "The Global Governance of the Internet", 488-489.
[177] Lessig, *Code*, 45.
[178] Jyh-An Lee and Ching-Yi Liu, "Real-Name Registration Rules and the Fading Digital Anonymity in China", *Washington International Law Journal* Vol. 25 No. 1 (2016): 1-34. https://digitalcommons.law.uw.edu/wilj/vol25/iss1/3
[179] Best and Wade, "The Internet and Democracy", 256-257.

restricting the Internet's "social" implications while preserving its "commercial" applications;[180] however, it did correctly predict that most authoritarian governments would still choose to connect to the global Internet. The only country actively pursuing a near-total disconnection from the global Internet is North Korea, where citizens, except for top-ranking governmental officers, only have access to a self-insulated national intranet, the Kwangmyong.[181] Others have accepted the need to engage with the Internet's fundamentally liberal infrastructure design and had to devise solutions to restrict its centrifugal tendencies as much as possible, with varying degrees of success.

Given the costs of these reaction strategies, it stands to reason that certain states would advocate for a revision not only of the Internet's models of governance but also of its logical infrastructure. A revised Internet protocol, integrating automatic data inspections and filtering without a loss of performance, would be the preferred standard for authoritarian states. As we will see more in-depth in **paragraphs 2.7.2** and **3.6**, China, in particular, has managed to simultaneously enforce one of the strictest Internet surveillance regimes and develop a powerful national Internet industry that is increasingly active in international projects and within standardization bodies. Because of this, China has emerged as one of the most credible "revisionists", advocating for a restructuring of the global Internet. Its "Internet sovereignty" doctrine and its recent proposals for a revision of the basic protocols in the TCP suite can be seen as an attempt at breaking away from the current model and imprinting new, more centralized visions of the network on a global scale.

2.4 Submarine cables, the Internet's backbone

As seen above, the Internet's logical infrastructure, which determines the ways in which data is transmitted across the network, was in large part shaped and influenced by researchers and firms based in the United States, and this influence, thanks to path dependence and network effects, continues to reverberate both in the Internet's functioning and in its governance bodies. We shall now proceed to analyze the dynamics affecting the Internet's physical infrastructure, that is, the conduits across which data is transported, inserting it into our theoretical framework, with the main aim of identifying possible disparities in the status countries occupy within the cable network.

As noted in **paragraph 2.2**, the existence of the Internet's physical infrastructure is largely neglected outside of technical communities. Perhaps because our everyday experience of the Internet is wireless, we tend to forget that, beyond the last-mile connection between modems or cell towers and the devices of the end users, data still requires material supports in order to be transmitted across the world. In IT parlance, the core infrastructure network enabling the Internet's global reach is called the Internet backbone, reflecting its importance as the main pillar supporting international data exchanges. The backbone enables the interconnection between ASes, linking independent networks together in a seamless fashion and allowing for the near-instantaneous transmission of information across long distances. In a similar vein to older

[180] Brett M. Frischmann, *Infrastructure. The Social Value of Shared Resources* (New York: Oxford University Press, 2012), 318-320.
[181] "North Korea", *The Internet Monitor*, https://thenetmonitor.org/country-profiles/prk (last accessed 18 February 2024).

telecommunications technologies, such as the telegraph and the telephone, the most crucial component of the Internet backbone is an extensive network of submarine fiber optic cables laid deep on the ocean's floor, which connect the continental landmasses. As of this writing, there are 513 active submarine Internet cables, for a combined length of approximately 1.4 million kilometers, and they carry about 99% of international data traffic.[182] Because of the Internet's status as a GPT, these data flows support nearly all sectors of human activity, ranging from academic research to diplomatic dispatches, from VTC to cloud networking, from military operations to video gaming. In addition, since transactions exchanged through the SWIFT system travel through them, submarine Internet cables are estimated to carry financial transactions for a value of circa $10 trillion daily.[183]

Submarine cables are not the only medium capable of supporting global data transmissions but, for various reasons, they are the most advantageous. Although they are more closely associated with the Internet in the collective imagination, and certainly more glamorous, satellites are largely marginal in providing international connectivity. Satellites were the most efficient global telecommunications infrastructure between 1965 and 1985, as they provided superior international telephony services compared to submarine coaxial cables.[184] However, the development of processes for the mass production of optical fiber, which coincided with the commercialization of the Internet, moved the backbone of international communications back to the sea floor. This is because, unlike satellites, optical fiber enables the transmission of data as light pulses rather than radio waves, allowing it to travel at drastically increased speed and, consequently, reduced latency. Thus, fiber optic cables provide larger bandwidth, further compounded by the possibility of supporting the simultaneous transmission of multiple data streams through wavelength division multiplexing, at a cheaper cost.[185] The main advantages of satellites are that they are able to transmit to any ground-based receiver, whereas cables are point-to-point in nature, and that they are more insulated from human activity; this makes them better suited for certain applications, including broadcasting, connecting remote areas, and military surveillance, but not as a primary source of interconnectivity.[186] In fact, in 2007, Burnett estimated that if all cables connecting the United States were severed simultaneously, satellites could sustain only 7% of American Internet traffic.[187] Although low-orbit satellite constellations such as Starlink could offer an

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[182] *Telegeography*, "Submarine Cable 101", available at https://www2.telegeography.com/submarine-cable-faqs-frequently-asked-questions (last accessed 29/01/2024).
[183] Tim Stronge, "Do $10 Trillion of Financial Transactions Flow Over Submarine Cables Each Day?", *Telegeography*, 6 April 2023. https://blog.telegeography.com/2023-mythbusting-part-1
[184] Edward J. Malecki and Hu Wei, "A Wired World: The Evolving Geography of Submarine Cables and the Shift to Asia", *Annals of the Association of American Geographers*, Vol. 99 No. 2 (2009), 363. https://www.jstor.org/stable/25515204
[185] Christof Gerlach and Richard Seitz, *Economic Impact of Submarine Cable Disruptions* (Singapore: Asia-Pacific Economic Cooperation, December 2012). https://www.apec.org/publications/2013/02/economic-impact-of-submarine-cable-disruptions
[186] Malecki and Hu, "A Wired World", 364.
[187] Douglas R. Burnett, "Submarine Cable Security and International Law", *International Law Studies* Vol. 97 (2021), 1066. https://digital-commons.usnwc.edu/ils/vol97/iss1/55/

alternative to submarine cables, they are unlikely to take over in the near future,[188] especially considering that blooming innovations such as 5G mobile connections, ultra-high-definition videos, and especially the Internet of Things (IoT) are projected to further increase the world's demand for bandwidth.[189] In fact, 61 new submarine cables are planned to enter service within 2027.[190]

Terrestrial fiber optic cables are also a key part of the Internet's backbone, but their relevance is predominant at the national level. Land-based cable networks are essential for the Internet's penetration within national territories, for connections between neighboring countries, as well as for connecting landlocked countries. However, the global dimension of the Internet – its ability to link together continents and regions of the world in the span of a few seconds – depends almost entirely on submarine systems. In fact, a study for the Association for Computing Machinery's 2020 Internet Measurement Conference calculated that, on average, 43.18% of all Internet resources accessed from any country travel on a submarine cable to reach the end-user, and that even for landlocked countries this figure remains relatively high (16.25%).[191] A notable exception to terrestrial cables' mostly national influence is the Eurasia Terrestrial Cable Network, an ensemble of cables providing a land-based connection between Western Europe, Central Asia, Russia, China, and the Middle East.[192] The development of this network was mainly promoted by Russian and Chinese telecommunications companies as a way to bypass the trans-Pacific route.

From a technical point of view, submarine Internet cables are relatively straightforward systems. Each cable consists of multiple pairings of optical fiber, surrounded by a copper conductor to feed electrical power into the cable and sheathed by insulating materials, for a total width akin to that of a garden hose. Every 50 to 120 kilometers, a repeater unit is inserted to regenerate the optical signals, which tend to attenuate when transmitted through glass.[193] The cable lays directly on the seabed, usually protected by layers of armor to prevent damage, and it comes ashore by arriving at a cable landing station. In the terminology established in **paragraph 1.5**, landing stations act as gateways. In addition to the equipment for providing the cable with the necessary electricity and for monitoring potential ruptures or failures, landing stations host the point of interconnection between the submarine cable and the terrestrial cable network, that is, between the global

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[188] Jonas Franken et al, "The Digital Divide in State Vulnerability to Submarine Communications Cable Failure", *International Journal of Critical Infrastructure Protection* No. 38 (2022). https://doi.org/10.1016/j.ijcip.2022.100522
[189] Jonathan E. Hillman, *Securing the Subsea Network: A Primer for Policymakers* (Washington, DC: CSIS, March 2021), 4. https://www.csis.org/analysis/securing-subsea-network-primer-policymakers ; Justin Sherman, *Cyber Defense Across the Ocean Floor: The Geopolitics of Submarine Cable Security* (Washington, DC: Atlantic Council, September 2021), 21. https://www.atlanticcouncil.org/in-depth-research-reports/report/cyber-defense-across-the-ocean-floor-the-geopolitics-of-submarine-cable-security/
[190] *Telegeography*, "Submarine Cables 101".
[191] Shucheng Liu et al, "Out of Sight, Not Out of Mind - A User-View on the Criticality of the Submarine Cable Network", *Proceedings of the ACM Internet Measurement Conference (IMC '20)*, 194-200. https://doi.org/10.1145/3419394.3423633
[192] *Submarine Cable Networks,* "Terrestrial Cables", available at https://www.transitchina.com/en/systems/eurasia-terrestrial (last accessed 29 January 2024).
[193] José Chesnoy, "Presentation of Submarine Fiber Communication", in José Chesnoy (ed.), *Undersea Fiber Communication Systems*, 2nd edition (Oxford: Academic Press, 2016), 6-10. https://doi.org/10.1016/C2015-0-00778-X

and national Internet infrastructure networks. To be more precise, the landing station is connected to a Point of Presence (POP), that is, a facility hosting the local servers and routers of one or, in most cases, more ISPs. Data is processed within the POP and then redirected to the end-users through various last-mile connections, such as terrestrial fiber optic cables, DSL, or wireless connections. POPs tend to be shared by multiple ISPs and are often co-located within Internet Exchange Points (IXPs), where ISPs directly exchange traffic so that they can reach IP addresses hosted by their peers. Similarly, landing stations tend to host multiple cable terminals. This results from a combination of factors, including the necessity to reduce costs, the interest in locating stations nearer to areas with high data consumption, and the difficulty in finding sites with suitable geomorphological characteristics.[194] At the same time, cables can include branching units, enabling them to bifurcate and connect to multiple landing stations, which allows for the same cable system to link together multiple countries and/or locations within the same country.

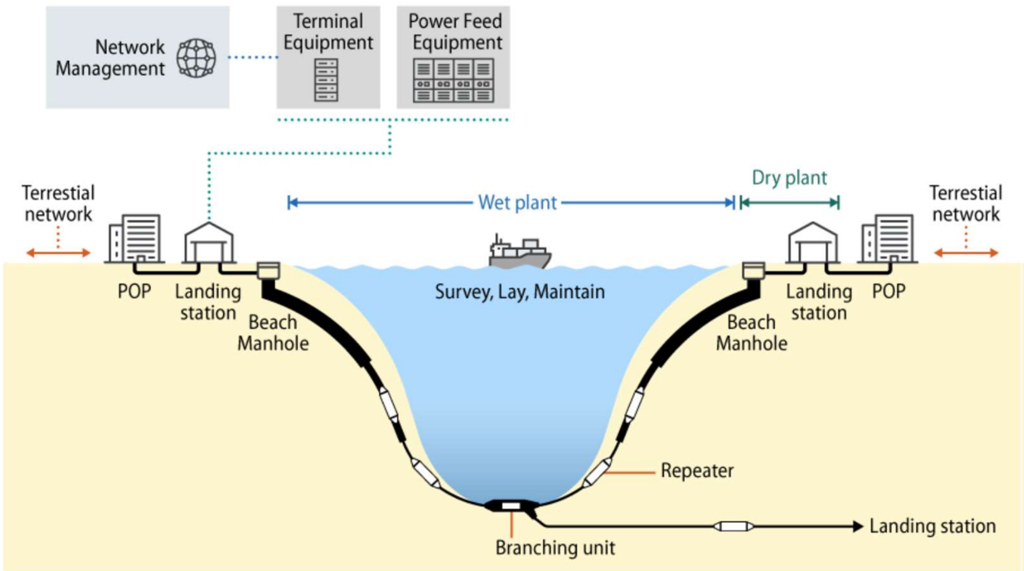

Figure 5. Diagram of a typical undersea cable system. Source: Jill C. Gallagher, Undersea Telecommunication Cables: Technology Overview and Issues for Congress (Washington, DC: CRS, September 2012). https://crsreports.congress.gov/product/pdf/R/R47237

Submarine Internet cables can vary considerably in length. Some cover only short distances, such as between an island and the mainland – for example, the Janna cable, linking Sicily and Sardinia to continental Italy, for a combined length of 634 km.[195] The major projects, however, span across the oceans to connect several countries and continents. Upon completion, 2Africa will be the longest cable in the world: it will circumnavigate the African continent and link it to Western Europe and the Persian Gulf, for a total of 45,000 km.[196] The longest, and most important, cables inevitably cross international waters, which for transoceanic systems typically make up the majority of the cable's length, as well as the national waters of multiple countries. This contributes to creating a complex mosaic of jurisdictions and regulations. As far as

[194] Rishi Sunak, *Undersea Cables. Indispensable, Insecure* (London: Policy Exchange, 2017). https://policyexchange.org.uk/publication/undersea-cables-indispensable-insecure/
[195] *Telegeography*, "Submarine Cable Map", available at https://www.submarinecablemap.com/ (last accessed 30 January 2024).
[196] 2Africa Cable, "Updates", available at https://www.2africacable.net/updates (last accessed 30 January 2024).

international waters are concerned, the only relevant treaty is UNCLOS, which limits itself to sanctioning the freedom of all actors to lay cables (in a generic sense, thus including also power transmission cables) in the maritime commons and obliges all states parties to the Convention to impose criminal penalties or fines on vessels and individuals responsible for accidental or intentional damage to cables. These provisions are largely inherited from the 1884 International Convention for the Protection of Submarine Cables, which disciplined the laying of telegraph cables, demonstrating the strong continuity between different generations of global telecommunications infrastructure.[197] However, given the increasing criticality of the Internet and its infrastructure, several authors lament the inadequacy of international rules for the protection of cables, believing it to be yet another instance of infrastructure being invisible to policymakers until it breaks down, and call for the establishment of an ad-hoc treaty for the Internet backbone.[198] In particular, they note that UNCLOS entered into force six years before the construction of TAT-8, the world's first transoceanic fiber optic cable and that its signatories could not have foreseen the critical role that submarine networks would play in sustaining the international economy.[199] Thus, the literature on the legal issues of cable protection highlights several gaps, including the lack of clear rules to determine whether Internet cables are lawful targets during armed conflict (as was the case with the telegraph)[200] and the absence of measures to ensure that all member states take active steps to ensure an adequate level of protection.[201] In fact, for what concerns national waters, states are free to set the regulations they see more appropriate, not only in terms of criminalizing cable disruptions but also in setting the conditions for receiving cable landing permissions. As stated in **paragraph 1.7.2**, the state has complete control over gateways, in this case, full jurisdiction over landing sites, and autonomously sets the rules for providing cable builders with the necessary license to establish a landing station. Bureaucratic procedures for the examination and granting (or denial) of cable landing licenses vary considerably across countries and, for federal or otherwise decentralized states, there might also be substantial differences at the sub-national level. It has been noted, for example, that landing a cable in certain US states is almost impossible.[202] Several states impose strict environmental requirements, even if it has been noted that submarine Internet cables, outside of the construction phase, have an extremely low environmental footprint and might actively contribute to the monitoring of sea pollution levels if

[197] Burnett, "Submarine Cable Security", 1673.
[198] Tara Davenport, "Submarine Cables, Cybersecurity, and International Law: An Intersectional Analysis", *Catholic University Journal of Law and Technology*, Vol. 24 No. 1 (2015): 57-108. https://scholarship.law.edu/jlt/vol24/iss1/4 ; Douglas Guilfoule, Tamsin Philippa Paige, and Rob McLaughlin, "The Final Frontier of Cyberspace: The Seabed Beyond National Jurisdiction and the Protection of Submarine Cables", *International & Comparative Law Quarterly* Vol. 71 (July 2022): 657-696. https://doi.org/10.1017/S0020589322000227
[199] Sunak, *Undersea Cables*, 18.
[200] Burnett, "Submarine Cable Security", 1673; James Kraska, "The Law of Maritime Neutrality and Submarine Cables", *EJIL Talk*, 29 July 2020, available at https://www.ejiltalk.org/the-law-of-maritime-neutrality-and-submarine-cables/ ; Blair Shepherd, "Cutting Submarine Cables: The Legality of the Use of Force in Self-Defense", *Duke Journal of Comparative & International Law*, Vol. 31 (2020): 199-220. https://scholarship.law.duke.edu/djcil/vol31/iss1/4/
[201] Bueger and Liebtrau, "Protecting Hidden Infrastructure", 398.
[202] Loic Lefur, "System Planning and Deployment", in Chesnoy, *Undersea Fiber Communications Systems*, 572-573.

equipped with appropriate sensors.[203] Given the sensitivity of the data transmitted through Internet cables, it is also common for cable applications to pass some sort of national security screening, such as in the case of the United States, with Team Telecom's scrutiny, (see **paragraph 3.2**) and China, where applicants must first receive a letter of nonobjection from the military.[204] Moreover, several states, such as various Middle Eastern countries, require the formation of "strategic partnerships" with local governmental or quasi-governmental companies or investment funds.[205]

Despite differences in legislation, submarine Internet cables, like all infrastructures, require the establishment of technical standards to enable interoperability, such as rules for managing wavelengths and testing insulation. Unlike the Internet's protocols, however, these issues cover strictly technical design aspects and are therefore less liable to political contestation. Most industry standards were developed autonomously by the private sector during the years of the Dot-Com construction boom, described in the following paragraph, and only subsequently turned into official documents by ITU and ISO.[206] Moreover, the International Cable Protection Committee (ICPC) is an important forum for reuniting the main actors in the various segments of the industry (cable owners and operators, builders, and repair fleets), similar to the IETF or the W3C. The ICPC reunites 216 members from private companies and governmental bodies from all over the world, with the aim of discussing and promoting best practices to guarantee the efficiency, security, and reliability of cable systems, as well as their environmental sustainability.[207] It is interesting to note that the ICPC was founded in 1958, with a focus on submarine telephone coaxial cables, and that, unlike the Internet's major governance bodies, it is based in the United Kingdom rather than the US. This reflects the UK's traditionally central role in international communications networks, which, as can be seen in the following paragraph, remains strong despite a relative decline from the apogee of British hegemony over telegraph networks. Still, American-based companies are the most represented in the ICPC, with 39 members, followed by the UK's 24 and China's 11.[208]

2.5 The economic geography of the submarine cable network

In **paragraph 1.7.1**, it was observed that in most cases global infrastructure networks are unevenly distributed around the world. Does this apply to submarine Internet cables? A glance at the interactive map of the subsea cable network provided by the specialized research company Telegeography (**Figure 6**) can

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[203] Douglas R. Burnett and Lionel Carter, *International Submarine Cables and Biodiversity of Areas Beyond National Jurisdiction The Cloud Beneath the Sea* (Leiden: Brill, 2017), 39-41; Tara Davenport, "The High Seas Freedom to Lay Submarine Cables and the Protection of the Marine Environment", *AJTIL Unbound*, Vol. 112 (2018): 139-143. https://www.jstor.org/stable/10.2307/27003823

[204] William Yuen Yee, "Laying Down the Law Under the Sea: Analyzing the US and Chinese Submarine Cable Governance Regimes", *Jamestown Foundation*, 4 August 2023. https://jamestown.org/program/laying-down-the-law-under-the-sea-analyzing-the-us-and-chinese-submarine-cable-governance-regimes/

[205] Dominique Reverdy and Ivan Skenderoski, *Submarine Cables: Structuring and Financing Options* (Dubai: Salience Consulting, January 2015). https://salienceconsulting.ae/whitepapers/submarine-cables/

[206] Chesnoy, "Presentation of Submarine Fiber Communication", 11.

[207] *Ibid*.

[208] ICPC, "Member List", available at https://www.iscpc.org/about-the-icpc/member-list/ (last accessed 29 January 2024).

provide a quick answer. Although all regions of the world are connected to the global Internet, cables are concentrated in the Northern Hemisphere. The trans-Atlantic and trans-Pacific routes, respectively connecting Northern America to Europe and Asia and Oceania, are the most densely packed and trafficked. Another increasingly important route, hosting some of the longest and most ambitious cable systems, is the one connecting Southern Europe to Northern Africa and the Middle East and from there to Southeast and Eastern Asia, passing through the Mediterranean and the Suez Canal. Intra-regional systems, such as those interconnecting the Americas, links between Asia or those wiring African coastal countries together are also highly dynamic. Furthermore, the existence of direct connections between South America and Africa – albeit sparse and limited – may put a small dent in Neo-Marxist theories denouncing the absence of links between underdeveloped countries.

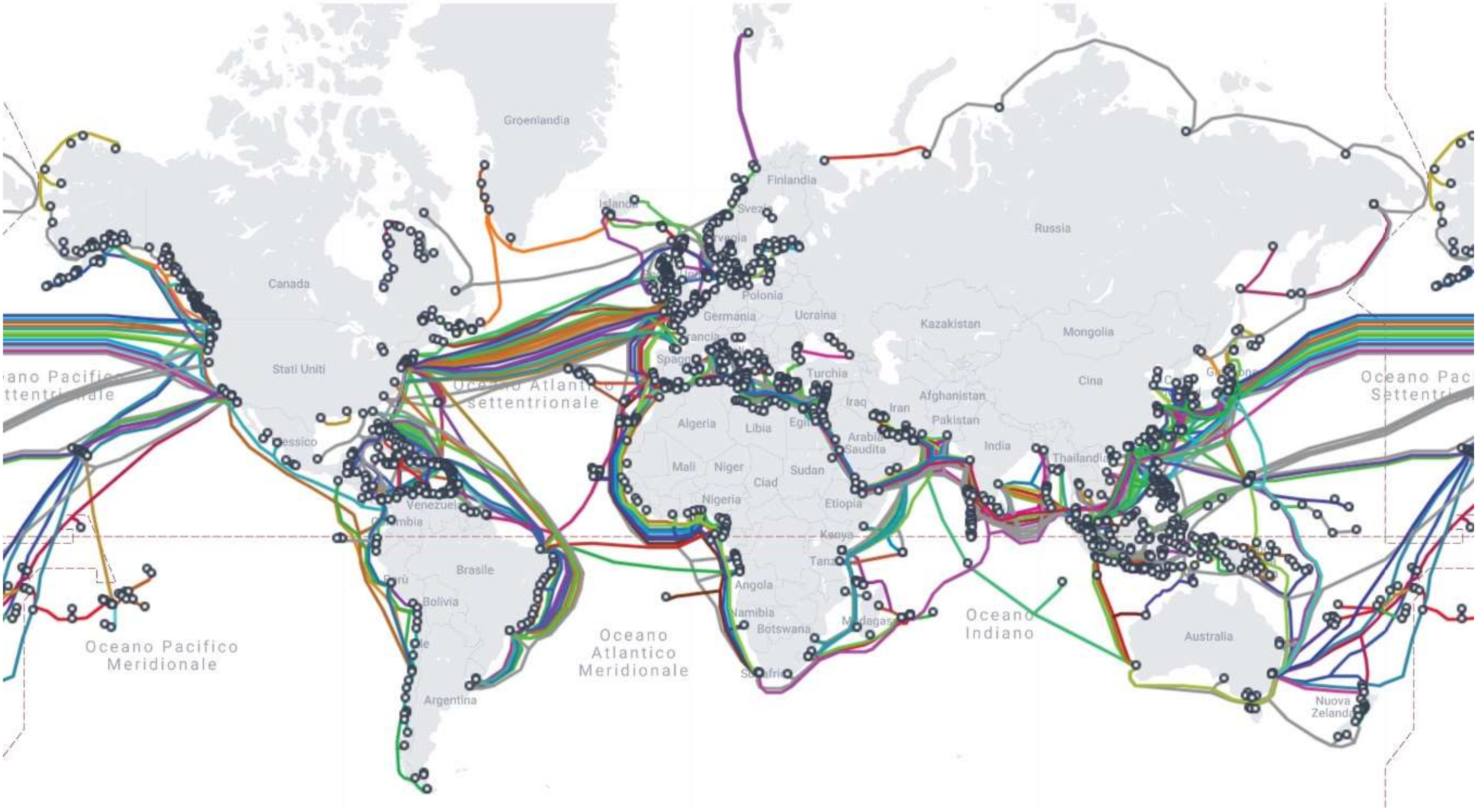

Figure 6. Map of submarine Internet cables as of January 2024. Source: Telegeography, available at https://www.submarinecablemap.com/ (last accessed 29/01/2024).

The geography of the cable network has gradually become more evenly distributed as Internet penetration grew in the whole world, attracting private investment in all regions. Historically, the global network began to develop from the trans-Atlantic route, starting with the construction of TAT-8, which linked the United States to the United Kingdom and France, in 1988. This creates an interesting parallel with the global telegraph cable network, whose early development in the 19th century similarly centered on the UK-

US axis.[209] The commercialization of the Internet rapidly intensified investments in submarine fiber optic cables. In fact, much like with the telegraph, excessive enthusiasm for the "information superhighway" fueled financial speculation, creating the so-called Dot-Com bubble. During those years, in the colorful language of a cable engineer interviewed by Starosielski, «banks decided you could have as much money as you want, as long as you wrote in the back of your cigarette packet "dot com" or "submarine cable"».[210] As a result of this exuberance, between 1998 and 2003, 16 new trans-Atlantic cables were built, creating such a fiber glut that 90% of transatlantic capacity remained unused for an entire decade.[211] The trans-Atlantic route attracted the majority of investments, partially because the United States and Europe were faster at creating digital economies and partially because they had already completed the privatization of the telecommunications market,[212] driving the appetites of ambitious new companies willing to engage with a previously closed-off industry.[213] Although the subsequent market crash was fatal to numerous companies, it ultimately created positive effects on the development of the global Internet: the large availability of unused bandwidth (referred to as "unlit" or "dark" fiber) supported the gradual development of data-intensive applications and accelerated price erosion, allowing for faster Internet penetration.[214] It also helped solidify the status of the trans-Atlantic route and of US- and Europe-based ISPs as the dorsal spine of the global Internet. Thanks to the solid base established at the turn of the century, the route did not require further expansion until 2016, when a combination of aging systems and the increasing demand for bandwidth fueled by the diffusion of more data-intensive applications finally caught up with the post-2001 fiber glut, stimulating the creation of new trans-Atlantic cables.[215]

The trans-Pacific cable route was the second-fastest developing, owing to the rapidly growing size of Eastern Asian digital economies on the rebound from the Asian financial crisis of 1997 and to their large population. The first trans-Pacific fiber optic cable, TPC-3, connecting the United States to Japan, was built just one year after TAT-8.[216] The trans-Pacific route was less affected by the exuberance of the Dot-Com bubble and, as a result, displays a more even development pattern. Between the 90s and early 2000s, Japan acted as the main gateway for Eastern Asia's international connectivity, as it provided the linkage between cable systems departing from the US West Coast and the then-rapidly blooming intra-Asian submarine cable network. In the subsequent years, new cable hubs emerged in the region, including Hong Kong and

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[209] Headrick and Griset, "Submarine Telegraph Cables"; Winseck, "The Geopolitical Economy", 234-237.
[210] Nicole Starosielski, *The Undersea Network* (Dunham and London: Duke University Press, 2015), 53. https://doi.org/10.1215/9780822376224
[211] Winseck, "The Geopolitical Economy", 237-241.
[212] Kenneth N. Cukier, "Bandwidth Colonialism? The Implications of Internet Infrastructure on International E-Commerce", *INET'99 Conference* (June 1999). Available through the Wayback Machine at https://web.archive.org/web/20080502031849/http://www.isoc.org/isoc/conferences/inet/99/proceedings/1e/1e_2.htm
[213] Starosielski, *The Undersea Network*, 47.
[214] Brian McCullogh, "A Revealing Look at the Dot-Com Bubble of 2000 – And How It Shapes Our Lives Today", *TED*, 4 December 2018. https://ideas.ted.com/an-eye-opening-look-at-the-dot-com-bubble-of-2000-and-how-it-shapes-our-lives-today/
[215] Submarine Telecoms Forum, *Industry Report 2023-2024* (October 2023), 144. https://subtelforum.com/industry-report/
[216] Starosielski, *The Undersea Network,* 45.

Singapore. Like the trans-Atlantic route, the US-East Asia route became saturated between 2010 and 2016, with cable construction halting. However, around the same period, there was a boom in projects linking South-Eastern Asia and Oceania, which had traditionally sat at the periphery of the global network, with the US and Eastern Asia.[217] Finally, the demand for new US-Asia projects surged after 2016, largely driven by the commercial interests of the so-called hyper-scalers (see **paragraph 2.6**). Consequently, the trans-Pacific route has been further revitalized as one of the most dynamic in the world and has expanded by nearly 68% between 2016 and 2023.[218]

Finally, the last decade saw a considerable expansion of Latin America, Africa, and the Middle East's connections to the global network, which also contributed to reducing their dependence on links with, respectively, the United States and Europe. The temporary saturation of the main trans-oceanic routes contributed to diverting the industry's attention to previously neglected markets, while the diffusion of mobile phone subscriptions boosted the demand for connectivity even in less developed countries.[219] The diversification of routes constitutes an improvement for the whole network. By expanding the available paths for data packets, each new cable provides a net positive contribution, as it enables the circumvention of chokepoints, reducing congestion on the main routes and improving resilience in case of ruptures or cable faults.

Nevertheless, certain countries tend to retain a central position in the networks. The United States is the country with the largest number of connections in the world. It hosts landing points for a total of 80 cables, nearly 15% of all cable systems in the world, sitting at the heart of both the trans-Atlantic and trans-Pacific routes. European countries are also among the best connected in the world, benefitting from the geographical advantages that allow for easy interconnections with Africa, Asia and the Americas. The UK, a traditional fulcrum of the trans-Atlantic route, boosts 57 cable landings, with France (24), Italy (29), and Spain (30) all playing prominent roles. For what concerns Eastern Asia, Japan (28 cables), Singapore (27), and China (20) are all significant centers of gravity.[220] The size of national economies, of course, is also correlated with the number of cable connections: in particular, the world's major stock exchanges, such as New York, London, and Tokyo, tend to also act as global connectivity hubs.[221] However, geography also provides less developed economies with higher value as transit countries: it is interesting to note that cable routes tend to concentrate around the same chokepoints characterizing global shipping routes, such as the aforementioned Suez Canal, whose importance for Europe-Asia connectivity causes Egypt (17 cables) to

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[217] Winseck, "The Geopolitical Economy", 241-252; Geoff Huston, "The Politics of Submarine Cable in the Pacific", *CircleID*, 5 June 2022. https://circleid.com/posts/20220605-the-politics-of-submarine-cable-in-the-pacific

[218] Submarine Telecoms Forum, *Industry Report*, 147-148.

[219] Eric Forden, "The Undersea Cable Boom in Sub-Saharan Africa", *USITC Executive Briefing on Trade*, June 2015.
https://www.usitc.gov/publications/332/executive_briefings/forden_submarine_cables_june2015.pdf

[220] Data for calculating the number of cable landings is derived from Telegeography's submarine cable maps. Cables not yet active as of December 2023 were not included in the computation.

[221] Malecki, "The Economic Geography", 404.

display a high degree of betweenness centrality.[222] Here, however, it is important to recall **paragraph 2.3.1**'s explanation of the way in which the BGP directs data across the Internet which, as noted above, can be counter-intuitive to human eyes, as physical distance, while not uninfluential, is ultimately secondary compared to the available bandwidth. This means that, even if a direct cable link between two countries exists, it is perfectly possible for the BGP to take a geographically longer route through a third country if the available bandwidth on that route is superior to that on the shortest one. While the quantity of cables connecting two given countries contributes to the bandwidth between them, the quality of the cables is also relevant. Newer cable systems, in general, contain more fiber pairs and superior networking equipment, which drastically increase their capacity compared to older ones. For instance, the trans-Atlantic cable Amitié, which entered service in October 2023, has a total capacity of 320 Tbps, five times that of Apollo, which went online in 2003.[223] However, there are also significant differences between contemporary cables, as their quality depends on the financial investment and the materials utilized. It is also worth noting that, for the most advanced cable systems, the total potential bandwidth far exceeds consumption levels. This is intentional: submarine cables are designed to accommodate more data traffic than expected demand, which enables network managers to better deal with sudden spikes in usage and, more importantly, to anticipate rising data consumption levels during the cable's lifespan. Although the average cable reaches senescence after around 25 years, most cables built in the 1990s were already obsolete after a decade, because cable builders failed to anticipate the rise in data consumption that would be caused by the increasing dominance of video content over text.[224] While the above-described Dot-Com bubble created the opposite problem, with companies vastly overestimating bandwidth demand in the short period, in the long term the trans-Atlantic fiber glut demonstrated the usefulness of having large amounts of unlit capacity available. Thus, to ensure the major cable systems remain up to date in the face of new Internet applications, only around 30/40% of their potential capacity is used.[225]

As seen in **Figure 7**, inter-regional bandwidth is centered around certain poles, which are connected not only by a larger number of cables but also by the most advanced ones, and which benefit from abundant capacity for data transit far exceeding their direct needs. As noted above, the United States, the European countries, and Eastern Asia are the core of the network, with other routes being more marginal and dependent on the major nodes. For instance, although Latin America and Europe are directly connected by the EllaLink cable, which has a good capacity of 72 Tbps, the overabundance of connectivity between the two Americas and between the United States and Europe means that there is still a high likelihood that data traveling, for instance, from Brazil to France would go through the United States. Similarly, Africa depends almost entirely on its connections to Europe to reach the rest of the world.

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[222] Franken et al, "The Digital Divide".
[223] Data from Submarine Telecoms Forum, *Submarine Cable Almanac*, Issue 48 (November 2023). https://subtelforum.com/almanac/
[224] Starosielski, *The Undersea Network*, 45-46.
[225] Jon Hjembo, "The Major Uncertainties of the Global Bandwidth Sector", *Telegeography*, 29 June 2022. https://blog.telegeography.com/the-major-uncertainties-of-the-global-bandwidth-sector

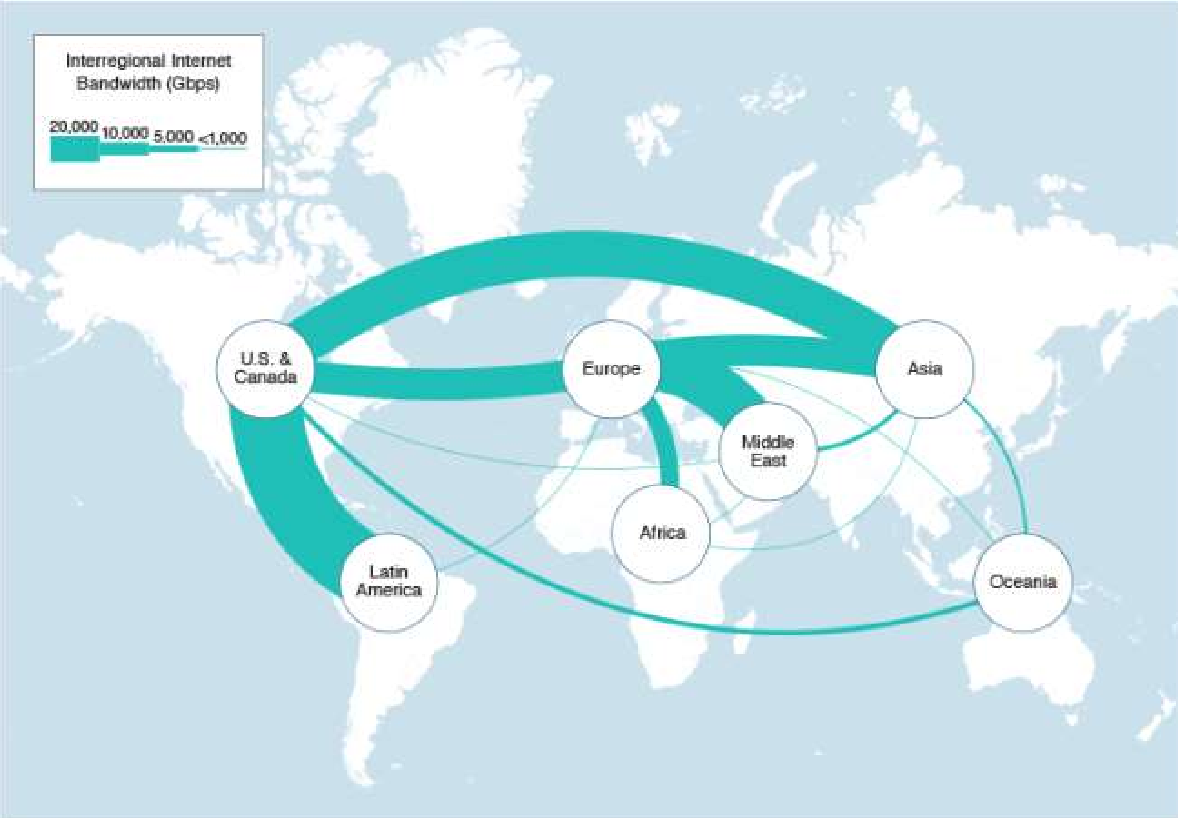

Figure 7. Interregional bandwidth as of 2021. Source: Jayne Miller, "The Global Internet: Then and Now", Telegeography*, 12 October 2021. https://blog.telegeography.com/the-global-internet-evolution-bandwidth-changes*

In **paragraph 1.7.4.**, states were assumed to have an interest in maximizing their infrastructural connections with the rest of the world. This concept applies to submarine Internet cables as well, since establishing a large number of state-of-the-art cable connections offers various advantages to a country. These advantages change as the number of cable terminals grows. At the baseline level, countries have an interest in possessing at least a single point of connection to the submarine cable network because, as noted above, this is the only infrastructure guaranteeing efficient and stable levels of international bandwidth. The difficulty in sustaining Internet connectivity without access to fiber optic cables is demonstrated by the issues affecting remote island nations such as Tuvalu, which is not yet connected to any submarine cable and relies entirely on satellite connections.[226] As previously stated, satellites offer considerably less capacity at substantially higher costs, which hinders citizens' Internet access and prevents the development of a local digital economy. For this reason, the establishment of the first submarine cable connections in developing countries has been observed to correlate with positive trends: lower Internet tariffs and increased speed sustain Internet penetration, which in turn enables the establishment of new services, creates the conditions for e-commerce, attracts investments from trans-national corporations, and improves literacy rates and skilled employment.[227] Additional cables increase the levels of available capacity, which enables the national Internet to sustain larger volumes of data traffic without issues of congestion, further driving down tariffs and

[226] USTDA, "USTDA Advances Secure Internet Connectivity in the Pacific Islands", 17 October 2023. https://www.ustda.gov/ustda-advances-secure-internet-connectivity-in-the-pacific-islands/
[227] Pierluigi De Rogatis, "The Political Economy of Submarine Cables: The Quantum Cable Project in the Mediterranean Sea", *The Square Insight* No. 18 (2022). https://ssrn.com/abstract=4144465

improving the quality of service. For example, a study on South Africa estimated that the construction of four new cables between 2009 and 2014 caused a 6.1% increase in GDP per capita,[228] whereas another research predicts Google's recent cable projects in five Latin American countries will cause a cumulative increase of $178 million in their GDP.[229] Furthermore, additional cables provide redundancy in case of cable faults and ruptures, an essential prerequisite for a reliable national Internet.[230] The best-connected countries, which can rely on dozens of cable connections, are provided with high centrality in the cable network, acting as global connectivity hubs both at the intra-regional and inter-regional levels. Because of their high centrality, these countries benefit from larger volumes of data traffic flowing from, to, and through their national Internet networks, which creates revenue for their local ISPs. Moreover, they are attractive destinations for investments in the digital economy such as the establishment of cloud servers, content delivery networks (CDNs), and data centers (see **paragraph 2.7**), which further contributes to their status as the core pillars of the global Internet.[231]

Finally, establishing new connections with other countries can also solidify diplomatic and commercial relations. The Raman cable, planned for 2024, will form the first connection between Israel and Saudi Arabia, which many commentators have seen as a sign of the ongoing rapprochement between the two traditional enemies.[232] The rising importance of the Philippines as a landing point for US-Asia cables, on the other hand, can be read in light of Manila's role as part of Washington's China containment strategy, as we will see in the next chapter.

2.6 The submarine cable industry

The submarine cable network developed in parallel with the process of privatization of infrastructure provision described in **paragraph 1.5.2**, which particularly affected the telecommunications industry. Consequently, the cable market has historically been driven by private firms, with governments playing a residual role. This was particularly true for the trans-Atlantic route, which connects Western countries more explicitly favorable to the liberalization of the market, while developing countries tend to reserve a larger role to state-owned, or partially state-owned companies.[233] Still, entirely state-owned cables account for less than 20% of the global total, whereas 60% are privately owned and the remaining 20% are controlled by

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228 Alan C. O'Connor et al, *Economic Impacts of Submarine Fiber Optic Cables and Broadband Connectivity in South Africa* (Research Triangle, 2020). https://www.rti.org/publication/economic-impacts-submarine-fiber-optic-cables-and-broadband-connectivity-south-africa/fulltext.pdf
229 David Abecassis et al, *Economic Impact of Google's Submarine Cable Network in Latin America and the Caribbean* (Analysis Mason, December 2022). https://www.analysysmason.com/consulting/reports/impact-of-google-network-latam-caribbean-2023/
230 Franken et al, "The Digital Divide".
231 Adam Bruns, "How Undersea Cables Drive Onshore Site Decisions", *Site Selection Magazine*, March 2020. https://siteselection.com/issues/2020/mar/data-centers-how-undersea-cables-drive-onshore-site-decisions.cfm
232 "Israel Hopes New Data Cables Can Make Friends of Former Enemies", *The Economist*, 5 March 2022. https://www.economist.com/middle-east-and-africa/2022/03/05/israel-hopes-new-data-cables-can-make-friends-of-former-enemies
233 Winseck, "The Geopolitical Economy", 242.

joint ventures including both private and state-owned companies.[234] Financing is also driven largely by private investment, with only about 5% of funding coming from multilateral donor agencies, mostly for projects in Africa.[235] This is because the demand for bandwidth has grown enough at the global level to fuel private investment in all regions of the world, although, as seen above, certain routes remain privileged over others. Moreover, industry players understand the importance of establishing alternative routes to enhance reliance and are actively trying to reduce the network's dependence on global chokepoints such as the Suez Canal and the Luzon Strait, which bundle together a large amount of the world's most important cables exposing the global network at the risk of simultaneous ruptures in case of accidents.[236]

The cable industry comprises two main categories of firms: cable suppliers, responsible for installing, maintaining, and upgrading networks, and firms that own and operate cables. The former group is a small and relatively homogeneous circle. Laying cables requires intensive know-how and highly specialized cable ships, which are in somewhat short supply. According to industry reports, there are only 60 active cable ships in the world.[237] These belong to a restricted pool of firms, most of which were already active in the coaxial cable industry. The largest suppliers include the American SubCom, the French Alcatel, the Japanese NEC, and the Chinese HMN, which are collectively responsible for the installation of 50% of the world's cables, including essentially all major intercontinental systems.[238] Cable ownership, however, is less concentrated and includes more diverse companies. At the onset of the industry, investments came mainly from traditional telecommunication firms, most of whom were former state-owned monopolists that had recently expanded to the provision of Internet services.[239] As late as 2009, traditional telecom carriers accounted for more than 75% of the global bandwidth market.[240] However, the liberalization of the sector and the growth of the digital economy caused new, diverse firms, such as non-incumbent ISPs like Cogent and Zayo, to acquire ownership stakes new cable projects;[241] at the same time, globalization created the incentive for the largest telecom firms to invest in cables beyond their traditional markets.[242] The industry underwent a profound change in the last decade, as a result of the progressive involvement of the so-called hyper-scalers in the submarine cable industry.[243] The term refers to the largest Internet companies in the world, such as Google, Meta, Microsoft, and Amazon. Unlike ISPs, which simply provide data transit, these firms are the major

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234 Sherman, *Cyber Defense Across the Ocean*, 7.
235 Doug Brake, *Submarine Cables: Critical Infrastructure for Global Communications* (Washington, D.C.: Information Technology & Innovation Foundation, April 2019). https://itif.org/publications/2019/04/19/submarine-cables-critical-infrastructure-global-communications/
236 Gerlach and Seitz, *Economic Impact of Submarine Cable Disruptions*.
237 Dan Swinhoe, "The Cable Ship Capacity Crunch", *Data Center Dynamics*, 6 December 2022. https://www.datacenterdynamics.com/en/analysis/the-cable-ship-capacity-crunch/
238 Data derived from Telegeography's cable map.
239 Starosielski, *The Undersea Network*, 45-46.
240 Lars Gjesvik, "Private Infrastructure in Weaponized Interdependence", *Review of International Political Economy* Vol. 30 No. 2 (2023), 732-733. https://doi.org/10.1080/09692290.2022.2069145
241 Winseck, "The Geopolitical Economy", 241; Starosielski, *The Undersea Network*, 48.
242 M.B. Sarkar, S. Tamer Cavusgil, and Preet S. Aulakh, "International Expansion of Telecommunication Carriers: The Influence of Market Structure, Network Characteristics, and Entry Imperfections", *Journal of International Business Studies* Vol. 30 No. 1 (1999): 361-382. https://doi.org/10.1057/palgrave.jibs.8490074
243 Hanspach, "Internet Infrastructure and Competition".

global content and applications providers; additionally, they offer cloud services.[244] The enormous volume of data carried each day by these giants pushed them to establish a complex web of content delivery networks (CDNs), that is, servers hosting copies of relevant data distributed in various regions of the world. This scaled-up infrastructure allows them to bring information closer to the end user without the need for longer data hauls through international connections, reducing latency as well as improving redundancy.[245] Given the scale at which they operate, rather than leasing capacity on cables owned by ISPs, it is more sensible for hyper-scalers to build their own proprietary submarine cable systems, thus ensuring their CDNs are properly connected and their data-intensive services retain a high level of quality for all global users, including those in traditionally less-connected areas such as the Southern Pacific.[246] Google's first foray into the industry was a 20% stake in the consortium for the construction of Asia Pacific Gateway, which entered into service in 2010. Between 2019 and 2023, hyper-scalers were the drivers for 21% of all new cable projects, a figure that will only slightly decline to 14% for the period 2024-2028.[247] Moreover, hyper-scalers have largely surpassed ISPs in total capacity usage levels: before 2012, content providers accounted for less than 10% of the total used bandwidth, whereas in 2020 this figure had surged to 66%.[248] Google, in particular, has extended its private network to the point it is now able to autonomously reach 89.9% of all existing ASes without going through any Tier-1 o Tier-2 ISP.[249] Other hyper-scalers, such as Apple, have not entered the industry – for the moment – but they are major buyers of capacity on several cables.

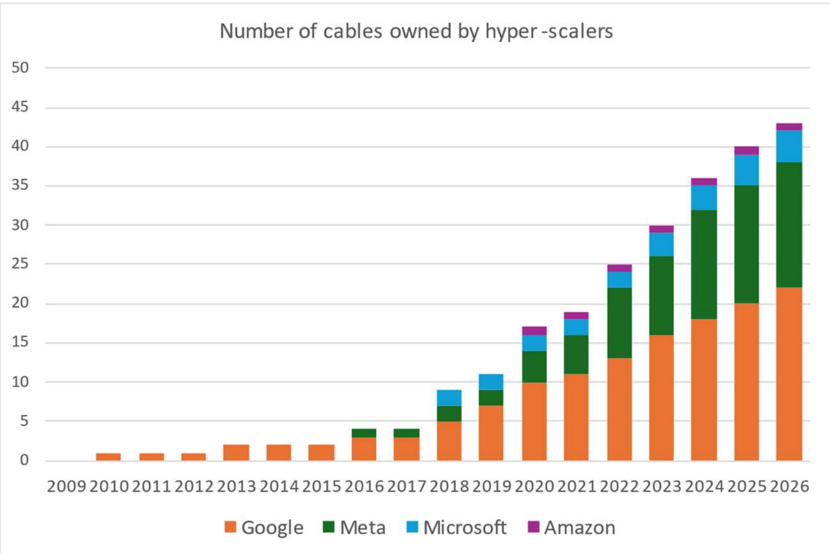

Figure 8. Cables owned by hyper-scalers. Includes only projects with known RFS dates. Data from Telegeography (https://blog.telegeography.com/telegeographys-content-providers-submarine-cable-holdings-list last accessed 27/12/2023).

[244] Todd Arnold et al, "Cloud Provider Connectivity in the Flat Internet", *ACM Internet Measurement Conference (IMC '20)* (October 2020): 230-246. https://doi.org/10.1145/3419394.3423613
[245] Greenstein, "The Basic Economics of Internet", 196-202;
[246] Gjesvik, "Private Infrastructure in Weaponized Interdependence", 737; Sherman, *Cyber Defence Across the Ocean*, 22-23.
[247] Submarine Telecoms Forum, *Industry Report*, 105-106.
[248] Alan Mauldin, "A Complete List of Content Providers' Submarine Cable Holdings", *Telegeography*, https://blog.telegeography.com/telegeographys-content-providers-submarine-cable-holdings-list (last accessed 27 December 2023).
[249] Arnold et al, "Cloud Provider Connectivity in the Flat Internet", 236.

The entry of hyper-scalers into the market has also affected the number of owners per cable. Transoceanic projects are a costly endeavor, with trans-Atlantic cables costing on average $200 million, which can climb up to more than thrice that figure for longer systems. Because of this, the traditional model of cable ownership consists of establishing consortia between different firms, pooling resources together in a joint venture and allotting capacity between them according to the level of participation in the investment.[250] Conversely, hyper-scalers have the financial capacity to directly invest in projects without the need for partnerships; moreover, the advantage of owning their own networks, which enables them to adjust levels of lit capacity in accordance with user demand, without the need to negotiate with ISPs and to compete with other content providers leasing capacity, more than compensates the initial investment.[251] When hyper-scalers do form partnerships, it is usually with each other or with the main telecommunications firms of the landing countries, as a local partner can be mandatory for receiving a cable landing license (as seen in **paragraph 2.4**) and, in general, facilitates the process of securing permits. This was also the case for Google and Meta's ill-fated trans-Pacific projects, as we will see in the next chapter. Comparing the consortium model with the increasing relevance of hyper-scaler owned cables offers the opportunity for an interesting consideration regarding the cable industry's nature as a truly globalized market. On the one hand, the consortium model, by reuniting large numbers of companies, creates a «kaleidoscope of jurisdictions and nationalities»,[252] which makes it impossible to trace ownership, much less control of a cable back to a single state;[253] at the same time, especially during the early development of the cable network, these consortia consisted mainly of traditional telecommunication carriers with strong and persistent institutional and historical ties with their national governments.[254] Conversely, recent years saw a boost in single-owner cables, entirely controlled by corporations that are based in the United States while at the same time strongly globalized in scope of action and market orientation; this global nature makes them essentially disenfranchised from any particular state authority, yet, as seen in **paragraph 2.3.2**, they are still more prone to give in to requests from Washington than from any other country.

It is also worth noting that some commentators have looked unfavorably at the expansion of hyper-scalers in the cable industry, noting that their direct ownership on communication lanes, which essentially amounts to vertical integration, further solidifies their market power.[255] In particular, some analysts express fear that Big Tech's increasing reliance on proprietary cables, bypassing traditional ISPs, constitutes a form

[250] Brake, *Submarine Cables*, 3-4; Malecki and Hu, "A Wired World", 366-367.
[251] Submarine Telecoms Forum, *Industry Report*, 105.
[252] Burnett, "Submarine Cable Security", 1661.
[253] Sherman, *Cyber Defense Across the Ocean*, 6.
[254] Gjesvik, "Private Infrastructure in Weaponized Interdependence", 16; Starosielski, *The Undersea Network*, 61.
[255] Hanspach, Internet Infrastructure and Competition"; Volker Stocker, Günter Knieps, and Christoph Dietzel, "The Rise And Evolution Of Clouds And Private Networks. Internet Interconnection, Ecosystem Fragmentation*", TPRC49: The 49th Research Conference on Communication, Information and Internet Policy* (2021). http://dx.doi.org/10.2139/ssrn.3910108

of pulling away from the public Internet to establish a global-scale private network.[256] It has also been noted that this can be a way to evade net neutrality, the principle according to which ISPs apply a best-effort approach rather than guarantee any level of performance in the delivery of data, without granting priority to any type of content or user.[257] Conversely, hyper-scalers apply additional processing to their networks to improve application performance, which, from a technical point of view, amounts to a deviation from the IP protocol.[258]

2.7 The US and China within the submarine network

Having established the main features of the global submarine cable network, this paragraph will analyze the role played within it by the United States and China. The former, as the primary developer and architect of the modern internet, has long held a dominant role in shaping global connectivity. The latter, with its technological advancements and expansive digital infrastructure initiatives, has instead emerged as a challenger to perceived US Internet hegemony. The paragraph will assess the status of both nations in terms of international connectivity, exploring the extent of their influence on the submarine cable network. It will also examine the roles played by respective digital firms, assessing their impact on the global cable industry. This will be important to establish the balance between the two countries, which will provide context for the next chapter's analysis of the evolution of US cable policies vis-à-vis China's rise.

2.7.1 The US in the submarine network

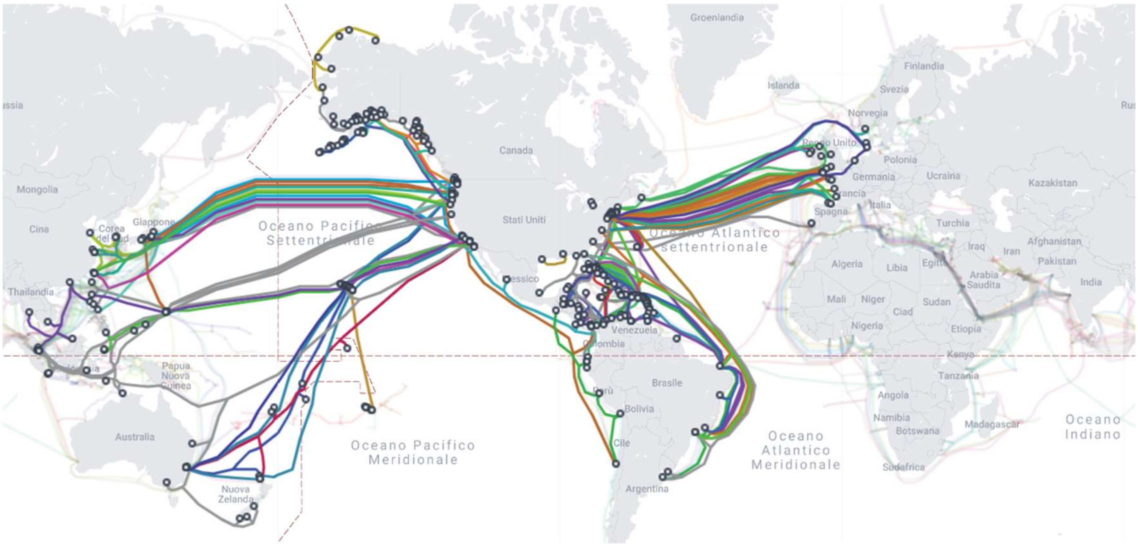

Figure 9. Map of all cables connected to the US. Detail from Telegeography's Cable Map https://www.submarinecablemap.com/country/united-states (last accessed 01/02/2024).

[256] Steve Song, "Internet Drift. How the Internet Is Likely to Splinter and Fracture", *Digital Freedom Fund*, September 2018. https://digitalfreedomfund.org/internet-drift-how-the-internet-is-likely-to-splinter-and-fracture/

[257] Michael Kende, "The Digital Handshake: Connecting Internet Backbones", *OPP Working Paper No. 32*, Federal Communications Commission (2000), 6. https://www.fcc.gov/Bureaus/OPP/working_papers/oppwp32.pdf

[258] Hari Balakrishnan et al, "Revitalizing The Public Internet By Making It Extensible", *ACM SIGCOMM Computer Communication Review*, Vol. 51 No. 2: 18-24. https://doi.org/10.1145/3464994.3464998

In **paragraph 2.3.2**, it was observed that, for various reasons, the United States has exerted and continues to exert a unique influence on the Internet's logical infrastructure. Is this true also for the physical layer? In 2017, Winseck, analyzing the patterns of cable construction, concluded that, while the US continued to dominate both the core Internet protocols and the content and applications industry, the center of the Internet's physical infrastructure was progressively shifting towards the European Union and the BRICS countries.[259] Indeed, it is true that throughout its development the global network has progressively moved beyond the US; nevertheless, this relative decline must be contextualized in the extreme American-centrism of the early submarine cable network.

As noted in the previous paragraphs, the global network developed starting from the trans-Atlantic and subsequently trans-Pacific routes, both of which have the US at their center. Moreover, in the 1990s and early 2000s, most companies caught in the Dot-Com frenzy were eager to construct inter-regional cables linking the US – where the major Internet companies were located – with the rest of the world, while intra-regional connections, which promised less spectacular returns, were developed at a much slower pace. This means that, paradoxically, countries had much stronger connectivity with the US rather than their own neighbors. For instance, in 1999, the bandwidth between the US and Europe amounted to over 3.5 Gbps, while between the US and Asia, it amounted to 2 Gbps; conversely, intra-European connectivity reached, on average, only 450 Mbps, and it stopped at 155 Mbps for intra-Asian connections.[260] This disparity was even more marked for inter-regional bandwidth, as alternatives to the trans-oceanic routes, such as Europe-Middle East-Asia, were almost completely unexplored. Comparing **Figure 10**, which shows the distribution of inter-regional bandwidth in 2001, with the current bandwidth map as seen in **Figure 7** provides a good idea of how connectivity concentrated around the US in the Internet's early days. As a result, following the BGP's logic, the vast majority of Internet communications, even between countries sharing a border, had to travel through the Atlantic or the Pacific, reach an IXP located in the US, and then cross the ocean again. This translated into higher Internet transit costs, which were offloaded onto consumers.[261] Furthermore, it created a strong global dependency on US national Internet infrastructure, playing at the advantage of American-based Internet companies, to the point that several voices complained against a form of "bandwidth colonialism",[262] and expressed worry at the potential for Washington to act as an «information broker or gatekeeper in international Internet flows».[263]

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[259] Winseck, "The Geopolitical Economy", 228.
[260] Cukier, "Bandwidth Colonialism?".
[261] Goldsmith and Wu, *Who Controls the Internet*, 57; Kende, "The Digital Handshake" Geoff Huston, "The Death of Transit?", *APNIC Blog*, 28 October 2016. https://blog.apnic.net/2016/10/28/the-death-of-transit/
[262] Cukier, "Bandwidth Colonialism?".
[263] George A. Barnett and Han Woo Park, "The Structure of International Internet Hyperlinks and Bilateral Bandwidth", *Annales des Télecommunications* Vol. 60 No. 9, 1121. https://doi.org/10.1007/BF03219838

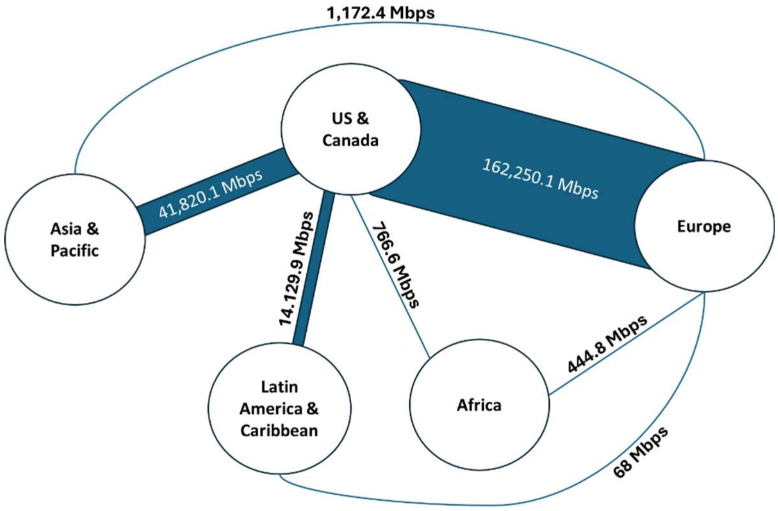

Figure 10. Inter-regional bandwidth in 2001. Source: re-elaboration of an infographic by Telegeography, available at https://blog.telegeography.com/the-global-internet-evolution-bandwidth-changes (last accessed: 30/01/2024).

However, this astounding level of centrality was destined to fade, as it created considerable inefficiencies, including a lack of resilience in case of major connectivity problems in the US. Europe was the first country to emerge from "bandwidth colonialism", as by 2002 it had already established stronger intra-regional bandwidth, as well as increasing links with Asia and Africa.[264] Intra-Asian connectivity grew significantly after 2005, partly because of the greater capacity of the new cables, which concentrated in the Pacific following the burst of the Dot-Com bubble.[265] Moreover, the increasing adoption of distributed network infrastructure, such as IXPs and CDNs contributed to reducing the reliance on international backhauls, which in turn made the global Internet less dependent on US servers. As a result, while in 2004 50% of the total global Internet traffic flew through the US, this figure has declined to just above 25%.[266]

This natural process of diffusion, however, should not be exaggerated into a decline of the American-centric Internet. Despite the expansion of the cable network to other countries, the US remains one of the most crucial nodes, especially at the inter-regional level. Although it is true that, because of the increase of intra-regional bandwidth in all continents, the share of data traffic going through the US has decreased, nevertheless 80% of inter-regional bandwidth is still connected to the US (**Figure 11**). This is because, while Asia and Europe have developed better connections with each other, Asia-Europe traffic volumes remain much smaller than trans-Atlantic and trans-Pacific flows.[267] Moreover, despite Europe's current status as a nexus between America, Asia and Africa, its largest connectivity remains that with the US.[268] As can be seen in **Figure 12**, Latin America is almost entirely dependent on the US to reach the rest of the world, and Oceania, despite its growing ties with Asia, still relies heavily on Washington. Africa and the Middle East are

[264] Malecki, "The Economic Geography", 406.
[265] Malecki and Hu, "A Wired World", 368-372.
[266] Winseck, "The Geopolitical Economy", 245.
[267] Alan Mauldin, "The Decline of a US-Centric Global Network". Presentation at *Pacific Telecommunication Council Annual Conference 2023 (PTC '23)*, Honolulu (15 January 2023). Available at https://blog.telegeography.com/the-decline-of-a-us-centric-global-network
[268] Christian Bueger, Tobias Liebetrau, and Jonas Franken, *Security Threats to Undersea Communications Cables and Infrastructure – Consequences for the EU* (Brussels: European Parliament, June 2022). https://www.europarl.europa.eu/thinktank/en/document/EXPO_IDA(2022)702557

the only regions that are completely disenfranchised from the US in terms of connectivity, owing to the lack of obvious geographical linkages between them.[269]

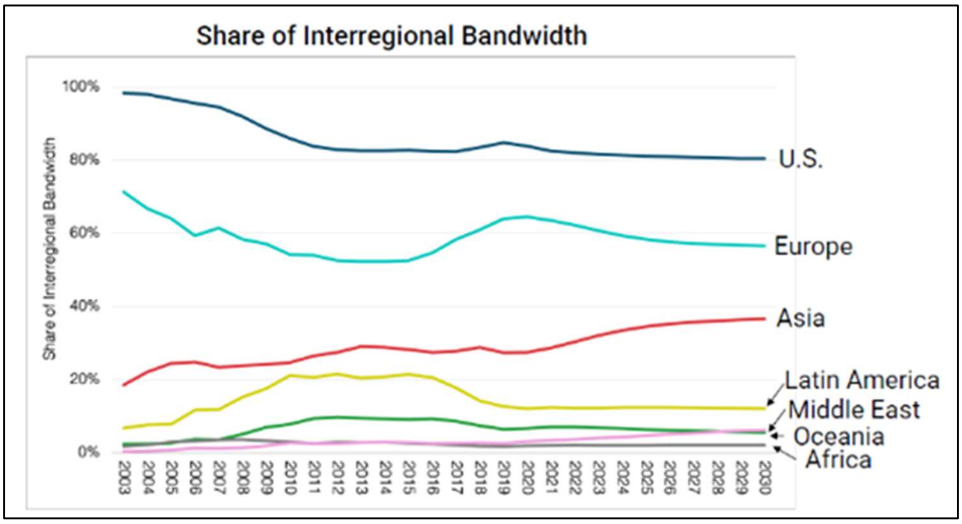

Figure 11. Share of total interregional bandwidth by region of the world, 2003-2030. Source: Alan Mauldin, "The Decline of a US-Centric Global Network", https://blog.telegeography.com/the-decline-of-a-us-centric-global-network

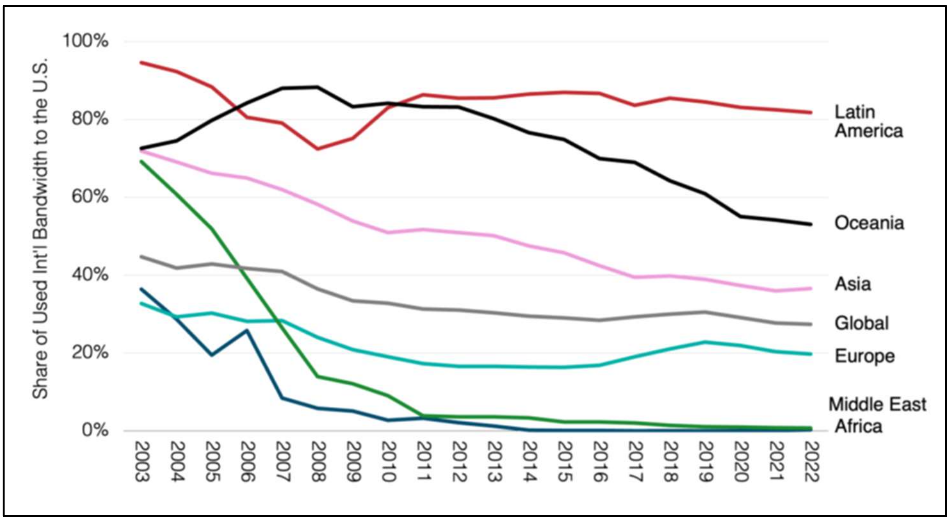

Figure 12. Share of used international bandwidth connected to the US. Source: Mauldin, "The Decline of a US-Centric".

Another important factor to consider is the location of the facilities where Internet data is stored. For example, while data centers, the facilities storing the main servers and databases of Internet companies, have become more widely distributed around the world, they still tend to cluster in the US. In fact, according to Data Center Map, a specialized website tracking the facilities of all major Internet companies, the US hosts 2136 out of 5621 data centers – more than double the number of Europe, and four times that of Asia.[270] A large number of these facilities are located in Northern Virginia,[271] which, with its 2 million km^2 of

[269] Mauldin, "The Decline of a US-Centric".
[270] *Data Center Map*, "Data Centers", https://www.datacentermap.com/datacenters/ (last accessed 2 February 2024).
[271] Dora Mekouar, "Here's Where the Internet Actually Lives", *VOA*, 11 February 2020. https://www.voanews.com/a/usa_all-about-america_heres-where-internet-actually-lives/6184090.html

operational capacity, is the largest data hub in the world, followed by Tokyo.[272] This is the result, once again, of infrastructural inertia, as this was the location of choice for several of the early Internet giants, such as AOL and Yahoo, which combines with factors such as a stable political environment with business-friendly regulations, reliable electrical power, and, of course, large bandwidth.[273] Because data center clusters are so important to the global Internet, they attract more cable investments, which in turn reinforces the position of the area, and the US in general, within the global network, a self-reinforcing mechanism already seen in the previous chapter. In fact, the importance of data facilities in the US has driven the continuous expansion of American-connected cables. Although, in the wake of the Dot-Com bubble, there were almost no new cable projects landing in the US between 2006 and 2015, bandwidth demand slowly catching up with the available capacity and, even more importantly, the entry into the market of the hyper-scalers has considerably revitalized US shores.[274] The need of Google, Meta, and other giant corporations to connect their CDNs around the world to their main data center facilities in Silicon Valley and Northern Virginia has pushed the construction of some of the world's most powerful cables, such as Grace Hopper, Marea, and Echo.

Finally, submarine cable ownership reflects the dominance of US companies in the digital economy. Although the American government directly owns only two submarine cables – GTMO-1 and GTMO-PR, linking Guantanamo Bay, respectively, to Florida and Puerto Rico – more than 22% of cables in the world have at least one private US-based owner.[275] This percentage is likely to rise in the near future as American hyper-scalers are increasingly involved in the market. Moreover, US-based ISPs, such as Level 3 and Cogent, occupy eight out of the top ten spots in CAIDA's ranking of ASes, which measures the relative importance of the networks of the main transit providers within the global Internet.[276] American companies, such as Equinix and Digital Reality, in addition to the hyper-scalers, are also the main global providers and operators of data centers, CDNs, and IXPs.[277] For what concerns cable suppliers, SubCom, which originated as then-monopolist AT&T's submarine cable unit,[278] is the second most active company in the industry after ASN. It has laid 72 of the currently operational cable systems, including the vast majority of trans-Atlantic and intra-Americas connections and some of the most important trans-Pacific links.

However, the US has drawn more than commercial advantages from this centrality. In 2013, Edward Snowden leaked confidential information revealing that US intelligence agencies had exploited the centrality of the US in the global cable network – which an NSA internal document explicitly referred to as a «home-

[272] Jon Hjembo, "Where in the World Is the Largest Data Center Hub?", *Telegeography*, 11 December 2023. https://blog.telegeography.com/where-in-the-world-is-the-largest-data-center-hub
[273] Bill Klein, "Data Center Alley: Why 70% of Internet Traffic Flows Through Ashburn Virginia", *Digital Tech*, 29 May 2019. https://digitaltech.com/data-center-alley-why-70-of-internet-traffic-flows-through-ashburn-virginia/
[274] Mauldin, "The Decline of a US-Centric".
[275] Sherman, *Cyber Defense Across the Ocean*, 23.
[276] Center for Applied Internet Data Analysis, "AS Rank", available at https://asrank.caida.org/ (last accessed 4 December 2023).
[277] Mary Zhang, "Top 250 Data Center Companies in the World as of 2024", *Dgtl Infra*, 14 January 2024. https://dgtlinfra.com/top-data-center-companies/
[278] Joe Brock, "Inside the Subsea Cable Firm Secretly Helping America Take on China", *Reuters*, 6 July 2023. https://www.reuters.com/article/us-china-tech-subcom-idUSL1N38P1Z3

field advantage»[279] – to enact large-scale information-gathering programs. With the direct collaboration of private firms such as AT&T, Verizon, Google, Facebook, Microsoft, and several others, American security agencies were able to directly tap into submarine cables, as well as data centers, to extract enormous quantities of data from all over the world.[280] Other members of the "Five Eyes" intelligence alliance, most notably the UK, similarly exploited their centrality in the cable network for intelligence gathering. The Snowden leaks were relevant because they managed to pierce the invisibility of Internet infrastructure, revealing its potential to be used in international power plays. They also provide a major source of inspiration for Farrell and Newman's theory of weaponized interdependence, which we cited in **paragraph 1.7.3** as a more aggressive form of (infra)structural power. These authors refer to a "panopticon effect", that is, the exploitation of infrastructure networks to collect information.[281] The Snowden leaks created outrage at the international level, with several countries, including traditional allies of the US, adopting stronger data localization policies, although it has been observed that, given the interconnection of the network, this "data reshoring" does not offer significant protection against foreign intelligence gathering, albeit it might work at the advantage of the state's own security apparatuses.[282] The scandal prompted the commitment to diversify submarine cable routes to mitigate US centrality, such as the construction of EllaLink to provide direct connectivity between Brazil and the EU.[283] It also enabled authoritarian countries to accuse the US of hypocrisy and to strengthen their proposals for alternative routes. Russia promoted the expansion of its terrestrial fiber optic network as an alternative to link Europe and Asia without the risk of American interceptions,[284] whereas the following year China launched its Digital Silk Road. There were also projects for a BRICS cable, which was slated to connect the five members of the group completely bypassing Europe and North America, although it never entered the implementation phase.[285]

However, the persistent centrality of the US in inter-regional connections, ten years after the Snowden leaks, suggests that infrastructural inertia and path dependence continue to support Washington's status within the global network. Despite Brazil being one of the strongest proponents of diversification strategies, its continued reliance on the US for international connectivity suggests the status quo is difficult to overturn.[286] Out of all the BRICS countries, only China has managed to establish the necessary economic and technological conditions to act as a serious competitor for US-sponsored Internet infrastructure, although, as can clearly be seen from the information analyzed below, it still lags largely behind.

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[279] Ryan Gallagher and Henrik Molte, "The Wiretap Rooms: The NSA's Hidden Spy Hubs In Eight U.S. Cities", *The Intercept*, 25 June 2018. https://theintercept.com/2018/06/25/att-internet-nsa-spy-hubs/
[280] Gjesvik, "Private Infrastructure in Weaponized Interdependence".
[281] Farrell and Newman, "Weaponized Interdependence", 46, 72-76.
[282] Drake, Cerf, and Kleinwächter, *Internet Fragmentation*, 41-45.
[283] Robin Emmott, "Brazil, Europe Plan Undersea Cable to Skirt U.S. Spying", *Reuters*, 24 February 2014. http://www.reuters.com/article/2014/02/24/us-eu-brazil-idUSBREA1N0PL20140224
[284] *Submarine Cable Networks*, "Terrestrial Cables"; Sherman, *Cyber Defense Across the Ocean*, 10-11.
[285] Stacia Lee, "International Reactions to U.S. Cybersecurity Policy: The BRICS Undersea Cable", *Henry M. Jackson School of International Studies, University of Washington*, 8 January 2016. https://jsis.washington.edu/news/reactions-u-s-cybersecurity-policy-bric-undersea-cable/
[286] Mauldin, "The Decline of a US-Centric".

In conclusion, although the Internet backbone has evolved to be progressively less US-centric, it still provides the US with a centrality that is not matched by any other single country, and that in fact enables it to compete with entire continents. The pattern of development of the cable network was clearly influenced by the American roots of the Internet: just like the technology and protocols for enabling interconnectivity developed in the US only to then expand to the rest of the world, so did the Internet's physical infrastructure initially center around America. Because of the inertial qualities of infrastructure, this advantage still exists even after the expansion of non-US-connected routes, and it is particularly evident at the inter-regional level. Furthermore, the absolute centrality of US-based firms in all sectors related to the provision of Internet infrastructure provides Washington – whose influence on these companies, although not absolute, is still stronger than the rest of the world's – with further control over the global network. Lastly, the predominance of private investment over public ownership of the cables at the global level is itself a product of US free-market policy preferences, diffused at a global level. Although the influence the United States exerts over the Internet's physical infrastructure is less strong compared to its control over soft infrastructure, nevertheless the US retains a central role in the global network which further reinforces its status as the nation that, more than any other, has shaped, and continues to shape, the nature, configuration, and inner rules of the Internet.

2.7.2 China's increasing relevance in the global cable network

As noted above, China is the most successful of the Internet revisionists. The expansion of the Internet has roughly coincided with Beijing's growth from an underdeveloped country to a powerful economy willing to expand its investments on a global scale, with the digital sector making no exception. Chinese ICT firms have developed into relevant competitors to US companies, partially thanks to non-market practices such as robust state subsidies, dumped prices, and a dubious handling of intellectual property rules.[287] This has proceeded in parallel with the development of one of the world's most effective Internet censorship systems, which has effectively maintained a strong separation between the global version of the Internet and China's national one, at least in terms of content: since access to major browsers, websites, and applications such as Google, Meta, and YouTube is blocked at the national level, Chinese Internet users gravitate instead around "super-apps" that are not as widespread outside of the People's Republic, such as Tencent's WeChat and Baidu. These super-apps automatically reset URLs after a certain period and their contents are not indexed so as to be invisible to other search engines, enforcing a *de facto* separation from the rest of the Internet's content layer.[288] As seen in **paragraph 2.3.3**, on the other hand, in order to be compatible with the global network, China's Internet still follows the US-influenced core protocols, although their decentralizing effects are mitigated by censorship-enabling legislation and practices.

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[287] Kristin Shi-Kupfer and Mareike Ohlberg, "China's Digital Rise. Challenges for Europe", *MERICS Papers on China* No. 7 (April 2019). https://merics.org/sites/default/files/2020-06/MPOC_No.7_ChinasDigitalRise_web_final_2.pdf

[288] Rebecca Arcesati et al, *Fragmenting Cyberspace. The Future of the Internet in China* (Berlin: MERICS, November 2023), 29. https://merics.org/en/report/fragmenting-cyberspace-future-internet-china

The need to balance digital development with political repression produces visible effects on China's submarine cable network, too. China is currently served by 20 submarine cables, a number that places it among the best-connected countries, although it is still inferior to other connectivity hubs in Eastern Asia such as Japan and Singapore, and only a quarter that of the United States. Moreover, the majority of these cables are part of intra-Asia systems, whereas only 6 of the cables landing in China form connections with Europe, Africa, Oceania, and the US (**Figure 13**). This means that China largely depends on neighboring countries, such as Japan, for its linkages with the rest of the world. Moreover, about 63% of China's international traffic still passes through the US.[289] At the same time, this is partially compensated by the aforementioned Eurasia Terrestrial Network, which provides Beijing's major linkage with Russia and an alternative source of connectivity to Europe without passing through the Suez Canal or the Pacific.[290]

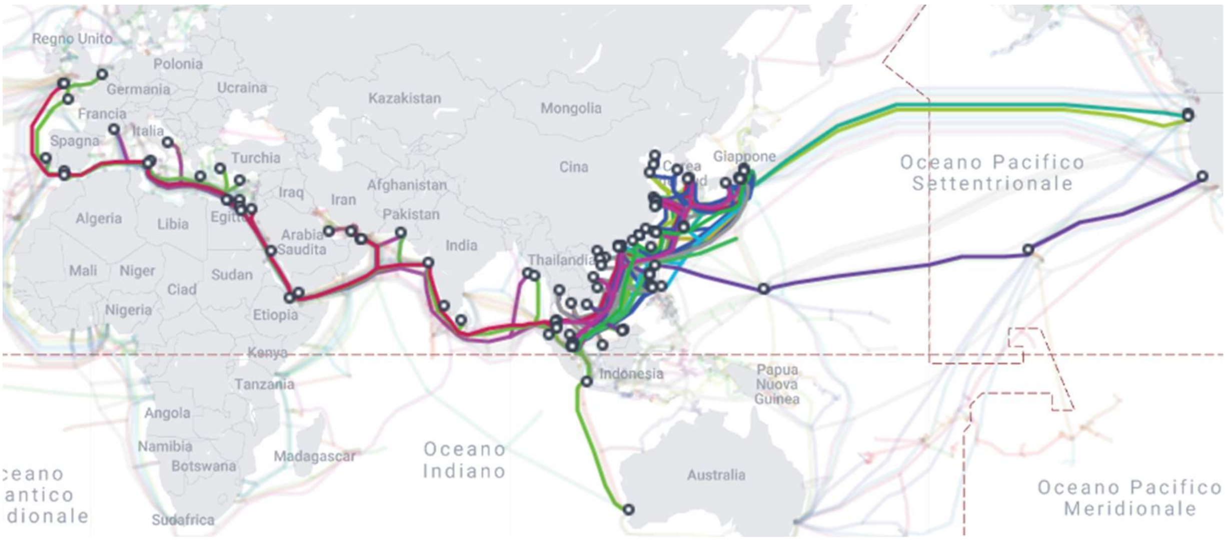

Figure 13. Map of all submarine cables landing in China, highlighting the predominance of intra-Asian connections in China's submarine network. Detail from Telegeography's cable map, https://www.submarinecablemap.com/country/china (last accessed 26/01/2024).

Another interesting observation is that cable landings are concentrated in a limited set of locations. In fact, the majority of China's international connections land in Hong Kong, while the rest of China's extensive coastline hosts only 6 landing stations, most of which contain the terminations for multiple cable terminations (**Figure 14**). This extreme concentration is not ideal in terms of resilience, as it creates the risk of large-scale disconnections in case of localized submarine earthquakes or similar accidents. It is also inefficient in terms of national connectivity, as the sparsity of cable landings disperses bandwidth, creating the need to integrate the landing stations with extensive land-based infrastructure. However, this is functional to the Communist Party's intense filtering activity. The limited number of cable landings means the Chinese government restricts the entry points of international data traffic to a handful of locations, where it can be processed by the Great Firewall, a complex ensemble of deep-packet inspection, DNS-spoofing, and keyword-based filtering systems allowing authorities to block undesirable content from entering and leaving

[289] Dale Aluf, *China's Subsea-Cable Power Play in the Middle East and North Africa* (Washington, DC: Atlantic Council, May 2023), 12. https://www.atlanticcouncil.org/in-depth-research-reports/issue-brief/chinas-subsea-cable-power-in-the-middle-east-and-north-africa/
[290] Gerlach and Seitz, Economic Impact of Submarine Cable Disruptions, 35.

the country. The Great Firewall, whose development began in 1994, immediately after the introduction of the Internet in the country, plays a central role in shaping the online landscape in China, restricting access to information and controlling the flow of digital communication within the country.[291] This censorship-oriented integration between physical and logical infrastructure is not unique to China: Ross found that a country's number of cable landing points does not correlate with its degree centrality or to its GDP per capita, whereas it correlates with that state's rank within Internet freedom indexes, leading her to conclude that authoritarian countries prefer to restrict landing points, sacrificing resilience in favor of greater control over information flows.[292] The Great Firewall constitutes a self-inflicted Internet bottleneck, as it naturally forces congestion in the servers where traffic is subjected to filtering; this is why, despite China having built a very powerful national Internet infrastructure (which includes, according to Chinese sources, the fastest fiber optic system in the world),[293] its citizens are confronted with strong latency especially for what concerns international Internet traffic.[294] This is not seen as an issue by the Party leadership, as it further incentivizes citizens to focus on government-sanctioned Chinese-based websites, although it creates strong limitations for researchers as well as, obviously, political activists.[295] Moreover, the inefficiencies of filtering are also felt at the national level, with traffic between Hong Kong and China being slowed down by up to 40% by the Great Firewall,[296] and the (purposeful) limitation of IXPs creating congestion and affecting bandwidth even in major cities.[297] These after-effects of censorship showcase the

Figure 14. Map of China's landing stations. Detail from Telegeography, "Submarine Cable Map 2022", https://submarine-cable-map-2022.telegeography.com/

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[291] Emily Quan, "Censorship Sensing: The Capabilities and Implications of China's Great Firewall Under Xi Jinping Great Firewall Under Xi Jinping", *Sigma: Journal of Political and International Studies*, Vol. 39: 19-31. https://scholarsarchive.byu.edu/sigma/vol39/iss1/4

[292] Margaret Ross, "Understanding Interconnectivity of the Global Undersea Cable Communications Infrastructure and Its Implications for International Cyber Security", *The SAIS Review of International Affairs*, Vol. 34 No. 1: 141-155. https://www.jstor.org/stable/10.2307/27000949

[293] Samantha Murphy Kelly, "China Says It's Built the World's Fastest Internet Network", *CNN*, 15 November 2023. https://www.cnn.com/2023/11/15/tech/china-launches-worlds-fastest-internet-network

[294] "China's In-Country Latencies and the Role of ISPs", *CDN Networks*, 13 December 2018. https://www.cdnetworks.com/emerging-markets-blog/chinas-in-country-latencies-and-the-role-of-isps/

[295] Quan, "Censorship Sensing".

[296] *CDN Networks*, "China's In-Country Latencies".

[297] Jonathan E. Hillman, "Techno-Authoritarianism: Platform for Repression in China and Abroad", *CSIS*, 17 November 2021. https://www.csis.org/analysis/techno-authoritarianism-platform-repression-china-and-abroad

difficulty, as described in **paragraph 2.3.3**, of reconciling authoritarianism with the Internet's inherently liberal logic while also trying to establish the conditions for a prosperous digital economy.

For foreign companies, China is a complicated, yet indispensable market. Its sheer population size and its increasing centrality in the global economy make it an attractive destination even amid content restrictions and regulations imposing the formation of complex joint ventures with local tech companies. Even firms whose services are banned, such as Google and Meta, have maintained subsidiaries in the country, in part because their services, owing to the principle of "One China, Two Systems" are still available in Macau and Hong Kong (although the special freedoms enjoyed by these administrative regions have been quickly eroding under Xi Jinping's leadership), in part because they hope to recover some presence in mainland China either by adapting to censorship requirements[298] or by expanding into other Internet-adjacent sectors.[299] To overcome international connectivity problems, most foreign firms have applied for a governmental license to establish CDNs in the People's Republic, either proprietary or leased by local providers such as ChinaCache.[300] China is also one of the largest data hubs in Asia, hosting 92 data centers,[301] mostly located in Hong Kong, as well as half of the continent's cloud regions, with Alibaba, Tencent, and Huawei all acting as major global cloud providers.[302] This infrastructure enables China to act as a significant regional connectivity hub.

It is critical to note that, despite China's overall limited relevance within inter-regional connections, Beijing's Internet industry has been extremely active in the provision of Internet infrastructure abroad. Although this is perceived to be a recent development, Huawei, China's largest manufacturer of ITC technology, had already begun to provide services overseas in the 1990s, notably in Russia, and by 2008 its international revenue accounted for 75% of the total.[303] In 2008, Huawei formed a joint venture with the British Global Marine Systems, a submarine cable supplier with a prestigious past – it had installed the first trans-Atlantic telegraph cable in 1866.[304] Huawei owned the majority share of the joint venture, named Huawei Marine Networks, which in the span of ten years became the fastest-growing cable supplier in the

[298] William Yuen Yee, "Google Parent Company Alphabet Is Back in China (Because It Never Left)", *The China Project*, 18 June 2020. https://thechinaproject.com/2020/06/18/google-parent-company-alphabet-is-back-in-china-because-it-never-left/
[299] Adam Clark, "Meta Has a Path Back Into China. It's a Rare Win for Zuckerberg's Metaverse Push", *Barron's*, 10 November 2023. https://www.barrons.com/articles/meta-platforms-stock-metaverse-buy-sell-e4895f5a
[300] John P. Gamboa, "Peering and the Chinese Internet", *Dispatches*, 1 July 2016. https://jpgamboa.com/peering-chinese-internet/
[301] Data from https://www.datacentermap.com/datacenters/ (last accessed 28 January 2024).
[302] Patrick Christian, "Mapping Out Asia's Cloud Data Center and Connectivity Market", *Telegeography*, 18 September 2023. https://blog.telegeography.com/mapping-out-asias-cloud-data-center-and-connectivity-market
[303] Hong Shen, "How to Understand China's Globalized Digital Infrastructure", *CIGI*, 4 July 2022. https://www.cigionline.org/articles/how-to-understand-chinas-globalized-digital-infrastructure/
[304] Jonathan E. Hillman, "War and PEACE on China's Digital Silk Road", *CSIS*, 16 May 2019. https://www.csis.org/analysis/war-and-peace-chinas-digital-silk-road

world, reaching fourth place in the global ranking.[305] In 2020, for reasons that will be explored in the following chapter, Global Marine divested from Huawei Marine Networks, which was entirely bought by Chinese fiber optic manufacturer Hengtong and rebranded to HMN.[306] Thus, currently HMN is a 100% Chinese corporation.

Initially, HMN's focus was on smaller-scale projects such as cross-Mediterranean and domestic systems. However, its activities received a boost with the launch of the Belt and Road Initiative in 2013 and by the inauguration of its Internet-focused component, the Digital Silk Road (DSR), in 2015. The DSR has the stated objective of supporting Chinese firms in increasing their role as global suppliers of digital technologies, with a particular focus on developing countries, which are more in need of technological upgrades and are thus ripe markets for the international expansion of China's industry. An implicit objective is to establish China as the core provider of digital technology for the Global South, replacing the centrality of Western countries.[307] Like the broader BRI, the DSR is divided into five focus areas (**Figure 15**) encompassing essentially all aspects of the digital economy, from e-commerce to content creation to cybersecurity. As can be seen, an additional objective of the DSR is to increase China's ability to shape Internet policy, including governance models, standards, and regulations.[308]

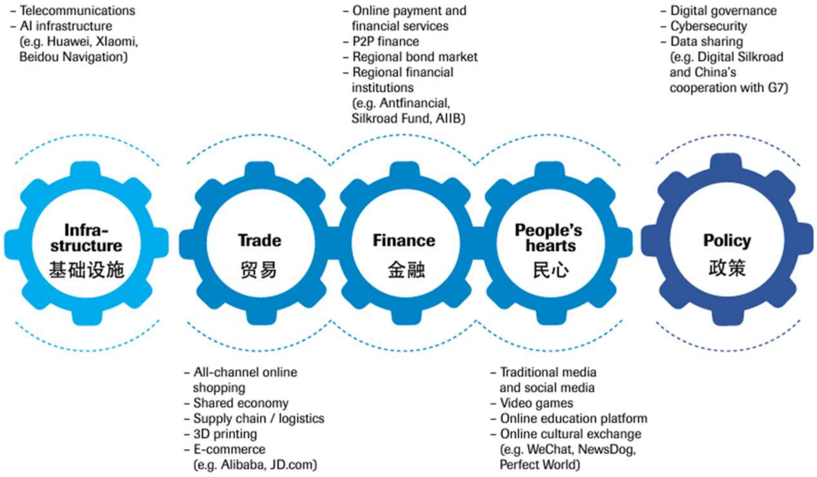

Figure 15. Focus areas of China's DSR. Source: Dekker et al, Unpacking China's Digital Silk Road*, 3.*

Infrastructure plays a large role in the initiative, also because several of the target countries have severe lacks in their connectivity to overcome. Under the DSR, Chinese firms have increasingly supplied 5G

[305] Joe Brock, "U.S. and China Wage War Beneath the Waves – Over Internet Cables", *Reuters*, 24 March 2023. https://www.reuters.com/investigates/special-report/us-china-tech-cables/

[306] Winston Qiu, "Global Marine Group Fully Divests Stake in Huawei Marine Networks", *Submarine Cable Networks*, 6 June 2020. https://www.submarinenetworks.com/en/?view=article&id=1334:global-marine-completes-sale-of-30-stake-in-huawei-marine-networks-for-85-million&catid=271

[307] Robert Greene and Paul Triolo, "Will China Control the Global Internet Via its Digital Silk Road?", *Carnegie Endowment for International Peace*, 8 May 2020, https://carnegieendowment.org/2020/05/08/will-china-control-global-internet-via-its-digital-silk-road-pub-81857 ; Brigitte Dekker, Maaike Okano-Heijmans, and Eric Siyi Zhang. *Unpacking China's Digital Silk Road* (The Hague: Clingendael, July 2020). https://www.clingendael.org/sites/default/files/2020-07/Report_Digital_Silk_Road_July_2020.pdf

[308] Clayton Cheney, "China's Digital Silk Road: Strategic Technological Competition and Exporting Political Illiberalism", *CFR*, 26 September 2019. https://www.cfr.org/blog/chinas-digital-silk-road-strategic-technological-competition-and-exporting-political

networks, data centers, and, of course, fiber optic cables, including both land-based and submarine systems. To make the DSR more accessible and appealing to developing countries, these initiatives receive generous financial backing by Chinese state-backed policy banks such as China Exim, China Development Bank, and the China-Africa Development Fund, whose financing models mandate the use of Chinese suppliers and equipment.[309] In fact, in 2015 and 2017, Chinese digital infrastructure financing in Africa surpassed the combined funds from local governments, multilateral donor agencies, and G7 countries.[310]

As mentioned above, since the launch of the DSR, HMN has intensified its operations. As can be seen in **Table 1**, the company has built a total of 39 systems for a combined length of 78,520 km. Notably, only four of these cables have a landing in China, whereas the majority consists of either domestic systems overseas or interconnections between third countries, with a particular focus on South-East Asia and Africa. Importantly, HMN has supplied SAIL, one of the two only direct connections between Africa and Latin America. Another politically sensitive project was the construction of the first cable to link Russia to Crimea after the latter's occupation. However, its crown jewel is the Pakistan & East Africa Connecting Europe (PEACE) cable (**Figure 16**). PEACE is HMN's longest cable project, spanning 25,000 km, and it offers a top-tier capacity of 192 Tbps. It is also the best demonstration of the integration between the BRI and HMN's cable systems,[311] as it provides a link between China's different target markets – developing countries and advanced Western economies. One of the cable's extremities is in Pakistan, traditionally one of China's closest allies and the center of the BRI's most intense infrastructural investments, designed to reduce China's reliance on the Malacca Strait for commercial shipping.[312] Another significant landing point is in Djibouti, the first country to host a Chinese military base on foreign ground.[313]

Figure 16. PEACE cable route. Source: Winston Qiu, "PEACE Cable System Goes Live", Submarine Cable Networks*, 24 December 2022.* https://www.submarinenetworks.com/en/systems/asia-europe-africa/peace/peace-cable-system-goes-live

[309] Motolani Agbebi, Gong Xue, and Zheng Yu, "China-Powered ICT Infrastructure: Lessons from Tanzania and Cambodia", *South African Institute of International Affairs Policy Briefing* No. 252, November 2021, 7. https://www.jstor.org/stable/resrep38689
[310] Rebecca Arcesati, "The Digital Silk Road Is a Development Issue", *MERICS*, 28 April 2020. https://merics.org/en/comment/digital-silk-road-development-issue
[311] Aluf, *China's Subsea-Cable Power Play*.
[312] Jacob Mardell, "The BRI in Pakistan: China's Flagship Economic Corridor", *MERICS*, 20 May 2020. https://merics.org/en/analysis/bri-pakistan-chinas-flagship-economic-corridor
[313] Erica Downs, Jeffrey Becker, and Patrick deGategno, *China's Military Support Facility in Djibouti: The Economic and Security Dimensions of China's First Overseas Base* (Arlington, VA: Center for Naval Analyses, July 2017). https://apps.dtic.mil/sti/citations/AD1063680

On the other hand, China's three largest telecommunications providers – China Mobile, China Telecom, and China Unicom – are part of several consortia owning cable systems, along with non-Chinese firms. Nearly all cables with a landing in China have at least one of these three companies as a co-owner, as forming a partnership with one of them is frequently the best way to navigate through the long bureaucratic process of receiving a landing license in mainland China. However, ever since the construction of early Europe-to-Asia projects in the 1990s, these carriers also own stakes into cables beyond China's waters, such as the aforementioned SAIL, the Bay of Bengal cable, and the soon-to-be-completed 2Africa. Furthermore, PEACE is owned by a subsidiary of Hengtong, the same firm owning HMN.[314] As of this moment, China's own hyper-scalers, such as Alibaba, Baidu, and Tencent, unlike their US counterparts, have not engaged in the construction of their own submarine cable networks, although Alibaba owns some terrestrial networks.[315]

Cables supplied by HMN, 2009-2025					
Cable	RFS year	Length (Km)	Capacity (Tbps)	Owner(s)	Landing countries
Asia Link Cable	2025	7,200	144	China Telecom, DITO, FPT Telecom, Globe Telecom, Singtel, TIME, Telekom Malaysia, UNN	Brunei, China, Malaysia, Philippines, Singapore, Vietnam
SEA-H2X	2024	5,000	160	China Mobile, China Unicom, Converge ICT, PP Telecommunication Sdn Bhd	China, Malaysia, Philippines, Singapore, Thailand
DSCoM	2024	286	n.a.	Dhiraagu, Ooredoo Malvides	Maldives
UMO	2023	2,227	n.a.	Campana Group	Myanmar, Singapore
UNSC	2023	1,145	n.a.	Unitel Angola	Angola
SHARE	2023	720	16	Agence de l'Informatique du Senegal	Cape Verde, Senegal
PEACE	2022	25,000	192	Peace Cable International Network Co Ltd. (subsidiary of HENGTONG)	Cyprus, Egypt, France, Kenya, Maldives, Malta, Pakistan, Saudi Arabia, Seychelles, Singapore, Somalia, Tunisia
PKA	2022	2,173	n.a.	Rostelecom	Russia
CDSCN	2021	1,300	0.8	Converge ICT	Philippines
MSC	2021	863	0.1	Dhiraagu, Dialog Axiata, Ooredoo Malvides	Maldives, Sri Lanka
H2HE	2021	675	300	China Mobile	China
SAIL	2020	5,800	32	Camtel, China Unicom	Brazil, Cameroon
Fibra Optica Austral	2020	2,800	16	Subtel	Chile
Fibra Optica al	2020	1,180	n.a.	Entel Bolivia	Peru
KSCN	2019	5,457	n.a.	PNG DataCo Limited	Indonesia, Papua New Guinea
Sakhalin-Kuril	2019	940	n.a.	Rostelecom	Russia
MARS	2019	677	16	Mauritius Telecom	Mauritius
Gulf of California	2019	250	n.a.	Megacable	Mexico
SSSFOIP	2019	21	307.2	National Grid Corp. of the Philippines	Philippines
Palapa Ring Middle	2018	2,100	n.a.	Indonesian Government	Indonesia
SEAX-1	2018	250	n.a.	SEAX	Indonesia, Malaysia, Singapore
Gulf2Africa	2017	1,500	12	Golis, Omantel, Telesom	Oman, Somalia
MCT Cable	2017	1,300	30	Symphony, Telcotech, Telekom Malaysia	Cambodia, Malaysia, Thailand
NaSCOM	2017	1,136	n.a.	Ooredoo Maldives	Maldives
Ceiba-2	2017	290	24	GITGE	Cameroon, Equatorial Guinea
SEUL	2017	24	n.a.	Belize Telemedia	Belize
Energy Bridge Cable	2017	13	n.a.	Miranda Media	Russia, Ukraine (Russian-occupied Crimea)
Far East SCS	2016	1,855	1.6	Rostelecom	Russia
Avassa	2016	260	16	Comores Telecom, STOI	Comoros, Mayotte (FR)
NCSCS	2015	1,100	12.8	Camtel	Cameroon, Nigeria
Flores-Corvo	2014	685	24	Viatel	Portugal
Silphium	2013	425	1.2	LITC	Greece, Libya
BPSCS	2013	332	19.2	Globe Telecom	Philippines
TSE-1	2013	260	6.4	China Mobile, China Unicom, Chunghwa Telecom, FET, TIGC, Taiwan Mobile	China, Taiwan
MKCS	2011	1,318	1.8	Telkom Indonesia	Indonesia
SG-SCS	2010	1,249	1.28	GT&T, Telesur	Guyana, Suriname, Trinidad and Tobago
Tobruk-Emased	2010	178	25.6	LITC	Libya
BDM	2009	353	2.56	Moratelindo, Telekom Malaysia	Indonesia, Malaysia
HANNIBAL System	2009	178	9.6	Tunisia Telecom	Italy, Tunisia

Table 1. Cables supplied by HMN. Data from Telegeography's cable map and Submarine Telecoms Forum Cable Almanac 48 (2023).

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314 Winston Qiu, "PEACE", *Submarine Cable Networks*. https://www.submarinenetworks.com/en/systems/asia-europe-africa/peace (last accessed: 1 February 2024).
315 Hanspach, "Internet Infrastructure and Competition", 29-30.

To summarize, China acts as central node within Asia, and its importance to the continent's connectivity is constantly growing thanks to the dynamic expansion of its digital economy. Its role in the global submarine cable network is more diversified: on the one hand, China's firms have risen to a prominent role in the provision of submarine cables, expanding on an international scale, both as owners and builders of submarine systems, with a particularly strong presence in the developing world; on the other hand, China's direct inter-regional connections are relatively limited compared to its status in global politics, partially as a result of Beijing's own repressive policies. This means that, while China's digital industry is now a relevant competitor for US firms, China's international connectivity still leaves it largely dependent on transit through foreign countries, primarily on the United States itself.

Chapter 3:
The shift in US cable policies

3.1 Introduction

In the previous chapter, we have seen that, like most global infrastructure, the submarine cable network concentrates around certain countries, providing them with a central status within the broader Internet flows, which in turn creates commercial, political, and strategic advantages. Consequently, we expect countries willing to participate in the international flows of information to strive to maximize their number of connections to the rest of the world, improving their national and international connectivity. We also expect them to diversify their linkages as much as possible to be able to autonomously reach a larger number of countries, reaping the benefits associated with becoming a global connectivity hub, while at the same time improving the redundancy of their national systems. This also applies to most authoritarian countries: although they must take precautions to ensure they can maintain strong control over their national Internet, in the majority of cases this does not translate into a disconnection from the global network but rather in the restriction of gateways to a few select landing stations and in a strong oversight over national digital firms.

As we have seen, the United States lies at the core of the submarine cable network, which complements the benefits of having shaped much of the Internet's core rules and standards. US centrality is mirrored by the dominance of American corporations over the digital economy, including within the submarine cable industry, which in turn contributes to perpetuating Washington's status as the heart of global Internet infrastructure. Another important element, itself a product of the influence of US policy preferences on a global scale, is that, unlike older telecommunications industries, the submarine cable network has traditionally been the playing field of private enterprises, both as owners and suppliers of cable systems, with state-owned infrastructure occupying a more defiled role. Given these premises, it would be fair to expect the US to be an active promoter of the construction of new cable systems linking it with the rest of the world. Although the US is by no means lacking in international bandwidth, the creation of new cable linkages is functional to maintaining and even increasing its role as a global connectivity hub, attracting investments in data centers and cloud regions from domestic and foreign firms alike. Moreover, Washington's traditionally pro-market and pro-globalization attitude leads us to assume US authorities would generally be supportive of private initiatives aimed at creating new cables with foreign landings. Of course, telecommunications networks in general are recognized as critical infrastructure: thus, like any other nation, the US established procedures for screening cable landing applications. These are entrusted to an independent administrative authority, the Federal Communications Commission (FCC). However, we would expect it to maintain a hands-off approach to cable projects, limiting itself to demand basic guarantees in terms of information security, while maintaining a generally business-friendly environment welcoming private investment.

As we will see in this chapter, US policies towards submarine Internet cables used to conform to these expectations until recently. Although obtaining a landing license in the US was always a complex bureaucratic process, it was accessible to a vast range of private enterprises, including foreign ones. Moreover, the diverse range of countries directly connected with the US shows an interest in forming a global, interwoven network, which is the basis of Washington's enduring status as the world's main provider of inter-regional bandwidth. The last few years, however, have seen a deviation from this model. The US government has intervened more directly and more visibly in the cable industry. Although, as we will see, this was a gradual process, the turning point can be placed in 2020, when the US reformed its procedures for cable landing applications, formalizing and expanding the consultancy role played by the Departments of Justice, Defense, and Homeland Security in the FCC's cable screening process. A few months later, this resulted in an unprecedented episode: for the first time in history, these authorities publicly recommended that the FCC deny an application for a cable landing. This verdict indirectly resulted in the cancellation of several projects and the modification of others that were already in their construction phase. Moreover, in repeated instances, US authorities adopted a mixture of diplomatic pressures and economic incentives to interfere with the international submarine cable industry, influencing other countries' choice of supplier for cable projects beyond US national waters. Finally, new cable-adjacent legislation was recently introduced or proposed, highlighting a rise in political attention.

Although individually these might seem minor incidents, when taken on aggregate these measures and decisions reveal a significant move away from the hands-off, private-centric approach that dominated US cable policies since the 90s. Indeed, beyond the content of the specific measures, perhaps the most surprising development is the politicization of submarine Internet cables. As already mentioned, the very existence of these cables has been mostly ignored outside of technical communities. One sign of US policymakers' traditional lack of attention toward submarine Internet cables is the near-complete absence of ad hoc legislation in federal law. US public authorities have seemingly seen no need to establish different rules from those that were introduced to regulate telegraph cables in the 19th and early 20th centuries, which, as seen in **paragraph 2.4**, reflects a similar situation at the level of international law. Significantly, the penalties for damaging an undersea cable are still regulated by the Submarine Cable Act of 1888,[316] which has not been amended for more than a century, despite some perplexities regarding the adequacy of its dispositions.[317] Even when cables briefly came under public attention in the wake of the Snowden leaks, they quickly faded back into obscurity, without any real repercussions on the global industry beyond the exploration of some alternatives to traditional cable routes. Conversely, the turn of the decade has seen submarine cables receive greater political attention from multiple administrations and Congress. Moreover, although submarine cables have been tied to national security considerations ever since the telegraph era, the new US policy adopts an almost exasperated tendency to securitization, which seemingly trumps over all considerations of a commercial nature. Importantly, this tendency emphasizes the dangers of interconnecting with foreign

[316] M. Wynn Tranfield, "Unspooling the Legacy of Submarine Cables", *DttP: Documents to the People*, Fall 2018, 8. https://journals.ala.org/index.php/dttp/article/view/6826/9185
[317] Yuen Yee, "Laying Down the Law".

countries over the economic opportunities it creates, which is a deviation from the vision of the Internet as a borderless, globally unifying network that was promoted by the US itself.

As we will see in this chapter, this policy shift is largely associated with the evolution of US perceptions towards China, which has gone from a promising developing country with whom to enact «a policy of comprehensive engagement designed to integrate [it] into the international community as a responsible member»[318] to «the only competitor with both the intent to reshape the international order and, increasingly, the economic, diplomatic, military, and technological power to do it».[319] Indeed, China's rise to prominence in the cable industry and the Internet economy at large, as seen in **paragraph 2.7.2**, was the catalyst for a revision of US attitudes towards Internet infrastructure, as evidenced by the "laser-sharp focus" on Beijing characterizing all the aforementioned measures.[320] However, while it is clear that China, in the eyes of the US, poses a threat to the global cable network, it will be necessary to gain a more thorough understanding of the precise nature and contours of this threat, which is apparently so great as to push the US to revise some of its foundational policy principles.

3.2 Government screenings of submarine cable landing licenses

As mentioned above, the first significant element of the new US policy stance toward submarine Internet cables is the reform of the landing license application process. It should be noted this has not been a complete upheaval: from a juridical point of view, the only change has been the formalization of security screening processes that had already been applied in a less standardized way for more than twenty years. What is truly significant, however, is the seeming change in the evaluation of the costs and benefits of interconnection, in a way that greatly emphasizes perceived threats over commercial advantages.

The paragraph will first provide an overview of how landing licenses are regulated in the US and of the modifications introduced in April 2020 with the formalization of the so-called "Team Telecom". It will then provide a description of the US cable market before and after the policy switch, with a particular focus on the changing attitude toward systems linking the US with China.

3.2.1 Cable landing licenses in US law

The regulatory framework for landing a cable in the US has remained mostly unchanged for more than a century. Formal cable landing licenses were introduced in 1921. Before then, the President used his prerogatives on foreign policy to issue landing permits for foreign companies, conditional on reciprocity

[318] William J. Clinton, *National Security Strategy* (Washington, DC: White House, 1996), 40. https://nssarchive.us/wp-content/uploads/2020/04/1996.pdf

[319] Joseph R. Biden Jr., *National Security Strategy* (Washington, DC: White House, 2022), 23. https://www.whitehouse.gov/wp-content/uploads/2022/10/Biden-Harris-Administrations-National-Security-Strategy-10.2022.pdf.

[320] Sohan Dasgupta, "Team Telecom's Laser-Sharp Focus on China", *Taft*, 25 January 2023. https://www.taftlaw.com/news-events/law-bulletins/team-telecoms-laser-sharp-focus-on-china

agreements with the governments of other countries.[321] This was a way to mitigate the market power of British companies, which, at the end of the 19th century, owned 63% of all telegraph cables in the world and had used their dominance of trans-oceanic networks to impose ramped-up rates on US customers.[322] However, the US government grew progressively aware of the need to establish a more formalized procedure, partially because companies had successfully challenged the legal basis of the President's decisions[323] and partially because of an early securitization of telecommunications cables. The First World War, in particular, demonstrated the extent to which telegraph cables could be exploited for intelligence gathering as Great Britain, again, craftily used its dominion over the global network in an information war against the Central Empires.[324] Consequently, Congress passed the 1921 Cable Landing License Act, which established by law the President's authority to grant or deny the permit to land any submarine cable connecting the US and its territorial possessions with any foreign country. This function was delegated to the Department of State until 1934, when it was transferred to the newly established Federal Communications Commission.[325]

The FCC constitutes an example of the regulatory agencies that, as seen in **paragraph 1.5**, were originally established to oversee monopolistic provision of infrastructure and, post-liberalization, ensure consumer protection, universal service, and effective competition.[326] It is an independent agency, subject to oversight from Congress and the Executive branch, responsible for regulating all aspects of international and interstate communications. Among other things, the FCC is responsible for granting licenses for the provision of international telecommunications services in the US (referred to as "Section 214 licenses").[327] Since the 1996 Telecommunications Act, this includes Internet services. For what concerns submarine cables, the FCC can decide to issue, withhold, or revoke landing licenses after obtaining approval of the Secretary of State and advice from any executive department the FCC may deem necessary.[328] The FCC's assessment must take into consideration regulatory compliance with US telecommunications regulations, environmental laws, and compliance with industry standards, as well as the general public interest of the US, which includes the new cable's potential effects on competition and market concentration, its benefits for the national economy, and its impact on national security.[329] Moreover, as noted in **paragraph 2.5**, individual states can set additional requirements and regulations for their coasts.

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[321] Henry Goldberg, "One Hundred and Twenty Years of International Communications", *Federal Communications Law Journal* Vol. 37 (1985), 131. https://heinonline.org/HOL/Page?handle=hein.journals/fedcom37&id=1&collection=journals&index=
[322] Headrick and Griset, "Submarine Telegraph Cables", 559.
[323] Goldberg, "One Hundred and Twenty Years", 131-132.
[324] Headrick and Griset, "Submarine Telegraph Cables", 577.
[325] Wynn, "Unspooling the Legacy", 9-10.
[326] Volker, Smaragdakis, and Lehr, "The State of Network Neutrality", 46.
[327] Federal Communications Commission, "International Section 214" (last accessed 13 February 2024). https://www.fcc.gov/general/international-section-214
[328] Executive Order No. 10530, 1954, 19 F.R. 2709 § 5. https://www.fcc.gov/cable-landing-license-act#EO10530
[329] Federal Communications Commission, "Submarine Cable Landing Licenses" (last accessed 10 February 2024). https://www.fcc.gov/research-reports/guides/submarine-cable-landing-licenses

The consultation of other governmental bodies during FCC screenings, which was somewhat redundant during AT&T's monopoly given its close relationship with the US government, became more important following the liberalization of the telecommunications market and its opening to foreign companies. For what concerns national security, starting with 1997 the FCC established a progressively more standardized procedure where it sought the counsel of the Departments of Justice and Defense, and, following its establishment in 2002, the Department of Homeland Security, collectively nicknamed "Team Telecom".[330] This informal grouping was consulted for all cable landing applications involving at least 10% foreign ownership to evaluate potential security and law enforcement concerns and suggest mitigation measures. This was the status quo for two decades. However, it was observed that Team Telecom's lack of official authority weakened its enforcement capabilities, while its unstructured nature and lack of dedicated human resources caused great delays in the screening process.[331] Thus, in April 2020, an Executive Order of President Trump formalized Team Telecom's status, officially renaming it the Committee for the Assessment of Foreign Participation in the US Telecommunications Services, although it is still commonly referred to as Team Telecom.[332] The Executive Order established stricter guidelines for its role within FCC procedures and expanded its membership by including other Executive agencies as advisors, including the intelligence agencies.[333] Additionally, the Order introduced a standardized list of questions to be posed to the applicant in order to evaluate possible national security risks and established a longer list of obligations cable owners must undertake. Finally, the Order attempted to streamline the process by imposing a maximum review period of 120 days, plus an additional 90 should a second scrutiny be necessary.[334]

From a strictly legal point of view, Trump's Executive Order merely formalized and partially reinforced what was already a well-established practice. However, from a political perspective, the formalization of Team Telecom signals the will to strengthen governmental oversight of cable projects. By formally involving a broader range of authorities, including the intelligence community, the new Team Telecom now encompasses the whole Executive branch, which increases the weight of its recommendations. Although the FCC is still ultimately responsible for deciding whether the construction of a new cable is in

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[330] Process Reform for Executive Branch Review of Certain FCC Applications and Petitions Involving Foreign Ownership, IB Docket No. 16-155, Report and Order, FCC 20-133 (1 October 2020), 2. https://docs.fcc.gov/public/attachments/FCC-20-133A1.pdf

[331] US Senate Permanent Subcommittee on Investigations, *Threats to U.S. Networks: Oversight of Chinese Government-Owned Carriers*, 9 June 2020, 2. https://www.hsgac.senate.gov/wp-content/uploads/imo/media/doc/2020-06-09%20PSI%20Staff%20Report%20-%20Threats%20to%20U.S.%20Communications%20Networks.pdf

[332] Executive Order No. 13913, Establishing the Committee for the Assessment of Foreign Participation in the United States Telecommunications Services Sector, 85 Fed Reg 19643 (Apr. 8, 2020). https://www.federalregister.gov/documents/2020/04/08/2020-07530/establishing-the-committee-for-the-assessment-of-foreign-participation-in-the-united-states

[333] Charles L. Capito, Joseph A. Benkert, and Jonathan M. Babcock, "A Formalized Team Telecom: White House Establishes Committee to Review Foreign Ownership or Control in U.S. Telecom Sector", *Morrison Foerster*, 10 April 2020. https://www.mofo.com/resources/insights/200410-formalized-team-telecom

[334] James H. Barker, Matthew A. Brill, and Elizabeth R. Park, "FCC Adopts Process Reforms for Foreign Ownership Reviews", *Latham & Watkins*, 7 October 2020. https://www.lw.com/admin/upload/SiteAttachments/Alert%202804v4.pdf

the public interest of the US, Team Telecom's recommendations will be difficult to ignore.[335] It is also quite clear that China is the intended recipient of this reinvigorated commitment toward cable security. This becomes apparent once the reform is inserted in the context of an escalation of US policies targeting the involvement of Chinese companies in US telecommunications infrastructure. In general, the reform came after a series of governmental actions targeting the operations of Chinese companies in the US. For example, in 2018, the "old" Team Telecom recommended that the FCC deny China Mobile's application for a Section 214 license, which had been pending since 2013, based on national security concerns,[336] while in 2019 President Trump issued a ban on Huawei technology (see **paragraph 3.3**). The day immediately following the promulgation of Executive Order 13913, instead, Team Telecom recommended that the FCC revoke China Telecom's Section 214 license, which had been granted in 2007, motivating it with «the evolving national security environment since 2007 and increased knowledge of the PRC's role in malicious cyber activity targeting the United States».[337] China Unicom's license, granted in 2002, would also be revoked in 2021.[338] The message was also clear for what strictly concerned submarine cables, as, on the same day of the Order's promulgation, Team Telecom took action regarding the planned Pacific Light Cable Network, which, as seen in **paragraph 3.2.3**, was the first instance of the US deeming interconnection with China an unacceptable security risk. Furthermore, the decision to issue press releases suggests an intention to make Team Telecom's activities as visible as possible, with its publicly available recommendations serving as an opportunity for onlookers to analyze the US government's concerns on cable security.[339]

In sum, although on a theoretical level the differences between the previous model for FCC screenings and its current version are minimal, on a practical basis the Executive Order marks a shift in the criteria used to evaluate risks related to Internet infrastructure including submarine cables, with greater consideration for national security concerns rather than commercial interests. This can be seen by comparing notable cable landing licenses obtained before 2020 with the projects that have since been rejected by Team Telecom.

3.2.2 US-China connections before 2020

During the boom in cable construction caused by the Dot-Com bubble, the impact of national security considerations in the FCC's process was limited to the bare minimum. Team Telecom had not yet emerged

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[335] Farhad Jalinous, Karalyn Mildorf, and Keith Schomig, "'Team Telecom' Formalized into New Committee; Increased Scrutiny of Chinese Involvement in US Telecommunications Services Continues", *White & Case*, 15 April 2020. https://www.whitecase.com/insight-alert/team-telecom-formalized-new-committee-increased-scrutiny-chinese-involvement-us
[336] Federal Communications Commission, Denial of International Section 214 Authority for China Mobile International (USA) Inc.: Memorandum Opinion and Order, ITC-214-20110901-00289, 18 April 2019. https://docs.fcc.gov/public/attachments/DOC-357087A1.pdf
[337] US Department of Justice Office of Public Affairs, "Executive Branch Agencies Recommend the FCC Revoke and Terminate China Telecom's Authorizations to Provide International Telecommunications Services in the United States", 9 April 2020. https://www.justice.gov/opa/pr/executive-branch-agencies-recommend-fcc-revoke-and-terminate-china-telecom-s-authorizations
[338] Federal Communications Commission, Order Instituting Proceeding on Revocation (China Unicom), ITC-214-20020728-00361, 17 May 2021. https://www.fcc.gov/document/order-revocation-china-unicom-americas-sec-214-authority
[339] Capito et al, "A Formalized Team Telecom".

even in its informal version. Looking, for instance, at the FCC's decision to grant the landing license for the trans-Atlantic cable Apollo (2001) or for TGN-Pacific (2000), it can be seen that the only involvement of other governmental authorities amounts to a joint letter from the Departments of State and Defense stating they have no objection to the construction of the cable.[340] The FCC's main focus was, instead, on competitiveness and market power, which chiefly meant to verify the availability of alternative routes to connect the US to the selected countries. Incidentally, this meant that the FCC recognized the public interest of the US in amplifying the number of cables connecting it to the rest of the world. This generally lax approach resulted in a relatively agile process, which saw most licenses be granted within five to six months from the application, and no doubt contributed to the vertiginous expansion of the US cable network. Security screenings became more rigorous after 9/11, when submarine Internet cables were classified as critical infrastructure and a potential target of terrorist attacks, given the relative ease with which they can be damaged (see **paragraph 3.6**).[341] This prompted the emergence of Team Telecom, albeit in its informal version. The greater emphasis on national security impacted the length of the licensing process, which grew to an average of about one year, with peaks of up to more than two. Although this created frustration in the industry,[342] it was mitigated by the fact that, despite enhanced security screenings, all cable landing applications submitted to the FCC between 2001 and 2020 ended up with a granted license. Team Telecom's practice shows that, even in the presence of foreign firms as co-owners, it was content with negotiating security conditions with the firm operating the cable landing station on US soil, often through a National Security Agreement.[343] Notably, one of the conditions contained in the standard Agreement is that the firm must be able to suspend all traffic flowing to and from the US upon request, alongside the designation of points of contact with national security agencies and procedures for ensuring the protection of data flowing through the cable.[344]

These practices were also applied to cables connecting the US to China. Between the commercialization of the Internet in 1996 and the formalization of Team Telecom in 2020, four such submarine cables received approval from the FCC. Although this number is inferior to, for example, the amount of US-Japan cables built in the same period, it is still remarkable, especially considering the difficulties of obtaining a landing license in the People's Republic.

The first fiber optic cable to directly link the two countries was the China-US Cable Network (CUCN), which entered its planning phase in 1997, at the onset of the Internet's globalization. China had

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[340] Federal Communications Commission, Cable Landing License (Apollo), SCL-LIC-20010122-00002 (7 June 2001), https://docs.fcc.gov/public/attachments/DA-01-1395A1.pdf ; Federal Communications Commission, Cable Landing License (TGN-1), SCL-LIC-20000717-00026 (8 December 2000), https://fcc.report/IBFS/SCL-LIC-20000717-00026/182946
[341] Starosielski, *The Undersea Network*, 55-56.
[342] *Ibid.*
[343] Andrew D. Lipman and Nguyen T. Vu, "Building a Submarine Cable: Navigating the regulatory Waters of Licensing and Permitting", *Submarine Telecoms Forum*, Vol. 56 (March 2011), 21-24. Available at https://www.morganlewis.com/-/media/files/docs/archive/stf_56_6196pdf.pdf
[344] See, for example, Federal Communications Commission, Petition to Adopt Conditions to Authorizations and Licenses (AAG), SCL-LIC-20070824-00015 (11 June 2008), https://fcc.report/IBFS/SCL-LIC-20070824-00015/646115

rapidly expanded its national Internet infrastructure and, thanks to its enormous population, by 2000 could already count 22.5 million users, despite its status as a developing country.[345] Given the then-absolute centrality of the US within the global network, both Chinese and American telecommunications carriers were interested in establishing a direct connection between the core of the Internet and a prosperous, rapidly expanding market. Furthermore, while China was already working on its censorship mechanisms, US browsers and websites would not be banned until the 2010s. The CUCN project was initiated by AT&T and China Telecom and it was soon joined by other Asian companies such as Nippon Telegraph and Telecom, Korea Telecom, and the Taiwanese Chunghwa, who built fiber branches to their respective countries.[346] The presence of a Chinese government-owned firm did not seem to factor at all in the FCC's decision, which is in fact more focused on evaluating whether CUCN could distort competition on the US-to-Asia route.[347] The involvement of national security was limited to a letter of approval from the Department of Defense, as was the common standard in the 90s, which also enabled the application to be granted within the span of five months.[348] In other words, despite its authoritarian government and its nascent model of state capitalism, China was not seen differently than any other country. For more than a decade, CUCN served as the main provider of international bandwidth for China, as testified by the repercussions of its accidental rupture in 2011.[349] It was early retired in 2016 because of its outdated design capacity.[350]

By the late 2000s, the growth of bandwidth demand in Asia was pushing new trans-Pacific investments. In particular, in light of China's ever-expanding digital economy, US ISPs were interested in strengthening the connectivity with the country, as CUCN was already becoming obsolete,[351] and in diversifying from the typical cable US-Japan cable route passing through the Luzon bottleneck.[352] China, on its part, aimed at reducing its dependence on Japan for international connections.[353] This led to the formation of a consortium for the construction of Trans-Pacific Express cable system (TPE), a new linkage between the US, the People's Republic, and other Asian countries, seeing the participation of AT&T, Verizon, China Unicom and China Telecom, among others. TPE's development process was closely associated to China's

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[345] Graham Webster, "A Brief History of the Chinese Internet", *Logics* No. 7 (May 2019). https://logicmag.io/china/a-brief-history-of-the-chinese-internet/
[346] Submarine Cable Networks, "China-US CN", available at https://www.submarinenetworks.com/en/systems/trans-pacific/china-us-cn (last accessed 12 February 2024).
[347] See Federal Communications Commission, Cable Landing License (CUCN), SCL-LIC-19980309-00005 (28 August 1998). https://fcc.report/IBFS/SCL-LIC-19980309-00005/643682
[348] *Ibid.*
[349] "China-US Cable Break Down Internet", *Submarine Cable Networks*, 4 February 2011. https://www.submarinenetworks.com/en/systems/trans-pacific/china-us-cn/china-us-cable-break-down-internet
[350] Submarine Cable Networks, "China-US CN".
[351] "AT&T Goes For The Gold", *Forbes*, 25 May 2008. https://www.forbes.com/2008/03/25/att-cable-asia-markets-equity-cx_mlm_0325markets15.html?sh=6caae47fe16d
[352] Submarine Cable Networks, "Trans-Pacific Express", available at https://www.submarinenetworks.com/en/systems/trans-pacific/tpe (last accessed 12 February 2024).
[353] "Report: China Starts Work on First Direct Undersea Cable to US", *Sidney Morning Herald*, 24 October 2007. https://www.smh.com.au/national/report-china-starts-work-on-first-direct-undersea-cable-to-us-20071024-gdretk.html

largest soft power initiative up to that moment, the 2008 Olympics in Beijing.[354] By that time, Team Telecom's role was already a well-established custom. Team Telecom did not object to the construction of the cable, provided that Verizon, as the firm responsible for operating the US landing station, entered a National Security Agreement, as was the standard at that point.[355] The overall process lasted one year, as expected by the applicants, who managed to have the cable operational by the Olympics' opening week. TPE's development coincided with that of another important cable project, the Asia-America Gateway (AAG), the first system to link the US with Southeast Asia, including countries that would become significant regional connectivity hubs such as Singapore and the Philippines.[356] Like TPE, AAG was intended to diversify Asia-US connections by avoiding Luzon, although it would prove to be one of the cables most susceptible to ruptures and damages.[357] Moreover, it has a landing point in Hong Kong. Notably, AAG's cable consortium does not include any of the main Chinese state-owned telecom carriers: the Hong Kong landing station is instead owned and operated by Reach, a joint venture between the Hong Kong-based private firm PCCW and the Australian Telstra.[358] This reflects the larger levels of economic liberty enjoyed by the province at the time. The FCC again took one year to grant the landing license and requested AT&T to enter a National Security Agreement.

The most recent cable system with a direct US-China connection is the New Cross Pacific (NCP) cable system, which also has landings in Korea, Taiwan, and Japan. NCP, which was first announced in 2013, is notable for being Microsoft's first foray into the submarine cable industry. Microsoft's involvement in the project was kept confidential until 2015, when the firm announced it alongside its participation in two other cable consortia, motivated by the expansion of its operations as a cloud provider and the need to better connect its data centers around the world.[359] Microsoft's interest in improving China's international connectivity is also explained by the fact that, unlike other American hyper-scalers, most of its services remain available in the People's Republic even amid stricter Internet censorship.[360] This include its cloud

[354] Brad Reed, "AT&T Joins Trans-Pacific Submarine Cable Consortium", *Networkworld*, 26 March 2008. https://www.networkworld.com/article/812992/lan-wan-at-t-joins-trans-pacific-submarine-cable-consortium.html

[355] National Security Agreement Between the Department of Homeland Security, Department of Justice, Department of Defense, and Verizon Business Global LLC, 9 January 2008. https://fcc.report/IBFS/SCL-LIC-20070222-00002/615039

[356] Chua Hian Hou, "Faster Starhub Broadband", *The Straits Times*, 8 December 2009. https://web.archive.org/web/20091212014652/http://www.straitstimes.com/BreakingNews/Singapore/Story/STIStory_463981.html

[357] "Asia-America Gateway Cable Breaks Down Yet Again", *Saigoneer*, 26 July 2014. https://saigoneer.com/vietnam-news/2335-asia-america-gateway-cable-breaks-down-yet-again

[358] "AAG Cable System Overview", *Submarine Cable Networks*, 1 February 2011. https://www.submarinenetworks.com/en/systems/trans-pacific/aag/aag-cable-system

[359] Winston Qiu, "Microsoft Announces Investment in NCP and Other Subsea Cables", *Submarine Cable Networks*, 13 May 2015. https://www.submarinenetworks.com/en/systems/trans-pacific/ncp/microsoft-announces-investment-in-ncp-and-other-subsea-cables

[360] Jeniffer Conrad, "A Brief History of Microsoft in China", *The China Project*, 19 August 2020. https://thechinaproject.com/2020/08/19/a-short-history-of-microsoft-in-china/

service, Azure, which now has more than ten data centers in China.[361] At the same time, China's government had strong interests in NCP. Given the global expansion of its digital economy, which was further sanctioned with the launch of the Digital Silk Road in 2015, Beijing needed to expand its international bandwidth. A sign of its commitment to NCP is that all the three main Chinese ISPs, China Mobile, Telecom, and Unicom, were part of its consortium.[362] Furthermore, the Chinese equivalent of the FCC was uncharacteristically rapid in reviewing the cable landing application, which was granted already in 2015, after a scrutiny of just above 70 working days.[363] Conversely, before obtaining its US landing license, NCP underwent a longer scrutiny than usual, from November 2015 to January 2017. At the end of the process, however, Team Telecom once again recommended that the FCC grant the license after signing an agreement with Microsoft.[364]

In other words, an examination of all instances involving cables directly linking the US with China shows that, until at least 2017, interconnection with the People's Republic was not seen as a national security risk but as an opportunity for strengthening the connectivity of the US, diversifying its cable routes, and improve its digital firms' access to an important market. Even as China's stance in international relations became more assertive, US authorities considered American firms as sufficiently trustworthy partners to balance any vulnerability in the cable system. It is worth noting that the same criteria were applied to the FASTER cable, one of Google's earliest investments in trans-Pacific connectivity. Although FASTER does not land in China, nevertheless it counts China Mobile and China Telecom among its co-owners.[365] In this case, too, Team Telecom considered it sufficient to enter a National Security Agreement with Google. Moreover, the fact that the FCC ultimately approved all landing applications generated a strong confidence in the global cable industry that the US would be open to all types of cable investments, provided that the cable owners committed to minimum security standards and that they maintained a «flexible and creative» attitude.[366]

3.2.3 US-China connections after 2020

These expectations would be subverted with the case of Pacific Lights Cable Network's landing license. The controversy generated by this incident, as opposed to the low attention given to previous cable systems, highlights how it served as a wake-up call to the industry while also attracting interest from external

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[361] Dan Swinhoe, "Microsoft Planning to Open Four More Chinese Data Centers by 'Early 2022'", *Data Center Dynamics*, 18 June 2021. https://www.datacenterdynamics.com/en/news/report-microsoft-planning-to-open-four-more-chinese-data-centers-by-early-2022/
[362] Winston Qiu, "Consortium Inks MOU for New Cross Pacific (NCP) Cable System", *Submarine Cable Networks*, 26 September 2013. https://www.submarinenetworks.com/en/systems/trans-pacific/ncp/consortium-inks-mou-for-new-cross-pacific-ncp-cable-system
[363] Winston Qiu, "China Authority Approves New Pacific Cross (NCP) Cable Project", *Submarine Cable Networks*, 5 February 2015. https://www.submarinenetworks.com/en/systems/trans-pacific/ncp/china-authority-approves-ncp-cable-project
[364] Federal Communications Commission, Cable Landing License (NCP), SCL-LIC-20151104-00029 (13 January 2017). https://docs.fcc.gov/public/attachments/DA-17-55A1.pdf
[365] Winston Qiu, "FASTER Cable System is Ready for Service", *Submarine Cable Networks*, 1 July 2016. https://www.submarinenetworks.com/en/systems/trans-pacific/faster/faster-cable-system-is-ready-for-service
[366] Lipman and Vu, "Building a Submarine Cable", 23.

observers. PLCN's history begins in 2015, when the Hong Kong-based company Pacific Light Data Communication (PLDC) announced it had contracted SubCom with the intention to build the first cable system to directly link Hong Kong to Los Angeles.[367] This project was highly attractive because, despite Hong Kong's prominent status as an intra-Asian connectivity hub, housing one of the largest data center regions in the world (see **paragraph 2.7.2**), it only has a single direct link with the US, the somewhat unreliable AAG: all other US-China cables land in other parts of China, such as Shanghai. Given that Hong Kong is also one of the cheapest Internet exchange points in Asia, it is understandable that Asian and American companies alike would be interested in expanding the bandwidth linking its data hubs with those of the US West Coast.[368] However, the specialized press was surprised that such project would be handled by PLDC, a recently created company with no previous experience in the market. Journalist Winston Qiu commented: «It shocked me when I got the invitation for the event. I have been thinking who will be the next player to participate in submarine cable games. I though [*sic*] it might be Amazon, Hurricane Electric, Baidu, Alibaba or Tencent, which will follow Google, Facebook and Microsoft to invest in submarine cable systems. I never expected such an invader».[369] Indeed, one year later, Google and Facebook announced they would invest in PLCN as co-owners; furthermore, it was announced that PLCN, by employing SubCom's highest-end technology, was intended to become the main trans-Pacific cable, with a capacity double that of FASTER and NCP.[370] At this point, both hyper-scalers had already acquired stakes in several cable projects, including some with landing points in China (FASTER for Google, Asia Pacific Gateway (APG) for Facebook). By 2017, PLCN had obtained the landing license for Hong Kong, whose landing station would be operated by PLDC together with PCCW,[371] the Philippines, handled by Facebook,[372] and Taiwan, operated by Google.[373] As of 2018, the submarine cable had already been landed in all three of its intended Asian terminals and its construction was almost completed. Its owners intended it to be operational by the end of the year.[374]

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367 Winston Qiu, "Invader to Build Pacific Light Cable Network Connecting Hong Kong and the US", *Submarine Cable Networks*, 16 November 2015. https://www.submarinenetworks.com/en/systems/trans-pacific/plcn/invader-to-build-pacific-light-cable-network-connecting-hong-kong-and-the-us

368 Shermaine Yung, "Trans-Pacific Cable Chaos, Shifting Asian Hubs", *Telegeography*, 20 May 2021. https://blog.telegeography.com/trans-pacific-cables-asian-hubs-plcn-status

369 Qiu, "Invader to Build Pacific Light".

370 Brian Quigley, "New Undersea Cable Expands Capacity for Google APAC Customers and Users", *Google Cloud Blog*, 13 October 2016. https://cloud.google.com/blog/products/gcp/new-undersea-cable-expands-capacity-for-google-apac-customers-and-users/

371 PCCW Global, *Pacific Light Cable Network (PLCN) – Deep Water Bay* (Hong Kong: ERM, April 2017). https://www.epd.gov.hk/eia/register/profile/latest/dir253/dir253.pdf

372 Roy Stephen C. Canivel, "PH Partners with Facebook to Build High-Speed Internet Infrastructure", *Inquirer.net*, 15 November 2017. https://technology.inquirer.net/69252/dict-bcda-high-speed-internet-luzon-bypass-infrastructure

373 Philip Charlier, "US Government Approves Activation of Direct USA to Taiwan Internet Cable", *Taiwan English News*, 9 April 2020. https://taiwanenglishnews.com/us-government-approves-activation-of-direct-usa-to-taiwan-internet-cable/

374 Federal Communications Commission, Streamlined Submarine Cable Landing License Application Accepted for Filing (PLCN), SCL-LIC-20170421-00012, 21 April 2017. https://fcc.report/IBFS/SCL-LIC-20170421-00012/1210477

Figure 17. Map of Pacific Light Cable Network. Source: OptimizeIAS, https://optimizeias.com/pacific-light-cable-network/ (last accessed 13/02/2024)

This rested on the assumption that the FCC, like in all previous cases, would grant the landing license. However, Google, Facebook, and PLDC's application, filed in 2017, remained pending before the FCC for almost three years while awaiting Team Telecom to perform its national security scrutiny. In the meanwhile, US-China relations, which were already marked by rising tensions, became openly confrontational. As seen in **paragraph 3.2.1**, episodes such as Team Telecom's recommendation to deny China Mobile's Section 214 license gave a clear indication that the context for PLCN was no longer as favorable as it appeared just a few years prior.[375] Since Team Telecom's review had already been prolonged for more than a year and threatened to linger for even longer, in October 2018 the applicants were granted a temporary authorization to construct, connect, and test the portion of PLCN in US territory while awaiting the final landing license, as further delays in the construction process risked compromising the project's financial viability.[376] This temporary authorization provided Google and Facebook with an opportunity to save at least part of PLCN as the prospect of the FCC granting a license for the US-to-Hong Kong fiber branch became progressively more unlikely. In fact, on April 2, 2020, while the Administration was adding the last refinements to the Executive Order formalizing Team Telecom's structure, Google applied to the FCC for an authorization to temporarily activate the segment connecting the US to Taiwan for six months, pending the Commission's final deliberation on the whole project. In this occasion, the company also entered a provisional National Security Agreement with Team Telecom.[377] Consequently, on 8 April, the same day of the Executive Order's promulgation, the Department of Justice, on behalf of the other members of Team Telecom, announced that

[375] Martyn Warwick, "Dark days for the Pacific Light Cable Network", *Telecom TV*, 5 September 2019. https://www.telecomtv.com/content/submarine-network/dark-days-for-the-pacific-light-cable-network-36227/
[376] Federal Communications Commission, Request for Special Temporary Authority (PLCN), SCL-LIC-20170421-00012, 5 October 2018. https://fcc.report/IBFS/SCL-LIC-20170421-00012/1547226
[377] Federal Communications Commission, Petition to Adopt Conditions for Special Temporary Authority, SCL-STA-20200402-00015, 8 April 2020. https://fcc.report/IBFS/SCL-STA-20200402-00015/2256300

they would publicly recommend that the FCC grant this temporary request.[378] This unusual choice to publicly announce the recommendation even before submitting it to the FCC highlights the "new" Team Telecom's intention to maximize public awareness of its activities, as already noted in **paragraph 3.2.1**. Further highlighting the recommendation's double function as a message to the cable industry in general, the DoJ's public announcement contained the following clarification:

> The Provisional National Security Agreement also includes a commitment by Google to "pursue diversification of interconnection points in Asia," as well as to establish network facilities that deliver traffic "as close as practicable" to its ultimate destination. This term reflects the views of the Executive Branch that a direct cable connection between the United States and Hong Kong would pose an unacceptable risk to the national security and law enforcement interests of the United States.[379]

The Agreement cites as examples of potential alternative interconnection points Indonesia, the Philippines, Thailand, and Vietnam.[380] This serves as an indication of Team Telecom's will to balance the need to diversify trans-Pacific interconnections, which are still dangerously reliant on Taiwan and Japan, with other connectivity hubs in "safe" countries – all of which can be counted as traditional US regional allies or countries that are growing closer to Washington in efforts to balance China's prominence.

Team Telecom had made its stance on China abundantly clear, thus, subsequent developments were not as surprising. In June 2020, the now-formalized Team Telecom recommended that the FCC deny the landing license for the segment of Pacific Light landing in Hong Kong and that it grant the license for the branches landing in Taiwan and the Philippines.[381] Team Telecom's highly detailed recommendation reiterates that the approval of submarine cables landing directly in Chinese territory cannot be in the public interest of the US as these landing points would provide the Chinese government with an opportunity to acquire sensitive personal data of US citizens and use them to threaten the country's security. Among reasons for its concern, the committee cited China's intelligence and cybersecurity laws, the erosion of Hong Kong's special autonomy, as well as the close relationship between the Chinese government and Dr. Peng Group, a telecommunications company which had bought PLDC during PLCN's troubled gestation.[382] In this regard, Team Telecom raised questions about PLDC's aforementioned status as a newcomer in the industry and its

[378] US Department of Justice, Office of Public Affairs, "Department of Justice Clears on Google's Application to the Federal Communications Commission to Operate a Portion of the Pacific Light Cable Network System", 8 April 2020. https://www.justice.gov/opa/pr/department-justice-clears-google-s-application-federal-communications-commission-operate
[379] *Ibid.*
[380] National Security Agreement Between the Department of Homeland Security, Department of Justice, Department of Defense, and GU Holdings Inc., 7 April 2020, Sec. C Clause 7. https://fcc.report/IBFS/SCL-STA-20200402-00015/2256300
[381] US Department of Justice Office of Public Affairs, "Team Telecom Recommends that the FCC Deny Pacific Light Cable Network System's Hong Kong Undersea Cable Connection to the United States", 17 June 2020. https://www.justice.gov/opa/pr/team-telecom-recommends-fcc-deny-pacific-light-cable-network-system-s-hong-kong-undersea
[382] Executive Branch Recommendation for a Partial Denial and Partial Grant of the Application for a Submarine Cable Landing License for the Pacific Light Cable Network (PLCN), 17 June 2020. Available at https://subscriber.politicopro.com/f/?id=00000172-c32f-de70-a973-d7bf9d9f0000

decision to immediately embark in such a project,[383] apparently alluding to a possible involvement of the Chinese government or other government-affiliated entities behind a façade. Moreover, both PLDC and its parent company Dr. Peng's collaborations with China Unicom and Huawei, as well as their stated support for the Belt and Road Initiative, were held against them as proof of dangerous collusion with the government.[384] According to Team Telecom, it would not be possible to mitigate these national security threats with any traditional agreement with Google as the US-based landing station operator. Following this recommendation, Google, Facebook, and PLDC decided to withdraw their 2017 application. The former two firms then filed a new application in August 2020 completely excluding the Hong Kong branch, which finally received the FCC's approval in January 2022, conditional on both companies each signing a National Security Agreement.[385] PLCN was finally activated, despite a multiple-year delay. The Hong Kong-connected fiber segment remains inert, «another symbol of the increasing physical separation of the two countries' telecom sectors».[386]

Although PLCN was announced first, between 2017 and 2020 several other US-to-Hong Kong submarine projects entered development, namely Hong Kong-Americas (HKA), Hong Kong-Guam (HK-G), and the Bay to Bay Express (BtoBE). These projects, and the ample involvement of American hyper-scalers, further testifies the commercial interests in the route, which of course were disrupted by Team Telecom's revised approach. HKA was first announced in January 2018 by a consortium including Facebook, Tata, Telstra, RTI, as well as China Telecom and China Unicom, and was supposed to provide another direct link between Hong Kong and California, as well as with Taiwan.[387] By November, it had already secured its landing license in China,[388] and thus began construction, handled by the French ASN, while waiting for the FCC to grant the license. Much like PLCN's, the application remained pending for more than two years. The PLCN decision was a strong blow for HKA. Nevertheless, in December 2020 the consortium, which had already almost completed the cable, attempted to replicate Google and Facebook's strategy in PLCN by demanding a temporary license to complete the US landing segment while only activating the US-Taiwan fiber. However, while in PLCN's case Team Telecom had almost immediately recommended that the FCC granted this temporary license, in HKA's case it demanded the FCC to defer its decision until the end of another ad-hoc security screening.[389] It is likely that the discriminant, in this case, was the continued presence of the Chinese state-owned telecommunications carriers in the consortium. Faced with the

[383] Executive Branch Recommendation, 33-37.
[384] Executive Branch Recommendation, 39-46.
[385] Federal Communications Commission, Cable Landing License (PLCN), SCL-LIC-20200827-00038, 26 January 2022. https://docs.fcc.gov/public/attachments/DA-22-141A1.pdf
[386] Paul Triolo, *The Telecommunications Industry in US-China Context. Evolving Toward Near-Complete Bifurcation* (Washington: Johns Hopkins University, 2020). https://apps.dtic.mil/sti/pdfs/AD1116899.pdf
[387] Winston Qiu, "HKA Consortium and ASN Announce Deal at PTC2018", *Submarine Cable Networks*, 22 January 2018. https://www.submarinenetworks.com/en/systems/trans-pacific/hka/hka-consortium-and-asn-announce-deal-at-ptc2018
[388] China Telecom, *HKA Submarine Cable - Chung Hom Kok Project Profile* (Hong Kong: ERM, November 2018) www.epd.gov.hk/eia/register/profile/latest/dir265/dir265.pdf
[389] Federal Communications Commission, Informative (HKA) SCL-STA-20201217-00049, 12 February 2021. https://docs.fcc.gov/public/attachments/DOC-369910A1.pdf

prospects of further delays and an uncertain final verdict, the consortium decided to unilaterally withdraw its application in March 2021.[390] HK-G, Google's other Hong Kong-based project co-owned with RTI, followed a similar trajectory. Unlike the other projects, HKG would have linked Hong Kong not to the continental US but to the island of Guam, a common mid-point for trans-Pacific cables as well as home to one of the most important American military bases in the Pacific. The main intention behind HK-G was to link it to pre-existing cables already routing through the island, such as 2017's SEA-US, one of the main connections between the US and Southeast Asia.[391] A direct linkage with China would have further contributed to enhancing Guam's centrality in the submarine network, which led it to be dubbed "the Big Switch in the Pacific".[392] Once again, HK-G's application was delayed by Team Telecom's review process. Since HK-G did not include any other landing country and thus could not be readily repurposed, following the PLCN license denial, the applicants decided to withdraw before the verdict.[393] The last trans-Pacific cable to be canceled, BtoBE, had been announced in 2018 as a joint project owned by, once again, Facebook, alongside Amazon – for which it marked the first foray in the submarine cable industry alongside another trans-Pacific project, Jupiter – and China Mobile.[394] BtoBE was initially planned to connect the US to Singapore, Malaysia, and Hong Kong and to be operational by 2020, although of course it was held up by Team Telecom. In the wake of PLCN's rejection, the consortium decided to withdraw its application, only for the same members to file a new one for CAP-1, essentially a reconfigured BtoBE connecting only the US and the Philippines.[395] Nevertheless, China Mobile's continued involvement proved to be an obstacle, further confirming that Team Telecom now views any Chinese involvement in a cable project as a national security threat. China Mobile left the project in August 2021, while Amazon and Facebook filed yet another application, which, significantly, remarked that China Mobile was no longer participating in the project in

[390] Sebastian Moss, "Facebook Drops Out of Hong Kong-Americas Submarine Cable Project Due to US Pressure", *Data Center Dynamics*, 12 March 2021. https://www.datacenterdynamics.com/en/news/facebook-drops-out-hong-kong-americas-submarine-cable-project-due-us-pressure/

[391] "Construction of HK-G Submarine Cable Interconnecting with SEA-US Begins", *Lightwave*, 25 September 2017. https://www.lightwaveonline.com/fttx/cables-enclosures/article/16673639/construction-of-hk-g-submarine-cable-interconnecting-with-sea-us-begins

[392] Geoffrey L. Irving, "Leaning on the Big Switch in the Pacific: Why the United States Dominates Pacific Telecom Infrastructure", *CIMSEC*, 1 February 2023. https://cimsec.org/leaning-on-the-big-switch-in-the-pacific-why-the-united-states-dominates-pacific-telecom-infrastructure/

[393] Federal Communications Commission, Notice Of Withdrawal of Cable Landing License Application (HK-G), SCL-LIC-20191122-00037, 6 November 2020. https://www.fcc.report/IBFS/SCL-LIC-20191122-00037/2777023

[394] Winston Qiu, "NEC to Build the Bay to Bay Express (BtoBE) Cable System", *Submarine Cable Networks*, 9 July 2018. https://www.submarinenetworks.com/en/systems/trans-pacific/btobe/nec-to-build-the-bay-to-bay-express-cable-system

[395] *Submarine Cable Networks*, "CAP-1" (last accessed 13 February 2024). https://www.submarinenetworks.com/en/systems/trans-pacific/cap-1

any capacity.[396] However, in 2022 the two companies decided to withdraw their application, despite the cable being nearly completed.[397]

Despite its evident focus on China, Team Telecom also prevented the owners of ARCOS-1, a cable linking the US to fourteen Latin American countries, in service since 2002, to add a landing in Cuba. The ARCOS-1 consortium, formed by Verizon and seventeen Latin American telecommunications carriers, had sought the opportunity to provide Cuba with its first commercial cable linked to the US and its second overall, as in 2016 the FCC, following a diplomatic detente, had removed legal restrictions for direct US-Cuba connections.[398] However, in 2022, Team Telecom recommended that the FCC deny the license for modifying the cable, stating that the government of Cuba's control over national telecommunications carriers threatened US security.[399] Even in this case, however, Team Telecom cited China as a source of danger, noting that Beijing's relationship with Cuba could lead ARCOS-1 to be exploited for intelligence purposes.[400] This decision somewhat unexpected, as the Trump administration – generally more hawkish than its successor – had expressed interest in building up connectivity with Cuba.[401] However, Havana recouped from the incident: just a week after Team Telecom's decision, it struck a deal with the French company Orange to connect Cuba to Martinique via the Arimao cable, which went live in April 2023.[402]

In conclusion, what were the effects of the new US submarine cable policy? The most immediate answer is the cancellation of four projects, as well as the delayed entry into service and mandatory reconfiguration of a fifth. This means an overall loss of potential international bandwidth for the US, which as we have seen is linked with the expansion of the digital economy. However, this effect should not be overestimated: because of its numerous cable linkages, US total international connectivity is not excessively impacted by the removal of a few connections. Moreover, the canceled projects are balanced by sustained investments in trans-Pacific connections, spearheaded by hyper-scalers. As noted above, in its National Security Agreement Google committed to diversify the US cable network by establishing landings in other Asian countries; furthermore, the continuous growth of bandwidth demand in Asia-Pacific will go on to drive such initiatives. These include, among others, Meta's Bifrost, Google's TPU, and their joint project Echo,

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[396] Simon Sharwood, "Facebook and Amazon Take Over Philippines-to-USA Submarine Cable After China Mobile Quits", *The Register*, 16 August 2021. https://www.theregister.com/2021/08/16/china_mobile_quits_cap_1_submarine_cable/

[397] Anna Gross et al, "How the US Is Pushing China Out of the Internet's Plumbing", *Financial Times*, 13 June 2013. https://ig.ft.com/subsea-cables/

[398] *Submarine Cable Networks*, "ARCOS-1", last accessed 13 February 2024. https://www.submarinenetworks.com/en/systems/brazil-us/arcos-1

[399] US Department of Justice, Office of Public Affairs, "Team Telecom Recommends the FCC Deny Application to Directly Connect the United States to Cuba Through Subsea Cable", 30 November 2022. https://www.justice.gov/opa/pr/team-telecom-recommends-fcc-deny-application-directly-connect-united-states-cuba-through

[400] *Ibid.*

[401] Larry Press, "What Became of the ARCOS Undersea Cable Connection to Cuba?", *CircleID*, 1 October 2020. https://circleid.com/posts/20201001-what-became-of-the-arcos-undersea-cable-connection-to-cuba

[402] Sebastian Moss, "Submarine Cable Connecting Cuba to Martinique Begins Tests", *Data Center Dynamics*, 4 May 2023. https://www.datacenterdynamics.com/en/news/submarine-cable-connecting-cuba-to-martinique-begins-tests/

which collectively will provide the US with new connections to Singapore, Indonesia, the Philippines, and Taiwan. The repercussions on the industry, however, are more severe. Team Telecom's new security standards created significant losses for companies that had to scrap or heavily modify their projects. By the time of their cancellation, HKA, HK-G, and BtoBE/CAP-1 were almost complete, which means that, currently, a combined length of about 30,000 km of marine-grade fiber optic lies unused on the ocean's floor, a waste of several hundreds of millions of dollars.[403] In addition to materials, cable laying operations, and accessory investments, opportunity costs must be taken into account, as well as the negative effects of the delays – for example, had PLCN been allowed to enter service at its planned date, it would have generated a boost in connectivity during the peak in global bandwidth demand growth caused by the Covid-19 pandemic,[404] which would have surely created large returns for its owners. However, the most relevant element is the impact of the new US cable policy on the industry's confidence. As shown above, before 2020, receiving a landing license in the US seemed within any company's reach; today, it is clear that being "flexible and creative" is no longer sufficient to ensure success. This is compounded by serious issues of regulatory uncertainty. Despite foreign ownership of submarine cables originally being the focus of Team Telecom's review, in the last years it has become its custom to review all landing license applications, regardless of the owners.[405] Moreover, despite the Executive Order's commitment to streamline the process by setting precise deadlines, these are rarely met: as can be seen in the former cases, Team Telecom's review extends well over its official 120+90-day time limit, which creates significant financial burdens.[406] Another significant issue is that the Order also creates the possibility for Team Telecom to recommend that the FCC revoke pre-existing landing licenses if it is satisfied that there has been a fundamental change in the overall conditions, even if the same Committee had previously expressed a positive opinion.[407] This retroactive power has not yet been applied to submarine cables, although it has already resulted in the revocation of China Telecom and China Unicom's Section 214 licenses. Therefore, systems such as TPE, AAG, and NCP are constantly under the sword of Damocles. As a final element, despite the FCC's insistence that Team Telecom's formalization has improved the transparency of its decision-making process, its recommendations remain ultimately based on suspicions and risk assessments that are liable to sudden shifts.[408] As a notable example, the choice to consider a landing point in Cuba a danger partly because of its association with China opens the possibility that, in the future, other countries that are currently considered "safe" could be reassessed as threats should they grow closer to Beijing. Coupled with the possibility of revoking existing licenses, this creates a form of perpetual uncertainty over all cable projects. Combined, these issues create greater risks for the industry and contribute to a reduction in the ease of doing business in the US, a notable

[403] Gross et al, "US Pushing China Out".
[404] Paul Brodsky, "Internet Traffic and Capacity in Covid-Adjusted Terms", *Telegeography*, 27 August 2020. https://blog.telegeography.com/internet-traffic-and-capacity-in-covid-adjusted-terms
[405] Joseph B. Keller, "The Disconnect on Undersea Cable Security", *Lawfare*, 7 May 2023. https://www.lawfaremedia.org/article/the-disconnect-on-undersea-cable-security
[406] David Plotinsky, *Analysis: How Team Telecom Can Conduct Faster Reviews in No-Risk Cases* (Morgan Lewis, April 2023). https://www.jdsupra.com/legalnews/analysis-how-team-telecom-can-conduct-5869415/
[407] Triolo, *The Telecommunications Industry*, 14.
[408] Keller, "The Disconnect on Undersea Cable Security".

inversion for a country that has historically been very open to private investments – which enhanced its status as the cornerstone of the global submarine cable network. In **paragraph 3.6**, we will assess whether these negative effects are justified by enhanced cable security.

3.3 The diplomatic offensive against HMN

Another significant element of the new US submarine cable policy is the attention given to cable suppliers. Again, US actions demonstrate a sharp focus on Chinese companies, as Washington has increasingly targeted HMN in an attempt at restricting its access to important projects. In this case, the US government has targeted HMN's activity in other countries, seeking to restrict its role in the cable market. The fundamental difference is that, while with cable landing licenses the US government could target Chinese companies through regulatory means, for what concerns HMN it had to apply a mixture of diplomatic pressures and incentives, both on foreign governments and firms.

The boycott of HMN actually predates the reform of Team Telecom and, in general, the spike in the US government's attention toward submarine Internet cables. This is because the company was affected by its affiliation with Huawei, which was the first Chinese tech firm to be involved in the rising tensions between Washington and Beijing. Already in 2012, well before the launch of China's DSR, the House Intelligence Committee had concluded that Huawei equipment posed a risk to national security because of its close relationship with the Chinese government.[409] However, at the time, the Committee limited itself to recommend that the US public administration be barred from employing Huawei products. The company became the primary target of anti-Chinese efforts in 2019, when the Trump administration issued a series of measures effectively banning US firms from purchasing Huawei equipment and from selling critical telecommunications technology to it without special approval.[410] In addition, the US made strong pressures on its allies, especially the European Union, to similarly exclude Huawei from their networks.[411] The campaign against Huawei was the reason for Huawei Marine Networks' sale to Hengtong and its rebranding to HMN, as anticipated in **paragraph 2.7.2**, in an attempt at evading restrictions. However, this was not sufficient for evading US legislators: in 2021, HMN Technologies was inserted in the Bureau of Industry and Security Entity List, restricting it from import-exports with the US.[412] It was also noted that Hengtong had similar connections to the Chinese government, as its founder Cui Genliang is a former army officer and

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[409] Michael S. Schmidt, Keith Bradsher, and Christine Hauser, "U.S. Panel Cites Risk in Chinese Equipment", *New York Times*, 8 October 2012. https://www.nytimes.com/2012/10/09/us/us-panel-calls-huawei-and-zte-national-security-threat.html

[410] Eric Geller, "Trump Signs Order Setting Stage to Ban Huawei from U.S.", *Politico*, 15 May 2019. https://www.politico.com/story/2019/05/15/trump-ban-huawei-us-1042046 ; David Shepardson and Karen Freifeld, "Trump Administration Hits China's Huawei With One-Two Punch", *Reuters*, 16 May 2019. https://www.reuters.com/article/idUSKCN1SL2QX/

[411] Robin Emmott, "U.S. Renews Pressure on Europe to Ditch Huawei in New Networks", *Reuters*, 29 September 2020. https://www.reuters.com/article/idUSKBN26K2MY/

[412] Jill C. Gallagher, *Undersea Telecommunication Cables: Technology Overview and Issues for Congress* (Washington, DC: CRS, 13 September 2022), 17. https://crsreports.congress.gov/product/pdf/R/R47237

member of the National People's Congress.[413] Nevertheless, diplomatic measures against HMN were taken well before its entry into the entity list.

The first diplomatic incident affecting Huawei Marine did not involve the US but the Australian government, although it is indicative of both the Chinese company's modus operandi and the concerns it raises. In 2012, the Asian Development Bank issued financing for the construction of the first submarine cable connecting the Solomon Islands, which, like many other Southern Pacific island-nations, were still entirely reliant on satellite connections, to Papua New Guinea and Australia. However, in 2017, Solomon's government suddenly announced its decision to withdraw from the ADB's ongoing tender and directly contract Huawei Marine as a supplier.[414] Allegedly, Huawei helped secure this contract through a donation to the Islands' ruling party.[415] However, Australia, which was already in the process of studying a ban on Huawei's equipment, expressed concerns that the Chinese company's involvement would pose a risk to the security of Pacific telecommunications.[416] Eventually, the Australian government managed to convince the Solomon Islands to revoke Huawei Marine's contract by mixing diplomatic pressures with the pledge to entirely fund the cable project, which finally entered service in 2020 under the name of Coral Sea Cable System (CS^2), built by ASN.[417] There is no official notice of any involvement of the United States in the case of CS^2. However, the close relationship between the two countries, both members of the Five Eyes intelligence alliance and the Quadrilateral Security Dialogue (Quad), makes it plausible that the nations' respective security bodies would at least exchange notes on the matter.

In fact, the US government would intervene directly in a very similar case concerning the East Micronesia Cable System, another project designed to connect several island nations of the Sothern Pacific, this time financed in conjunction by the World Bank and ADB. The tender, launched in 2017, attracted bids from ASN, NEC, and HMN.[418] The latter's bid was more than 20% below its rivals, a common occurrence with HMN, which has been linked to the availability of conspicuous state subsidies from the Chinese government.[419] This dumped price seemed to tilt the tender in favor of HMN. However, in 2020 the US government issued a formal security warning to the Micronesian nations raising concerns over HMN's involvement, soon followed by Taiwan and its historical ally Nauru, one of the cable's intended landing

413 Francesco Bechis, "Undersea Cables: The Great Data Race Beneath the Oceans", *ISPI*, 28 May 2021. https://www.ispionline.it/en/publication/undersea-cables-great-data-race-beneath-oceans-30651

414 Jonathan Brewer, "Re-Alignment of Submarine Cables in Asia and the Pacific". Presentation at APNIC '54 (Singapore, September 2022). https://conference.apnic.net/54/assets/files/APSG129/brewerjsubcablesapni_1663118787.pdf

415 David Wroe, "Solomon Islands Undersea Cable Red-Flagged by Australia's Spy Agencies Dogged by Donation Allegations", *Sydney Morning Herald*, 19 August 2017. https://www.smh.com.au/politics/federal/solomon-islands-undersea-cable-redflagged-by-australias-spy-agencies-dogged-by-donation-allegations-20170818-gxzlgd.html

416 *Ibid.*

417 Brewer, "Re-Alignment of Submarine Cables".

418 *Ibid.*

419 Gross et al, "US Pushing China Out".

sites.[420] In addition, Mike Pompeo was the first Secretary of State to visit Micronesia, where he committed to financial assistance in infrastructure projects.[421] However, the situation stalled as Kiribati, another landing party which had established close relations to China, reiterated its preference for HMN. In June 2021, the World Bank solved the impasse by declaring all three bidders non-compliant on a technicality and cancelling the tender.[422] A few months later, the US government officially announced the establishment of a partnership with Australia and Japan to provide full funding for a new cable connecting Micronesian countries,[423] including Kiribati, which has demonstrated great proficiency in playing the US and China one against the other to gain more concessions.[424] HMN sources expressed great dissatisfaction with the World Bank, connecting its decision to terminate the bid to American pressures.[425] As can be seen, the US mirrored Australia's behavior regarding CS^2: it complemented warnings in terms of network security with donations to balance the financial advantage provided by HMN's underpriced offers, as well as with side initiatives and promises of further infrastructure investments. The notable difference is that, while Australia was a landing point in CS^2, the US had no direct involvement in the East Micronesia Cable aside from a planned interconnection between the new system and HANTRU1, which has a landing in Guam.[426]

The third case to be analyzed involves the sixth South East Asia-Middle East-Western Europe cable system (SEA-ME-WE 6). The series of SEA-ME-WE cables represents an important part of the history of the submarine network, as they provided the first diversification from the US-centric trans-Oceanic routes by linking Europe, Africa, and Asia through the Suez Canal and Bab-al-Mandab (see **paragraph 2.5**). The route is also notable for its consistency in the number of systems deployed annually, an exception in the highly cyclical cable industry.[427] Set to enter service in 2025, SEA-ME-WE 6 will have a total length of 21,700 km, connecting Singapore to France with stops in fifteen other countries.[428] Chinese telecommunications carriers have historically been highly active in the route, having already participated in the consortia for SEA-ME-WE 3 (1999) and 5 (2016), as well as in Asia Africa Europe-1 (AAE-1, 2017) and of course PEACE, which,

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[420] Jonathan Barrett, "U.S. Warns Pacific Islands About Chinese Bid for Undersea Cable Project", *Reuters*, 18 December 2020. https://www.reuters.com/article/idUSKBN28R0KW/
[421] "U.S.-Japan Dueling China for Influence in Indo-Pacific Region", *Asahi Shimbun*, 1 June 2020. https://www.asahi.com/ajw/articles/13394985
[422] Sebastian Moss, "East Micronesia Subsea Cable Scrapped as US Says Chinese Firms Pose Threat", *Data Center Dynamics*, 18 June 2021. https://www.datacenterdynamics.com/en/news/east-micronesia-subsea-cable-scrapped-as-us-says-chinese-firms-pose-threat/
[423] US Department of State, "Joint Statement on Improving East Micronesia Telecommunications Connectivity", 11 December 2021. https://www.state.gov/joint-statement-on-improving-east-micronesia-telecommunications-connectivity/
[424] Kirsty Needham, "Kiribati Atoll 2,000 km from Hawaii Gets U.S. Wharf as China Eyes Airport", *Reuters*, 26 October 2023. https://www.reuters.com/world/kiribati-atoll-2000-km-hawaii-gets-us-wharf-china-eyes-airport-2023-10-26/
[425] Jonathan Barrett and Yew Lun Tian, "East Micronesia Cable Stalls After U.S. Security Concerns", *Submarine Telecoms Forum*, 18 June 2021. https://subtelforum.com/east-micronesia-cable-stalls-after-u-s-security-concerns/
[426] Brewer, "Re-Alignment of Submarine Cables".
[427] Submarine Telecoms Forum, *Industry Report*, 162.
[428] Submarine Cable Networks, "Sea-Me-We 6" (last accessed 14 February 2024). https://www.submarinenetworks.com/en/systems/asia-europe-africa/smw6

seen in **paragraph 2.7.2**, currently represents the apex of China's DSR.[429] Thus, it is little surprise that China Mobile, China Telecom, and China Unicom would all be part of the consortium, alongside Orange, Microsoft, and several other carriers from the landing countries. However, the high level of participation on behalf of Chinese firms can also be explained with the intention to replicate PEACE's success by having HMN win the contract as supplier. In this way, Chinese companies would acquire a significant stake in Asia-Europe connectivity, as PEACE and Sea-Me-We 6 are among the cables offering the highest capacity in the region.

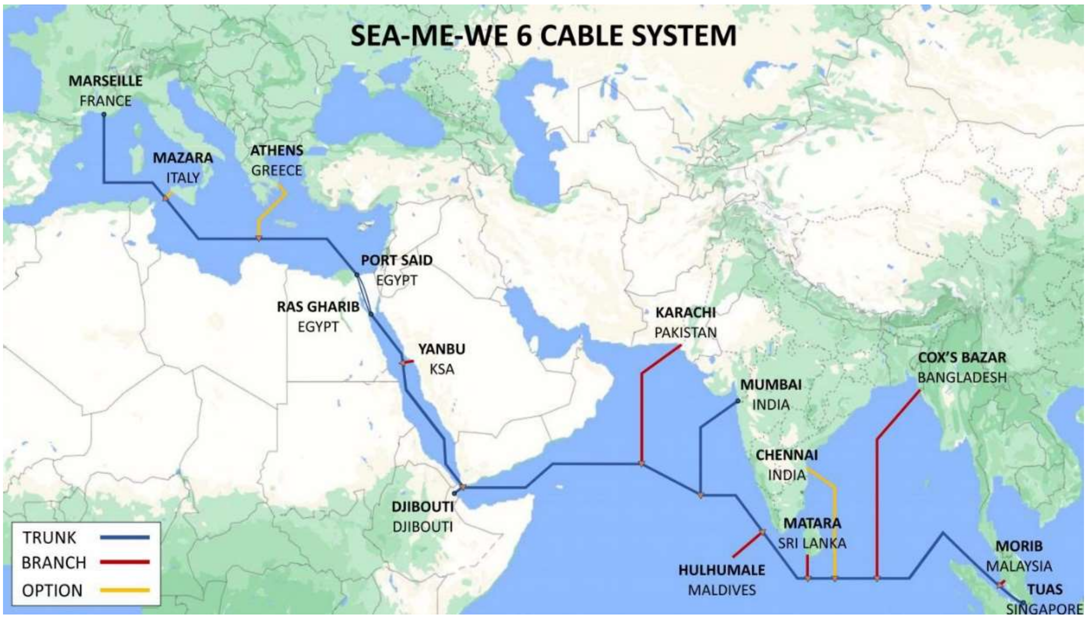

Figure 18. Map of SEA-ME-WE 6. Source: Total Telecom, "Work Begins on SEA-ME-WE 6 Submarine Cable", 21 February 2022. https://totaltele.com/work-begins-on-sea-me-we-6-submarine-cable/

As revealed years later by a landmark report from journalist Joe Brock, in 2020, HMN was on the verge of winning the contract, thanks to the Chinese carriers' strong support and to a $500 million bid that was, once again, about one third cheaper than that of its competitor SubCom.[430] Unlike with the East Micronesia Cable, the US did not issue public statements on the matter, perhaps seeing the involvement of multiple Middle Eastern countries, as well as France, as requiring a less heavy-handed approach. Behind the scenes, however, the US launched a whole-of-government campaign in favor of SubCom. This included a loan from the Federal Export-Import Bank, which enabled SubCom to lower its bid to about $600 million, a diplomatic campaign advocating for further commercial cooperation with the US, as well as million-dollar training grants distributed by the US Trade and Development Agency to the national telecom companies of Egypt, India, Djibouti, Sri Lanka, and the Maldives.[431] However, the strongest factor influencing the final outcome was the warning, conveyed through diplomatic channels, that the US government would consider the adoption of sanctions against HMN in the future: these would have prevented US hyper-scalers from

[429] Aluf, *China's Subsea-Cable Power Play*, 3.
[430] Joe Brock, "U.S. and China Wage War Beneath the Waves – Over Internet Cables", *Reuters*, 24 March 2023. https://www.reuters.com/investigates/special-report/us-china-tech-cables/
[431] *Ibid.*

leasing bandwidth on SEA-ME-WE 6, destroying its commercial viability.[432] After tense negotiations, in February 2022 the consortium announced that SubCom had finally been awarded the contract.[433] The same month, China Mobile and China Telecom withdrew from the project, although China Unicom, for the moment, has maintained its stake in the consortium.[434] Although consortium president Yue Meng Fai attempted to minimize the incident,[435] it is difficult not to see it as a retaliation against US maneuvers. As further proof, in April 2023, the press leaked plans on the part of the three Chinese carriers for the construction of the Europe-Middle East-Asia (EMA) cable, which would connect Hong Kong to France through Singapore, Pakistan, Saudi Arabia, and Egypt.[436] EMA would largely overlap with SEA-ME-WE 6. While re-using the same route is a common feature of the industry, there is no precedent for two cables being built almost simultaneously on the same exact path – which is also liable to create incidents with overlapping cable laying permits. Although no news on EMA have surfaced since the leak, should it be greenlit, it would mark a further step towards the physical separation of the US and Chinese Internets (see **paragraph 3.7**).

3.4 Other cable-adjacent measures

Although the review of the landing license screening process and the diplomatic offensive against HMN are the main elements of Washington's activism toward submarine Internet cables, there are additional measures, either enacted or proposed, signaling an increased legislative interest in the matter.

In August 2020, during the salient phases of the PLCN incident, the Trump Administration announced its Clean Network initiative, a program based on the formation of a coalition of «freedom-loving countries» and «trusted partners» to increase cybersecurity by ousting untrustworthy tech companies from their Internet networks.[437] These companies were of course explicitly identified with Chinese ones. The Clean Network program included six components: Clean Carrier, Clean Store, Clean Apps, Clean Cloud, Clean Cable, and Clean Path, which sought to name and shame dangerous vendors involved in the provision of every Internet-adjacent service, including submarine cables as well as other physical infrastructure, content applications, hardware, and software.[438] As noted by Burdette, this initiative represented the culmination of an isolationist strategy, as its implementation would logically require the US and its allies to completely insulate themselves

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[432] *Ibid.*

[433] Winston Qiu, "SubCom Announces SEA-ME-WE 6 Contract in Force", *Submarine Cable Networks*, 22 February 2022. https://www.submarinenetworks.com/en/systems/asia-europe-africa/smw6/subcom-announces-sea-me-me-6-contract-in-force

[434] Anna Gross and Alexandra Heal, "China Pulls Back from Global Subsea Cable Project as US Tensions Mount", *Financial Times*, 10 February 2023. https://www.ft.com/content/8f35bf1e-fe32-4998-9e13-a13bac23506d

[435] Saf Malik, "All Aboard SEA-ME-WE 6", *Capacity Media*, 19 May 2023. https://www.capacitymedia.com/article/2boihe41ommbeopfcmvb5/big-interview/all-aboard-sea-me-we-6

[436] Joe Brock, "China Plans $500 Million Subsea Internet Cable to Rival US-Backed Project", *Reuters*, 6 April 2023. https://www.reuters.com/world/china/china-plans-500-mln-subsea-internet-cable-rival-us-backed-project-2023-04-06/

[437] U.S. Department of State, "The Clean Network". https://2017-2021.state.gov/the-clean-network/ (archived content: last accessed 15 February 2024).

[438] *Ibid.*

from all networks including Chinese-manufactured components.[439] However, given the interconnected nature of the Internet and its inner functioning mechanisms (see **paragraph 3.6**), this program was evidently unimplementable if not at the price of completely unraveling the digital ecosystem. For this reason, the Biden Administration, despite prosecuting and refining its predecessor's opposition on Chinese-made submarine cables, quietly cancelled the Clean Network program.[440]

Other measures address the risks posed by the intentional or unintentional damage of cable systems. In 2019, Congress voted to institute the Cable Security Fleet, designed to mitigate the scarcity of cable repair ships, which could prove disastrous during an international crisis.[441] The CSF consists of two privately-owned US-flagged cable ships. In ordinary circumstances, these ships participate in normal commercial cable laying and repair operations; however, upon the declaration of a national emergency, they are to be immediately placed at the government's disposal. Unsurprisingly, the choice fell on two ships belonging to SubCom's fleet, CS Dependable and CS Decisive.[442] Moreover, the two ships are required to be entirely staffed with US citizens and receive a $5 million annual stipend as compensation for the increased costs of maintaining a US crew and complying with the requirements to fly a US flag.[443] This disposition is interesting because it highlights tensions between national security requirements and the globalized nature of the cable industry: cable repair ships usually have highly diverse crews, whose loyalties could be conflicting in case of war.[444] In addition, in March 2021 the US Navy awarded contracts for the construction of two next-generation cable repair ships that will replace the 40 years old UNSN Zeus, the Navy's only cable repair ship currently in service. The Navy will commit up to $1.4 billion for each unit.[445] Furthermore, Congress has received multiple recommendations for the institution of cable protection zones, sectors of national waters where naval activities are restricted to minimize the risk of damage to undersea cables, a solution adopted by both Australia and New Zealand.[446]

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[439] Lane Burdette, "Leveraging Submarine Cables for Political Gain: U.S. Responses to China", *Journal of Public and International Affairs*, 5 May 2021. https://jpia.princeton.edu/news/leveraging-submarine-cables-political-gain-us-responses-chinese-strategy ; Robert K. Knake, "What's Wrong with the Clean Network Initiative? China Can't Join It", *CFR*, 30 September 2020. https://www.cfr.org/blog/whats-wrong-clean-network-initiative-china-cant-join-it

[440] Mike Dano, "Biden May Retire Trump's 'Clean Networks' Campaign Against Huawei", *LightReading*, 11 February 2021. https://www.lightreading.com/security/biden-may-retire-trump-s-clean-networks-campaign-against-huawei

[441] 46 USC Ch. 532: Cable Security Fleet, https://uscode.house.gov/view.xhtml?req=granuleid%3AUSC-prelim-title46-chapter532&edition=prelim (last accessed 14 February 2024).

[442] Joe Brock, "Inside the Subsea Cable Firm Secretly Helping America Take on China", *Reuters*, 6 July 2023. https://www.reuters.com/article/us-china-tech-subcom-idUSL1N38P1Z3

[443] Douglas R. Burnett, "Repairing Submarine Cables Is a Wartime Necessity", *Proceedings* Vol. 148/10/1,436 (October 2022). https://www.usni.org/magazines/proceedings/2022/october/repairing-submarine-cables-wartime-necessity

[444] Burnett, "Submarine Cable Security", 1679-1680.

[445] AMI International, *Future Cable Repair Ship (T-ARC(X))* (Bremerton, WA: AMI, February 2024). https://amiinter.com/wnpr/pdfami/pdfex/amiproject.php?newcontID=1120&countryID=68

[446] Jill C. Gallagher and Nicole T. Carter, *Protection of Undersea Telecommunications Cables: Issues for Congress* (Washington, DC: CRS, 7 August 2023). https://sgp.fas.org/crs/misc/R47648.pdf

For what concerns, on the other hand, China-focused measures, in March 2023 the House of Representatives approved, with a bipartisan majority, Congressman Mast's bill for an Undersea Cable Control Act, whose aim is «to protect American superiority in undersea cable capabilities from China's economic and military reach».[447] If approved by the Senate, the Act would require the President to develop a strategy to restrict the access of «foreign adversaries» – a definition that, as specified in the bill itself, includes China – to goods and technologies supporting the construction, maintenance, or operation of submarine cables.[448] The bill also calls for intensifying efforts «to promote United States leadership at international standards-setting bodies for equipment, systems, software, and virtually defined networks relevant to undersea cables»,[449] as well as to reduce foreign adversaries' influence in the same bodies. Rather than introducing specific regulations, the bill's main function is to call on the Executive branch for further actions against China's influence in the cable industry. Thus, should it not become law before the end of the current Congress, its bipartisan support serves as a simple indication that US authorities have the intention to maintain their current policy stance on submarine cables in the future.

3.5 Subverted expectations

Having studied all instances where the US government intervened in the development of new submarine cable networks, we are now able to better define the contours of its new policy, as well as to identify the elements marking a difference with Washington's traditional stance on the matter. As we have seen, the revised approach to submarine Internet cables is centered on a perceived threat coming from China's involvement in the industry. Although there was a single instance of a cable landing license being denied involving a different country, Cuba, even in that case Team Telecom's decision made specific reference to Havana's relationship with China as an element leading to its final recommendation. From our case studies, we can determine that the US government sees all three of these circumstances as posing a threat to national security:

1. The construction and activation of a submarine Internet cable with landing points both in the US and in China.
2. The involvement of a Chinese telecommunications carrier as (co-)owner and operator of a cable with a landing point in the US.
3. The involvement of a Chinese company as supplier for a cable, even if it has no landing points in the US.

It is safe to assume the US would also oppose the choice of a Chinese supplier for a cable project landing in the US even if it did not involve other Chinese companies as co-owners. On the other hand, there is no evidence of American authorities acting against the participation of Chinese telecommunications carriers in

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[447] Brian Mast, "Mast Bill to Limit China's Ability to Develop Critical Undersea Cables Passes House", 27 March 2023. https://mast.house.gov/2023/3/mast-bill-to-limit-china-s-ability-to-develop-critical-undersea-cables-passes-house
[448] Undersea Cable Control Act, H.R. 1189, 118th Cong. (2023). https://www.congress.gov/bill/118th-congress/house-bill/1189/text
[449] *Ibid.*, Sec. 2b (7).

cable projects overseas as long as HMN is not the supplier – as seen with the continued membership of China Unicom within the SEA-ME-WE 6 consortium. However, given the confidential nature of these maneuvers (US pressures on the same project became publicly known only years after the fact), it cannot be excluded that Washington has tried to influence the construction of other cable systems without success. Conversely, we do know that, for the moment, Team Telecom has not opted for a review and possible revocation of existing cable landing licenses for already existing systems directly linking the US to China (AAG, TPU, NCP) or involving Chinese ownership (FASTER). This measure would have serious repercussions on the industry at large, as well as severely reduce capacity on the trans-Pacific route, although it will become more viable – strictly in terms of bandwidth – within 2025, when other trans-Pacific projects such as Topaz, Echo, TPU and JUNO will provide a significant connectivity boost. It is more surprising that the US has not taken action for what concerns the involvement of Chinese companies in providing cable repairs. For instance, in 2022, according to the *Financial Times*, a Chinese cable repair ship fixed a cable belonging to AT&T and Verizon and another one owned by Microsoft and Softbank (although it should be noted that, from this description, it is highly likely that the cables in question are, respectively, TPE and NCP, which are already "compromised" by Chinese involvement).[450] Furthermore, although the US threatened to ban American digital companies from leasing capacity on cables owned by HMN, it has not prevented them from exchanging traffic with Chinese ISPs. This is important, because, as we will see below, it means that US Internet data can still flow through Chinese-supplied, owned, and operated networks.

Before addressing this issue, however, it is important to underline the ways in which the new cable policy differs from what could be expected of the US based on theoretical evaluations as well as on the general political principles associated with the US. There are multiple elements that concur to making Washington's increasingly aggressive conduct difficult to reconcile with past assumptions. The first factor is that, in order to preserve and enhance its centrality in the global submarine cable network, the US would be expected to look favorably at opportunities to add new cables to its shores. Instead, as a consequence of Team Telecom's enhanced security screenings, four potential additions to the American undersea network were ultimately canceled. As already noted in **3.2.3**, thanks to its already robust connections and its ongoing ability to attract new investments, the US is not as impacted by the cancellation of these projects. Still, the industry's interest in constructing these cables in the first place highlights the need for enhanced connections between two of the largest countries in the Internet landscape. Team Telecom itself acknowledged the commercial relevance of the initiatives, although it ultimately placed it on the losing side on a trade-off against perceived security risks. This marks a noticeable difference from the levels of openness that enabled the US to become the world's core connectivity hub in the first place. Somewhat ironically, in 2019 Hillman, drawing a parallel between 19th century Great Britain and modern-day China's DSR initiative, and analyzing the difficulties for foreign firms to land a cable in China without partnering with local firms, commented:

> During the global telegraph race, unlike most countries, Britain granted rights for landing cables on its territory without restrictions. Far from weakening its firms, this helped turn London into the global communications and

[450] Gross et al, "U.S. Is Pushing China Out".

> financial hub it remains today. Ultimately, China's best answer to suspicions about its activities abroad would be greater openness at home.[451]

It is, in fact, a remarkable occurrence that China, by accepting the involvement of US-based tech companies such as Google, Amazon, Meta, and SubCom, would appear as the economy more open to foreign investments of the two. It should also be noted that, given China's relative lack of inter-regional connectivity (see **paragraph 2.7.2**), the new cables landing in Hong Kong would have likely increased Beijing's dependence on the US for international bandwidth, rather than the contrary.

A second significant element is that these new policies see the government interfere quite directly within private market initiatives. This marks an inversion from Washington's traditional private-centric approach and the presumption that private choices and competition will be the best guarantors of an efficient infrastructure network. This is particularly relevant in this context because the preference for private initiatives, a core tenet of American ideology, has contributed to shaping the very intrinsic nature of the Internet, as seen in **paragraph 2.3.2**. The diplomatic offensive against HMN's activities abroad can be framed as a form of non-tariff barrier. It could be argued that these actions were a necessary counterbalance to the adoption of similar strategies by China, which, as we have seen, also uses dumping practices and, allegedly, illegal side payments to promote its companies' business deals. Nevertheless, the pressures on the World Bank and foreign governments represent a heavy-handed governmental intervention within private competition dynamics. Furthermore, Team Telecom's enhanced security reviews is also exerting a strong governmental influence on the US cable industry. In addition to generating regulatory uncertainty and creating further risks for companies willing to invest in interconnections with the US, as already described in **paragraph 3.2.3**, Team Telecom's recommendations have the effect of shaping and constraining private investment choices. This is most evident in the explicit request, contained in Google's National Security Agreement, for US firms to pursue a differentiation of landing points by investing in countries such as Singapore, the Philippines, Indonesia, and Vietnam.[452] There are several reasons why private companies, absent governmental pressures, would have preferred landing their cables in Hong Kong rather than in these countries. As seen in **paragraph 2.7.2**, Hong Kong is one of the most important intra-Asian connectivity hubs and data regions. Moreover, its Internet exchange points offer some of the cheapest transit prices in the continent.[453] While Singapore already surpasses Hong Kong's relevance and is set to further expand its centrality,[454] the same cannot be said for the other cited nations. Although new cable investments might allow them to evolve into regional hubs, more cable connections are not sufficient: these governments must also solve serious problems such as low Internet penetration rates, high costs, regulatory issues, and geographical

[451] Hillman, "War and PEACE".
[452] Department of Justice, "Department of Justice Clears on Google's Application".
[453] Alan Mauldin, "The Subsea Cold War", presentation at *Submarine Networks World 2023*, Singapore (28 September 2023). https://blog.telegeography.com/submarine-networks-world-2023
[454] Tsubasa Suruga, "Singapore to Double Subsea Cable Landings in Digitization Push", *Nikkei Asia*, 5 June 2023. https://asia.nikkei.com/Business/Telecommunication/Singapore-to-double-subsea-cable-landings-in-digitization-push

constraints increasing the chance of cable faults.[455] Furthermore, another reason for the hyper-scalers' interest in connecting to Hong Kong is that their services are, for the moment, still available in the region; forcing a (literal) re-shoring might provide China with the pretext to accelerate the erosion of Hong Kong's residual Internet freedom and ban American content providers from this vital market.[456]

This last consideration leads us to a third element of great importance. The new US policy undermines the core ideological tenets supporting the process of globalization in general, and the globalization of the Internet in particular. Arguments in favor of the globalization of trade and information flows usually rest on the assumption, rooted in international liberalism, that the growing interconnectedness between the world's economies, the erosion of borders and barriers, and the establishment of cooperative governance will reduce conflict, create diffused prosperity, foster stability, and promote the diffusion of democracy on a global scale.[457] The Internet was especially seen as an intrinsically democratizing force by design (see **paragraph 2.3**). In fact, China's decision to adopt it was seen as the beginning of the Communist Party's inevitable fall. In a now-infamous 2000 speech, President Clinton compared China's early censorship program to «trying to nail Jello to the wall».[458] The development of China's unique blend of repression and technological advancement would disprove him. Nevertheless, the fact that the US government now sees the mere interconnection with China as a threat to the nation marks a drastic change in perceptions. As noted above, the 1996 National Security Strategy portrayed China's integration within global networks as the key strategy to ensure its eventual transformation into a liberal country.[459] Even in the face of increasing Internet repression and the ban of several US companies from the Chinese Internet, under both the Bush and Obama administrations the main focus of US policy initiatives was to promote Internet freedom, which included efforts to provide Chinese citizens with access to anti-censorship resources.[460] In this sense, Google, Facebook, and other American companies' activities in China should be seen as an opportunity to challenge the Party's dominance over the network: in fact, insulating Hong Kong signifies forcing its citizens to rely entirely on Chinese digital firms, which will likely erode their remaining access to free information. That the US would see a vulnerability rather than an opportunity in these projects signals a loss of confidence in the

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455 Shermaine, "Trans-Pacific Cable Chaos"; William Yuen Yee, "Indonesia Isn't Ready to Become Asia's Submarine Cable Hub", *Foreign Policy*, 31 August 2023. https://foreignpolicy.com/2023/08/31/indonesia-submarine-cable-internet-meta-google-us-china-competition/ ; Luu Quy, "Vietnam to Build Three Undersea Cables, Ministry Says", *The Star*, 14 February 2023. https://e.vnexpress.net/news/news/vietnam-to-own-three-undersea-cables-by-2025-information-ministry-4570649.html

456 Xinmei Shen, "Google Executive Says Company Is Committed to Hong Kong Amid Fear of Search Engine Pull-Out Over Potential Protest Song Ban", *South China Morning Post*, 15 June 2023. https://www.scmp.com/tech/big-tech/article/3224224/google-executive-says-company-committed-hong-kong-amid-fear-search-engine-pull-out-over-potential

457 G. John Ikenberry, "The End of Liberal International Order?", *International Affairs* Vol. 94 No. 1 (2018): 7-23. https://doi.org/10.1093/ia/iix241.

458 Bethany Allen-Ebrahlmlan, "The Man Who Nailed Jello to the Wall", *Foreign Policy*, 29 June 2016. https://foreignpolicy.com/2016/06/29/the-man-who-nailed-jello-to-the-wall-lu-wei-china-internet-czar-learns-how-to-tame-the-web/

459 Clinton, *National Security Strategy*, 40-41.

460 Thomas Lum, Patricia Moloney Figliola, and Matthew C. Weed, *China, Internet Freedom, and U.S. Policy* (Washington, DC: CRS, 13 July 2012). https://www.files.ethz.ch/isn/150775/195388.pdf

Internet's potential to advance American values. Moreover, by creating an explicit distinction between safe and unsafe landing countries, the US contributes to destroying the illusion of a borderless Internet which dominated early discourse on the network.[461] The canceled Clean Network campaign was the logical conclusion of a sentiment that still appears to dominate American cable policies. As described in **paragraph 2.5**, submarine cables form a truly global infrastructure network, where the addition of each new cable system improves the capability and resilience of the whole Internet. This is compounded by the Internet's design choices: as explained in **paragraph 2.3.1**, the BGP ensures that data flows freely through the Internet, hopping from system to system, based entirely on calculations of available bandwidth and latency, without any regard for political geographies. To identify landing points as friendly or hostile means going against the very nature of the network – a nature that has been shaped by the values of the US itself. This is also the reason why the policy's effects on security are dubious, as will be seen in the following paragraph.

In conclusion, as negative repercussions on the US itself, the new cable policy: prevented the realization of planned interconnections and cast a shadow of uncertainty over future ones; negatively affected US-based companies; and weakened fundamental ideological tenets inspiring the current, US-shaped global infrastructure regime. On the positive side, it succeeded in preventing the further involvement of Chinese companies in submarine cables landing on US shores and forced them out of several important investments overseas. The question that arises, however, is if the gains justify the losses. As noted in **Chapter 1**, the interconnection of infrastructure networks inevitably forces states to relinquish a degree of control over their own national infrastructures. Submarine cables do not make an exception. As we have seen, even authoritarian countries accept the trade-off between the advantages of interconnection and the circumstantiated loss of autonomy. At this point, we must wonder whether the threat that the US recognize in China's submarine cable operations is so dangerous as to require extreme measures such as pursuing complete disconnection, rather than simple mitigating solutions such as those that were already applied prior to 2020. This, however, will require us to gain a better understanding of what exactly are the contours and implications of this perceived threat.

3.6 Explaining the shift: a security perspective

As seen in the case studies, the main argument used by US authorities to justify their renewed attention to submarine cables is that the involvement of Chinese actors within this critical infrastructure network poses unacceptable national security risks. It is necessary, however, to understand what these risks are exactly and how effectively the new US policy addresses them. The most frequently cited concerns related to submarine Internet cables are their possible exploitation for intelligence collection purposes and their vulnerability to sabotage and military attacks.

The exposure of submarine cables to attacks is not a new theme. As noted in **paragraph 3.2.2**, the early securitization of cable landing licenses in the US stems from concerns that cable segments or landing

[461] Goldsmith and Wu, *Who Controls the Internet?*

stations could be targeted by terrorist groups.[462] After the Russian invasion of Crimea, during the early phases of which Russia's "little green men" cut the fiber optic cables connecting the peninsula to mainland Ukraine, these fears were reframed in the context of hybrid war operations.[463] Furthermore, the sabotage of the Nord Stream 2 pipeline in 2022 generated new concerns for the vulnerability of subsea infrastructure, prompting the Navy forces of various countries to devote greater resources to submarine surveillance.[464] These fears are well-justified, considering that cable faults can have a serious impact on Internet connectivity and, at the same time, can be damaged without the need to employ sophisticated means: in fact, fishing activities and anchoring accidents are the main cause of disruptions. In 2007, Vietnamese fishermen were able to steal more than 200 km of fiber optic from two submarine cables, almost completely cutting off the country from the Internet.[465] That these events are common occurrences enables to cover malicious activities under plausible deniability. For instance, in 2023, two Chinese ships severed all cables connecting Matsu to Taiwan's main island.[466] According to Taipei, it was a deliberate sabotage, but this is extremely difficult to prove. In addition, cables can be disrupted through cyberattacks targeting their remote network management software,[467] as proven by the thwarted hacking of an undersea cable in Hawaii, in 2022.[468] It is therefore sensible that the US would devote new attention to securing the physical integrity of its cables. However, of all the measures seen hereto, only the institution of the Cable Security Fleet (**paragraph 3.4**) actively contributes to this goal. Conversely, there is no apparent correlation between the reduction of direct connections to China and sabotage risks. The only plausible justification rests in fears that cable suppliers or operators might intentionally compromise the system's physical integrity,[469] in a more malicious form of "planned obsolescence".[470] However, given the ease with which cables can be damaged, there is no apparent need for the Chinese authorities to take such a roundabout approach; moreover, no cable planned to land in the US had a Chinese company as supplier. In fact, the strategy could even prove counterproductive, as far as sabotage is involved. This is because researchers have suggested that, given the multiple points of

[462] Starosielski, *The Undersea Network*.
[463] Sherman, *Cyber Defense Across the Ocean*, 5.
[464] John Leicester, "A Deep Dive into Risks for Undersea Cables, Pipes", *AP News*, 30 September 2022. https://apnews.com/article/russia-ukraine-business-economy-baltic-sea-82d5453f9b4a20b858cb61d83cd84a7c ; Pietro Batacchi, "Intervista al Capo di Stato Maggiore della Marina Militare", *Rivista Italiana Difesa* No. 3, March 2023.
[465] Jeslyn Tan, "Challenges to Submarine Cable Connectivity in Southeast Asia and the Implications for Regional States", *Maritime Institute of Malaysia*, 20 July 2023. https://www.mima.gov.my/sea-views/challenges-to-submarine-cable-connectivity-in-southeast-asia-and-the-implications-for-regional-states
[466] Huizhong Wu and Johnson Lai, "Taiwan Suspects Chinese Ships Cut Islands' Internet Cables", *AP*, 18 April 2023. https://apnews.com/article/matsu-taiwan-internet-cables-cut-china-65f10f5f73a346fa788436366d7a7c70
[467] James Coker, "Submarine Cables at Growing Risk of Cyber-Attacks", *Infosecurity Magazine*, 27 June 2023. https://www.infosecurity-magazine.com/news/submarine-cables-risk-cyber-attacks/
[468] Jill C. Gallagher, *Undersea Telecommunications Cables*, 13.
[469] Bueger, Liebetrau, and Franken, *Security Threats to Undersea Communications*, 32; Sherman, *Cyber Defense Across the Ocean*, 11.
[470] "Built to Fail: Is Planned Obsolescence Really Happening?", *Consumers International*, 6 November 2019. https://www.consumersinternational.org/news-resources/blog/posts/built-to-fail-is-planned-obsolescence-really-happening/

vulnerability, the only measure able to – partially – mitigate the risk of sabotage by state actors is the self-deterrence generated the interconnected nature of the cable network, which makes it almost impossible to accurately evaluate the effects of a cable disruption on third countries.[471] In other words, should tensions between China and the US escalate to the point that the former decides to engage in hybrid war tactics, the only possible deterrent to Beijing targeting submarine cables would be its own dependence on those cables. Overall, we can say that US policies are only tangentially focused on preventing physical damage to cables.

Intelligence considerations, on the other hand, vastly dominate the narrative on the security implications of submarine cables, and rightly so. As mentioned in **Chapter 2**, telecommunications infrastructure, by virtue of carrying sensitive information, has inevitably been the favorite target of international espionage since the 19th century. In this matter, US officials and security researchers have expressed two concerns. The first is that China can exploit submarine cables built, owned, or managed by its companies to extract sensitive data.[472] The second is that China seeks to enhance its centrality in the global network, and specifically that of data hubs such as Hong Kong, so that more data will flow through its national infrastructure, where it can be easily accessed by Chinese intelligence forces – that is, to exploit Farrell and Newman's panopticon effect.[473] In other words, although obviously they cannot say it directly, the US are accusing China of trying to reproduce Washington's same tactics exposed by the Snowden leaks and described in **paragraph 2.7.1**. This exposes the US policy to easy accusations of hypocrisy from the Chinese government and its state-owned media.[474] Ironically, the US precedent provides us with abundant information on the strategies China could employ to exploit submarine cables. It is worth noting, for example, that, although technology for tapping the submerged portion of a cable exists,[475] the most efficient means of intercepting information flows is simply to cooperate with companies operating cable landing stations to insert probes near the shore. Several sources note that former monopolist companies such as AT&T in the US and Cable & Wireless for the UK, owing to their longstanding relationship with the respective governments and relevance within national networks, were the closest collaborators in the

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[471] Camille Morel, "La Mise én Peril du Réseau Sous-Marin International de Communication", *Flux* No. 118: 34-45, http://doi.org/10.3917/flux1.118.0034 ; Laurence Reza Wrathall, "The Vulnerability of Subsea Infrastructure to Underwater Attack: Legal Shortcomings and the Way Forward", *San Diego International Law Journal*, Vol. 12 (2010): 230-262. https://digital.sandiego.edu/ilj/vol12/iss1/8/

[472] Executive Branch Recommendation (PLCN), 24-28; Sherman, *Cyber Defense Across the Ocean*, 11-17.

[473] Executive Branch Recommendation (PLCN), 53-56;

[474] Ministry of Foreign Affairs of the People's Republic of China, "Reality Check: Falsehoods in US Perceptions of China", 19 June 2022, https://www.mfa.gov.cn/eng/wjbxw/202206/t20220619_10706059.html ; Chen Qingqing, "Huawei's Undersea Cable Project Moves Forward in SE Asia", *Global Times*, 20 June 2019. https://www.globaltimes.cn/content/1155060.shtml

[475] According to leaked NSA material, this involves splicing the cable through a specialized submarine or underwater drone to insert probes ("prisms") capable of mirroring the light waves traveling through the optical fiber and creating a copy of the data. See: Olga Khazan, "The Creepy, Long-Standing Practice of Undersea Cable Tapping", *The Atlantic*, 16 July 2013. https://www.theatlantic.com/international/archive/2013/07/the-creepy-long-standing-practice-of-undersea-cable-tapping/277855/

surveillance programs,[476] providing intelligence agencies with operational bases within their own premises.[477] In addition, these firms used their partnerships within the industry to provide security apparatuses with access to cables belonging to companies that were not involved in the program: for example, Cable & Wireless allowed British intelligence to tap on a cable owned by the Indian firm Reliance, with whom it shared a landing station.[478] This highlights how states can exploit the collaborative, trust-based nature of the industry to their advantage. Moreover, it shows how states can weaponize even private-dominated infrastructure networks, provided that they manage to align their interests with those of private companies through incentives, pressures, or both.[479] Following the Snowden leak, several companies were affected by credibility losses and tried to compensate by resisting requests from the US security sector and its allies.[480] The downfall of Alibaba founder Jack Ma after he criticized some public policies make it hard to imagine Chinese companies, state-owned or not, will be willing or able to deny requests from their government.[481] Moreover, China's National Intelligence Law requires tech firms to share both data and metadata with the security authorities upon request.[482] Thus, there is a high likelihood that information traveling on submarine cables landing in China will be subject to probes and interceptions. While to this day there is no proof of HMN-supplied cables containing backdoors or other interception-enabling equipment, there is already precedent for Chinese equipment being rigged for espionage purposes. In 2018, Huawei was accused of having exploited its role as ICT provider for the African Union's headquarters to install spying devices and reroute confidential data to its servers in Shanghai.[483] In other words, US concerns are realistic. The question, however, is if the new cable policy – taking into account its aforementioned costs – is a viable solution to the issue.

There are several reasons why the new cable policy can only have a limited impact on China's espionage potential. A first, glaring issue is the existence of older submarine cables directly connecting the US and China. Although some of these systems are showing signs of senescence, NCP is only five years old and is still one of the trans-Pacific cables offering the largest amount of capacity, which makes it an important part of the route. As noted above, revoking the landing licenses for these systems would be a drastic and costly move on the FCC's part. However, there is an even greater problem. As we have noted

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[476] Gjesvik, "Private Infrastructure in Weaponized Interdependence", 16.
[477] Ryan Gallagher, "Vodafone-Linked Company Aided British Mass Surveillance", *The Intercept*, 20 November 2014, https://theintercept.com/2014/11/20/vodafone-surveillance-gchq-snowden/ ; Ryan Gallagher and Henrik Molte, "The Wiretap Rooms: The NSA's Hidden Spy Hubs in Eight Cities", *The Intercept*, 25 June 2018. https://theintercept.com/2018/06/25/att-internet-nsa-spy-hubs/
[478] Geoff White, "Spy Cable Revealed: How Telecoms Firm Worked With GCHQ", *Channel 4 News*, 20 November 2014. https://www.channel4.com/news/spy-cable-revealed-how-telecoms-firm-worked-with-gchq
[479] Gjesvik, "Private Infrastructure in Weaponized Interdependence".
[480] *Ibid*, 17.
[481] Katsuji Nakazawa, "Jack Ma Downfall Spells End of China's Golden Age", *Nikkei Asia*, 19 January 2023. https://asia.nikkei.com/Editor-s-Picks/China-up-close/Analysis-Jack-Ma-downfall-spells-end-of-China-s-golden-age
[482] Burdette, "Leveraging Submarine Cables".
[483] Ghalia Kadiri and Joan Tilouine, "A Addis-Abeba, le Siège de l'Union Africaine Espionné par Pékin", *Le Monde*, 26 January 2018. https://www.lemonde.fr/afrique/article/2018/01/26/a-addis-abeba-le-siege-de-l-union-africaine-espionne-par-les-chinois_5247521_3212.html

multiple times through the course of this dissertation, the Internet and its submarine cables are designed to behave as a single network where data can flow unrestrained. This logic, which transcends borders, is encoded within the Internet's logical infrastructure, such as inside the BGP. Data traffic is liable to take unpredictable paths and will often cross multiple submarine cables on its route to destination. Consequently, preventing the establishment of direct connections between the US and China cannot guarantee that US data traffic will not travel on a cable that is connected to China or has a Chinese owner or supplier.[484] In order to ensure such a result, the US government should force its digital firms to exit all their peering agreements with Chinese ISPs and to completely divest from physical interconnection points where they exchange traffic with Chinese companies, such as IXPs and co-located data centers. This would effectively split the Internet into two separate networks. However, the US has not signaled the intention to move in such a drastic direction: in fact, the number of direct connections between American and Chinese network operators has been constantly growing in the last decade, without seemingly being affected by geopolitical tensions (**Figure 19**).[485] This is because the volume of data exchanges between the two countries is still growing. Moreover, both American and Chinese hyper-scalers are continuing to expand their cloud regions in the opposite country, which calls for even greater data exchanges.[486]

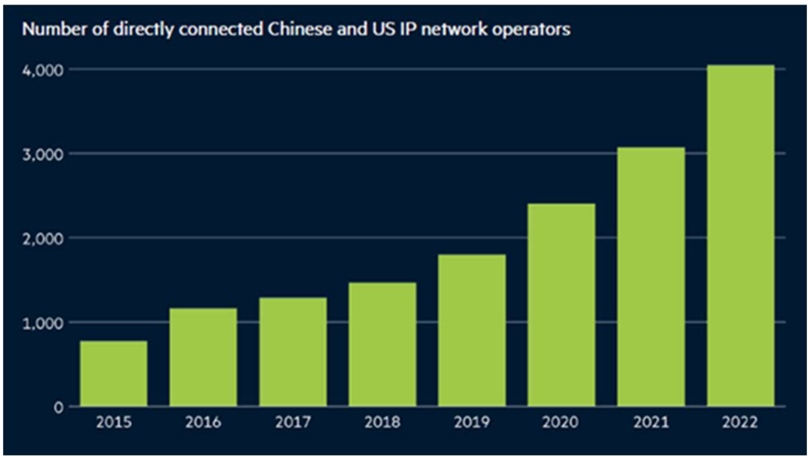

Figure 19. Number of directly connected Chinese and American network operators. Source: Financial Times, 13 June 2023. https://ig.ft.com/subsea-cables/

Even if the US pursued a total disconnection with China, they would still be vulnerable to Chinese espionage because of other countries' interconnections to the People's Republic.[487] Although Team Telecom efforts succeeded in insulating it from the new investments of American firms, Hong Kong remains a core intra-regional connectivity hub whose role is set to expand as new intra-Asian cables are developed: systems such as SJC2, Asia Direct Cable, SEA-H2X, and Asia Link Cable, all set to enter service in 2024 and 2025, will create new links between the Chinese city and several countries that the US recommended as "secure" landing points, such as the Philippines, Singapore, and even Japan.[488] In addition, the latter two are supplied by HMN. Although the US could attempt to exert pressures similar to those adopted in regard to SEA-ME-WE 6 and the East Micronesia Cable, Southeast Asian nations cannot afford to cut themselves off from Hong

[484] Gross et al, "US Is Pushing China Out"; Brian T. Horowitz, "What China's Major Submarine Internet Cable Means for U.S. Network Architects", *NetworkComputing*, 26 April 2023. https://www.networkcomputing.com/networking/what-chinas-major-submarine-internet-cable-means-us-network-architects
[485] Gross et al, "US is Pushing China Out".
[486] Mauldin, "The Subsea Cold War".
[487] Burdette, "Leveraging Submarine Cables".
[488] Yung, "Trans-Pacific Cable Chaos".

Kong's data centers, at least not within the foreseeable future.[489] These complex interdependencies, which are corroborated by the Internet's decentralized nature, make it essentially impossible to distinguish between "clean" and "unclean" networks. In fact, it is somewhat ironic that the Philippines, a "safe" country according to Team Telecom, relies on Converge, a cable system supplied by HMN, as the main domestic infrastructure connecting the nation's various islands; moreover, a good part of the country's domestic network is owned by the National Grid Corporation of the Philippines, which is controlled by China's State Grid.[490]

Finally, China retains the possibility to force US traffic through its own networks even when this would not be the fastest route available. As seen with Pakistan's example in **paragraph 2.3.1**, the BGP, which ultimately rests on trust between Internet companies, can be hacked with relative ease. China Telecom has already been part of several incidents where faulty information was inserted inside BGP route tables, diverting large quantities of traffic to its networks.[491] Although the company has always justified these episodes with technical errors, they indicate that Chinese companies possess the ability to willingly hijack Internet traffic, if desired.[492] Team Telecom cited the risk of BGP hacking as one of the reasons for blocking ARCOS-1's landing to Cuba; however, preventing the construction of such cable, or for that matter any direct cable to China, would not do anything to prevent such hijackings.[493]

In conclusion, despite its purported focus on national security, the US cable policy can only have minor mitigation effects on sabotage and intelligence risks associated with China's control of submarine cable systems. Ultimately, having prevented the construction of a few cables has not improved US information security much beyond what could have been accomplished simply by ensuring that US-based cable landing stations would be operated by trusted American companies and by binding the same companies to stricter security procedures through National Security Agreements. This is despite having borne significant costs, as seen in the previous paragraph. How can we explain such a disconnect between costs and results? A possibility is that US authorities are simply misguided, having acted based on a faulty conception of the submarine cable network and of the Internet's mechanisms. However, assuming that they are acting rationally, there is also the possibility that US actions are less concerned with the immediate security of America's cable network and more with restraining China's ability to shape global networks.

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489 Mauldin, "The Subsea Cold War".

490 Cliff Venzon, "Philippines' Marcos Backs Probe on China-Owned Power Grid Company", *Nikkei Asia*, 17 May 2023. https://asia.nikkei.com/Business/Energy/Philippines-Marcos-backs-probe-on-China-owned-power-grid-company

491 Sherman, *The Politics of Internet Security*, 12; Chris C. Demchak and Yuval Shavitt, "China's Maxim – Leave No Access Point Unexplored: The Hidden Story of China Telecom's BGP Hijacking", *Military Cyber Affairs* Vol. 3 No. 1, Article 7. https://doi.org/10.5038/2378-0789.3.1.1050

492 Dan Goodin, "Citing BGP Hijacks and Hack Attacks, Feds Want China Telecom out of the US", *Ars Technica*, 10 April 2020. https://arstechnica.com/tech-policy/2020/04/citing-bgp-hijacks-and-hack-attacks-feds-want-china-telecom-out-of-the-us/

493 Doug Madory, cited in Larry Press, "Justice Department Recommends That the FCC Deny the Proposed ARCOS Cable Segment Connecting Florida and Cuba", *CircleID*, 3 December 2022. https://circleid.com/posts/20221203-justice-department-recommends-that-fcc-deny-proposed-arcos-cable-segment-connecting-florida-and-cuba

3.7 US cable policies under the lens of (infra)structural power: the struggle for the Internet

The shift in US cable policies acquires new meaning if recontextualized under the framework established in **Chapter 1**, through a combination of Mann's notion of infrastructural power, Strange's concept of structural power, and STS discourses on the centrality and political sensitiveness of standards and design choices. Under this theoretical lens, US objectives and strategies are broadened to encompass not only security concerns but, more in general, a struggle to preserve the current principles, models, and dynamics of the Internet, which, as we have seen, are strongly influenced by American values and policy preferences. As seen above, there is a strong connection between the Internet's logical rules and the US-led development of its logical and physical infrastructure. The US, or to be more precise, US-based companies working in close coordination with and under the supervision of American authorities, were responsible for wiring the global Internet network and for crystallizing American preferences within its physical form. In this framework, surveillance activities are only one of the possible uses of (infra)structural power, that is, one of the advantages opened by a state's influence over global infrastructural networks: however, it is not the only one, nor the most important one, compared with the possibility to influence the inner laws of the Internet. The capability to shape the Internet, or any global infrastructure network, enables the US to exert both infrastructural power, in the sense that it can enact its policies through material structures, and structural power, as this influence extends to other states in the system, constraining their choices and forcing them to adopt complex reaction strategies if they want to manage their national infrastructure networks in a way that diverges from the hegemon's values. China, however, has not only been able to employ successful strategies to constrain the Internet's liberal tendencies but has begun to advocate for a deep revision of the Internet's foundational principles. Its increasing role as provider of global infrastructure provides its requests with more credibility. Beyond intelligence risks, US authorities have expressed preoccupation with China's apparent intention to revision the fundamental mechanisms of the Internet. For example, although Team Telecom's recommendation in the PLCN case mainly focused on the risks to data security, it also expressed concern with the DSR's stated goals of turning China into a "cyber super-power" through investments in digital infrastructure, and made reference to several testimonies concerning China's Internet revisionism.[494] These include the US-China Economic and Security Review Commission's warning that «as Chinese companies lay fiber optic cable, supply smart city projects, and expand e-commerce offerings, they are extending China's influence over the global digital economy to align more closely with Beijing's vision of Internet governance»,[495] as well as Mark Zuckerberg's worries that «China is building its own Internet focused on very different values, and is now exporting their vision of the Internet to other countries».[496] The 2023 National Cybersecurity Strategy similarly links China's investments in digital infrastructure with the

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[494] Executive Branch Recommendation (PLCN), 19-20.

[495] US-China Economic and Security Review Commission, *2018 Report to Congress* (Washington, DC: November 2018), 266. https://www.uscc.gov/sites/default/files/2019-09/2018%20Annual%20Report%20to%20Congress.pdf

[496] Cited in Executive Branch Recommendation (PLCN), 21.

intention to reshape the Internet's logic: «having successfully harnessed the Internet as the backbone of its surveillance state and influence capabilities, the PRC is exporting its vision of digital authoritarianism, striving to shape the global Internet in its image and imperiling human rights beyond its borders».[497] Consequently, it acknowledges «the need to work with partners to thwart the dark vision for the future of the Internet that the PRC and other autocratic governments promote».[498]

In fact, China has been quite open in its aspirations to expand its influence over the global Internet. As seen in **paragraph 2.7.2**, one of the goals of its Digital Silk Road is to influence "policy", that is, the Internet's standards and governance models.[499] This signals that China, like the US, acknowledges the nexus between the provision of digital infrastructure and influence on Internet rules and governance. Beijing has expressed dissatisfaction with the current Internet order, characterizing it as anarchic and chaotic and, at the same time, as a tool for the US to reproduce its hegemony over world affairs while hypocritically advancing concepts such as openness and decentralization.[500] Interestingly, China's discourse on Internet governance is specular to that of the US, as it portrays the People's Republic in a defensive role against Washington's overbearing influence. In the wake of the Snowden leaks, author Lu Chuanying cited the US «monopoly» on Internet infrastructure and governance structures as means to undermine the security of other countries:

> The US believes that cyberspace is a "global public domain", and that countries should not exert their sovereignty in cyberspace. But in reality, the strategic goal of the US is to seize the resources and power of those spaces that cannot be characterized as states through the hegemony it has established in the global public domain. Without the protection of sovereignty, the US can use its superiority in coercive cyberpower and institutional cyberpower to undermine the cybersecurity of other countries, and to enter and control other countries' cyberspace resources at will.[501]

In other words, Lu sees the current Internet order as enabling the US to extend its infrastructural power to other countries' Internet networks, using its influence over digital companies and governance bodies to enact surveillance programs and compromise information security: essentially, the same allegations Team Telecom moved against China. However, there are other reasons that justify China's interest in a revision of the global Internet: as we have seen in **paragraph 2.3.3**, the Internet's current, liberal-inspired design clashes with China's conception of domestic order and its will to repress the freedom of expression of its citizens. Technologies such as the Great Firewall, while impressive from a technical point of view, represent the need for reactive strategies against the political implications of an infrastructure network that China, because of its delayed development, was unable to influence and which instead reflects the values of its main strategic

[497] Joseph R. Biden Jr., *National Cybersecurity Strategy* (Washington, DC: White House, 2023), 3. https://www.whitehouse.gov/wp-content/uploads/2023/03/National-Cybersecurity-Strategy-2023.pdf
[498] Biden, *National Cybersecurity Strategy*, 29.
[499] Dekker, Okano-Heijmans, and Zhang, *Unpacking China's Digital Silk Road*, 10.
[500] Séverine Arsène, "Global Internet Governance in Chinese Academic Literature: Rebalancing a Hegemonic World Order?", *China Perspectives* Vol. 106 No. 2 (2016): 25-35. https://www.jstor.org/stable/44090429
[501] Lu Chuanying, "Yao lizhiqizhuang tan wangluo zhuquan" ("It Is Legitimate to Talk About Cybersovereignty"), *Huanqiu Wang*, 16 December 2015, 80; cited in Arsène, "Global Internet Governance", 30.

rival. As we have seen in **paragraph 2.7.2**, the attempts at reigning in the Internet's decentralized nature impose a significant burden on China's authorities, which generates inefficiencies such as the slowdown in international traffic or the lack of resilience-enhancing route diversification.

A cornerstone of China's proposals is to replace the multi-stakeholder governance model with a more state-centric one, based on the role of international organizations such as ITU, where nations have equal voting rights, rather than on private-based fora, which, as seen in **paragraph 2.3.2**, tend to advantage American-based companies. Already in the early 2000s, China, along with Russia and numerous developing and authoritarian countries, unsuccessfully argued for transferring ICANN's competences to the UN circuit.[502] However, the growth of the Chinese digital economy, coupled with the Snowden scandal, provided Beijing with more serious standing in advancing reforms. In 2015, in concomitance with the launch of the DSR, China used the ITU-organized World Summit on the Information Society Forum as a vehicle to advance its new concept of "cyber-sovereignty", later reiterated at the World Internet Conference, a Beijing-sponsored annual summit established to rival the American-led discussion fora.[503] The concept rests on principles such as states' right to independently choose their Internet regulations and policies and on the «cultivation of good order», which includes silencing all anti-governmental discourse.[504] Unsurprisingly, China's vision has been mainly espoused by authoritarian countries. Moreover, the rhetoric of cyber-sovereignty places emphasis on each country's right to freely regulate its own "national Internet segments", interpreted as an extension of states' physical territory; this opens to the possibility of breaking away from the unified global network in favor of several independent Internet networks, each with its own standards and regulations, linked to each other yet administered separately under the strict supervision of national authorities.[505] While, as noted in **paragraph 2.3.3**, all countries enact some form of oversight over Internet content, China's proposal goes a step further by sanctioning the right to embed filtering and surveillance technology within the architecture of national Internet infrastructure.

The last decade has also seen China become more involved in proposing new Internet standards. In various speeches, Xi Jinping underlined the importance for China to foster innovation in core standards, both regarding upcoming innovations in Internet technology such as AI and the IoT and in updating the already existing Internet protocols in a way that is consistent with China's vision of cyber-sovereignty.[506] The "China Standards 2035" program allocates public funding to sponsor companies in their development of new patents and standards, in a unique blend of public- and private-led standardization activities, with a specific focus on

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[502] Drake, Cerf, and Kleinwächter, *Internet Fragmentation*, 32; Bader, "To Sign or Not to Sign", 247.
[503] Drake, Cerf, and Kleinwächter, *Internet Fragmentation*, 45-46; "China Internet: Xi Jinping Calls for 'Cyber Sovereignty'", *BBC*, 16 December 2015. https://www.bbc.com/news/world-asia-china-35109453 ; Edoardo Campanella and John Haigh, "China Wants to Run Your Internet", *Foreign Policy*, 25 August 2023. https://foreignpolicy.com/2023/08/25/china-wants-to-run-your-internet/
[504] Dakota Cary, *Community Watch: China's Vision for the Future of the Internet* (Washington, DC: Atlantic Council, 4 December 2023). https://www.atlanticcouncil.org/in-depth-research-reports/report/community-watch-chinas-vision-for-the-future-of-the-internet/
[505] Drake, Cerf, and Kleinwächter, *Internet Fragmentation*, 46; Dekker, Okano-Hejimans, and Zhang, *Unpacking China's Digital Silk Road*, 12-13.
[506] Arcesati et al, *Fragmenting Cyberspace*, 38.

high-value-added sectors, such as digital technology.[507] This has led to a boom of Chinese-submitted patents in international standardization bodies. Commercial considerations are part of Beijing's rationale. Because of its status as a late-comer in the race for setting Internet standards, China's digital companies have to sustain enormous costs for using Western patented standards.[508] Furthermore, China can exploit the internationalization of its standards to enhance the market power of its companies.[509] Thus, China is attempting to establish a first-mover advantage in digital innovations. This strategy has proved especially successful with 5G patents, one-third of which is owned by Chinese firms.[510] However, China's standardization efforts also appear to be targeted at bringing the Internet more in line with the preferences of authoritarian countries. A first, notable element is that China has concentrated its digital standardization efforts within the ITU-T rather than the IETF and the other bodies that have traditionally led the Internet's development. This marks the overlap between China's standard-making and its attempt at revising the model of Internet governance in favor of inter-governmental organizations where it can count on the support of like-minded countries, such as Russia and Iran.[511] It was through ITU-T, for instance, that China attempted to internationalize its own version of Wi-Fi, the more centralized WAPI protocol, which is now the standard within China.[512] Another important indication of China's intent to revise the Internet's foundational logic is its attempt at promoting a revision of the Internet Protocol itself. In two closed-door meetings at ITU-T, in September 2019 and February 2020, a delegation from Huawei advanced a proposal for "New IP", a redesigned version of the Internet Protocol developed with other firms including China Mobile and China Unicom.[513] New IP was officially developed to compensate for inefficiencies in the old IP that, according to Huawei, make it unsuitable for supporting future innovations.[514] As notable differences with the current standard, New IP includes automatic inspections of data packets to differentiate content based on bandwidth needs and congestion levels, officially as to improve quality of service, the replacement of IP numbers with semantic addresses, and a concept of «QoS and security policies based on user identity».[515] Moreover, it introduces a little-elaborated-upon notion of «ManyNets», which, despite overall obscurity, alludes to the

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[507] John Seaman, *China and the New Geopolitics of Technical Standardization* (Paris: IFRI, January 2020). https://www.ifri.org/en/publications/notes-de-lifri/china-and-new-geopolitics-technical-standardization
[508] Seaman, *China and the New Geopolitics*, 14-15.
[509] Matt Sheehan and Jacob Feldgoise, "What Washington Gets Wrong About China and Technical Standards", *Carnegie Endowment for International Peace*, 27 February 2023. https://carnegieendowment.org/2023/02/27/what-washington-gets-wrong-about-china-and-technical-standards-pub-89110
[510] Heejin Lee, "The US-China 'Standard-Off' Over Technology", *East Asia Forum*, 2 September 2022. https://eastasiaforum.org/2022/09/02/the-us-china-standard-off-over-technology
[511] Bader, "To Sign or Not To Sign"; Mark Montgomery and Theo Lebryk, "China's Dystopian 'New IP' Plan Shows Need for Renewed US Commitment to Internet Governance", *Just Security*, 13 April 2021. https://www.justsecurity.org/75741/chinas-dystopian-new-ip-plan-shows-need-for-renewed-us-commitment-to-Internet-governance/
[512] Seaman, *China and the New Geopolitics*, 23.
[513] Madhumita Murgia and Anna Gross, "Inside China's Controversial Mission to Reinvent the Internet", *FT Magazine*, 27 March 2020. https://www.ft.com/content/ba94c2bc-6e27-11ea-9bca-bf503995cd6f
[514] *Ibid.*
[515] Alain Durand, *New IP* (ICANN, October 2022). https://www.icann.org/en/system/files/files/octo-017-27oct20-en.pdf

need to abandon the notion of the Internet as a single network in favor of a system of interoperable but federated networks.[516] The proposal attracted severe criticism from Western delegates, as well as from ICANN, the Internet Society, and the European Telecommunications Operators Group, who contested New IP on a procedural level (since it was submitted to ITU-T rather than multistakeholder organizations), a technical level (citing issues of interoperability and implementation), but also for political aspects.[517] In fact, several features of New IP closely align with China's censorship practices. For example, New IP's focus on packet inspections and differentiation could facilitate the Great Firewall's filtering process by enabling ISPs to automatically discard undesirable content or flag users, hindering anonymity.[518] Moreover, the ManyNets concept of federated networks resembles China's notion of the Internet as a collection of sovereign cyber-spaces, linked only by closely guarded gateways. As noted by ICANN, it «brings along not only the end of a single Internet model but also the prospect of a strong regulatory binding between an IP address and a user that could make pervasive monitoring much easier and increase the oversight of published content».[519] After its failure to be adopted by ITU-T New IP was quietly retired and its dedicated page disappeared from Huawei's website. However, Huawei has since advanced its IPv6+ standard, another proposal for reworking the Internet Protocol, which contains several of the constitutive elements of New IP, leading some sources to openly talk of a "rebranding".[520]

There is a strong connection between China's efforts to reshape Internet governance and standards and its increasing role as a global provider of digital infrastructure on a global scale. This is because, as we have seen in the previous chapters, physically building infrastructure networks provides state actors with the power to shape their inner functioning. The DSR advances China's new vision of the Internet in at least three ways. First, investments in digital infrastructure enable China to enhance its centrality within the Internet economy. This is most apparent with the construction of submarine cables. By establishing more connections with the rest of the world, China increases its status as a central node within the submarine network. Moreover, China's submarine cable investments without a landing in China, such as PEACE and SAIL, provide its digital firms with access to further markets and opens the way for additional investments, such as the construction of data centers, CDNs, and cloud regions by Chinese tech firms all over the world. This does not simply provide China with the potential for enhanced intelligence collection – although this is certainly

[516] Durand, *New IP*, 25.
[517] Murgia and Gross, "Inside China's Controversial Mission"; Durand, *New IP*; Campanella and Haigh, "China Wants to Run Your Internet"; Internet Society, "Huawei's 'New IP' Proposal – Frequently Asked Questions", February 2022, https://www.internetsociety.org/resources/doc/2022/huaweis-new-ip-proposal-faq/ ; ETNO, *ETNO Position Paper on the New IP Proposal* (Brussels: November 2020), https://www.etno.eu/library/positionpapers/417-new-ip.html
[518] Murgia and Gross, "Inside China's Controversial Mission"; Arcesati et al, *Fragmenting Cyberspace*, 42; Campanella and Haigh, "China Wants to Run Your Internet".
[519] Durand, *New IP*, 28.
[520] Simon Sharwood, "China Again Signals Desire to Shape Global IPv6 Standards", *The Register*, 28 April 2023. https://www.theregister.com/2023/04/28/china_ipv6_control_adoption/ ; Luca Bertuzzi, "China Rebrands Proposal on Internet Governance, Targeting Developing Countries", *Euractiv*, 6 June 2022. https://www.euractiv.com/section/digital/news/china-rebrands-proposal-on-internet-governance-targeting-developing-countries/

an important side benefit – but also allows its companies to expand their prestige, increase their returns by handling larger volumes of traffic, and become key players in the market. With the government's economic and diplomatic assistance, Chinese firms have quickly climbed market ranks to become serious competitors for US companies. Secondly, China's role as a provider of digital infrastructure enables it to act encode its own vision of the Internet within physical hardware. For instance, China has become a prime exporter of ICT technologies enabling enhanced surveillance and censorship.[521] It is worth noting that PEACE lands almost exclusively within countries that repress Internet freedom.[522] Moreover, Chinese digital infrastructure is mainly popular among developing countries, which, of course, are also those in greater need of reliable networks. China's artificially low prices, the availability of state-issued credit lines (conditional on relying on Chinese manufacturers), and a rhetoric emphasizing the opportunity of breaking away from the US-centric model to enable other voices to be heard within Internet governance structures are all factors attracting the interest of the Global South.[523] Cyber-sovereignty has proven to be a powerful narrative for African countries: Gao notes that nations such as Djibouti have expressed a preference for an Internet based on non-Western values and distaste for American hyper-scalers, which they perceived as digital colonial powers.[524] Furthermore, even without genuine convincement, countries that become dependent on cheap Chinese-supplied technology are more likely to support its proposals for a revision of the Internet within intergovernmental bodies.[525] A third and final element is that, through its investments in undersea cables and land-based digital infrastructure, China is building its own global-scale network within the American-dominated Internet. As its network enlarges, China becomes able to reach more countries autonomously, without the need to rely on others. Some observers express concern with the possibility of the Internet splitting in two separate networks, one dominated by China and influenced by its values, and another with the US at its center.[526] Others, however, note that this remains more of a theoretical scenario, considering that Chinese ISPs still lease capacity on several non-proprietary cables and that HMN's network, while rapidly expanding, is still relatively limited.[527] In addition, BGP tracing tests demonstrate that US-China connections

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[521] "Assessing China's Digital Silk Road Initiative", *CFR*, https://www.cfr.org/china-digital-silk-road/ (last accessed 16 February 2024); Adam Segal, "China's Alternative Cyber Governance Regime", *CFR*, 13 March 2020, https://www.uscc.gov/sites/default/files/testimonies/March%2013%20Hearing_Panel%203_Adam%20Segal%20CFR.pdf

[522] Hillman, "War and PEACE".

[523] Arcesati, "The Digital Silk Road Is a Development Issue".

[524] Xinchuchu Gao, "Sovereignty and Cyberspace: China's Ambition to Shape Cyber Norms", London School of Economics, 18 August 2022. https://blogs.lse.ac.uk/cff/2022/08/18/sovereignty-and-cyberspace-chinas-ambition-to-shape-cyber-norms/

[525] Hillman, "Techno-Authoritarianism".

[526] Hill, "Internet Fragmentation"; Burdette, "Leveraging Submarine Cables"; Song, "Internet Drift"; Gross et al, "US Pushing China out"; Drake, Cerf, and Kleinwächter, *Internet Fragmentation*; Joshua Park, "Breaking the Internet: China-US Competition Over Technology Standards", *The Diplomat*, 9 February 2022. https://thediplomat.com/2022/02/breaking-the-internet-china-us-competition-over-technology-standards/

[527] Mauldin, "The Subsea Cold War".

on the logical layer have continued to grow even amid increased tensions.[528] This is because, ultimately, the economies of both nations are still heavily connected and it would not be in the interest of either to take their rivalry to the level of complete insulation. However, China could use its cable connections to experiment with alternative Internet protocols or test the application of advanced filtering within the cables themselves. Russia, whose digital capabilities are significantly less advanced than China's, has already conducted several experiments with disconnecting its national Internet from the global network, although with little success.[529] Beijing could conduct similar tests on a larger scale, establishing Internet communications with another country without relying on TCP/IP but, for instance, on New IP. This could serve as proof that China would be capable to build its own separate Internet if it wished so, and strengthen its claims to be more involved within digital governance. Based on all these considerations, China's DSR, by boosting Chinese investments in digital infrastructure, increases the People's Republic's stake in Internet governance and reinvigorates its credibility as an advocate of a different conception of the Internet, especially before developing countries.

In this sense, the shift in US cable policies can be interpreted not merely as a semi-effective counterintelligence plot but as a whole-of-government effort to constrain China's fledgling (infra)structural power. The US seeks to preserve the shape it has imprinted on the Internet, the centrality of its values such as the freedom of speech and the preference for privatization and deregulation, the prominence of its companies in the digital economy, the multi-stakeholder model of governance that reflects all of these characteristics, and the standards that encode them within the Internet's very infrastructure. The 2017 National Security Strategy stated this objective in a very techno-nationalist light: «The Internet is an American invention, and it should reflect our values as it continues to transform the future for all nations and all generations».[530] The US is advantaged by path dependence and by its first-mover advantages. However, its approach to Internet governance can leave its (infra)structural power vulnerable to erosion. A notable difference between the US and China is the degree of independence enjoyed by the respective digital companies. The lack of interference in the market on part of Washington's authorities has certainly had positive effects in terms of enhancing competitiveness and stimulating innovation, compared to the distortive effects of China's subsidies.[531] However, the independence of the private sector typical of liberal countries inevitably creates a

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[528] Tim Stronge, "Has Geopolitical Conflict Between China and the U.S. Caused Their Networks to Disconnect?", *Telegeography*, 5 June 2023. https://blog.telegeography.com/2023-mythbusting-part-5

[529] Timmy Broderick, "Russia Is Trying to Leave the Internet and Build Its Own", *Scientific American*, 12 July 2023, https://www.scientificamerican.com/article/russia-is-trying-to-leave-the-internet-and-build-its-own/ ; "Russia Disconnects from Internet in Tests As It Bolsters Security", *Reuters*, 22 July 2021, https://www.reuters.com/technology/russia-disconnected-global-internet-tests-rbc-daily-2021-07-22/

[530] Donald J. Trump, *National Security Strategy* (Washington, DC: White House, 2017), 13. https://trumpwhitehouse.archives.gov/wp-content/uploads/2017/12/NSS-Final-12-18-2017-0905.pdf See also Jon Bateman, *U.S.-China Technological "Decoupling". A Strategy and Policy Framework* (Washington, D.C.: Carnegie Endowment, 2022). https://carnegieendowment.org/files/Bateman_US-China_Decoupling_final.pdf

[531] Lee G. Branstetter, Guangwei Li, and Mengja Ren, "Picking Winners? Government Subsidies and Firm Productivity in China", *Journal of Comparative Economics*, Vol. 51 No. 4 (December 2023): 1186-1199. https://doi.org/10.1016/j.jce.2023.06.004

partial disconnect between the interests of the US government and US-based firms.[532] For instance, as we have seen in **paragraph 2.6**, American hyper-scalers are themselves deviating from global Internet standards to the extent they employ proprietary protocols within their private-controlled networks to improve performance.[533] Moreover, US firms have had no qualms in providing authoritarian countries with censorship-enabling capabilities: the early version of the Great Firewall was supplied by Cisco.[534] Cooperation such as Google and Meta's partnerships with state-owned Chinese ISPs contributes to legitimizing China's standing as a stakeholder in the digital economy. Consequently, the US government must employ strong regulatory approaches, such as the tightening on cable landing licenses, in order to insulate US-based companies from their Chinese counterparts. This containment strategy is best accomplished by placing strong emphasis on the most manipulative aspects of (infra)structural power, such as espionage programs, even if Washington's own experience highlights how such initiatives are certainly not the prerogative of authoritarian states. In a similar vein, the US uses diplomatic pressures and incentives to force third countries out of deals with Chinese companies which could either provide further legitimation to China's revisionist intent or create technological dependency relationships enabling Beijing to coerce states into supporting its proposals.

However, the new US cable policy is not without risks. As noted above, it creates contradictions with the very values that characterize the US-designed Internet, such as the centrality of private actors in investment choices, which is only partially compensated by the encouragement of private investments in alternative locations. This is compounded by proposed legislation such as export restrictions, which would take the US digital economy in an illiberal direction.[535] Moreover, the "clean network" rhetoric is extremely dangerous, as it essentially argues against the globality and openness of the Internet and instead portrays it as compartmentalizable while implying that certain parts of the Internet – namely, those controlled by Chinese actors – should be closed off from the rest of the network. This logic dangerously resembles the concept of cyber-sovereignty and is antithetical to the principles of globalism and openness the US ostensibly strives to defend. In fact, overemphasizing the risks of interconnection risks legitimizing China's surveillance techniques and it risks being perceived as hypocritical considering that the US itself has been proven to engage in such efforts. In addition, emarginating China could push it to enhance its revisionist efforts and embark on the path of network fragmentation.[536] Fortunately, although the Biden administration has largely continued the cable policies of the preceding Executive, it shed these elements of digital isolationism. Another issue with the US policy is that its openly confrontational nature has already led to a tit-for-tat with China. Beijing has retorted against Team Telecom by ramping up bureaucratic delays in transit permits for projects passing through its national waters; moreover, it allegedly violates UNCLOS by sending its

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[532] Gjesvik, "Private Infrastructure in Weaponized Interdependence"; Abels and Bieling, "Infrastructures of Globalisation", 52; Kelton et al, "Virtual Sovereignty?", 1979.
[533] Song, "Internet Drift"; Hanspach, "Internet Infrastructure and Competition".
[534] Goldsmith and Wu, *Who Controls the Internet?*, 93.
[535] Keller, "The Disconnect on Undersea Cable Security".
[536] Burdette, "Leveraging Submarine Cables".

maritime forces to disturb cable laying operations in international waters it lays claim on.[537] The construction of the EMA cable as a rival to SEA-ME-WE 6, if confirmed, will be an even more blatant response to the US strategy, once again remarking the possibility of a physical separation between US and Chinese networks. Finally, although the US can easily prevent China from landing cables on its shores, diplomatic efforts to keep it from doing the same in foreign countries are less guaranteed to succeed. Chinese projects are often too convenient for developing countries to pass over; American, and in general Western infrastructure, while usually of superior quality, tends to be very expensive. The same applies to US-patented standards.[538] The US and its allies are trying to even the field through initiatives such as the Build Back Better World[539] and the Partnership for Global Infrastructure and Investment initiatives.[540] For what strictly concerns submarine cables, the Quad has recently launched a Partnership for Cable Connectivity and Resilience, which aims at establishing public-private partnerships to address connectivity gaps in the Pacific.[541] However, these programs lag behind the BRI and DSR in terms of strategic communication and planning and will likely be more difficult to implement given the arm's length relationships between governments and industry, compared to the brutal compactness of China's state capitalism. It should also be noted that developing countries have realized they can profit from the situation by strategically positioning themselves between the US and China, attracting advantageous infrastructure deals from both. Kiribati, as noted in **paragraph 3.3**, has successfully implemented these tactics. In another example, shortly after the Quad's success in ousting HMN from the CS^2 cable project, the Solomon Islands awarded Huawei a contract for the construction of mobile tower cells, financed by a $66 million loan from China Exim Bank.[542] A final problem is that US pressures are most likely to succeed over countries that already share its vision for the Internet or at the very least are neutral toward it: it will be difficult to prevent China from continuing to provide infrastructure to non-democratic regimes in the Global South, which express an ever-growing demand not only for connectivity, but specifically for surveillance-enabling ICT materials.[543] An excessively aggressive focus on emarginating Chinese-built networks from the global Internet would likely push these countries to align even more closely with China's Internet revisionism, force others to pick sides, and further risk engineering a fragmentation of the Internet.

[537] Anna Gross et al, "China Exerts Control Over Internet Cable Projects in South China Sea", *Financial Times*, 13 March 2023. https://www.ft.com/content/89bc954d-64ed-4d80-bb8f-9f1852ec4eb1
[538] Seaman, *China and the New Geopolitics*, 25.
[539] Steve Holland and Guy Faulconbridge, "G7 Rivals China with Grand Infrastructure Plan", *Reuters*, 13 June 2021. https://www.reuters.com/world/g7-counter-chinas-belt-road-with-infrastructure-project-senior-us-official-2021-06-12/
[540] White House, "Fact Sheet: Partnership for Global Infrastructure and Investment at the G7 Summit", 20 May 2023. https://www.whitehouse.gov/briefing-room/statements-releases/2023/05/20/fact-sheet-partnership-for-global-infrastructure-and-investment-at-the-g7-summit/
[541] White House, "Quad Leaders' Summit Fact Sheet", 20 May 2023. https://www.whitehouse.gov/briefing-room/statements-releases/2023/05/20/quad-leaders-summit-fact-sheet/ ; Asha Hemrajani, "The Quad Partnership for Cable Connectivity and Resilience", Nanyang Technological University, 17 November 2023. https://www.rsis.edu.sg/rsis-publication/cens/the-quad-partnership-for-cable-connectivity-and-resilience/
[542] Irving, "Leaning on the Big Switch".
[543] Greene and Triolo, "Will China Control the Global Internet".

Ultimately, the US cable policy is functional to preserving the country's centrality within the global Internet and protecting its vision of the network against a rapidly emerging rival. However, it requires precise calibration, as excessive interferences from the US government risk weakening the very principles it purportedly tries to defend. Excessive governmental interferences can compromise the tenets of the private-centric, liberal Internet, strain relationships with the industry, and undermine investments in new US-linked cables. Moreover, deviations from the concept of the Internet as an open, decentralized, yet unified global network undermine the core of the technology's design, reinforcing China's appeals for an overhaul and pushing developing countries towards its revisionist attempts. The risk of a fragmentation of the global network, while still a remote possibility, should be avoided at all costs, as it would have serious repercussions on the free, almost-instantaneous circulation of information flows our current society is largely dependent on. Submarine Internet cables, despite their invisibility, are a key part of this crucial struggle.

Conclusion

I. Findings

The aim of this research was to understand the reasons for the increased interventionism of the US government toward submarine Internet cables, in order to better contextualize the factors causing Washington to adopt an openly confrontational stance against China's involvement in the cable industry. Throughout the analysis, we have established the ways in which influencing global infrastructure networks enables states to encode their policy preferences into material assets and enforce them on a global scale. Under this lens, the contestation of submarine Internet cables was recontextualized as a struggle that goes beyond the simple attempt at reigning in national security risks to embrace broader considerations on the future of the global Internet and the preservation or renovation of its defining characteristics.

First, we have built a theoretical framework able of capturing the relationship between infrastructure and state power. Infrastructure was established as a multifaceted concept, applicable to a vast universe of systems, artifacts, technologies, and facilities, including both physical and non-physical items. Nevertheless, these diverse types of infrastructure are tied together by their ability to invisibly support all sorts of productive activities and to generate disproportionate, generalized returns thanks to large positive externalities. We have established the importance of infrastructure networks as means to tie together national territories and, on the global scale, the world economy, and reflected on the centrality of technical standards as the inner laws of infrastructure, which define its basic functioning and contribute to shape and constrain its applications. Standards have been analyzed in the context of STS research emphasizing their intrinsically political qualities, as they provide the opportunity to encode the developer's preferences within material structures, impacting user agency. Moreover, because of standards' exposure to path dependence and infrastructure's pervasiveness in all aspects of everyday life, these preferences tend to crystallize and become perceived as natural, unchangeable features, akin to the laws of physics. Building on this political reading of infrastructure, we combined Mann's concept of infrastructural power, which sees infrastructure as the means to ensure the implementation of state policies throughout the national territory, and Strange's notion of structural power, which interprets hegemony as the capability to shape global economic structures in accordance with the state's own preferences. We subsequently applied these two concepts to global infrastructure networks, understood as the interconnection system of national infrastructure networks. This interlinkage requires the establishment of common standards for interoperability, constraining the ability of states to regulate their own national networks if they value interconnectivity with the rest of the world. Thus, combining the political sensitiveness of standards with Mann and Strange's notions, we have established the ability to shape global infrastructure networks as a vehicle for (infra)structural power, enabling states to enforce their policy preferences on an international scale. However, this is an unequitable process, as while some states, thanks to first-mover advantages and an enhanced centrality within global networks, are able to influence global standards, others must adapt by either isolating themselves, passively accepting less-preferred standards, or attempting at enhancing their own (infra)structural power to push for a revision of the status quo.

Secondly, this reading was applied to Internet infrastructure. We have analyzed the overbearing role played by US institutions, companies, and researchers in the development of the foundational Internet standards, such as the protocols enabling the seamless transmission of data through the Internet's physical infrastructure, to see how this influence resulted in digital standards reproducing American preferences, such as an emphasis on free speech and the free circulation of information, as well as a global vision of the network where data can flow in a borderless fashion, guided only by capacity and latency considerations rather than by geopolitical boundaries. Moreover, we have reconstructed the influence of the US on the Internet's multi-stakeholder governance model, which reflects its preference for private management of infrastructure over excessive governmental involvement, while at the same time enhancing the ability of US companies to steer the Internet's development. We have seen that authoritarian countries, with China at the forefront, had to develop technical solutions to restrain the influence of the liberal values embedded within the Internet and that they have advanced proposals for shifting its governance to a more state-centric, control-enabling system. Subsequently, these considerations were applied to the context of submarine Internet cables. Analyzing the economic geography of the cable network, we have seen how the US is the most central node in the network, responsible for the majority of the world's intra-regional connectivity, although this centrality has progressively diminished compared to the early years of the Internet, when nearly all global traffic had to travel through US servers. A study of the submarine cable industry has similarly registered the importance of US digital companies, with the so-called hyper-scalers increasingly becoming the main investors in the submarine cable market. Although the interests of these transnational tech giants are not always aligned with those of the state, we have seen that they are most conditioned by the requests of US authorities compared to any other nation. On the other hand, a study of China reveals its growing influence on the submarine cable network, sustained by governmental initiatives such as the Digital Silk Road which assist Chinese tech firms in the provision of cables and other digital infrastructure, with a particular focus on developing countries. At the same time, China's own cable connections suffer by the need to resist the Internet's decentralization tendencies, which force China to sacrifice resilience and efficiency in exchange for tighter control over national Internet gateways. This tension between China's cyber aspirations and the need to constrain the Internet's liberal design were posed as the main driver of China's proposal for a revision of the Internet's governance model and its core standards.

Subsequently, we proceeded to analyze the new US policy toward submarine cables in light of the previously established framework. Using case studies, we registered a change in the governmental attention devoted to submarine cable projects. Until the last decade, the private sector was left essentially free to pursue connections with various parts of the world, while the role of the US state was limited to bureaucratic screenings of cable landing applications, inevitably resulting in an approval. National Security Agreements were considered as providing sufficient guarantees against possible threats. By contrast, the new decade has seen US authorities reject all applications involving Chinese entities in any capacity, as well as directly intervening through diplomatic measures to ensure the exclusion of Chinese companies from the construction of submarine cables overseas. In trying to explain the reasons for this shift, we have first addressed concerns that are frequently cited both in the literature and in political debates: the exposure of submarine cables to sabotage and their possible exploitation for intelligence purposes. However, analyzing these measures from a security perspective, we have found that they do not provide much in the way of risk mitigation. In fact, the Internet's very design features, as previously described, create the possibility for various forms of data interception regardless of the existence of direct linkages between two countries or the affiliations of the cable supplier. Conversely, the new US policy came at significant costs, including lost opportunities, the diffusion of uncertainty in the cable industry, and a weakening of US narratives on the benefits of privatization and deregulation, hardly warranted in the face of a minimal boost in security. Thus, we attempted at formulating a different explanation that would justify such a resolute reaction against China's submarine cable initiatives, centered on the relationship between infrastructures and state power. We connected China's digital infrastructure initiatives with the attempt at enhancing the legitimacy of its proposals for a revision of the status quo, enabling it to promote its alternative concepts of cyber-sovereignty and enhanced centralization. Furthermore, we noted these initiatives are strongly attractive not only for fellow authoritarian regimes but also for developing countries, which are in serious need of expanding their connectivity and can find appealing solutions in China's artificially underpriced cables. Under this light, the US policy is an attempt at containing China's efforts to gain (infra)structural power by insulating US-based companies, allied countries, and developing nations from such projects. In order to do so, the US emphasizes China's possible exploitation of the networks, while at the same time devoting efforts from all branches of government to marginalize China's role in the global network. However, this strategy is problematic in that it marks contradictions with several principles of global Internet governance that the US ostensibly seeks to preserve. The occasionally heavy-handed interference within the cable market poses a contradiction with Washington's commitment to the protection of private market initiatives, already expressed in the fact that the US policy is hindering projects that respond to a real demand of greater connectivity between two of the world's largest digital economies. Moreover, and even more fundamentally, if not properly calibrated US policies risk compromising the Internet's global nature: emphasizing the dangers of interconnecting with one's rival and marginalizing Chinese-connected networks could accelerate a fragmentation of the network, which would paradoxically more closely resemble China's cyber-sovereignty doctrine than the open Internet the US advocates for.

In conclusion, the shift in US submarine cable policies can be explained with the emergence of China not only as an increasingly important provider of subsea infrastructure but also as a strategic competitor with a serious stake in advancing proposals for an overhaul of Internet standards and regulations. Paradoxically, the struggle to preserve the status quo forces the US to deviate from principles Washington itself has enshrined as the constitutive elements of the global Internet. Consequently, the US government must exercise great care in maintaining its efforts within the threshold of liberal politics: excessive pressures on the industry, an over-confrontational attitude, the exasperation of securitization and international competition, and the descent into techno-nationalism or protectionist tendencies would undermine the openness and global nature of the information networks, to the loss of the whole international community.

II. Future research

The main advantage of the theoretical framework presented here is that it can be applied to any type of global infrastructure network, including transportation and shipping, energy, and finance. The lens of (infra)structural power can be an especially useful tool at a time where infrastructure is increasingly the object of international competition between states advancing different visions of international order. Submarine Internet cables are, after all, only part of a broader struggle between China's infrastructure projects within the Belt and Road Initiative and the attempt of the United States to counterbalance them through its own programs. Similarly, the political implications of setting standards and design choices can be applied to other types of technology beyond information systems and can be read in conjunction with growing preoccupations over the declining capabilities of the US industry to innovate, faced with rapid advances on part of China's state-sponsored research programs.[544]

For what strictly concerns submarine Internet cables, this dissertation represents an attempt at contextualizing an infrastructure that is critical for the global economy under an IPE lens, to expand perspectives on its impact and importance in a direction that goes beyond considerations strictly tied to security measures. While this research focused on US policies in relation to China, the submarine network offers several other inputs for further studies. More research, for instance, is needed to quantify the economic advantages of becoming a connectivity hub. Another necessity is to better understand the strategies that can be adapted by smaller countries, such as Egypt, which, despite being unable to shape the submarine network like the US or China, nevertheless occupy a relevant position because of their geographical advantages. What benefits can they draw from their status as key transit points in the global network? Finally, a study on the European Union's capacity to influence the submarine cable network is warranted. The EU is home to the largest company in the cable market, ASN, as well as other relevant industry players such as Prysmian Group, Nexans, and Hexatronic, for what concerns cable suppliers, and Orange, Sparkle, and Telxius for cable owners and operators. Furthermore, as we have seen in this research, it can count on powerful connections with the Americas, Africa, and Asia, making it a crucial node in the cable network. Understanding the position on submarine cables of the EU as a whole and of its member states amid the increasing Sino-American competition would be a precious contribution for broadening the perspective presented here and deepen our understanding of the connections between submarine cables and global influence.

[544] The Australian Strategic Policy Institute keeps track of the race between the US and China for leading innovations in critical technologies through its "Critical Technology Tracker", available at https://techtracker.aspi.org.au/ (last accessed: 18 February 2024). See also: James T. Areddy, "China Trumps U.S. in Key Technology Research, Report Says", *Wall Street Journal*, 2 March 2023, https://www.wsj.com/articles/china-trumps-u-s-in-key-technology-research-report-says-adbb56bc ; Jon Schmid, "Rethinking Who's Winning the U.S.-China Tech Competition", *RAND Blog*, 16 August 2023, https://www.rand.org/pubs/commentary/2023/08/rethinking-whos-winning-the-us-china-tech-competition.html

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