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UNDERWATER COMMUNICATION CABLES:

VULNERABILITIES AND PROTECTIVE MEASURES RELEVANT TO INDIA

PART-1

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This two-part article aims to provide Indian policy-makers and lay readers alike with an overview of submarine communications cable systems in India, highlighting their criticality, their vulnerabilities, and the inadequate protection they receive under national and international law. This piece also speaks directly to authorities within the Indian Navy and the Indian Coast Guard, as well as to other organisational structures concerned with India's national security and the physical and electronic protection of India critical infrastructure. In seeking to mitigate the vulnerabilities attending submarine cables in India, Part-2 of this article will address legal aspects that ought to be of interest (and concern) to the Indian Navy's Judge Advocate General's Branch, the Legal & Treaties Division of the Ministry of External Affairs, the Ministry of Telecommunications, and, the Ministry of Law and Justice, as also to legal academic and research institutes in India and the larger Indian Ocean Region. The article strongly recommends that submarine communications cables landing in India be included within India's "Critical Information Infrastructure System" (CIIS), and, that India exercise prescriptive jurisdiction over such submarine cables even under the High Seas, under the principle of "protective jurisdiction".

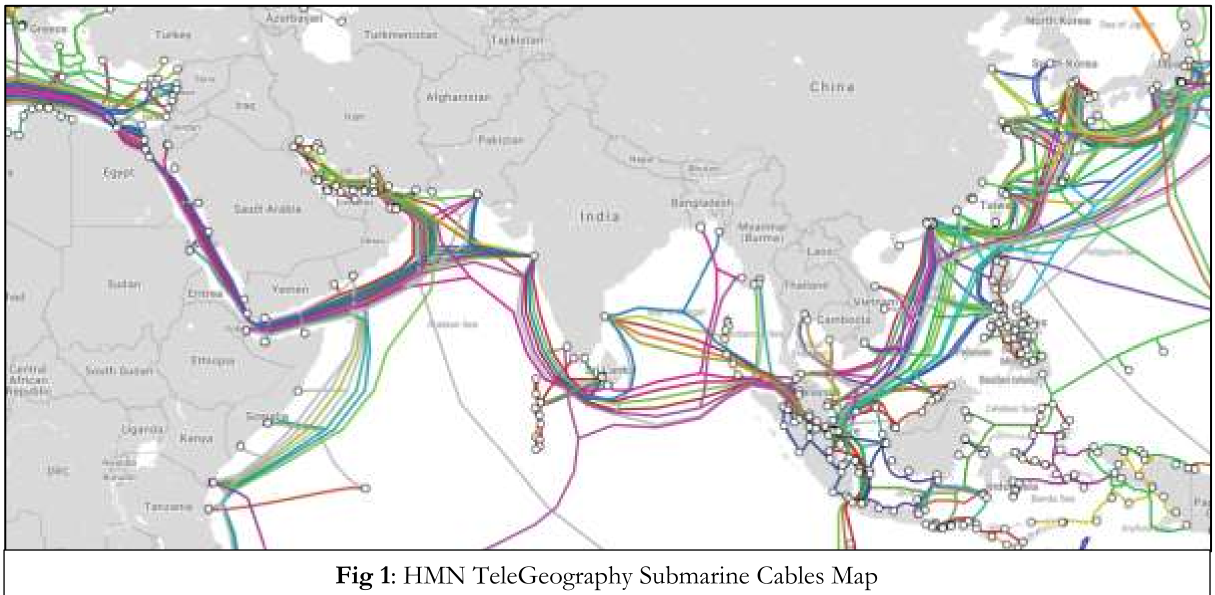

Fig 1: HMN TeleGeography Submarine Cables Map
Source: https://www.submarinecablemap.com/#/submarine-cable

While rapid technological advancements have transformed the submarine communications cable from a copper-based telegraph cable in 1850 to advanced fibre-optic cables today connecting continents across the globe[1] (**Figure 1** refers), the development of the legal and regulatory mechanism to protect such cables from damage and interception leaves much to be desired.

The term "submarine cable" has been widely used, including in international treaties such as the United Nations Convention on the Laws of the Sea,[2] but very little attempt appears to have been made to define it or to address the systems and networks associated with the term, at the international level. Even at the domestic level, at least amongst countries of the Indo-Pacific, there appears to be a very worrisome dearth in the degree of legal comprehensiveness with which this subject has been dealt. An exception is Australia, which *"...is one of only a few nations with a dedicated regime for the protection of submarine cables"*.[3] Schedule 3A of Australia's "Telecommunications Act 1997" (as amended and in force on 2 March 2019) specifies in considerable detail, the legal regime for the protection of international submarine cables landing in Australia.[4] As such, it offers an excellent example of a "best practice" that India's own legal and maritime-strategic communities would do exceedingly well to study.

Australia's domestic "Telecommunications Act" under reference defines a submarine cable as a specific type of "line link". Within this expression, a 'line' itself *"is defined as a wire, cable, optical fibre, tube, conduit, waveguide or other physical medium used, or for use, as a continuous artificial guide for or in connection with carrying communications by means of guided electromagnetic energy".*[5] A "line link", therefore, links two distinct places. Continuing on, an international ***submarine*** cable is defined (albeit for the purposes of that legislation) as *"that part of a line link that is laid on or beneath the seabed that lies beneath Australian waters or for purposes that include connecting a place in Australia with a place outside Australia (whether or not the cable is laid via another place in Australia) ... and includes any device attached to that part of the line link... used in or in connection with the line link".*[6]

Indian legislation, on the other hand, does not define a submarine cable. The term 'international submarine cable' has been used and defined in the "*International Telecommunication Access to Essential Facilities at Cable Landing Stations Regulations 2007",*[7] but has been defined using

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[1] Lionel Carter et al, *Submarine Cables and the Oceans- Connecting the World* (UNEP-WCMC Biodiversity Series No. 31. ICPC/UNEP/UNEP-WCMC 2009) https://www.unep-wcmc.org/system/dataset_file_fields/files/000/000/118/original/ICPC_UNEP_Cables.pdf?1398680911

[2] *The United Nations Convention on Law of the Sea,* 1982 [UNCLOS]

[3] Genevieve Butler, "Telecommunications Legislation Amendment (Submarine Cable Protection) Bill 2013", Parliament of Australia, Law and Bills Digest Section, Bills Digest no. 46 2013–14, 27 February 2014, https://parlinfo.aph.gov.au/parlInfo/download/legislation/billsdgs/3022582/upload_binary/3022582.pdf;fileType=application/pdf

[4] Parliament of Australia, *Telecommunications Act 1997,* Volume 2, Schedule 3A http://classic.austlii.edu.au/au/legis/cth/consol_act/ta1997214/sch3a.html

[5] Parliament of Australia, *Telecommunications Act 1997*, Volume 1, Article 7: Definitions

[6] Parliament of Australia, *Telecommunications Act 1997,* Volume 2, Schedule 3A, Part 1, Article 2: Definitions http://classic.austlii.edu.au/au/legis/cth/consol_act/ta1997214/sch3a.html

[7] Telecom Regulatory Authority of India, *International Telecommunication Access to Essential Facilities at Cable Landing Stations Regulations, 2007 (5 of 2007),* Chapter 1, Section 2 (u): Definitions https://www.trai.gov.in/sites/default/files/Regulation_07june07.pdf

the term 'submarine cable' without elaborating on what it constitutes. Further this term has been used in the context of facilitating access of submarine cables to cable landing stations in India rather than ensuring their protection.

The closest that Indian legislation comes to addressing communication cables is "The Indian Telegraph Act 1885" (1885 Act).[8] The broad definition of 'telegraph' as "*any appliance, instrument, material or apparatus used or capable of use for transmission or reception of signs, signals, writing, images and sounds or intelligence of any nature* ***by*** *wire,* ***visual or other electro-magnetic emissions,*** *Radio waves or Hertzian waves, galvanic, electric or magnetic means"* (emphasis added), read with the definition of a 'telegraph line' as a "*wire or wires used for the purpose of a telegraph*", does seem to suggest that the 1885 Act may extend its application to the version of the communication cable evolved from the telegraph, the optical fibre cable which uses modified pulses of infrared light (an electro-magnetic emission) to carry data.[9] This interpretation is supported by the completion of a domestic underwater optical fibre cable system from Chennai to Andaman & Nicobar Islands (Ser 16 in **Table 1** below) under the Universal Service Obligation Fund (USOF) project set up under s9A-9D [inserted vide Act 8 of 2004 w.e.f. 1.04.2002] of the 1885 Act.[10]

However, the 1885 Act does not explicitly identify optical fibre submarine cables. This is hardly surprising, as the 1885 Act was conceptualised at a time long before the development of such a network, and its need within our society. Further there is no clarity whether it also includes 'international' submarine cables connecting India to places outside India. There has been an indication that the Department of Telecom's optical fibre cable projects connecting India's neighbouring countries would not fall under the USOF project.[11] The focus of the USOF project, which uses funds appropriated from the Consolidated Fund of India, is to provide connectivity to the hinterlands and unconnected areas within India.[12] Therefore, the present regime in India is far from being a dedicated regime for the protection of submarine cables connecting India to the rest of the world. The necessity for such a dedicated regime is highlighted below.

Of course, submarine cables are not limited to communications cables alone. Indeed. the term includes submarine communications cables as well as submarine power cables used to transmit power from one place to another.[13] This article, however, concentrates upon submarine

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[8] The Indian Telegraph Act, 1885 (Act no. 13 of 1885) https://www.indiacode.nic.in/handle/123456789/2307?view_type=browse&sam_handle=123456789/1362

[9] The Indian Telegraph Act, 1885 Section 3: Definitions https://www.indiacode.nic.in/showdata?actid=AC_CEN_37_58_00003_188513_1523273054156&sectionId=42857&sectionno=3&orderno=3

[10] Deeksha Bharadwaj, "Andaman optical fiber [sic] may pitch India as alternative to China in ASEAN region", *Hindustan Times* 11 August, 2020 https://www.hindustantimes.com/india-news/india-inaugurates-optical-fibre-project-to-provide-international-connectivity-to-asean-nations/story-ANoK30ADYbfaP4xPZuDx7J.html

[11] Deeksha Bharadwaj, "Andaman optical fiber [sic] may pitch India as alternative to China in ASEAN region"

[12] Pankaj Kumar, "Universal Service Obligation Fund Bridging the Digital Divide" *Telecom Regulatory Authority of India* https://trai.gov.in/sites/default/files/asean/Presentation/Pankaj_Kumar_S7.pdf

[13] Tara Davenport, "Submarine Cables, Cybersecurity and International Law: An Intersectional Analysis," *Catholic University Journal of Law and Technology* No 24 (December 2015) https://scholarship.law.edu/jlt/vol24/iss1/4

communication cables, which, taken in aggregate, form part of a network designed to transmit data from one place to another. This is schematically depicted in **Figure 2**.

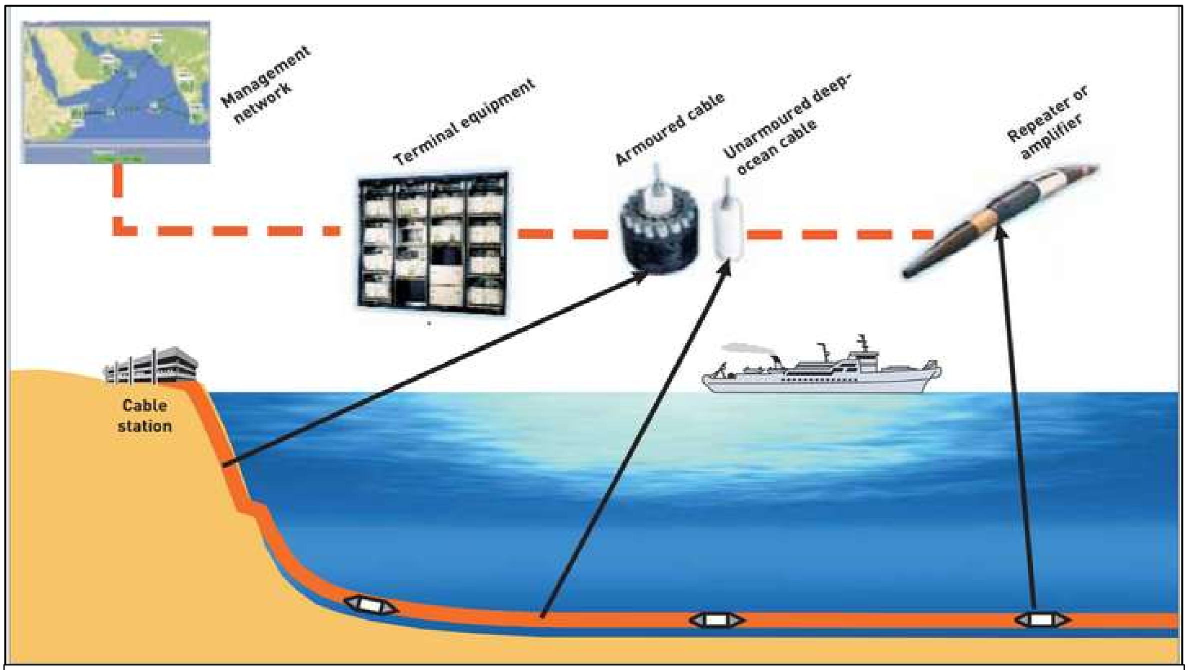

Fig 2: Simplified Schematic of a Submarine Cable System
Source: Submarine Cables and the Oceans — Connecting the World, https://www.unep-wcmc.org/system/dataset_file_fields/files/000/000/118/original/ICPC_UNEP_Cables.pdf?1398680911

The cable network begins with an armoured submarine cable connected to a cable station, which contains the servers from/to which data is to be transmitted. Cables that are laid in depths shallower than 1,500 metres (m) are often buried some 60 cm under the seabed in order to prevent them from damage by ships working their anchors, or other activity such as mining and dredging.[14] However, those laid in depths in excess of 1,500 m are not buried but simply laid upon the seabed, because the chance of accidental damage at such depths is unlikely.[15]

In India, the opportunity to provide international telecommunication links was made available to the private sector in 2002 and private players could operate in this industry after being issued an appropriate license. These private players are known as International Long Distance (ILD) providers. Cable systems in India are currently owned almost uniformly by private operators, who also undertake operations associated with these systems. While there are currently 16 operational submarine cable systems in India, at least 4 additional cable systems are planned.[16]

[14] Carter, "*Submarine Cables and the Oceans- Connecting the World*" 45
[15] Carter, "*Submarine Cables and the Oceans- Connecting the World*" 46
[16] See Suyesh Chattopadhyay, "Questionable State of Submarine Cables that globalises India", 09 April 2019 https://www.submarinenetworks.com/en/insights/questionable-state-of-submarine-cables-that-globalizes-india; "IOX" IOX accessed 31 March 2021
http://www.iox.mu/;
Winston Qiu, "NTT to Build MIST Cable Connecting Singapore, India and Myanmar" Submarine Cable System Network, 16 December 2019

Two ownership models are prevalent in India, namely, private ownership and consortium-based ownership. A 'private ownership model', as the name suggests, refers to a system wherein the cable is constructed and managed by a single entity who sells the international capacity to other telecom operators.[17] The 'consortium model', on the other hand, is one wherein a group of international operators form a club to fund, build, operate and own the cable system. The members of the consortium build the cable landing stations in their respective countries and lay cables in accordance with the agreement executed between them.[18] The capacity on the cable is then allocated according to the financial contribution and responsibilities of the telecom operator.[19] **Table 1** indicates the cable systems existing in India as of 2021, with details of ownership and location:

	Name of Cable System	**Type of Cable System**		**Cable Landing Station (CLS) Ownership**	**Location of CLS**
		Consortium/ Private (Members)	**Protected/ Unprotected**		
1	FEA	Private	Unprotected	Global Cloud Xchange (GCX)	Mumbai
2	SEA-ME-WE 3	Consortium (54)	Unprotected	Tata Communications Ltd. (TCL)	Mumbai, Kochi
3	SAFE	Consortium (29)	Protected (Ring Network)	TCL	Kochi
4	I2I	Private	Unprotected	Bharti Airtel	Chennai
5	TIC	Private	Unprotected	TCL	Chennai
6	SEA-ME-WE 4	Consortium (16)	Unprotected	TCL	Mumbai
				Bharti Airtel	Chennai
7	BLCS	Consortium (2)	Unprotected	BSNL	Tuticorin
8	FALCON	Private	Unprotected	GCX	Mumbai Trivandrum
9	WARF	Consortium (3)	Unprotected	GCX	Kochi
10	IMEWE	Consortium (9)	Unprotected	Bharti Airtel	Mumbai (Santacruz)
				TCL	Mumbai (BKC)
11	TGN Indicom + EA/SEACOM	Private (Co-ownership in certain EA segment)	Unprotected	TCL	Mumbai, Chennai
12	EIG	Consortium (16)	Protected (MESH Restoration Architecture)	Bharti Airtel	Mumbai
13	GBIC/MENA	Private	Partly Protected (Self-Healing Core Ring in the Gulf)	Sify Technologies	Mumbai
14	BBG	Consortium (10)	Unprotected	Vodafone	Mumbai
				Reliance Jio	Chennai
15	AAE-1	Consortium (19)	Unprotected	Reliance Jio	Mumbai
16	CANI-SMC	Private	Unprotected	BSNL	Chennai, Port Blair

Table 1: Cable Systems in India (2021)
Source: Compiled by Authors from:
Consultation Paper No 08/12 on *"Access Facilitation Charges and Co-Location Charges at Cable Landing Stations"*, Telecom Regulatory Authority of India 2012, https://www.trai.gov.in/sites/default/files/Consultation_paper_on_CLS.pdf
and
Suyesh Chattopadhyay, "Questionable State of Submarine Cables that globalises India", 09 April 2019 https://www.submarinenetworks.com/en/insights/questionable-state-of-submarine-cables-that-globalizes-india

https://www.submarinenetworks.com/en/systems/intra-asia/mist/ntt-to-build-mist-cable-connecting-singapore-india-and-myanmar
[17] Consultation Paper No. 08/12, 19
[18] Consultation Paper No. 08/12, 19
[19] Consultation Paper No. 08/12, 19

For example, in the SEA-ME-WE 4 cable system (Ser 6 in **Table 1**), with Bharti Airtel and TCL as consortium members, TCL owns the landing station at Mumbai and would have laid the cables for that segment of the cable network, while Bharti Airtel owns the landing station in Chennai and probably laid the Chennai segment of the network. However, it is unclear whether the ownership is only of the landing station and the cable segment connecting it, or ownership extends to the entire cable network to the extent of the cable capacity allocated.

Vulnerabilities and Threats

Our interconnected, tech-enabled, globalised world, which allows for a message to be sent from India to the United States in 'real time', owes its existence to these physical cables travelling across continents. 97% of global communications are transmitted over 213 independent cable systems traversing 545,018 miles of fibre.[20] These submarine communication cables are the backbone of the modern-day Internet and are heavily relied-upon by critical sectors such as financial markets, industries, and military and diplomatic organisations, making them critical to a State's economic and political functioning. For instance, the Society for Worldwide Interbank Financial Telecommunication (SWIFT) relies primarily upon undersea fibre-optic cables to transmit more than 15 million messages a day valuing $10 trillion of financial transfers to 208 countries, including India.[21]

This reliance is even more critical for India as there is evidence of the extent of loss to India on the disruption of these communication cables. In 2008, the severance of multiple undersea cables off the coast of Egypt and Dubai caused India to lose more than 80% of its international service.[22] India lost 60 million users for over two weeks and India's business-processing industry (which is one of India's biggest exports) faced decreased connectivity of upwards of 60%.[23] Such outages have extreme economic consequences for India.

Lack of route-diversity is, in and of itself, a major vulnerability. Three main factors account for this bunching-up of undersea cables. The first is the cost (and ease) of laying the cables, which itself is dependent upon the topography of the seabed. The second is the cost-implications of ensuring the protection of marine environments (or at least the cost of convincing national and local authorities that such protection will be assured). The third is simply the ease with which States — and, in India's case, the states of the Union — allow and encourage or discourage the building of infrastructure such as landing stations to be built. As a result, a large number of cable routes (and the physical cables themselves) tend to converge a given landing point. An analysis of the undersea cables between India and Europe demonstrates

[20] Rishi Sunak, "*Undersea Cables: Indispensable, insecure"* (Policy Exchange 2017) p 12 https://policyexchange.org.uk/wp-content/uploads/2017/11/Undersea-Cables.pdf
[21] Michael Sechrist, "*Cyberspace in Deep Water: Protecting Undersea Communication Cables by Creating an International Public-Private Partnership"* (PhD diss., Harvard Kennedy School, 2010) https://www.belfercenter.org/sites/default/files/files/publication/PAE_final_draft_-_043010.pdf
[22] Sechrist, "*Cyberspace in Deep Water*"
[23] Sechrist, "*Cyberspace in Deep Water*", 38

that five interdictions to the cables, would completely isolate India from Europe.[24] **Figure 3** depicts the percentage loss of data traffic to/from India with each successive interdiction. It may be noted that 70% of the traffic from/to India is lost with just three simultaneous

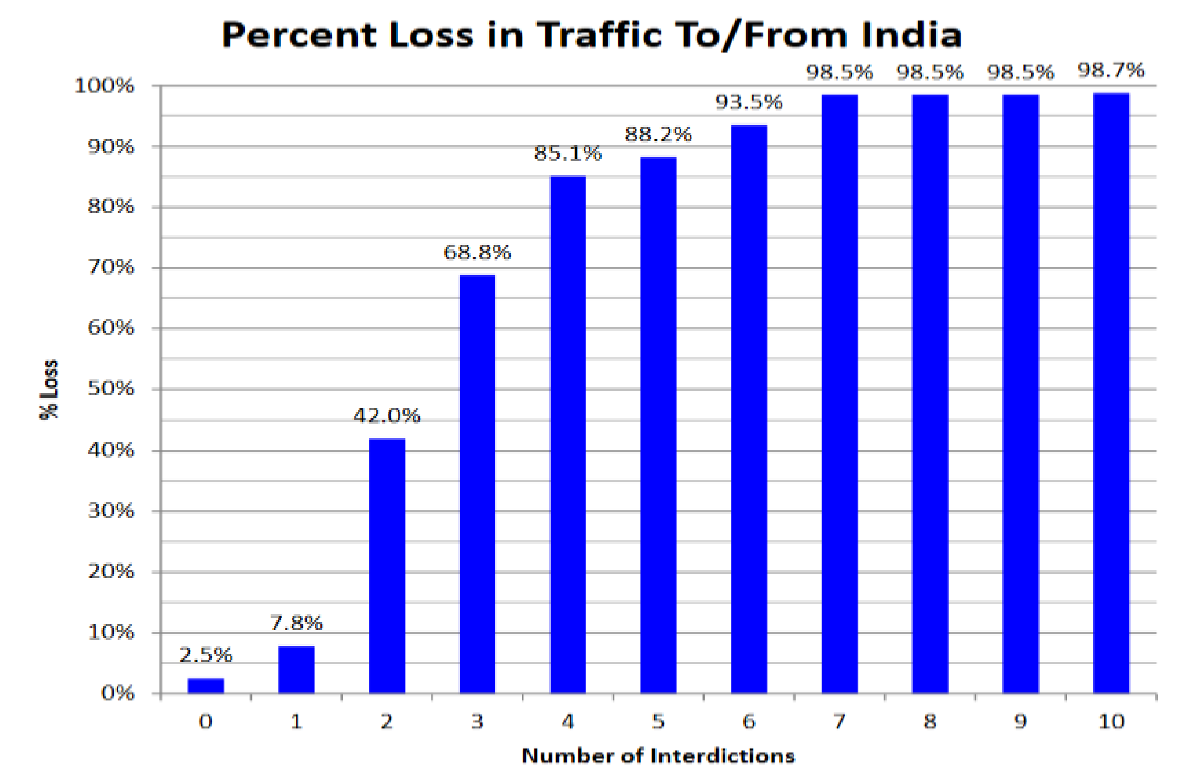

Fig 3: Percent Loss in Traffic To/From India
Source: John K. Crain, "Assessing Resilience in the Global Undersea Cable Infrastructure", PhD diss., Naval Postgraduate School 2012, 41 https://apps.dtic.mil/dtic/tr/fulltext/u2/a562772.pdf

interdictions.

It has been found that the optimal locations of attack lie between Europe and Africa in the Mediterranean Sea.[25] Therefore, India faces substantial loss in its communications traffic to/from Europe and the Middle East, even without a single cable being interdicted in or near Indian territory.[26] Even more critical are attacks against the cable landing stations. Just two simultaneous interdictions on cable landing systems (especially in Alexandria, Egypt, through which most of the cables passing from India to Europe traverse) is enough to isolate India from Europe.[27] This accurately represents the nature of the problem. India needs to protect its communications network against disruptions that may take place more than 1,000 miles away.

However, disruptions may be of many types. Damage that affects transmission is known as a "fault".[28] A "fault" may arise from the complete severing of the cable (as when the cable is physically pulled apart). Such severance could include the optical fibres carrying the

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[24] John K. Crain, "*Assessing Resilience in the Global Undersea Cable Infrastructure*" (PhD diss., Naval Postgraduate School 2012), 59 https://apps.dtic.mil/dtic/tr/fulltext/u2/a562772.pdf
[25] Crain, "*Assessing Resilience*", *41*
[26] Crain, "*Assessing Resilience*", *41*
[27] Crain, "*Assessing Resilience*", *48*
[28] Carter, "*Submarine Cables and the Oceans- Connecting the World*", 44

communications, and/or the copper conductors that provide electricity to the repeaters that boost the signal. Another type of "fault", called a "shunt fault", occurs when there is damage to the electrical cable, which cause the repeaters to cease functioning even while the optical fibre remains intact. Such faults are often caused by external human activity, external natural calamities, or component-level failure.[29]

To mitigate vulnerability, submarine cables are either lightly or heavily armoured, with the breaking strength of these cables varying from a few tonnes to more than 40 tonnes.[30] When laid on the seabed beneath relatively shallow waters, relatively heavy armour is preferred and, as stated earlier in this article, the cable is additionally buried to a depth of about 60 centimetres. In deep waters, however, the cables are more fragile in that they are less heavily armoured, largely because heavier cables are far more difficult to handle and deploy at greater depths.

A major cause of cable faults caused by human activity is the result of fishing (especially bottom trawling) and dredging. It is to protect from this kind of damage that cables close to shore, where most bottom-trawling occurs, are not only armoured but also buried in the seabed. However, burying the cable does mitigate the risk from fishing to some extent, but does little to address the risk from dredging activities. Moreover, burying the cable is not always possible, especially where a rocky seabed or one strewn with rocky mounts are concerned. In such cases, the cable segment between two such rocky seamounts might even lie suspended above the seabed. In such cases, the chances of the cable being snagged by demersal or benthic fishing gear rise exponentially. Moreover, if a vessel that is trying to locate and/or recover lost fishing gear or anchoring gear (such as chain cables or anchor themselves) uses grapnels or lightweight kedge anchors, there is a significant danger of such gear 'hooking' the cable and causing very significant damage.[31] Demersal fishing is not limited to bottom-trawling alone. In deeper water, static fishing gear, involving lobster-pots that are weighted by heavy, grapnel-shaped multi-fluked anchors are used. If these happen to be laid in the immediate proximity of an underwater cable (which in deep waters is generally very lightly armoured), the chances of a fault ensuing are bright. Likewise, vulnerabilities arise from competing offshore activities such as oil and gas development, the setting-up and maintenance of infrastructure for offshore wind energy and other ocean-mechanical and ocean-thermal renewable-energy resources, exploration and operations related to seabed mining, and so forth. Natural disasters, such as earthquakes, tsunamis, typhoons, and subsea landslides, pose other but equally significant threats to undersea cable networks.

A darker and an increasingly more serious threat that has resulted from the rise of the non-State malevolent actor in general and the State-sponsored non-State malevolent actor in particular. This threat manifests itself in intentional and targeted damage to submarine cables. Some sources believe that Egypt's internet outage in 2008, in which three cables were cut, was intentional, especially as the Egyptian Coast Guard caught divers trying to cut a fourth cable.[32]

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[29] Carter, "*Submarine Cables and the Oceans- Connecting the World",* 45
[30] Carter, "*Submarine Cables and the Oceans- Connecting the World",* 44
[31] Carter, "*Submarine Cables and the Oceans- Connecting the World",* 46
[32] *Submarine Cables*, Maritime Awareness Project (National Bureau of Asian Research) https://www.nbr.org/publication/submarine-cables/

There have also been incidents of intentional sabotage in Bangladesh in 2007 and in the United States in 2009.[33] While a deeper assessment of this form of threat and its counters will be addressed in a subsequent article, there is clearly a pressing need to protect these submarine communications cables as they provide a critical, yet difficult to defend, target in the oceans of the world.

How such protection could and should be afforded by India in particular, will be addressed in the second part of this article.

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[33] Sechrist, "*Cyberspace in Deep Water*" 40