# Technological Interaction Capacity: A Structural English School Analysis of Global Undersea Communications Cable Infrastructure

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## Structured Abstract

Article Type: Research Paper

*Purpose*—The purpose of the paper is to highlight potential changes to the structure of the international system that may stem from recent trends of state and non-state actor interaction with the global undersea communications cable infrastructure (GUCCI). More generally, the paper wishes to highlight the potential of global technological interaction capacity as an analytical tool by which to hypothesize changes in the international system.

*Design, Methodology, Approach*—A structural approach of English School theory expands the concept of disaggregative technological interaction capacity and offers a new qualitative method by which to analyze the flows of interaction between units and structure in the international system.

*Findings*—The results indicate that increased flows of interaction with GUCCI by the United States are being used to obstruct changes to international structure, while increased forces of non-state actor activity may eventually alter or override system structure by dominating ownership of cables and control of data flows in the future.

*Practical Implications*—The analysis demonstrates the utility of the English School concept of interaction capacity for hypothesizing potential changes to the structure of international systems.

*Originality, Value*—This paper is unique in its proposal for expanding the concept of technological interaction capacity in English School theory and offering a new method of analysis for this capacity.


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## I. Introduction

There is little doubt that international relations of state and non-state actors are influenced by the cyber[1] realities of the twenty-first century,[2] the breadth and depth of which are made possible in large part by the global undersea communications cable infrastructure (GUCCI). GUCCI is a term used to describe the web of more than 500 current and planned domestic and international communications cable systems that span roughly 1.4 million kilometers globally and are responsible for carrying ninety-five percent[3] or more of all international telecommunications traffic.[4] "The submarine communications cable network, a physical manifestation of transnational connectivity, is an understudied area of international relations."[5] Yet, in his seminal work for the English School (ES) perspective of international relations, Hedley Bull pondered global communications technology when he considered *The Technical Unification of the World* and other aspects of world society.[6] He wrote, "There is no doubt of the existence of one important and novel factor affecting transnational relations today: the development of global communications creating an unprecedented degree of mutual awareness among different parts of the human community…."[7] Bull's "degree of mutual awareness" would take form as interaction capacity under a structural perspective of ES theory proposed years later.

ES scholarship has encompassed a range of perspectives, structural, functional, or historical in nature, while spanning theoretical foundations from classical realism to historical-sociological.[8] As such, the varied approaches to ES scholarship have opened the School to some biting criticism, especially to claims that the School lacks clarity of method, theory, identifiable assumptions, or foundational principles.[9]

Despite the criticism, the structuralist approach to ES theory[10] promoted by Barry Buzan and others embraces concepts that may increase theoretical clarity for critics and practitioners alike. Previously, Buzan, Jones, and Little[11] proposed a three-level analytical framework with a structural level of analysis at the top, an interaction level of analysis in the middle, and a unit level of analysis at the bottom. In this framework, shoving and shaping forces at the structural level play alongside those generated by interaction capacity (IC) in the middle level of analysis, and act upon units in the system that reside at the lowest level of analysis.[12] The argument made here is that IC can be more highly theorized than is currently the case in ES scholarship and that it can offer an element of predictive capability with a more defined method of analysis.[13] If this be the case, it would be a unique contribution to the ES literature.

The approach taken here to disaggregate and investigate a systemic physical feature (i.e., IC) of the international system may seem debatable to some who follow ES scholarship. It is certainly a rarity in ES literature, even though Buzan, Jones, and Little hypothesised, "When interaction capacity moves from middling to some higher level, it does not seem unreasonable to hypothesise that the interaction variable might … override structural effects in the overall logic of the system."[14] Currently, the physical capabilities of IC seem relegated to a minor supporting role in structural analyses as a facilitating tool of units. However, this paper hopes to elevate the role of IC in structural analyses and impress on readers that technological IC may have some predictive value and be a crucial facet of future ES scholarship, as the shoving and shaping forces of technological IC force a reaction from units that may ultimately affect the structure of the world system. GUCCI is the vehicle for this first case study. It is hoped the approach offers something not often considered in ES literature.

## II. Interaction Capacity in English School Theory

The relationship of GUCCI to ES theory and methods as first explored by Buzan and Little lies squarely in the ES concept of technological IC.[15] IC has been explored in some detail in structural ES theory.[16] According to Buzan and Little, IC

> refers to the amount of transportation, communication, and organizational capability within the unit or system: how much in the way of goods and information can be moved over what distances at what speeds and at what costs? … [It] captures both the physical and the social aspects of capabilities that are system- or unit-wide. These capabilities play a role in defining the dominant units, and act as a distinct source of shoving and shaping forces playing alongside those generated by structure.[17]

Buzan, Jones, and Little believe technological capabilities, as well as shared norms and organizations are two key aspects of systemic capabilities that determine the types and levels of interaction possible and desired in the international system and affect the ability and the willingness of units to interact.[18] In this sense, IC is seen as an absolute capability in the system that "cannot be adequately expressed in unit terms."[19]

Buzan and Little note how technological IC "quickly transforms conditions of interaction for all units" and "change[s] the quality and character of the system as a whole."[20] According to Buzan, Jones, and Little, "There is a strong case for saying that interaction capacity ranks alongside structure as a 'shoving and shaping' force on the interactions of the units throughout the system. It provides the essential third leg of a full system theory (units + interaction + structure)."[21] Yet technological IC, the physical aspects of capabilities, seems underexplored in ES literature. Buzan and Little claim, "The main question to ask of any international system is whether its interaction capacity is high or low."[22] If this be the case, there is little left to explore. Buzan, Jones, and Little already declared that the modern international system is system dominant and therefore has high IC.[23] For GUCCI specifically, there is little doubt IC is high. Newer cables are capable of transmitting hundreds of petabytes of data per second and "there are 475 of these undersea cables deployed around the world as of December 2020."[24] With some claiming that communication breakthroughs of the last few decades do not compare with the fundamental breakthroughs of the nineteenth and early twentieth centuries,[25] it seems all had been said.

However, the analysis by Buzan and Little offers a number of concepts left unexplored when interaction capacity is seen as an aggregate. Although global IC is seen in the binary of either high or low, they concede, "there can be no doubt that the international system is marked by quite extreme uneven development in interaction capacity as in many other spheres of life."[26] This is likely the outcome of their claim that "both physically and socially, the global system was made by a small number of leading states,"[27] a conclusion drawn from their analysis of the revolutionary changes that have occurred in IC from the ancient to the modern era. They note more specifically that the flows of interaction sustained by IC exhibit "a centre-periphery pattern, with heavy concentrations amongst the most developed states, thinner traffic between centre and periphery, and the thinnest between units in the periphery. Some parts of the periphery are even going backward, as in those African countries that have proved unable to maintain the road and railway systems they inherited from the Europeans."[28] If physical and social IC was made by a small number of states, as claimed by Buzan and Jones, and if IC manifests in heavier or thinner interaction flows between units in the system, then the logical question is whether IC should be thought of in the aggregate binary of high or low.

To be fair, Buzan, Jones, and Little seem concerned with how to categorize the level and type of IC, in order to conclude whether structural logic can occur in a system.[29] Reflective of such thinking, Buzan and Little claim that "structural effects vary directly according to the frequency and intensity of interaction. When interaction is high (e.g. frequent wars or regular trade amongst the units) structural effects should be strong; when it is low (e.g. infrequent and low-level conflict, sporadic and small-scale trade) structural effects should be weak."[30] In this sense, IC is considered to be

> aspects of absolute capability that transcend the unit level, but which are not structural in the sense of having to do with the positional arrangement of the units. They are systemic not only because they represent capabilities that are deployed throughout the system, but also, and mainly, because they profoundly condition the significance of structure and the meaning of the term system itself. This is a different quality from selective unit capabilities that have system-wide effects, such as nuclear weapons, which Waltz rightly places within the unit level.[31]

However, this is where the theoretical description of technological IC seems somewhat weak, if not problematic.

Firstly, technological IC is not evenly distributed in the system, and Buzan and Little note it is regressing in some parts of Africa. Although they claim IC "represent[s] capabilities that are deployed throughout the system," if some units have more or less access to these capabilities, then how can positional structure of those units in the system be unaffected? This question reflects what Waltz characterized as distributional capabilities[32] and what Buzan, Jones, and Little label as distributional structure,[33] whereby a system may be unipolar, bipolar, multipolar, etc. Secondly, as noted above, Buzan, Jones, and Little claim nuclear weapons are a unit-level capability, yet Buzan and Little include the rockets which carry those nuclear weapons as having "very specific and important impacts on the revolution of interaction capacity as a whole," as they spawned "long-range, impossible to stop, delivery systems for military payloads," which "changed the entire face of great power war and strategic thinking."[34] The problem here is that knowledge of how to construct these two differing technologies is available throughout the system, but many units in the system do not have the capabilities to construct or operate either of these technologies. This being the case, how can one be system-wide IC and one be a unit-level capability? Either both are social IC as system-wide knowledge that has altered system thinking, or both are technological IC, systemic capabilities available to all units within the system, but differentiating these two technologies (as just one example) seems rather arbitrary.

This brings us to the final apparent weakness in the theoretical logic of IC. Buzan, Jones, and Little claim that "interaction capacity rests on the absolute qualities of attributive power rather than the relative weight of relational power."[35] They further claim that "depending on their attributes, states can or cannot do certain things, like building a nuclear weapon, or putting 12 million men into uniform."[36] They believe attributive power is not relative but absolute because "all units can increase (or decrease) their levels of it through such capability-expanding activities as technological development, industrialization, administrative efficiency, and collective identity."[37] Theoretically this may be true for social IC, but some states may never attain the attributes necessary to create certain forms of technological IC, especially if blocked by the use of relative power by other states. Technological IC is the physical manifestation of transport, communications, and other types of physical IC, which logically can only be wielded by units with the capability to construct or operate such IC. Since this is the case, technological IC like GUCCI should be grounded in relative capabilities of units—the knowledge (a social IC) is systemic but the capability of use is a unit capability. If this be the case, has technological IC simply been reduced to a relative capability dependent on unit-level action, or can it still be considered independently responsible for shoving and shaping forces on structure?

While disaggregating power, Buzan, Jones, and Little conclude, "the overall pattern of distributional structure has to be related to the shifting contexts (or regimes) of non-state activity within which state capabilities are exercised."[38] A methodological door is therefore opened when they write, "A case could be made for both aggregative or disaggregative conceptions of interaction capacity.… A disaggregative approach would look separately at technological and societal capabilities in the system. One advantage of disaggregation is that it enables account to be taken of the different logistical requirements of interaction in different sectors."[39] A disaggregative approach certainly seems appropriate for the study of GUCCI, which, although not distributed evenly across the international system, is available for any individual or unit to access and use depending on available capabilities.

For an effective disaggregative approach toward GUCCI, one must note the disaggregation takes place at two levels. Firstly, disaggregation of the physical infrastructure demarcates responsibilities of state and non-state units involved in deployment and operation of GUCCI. Cable systems traverse the high seas, exclusive economic zones and territorial waters of sovereign states. Cable landing stations and data traffic routing equipment sit on sovereign territory and can be manipulated by any actor with access to such facilities. Secondly, analytically speaking, GUCCI is simply one aspect of the cyber realm. For most individuals, the most familiar aspect of this realm is probably *cyberspace*—a virtual global domain resulting from the interaction of people, software and services within the information environment consisting of the interdependent network of information systems infrastructures including the Internet, telecommunications networks, computer systems, and embedded processors and controllers.[40]

Cyberspace aligns with IC as the definition has both social elements (the information environment) and physical elements (infrastructures). In addition to aligning with IC, Barrinha and Renard note a number of characteristics about cyberspace: "It is a global domain connecting nations and citizens worldwide in a variety of manners, generating interactions and frictions between them.… Cyberspace is then comparable to other global commons, like the high seas, airspace and outer space. As such, it is considered that a minimum of rules and regulations are required, in order to ensure access to all and avoid conflict, which can only result from diplomatic negotiations."[41] They go on to note "cyberspace's contested nature in which its major powers promote competing visions, interests and values for the cyberspace." These characteristics seem commensurate with the concept of IC in ES theory. Already, a number of authors have tied ES theory to current cyber issues,[42] with Lemke and Habegger making a strong case for how the digital communication revolution allows for "a significant shift in the global opportunity structure of collective mobilization" and an "alternative site for transnational contention" all predicated on the exponential growth of digital interaction capacity.[43] Therefore, to answer our question above, it does appear that technological IC can independently create shoving and shaping forces that may act on structure.

It is now possible to elevate the theorizing of technological IC and IC more generally. IC encompasses system structure and units (i.e., states in the modern state system). Shoving and shaping forces from structure and from IC itself, interact with units in the system, and in turn, these units generate flows that rest upon the varying types of IC. Flows utilizing IC, between units and between units and structure, are thick or thin (in varying degrees) dependent on the capabilities of the units and dependent on the shifting contexts of non-state activity that infuse such flows. The positional structure of the system may be affected in part by the flows with which the structure interacts (see Figure 1).

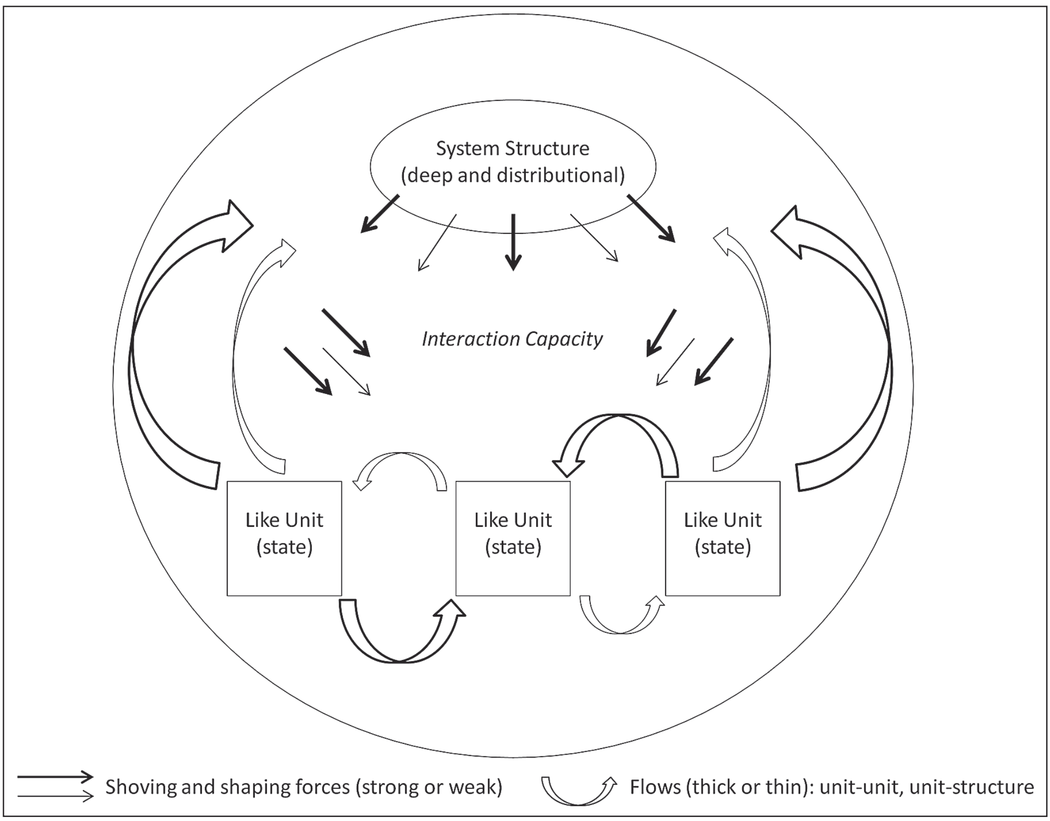


**Figure 1: Interaction Capacity from a Structural Perspective**

Methodologically speaking, flows can be analyzed as thickening or thinning, depending on unit or other actor appropriation or manipulation of individual types of IC. As measuring the thickening or thinning of flows in a quantitative sense would be quite difficult (flows are affected by a number of factors), historical trends or changes, as well as comparative analysis, may provide the best methods by which to gauge changes in flows.[44] Such an analysis should open insights into possible coming changes to the structure of the system.

## III. GUCCI as Indispensable Infrastructure

Since the introduction of the telegraph, states have leveraged telecommunications technology to enhance their power and extend their reach across the globe.[45] Interestingly, although the importance of earlier telegraphic cables were recognized in times of war and peace,[46] the ownership, construction, and operation of the cable infrastructure was almost wholly undertaken by private companies. Supported and subsidized by states, included in and influenced by international conventions and treaties, and subject to the whims of the global marketplace and the demands of national authorities, cable companies set out to connect the world. These fundamental aspects of the cable business have changed little since U.S. President James Buchanan sent greetings to Britain's Queen Victoria over the first Atlantic cable in 1858, though the evolution of undersea cable technology has been significant.

At the component level, modern fiber-optic undersea communications cables are a fairly simple concept.[47] The basic design requires two landing stations and a cable. A cable landing station is a building that sits on a beach or slightly further inland. The station is one end termination point for the cable. On the shore of another country (for an international cable) sits another landing station that acts as the second termination point for a cable. The cable is run from one landing station to the other and rests on the sea floor between them. Cable landing stations may house one or more cables and perform three essential functions. They provide power feeding equipment for the submerged equipment; terminal transmission equipment emits wavelengths and receives communications signals arriving on the receive fiber; and a network management system monitors the system for status and errors.[48] The landing station is also the "the beginning of what is called the 'home run.' The home run is the terrestrial cable route running further inland to the telecommunications point of presence—the handoff of signals from the international to the domestic telecommunications network."[49]

By purpose, design, and definition, GUCCI is critical infrastructure.[50] Besides carrying ninety-five percent or more of international voice and data communications traffic, Sechrist notes that for the United States "nearly all government traffic, including sensitive diplomatic and military orders" that must reach officials in the field traverses GUCCI.[51] Landing stations are in fact so important that nearly twenty-four percent of all U.S. overseas critical infrastructure and key resources are undersea communications cable landings—seventy-one of some three hundred resources listed by the U.S. Department of State.[52] Economically, GUCCI is just as critical. "Without GUCCI, the world's economic financial market would immediately freeze."[53] CLS Bank for foreign exchange settlement set a daily record settlement for its members valued at US$11.1 trillion in 2017 and a daily record volume of 2.58 million transactions in 2016.[54] When the Hengchun earthquake off the coast of Taiwan severed nine of eleven cables to the island in 2006, Korea's financial markets mostly halted trading of the Korean won due to communications problems.[55] Hill estimated as an industry that telecommunications "accounts for two to four percent of Gross Domestic Product (GDP) in developed countries and two to ten percent in developing countries."[56] Rauscher believes "for the most part, the countless government agencies, businesses and individuals who rely on the Internet, global supply chains and modern financial markets everyday have been able to enjoy the luxury of grossly under appreciating the contributions of this [undersea cable] industry to modern society."[57]

For more than 150 years, GUCCI has fueled and responded to enormous evolutions in data communications. Today, it is arguably the world's most important global asset, without which the world's level of modernity collapses. In 2014, traffic between machines exceeded capacity exchanged between human beings[58] and "the world continues to consume ever-increasing amounts of data, with bandwidth demand projected to almost double every two years for the foreseeable future."[59]

## IV. GUCCI as Interaction Capacity

The shoving and shaping forces related to GUCCI that interact with states in the system come in two primary forms: (1) structural forces that stem from the rise of a potential new hegemon in the system and from the evolution of digital technology; and (2) IC forces that stem from non-state actor activity, especially demand for more digital throughput on cables and the business decisions of hyperscalers, which are large digital platform providers. The analysis that follows will focus on these current forces.

### *4.1 Shoving and Shaping Forces of Structure*

Today's shoving and shaping structural forces come primarily from the rise of China as a hegemon in the system.[60] China's rise has led to a strategic competition with the United States, the world's global military hegemon and one of the world's economic hegemons.[61] A primary focus of this strategic competition has been the dominance or control of current and future digital technologies, which stems from a somewhat conspicuous shift toward the idea of techno-nationalism by states in the system. GUCCI is one of the digital infrastructure technologies subjected to this new strategic competition.

There are three prominent ways in which the United States has recently thickened its flows of interaction on GUCCI and one way in which China has attempted to do so. Chronologically may be the best method by which to show the evolution of thickened flows, which means beginning with the case of Huawei. Huawei is a Chinese telecommunications technology company that makes digital networking components and other products. Started in 1987 by a former People's Liberation Army engineer and current Chinese Communist Party member Ren Zhengfei,[62] Huawei grew to become the world's largest network equipment maker, holding about thirty percent of the global market in the first half of 2021.[63] However, "for more than two decades, U.S. government officials have raised national and economic security concerns with Huawei, citing its ties to the Chinese government and military, preferential Chinese policies and financing that enabled its growth and expansion globally, and the potential for espionage."[64]

U.S. actions toward Huawei have been varied and increased over time. U.S. government agencies have discouraged or blocked mergers, acquisitions, and financing deals involving Huawei and U.S. companies; in 2017, the U.S. Department of Defense was restricted by law from using Huawei equipment in certain networks; in 2018, other government agencies were prohibited by law from obtaining equipment, systems or services that use Huawei equipment; in 2019, the U.S. Department of Commerce added Huawei to its Entity List requiring companies to obtain an export license to export goods to Huawei; and other restrictions on 5G technology have followed.[65] Even though both the Trump and Biden administrations allowed some $60 billion in transactions between U.S. firms and Huawei,[66] the restrictions have taken a toll on Huawei's submarine communications cable equipment business.

Huawei has the distinction of being the only submarine cable equipment manufacturer accused of espionage on behalf of a state. The suspicions and accusations have been ongoing for years,[67] with some worries most likely rooted in China's *2017 National Intelligence Law* that states companies must "support, assist, and cooperate with" China's intelligence-gathering authorities.[68] In the period of 2017 to 2021, Huawei Marine Networks (rebranded as HMN Technologies) supplied eleven systems globally, nearly twenty percent of all new systems. From 2021 to 2026, it is projected to supply four new systems of the planned 38 systems, approximately eleven percent.[69] Huawei has dropped from the second largest supplier of new systems to fourth, with its competitors ASN, SubCom, and NEC holding steady or increasing the number of systems they will supply.[70]

In addition to obstructing Huawei's submarine cable business, the United States has recently begun to block the rights to land a cable and allow operations of cable landing stations and points of presence through domestic regulatory administration. States can block the operations of submarine cable installations in their territory if they have concerns regarding the cable's international landing points. In February 2020, the United States delayed licensing a Chinese majority owned cable system, Pacific Light Cable Network, that was planned to connect Hong Kong, Taiwan, the Philippines, and the United States.[71] The cable license was denied in June of that same year, which caused a domino effect. Three planned trans-Pacific systems withdrew their licensing requests to land in Hong Kong, and two new trans-Pacific systems did not include Hong Kong landings.[72] In cases such as these, cable owners must determine which landing points are most important to their planned operations and make adjustments to accommodate the concerns of states.

Lastly, what is clear in regards to GUCCI is that governance for protection, security, and industry harmonization has been left mostly to the private sector.[73] When it comes to security and protection, a system of maintenance agreements devised by the private sector ensures that cable ships are dispersed globally so that a damaged cable may be reached within 24 hours and repairs can commence.[74] There are currently 51 cable-laying vessels in the world, of which 21 are dedicated to club and private maintenance zones. Of the remaining vessels, 26 are dedicated to installation work and four are multi-purpose.[75] As this is the case, the U.S. government has already approved funding for a cable ship security program "to speed up repairing damage to U.S. national security–relevant submarine cables."[76]

In addition, as *Reuters* reports, "SubCom [a New Jersey based company] is the exclusive undersea cable contractor to the U.S. military, laying a web of internet and surveillance cables across the ocean floor, according to the four people with knowledge of the matter: two SubCom employees and two U.S. Navy staffers…. The cable firm now works almost exclusively for the U.S. military and big U.S. tech firms."[77]

The contention here is that U.S. restrictions on the Chinese company Huawei, U.S. regulatory obstruction to the landing of certain cables in the U.S., a new cable ship security program, and a partnership with the private submarine cable laying company Subcom, all indicate that the U.S. is increasing its IC flows regarding GUCCI. These actions by the U.S. seem correlated to a new strategic competition between the U.S. and China that seems rooted in China's hegemonic rise. Additionally, the actions seem meant to hinder or obstruct China's rise, a rise which could potentially have long-term effects on the international system structure.

### *4.2 Shoving and Shaping Forces of Non-State Activity*

Besides structural shoving and shaping forces that have affected China and the United States most prominently, states in the system also must contend with IC shoving and shaping forces from non-state actor activity. The biggest force shaping GUCCI is demand for more bandwidth by individuals across the globe. The demand for ever-increasing amounts of data seems largely driven by a need to share experiences and information and to receive experiences, especially through social networking platforms like Facebook, offered by Meta. Facebook has over 2 billion users,[78] 1.4 billion of whom use Facebook Groups.[79] The platform generates four petabytes of data daily.[80] It is one of seventeen social networking applications that have 300 million users or more.[81] Instagram has more than 1 billion users sharing more than 95 million photos each day.[82] The platform had 5 million videos uploaded within 24 hours of offering a video service,[83] while 500 million of its subscribers use Instagram Stories every day.[84] This is all of course in addition to the need of GUCCI for international economic activity, as noted above.

In response to social need, the hyperscalers Alphabet, Microsoft, Meta (formerly Facebook), and Amazon—companies that require a large amount of bandwidth on cable systems—have entered the submarine system ownership market; others may in the future as well. Unlike traditional cable owners, hyperscalers do not necessarily need cables in locations with many interconnect options, like New York or London. They often locate their data centers in regions that offer greater cost savings, and therefore, supplying new cable infrastructure to meet their bandwidth needs in these areas is of greater concern.[85] In the years 2017–2021, twenty percent of the systems that went into service were driven by hyperscalers. This is projected to increase to twenty-three percent in the period 2022 to 2024 and is expected to continue increasing beyond that.[86] As cable costs are but a fraction of the annual operating expenses of a number of hyperscalers, growth in the number of cable systems should continue. In addition, "the world continues to consume ever-increasing amounts of data, with bandwidth demand projected to almost double every two years for the foreseeable future. This demand—largely driven by a continued shift towards cloud services, continued explosion of mobile device usage and mobile technology like 5G"[87] means capacity of GUCCI will continue to grow as well. Capacity growth for greater amounts of data transmission in the period of 2017 to 2021 had a compound annual growth rate of 18.6 percent.[88] In 2020, the average amount of global data traffic on international links was 170 tbps (terabits per second), while peak traffic was 280 tbps.[89]

Moreover, ownership of cables is changing. Generally, cable systems are either multiple-owner cables or single-owner cables. Multiple-owner cables have traditionally been consortia, where numerous companies from across the globe come together and finance and manage the project through negotiation, spreading the risk among them. Single-owner cables have one or just a few owners, taking on greater risk if the project does not succeed. They usually secure funding as loans from other sources. The fact that ownership is becoming heavily skewed toward single-owner cables may be a concern.

The 2021 Submarine Cable Map from industry leader TeleGeography shows 464 cable systems and 1,245 submarine cable landing stations globally.[90] Of the more than 500 current and planned domestic and international cable systems, the vast majority are wholly or majority owned by private companies, including the more recent trend of global content providers, often referred to as hyperscalers—Amazon, Meta, Alphabet, and Microsoft among others—becoming whole or partial owners of cable systems.[91] In 2011, single-owner cables comprised fifty-six percent of cable systems worldwide. However, new builds beginning in 2021 took this number to sixty-three percent and by 2024 single-owner systems will constitute a full eighty percent of all new builds.[92] Why does this turn toward single-owner systems matter?

Single-owner systems, as private entities, have much greater control, and possibly complete control of data traffic through their cable infrastructure. This means they can route data however they choose. In 2020, Subtel Forum Analytics wrote, "The OTT [Over-The-Top] providers such as Amazon, Facebook, Google and Microsoft are completely transforming the submarine cable market. They are no longer reliant on Tier 1 network operators to provide capacity and are simply building the necessary infrastructure themselves. This is likely to have a long-term impact as the largest consumers of bandwidth are essentially exiting the market. A side effect of this is that traditional carriers may have a harder time developing a business case for new cable systems."[93] In fact, GUCCI systems are generally regarded to have a lifespan of 25 years, though some are upgraded or utilized longer. It is predicted that approximately 190 systems will reach end-of-service by 2031, which is forty-three percent of all current systems. If traditional carriers have a hard time developing a business case for new systems, then the eighty percent of new builds by single-owner entities may climb higher, which means most data traffic may be subjected to manipulation and/or the trafficking priorities of single-owners. This may impact the relative neutrality of data flows compared to consortia-built systems.

There is little doubt that hyperscalers are thickening their flows on the technological IC of GUCCI. U.S.-based hyperscalers have a history of supporting U.S. intelligence agencies and the U.S. government with data sharing, but also have an interest in developing the new economic model known as surveillance capitalism.[94] As GUCCI trends more toward single-owner systems, many potentially owned by hyperscalers, there are questions to be asked concerning the future of system structure. Will these hyperscalers be helping governments maintain the status quo? Will they affect distributional structure in the system? Will they become new leaders and create a new form of structure beyond the state system?

## V. Conclusion

The purpose of the presented analysis was to highlight potential changes to the structure of the international system that may stem from recent trends of state and non-state actor interaction with the global undersea communications cable infrastructure. To do this, the paper used a disaggregative approach to GUCCI and elevated the theorizing of the concept of technological IC (and IC more generally) in English School structural theory; it then proposed qualitative methods, historical or comparative, by which to analyze interaction flows of units in a system as either thickening or thinning, in order to determine potential effects on system structure.

It is nearly impossible to overstate the importance of GUCCI to modern, global society as critical infrastructure or interaction capacity. As such, there are shoving and shaping forces related to GUCCI from both structure in the international system and from non-state activity in the system that affect state interaction in the system. An analysis of GUCCI as technological IC shows increased flows from the United States on this particular type of IC as a response to structural forces in the system, most likely caused by the rise of China as a new potential hegemon. The analysis also shows significant shoving and shaping forces from non-state activity over IC, which may potentially allow IC, in the words of Buzan and Little, to "override structural effects in the overall logic of the system."

The potential of non-state activity to gain material dominance over GUCCI as IC may certainly have future implications for the structure of the international system. The trend in growth of single-owner cable systems, and the potential crowding out of multiple-owner cables by hyperscalers' ability to finance cable systems easily, creates the potential of a balkanised cyberspace, where a relatively small number of hyperscalers wield enormous influence in the routing and manipulation of data. It is not too difficult to imagine an infrastructure of GUCCI built and operated by a hyperscaler that does not let data travel outside of that infrastructure, or at least, routes that data around states with which it does not have positive relations. The technology available allows such routing choices to be made. A balkanization of cyberspace in such a way could create region-based cyberspaces where like-minded states and their transnational backers sever connections with other states or entities.

Such a balkanization is possible in that the opportunity to create region-based cyberspaces is afforded by the evolution of technology in telecommunications and the current trends of expansion by hyperscalers. This could have enormous ramifications for the structure of the global system, as regional systems rise and individual states lose prominence. Nonetheless, there are constraints in place to make such a creation difficult. States still have sovereign rights over their territories, and as demonstrated by the United States, they may refuse the licensing or landing of cables that do not conform to their values or national interests. Operations of GUCCI are also reliant on states adhering to international law and not disturbing the laying of cables or the transmission of communications along them. Nevertheless, states are awakening to the incredible importance of this critical infrastructure, as demonstrated by actions of the United States that appear to have thickened its flows in IC.

We can conclude that GUCCI as technological IC and the shoving and shaping forces that accompany it continue to evolve, and as such, its ability to affect structure may be very real at this point in history or in the near future. A future study covering the history of

GUCCI, from its importance as "the nerves of Empire"[95] for the British in the early twentieth century, to the growth of digital finance and fiber optic communications in the 1970s and further into the evolution of personal computing in the twenty-first century, may show how IC evolved to become a factor of potential structural change within the system. Nonetheless, ES theory has traditionally understood IC as a medium in the global system providing a conduit between regime-level agency and the structural level of the state system. Such thinking seems to have limited the exploration of IC's potential impact through its shoving and shaping forces on the structure of the international system. This being the case, perhaps it is time to reevaluate how technological IC and technology in general are viewed by the English School.

## *Notes*

1. Cyber refers to both information and communication networks.

2. Nazli Choucri, *Cyberpolitics in International Relations* (Cambridge, MA: MIT Press, 2012); Chris C. Demchak, "Foreword," *Cyberspace and International Relations: Theory, Prospects and Challenges,* eds. Jan-Frederik Kremer and Benedikt Müller (Heidelberg: Springer, 2014), pp. v–ix; Jan-Frederik Kremer and Benedikt Müller (eds.), *Cyberspace and International Relations: Theory, Prospects and Challenges* (Heidelberg: Springer, 2014); Massachusetts Institute of Technology, Challenges, last revised September 21, 2020, http://ecir.mit.edu/challenges, accessed May 12, 2022; Massachusetts Institute of Technology, Minerva Initiative, last revised September 21, 2020, http://ecir.mit.edu/, accessed May 12, 2022; Milton. L. Mueller, *Networks and States: The Global Politics of Internet Governance* (Cambridge, MA: MIT Press, 2010); Thomas Rid and Mark Hecker, *War 2.0: Irregular Warfare in the Information Age* (Westport, CT: Praeger Security International, 2009).

3. This number is contested. Some authors claim ninety-five percent or more (see Karl F. Rauscher, *ROGUCCI: The Report. Proceedings of the Reliability of Global Undersea Cable Communications Infrastructure Study and Global Summit, Issue 1, rev. 1* (Dubai, UAE: IEEE Communications Society, 2010), p. 33; Justin Sherman, *Cyber Defense Across the Ocean Floor: The Geopolitics of Submarine Cable Security*, Atlantic Council (2021), p. 2, https://www.atlanticcouncil.org/in-depth-research-reports/report/cyber-defense-across-the-ocean-floor-the-geopolitics-of-submarine-cable-security/, accessed August 08, 2022; Ian Walden, "International Regulatory Law," in Ian Walden (ed.), *Telecommunications Law and Regulation*, 5th ed (Oxford: Oxford University Press, 2018), p. 802, while Ruggeri claims 99 percent (Yves Ruggeri, "Forward," in José Chesnoy [ed.], *Undersea Fiber Communications Systems*, 2d ed. (London: Academic Press, 2016), p. xxiv, and Bergano believes it to be 99.999 percent for typical Internet traffic (Neal S. Bergano, "Foreword," in José Chesnoy [ed.], *Undersea Fiber Communications Systems*, 2d ed. (London: Academic Press, 2016), pp. xxvii–xxviii.

4. See Submarine Telecoms Forum, *Industry Report 2021/2022*, Issue 10 (2021), pp. 13, 28, https://subtelforum.com/products/submarine-telecoms-industry-report/, accessed August 14, 2022; Submarine Telecoms Forum, *Submarine Cable Almanac*, Issue 40 (November 2021), p. 10, https://subtelforum.com/products/submarine-cable-almanac/, accessed February 4, 2022.

5. Lane Burdette, "Leveraging Submarine Cables for Political Gain: U.S. Response to Chinese Strategy," *Journal of Public and International Affairs* May 5 (2021), para.1, https://jpia.princeton.edu/news/leveraging-submarine-cables-political-gain-us-responses-chinese-strategy, accessed August 12, 2022.

6. Hedley Bull, *The Anarchical Society: A Study of Order in World Politics*, 2d ed. (New York: Columbia University Press, 1995), pp. 263–271.

7. *Ibid.*, pp. 269–270.

8. See Andrew Linklater and Hidemi Suganami, *The English School of International Relations: A Contemporary Reassessment* (Cambridge, UK: Cambridge University Press, 2006), Introduction and Chapter 1, https://doi.org/10.1017/CBO9780511491528.

9. See Mark Bevir and Ian Hall, "Interpreting the English School: History, Science and Philosophy," *Journal of International Political Theory* 16(2) (2020), p. 121, https://doi.org/10.1177/1755088219898884; Dale C. Copeland, "A Realist Critique of the English School," *Review of International Studies* 29(3) (2003), p. 427, https://doi.org/10.1017/S0260210503004273; Martha Finnemore, "Exporting the English School?"

*Review of International Studies* 27(3) (2001), p. 509, https://doi.org/10.1017/S0260210501005095; William A. Callahan, "Nationalising International Theory: Race, Class and the English School," *Global Society* 18(4) (2004), Abstract, https://doi.org/10.1080/1360082042000272436; Robert W. Murray, "The Need for an English School Research Programme," in Robert Murray, ed. *System, Society, and the World: Exploring the English School of International Relations*, 2d ed. (E-International Relations Publishing, 2013), pp. 116–117.

10. Barry Buzan, *From International to World Society? English School Theory and the Social Construction of Globalization* (Cambridge, UK: Cambridge University Press, 2004).

11. Barry Buzan, Charles Jones, and Richard Little, *The Logic of Anarchy: Neorealism to Structural Realism* (New York: Columbia University Press, 1993), under "Systemic Capabilities," https://doi.org/10.7312/buza93756.

12. Buzan, Jones, and Little 1993, under "Systemic Capabilities," figure 4.2; Barry Buzan and Richard Little, *International Systems in World History: Remaking the Study of International Relations* (Oxford: Oxford University Press, 2000), p. 81.

13. For an argument against an analytical level called interaction capacity see WiZ Haut and Robert H. Lieshout, "The Limits of Theory: Detecting Contemporary Global Change and Predicting the Future of the States System," in Robert H. Lieshout, Kees van Kersbergen, and Grahame Lock (eds.), *Expansion and Fragmentation: Internationalization, Political Change and the Transformation of the Nation-State* (Amsterdam University Press, 1999), pp. 43–70. http://www.jstor.org/stable/j.ctt46n03w.6.

14. Buzan, Jones, and Little 1993, under "Systemic Capabilities," para.21.

15. Buzan and Little 2000, pp. 287–288.

16. Buzan, Jones, and Little 1993, under "Systemic capabilities"; Buzan and Little 2000; Barry Buzan and George Lawson, *The Global Transformation: History, Modernity and the Making of International Relations* (Cambridge, UK: Cambridge University Press, 2015); Barry Buzan, *An Introduction to the English School of International Relations: A Societal Approach* (Cambridge, UK: Polity Press, 2014).

17. Buzan and Little 2000, pp. 80–81.

18. Buzan, Jones, and Little 1993, under "Systemic Capabilities," para.2.

19. *Ibid*., under "Systemic Capabilities," para.3.

20. Buzan and Little 2000, p. 82.

21. Buzan, Jones, and Little 1993, under "Systemic Capabilities," para.23.

22. Buzan and Little 2000, pp. 80–81.

23. Buzan, Jones, and Little 1993, under "Systemic Capabilities," figure 4.1.

24. Sherman 2021, p. 6.

25. Buzan and Little 2000, p. 288; Buzan and Lawson 2015, p. 96.

26. Buzan and Little 2000, p. 297.

27. *Ibid.*

28. *Ibid.*

29. Buzan, Jones, and Little 1993, under "Systemic Capabilities," para. 10.

30. Buzan and Little 2000, p. 85.

31. Buzan, Jones, and Little 1993, under "Systemic Capabilities," para. 9.

32. Kenneth Waltz, *Theory of International Politics* (Long Grove, IL: Waveland Press, 1979), pp. 97–99.

33. Buzan, Jones, and Little 1993, Figure 3.3.

34. Buzan and Little 2000, p. 286.

35. Buzan, Jones, and Little 1993, Chap. 13, para. 17.

36. *Ibid*., Chap. 4, para. 4.

37. *Ibid.*

38. *Ibid*., Chap. 13, para. 15.

39. *Ibid*., under "Systemic Capabilities," para.10. By "different sectors," it seems Buzan, Jones, and Little meant aspects of the international system affected by absolute IC, for example finance, trade, diplomacy, intelligence gathering, etc. However, the argument here is that technological IC can be disaggregated further and expanded as a methodological tool of inquiry.

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47. An example of a simple cable would be the newly laid 155km CrossChannel Fibre cable. This span is a direct–connection cable link that runs along the sea floor of the English Channel. One end of the cable terminates at the Brighton Cable Landing Station, in England's southern coastal city of Brighton, while the other end terminates at the Veules-les-Roses Cable Landing Station, in Veules-les-Roses, France (see TeleGeography, https://www.submarinecablemap.com, accessed February 7, 2022). The cable has 96 fibre pairs with a data capacity of 192 Pbps (petabits per second) (see TeleGeography, Submarine Cable Map [2021], https://submarine-cable-map-2021.telegeography.com/, accessed February 4, 2022). An example of a complex undersea cable network is the Asia Pacific Gateway cable. The cable has eleven landing stations in eight different countries. Along the main stretch of cable are branch units (transfer points) that allow shorter spans of cable to run in a different direction so they may connect to a landing station ashore. If a person in Tokyo, Japan, wishes to send a message to Hanoi, Vietnam, the data will travel south along the main stretch of cable, but before reaching the southernmost station in Singapore, a branch unit off the coast of Vietnam will redirect the data in a more northerly direction to the landing station in Danang, Vietnam (see TeleGeography, https://www.submarinecablemap.com, accessed February 7, 2022). The Danang Landing Station will forward the data on domestically.

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51. Michael Sechrist, *Cyberspace in Deep Water: Protecting Undersea Communication Cables,* Harvard Kennedy School (2010), p. 4.

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54. Wikipedia contributors. CLS Group, last edited March 15, 2021, https://en.wikipedia.org/w/index.php?title=CLS_Group&oldid=1182731393, accessed June 17, 2022.

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an excellent overview of legal instruments see Daria Shvets, "The International Legal Regime of Submarine Cables: A Global Public Interest Regime," PhD diss., Universitat Pompeu Fabra, Barcelona (2020), p. 119, https://www.tdx.cat/handle/10803/671344 and Tara Davenport, "Submarine Cables, Cybersecurity and International Law: An Intersectional Analysis," *Catholic University Journal of Law & Technology* 24(1) (2015), pp. 57–109. Otherwise, private protection falls to the International Cable Protection Committee (ICPC), a private, non-profit organization with more than 185 members in over 65 countries and represents 98 percent of the world's subsea telecom cables (see the ICPC homepage at https://iscpc.org/).

74. Maintenance agreements are either global or zone. Zone agreements are comprised generally of multiple cable owners of a particular region that have joined an agreement to facilitate post-installation maintenance. Private maintenance agreements are often contracted by a cable owner with the cable system installation company to provide post-installation maintenance. The function of these agreements is to ensure timely dispatch of cable maintenance and repair ships when damage has occurred. Zone agreements exist as the North America Zone Agreement, Atlantic Cable Maintenance & Repair Agreement, Mediterranean Cable Maintenance Agreement, Southeast Asia and Indian Ocean Cable Maintenance Agreement Extended and the Agreement for the Maintenance of Pacific Ocean Cable Systems in the Yokohama Zone. There is also the Pacific and Indian Ocean Cable Mutual Agreement comprised of the North America, Yokohama, and Southeast Asia zones agreements (see Shvets 2020, pp. 218–223).

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## Biographical Statement

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