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Contents

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I. INTRODUCTION

Submarine cables are critical links in the infrastructure that enables worldwide communications. This article first examines the vital role that submarine cables play and how communications reliability is maintained by cable traffic restoration and cable repair. The article then reviews international law within the context of submarine cable history and the evolution of cable technology. In Part II it discusses how international law, as codified in the 1982 Law of the Sea Convention and the 1884 Cable Convention, is central to the success of submarine cable communication. In Part III it provides examples of how key compromises codified in the Cable Convention can serve as a springboard to develop new techniques to protect submarine cables from hostile action by third parties and belligerents. Part IV addresses threats to the submarine cable system during peacetime. Part V discusses current vulnerabilities in the ability to repair cables during armed conflict and a recent initiative to address those vulnerabilities. This article concludes in Part VI by encouraging scholars and policy makers to propose, discuss, and debate these ideas. It suggests providing for improved cable route diversity, amending the Convention for Suppression of Unlawful Acts Against the Safety of Navigation to include submarine cables and cable ships, and according to cable ships an exemption from belligerent attack in wartime.

II. THE IMPORTANCE OF SUBMARINE CABLES

A. Fiber Optic Submarine Cable Characteristics

Submarine cables on the high seas are typically 17–22 mm in diameter—about the diameter of a beer bottle cap. The cable is comprised of a high-grade, marine-quality polyethylene tube with a core of steel wire for strength, a copper conductor to power acoustical optical amplifiers (repeaters), and glass fibers for communications. A single cable can have anywhere from six to over thirty-two fiber optic pairs. The light spectrum in a fiber is divided into numerous color spectrum wave bands. Each wave band transmits data independently and simultaneously, yielding a continuously increasing torrent of terabits of data traveling at the speed of light. There have been continuous exponential improvements in transmission capacity. For example, while the 8-fiber pair "GTT Atlantic" cable laid in 2001 (connecting the United Kingdom, Ireland, Canada, and the United States) can carry 2.5 terabits per second, the 8-fiber pair "MAREA" cable laid in 2018 (connecting Spain and the United States) can carry 24 terabits per second.[1]

Cables are chemically inert in the marine environment and have a small footprint.[2] The power required for the cable is a constant direct current of about 0.6 to 1.0 amperes—less than the three amperes required for a midrange laptop computer.[3] In territorial seas and exclusive economic zones where fishing and anchor threats are present, cables may be sheathed with high quality steel armor wiring. Additionally, cables in these waters may be buried to a seabed depth of one to three meters, depending upon the seabed sediment and the fishing threat. Extensive peer review scientific papers document the benign impact of fiber optic cables in the marine environment.[4]

B. Submarine Cable Traffic Restoration

A basic understanding of what happens to restore the traffic carried on a submarine cable when the cable suffers a fault clarifies why submarine cables have a well-deserved peacetime recognition for communication resilience. With rare exception,[5] this important topic is not addressed in peer reviewed literature.

Restoration is the term used to describe the process of rerouting and restoring traffic on a submarine cable when the cable is down for maintenance or when it has been disrupted by a fault that damages or cuts the cable. When a fault occurs, two actions are required. The first is restoration of the traffic and the second is the physical repair of the cable. Each process runs in parallel and is handled by different professionals employed by the cable owner. Restoration in peacetime normally takes place in seconds or minutes while the peacetime repair process takes days or weeks. Cable repair is important not only to get the damaged cable back in operation, but because each cable is a back-up for restoration of other cable systems.

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1. Submarine Cable Map 2021, TELEGRAPHY, https://submarine-cable-map-2021.telegeography.com/.

2. DOUGLAS BURNETT & LIONEL CARTER, INTERNATIONAL SUBMARINE CABLES AND BIODIVERSITY OF AREAS BEYOND NATIONAL JURISDICTION 29–30 (2017).

3. *Id.* at 53.

4. *Id.* at 63–71 (references include about forty-four books, papers, and studies addressing various environmental aspects of submarine cables).

5. Mick Green, *The Submarine Cable Industry: How Does It Work?*, *in* SUBMARINE CABLES: THE HANDBOOK OF LAW AND POLICY 41 (Douglas Burnett et al. eds., 2014).

Before fiber optic cables were used, restoration of submarine cables was carried out by using other cables or by satellite. With the advent of fiber optic cables, restoration by satellite is no longer practical. Moreover, major commercial customers in their contracts with cable owner specify that restoration must be by other fiber optic cables.

In many respects, restoration is the "secret sauce" for submarine cable resiliency. For example, if a transatlantic cable is cut, in milliseconds the traffic is rerouted to other transatlantic cables. If those are not available, traffic is rerouted to U.S.-Brazil cables and then across the South Atlantic to Africa and north to Europe, and if these are not available then across the Pacific Ocean to Asia landings and thence across the Indian Ocean to the Mediterranean Ocean to Europe, typically all in seconds or minutes. Restoration like this is normal and functions well unless large numbers of cables are knocked out at the same time by major natural disasters or belligerent actions. The situation will be dramatically aggravated if similar events simultaneously compromise multiple cables in more than one ocean.

Cable systems are designed with restoration features. One older solution is to design a self-healing ring cable system where one system has two roughly parallel transoceanic cables joined at either end by land or submarine cable to form a ring. In the event of a fault on one leg of the cable, the traffic is immediately rerouted back around using the other leg of the ring with no delay or cost. "TAT-14," taken out of service in December 2020 after a twenty-year service life, is an example of a self-healing ring submarine cable system.

Ring architecture is being replaced by point-to-point "mesh" architecture that allows cable traffic to be restored on any cable in which the cable owner has capacity ownership or an indefeasible right of use agreement. This avoids having to build two cables in parallel and provides greater redundancy and flexibility.

Restoration nowadays is largely controlled by revolutionary automatic switches that, when triggered by a cable fault, automatically reroute traffic in milliseconds to other transoceanic cable paths. A cable system also normally has a restoration liaison officer to plan restoration with cable design engineers, conduct exercises with other systems, and handle restorations when the need arises from a cable fault or repair on a 24/7 basis. Cable systems may differentiate the costs of services provided to their customers based in part on the degree and speed of restoration specified in the relevant contract. This is particularly true for cable owner customers that use the cable system under lease or indefeasible right of use agreement.

Cable systems have a 24/7 network operations center (NOC) to monitor traffic and identify any disruption to the traffic or a change in the normal operating conditions of the marine portion of their network. The NOC monitors automatic switching and alerts the restoration liaison officer for restoration contingencies and the maintenance authority for repair.

There are three restoration options. The first option is self-restoration. Self-restoration allows a cable owner to restore traffic automatically on other cables where it owns capacity or fiber pairs. This approach is known as a "mesh." Cable content providers and "hyperscalers"[6] like Google and Facebook are designing their global systems to be entirely restored to the maximum extent possible on their own fiber pairs in other systems they co-own. Their goal is to keep connectivity between their server farms and allow the "cloud" to function without interruption. Traditional telecom companies such as AT&T and BT Group (formerly British Telecom) have a different goal of keeping their direct customers in communication around the world. This dichotomy in goals between the cable content providers and the telecom companies is a new phenomenon. How these approaches will work in cases of multiple cable failures, especially in more than one ocean, is an open question.

In modern fiber optic cable systems extra or spare capacity is reserved for restoration or future capacity needs. Capacity in cables actively being used (called "lit" cables) is immediately available for restoration if the cable is fully equipped. Some analysts fail to calculate that only equipped lit capacity counts for timely restoration. To be considered equipped, the terminal equipment must have the circuit cards installed to send and receive the newly activated lit capacity and be fitted with adequate power and cooling equipment in the terminal cable station to handle the increased use. Equipping lit capacity is expensive and time consuming if it is not already installed. A new circuit card alone may take four to six months to order from a manufacturer. Add to that the engineering implementation, testing, and procedures required—it is not an automatic process. The result is that only a fraction of lit capacity is equipped as cable system operators carefully measure how much lit capacity they need for business reasons. When an active cable system has unused or spare dark or unlit fibers, there are major expenses and

6. Hyperscaler is a term used in the cable industry to refer to companies that operate data centers. Hyperscale computing is necessary to build a robust and scalable cloud, big data, map reduce, or distributed storage system and is often associated with the infrastructure required to run large, distributed sites. Examples are Amazon, Facebook, Microsoft, and Google.

time required to bring these dark fibers into operation. The decision to equip and activate the dark fibers to carry traffic is a carefully made business decision and not one readily available in an emergency.

The second option is through mutual restoration agreements with other cable systems. In these arrangements—negotiated by the restoration liaison officer—a cable owner agrees that in the event of a fault or repair on a cable system under the arrangement, traffic will be restored on the cable system not impacted by the fault. Normally, mutual restoration agreements are performed at no cost on a reciprocal basis.

A third option is an ad hoc commercial arrangement where a cable system sells restoration services to other cable systems at a posted or negotiated market price. This type of arrangement is largely replaced by the first two restoration options but may still be used if the first two options, for whatever reason, are not up to the task.

Restoration may combine the various restoration options to give a cable system the required reliability. An important restoration objective is to provide protection and flexibility by spreading traffic among various cable system "baskets" instead of placing most or all of the traffic "eggs" in one or two baskets.

In a scenario where large numbers of cables are out of service during wartime or major natural disasters, the normal peacetime restoration process would be seriously challenged if not overtaxed. There are several reasons for this vulnerability.

First, unlike historic industry practice, modern mesh restoration is handled by each company using its owned or indefeasible right of use capacity in the various cable systems in which it has interests. As a result, there is only limited spare equipped capacity to receive restoration traffic from other cable systems.

Second, the division of cable system owners into hyperscalers or content providers and traditional telecom companies introduces different business models that directly impact restoration. A hyperscaler is focused on service between its server farms that form its cloud services, not the end customers. The traditional telecom company is focused on its end customers. Unlike the traditional telecom companies, the hyperscaler is not disposed or practiced in allowing third parties to use its systems for restoration. Hyperscalers that are responsible for the newest submarine cables may have optical amplifiers and equipment that is not conducive to ad hoc additions of restoration capacity from third parties.

Third, in a wartime situation, where large numbers of cables are damaged, a likely scenario will be numerous cable owners trying to compete for the limited restoration capacity available on the surviving cable systems. This ad hoc impact will likely be chaotic as each company makes decisions about which traffic has priority over other traffic and national governments struggle to do likewise with priorities on a national scale.

In terms of global resilience for submarine cables, the more diverse the paths, the better. Route diversity should be welcomed, encouraged, and facilitated by national governments. Many times, this is not the case because of conflicts with other seabed users like offshore wind and fishing; misplaced environmental concerns surrounding marine protected areas; and complacent and "stove piped" government permitting authorities that do not consider the international restoration picture.

It is emphasized that there is no government requirement to restore traffic if a cable is disrupted. The pressure and requirement to provide restoration are driven commercially by the cable system's customers or server farm connectivity, and its market competition. Sophisticated buyers of capacity in their agreements have terms dealing with the speed, cost, means, and reliability of restoration. Premium paid restoration options allow a customer to ensure its traffic has priority over other user traffic. If a cable system does not meet these contractual terms, its customers will contract with other, more reliable or cost-effective cable systems. This approach works quite well in a normal peacetime environment, but the question remains if it works when large numbers of cables are damaged at the same time.

C. Contemporaneous Submarine Cable Usage and Reliance

International submarine cables, which vary between 131 kilometers and 20,000 kilometers in length, lie on the sea bottom at depths as much as 9,912 meters (exceeding Mt. Everest's height), do not enjoy automatic protection or immunity from peacetime theft or intentional disruption or from hostile actions during wartime.

Before delving into international law, a hard look is in order at just how dependent countries around the world are on submarine cables. As many may know, but not often think about, submarine cables enable us to connect with family, friends, businesses, and even online events like the Disruptive Technologies and International Law Conference hosted virtually by the U.S. Naval War College in December 2020, where this article was presented to a worldwide audience.

Consider that, without cables, no one would be able to FaceTime, Skype, Zoom, or communicate internationally on the Internet, whether by video, data, or voice. All such means of communications would stop abruptly if the services provided by submarine cables were disrupted.

Unfortunately, satellites do not serve as an effective substitute. The popular belief that modern communications are satellite-driven has not been accurate since the first transoceanic fiber optic cable, TAT-8, was laid across the Atlantic in 1988.

In fact, in 2007—the year the author testified before the Senate Foreign Relations Committee on submarine cables and the UN Convention on the Law of the Sea (UNCLOS)—if all the submarine cables connecting the United States to other nations had been cut, using every single satellite in the sky would have resulted in only seven percent of the U.S. traffic having been restored.[7] The same exercise today would undoubtedly lower this percent. An analysis today estimates that only 0.37 percent of U.S. international traffic is currently carried by satellite.[8]

Why? Because the capacity of a single transatlantic cable has increased by a factor of one hundred thousand in twenty-five years. About fifty-four of these cables—each with a diameter the width of a garden hose—provide the United States with over 99 percent of its international communications. Australia, Japan, the United Kingdom, Singapore, and a host of other nations are similarly situated in their reliance on cables. Submarine cables connect land-based server farms across the globe, underscoring that the "cloud" is beneath the sea.[9] Even the server farms may be heading to sea, as demonstrated by Microsoft's experimental submerged data center, which was housed in a sealed storage capsule that was retrieved in summer 2020 from the seafloor near Scotland's Orkney Islands.[10]

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7. *Hearing on the United Nations Convention on the Law of the Sea Before the S. Comm. on Foreign Relations*, 110th Cong. 145 (2007) (testimony of Douglas Burnett).

8. Submarine Cable Map 2021, *supra* note 1 ("Statistics released by U.S. Federal Communications Commission indicate that satellites account for just 0.37% of all U.S. international capacity").

9. BURNETT & CARTER, *supra* note 2, at 3.

10. Mike Clare, *Successful Deployment of An Underwater Data Centre*, INTERNATIONAL CABLE PROTECTION COMMITTEE ENVIRONMENT UPDATE, Oct. 2020, at 3–4. The 12.2 meter long, 3.2 meter diameter, pressurized capsule, powered by renewable energy sources, held 855 on-board servers that had a server failure rate one-eighth of a land-based center over the two-year trial period while operating with better cooling efficiency.

Consider the massive investment in submarine cables in the last decade by Google, Microsoft, Facebook, and Amazon.[11] As former Chief of Naval Operations, Admiral Jonathan Greenert, and former Commandant of the Marine Corps, General James Amos, note, "Cyberspace, in the physical form of undersea fiber-optic cables," carries a greater value of trade, through financial transactions and information, than the value of goods carried at sea.[12]

Indeed, each day, the Society for Worldwide Internet Financial Telecommunications transmits about fifteen million messages representing about four trillion dollars daily to more than 8,300 banking organizations, securities institutions, and corporate customers in 208 countries. Consider this statement made by Stephen Malphrus when he was the Chief Information Officer with the United States Federal Reserve, "When the communication [cable] networks go down, the financial sector does not grind to a halt, it snaps to a halt."[13]

Former Secretary-General of the United Nations, Ban Ki-moon, in the Oceans and Law of the Sea Report, wrote "Functioning as the backbone of the international telecommunications system, submarine cables are a fundamental component of the critical global infrastructure and play a direct role in sustainable industrialization; indirectly they contribute to all other areas recognized as important for sustainable development."[14]

In 2020, that "backbone" can be measured by the scope of demand on international fiber optic telecommunication cables—estimated to involve four billion people, four trillion dollars in revenue opportunity, over twenty-five million applications, more than twenty-five billion embedded and intelligent systems, and fifty trillion gigabits of data.[15] This fact is astonishing given the garden hose diameter of an individual cable.

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11. *Id.* at 5–6.

12. Jonathan Greenert & James Amos, *A New Naval Era*, PROCEEDINGS, June 2013, at 17.

13. Stephen Malphrus, Chief of Staff, Federal Reserve Board, Speech at ROGUCCI Conference (Oct. 19, 2009), *quoted in Threats to Undersea Communications Cables* 6 (Sept. 28, 2017), https://www.dni.gov/files/PE/Documents/1---2017-AEP-Threats-to-Undersea-Cable-Communications.pdf.

14. U.N. Secretary-General, *Oceans and the Law of the Sea Report*, ¶¶ 53, 55, U.N. Doc. A/70/74 (Mar. 30, 2015).

15. Mario Morales, Vice-President, IDC Research Inc., Presentation in the TeleGeography Webinar: New Cable Builds Return to the Trans-Atlantic: What are the Impacts? (Oct. 6, 2015).

During the COVID-19 pandemic, the International Cable Protection Committee[16] estimates that Internet traffic increased between 25 and 50 percent between November 2019 and the early stages of lockdown in April 2020.[17] Zoom Video Communications revenue for the quarter ending July 31, 2020, saw a 355 percent increase compared to the previous year.[18]

Given the above facts, I phrase the former U.N. Secretary-General's words in a slightly different way: Fiber optic submarine cables, in and of themselves, constitute—by any standard—critical international infrastructure. By understanding that truth, international scholars and policy experts should grasp the importance of the following nine facts in navigating international law and in proposing solutions to protect submarine cables:

1. Approximately 464 separate international cable systems use 1,245 cable landing stations and about 1.4 million km of fiber optic cables.[19]

2. Ninety-nine percent of these cables are not government-owned. Each cable system is generally owned by separate consortiums of about four to forty private companies or entities, or occasionally by a single company. There is no worldwide submarine cable network any more than there is a world airline network; rather, independent individual cable systems freely cooperate and compete 24/7 year-round, with virtually no international governance, and with what most of us perceive to be a seamless fit. The world's subsea communication systems are provided by free enterprise at no charge to States!

3. Cables, unlike ships, are not flagged to any one State—nor is the nationality of the cable a simple question. Legal ownership of a cable is logically divided among the various co-owners, resulting in a legal kaleidoscope of jurisdictions and nationalities.

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16. The International Cable Protection Committee is a non-governmental organization made up principally by the companies that own and operate the world's submarine cable systems and the cable ships that lay and maintain them. *See generally* International Cable Protection Committee, www.iscpc.org (last visited Nov. 26, 2021).

17. Press Release, International Cable Protection Committee, ICPC Calls on Governments and Industry to Facilitate and Expedite Submarine Cable Installation and Repair During the COVID-19 Pandemic to Protect Internet Connectivity and Critical Communications (Apr. 3, 2020), https://iscpc.org/news/; *See also* U.N. Secretary-General, *Oceans and the Law of the Sea Report*, ¶ 8, U.N. /Doc. A/75/340 (Sept. 9, 2020).

18. *Zoom Video Communications Revenue 2019–2021*, MACROTRENDS, https://www.macrotrends.net/stock/charts/ZM/zoom-video-communications/revenue (last visited Nov. 26, 2021).

19. SUBMARINE CABLE ALMANAC, Nov. 2020, https://issuu.com/subtelforum/docs/subtel_forum_almanac_issue_40; Submarine Cable Map 2021, *supra* note 1.

4. Cable repair is organized regionally by private contract—subject to no applicable government mandates. Repairs are carried out strictly by contract terms, and not according to any national government priority.

5. Cable repair ships are contractually obligated to sail from their base port within twenty-four hours of notification for fast repair response.

6. Fifty or so cable ships operate worldwide.[20] Half are on standby awaiting a repair call out. The other half are laying new cables.

7. Cable ships are custom built, conspicuous, expensive, and carry specialized crews trained at sea through "hawespipe" experience. These ships fly diverse national flags (e.g., United Kingdom, France, Marshall Islands, Singapore, Indonesia, Japan, and China).

8. Cable repairs are urgent—each cable system serves as the backup for other cables that need repair.

9. The environmental footprint of cables on the seabed is benign.[21] Once a cable is laid, it is designed to remain undisturbed unless it needs repair. The typical manufacturer warranty of twenty to twenty-five years is not based on the cable itself, but on the optical amplifier (repeater) that reenergizes the light, placed every sixty to eighty kilometers in the cable.

While this article concentrates on fiber optic telecommunication cables, other types of submarine cables traverse—with increasing frequency—the world's oceans. Military cables are used for acoustic sensing and antisubmarine warfare.[22] More than an estimated twelve hundred scientific cables provide continuous streams of environmental data that advances our understanding of the oceans.[23] Finally, advances in technology also open the door to international electrical power cables, such as the 580 km, 700 megavolt

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20. Rebecca Spence, *Where in the World Are Those Pesky Cable Ships*, SUBMARINE TELECOMS FORUM, Nov. 16, 2020, at 15 (full-service cable ships capable of high seas operation involving laying and repair).

21. *See generally* Burnett & Carter, *supra* note 2; Lionel Carter, *Submarine Cables and Natural Hazards*, *in* SUBMARINE CABLES: THE HANDBOOK OF LAW AND POLICY, *supra* note 5, at 237.

22. J. Ashley Roach, *Military Cables, in* SUBMARINE CABLES: THE HANDBOOK OF LAW AND POLICY, *supra* note 5, at 330, 340.

23. Lionel Carter & Alfred H.A. Soons, *Marine Scientific Research Cables*, *in id.* at 323, 326.

high voltage direct current "NordNed" cable linking Norway to the Netherlands[24] and the planned 1000 km, 1200 megavolt high voltage direct current "Icelink" cable between Iceland and the United Kingdom.[25]

III. INTERNATIONAL LAW

Military, power, and scientific submarine cables have distinct uses and vary by design and construction, but, under international law, they enjoy the same rights and obligations as those relied on for telecommunications. The growth and success of submarine cables—whatever the type—are intrinsically tied to the protections provided to international cables under international law. And, that impressive growth—fueled by the endless ingenuity expressed in cable design, installation, and maintenance—historically depends upon the freedoms to lay and repair submarine cables under international law in an unregulated space outside of territorial seas.

A. Historical Treaty Development

From the time submarine cables were launched in the nineteenth century, technology disruption inflicted by third parties and resulting from natural causes posed central concerns for diplomats and ocean policy makers.

The first transoceanic submarine telegraph cable was laid in 1866 by the entrepreneur Cyrus Field.[26] It was as revolutionary then as the Internet was for us when it was launched in the 1990s. The significance of the then-new technology was captured by the famed English jurist Sir Travers Twiss in 1880:

> The preliminary question, which deserves consideration is whether the maintenance of telegraphic sea-cables, which have an international importance, is an interest of the highest order of States, analogous to the interest of the public health and of the public revenue, which each nation is allowed by courtesy to protect beyond the strict limits of its territorial waters.

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24. Malcolm Eccles et al., *Submarine Power Cables, in id.* at 299, 303.

25. Jemima Kelly & Nerijus Adomaitis, *Giant Iceland-UK Power Cable Plan Seen Facing Brexit Delay*, REUTERS (Oct. 21, 2016), https://www.reuters.com/article/uk-britain-iceland-power-idUKKCN12L1O5.

26. Stewart Ash, *The Development of Submarine Cables*, *in* SUBMARINE CABLES: THE HANDBOOK OF LAW AND POLICY, *supra* note 5, at 23.

> If we look to the public services which the telegraphic sea-cable is now called upon to perform in time of peace, that it has become the normal instrument of communication between Governments and their envoys in foreign countries; that international treaties are from time to time concluded between the nations of the two hemispheres through the medium of telegraphs; that through the same instrumentality approaching tempests are announced in advance to Europe from America, by which great damages and destruction to life and shipping may be averted; that no great criminal can now hope to escape from Europe to the western shores of the Atlantic Ocean with the fruits of his crime without a telegram anticipating his arrival, when he finds himself the captive of the law at the moment when he expect to set his foot upon a land of liberty:
>
> . . .the answer to the question above stated must, we think, be in the affirmative, and there can be no doubt that the great arterial lines of telegraphs have become indispensable for the circulation of the political life blood so necessary to maintain the vitality of our modern international State System.[27]

If one substitutes "fiber-optic cables" and "email or text message" for the words "telegraphic sea-cables" and "telegram," respectively, all must agree that Sir Travers' words are as relevant today as they were in 1880. Further, Sir Travers' "affirmative" to the question about the critical nature of "sea-cable" maintenance found results in the pioneering 1884 International Convention for the Protection of Submarine Cables.[28]

The 1884 Cable Convention constitutes the world's very first law of the sea convention. It was the product of two summers of negotiations in Paris in 1882 and 1884 that reunited not only diplomats, but also fishermen, naval officers, and electrical engineers, all striving to devise a legal regime that addressed about twenty years of the world's experience with the revolutionary new international submarine telegraph cables. The result is a series of compromises that form the bedrock of modern international law on submarine cables, as reflected in UNCLOS[29] and the International Regulations for Preventing Collisions at Sea (COLREGS).[30]

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27. Travers Twiss, *Submarine Telegraph Cables*, 49 THE NAUTICAL MAGAZINE 879, 883–84 (1880).

28. Convention for the Protection of Submarine Telegraph Cables, Mar. 14, 1884, T.S. 380 (entered into force May 1, 1888) [hereinafter Cable Convention].

29. United Nations Convention on the Law of the Sea, Dec. 10, 1982, 1833 U.N.T.S. 397 [hereinafter UNCLOS].

30. Convention on the International Regulations for Preventing Collisions at Sea, Oct. 20, 1972, 28 U.S.T. 3459, T.I.A.S. 8587, 1050 U.N.T.S. 16 [hereinafter COLREGS].

Examining the evolution of how international law affects submarine cables is instructive as one considers ways to avert potential disruptions to this vital infrastructure. Toward that end, I summarize below the key compromises that are codified in the Cable Convention, as they may provide ideas for new or updated techniques to avoid disruptions:

1. All States and their nationals enjoy the freedom to lay and repair cables outside of what was then the three-nautical mile territorial sea.[31]

2. Ships that damage a submarine cable because of intentional actions or culpable negligence are to be subject to criminal penalties of fines and imprisonment without prejudice to the cable owner's right to recover civil damages. From the start, cables had been cut or damaged from fishing activity and anchor contacts, and these provisions were designed to punish and deter not only intentional but negligent actions. Under the treaty, there is an exemption from criminal and civil actions if the master damaged the cable to save the ship and its passengers. An example would be a ship, losing power and being driven onto the rocks, on which a crew member throws out an anchor to prevent the allision, but damages a cable. [32]

3. If a vessel, through no fault of its own, snags a cable with its fishing gear or anchor, the vessel is to sacrifice its gear or anchor to avoid injury to the cable. If the sacrifice is made, the cable owner is required to indemnify the vessel for the sacrificed gear or anchor. Here the priority of the Cable Convention was to prevent the greater harm of communication disruption.[33]

4. A cable owner enjoying the freedom to lay cables can cross other cables without permission. If in the process of crossing a cable, that cable is damaged, the crossing cable owner must indemnify the owner of the crossed cable for the cost of repairs.[34]

5. If a cable ship displays day shapes (i.e., masthead signals showing vessel status) or night lights indicating it is engaged in laying or repairing a submarine cable, other ships are to stay one nautical mile distance from the cable

31. *Compare* Cable Convention, *supra* note 28, art. 1, *with* UNCLOS, *supra* note 29, arts. 87, 112.

32. *Compare* Cable Convention, *supra* note 28, arts. 2, 8–12, *with* UNCLOS, *supra* note 29, art. 113.

33. *Compare* Cable Convention, *supra* note 28, art. 7, *with* UNCLOS, *supra* note 29, art. 115.

34. *Compare* Cable Convention, *supra* note 28, art. 4, *with* UNCLOS, *supra* note 29, art. 114.

ship and one quarter mile from any cable repair buoy and avoid actions that interfere with the cable laying or repair.[35]

Two provisions of the Cable Convention not reflected in UNCLOS stand out. The Cable Convention contains a provision that allows a party from a warship to board a vessel suspected of damaging a submarine cable.[36] This provision was relied upon by a U.S. Navy destroyer in 1959 to board a Soviet trawler on the high seas to obtain evidence of the ship having cut several transatlantic cables.[37]

B. *State Practice*

The Cable Convention also states that nothing in it "affect[s] the liberty of action of the belligerents."[38] State practice is solidly consistent with freedom of action against cables by belligerents. In 1914, a German Navy cruiser (*SMS Emden*) destroyed a British cable station at Fanning Island in the Central Pacific.[39] In 1918, a German submarine (*U-151*), outfitted with a cutting device, severed cables between New York and Nova Scotia and New York and Panama.[40] Another German submarine (*U-156*), on July 21, 1918, reportedly was attempting to cut a cable between Massachusetts and France when it was spotted and attacked by two flying boats.[41] Britain's first naval acts of war in World Wars I and II were to have ships sever telegraph cables linking Germany to the Americas.[42] Particularly noteworthy is the action of the British cable ship *Alert* in 1914, severing five German cables from Germany to the Azores and the United States. This act deprived Germany of secure communications outside of Europe, allowing British codebreakers to

35. *Compare* Cable Convention, *supra* note 28, arts. 5, 6, *with* COLREGS, *supra* note 30, r. 18, 27.

36. Cable Convention, *supra* note 28, art. 10.

37. *See* U.S. and U.S.S.R. Exchange Notes on Damage to Submarine Cables, 40 DEPARTMENT OF STATE BULLETIN 555, 556 (1959).

38. Cable Convention, *supra* note 28, art. 15.

39. ERIC BROSE, DEATH AT SEA: GRAF SPEE AND THE FLIGHT OF THE GERMAN EAST ASIATIC NAVAL SQUADRON IN 1914, at 189 (2010); WES OLSON, THE LAST CRUISE OF A GERMAN RAIDER: THE DESTRUCTION OF *SMS EMDEN* 56–79 (2018).

40. *SM U-151*, WIKIPEDIA, https://en.wikipedia.org/wiki/SM_U-151 (last visited Dec. 9, 2021).

41. JAKE KILM, ATTACK ON ORLEANS: THE WORLD WAR I SUBMARINE RAID ON CAPE COD 102 (2015); *Attack on Orleans*, WIKIPEDIA, https://en.wikipedia.org/wiki/Attack_on_Orleans (last visited Dec. 9, 2021).

42. ROBERT K. MASSIE, CASTLES OF STEEL: BRITAIN, GERMANY, AND THE WINNING OF THE GREAT WAR AT SEA 77 (2003).

read German signals to their embassies, including the famous Zimmerman Telegram[43] whose publication helped push the United States into war with Germany.

If the current Russian naval order of battle with ships and submarines designed to attack international cables is any indication, one can safely assume that State practice recognizing freedom of action by belligerents continues unabated.[44]

There is one legal case where a submarine cable's legal status in war was the issue. Following the Spanish American War, Great Britain brought a claim on behalf of English owners of the cable connecting Spain to its colonies in the Americas that the U.S. Navy cut. A 1923 international arbitration tribunal ruled that while Great Britain was neutral in the war between the United States and Spain, the fact that the submarine telegraph cables transmitted military information between Spain and its colonies made these cables legitimate military targets. No compensation was owed by the United States to Great Britain.[45]

A tenuous step was made to protect international cables in wartime in Article 54 of the Annex to the 1907 Hague Convention (IV) Respecting the Laws of War on Land: "Submarine cables connecting an occupied territory with a neutral territory shall not be seized or destroyed except in case of absolute necessity. They must likewise be restored and compensation fixed when peace is made."[46] This provision is obsolete and impracticable because the concept of a neutral cable is meaningless in terms of modern submarine cable usage, interconnectivity between cable systems, and diverse opaque cable ownership structures. Moreover, even if the weak Article 54 was to be embraced by State practice—which it has not—it still allows for destroying

43. The Zimmerman telegram, sent by the German Ambassador to Mexico, stated that if the United States went to war with Germany, and Mexico entered into an alliance with Germany, Mexico would receive the states of Texas, New Mexico, and Arizona following the defeat of the United States.

44. Pierre Morcos & Colin Wall, *Invisible and Vital: Undersea Cables and Transatlantic Security*, CENTER FOR STRATEGIC AND INTERNATIONAL STUDIES (June 11, 2021), https://www.csis.org/analysis/invisible-and-vital-undersea-cables-and-transatlantic-security.

45. Eastern Extension, Australasia and China Telegraph Company, Ltd. (Gr. Brit. v. U. S.), 6 REPORTS OF INTERNATIONAL ARBITRAL AWARDS 112 (Arb. Trib. 1923).

46. Regulations Respecting the Laws and Customs of War on Land art. 54, annexed to Convention No. IV Respecting the Laws and Customs of War on Land, Oct. 18, 1907, 36 Stat. 2227, T.S. No. 539 [hereinafter Hague Regulations].

neutral cables between occupied and neutral territories if a belligerent sees a need.

The lessons of the 1923 arbitration case, along with the State wartime practice precedent for modern submarine cables, prove telling. As the noted law of the sea scholar James Kraska concludes in a recent article, "the technology of the global cable system, and customary law reflected in state practice, suggest that belligerent states would use or even destroy neutral submarine cables during armed conflict."[47] Professor Kraska is right for two reasons: First, cables, unlike ships, have no flag to confirm their national identity. Legally, ownership of cables reflects many jurisdictions, such that in a global wartime situation, it is likely that one or more of the part owners is a belligerent. That alone would justify treating the cables as legitimate military targets. Second, following the logic of the 1923 arbitration case, the traffic on modern fiber optic cables undoubtedly carries communications of one or more of the belligerents. The continuously flowing gigabit-rich slurry of data packages transmitted at the speed of light over modern cables contain military, diplomatic, government, and economic data. Such traffic is transferred or switched to other cables in fractions of a second. This undeniable cable usage, regardless of cable "nationality," makes the cable a legitimate military target.

IV. NON-WARTIME INTENTIONAL ACTIONS AGAINST SUBMARINE CABLES

Even in peacetime, the evidence highlights noticeable gaps in submarine cable security.

- In November 2007, intentional sabotage of a cable landing in Bangladesh disabled communication for over a week.[48]
- Cable segment thefts took place in Jamaica in 2008.[49]

47. James Kraska, *The Law of Maritime Neutrality and Submarine Cables*, EJIL:TALK! (July 29, 2020), https://www.ejiltalk.org/the-law-of-maritime-neutrality-and-submarine-cables/.

48. Michael Sechrist, *Cyberspace in Deep Water: Protecting Undersea Communications Cables by Creating an International Public-Private Partnership* 38, HARVARD KENNEDY SCHOOL (Mar. 23, 2010), https://www.belfercenter.org/sites/default/files/files/publication/PAE_final_draft_-_043010.pdf.

49. *Id.*

- In 2010 terrorists attacked a cable station disrupting a cable linking the Philippines and Japan.[50]
- In March 2013 sixteen tons of submarine cable in the seabed between Banka Island and the Riau Islands in Indonesia was stolen.[51]
- The same month, three men were arrested by the Egyptian coast guard attempting to cut the SEA-ME-WE-4 cable system.[52]
- In July 2013, 31.7 km of cable linking Indonesia and Singapore was stolen.[53]

The author's personal experience with cable theft dates to March 23, 2007, when at least two ships were involved in the high seas removal of ninety-eight kilometers of cable from the TVH cable system and seventy-nine kilometers of cable from the APCN cable system. Both incidents included the removal of critical optical amplifiers. At the time, these cables constituted Vietnam's entire cable connections to the rest of the world. A cable repair ship arrived on the scene and photographed one of the ships in the act of removing cable. The Indonesia Marine security team on the cable ship declined to intervene because their orders were to provide defensive protection and not to take offensive action. The repairs took over three months because a French factory had to be restarted to produce optical amplifier replacements.[54]

As these events were unfolding, the author was at a conference in Baltimore. International Cable Protection Committee leadership, including AT&T (United States), BT (United Kingdom), and Southern Cross (Australia), quickly convened an ad hoc meeting to analyze what were unmistakable and near simultaneous high seas attacks by two separate vessels on two different cable systems. Assignments were made to contact respective national defense and security agencies. It fell to the author to notify the United States Navy and Coast Guard. Telephone briefs were provided over several

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50. Alfred P. Dalizon, *Reds Bomb Cagayan Globe Site, Disarm Guards*, PEOPLE'S JOURNAL, June 11, 2010.

51. *Duh, Kabel Internet Indonesia Sering Dicuri untuk Best Tua Kompas* [Indonesian Internet Cables Are Often Sold for Scrap], KOMPAS.COM (Mar. 27, 2013), https://tekno.kompas.com/read/2013/03/27/09324795/duh.kabel.internet.indonesia.sering.dicuri.untuk.besi.tua.

52. International Cable Protection Committee, *Three Cable-Breaking Incidents Affect Internet*, ENVIRONMENT UPDATE, Apr. 3, 2013, at 1.

53. Robert Beckman, *Protecting Submarine Cables from Intentional Damage—The Security Gap*, *in* SUBMARINE CABLES: THE HANDBOOK OF LAW AND POLICY, *supra* note 5, at 283 n.8.

54. Mick P. Green & Douglas R. Burnett, *Security of International Submarine Cable Infrastructure: Time to Rethink?*, *in* LEGAL CHALLENGES IN MARITIME SECURITY 557, 559–563 (Myron H. Nordquist et al. eds., 2008).

days. It became apparent that the notification was discussed in high level briefings, but at the end of the day, no visible actions were taken.

This experience underscores a telling feature of national governance of critical international submarine cable infrastructure. Many agencies own part of the submarine cable puzzle, but no agency is in charge. In the United States, approximately twenty-one government agencies regulate some aspects of submarine cables. This situation—multiple agencies with no agreed lead—creates a major security shortcoming when cable systems are under attack or multiple systems are impacted by a natural disaster, such as a major tsunami or earthquake.[55]

Although not the result of a natural disaster, a reef abrasion in July 2015 caused a cable break, rupturing the island of Saipan's connectivity with the rest of the world and demonstrating the havoc that can be wrought by a technology disruption. At that time, Saipan depended upon a single fiber optic cable. Normally, a single cable break would not be an issue. Worldwide, an average of two hundred cable breaks, resulting from both man-made and natural causes, occur each year. Participating in a maintenance agreement provides for prompt repair and restoration—supplied by cable ships—allowing traffic to be rerouted in seconds so that consumers experience no impact. In Saipan, however, to save expenses the cable operator did not participate in a maintenance agreement and the local government had allowed back-up microwave communication facilities to atrophy. Contingency planning, if it existed, was not practiced by the local government and communication company. Thus, the island had greatly diminished international communications for over two months, until the $2 million repair could be completed. During this time, airlines resorted to visual flight rules to land, tourism collapsed, and residents were unable to use credit cards and automated teller machines to pay for food and other purchases at stores.[56]

Imagine the chaos, panic, and disruption that would ensue in major nations if a similar scenario played out where multiple cables were cut, as one

55. International Cable Protection Committee, *A Global Comparison of Repair Commencement Times: Update on the Analysis of Cable Repair Data*, ANNUAL UPDATE, Apr. 27, 2020.

56. Gaynor Dumat-ol Daleno, *CNMI Disconnected: Cut Cable Shuts Down Phones, Banking*, PACIFIC DAILY NEWS (July 8, 2015), https://www.guampdn.com/news/local/cnmi-disconnected-cut-cable-shuts-down-phones-banking/article_eabebf7f-9988-5b8f-820f-49e15847d074.html; Dennis P. Chan, *IT&E: Fiber Optic Cable Strong for Another 32 Years*, SAIPAN-TRIBUNE.COM (Sept. 11, 2015), https://www.saipantribune.com/index.php/ite-fiber-optic-cable-strong-for-another-32-years/.

writer expressed in an article entitled, *Forget Nuclear Weapons, Cutting Undersea Cables Could Decisively End a War*.[57]

Well-respected legal scholar Robert Beckman highlights the gap in international law with respect to protecting submarine cables from intentional actions carried out beyond territorial seas.[58] Beckman coined the phrase, "Submarine cables are the orphans of international law." He correctly notes that no applicable international treaty exists to deal with attacks on submarine cables outside of territorial seas by terrorist or "grey" forces. The Convention for the Suppression of Unlawful Acts Against the Safety of Maritime Navigation and the Convention for the Suppression of Unlawful Acts against the Safety of Civil Aviation (together called the "SUA Conventions")[59] cover aircraft, ships, offshore platforms, and navigational aids, but are silent on cables.

The October 30, 2020, seizure of the tanker *Nave Andromeda* in the English Channel by special boat squadron commandos responding to a master's SOS because stowaways were threatening control of the vessel is a textbook case of SUA Convention action.[60] It can also serve, by way of comparison, as an illustration that no international law covers peacetime cable attacks outside of territorial seas, even though few dispute how critical cables are to international economies and State relationships. Beckman's call to amend the SUA Conventions to include submarine cables is common sense; a solution to respond to this critical need is long overdue.

We find a similar situation with respect to the wartime protection of submarine cables. Neither international law nor State practice affords any protection to international submarine cables. The likelihood that UNCLOS or the Cable Convention might be amended to provide such protection seems

57. Steve Weintz, *Forget Nuclear Weapons, Cutting Undersea Cables Could Decisively End A War*, THE NATIONAL INTEREST (Dec. 30, 2019), https://nationalinterest.org/blog/buzz/forget-nuclear-weapons-cutting-undersea-cables-could-decisively-end-war-108651.

58. Robert Beckman, *Protecting Submarine Cables from Intentional Damage—The Security Gap*, *in* SUBMARINE CABLES: THE HANDBOOK OF LAW AND POLICY, *supra* note 5, at 281.

59. Convention for the Suppression of Unlawful Acts Against the Safety of Maritime Navigation, Mar. 10, 1988, 1678 U.N.T.S. 221; Convention for Suppression of Unlawful Acts Against the Safety of Civil Aviation, Sept. 23, 1971, 24 U.S.T. 565, 974 U.N.T.S. 177.

60. Stephen Askins, *Stowaways Case Rests on Law with Origins in Achille Lauro Tragedy*, LLOYD'S LIST (Oct. 30, 2020), https://lloydslist.maritimeintelligence.informa.com/LL1134488/Stowaways-case-rests-on-law-with-origins-in-Achille-Lauro-tragedy.

remote. The only attempt to protect cables in wartime by treaty was in 1866 and it failed. The subsequent Cable Convention flatly rejected the concept.[61]

V. CABLE SHIP SECURITY FLEET

A critical element of national security is the availability of cable ships to repair cables in wartime. In the case of widespread hostilities and contested oceans, there is a strong likelihood that the peacetime arrangements for repairing cables will founder. For one thing, cable ship maintenance agreements contain force majeure clauses that excuse performance of cable ships in the event of war involving the flag State or major global powers. Even if the agreements were to be observed, the normal peacetime call out procedures such as the customary "first come, first serve" cable repair priority and shared international consensus decision making practices would be overwhelmed in a chaotic situation with multiple damaged submarine cables and multiple cable owners or national governments requesting priority for their cables. Also, crews will be reluctant to sail in contested waters where the cable ships would be likely targets. Polyglot crewing with divided national loyalties adds complexity to manning and operating ships in wartime conditions. Finally, cable ship owners will not risk their ships without adequate and affordable war risk insurance or national guarantees to replace sunk, damaged, or captured cable ships, and assume liability for breaking existing maintenance contracts and other damages associated with hostilities.

Recognition of these reasons was central to recent U.S. government action. An innovative solution to the lack of U.S. flag cable ships in wartime or national emergency is the Cable Security Fleet (CSF),[62] implemented in the second half of 2021. The CSF provides for two U.S. flag cable ships to be accepted into this new critical infrastructure protection program. Each cable ship operator receives a $5 million stipend annually, provided the cable ship meets the statutory and related contractual requirements. The annual stipend is designed to partially compensate the cable ship owner for the increased cost of using a U.S. citizen crew and complying with the requirements for a ship to fly the U.S. flag. A U.S. flag ship allows a highly trained U.S. merchant marine crew to fulfill its traditional mission of delivering service "in peacetime, in wartime, every time." The CSF requirements include

61. Douglas Burnett et al., *Overview of the International Legal Regime*, *in* SUBMARINE CABLES: THE HANDBOOK OF LAW AND POLICY*, supra* note 5, at 65–66.

62. National Defense Authorization Act for Fiscal Year 2020, Pub. L. No. 116-92, § 3521, 133 Stat. 1198 (2019).

compliance with the terms established by agreement with the Maritime Administration (MARAD), U.S. Department of Transportation (DOT)—essentially guaranteed availability of a cable ship and crew on twenty-four hours' notice following a national emergency declaration and entering a contingency contract with a federal operating authority for wartime operations. CSF provides the U.S. government with not only U.S. flag cable ships, but experienced U.S. crews, access to commercial spares (cable, amplifiers/repeaters, universal joint kits, etc.), the cable owner's marine depots worldwide, and the ability to leverage the cable owner's working relationships with other cable ship owners and operators, survey companies, and vendors worldwide.

The seemingly solid arguments that submarine cables are considered universally as critical international infrastructure, including the means to lay and repair cables, and the strong endorsement by all national security agencies were not enough to sway some senior DOT officials. Congress recognized the compelling needs and acted. The DOT opposition by senior officials is tied to bureaucratic complacency, outdated concepts of modern technology and potential disruptive impacts, and a Luddite view that protection of cables is not important or is a problem for others since transporting data is not something for DOT's concern. Even though the Secretary of Transportation[63] directed DOT civil servants to stop delaying implementation of the law enacted and funded by Congress, the opposition to CSF continues in a new administration as DOT and the Office of Management and Budget continue to oppose MARAD budget support for this critical program.

VI. What is Next for International Law and Fiber Optic Submarine Cables

The traditional freedoms of navigation and laying and maintaining submarine cables are firmly documented in international treaties and customary international law and should not be diluted. If anything, these freedoms should be publicly recognized and reinforced. Encouraging more diverse cable paths with streamlined national landing regulation provides added resilience by timely creating more "secret sauce" of multiple paths for restoration when

63. Secretary of Transportation Elaine L. Chao, after a 2020 formal meeting with MARAD administrator Mark Buzby and the DOT's budget director Lana Hurdle, decisively dismissed the internal DOT budget and Office of Management and Budget arguments against CSF and directed MARAD to implement the program forthwith. MARAD carried out the instruction and published the required Federal Register notice to initiate CSF on January 5, 2021.

cables are cut. The current arguments by well-intentioned environmental and world government advocates to establish area-based management and international regulatory control of the world's cable industry in waters outside of territorial seas and beyond national jurisdiction compromises one of humankind's greatest and most remarkable technological achievements. Route diversity based on private industry market initiatives, innovation, financing, and operation best serves the world in peacetime and wartime.

States should work to close the glaring gap that omits third parties, grey zone actors,[64] and terrorists from the SUA Conventions by amending the Conventions to add submarine cables and cable ships to the protection currently provided to ships, aircraft, offshore structures, and navigational aids.

To ameliorate the wartime situation, an idea that perhaps merits further study involves according to cable repair ships an exemption from attack. Such an initiative would be modeled on the wartime protection under international law for hospital ships.[65] Cable ships already enjoy peacetime protection from navigation interference when they are laying and repairing cables. To facilitate that protection, this small class of ships ensure that they are visually conspicuous[66] by carrying special lights and day shapes. During wartime, further protection methods—like those applied to hospital vessels under international law—could be devised for cable ships in terms of unencrypted communications, public voyage routing disclosure, weapons limitations, and unmistakable ship markings. This modest step contributes to

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64. The grey-zone is defined by the United States Special Operations Command as "competitive interactions among and within state and non-state actors that fall between the traditional war and peace duality." U.S. Special Operations Command, White Paper, The Gray Zone (Sept. 9, 2015), https://www.soc.mil/swcs/ProjectGray/Gray%20Zones%20-%20USSOCOM%20White%20Paper%209%20Sep%202015.pdf; British Defense Secretary Ben Wallace called the grey-zone "that limbo land between peace and war." Dominic Nicholls, *SAS Ordered to Start Disrupting Russian Meddling Around the World*, THE TELEGRAPH (Mar. 20, 2021), https://news.yahoo.com/sas-takes-fight-meddling-russians-194726397.html?guccounter=1; CONOR M. KENNEDY & ANDREW S. ERICKSON, CHINA'S THIRD SEA FORCE, THE PEOPLE'S ARMED FORCES MARITIME MILITIA: TETHERED TO THE PLA, CHINA MARITIME STUDIES INSTITUTE CHINA MARITIME REPORT (Mar. 2017), https://digital-commons.usnwc.edu/cgi/viewcontent.cgi?article=1000&context=cmsi-maritime-reports.

65. U.S. NAVY, U.S. MARINE CORPS & U.S. COAST GUARD, NWP 1-14M/MCTP 11-10B/COMDTPUB P5800.7A, THE COMMANDER'S HANDBOOK ON THE LAW OF NAVAL OPERATIONS ¶ 8.6.3.1 (2017).

66. Cable Convention, *supra* note 28, arts. 5, 6; COLREGS, *supra* note 30, r. 18, 27.

achieving two objectives: the restoration of vital fiber optic telecommunication infrastructure and the fostering of valid humanitarian objectives.

One can argue that the challenge with this idea is the reality—previously described in this article—that modern fiber optic cables carry traffic that directly or indirectly benefits belligerents. A counterargument could be that massive attacks on submarine cables would incur the need to repair and restore communications that are critical for global stability and recovery.

There are no easy answers, although the further examination of the topics discussed in this article could yield compromises that serve to protect submarine cables and cable repair ships in peacetime and wartime. This article concludes by encouraging international scholars, policy makers, and the cable industry to continue discussing and debating these ideas.