SUBMARINE TELECOMS FORUM

ISSUE 111 | MARCH 2020

FINANCE & LEGAL

EXORDIUM FROM THE PUBLISHER

WELCOME TO ISSUE 111, OUR FINANCE & LEGAL EDITION

If ever there was a need for connectivity, it is today…

From my vantage along the Potomac River the news has been coming like a slow moving, yet unstoppable train. Contingency plans have been prepared and revised. Supplies have been purchased and stored, ready for use if absolutely necessary.

We have already experienced a single wave of chest colds through the office, which is typical this time of year, and have decided, if it comes to it, that we can all work remotely. Half of our people are located somewhere else anyway; so, we can simply Skype or Webex or whatever each other for various project or marketing or planning meetings, and bank the travel budget for now.

I was on a video telecon the other day with two international locations and was struck how the general consensus was that no one was traveling for now. I am still in awe of our ability to hold such a teleconference, which only a few years ago was unheard of. Even my ability to What's App my buddy, Nick, in England to talk through the recent Wales match is still mind boggling.

It is very much a wait and see kind of a time.

We watch with great interest how the many industry conferences are adapting to the changing circumstances. Many are simply "postponing" their events to a better time. And so, our list of "must-attends" is slowly being crossed out from the list - top down, month-by-month.

I was on a video telecon the other day with two international locations and was struck how the general consensus was that no one was traveling for now. I am still in awe of our ability to hold such a teleconference...

Maybe this is the time to perfect virtual conferences.

But on the flipside, I read an article recently saying if everyone stayed home, we would "break" the internet. Wow, really? I know I play too much Team Fortress as it is, but I doubt my supposed increase will shatter anything.

Yet as an industry we are still incredibly busy, adapting to new, challenging rules for fielding personnel and assets, but still getting the job done.

Q&A WITH BERMUDA

This issue we are talking trends with Bermuda's Deputy Premier and Minister of Home Affairs, and gaining an understanding of the island's new legal framework and future plans for submarine cables. Bermuda is looking to establish itself as a landing hub for transatlantic submarine cables; so, this is certainly a very interesting read.

SUBTELFORUM.COM

We've added a new department to the magazine, namely SubTelForum.com, which describes in a nutshell and links free resources for all our readers, as well as subscription-based market sector reporting for those interested in drilling down further on various subjects. It will be updated from time-to-time as new informational opportunities for our readers arise.

PORTHCURNO 150TH ANNIVERSARY

SubTel Forum is publishing the third article of a series leading up to the main 150th anniversary of the first Transatlan-

tic telegraph cable, which will be celebrated for the month of June 2020 at the Telegraph Museum Porthcurno in Cornwall, England. Bill Burns and Stewart Ash have written a piece entitled, "The Red Sea Line: The 1870 Cable from England to India," as well as highlighted the month-long schedule for the Porthcurno event.

BACK REFLECTION

Our ever popular historical department, Back Reflection, returns and in this issue, José Chesnoy discusses the art over the many industry years of submarine cable positioning and how cable laying became over time extremely precise.

As always, we have some really excellent articles this issue from a number of exceptional international authors. Finance & Legal is meant to be a laser-focused theme, highlighting topics and complexities that are often over looked or underappreciated in the cable implementation process and I think you'll agree that our authors have certainly hit that mark; and of course, our ever popular "where in the world are all those pesky cableships" is included as well.

If ever there was a need for connectivity, it is today. STF

Good reading and stay well,

Wayne Nielsen, Publisher

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NEXT ISSUE: MAY 2020 – Global Capacity

AUTHOR AND ARTICLE INDEX: www.subtelforum.com/onlineindex

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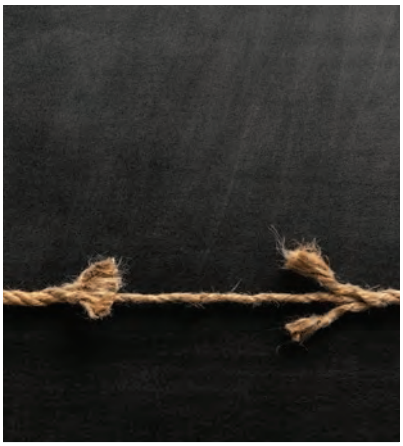

departments

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FREE RESOURCES FOR ALL OUR SUBTELFORUM.COM READERS

TOP STORIES OF 2019

The most popular articles, Q&As of 2019. Find out what you missed!

NEWS NOW RSS FEED

Keep on top of our world of coverage with our free News Now daily industry update. News Now is a daily RSS feed of news applicable to the submarine cable industry, highlighting Cable Faults & Maintenance, Conferences & Associations, Current Systems, Data Centers, Future Systems, Offshore Energy, State of the Industry and Technology & Upgrades.

PUBLICATIONS

Submarine Cable Almanac is a free quarterly publication made available through diligent data gathering and mapping efforts by the analysts at SubTel Forum Analytics, a division of Submarine Telecoms Forum. This reference tool gives details on cable systems including a system map, landing points, system capacity, length, RFS year and other valuable data.

Submarine Telecoms Industry Report is an annual free publication with analysis of data collected by the analysts of SubTel Forum Analytics, including system capacity analysis, as well as the actual productivity and outlook of current and planned systems and the companies that service them.

CABLE MAP

The online SubTel Cable Map is built with the industry standard Esri ArcGIS platform and linked to the SubTel Forum Submarine Cable Database. It tracks the progress of

some 300+ current and planned cable systems, more than 800 landing points, over 1,700 data centers, 46 cable ships as well as mobile subscriptions and internet accessibility data for 254 countries. Systems are also linked to SubTel Forum's News Now Feed, allowing viewing of current and archived news details.

The printed Cable Map is an annual publication showcasing the world's submarine fiber systems beautifully drawn on a large format map and mailed to SubTel Forum Readership and/or distributed during the Pacific Telecommunications Conference in January each year.

VIDEO STREAMING AND TUTORIALS

Watch all our industry relevant videos and streams. SubTel Forum streams the Submarine Cable Sunday sessions during the Pacific Telecommunications Conference in January each year on both YouTube and Facebook, as well as other special events during the year.

SubTel Forum tutorials teach how to use the ever growing SubTel Cable Map, including various map layers for data centers, cable ships, etc.

CONTINUING EDUCATION

SubTel Forum designs educational courses and master classes that can then appear at industry conferences around the world. Classes are presented on a variety of topics dealing with key industry technical, business, or commercial issues.

See what classes SubTel Forum is accrediting in support of the next generation of leaders in our industry.

AUTHORS INDEX

The Authors Index is a reference source to help readers locate magazine articles and authors on various subjects.

EXCLUSIVE INFORMATION FOR SUBSCRIBERS OF MARKET SECTOR REPORTS

SUBTEL FORUM ANALYTICS MARKET SECTOR REPORTS

SubTel Forum Subscribers have exclusive access to SubTel Forum online MSRs updated quarterly:

DATA CENTER & OTT PROVIDERS: details the increasingly shrinking divide between the cable landing station and backhaul to interconnection services in order to maximize network efficiency and throughput, bringing once disparate infrastructure into a single facility.

If you're interested in the world of Data Centers and its impact on Submarine Cables, this MSR is for you.

GLOBAL CAPACITY PRICING: historic and current capacity pricing for regional routes (Transatlantic, Transpacific, Americas, Intra-Asia and EMEA), delivering a comprehensive look at the global capacity pricing status of the submarine fiber industry.

Capacity pricing trends and forecasting, simplified.

GLOBAL OUTLOOK: dive into the health and wellness of the global submarine telecoms market, with regional analysis and forecasting. This MSR gives an overview of planned systems, CIF and project completion rates, state of supplier activity and potential disruptive factors facing the market.

OFFSHORE OIL & GAS: provides a detailed overview of the offshore oil & gas sector of the submarine fiber industry and covers system owners, system suppliers and various market trends. This MSR details how the industry is focusing on trends and new technologies to increase efficiency and automation as a key strategy to reduce cost and maintain margins, and its impact on the demand for new offshore fiber systems.

REGIONAL SYSTEMS: drill down into the Regional Systems market, including focused analysis on the Transatlantic, Transpacific, EMEA, AustralAsia, Indian Ocean Pan-East Asian and Arctic regions. This MSR details the impact of increasing capacity demands on regional routes and contrasts potential overbuild concerns with the rapid pace of system development and the factors driving development demand.

SUBMARINE CABLE DATASET: details 400+ fiber optic cable systems, including physical aspects, cost, owners, suppliers, landings, financiers, component manufacturers, marine contractors, etc.

COMING SOON! Cable Analysis Toolbox, Cable Planner's Toolbox, Mapping Tools, and more features in 2020 and beyond! STF

ANALYTICS

BY KIERAN CLARK

FINANCE & LEGAL UPDATE

Welcome to SubTel Forum's annual Finance and Legal issue. This month, we look at the industry's current finance and ownership status and see what the future might bring. The data used in this article is obtained from the public domain and is tracked by the ever evolving SubTel Forum Analytics Submarine Cable Database, where products like the Submarine Cable Almanac, Submarine Cable Map and Submarine Telecoms Industry Report find their roots.

It has been a full year since our last look at the financial situation of planned systems around the world. New systems have been announced and planned systems have gone into service, while others have been delayed or changed. Quite a lot can happen in one year, and this year was no different.

Since 1991, $42.4 billion has been invested in submarine fiber optic telecommunication cables — comprising nearly 1.2 million route kilometers — annually averaging $1.46 billion worth of investment and 41,330 kilometers of deployed systems.

Historically, consortia/multiple owners have been responsible for the bulk of new system investment. However, in recent years there has been a noticeable shift towards more private and Multilateral Development Bank (MDB) investment. (Figure 1)

The way systems are being financed sustains a shift towards single owners. This trend was first observed in 2015 and has since continued to move in this direction. Over the next several years, only 36 percent of systems will have multiple owners, 10 percent will involve MDBs and the remaining 65 percent will have a single owner. While multiple owners reduce the financial risk to any single owner should a cable system fail, single ownership

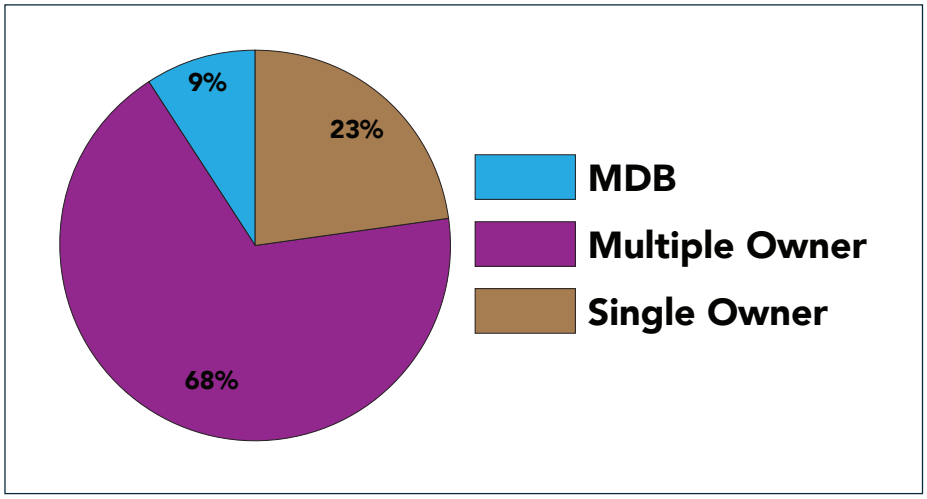


Figure 1: Financing of Systems, 2015-2019

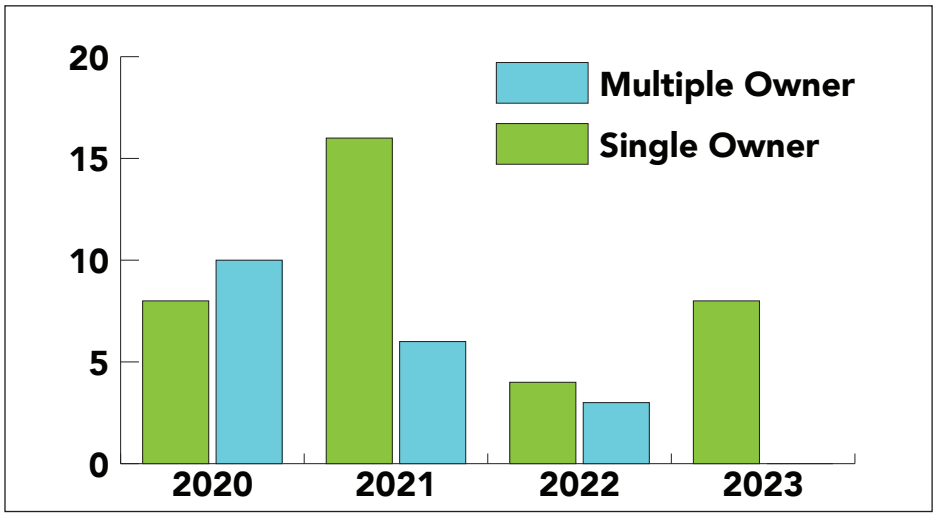


Figure 2: System Ownership Type, 2020-2023

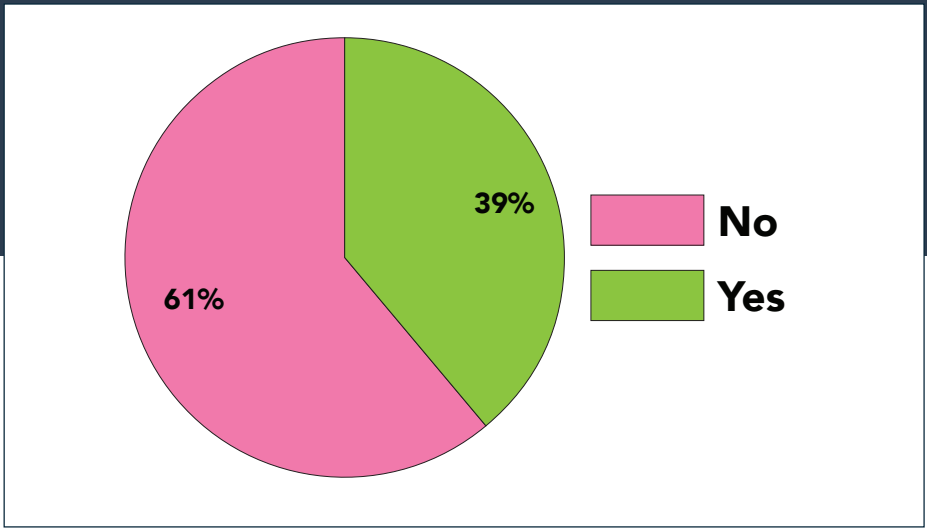


Figure 3: CIF Rate of Planned Systems, 2020-2023

provides potentially greater flexibility and speed to the cable development process. (Figure 2)

With OTTs continuing to drive cable demand because of the need for more control over the development process and a desire for faster system installations to keep up with their bandwidth and routing requirements, this trend towards a higher percentage of single owners is expected to continue over the next several years.

The true measure of a cable system's viability – and the strongest indicator that a system will be completed – is whether it is Contract in Force (CIF). As of March 2020, the CIF rate for planned systems through 2023 is 39 percent and 66 percent for 2020 alone. With such a large percentage of systems for the next 4 years already achieving the CIF milestone by the first quarter of 2020 this is an encouraging sign for the overall health of the submarine cable industry. (Figure 3)

Legal and regulatory hurdles continue to be a point of concern for prospective cable owners. Political tensions between various world powers have complicated vendor relationships, the ability for carriers to operate abroad and increased concerns of spying or sabotage. Governments around the world are putting increased restrictions on vendors for new builds and upgrades and pressuring local carriers to "rip and replace" equipment and software in existing infrastructure from no longer welcome vendors. (Bressie, 2019)

Alongside new vendor requirements have come stronger cybersecurity standards and enhanced outage and incident reporting requirements. The International Cable Protection Committee (ICPC) has created a Cable Security Working Group to address these concerns and push the industry to self-regulate before world governments do it for them. In addition, the ICPC has been granted consultative status with the United Nations – allowing it to advocate for cable protection and regulation on an international stage. (International Cable Protection Committee, 2018)

In the United States, Team Telecom security and law enforcement reviews continue to be a huge burden to prospective cable owners. Team Telecom reviews currently take up between 85 and 90 percent of the total regulatory review process – anywhere from 300 to over 500 days. Acquisitions and mergers are equally challenging and beset by similar time delays. As a significant majority of submarine cables around the world land or will land in the United States, this affects more than just United States based companies. However, some relief may be in site as the FCC is working to revise reporting requirements and the executive branch of the United States may act to streamline more of the Team Telecom review process.

Additionally, new threats from international disease outbreaks such as COVID-19 are forcing companies to prepare for supply chain and labor disruptions. As the number of new cases continues to rise around the world governments will potentially have to restrict the flow of people, goods and services to contain the virus. This current outbreak may result in long term regulatory and procedural changes to minimize the impact of future disease transmission.

Financing for systems continues to be the largest hurdle for many prospective owners – a fact that is unlikely to go away any time soon. Even with these difficulties, the next several years look to keep the industry busy. STF

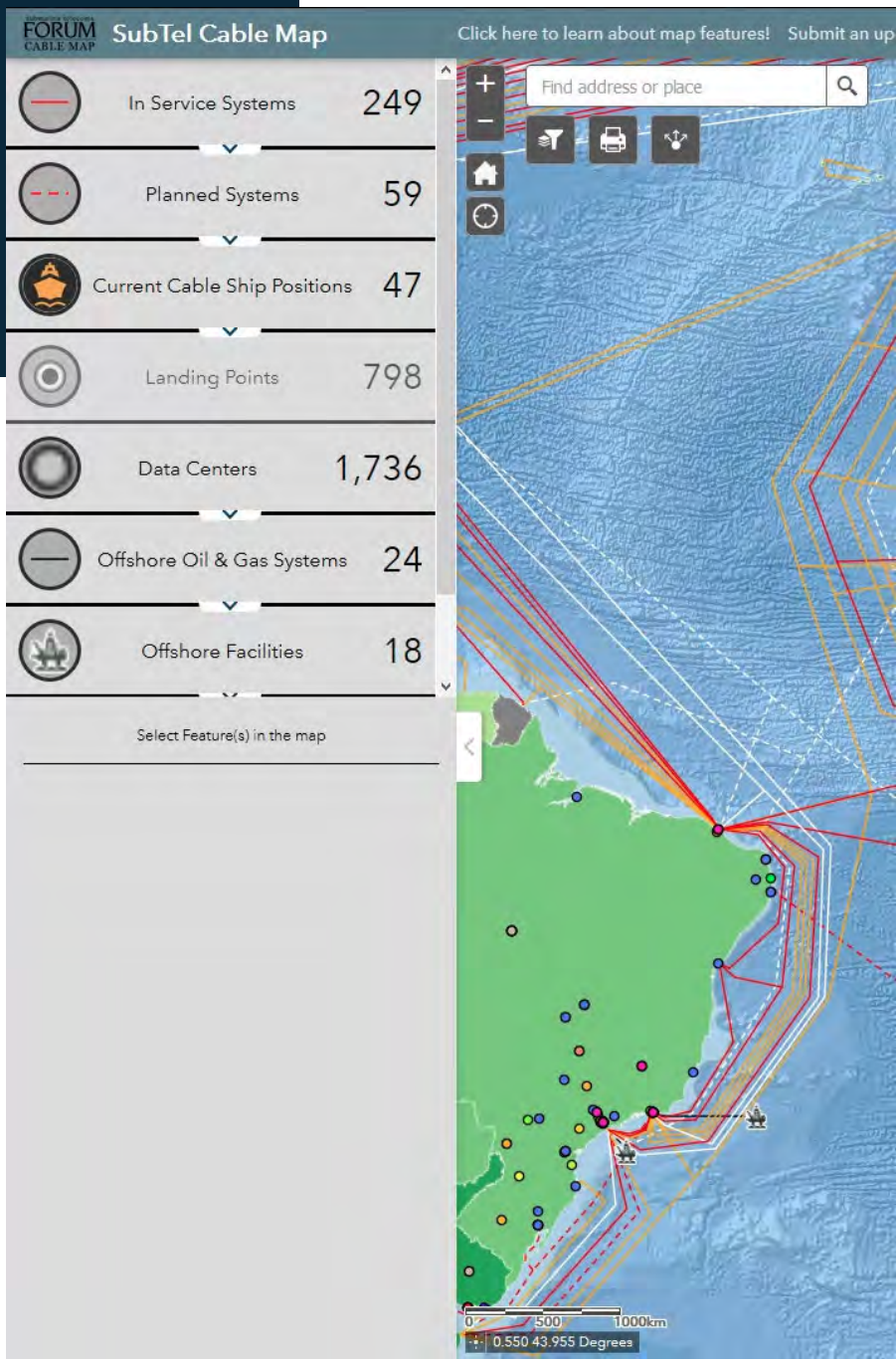
KIERAN CLARK *is the Lead Analyst for STF Analytics, a division of Submarine Telecoms Forum, Inc. He originally joined SubTel Forum in 2013 as a Broadcast Technician to provide support for live event video streaming. He has 6+ years of live production experience and has worked alongside some of the premier organizations in video web streaming. In 2014, Kieran was promoted to Analyst and is currently responsible for the research and maintenance that supports the STF Analytics Submarine Cable Database. In 2016, he was promoted to Lead Analyst and put in charge of the newly created STF Analytics. His analysis is featured in almost the entire array of SubTel Forum publications.*

Works Cited

Bressie, K. (2019). Global Regulatory Update. PTC '19. Honolulu, HI: Pacific Telecommunications Council.

International Cable Protection Committee. (2018, May 17). Subsea Cable Community Gains Voice in the United Nations. Retrieved from International Cable Protection Committee: https://www.iscpc.org/documents/?id=2971

Interactive Cable Map Updates



The SubTel Cable Map is built with the industry standard Esri ArcGIS platform and linked to the SubTel Forum Submarine Cable Database. It tracks the progress of some 300+ current and planned cable systems, over 800 landing points, as well as mobile subscriptions and internet accessibility data for 254 countries. Systems are also linked to SubTel Forum's News Now Feed, allowing viewing of current and archived news details.

This interactive map is a continual work and progress and regularly updated with pertinent data captured by analysts at SubTel Forum and feedback from our users. Our goal is to make easily available not only data from the Submarine Cable Almanac, but also more and more new layers of system information.

Want to learn more about how to use the great features of the map? Take a look at our tutorial video series below:

1. Print Widget
2. General Map Usage
3. Group Filter Widget
4. Select Tool
5. Control Buttons
6. Share Widget
7. Data Centers
8. Cable Ships

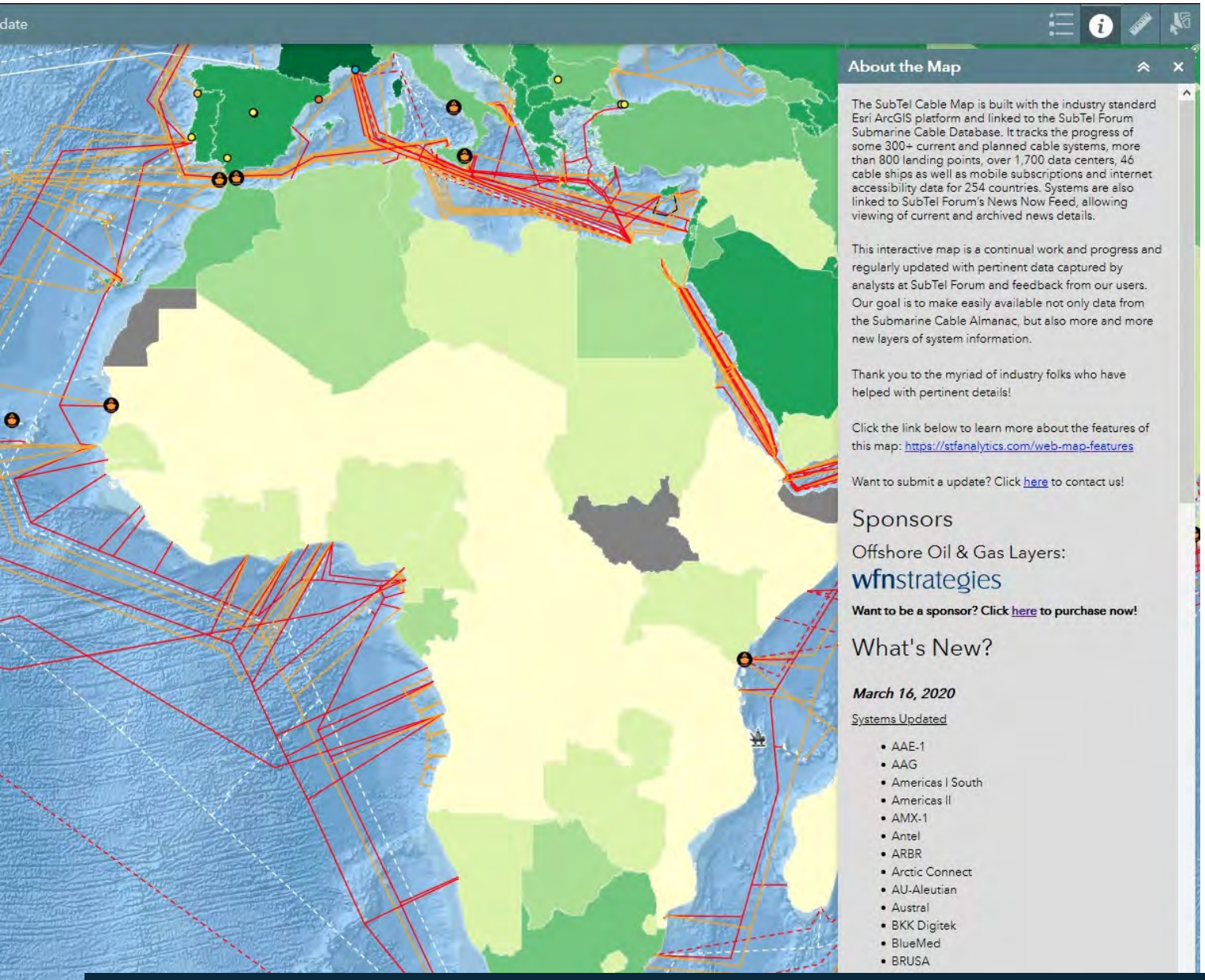
We hope you continue to make use of the SubTel Cable Map in order to learn more about the industry yourself and educate others on the importance of submarine cable systems.

Please feel free to reach out to our Lead Analyst, Kieran Clark, should you have any comments, questions or updates at *kclark@subtelforum.com*.

Since the last issue of the Magazine, the map has updated ninety systems. The full list of updated systems are as follows:

March 16, 2020 SYSTEMS Updated:

AAE-1
AAG
Americas I South
Americas II
AMX-1
ARBR
Arctic Connect
AU-Aleutian
Austral
BKK Digitek
BlueMed
BRUSA
BtoBE
CANI
Celtic Norse
C-Lion 1
Coral Sea
Curie
DARE1
Dunant
Eastern Light
EAUFON
EllaLink
Englandcable
Falcon
Faster
Galapagos Subsea System
Gemini Bermuda
GlobeNet
Greenland Connect
Guantánamo Bay Cable 2



SUBTELFORUM.COM/CABLEMAP

H2 Cable
HAVFRUE/AEC-2
Hawaiki
HKA
HK-G
IAX
IOX
JGA North
JGA South
Jupiter
Kanawa
Katittuq Nunavut
Malbec
Manatua One
MAREA
MARS
METISS
MIST
Monet
NATITUA
NCP
New Pacific
North Sea Connect
OAC
Okinawa Cellular Cable
Orient Express
Orval
PAC
PAN-AM
PCCS
PEACE
PLCN
Project Koete
Quintillion Subsea
SAC
SACS
SAEx1
SAEx2
SAIL
SAM-1
SAPL
Seabras-1
SEACOM
SEA-ME-WE 5
SEA-US
SIGMAR
SJC2
SkagenFiber
Southern Cross
Southern Cross
NEXT
SxS
TampNet
Tannat
TEAS
TPN
Unity
WALL-LI

WHERE IN THE WORLD ARE THOSE PESKY CABLESHIPS?

BY REBECCA SPENCE

Welcome to the first edition and triumphant return of Where in the World are Those Pesky Cableships!

Once only a static table, the goal of this piece is to provide readers with a quick overview of the status of the world's constantly flowing cableship locations and allow them to follow their progress in each issue. SubTel Forum commenced tracking the whereabouts of 47 cable vessels across the globe this year based on information publicly available through AIS tracking. Most of these vessels are working to install new systems or maintain those already in place, leaving a small portion working on various support activities. As you read below, bear in mind that all figures are accurate to the date of publishing and by the nature of this industry will likely change in the days following.

One of the longest lead management concerns for all maritime work is time in transit, taking anywhere from a few days up to multiple months for a vessel to reach its intended destination. Project and resource managers weave transit times between projects like air traffic controllers, striking a delicate balance between effective work time, crew change overs and repair and docking requirements. Illustrated in Table 1, of the 47 vessels tracked, currently 27 percent have reached their destination. The remaining 73 percent are reporting to still be steaming towards their destinations.

Table 2 details the announced Estimated Time of Arrival for all vessels still in transit. Almost half of the vessels in transit will have reached their final destinations by the end of February. Through March another 44 percent of the 47 vessels are due to reach their destinations. Only 9 percent of the cable fleet have long lead estimations, resulting in arrivals as late as September 2020.

Figure 1: Vessels Arrived at Destination

Tracking with current project load, the TransPacific route is currently the busiest region. East Asia, Southeast Asia, the North American West and the Coast of China, North and South Pacific account for 50 percent of the vessels our analysts are track-

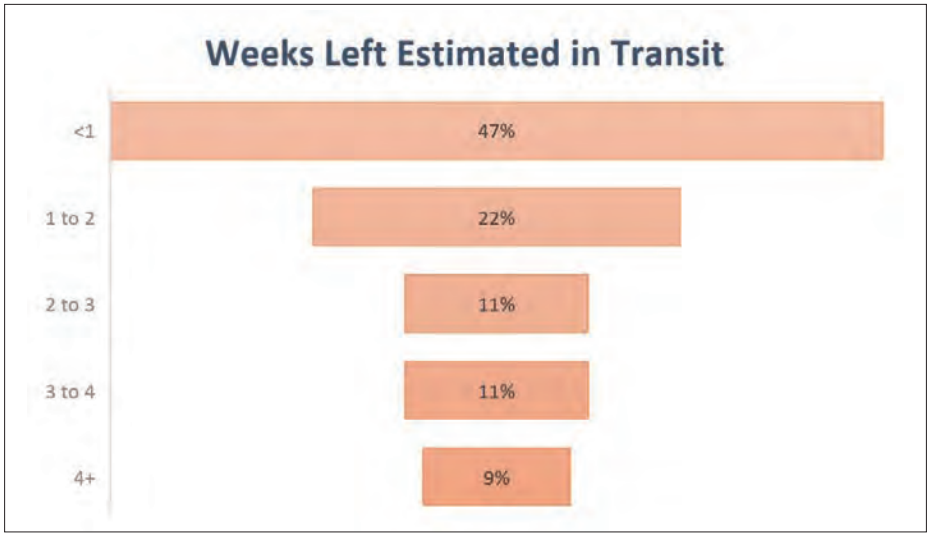


Figure 2: Weeks Left in Transit

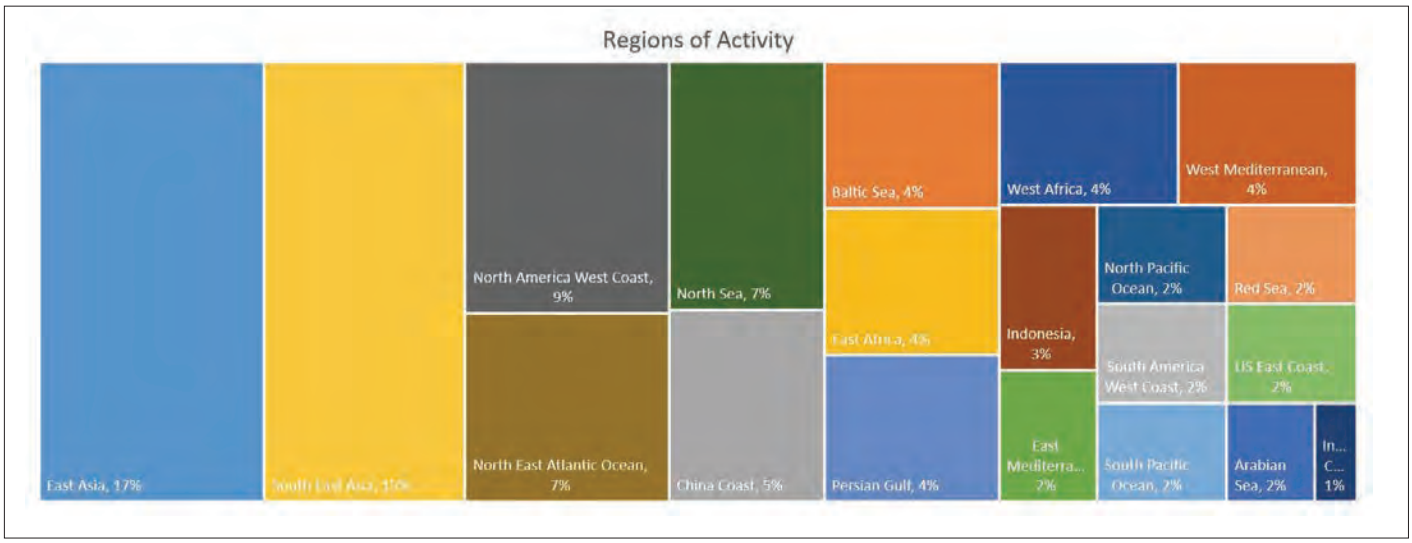


Figure 3: Regions of Activity

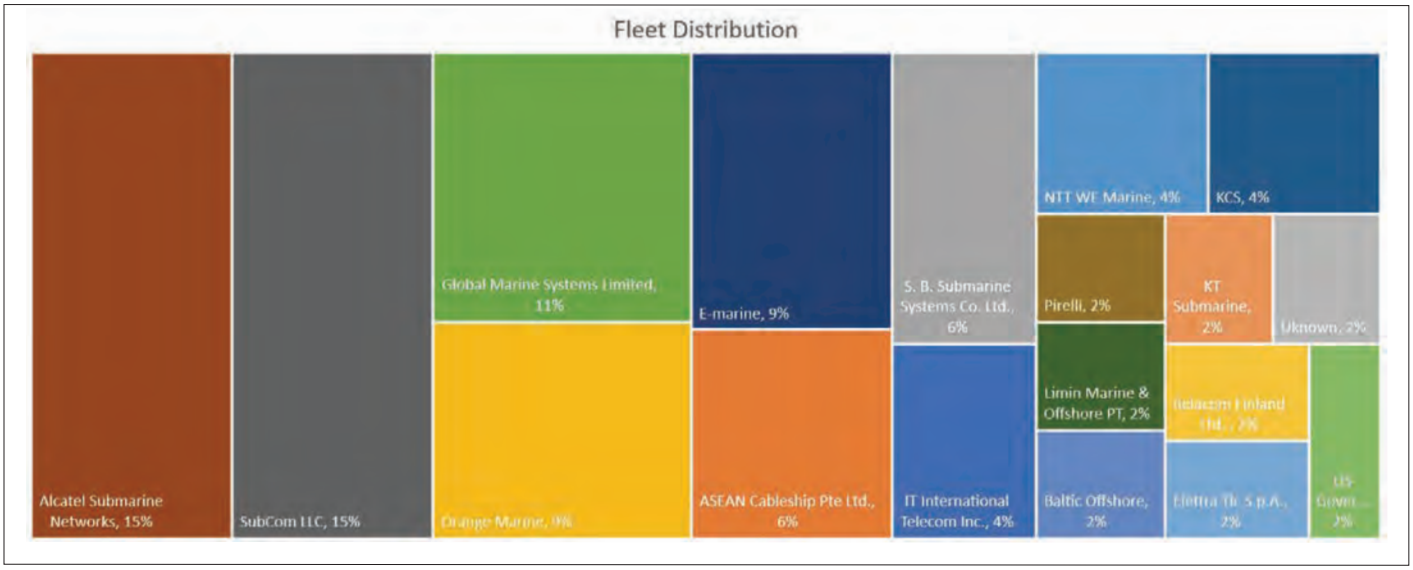


Figure 4: Fleet Distribution

ing. With such a large area to cover, naturally there is a higher need for more vessels to repair, replace and lay new cable. With 7 percent each, North East Atlantic Ocean and the North Sea are the subsequent regions with the highest number of vessels. The Baltic Sea, East Africa & West Africa, the Persian Gulf, and West Mediterranean are all represented but are the beginning of the smaller percentages on the chart. The remaining regions all have 3 percent or less of active ships each with the Indian Coast trailing at only 1 percent.

As with any industry, the front runners tend to have the largest showing and cable system installation ownership is no different. The 47 vessels SubTel Forum analysts are actively tracking are owned and operated by 18 companies and entities but roughly 30 percent are controlled by just two companies. Alcatel Submarine Networks and SubCom own the greatest number of vessels, with seven each. Global Marine, Orange Marine, E-marine, and ASEAN are all represented with several vessels under control of each company. Though the smaller fleets are comprised of only one or two vessels each, they still make up almost 30 percent of the vessels currently working across the globe.

For daily cableship location updates, go to *https://subtelforum.com/cablemap*.

This article represents a snapshot in time, look forward to the next issue of Submarine Telecoms Forum Magazine where I will be digging deeper into our database to provide analysis and some forecasting. Tune in next issue for an exciting update on Where in the World are Those Pesky Cableships! STF

REBECCA SPENCE *is the newest member of the SubTel Forum team. She joined our ranks as a Research Analyst at the end of 2019. A graduate of Christopher Newport University, this is Rebecca's premier article for the STF magazine.*

7 QUESTIONS WITH THE HON. WALTER ROBAN

Talking Trends with Bermuda's Deputy Premier and Minister of Home Affairs

The Hon. Walter H. Roban JP MP is the Deputy Premier of Bermuda and the Minister of Home Affairs since November 2018. He was previously the Minister of Transport and Regulatory Affairs from July 2017. Minister Roban is part of a leadership team that successfully returned the Progressive Labour Party (PLP) to Government for the fourth time on Tuesday 18 July 2017. This achievement follows a career in politics spanning nearly 30 years. A man with a passion for politics and the community, he joined the Bermuda Progressive Labour Party Youth Wing, "Progressive Youth", in the late 1980s. Roban served as its Chairman and representative to the party's Central Committee from 1991 to 1993. In 1995, he was elected to the position of Secretary General of the PLP, which he held until August 1999.

As a member, he worked on a variety of internal projects shaping the party and its policies. In 1995, Mr. Roban worked on the team that revised the PLP independence policy. Roban served as an aide to former Opposition Leader the late L. Frederick Wade doing research projects and writing in different areas of policy to assist the party to be an effective Opposition.

In 1996 at the request of then Opposition Leader and Party Leader Jennifer Smith, Mr. Roban served as deputy chairman of the PLP Campaign Committee for the 1998 election. He played a key role in all aspects of the historic national election campaign when the PLP won its first historic victory. In 2002 Roban worked with the Party committee responsible with implementing key reforms required to restructure the party branch system. In 2003, he was appointed to the PLP's Executive where he held the positions of Acting Secretary General Membership and Acting Public Relations Officer. In addition, he was spokesman for the Party during the 2003 General election campaign as well as a Campaign Committee member with responsibility for major aspects of the campaign. Mr. Roban is a former government Senator and held the Junior Ministerial portfolios of Health & Family Services, Tourism & Transport and Education and Development, serving in the Senate from 2003 to 2006.

He was first elected to office December 18, 2007. Roban served as Junior Minister of Labour, Home Affairs and Housing from February 2008 and was appointed to Cabinet June 23, 2009 as Minister Without Portfolio responsible specifically for Municipal Reform. Roban later held the portfolios of Environment Planning and Infrastructure Strategy and served as the Minister of Health. He also served as Minister of Transport from June 2009 to December 2012.

1. What is Bermuda's mission?

Bermuda has demonstrated its ability to build a world-leading international financial centre. It is now looking to do the same in telecommunications and technology. Specifically, Bermuda is looking to establish itself as a landing hub for transatlantic submarine cables.

To this end, new and innovative legislation – the Submarine Communications Cables Act 2020 - was passed by the Government on 26th February 2020 and will become operational in the first half of this year.

2. Can you tell us more about what the new Act entails?

In addition to ensuring an efficient and streamlined licensing process, with a 60-day approval approach,

the establishment of Bermuda's Submarine Cable Protection Zone is significant. The zone ensures the protection of submarine cables in our waters while also protecting our natural marine environment and heritage.

Working together with ESG Survey, an internationally recognised company in this field, a comprehensive report looked at all of the factors required to develop a submarine cable sector. Most notably, Bermuda's geology, existing and potential landing sites, hazards and restrictions, and cable engineering.

The result is a single area which covers two geographically diverse locations on the Island. It incorporates all the existing deep-water submarine cables routes and which is designed to have minimal impact on current and future use of the area, while allowing sufficient scope for the development of the submarine cable sector to the best industry standards.

3. How does Bermuda participate in the submarine cable market?

Bermuda has long been involved with the submarine cable market and so this legislation is really a reflection of our renewed interest and commitment to the industry. Three cable systems currently land in Bermuda, namely GlobeNet, Challenger and Gemini, and industry leading companies, such as Southern Cross Cable Network and Australia-Japan Cable, have head offices based on the island. Bermuda is also home to a range of professional service providers who are highly experienced in submarine cable assets. Historically, we have also been the home for cable installation/maintenance ships and storage of cable, we aim to re-energise this sector. Furthermore, the Regulatory Authority has recently applied to become a member of the International Cable Protection Committee (ICPC).

4. Is Bermuda currently involved with any new submarine cable projects?

There are more than twenty submarine cables that cross the Atlantic from Americas to Europe and Africa, and others that link North and South America, and the Caribbean. Many other transatlantic cables are being built that transit around the island, but do not land here. We want to highlight, to the large technology companies like Google, Microsoft, Amazon, and Facebook who are building these cables, the opportunity to do a branching unit into Bermuda, making the island the first Atlantic Digital Hub.

Cable companies are looking for a hub to manage traffic capacity and where that traffic can be conveniently split for different destinations, such as the US, Europe, Latin America and South Africa.

They also want a way to manage data sovereignty to avoid sending data through certain locations. Bermuda can provide this.

In addition, for technology companies with global intellectual property companies in Bermuda, a hub would provide further economic substance for them. The island also has the added benefit of being able to provide captive insurance solutions for these companies and be home to head office operations.

There are three such hubs in the Pacific Ocean, in Hawaii, Guam and Fiji, but none in the Atlantic. We are hoping to change that.

5. What is your view on the connectivity market?

More than 99 per cent of the world's global communications is carried on submarine cable networks, and these networks have increased due to the exponential growth of data. As such, submarine cables are a vital component of a country's national infrastructure and many governments have declared subsea cables strategic national assets.

The internet has become ingrained into everyday business tasks and digital transformations are impacting every industry. Bermuda knows well that embracing new technology, allowing existing and new businesses to innovate, is necessary for the future growth of its economy. In support of this, Bermuda is taking a proactive approach and has not only passed the Submarine Communications Cables Act 2020, in 2018 we pioneered a robust regime around digital asset businesses and initial coin offerings in keeping with the Government's pledge for Bermuda to become a technological hub of the future.

6. What makes Bermuda unique in the submarine system market?

The same fundamental principles that have underpinned Bermuda's development as a blue-chip jurisdiction for the last 70 years - namely its pro-business environment, gold standard regulatory regime, stability and convenient location. This, combined with the island's specific experience in the industry and the new legislation that is now in place, makes Bermuda a unique and compelling destination for the submarine system market.

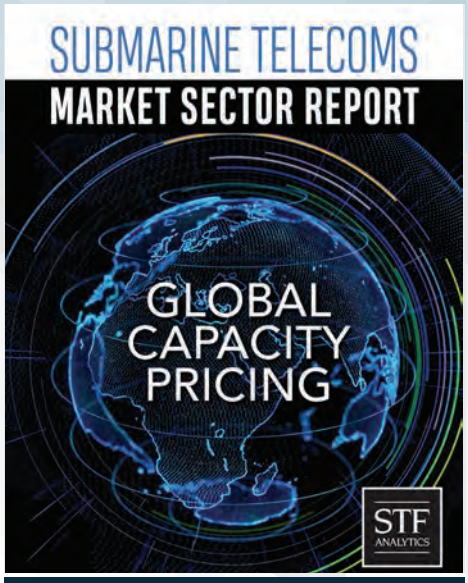
7. What's next for Bermuda?

In this space specifically, now that we have the legislation in place, our main focus will be on promoting the potential for Bermuda to become an Atlantic digital hub as a place that is business friendly for the submarine cable industry all the while ensuring the market understands Bermuda's offering.

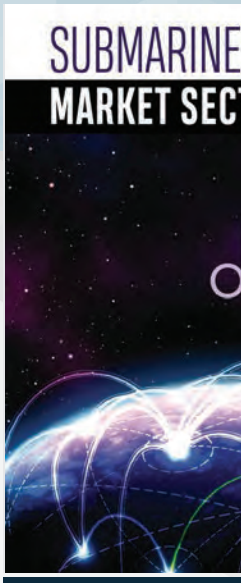
Otherwise, the Bermuda Government continues to focus on the growth of the two key economic drivers, international business and tourism, which have served Bermuda well, while also exploring new and emerging industries from the blue economy to space and satellites. STF

MARKET SECTOR

Data Centers & New Technology



Global Capacity



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SUBTELFORUM.COM/ANALYTICS

The submarine cable industry continues to expand as entrepreneurs and consortiums continue to find opportunities to create value despite global challenges. Growth in the submarine cable industry is driving innovation in the financing of these systems. This article discusses the most important aspects of financing a submarine cable system including forming a business plan, the different types of structures of financing, the role of debt, corporate governance and other important considerations.

Structuring and negotiating financing is a delicate balancing act and plays a significant role in the timing and success of a submarine cable project. Despite rising challenges, entrepreneurs can continue to secure financing arrangements that drive growth in the industry by diligently considering the factors below.

INTRODUCTION

The global demand for data has never been greater. Successfully building and operating submarine cable systems will be key to meeting this demand. Submarine cable systems carry over 99 percent of all international communications, and remain the primary method of transporting internet traffic because of their speed, capacity and security.

The combined submarine cable industry is expected to increase in value from approximately US $12 billion in 2018 to approximately US $30 billion by 2027. In particular, systems in the Middle East, Africa and the Americas will continue to drive global growth. The industry is experiencing rapid change because of the increase in not only large, consortium-driven transcontinental systems but also new, targeted regional projects led by private entrepreneurs.

At the same time as the demand for connectivity rises, the challenges of constructing a submarine cable project have never been greater. Geopolitics present an obvious hurdle, as the United States, the United Kingdom, and other countries experience a rise in economic nationalism that threatens international cooperation and countries such as China continue to assert political influence over the global economy. Navigating national security, data privacy, cybersecurity and other regulations will continue to be challenge in the coming years.

INNOVATIVE FINANCING AND DEBT STRATEGIES FOR PRIVATE SUBMARINE CABLE PROJECT SPONSORS

ANDREW D. LIPMAN, ULISES R. PIN AND PAUL ST. CLAIR

Out of all of these difficulties, financing a submarine cable system remains one of the most complex challenges for sponsors. Constructing, maintaining and upgrading a private (i.e., non-consortium) submarine cable network requires significant amounts of capital. Without an adequate financing scheme, private projects will not be able to capitalize on the expanding market opportunities.

Financing submarine cable projects requires a deep, industry-specific understanding of the legal, technical and financial aspects of the process. This article discusses important aspects of financing to consider throughout the process, including business planning, identifying sources of funding, negotiating funding from multiple sources and the role of debt.

CREATING A BUSINESS PLAN IN A DYNAMIC MARKET

The first step in structuring a successful private cable system project is identifying a market opportunity. Recent trends have led to more local and regional systems as content and cloud service providers seek to implement content delivery networks (CDNs) closer to, and in developing markets. Additionally, geopolitical forces have led to a trend in localization of data and networks. Developers and entrepreneurs should consider South Asia, Africa, Latin America, the Caribbean and the Middle East as strategic growth opportunities for the industry.

Other market factors that should be examined in business planning include current capacity on existing networks, future traffic demands, other planned infrastructure in the region and technology trends. Financial factors include any requirements likely to be requested by equity financiers, identifying sources of debt financing including vendor financing, licensing, permitting, and other regulatory and environmental obstacles, tax issues, and assembling a management team with experience and agility.

The next step is determining which organizational structure to use, as the structure affects financing options that are available. Traditionally, telecommunications providers of one or more countries join forces to build and operate a network in consortium systems or "carrier clubs." Typically, one carrier leads the group and is responsible for overall administration of

the network. Funds for construction and operation are collected from cable participants. This pool of participants has expanded beyond traditional carriers to include content providers directly such as Google, Facebook and Microsoft. In this arrangement, there is usually no need for outside equity financing (or much financing at all), as carriers and content providers generally fund the projects from their own larger balance sheets.

In contrast, private cables need to secure funding in order to build and operate a new system. Generally, private systems are started by a "sponsor" developer or entrepreneur who raises funds from sources such as capital markets and commercial banks. Private systems use the "carrier's carrier" model. In this model, the sponsor or sponsors lease circuits or enter into sales of bulk capacity with competitive telecommunications providers, content providers and large corporate users. These capacity agreements typically take the form of Indefeasible Rights of Use (IRUs), which are long-term arrangements similar to a sale of capacity. Any successful business plan will demonstrate the network will be "fully funded" when construction starts, so securing tenants and purchasers should be a priority for sponsors. Despite being susceptible to global capital and economic conditions, private funding is still a widely-employed structure. Increasingly, however, investors are looking at innovative, hybrid models of funding in an effort to minimize risk.

VENTURE CAPITAL AND PRIVATE EQUITY

When seeking outside equity, sponsors will often look to venture capital (VC) or private equity (PE) to fund submarine cable projects. New systems rely on VC more than on PE, because VC investors are generally more likely to invest in early-stage projects. PE investors have a tendency to be more selective about investing in immature projects and companies, seeking a more stable but less aggressive longer-term return. However, entrepreneurs should be aware that PE funds can serve as financing sources in cases where entrepreneurs are building subsequent systems, updating or upgrading an existing network, where there are significant customer commitments (and therefore cash flows) or as an exit strategy for a successful VC-funded system.

When considering either VC or PE investment, entrepreneurs in the submarine cable industry should be aware that both VC and PE funds have some similarities. Namely, both types of funds will look for sponsors to have some "skin in the game," including contributions of capital and hard assets such as contracts and licenses. VC and PE investors will want to know about (1) cash flow and profitability; (2) whether they can obtain preferences over other common stockholders and sponsors; (3) whether they can obtain anti-dilution protections; (4) whether the company has strong corporate governance provisions; and (5) whether there is a clear exit strategy to monetize their investment.

The most common equity security used by venture capital is convertible preferred stock. Other equity securities, or combinations of debt and equity such as convertible notes and warrants, have been used historically. However, debt-flavored instruments have seen more limited use because of their complexity and tendency to create problems with subsequent debt offerings.

THE IMPORTANCE OF DEBT

The importance of debt in determining the success or failure of a project can hardly be overstated. Beyond presales and early capacity commitments, debt should be a principal focus of a developer in the submarine cable industry, as debt generally accounts for approximately 50 percent or more of the total cost of construction.

Innovative financing techniques have been used in the submarine cable industry involving sale-lease-back, lease-to-own, and "project finance" solutions. The project finance structure combines senior secured, nonrecourse or limited-recourse credit arrangements payable solely from the cash flows of the project. Increasingly, system suppliers and equipment vendors participate in this process by providing vendor financing packages on preferential terms.

The more complex a project is, the more likely it is that developers would need a diverse portfolio of debt. Sources of debt financing include technology vendors, traditional commercial sources such as a bank syndicates, alternative commercial sources, development banks and multilateral organizations.

Commercial financial institutions (e.g., banks) have historically been the primary source of funding for submarine cable systems. However, this funding generally is expensive as terms and conditions on loans are likely to be stringent, and fees and other origination costs can be high. Hedge funds or other alternative commercial lenders may also be interested as they expand into financial services, technology, consumer goods and infrastructure. Traditional commercial banks are subject to regulatory barriers that create opportunities for nontraditional lenders in this field. So long as interest rates remain low, commercial lending is possible with the right business plan and management team in place.

An alternative to commercial lending may be the availability of funding from development banks and multilateral organizations. Sponsors should investigate partnership with development banks, and especially in the development of emerging markets. Examples include the Asia Development Bank, the Inter-American Development Bank, the

Overseas Private Investment Corporation (OPIC), and the International Finance Corporation (IFC).

Sponsors should also initiate discussions with local or domestic development funds, infrastructure funds, sovereign wealth funds, broadband development plans and any other funding sources from national or local organizations (collectively referred to herein as multilateral organizations). Multilateral organizations generally provide better terms than commercial banks. However, the funding will have specific conditions, possibly including restrictive provisions such as covenants related to child labor, collective bargaining, pornographic content and more stringent environmental standards than commercial loan arrangements. Another factor to consider is that insurance in emerging markets tends to be more expensive, as do legal, accounting, engineering and consulting fees. A less developed legal and regulatory structure tends to produce greater risk as well, lengthening permitting, licensing and other governmental approval processes. Partnership with domestic or regional multilateral organizations eases some of this risk.

The principal role of multilateral organizations as debt providers occurs usually in the form of "A Loans" project financing. In some cases, multilateral organizations may also act as equity sponsors. The IFC, for example, has an equity program for telecommunications companies. Development agencies can also act as (1) secondary debt arrangers/providers, typically through "B Loans" where the development agency acts as an administrative agent and syndicates loans to other commercial banks; (2) guarantors (generally partial guaranties of bonds or loans); (3) political and currency risk insurers; and (4) providers of technical cooperation and grants for feasibility studies.

Sponsors should consider the many aspects of debt financing, regardless of which option above is used. Most business plans would likely require short-term financing in addition to long-term debt. This may include having revolving facilities, letters of credit and some other forms of short term loans. Developers should also keep in mind that there would likely be heavy negotiations with lenders over financial covenants, including debt-to-equity and debt coverage ratios. Lenders generally request that a borrower secure enough cash reserves or additional equity backstops to cover unexpected costs. Financial institutions may request more stringent conditions under which dividends and other

distributions will be significantly limited during the term of the credit facility. Also, debt sources invariably seek a full collateral package, including liens over hard assets, contracts and stock. Finally, inter-creditor arrangements will need to be in place to secure each lender's place in the capital structure.

CORPORATE GOVERNANCE, MANAGEMENT AND OTHER KEY NEGOTIATION ISSUES

In addition to negotiating over debt terms, sponsors should be prepared to negotiate corporate governance terms. Investors invariably negotiate over control of the board and/or negative blocking rights. Sponsors should be prepared to be flexible in this industry. Based on our experience, it is advisable that sponsors implement world-class corporate governance structures, even if the company is only in its infancy. Having strong corporate governance provisions would provide investors with confidence that the business will be run in a professional manner. Other unique aspects of corporate governance in the submarine cable industry include the advisability of implementing a corporate governance structure that meets the Sarbanes-Oxley requirements, even if no U.S. landing point is planned.

Another major negotiation component is exit strategy. Institutional investors generally expect the network to generate a profit in 3-5 years. Such investors will seek an exit at this point from the project. All options should be on the table in the submarine cable industry. Public equity offerings are typically not available anymore, so sponsors should be aware of exit strategies including the identification of strategic buyers and merger candidates, combining with other regional networks, and securing new private equity or funds from institutional investors that may prefer more mature systems.

As mentioned above, investors in this industry are keen on seeing a top-notch management team in place. Management should not only have a deep understanding of business and technical matters, but also be aware of regulatory and environmental issues. Securing landing licenses and permits in a timely manner will be crucial to lenders, so sponsors must involve advisors and counsel as early as possible in the negotiation process. Sponsors must be ready to address diverse laws, cross-border risks, evolving technology and dynamic markets. An experienced management team, expert advisors and world-class counsel will enable any sponsor to negotiate these diverse challenges.

CONCLUSION

The demand for connectivity is leading to new opportunities for growth in the submarine cable industry. After identifying the right business opportunity, entrepreneurs must craft a realistic business plan and embark on securing funding for the project. Financing a new submarine cable is a complex process that requires significant patience and skill as there is no "one size fits all solution" to funding a new network. Being able to anticipate the potential demands from equity and debt sources, would go a long way in improving the probability of closing funding for a new system. STF

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To open the US local telephone market to competition, Andy has been involved in most new legal and regulatory policies at the Federal Communications Commission, at state public service commissions, in Congress, and before courts. He helped shape crucial provisions of the Telecommunications Act of 1996 and used similar approaches to promote the opening of foreign markets. He also obtained one of the first competitive local service and interconnection agreements in continental Europe and the first competitive fiber network application in Japan.

Andy's practice includes strategic analysis of companies' telecom user agreements, renegotiating existing agreements, and negotiating new, more favorable telecom user agreements.

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Ulises's practice covers all sectors of the TMT market, including wireline, wireless and international communications, Voice over Internet Protocol (VoIP), infrastructure projects (land and submarine networks), satellite services, and emerging technologies. He counsels on complex cross-border transactions, including mergers, acquisitions, and divestitures; public offerings; joint ventures; and private and public equity investments. He also represents public and private companies in international corporate and finance transactions across industries, including telecommunications, technology, energy, retail, and real estate. Additionally, Ulises drafts and negotiates telecommunications and technology contracts on behalf of telecommunications operators, equipment manufacturers, and large telecommunications users.

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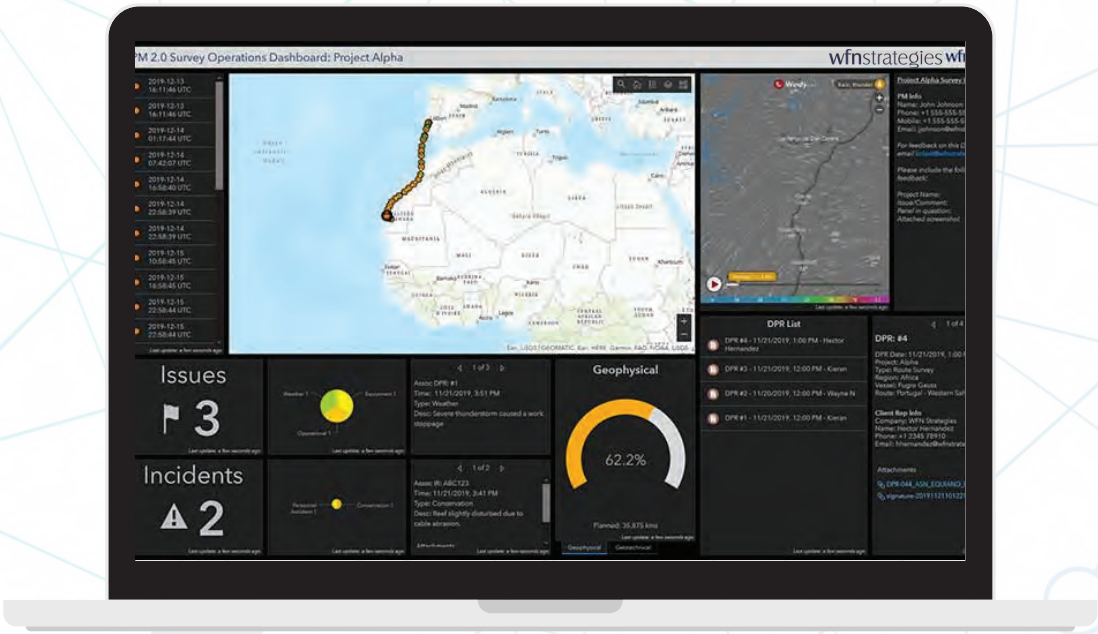

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THE FUTURE OF PROJECT MANAGEMENT

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FEATURE

TRIPPING HAZARDS FOR PERMITTING OF SUBSEA CABLES IN BRITISH COLUMBIA, CANADA

BY JAMES IAN ANTHONY NEVILLE

As everyone with experience obtaining regulatory approvals for submarine cables knows, the devil can be in the details. Each potential alignment and landing location may lie within multiple regulatory jurisdictions as represented by entities of various government levels: national, provincial or state, regional, municipal, and Indigenous. Processes can often seem, or be, byzantine and fraught with unknowns and surprizes. The province of British Columbia (BC), on Canada's west coast, is a prime example of a place where a deft shepherd, knowledgeable of relevant history and intricacies, is essential.

SEAFLOOR TENURES – AND A BIT OF HISTORY

A key consideration in BC is ownership of the seabed, or "submerged lands". People with project experience elsewhere in Canada may be forgiven for assuming that the seabed is federal Crown land; the term "Crown" originates from the concept of the monarch being the legal embodiment of the state. Generally in Canada, provinces with marine shorelines own the foreshore as provincial Crown land, that is, the area between high-tide and low-tide levels, while the federal government owns submerged lands. Surprisingly, that is not the case in BC. There, the province owns the seabeds, along with natural resource rights, of "inland seas" between the BC mainland and Vancouver Island and other islands. Those inland seas include the Canadian portion of Juan de Fuca Strait and the Strait of Georgia which, together with Puget Sound in Washington, form the Salish Sea. The map accompanying this article illustrates the region.

How did this situation originate? Why is BC and its Pacific coast different from, say, Nova Scotia and its At-

lantic coast, or Manitoba and its Hudson Bay coast? As ably described in a 2013 article by David Sheffield (*http://www.nauticapedia.ca/Articles/Waterfront_Property.php*), the answer lies with peculiarities surrounding the entry of BC into the then five-province confederation of Canada in 1871. BC had until then been a separate British colony, hence its name. After decades of mostly low-key rancour over resource allocation, in a decision on what is known as the "Georgia Strait Reference", the Supreme Court of Canada ruled that the British colony as it entered Canada must remain intact, meaning that BC still includes submerged lands of coastal straits, along with the dry lands that make up most of the province. If you have a particularly legal bent, the full text of the decision is available at *https://scc-csc.lexum.com/scc-csc/scc-csc/en/item/5267/index.do*.

That decision ran counter to the *Constitution Act* of 1867, which assigned general responsibility for oceans to the Canadian federal government. Indeed, federal jurisdiction for the seabed of the open ocean off BC extends to 12 nautical miles from the outside shore of coastal islands, and Canada's Territorial Sea extends to 200 nautical miles of ocean waters. One result of the Supreme Court decision is that fees for seabed tenures and other resources within those coastal straits go into provincial coffers and not federal coffers.

But, as always, there are exceptions. Most international, commercial harbours along the BC coast, including those of Prince Rupert, Vancouver, and Port Alberni, fall under the jurisdiction of port authorities, which are enabled under federal legislation. The Port of Victoria, serving the BC capital, has no port authority, owing to its not being an international container terminal; instead, its ferries, cruise-ship terminal, floatplane runway, and heliport functions are under direct governance of the federal transportation department, Transport Canada. In addition, there are Crown-granted water lots along the BC coast, mostly privately owned by resource companies.

How does that constitutional wrangling affect owners who wish to land subsea telecommunications cables in Canada? As a cable route leaves federal waters, enters waters with provincial seabed, and then possibly re-enters federal jurisdiction in a port, proponents need to fully understand the boundaries of those jurisdictions and the entities that require tenure applications. The required content of the applications is also important, as it is cost-effective to concurrently gather data and information pertinent to multiple regulators, each with separate permitting requirements.

The lead regulator of subsea telecommunications cables entering Canada is a federal department called Innovation, Science and Economic Development Canada (ISED). ISED administers the *Telecommunications Act*, which stipulates that a licence is required to construct or operate an international submarine cable within Canadian jurisdiction. Part of the Act, the International Submarine Cable Licences Regulations, sets out the terms and conditions for licences, in support of the policy objective of an orderly development of Canada's telecommunications system. ISED, while officially neutral on approving submarine cables, is seen as helpful to proponents by facilitating coordination of required federal permits.

Section 2 of the Regulations provides that a person may hold either of two classes of international submarine cable licence:

- A Terminating Cable Licence for cables that land in Canada and interconnect with Canadian telecommunications facilities; or
- A Through Cable Licence for cables that pass through Canada (for example, through ocean waters under Canadian jurisdiction), but that do not interconnect with telecommunications facilities in Canada.

Interestingly, while ISED is the federal regulator for subsea cables being laid on Canadian Crown seabed off BC, it has no Crown seabed tenure role. Tenures for federal Crown lands are typically administered by a department called Public Works and Government Services Canada (PWGSC), but that agency has not yet been given the authority for seabed-use authorization within the 12 nautical miles of offshore federal seabed jurisdiction. This seeming regulatory gap likely resulted from the tenure roles of the federally mandated harbour authorities and Transport Canada within large ports, combined with the (relatively) recent advent of modern trans-Pacific cables. Within federally administered ports, a Licence of Occupation is generally required for cables installed within federal Crown seabed.

A subsea telecommunications cable being laid on submerged lands considered internal to the Province of BC, including those of Juan de Fuca Strait and the Strait of Georgia, requires a Statutory Right-of-Way (SRW) once complete to provide permanent tenure. A Licence of Occupation may be issued temporarily during construction before the SRW is finalized. BC Crown lands applications are processed and administered by the Ministry of Forests, Lands, Natural Resource Operations, and Rural Development (MFLNRORD). That mouthful of an agency came about when the provincial government of the day consolidated management of all natural-resources licensing, from industrial forestry tenures to hunting licences.

Seafloor tenures are the final goal of the permitting process for subsea telecommunications cables. But getting your puck across the blue line and into the net will require adept stickhandling!

IMPORTANT STATUTORY REQUIREMENTS FOR SUBSEA CABLE PROJECTS

Despite the divided ownership of seabeds off the BC Coast, the federal government has jurisdiction over navigation and most environmental matters in ocean waters (an exception is shared federal and provincial regulation of potential contaminants from spills and outfalls). The main pieces of federal legislation that pertain to laying of submarine cables are the *Fisheries Act*, the *Canadian Navigable Waters Act*, the *Species at Risk Act*, and the *Impact Assessment Act*. Like many other countries, changes of government in Canada often result in overhauls of a variety of laws, including environmental legislation. These Canadian acts, their component enabling regulations, and resultant policies and administrative staffing levels underwent upheavals in 2012 and 2019, a pattern that will no doubt repeat itself. So, the licensing requirements for the telecommunications cable you install in 2025 may differ significantly from those for previous installations.

The *Fisheries Act* is the federal government's primary instrument for protecting fish habitat and controlling water pollution. The primary purpose of the Act is to protect Canada's fisheries as a natural resource by safeguarding both fish and fish habitat. The definition of "fish" under the Act includes all marine animals at all life stages. While much of the Act is aimed at regulating harvesting and protecting fisheries, it also provides protection for waters that constitute fish habitat. The Act applies to both coastal and inland waters, and is generally administered by Fisheries and Oceans Canada, also known as the Department of Fisheries and Oceans (DFO), although portions of the Act relating to water quality protection are administered by Environment and Climate Change Canada (ECCC).

The *Fisheries Act* has long been viewed as the paramount environmental law in Canada, owing to its far-reaching ramifications. DFO is responsible for managing fisheries resources and for habitat protection under the *Fisheries Act*, and for developing and implementing policies and programs in support of Canada's scientific, ecological, and social and economic interests in oceans and fresh waters. That role includes management of commercial fisheries and oversight of commercial fleets. DFO does not have jurisdiction over the use of inland waters or watercourses but does have jurisdiction over fish and fish habitat in inland waters. Prohibitions under Section 35 and Section 36 of the Act have implications for the cable-laying projects.

Subsection 35(1) of the Act makes it an offence for anyone to "carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat" (HADD). The only relief from this general prohibition is when DFO issues an Authorization under Subsection 35(2) that places conditions on how work in and around water is to be carried out and sets out mitigation requirements for any habitat lost or impaired.

Subsection 36(3) of the Act, the part administered by ECCC, makes it an offence for anyone to deposit or permit the deposit of any type of deleterious substance in water frequented by fish without a permit or under a regulation. "Deleterious substance" is defined in the Act as including any substance that would degrade, alter or contribute to the degradation or alteration of the quality of water so as to render it deleterious to fish or fish habitat. Sediment discharges into water during project installation, for example, could be considered deleterious substances under the Act.

To streamline the Authorization process and help screen out activities not likely to cause HADD, DFO has established a procedure for Requests for Review. DFO recommends that an Application for Authorization be pursued only after a project review has been completed. When a proponent submits a Request for Review form to DFO, the agency evaluates whether proposed mitigation measures are sufficient; if not, DFO will recommend that an Application for Authorization be completed.

Proponents of activities not requiring Authorization must still avoid causing HADD by following best practices, referred to as "measures to avoid causing harm to fish and fish habitat." Notably, marine mammals are included in the *Fisheries Act* definition of "fish". Regulatory agencies granting permissions for the Project will require that a proponent provide a detailed Environmental Management Plan (EMP) that includes DFO-specific measures. Protection of the endangered Southern Resident Killer Whale, with critical habitat in the Salish Sea, is of paramount concern, and there will be a requirement for marine mammal monitors on vessels associated with laying cables. The EMP would also need to be protective of any identified Ecologically and Biologically Significant Areas.

DFO also has responsibility under the Species at Risk Act for issuing Permits Authorizing and Activity Affecting Listed Wildlife Species. This type of permit would not be required if the EMP thoroughly addresses potential adverse effects on rare, endangered, and threatened species in the marine environment. Under the pre-2019 version of the Act, installation of underwater cables was among a set of project activities listed on the DFO website as not requiring review. A specific requirement for such projects was that, if any aquatic species listed under the *Species at Risk Act* were present, no open-trench methods were to be used to bury cables, including ploughing and water-jetting. De-

sirable mitigation measures would still include avoidance of such open-trench methods.

The Canadian Coast Guard is a branch of DFO. Prior to a cable lay, the Coast Guard must be informed of vessel activities, and they will then notify other vessels as necessary. Details of the cable location must be provided to Coast Guard and Canadian Hydrographic Service for distribution through Notices to Mariners and Canadian Hydrographic Service navigation charts.

The *Canadian Navigable Waters Act* (NWA) is administered by Transport Canada, a federal government department that regulates air, marine, rail, and road transportation; oversees 17 port authorities across Canada (including that in Port Alberni); and directly manages several public ports (including Victoria's). It sets and monitors port and marine facility service standards and co-ordinates public notices and consultations regarding ports.

The NWA is designed to protect the public right of navigation. Section 5(1) of the NPA prohibits any work that may interfere with navigation without prior approval of the work, its site, and work plans. There are two levels of permitting under Transport Canada's Navigation Protection Program:

- A Minor Works Order allows works that meet criteria for the applicable class of work, and specific terms and conditions, to proceed without approval or public notice.
- A Major Works Order that is required if work is "likely to substantially interfere with navigation."

The *Impact Assessment Act* (IAA), which in 2019 replaced previous legislation, is the legal basis of the federal environmental assessment (EA) process. The Impact Assessment Agency of Canada (IAAC) is the federal Responsible Authority for EAs at the federal level. The Act sets out the responsibilities and procedures for carrying out EAs of projects that involve federal government decision making. There are two main triggers for EA requirements under the Act: 1) designated projects, and 2) non-designated projects on federal lands or otherwise subject to federal decisions. The Physical Activities Regulations under the IAA identify the physical activities that constitute "designated projects" and that may require an EA by IAAC. It is the second trigger pertaining to non-designated projects that is easy to overlook or underscope in a project plan.

Telecommunications cables are not designated and, as such, there is no requirement for a full federal EA of such a Project. The IAA stipulates, however, that federal authorities must conduct EAs for non-designated physical-works

projects proposed on federal lands. Under Section 82, "An authority must not carry out a [non-designated] project on federal lands, exercise any power or perform any duty or function conferred on it under any Act of Parliament other than this Act that could permit a project to be carried out, in whole or in part, on federal lands", unless

1. the authority determines that the carrying out of the project is not likely to cause significant adverse environmental effects; or
2. the authority determines that the carrying out of the project is likely to cause significant adverse environmental effects and the Governor in Council (i.e., Cabinet) decides that those effects are justified in the circumstances.

Section 82 is applicable to subsea cables entering Canada, as such projects affect federal lands and entail regulatory roles for federal authorities. Agencies of the federal government that could be required to fulfill this requirement by preparing Environmental Effects Determination (EED) Reports are DFO, ISED, a port administrator (port authority or Transport Canada), and Public Works and Government Services Canada, if the latter agency is assigned the responsibility for the federal seafloor tenure process not yet in place. All these agencies have a duty to consult with indigenous groups on proposed projects and would coordinate that consultation as practicable. EEDs are typically based on project information, including potential adverse effects and mitigation measures, provided by proponents. It is prudent to anticipate the requirements of multiple agencies when doing research and conducting field investigations.

ENGAGEMENT WITH INDIGENOUS GROUPS

The Canadian Constitution includes the duty for federal, provincial, and territorial governments to consult and accommodate Indigenous groups on actions or decisions that may affect an Aboriginal person's Aboriginal or Treaty rights. As such, all permissions required for the Project from federal and provincial authorities will be subject to that requirement.

The federal and provincial governments maintain consultative databases and mapping tools for identifying the Indigenous groups that must be included in consultation by geographic area. Except for major resource projects, such consultation may consist simply of sending referral letters to each applicable Indigenous government requesting review and comment on an enclosed project summary. Time given for responses varies, but is typically about two months, and the process can be iterative.

A challenge for Indigenous groups is that their staff members are often overstretched, owing to multiple project reviews often being added to their regular duties. Capacity funding mechanisms within government enable additional staff or outside consultants to be hired.

Owing to the pressures often felt by Indigenous groups, project proponents are advised to provide project information to Indigenous groups and meet with them as needed to address any concerns, before the regulatory agencies send referrals. The timeline for responses to referrals can be greatly reduced if a positive relationship is established between the Indigenous group and the proponent. It is often the case, however, that government agencies will receive no response from one or more Indigenous groups before issuing permissions.

Engaging with Indigenous groups can provide great insight into the context of an area proposed for a project. Studies of potential environmental effects of projects often benefit in unexpected ways from full integration of Indigenous knowledge and empirical science, and such studies can be incomplete or deficient without that insight.

In this article I have briefly described the tripping hazards that face proponents and constructors of trans-Pacific subsea cables landing in British Columbia and described the key regulatory players. Pitfalls include misunderstanding of seafloor jurisdiction, not anticipating involvement of a regulatory agency, underscoping a process, missing the IAA Section 82 requirements, ineffective engagement with Indigenous groups, and changes to environmental legislation during the planning process.

Those hazards can cause significant scope, budget, and schedule risks for your project if your project team is not armed with the local knowledge, historical perspective, established relationships with regulators, and experience collaborating with Indigenous groups to navigate BC's complex regulatory waters. STF

JAMES NEVILLE *grew up Ottawa, Canada, where he obtained an Honours Bachelor of Science in Biology. He then headed to the University of Calgary, and earned a Master of Environmental Design, with a specialty in environmental impact assessment. Shortly after completing that degree, James moved to the beautiful city of Vancouver, British Columbia. For more than 30 years, James has been a consultant, both freelance and with small and large firms, and he has worked on projects throughout Canada and in South America. He joined AECOM Canada Ltd. in 2012, where he is a senior scientist and regulatory specialist in the Burnaby, BC, office in suburban Vancouver. After several years of regulatory experience on mining, pipeline and LNG Terminal projects, James is now the Permitting Manager for the new McLoughlin Point Wastewater Treatment Plant, under construction at the mouth of Victoria harbour. James holds professional biologist designations in BC, Alberta, and the United Kingdom.*

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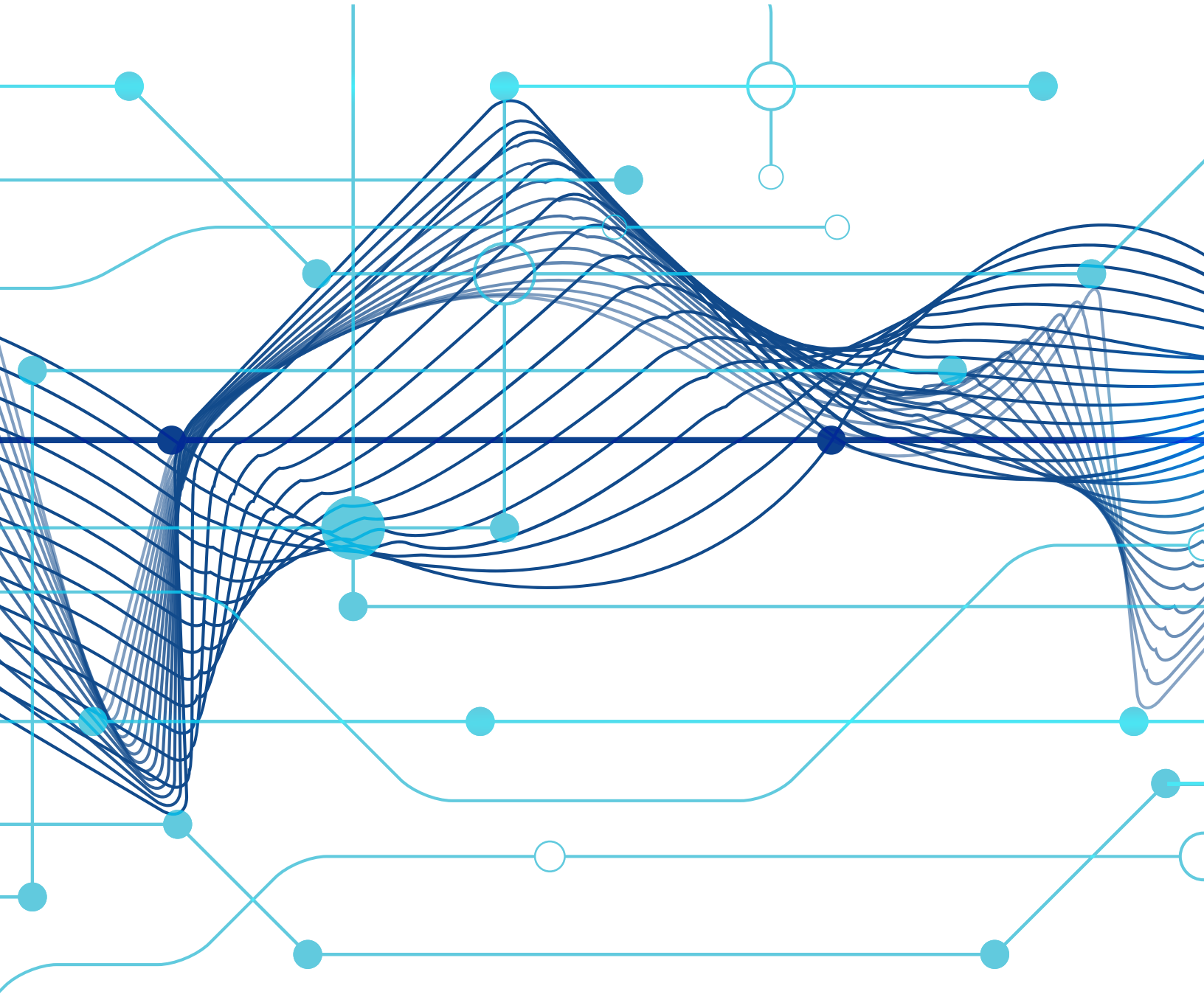

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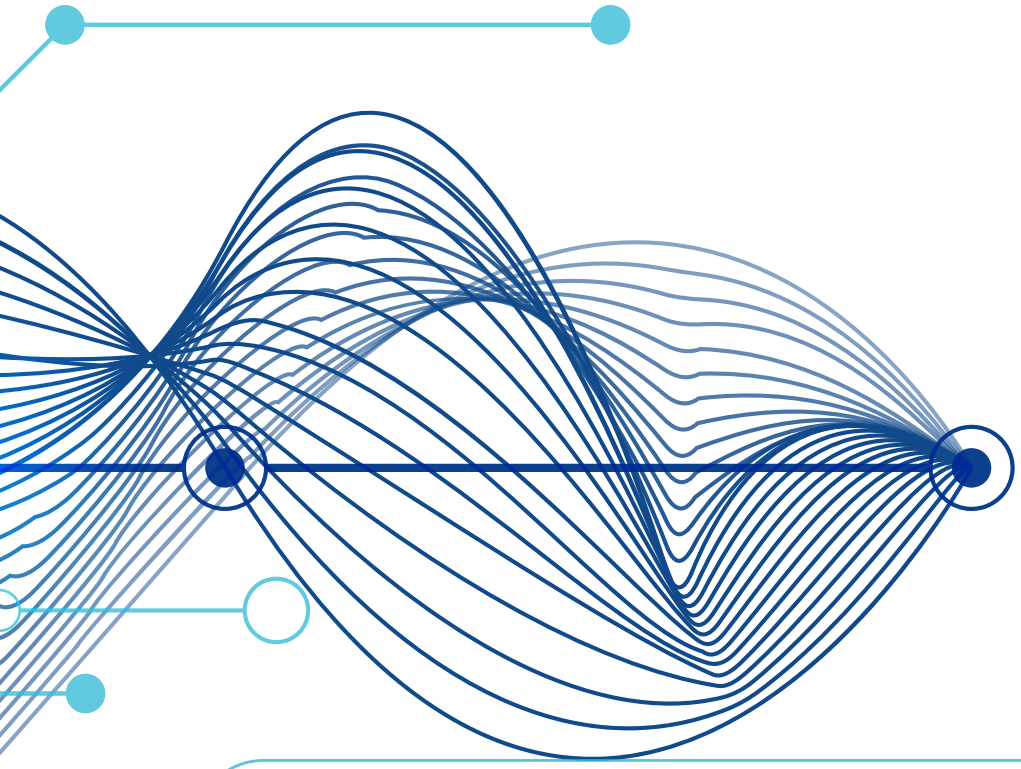

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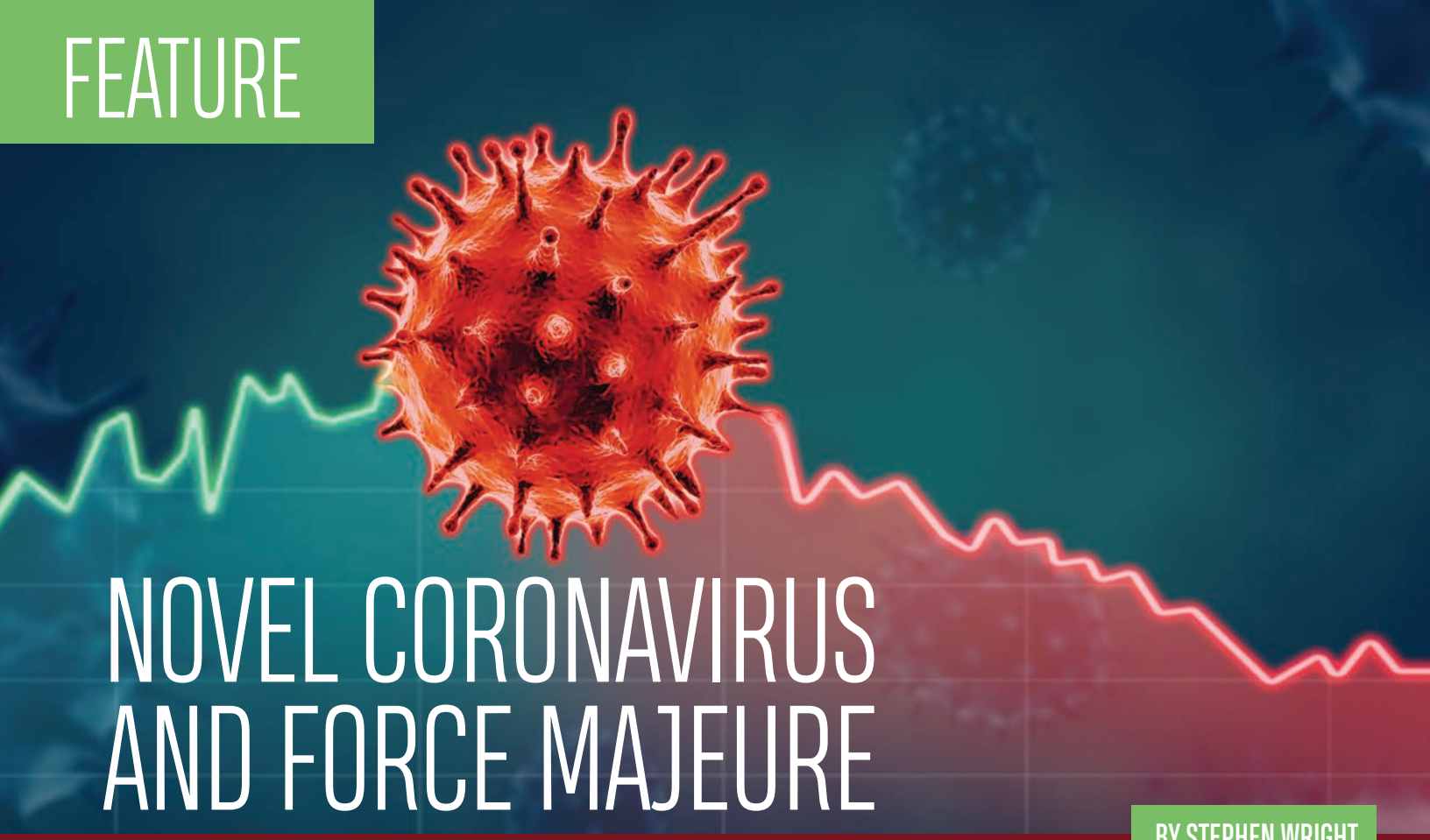


NOVEL CORONAVIRUS AND FORCE MAJEURE

How Are Your Contracts Being Affected?

BY STEPHEN WRIGHT AND ADAM KELLY

The outbreak of the Wuhan novel coronavirus COVID-19 has caused, and continues to cause, great uncertainty for organisations operating in the region as well as businesses around the world that rely on China for trade. As a result of the shutdown, mandatory quarantine for travellers and the country's focus on controlling the outbreak, those who do business in the region are facing growing uncertainty and volatility in the market.

DLA Piper is currently advising clients who are concerned about how these events are affecting their businesses. Given the location of the outbreak, it is no surprise that the main impact we're seeing relates to manufacturing and supply chain, which has resulted in difficulties for businesses in fulfilling their contractual obligations.

Businesses who have been affected are now seeking to understand their rights and obligations and any relief that might be available to them. Often the first thought that comes to mind in such circumstances is a force majeure clause, which is typically agreed between parties in B2B contracts to allow a period of relief in performance where circumstances arise that are beyond their control. There are several issues to consider before invoking a force majeure clause, some of which we have set out below as an initial guide.

DO YOU HAVE A FORCE MAJEURE CLAUSE?

You will only be able to rely on a force majeure clause if one is included in the relevant contract and it applies to you. English law does not imply force majeure relief into contracts that are silent on the matter.

CAN YOU RELY ON YOUR FORCE MAJEURE CLAUSE IN THE CIRCUMSTANCES?

Simply because a force majeure clause exists (that operates in your favour), doesn't necessarily mean you have the right to invoke the relief in all situations. Force majeure clauses are typically drafted to include specified events (often called 'force majeure events'). Whether the current situation constitutes a 'force majeure event' is a matter for interpretation that requires specialist legal advice. It is unlikely that your clause envisages the Wuhan novel coronavirus COVID-19 (2019-nCoV) specifically, however it may specify events such as pandemics, epidemics and work stoppages, in which case you may find it possible to argue that the outbreak constitutes one or more of those specified events.

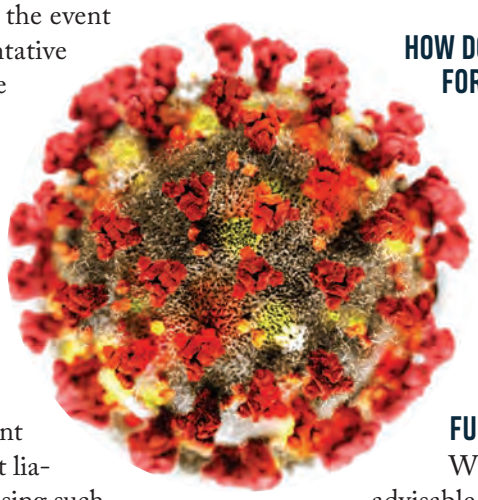
If your force majeure clause is particularly favourable to you, it may have been drafted to include events such as:

- compliance with a law or governmental order, rule, regulation or direction;
- any action taken by a government or public authority, including imposing embargo, export restriction or other restriction or prohibition;
- delays by suppliers or materials shortages;

- difficulty or increased costs in obtaining workers, goods or transport; or
- other circumstances affecting the supply of goods or services.

It is also wise to consider how the outbreak is being classified by bodies such as the World Health Organisation at the time you're seeking to invoke the force majeure clause, as this may or may not support your argument or claim.

Force majeure clauses typically include a requirement, for the party seeking relief, to show that the event could not have been mitigated by preventative action. This demonstrates the point force majeure may only be invoked when the relevant event has prevented performance of the contract, not simply that the event exists, has caused economic hardship or that performance has become difficult or commercially undesirable.



Government agencies in China have begun to issue 'force majeure certificates' to some businesses in an attempt to prevent or stall breach of contract claims and limit liability. Please get in touch with us before using such certificates as their effectiveness in relation to your contract (including its governing law) must be carefully assessed. As the leading global business law firm, DLA Piper has lawyers in more than 40 countries who can help.

SHOULD YOU INVOKE YOUR FORCE MAJEURE CLAUSE?

This question is typically the one on which DLA Piper is instructed to advise as it involves careful consideration of the circumstances. The following non-exhaustive list contains some of the matters you should consider:

- force majeure clauses typically include a right for the unaffected party to terminate when the event has continued for a specified period of time. Although claiming force majeure relief may seem immediately beneficial to your business, it may have unintended consequences, such as triggering termination rights for your customers;
- what do the contracts say? Do not assume or guess the language of the relevant contracts. No force majeure clause is the same, therefore a one-size-fits-all approach will not work. Each relevant contract must be reviewed, and DLA Piper has specialist contract lawyers, experienced in such matters, who can support you with this;
- have you communicated with your customers and suppliers? The outbreak continues to affect global trade and the number of cases and countries involved is increasing, so it may be that simple communication will suffice without the need to resort to legal action. DLA Piper can provide advice and suitable language for such communications to avoid inadvertently waiving your rights, varying the contract terms or admitting liability;
- there may be other remedies available to you in addition to a force majeure claim. DLA Piper can advise you of all available options and help you determine the most suitable course of action in line with your business needs.

HOW DO YOU INVOKE YOUR FORCE MAJEURE CLAUSE?

Force majeure clauses typically set out a procedure which must be followed to effectively claim relief under the clause. You should obtain advice before invoking the clause to ensure that you have properly complied with that procedure. Recent case law suggests that failure to comply can jeopardise subsequent legal claims.

FURTHER CONSIDERATIONS

When faced with such circumstances, it is advisable to have each affected contract reviewed in its entirety, as there are likely to be several terms that are impacted, including but not limited to exclusivity, liability and liquidated damages, delivery and termination rights, change control regimes, governing law and jurisdiction. STF

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Steve is particularly sought out by clients in the public and private sectors for their strategic and high value transactions (many of which are multi-jurisdictional and/or in highly regulated sectors such as financial services). In addition to the UK Government (for which Steve recently advised on a project relating to Critical National Infrastructure), Steve's clients have included major high street clearing banks, global banks, payment service providers, educational institutions, defence companies, retailers and IT service suppliers and customers.

ADAM KELLY *is Associate, Intellectual Property & Technology at DLA Piper UK LLP. He is a commercial and technology lawyer who has a number of years' experience advising a broad range of private and public sector clients on a variety of commercial and IP matters.*

Adam has a particular focus on supply chain contracts and applicable laws, including agency, distribution, manufacturing and third party logistics. He also advises clients on structuring and documenting commercial collaborations, joint ventures, strategic partnerships and outsourcings.

FEATURE

SUBSEA CABLE SECTOR NEEDS A NEW FINANCING MODEL

How a New Funding Approach Could Release Vital Capital

BY STEVE SCOTT

A boom in world-wide data traffic has sparked the biggest construction boom in subsea cable for two decades, with a string of new multi-million dollar high-speed data highways lighting up the seabed and more big projects in the pipeline.

Tech giants including Google, Facebook, Amazon and Microsoft are leading a drive to build more subsea cables to meet mushrooming data traffic needs. These 'hyperscale' companies are pursuing the lowest 'cost per bit' and driving hard bargains with companies building, operating and leasing cable networks.

This is putting pressure on cable company finances and squeezing capital available for new investment. The bind in which the industry now finds itself warrants a fresh look at financing models which have changed at a far slower pace than other aspects of this innovative industry.

Creating a wider pool of liquidity would enable cable companies to derive maximum benefit from unprecedented demand. More specifically, there is a case to be made that adding working capital finance to the funding mix could alleviate balance sheet pressure and free much-needed capital for new investment.

There is an imbalance between increased capacity requirement and the sector's ability to invest to meet not just today's but tomorrow's demand profile. With tomorrow fast approaching, new thinking is required. Against this backdrop, working capital finance is a potential solution to some of the industry's funding needs.

AGEING INFRASTRUCTURE NEEDS INVESTMENT

New investment is required as much of the cable on the seabed was built at the turn of the century and is approaching the end of its economic life (the design life of cable is 25 years, but the economic life can be several years shorter). Older cables have roughly the same operating cost as newer ones but only around one-tenth of their data capacity, which means they generate lower revenue and require upgrading to remain competitive.

The cost of upgrades can be considerable. Companies must assess a cable's age and performance when deciding whether a business case for an upgrade can be justified or whether a new build would be more cost-effective in the long term. It requires expert judgement, from both technological and financial perspectives.

In terms of capital, construction costs remain well below their peak at the start of the millennium (before the Dotcom crashed caused the market to collapse), running at roughly $25,000 per kilometer. Depending on the length and complexity of a project, a new cable can cost anywhere from $50 million to $400 million, with most recent projects at the upper end of the spectrum.

REVENUE AND MARGINS UNDER PRESSURE

On the revenue side however, the price for leasing cable capacity has not risen in line with demand. Hyperscale companies have deep financial pockets - the top five global tech firms collectively have a market capitalization of more than $5 trillion - giving them enormous bargaining clout which they have used to exert downward pressure on leasing costs.

That creates an industry conundrum over how to free capital for investment with revenue under pressure and likely to remain so. It requires bold thinking but there is every probability that companies that take a long-sighted view on allocating capital for strategic investment will enjoy longevity of returns.

It not just cables that need fresh capital, the need for investment encompasses the wider supply chain - from factories to the cable shipping fleet. Factories and fleets are working flat out as demand outstrips supply. The cable fleet is ageing, with many vessels over 20 years old which means they will soon need to be refurbished or replaced. It takes two years and around $150 million to build a new ship, so investment decisions require a solid belief in future demand.

Adding to the pressure, fierce competition among companies involved in building, owning, operating and leasing cables has pared margins to the bone. Total annual spend on subsea cable is around $3.5 billion currently but is set to increase as demand continues to rise. SubTel Forum predicts that global subsea cable capacity will increase by up to 143% from 2017 to 2022.

Meantime there is no sign of a battle for market share abating, which is why, despite being in the middle of the biggest boom in demand for decades, the cable industry is feeling the pinch and in need of new financing options.

A NEW FINANCING CONCEPT

The concept of working capital finance is fairly new to the subsea cable sector although it is a financing model that has been successfully applied by some of the world's biggest companies as well as smaller ones across a range of sectors, including telecoms, IT, shipping and construction.

My experience in other industries, particularly in data centers, gives me confidence that it presents a pragmatic potential solution to funding issues facing the subsea cable sector. It is not a silver bullet, nor would it be appropriate to all funding situations. However, there is clear potential for working capital finance to become an element in refinancing packages, sitting alongside traditional forms of funding such as debt or equity, potentially replacing more expensive funding sources such as mezzanine debt. It could help to layer development costs.

SECURING LOWER COST FUNDING

There are parallels between issues facing the cable sector and onshore data centers, with stark similarities in capital structure, particularly the high cost of construction and low build risk. The most important similarity is that they serve essentially the same client pools of telecom and IT clients and sell capacity to multiple lessees for substantial periods.

This provides an opportunity to use working capital finance to monetize contracted customer obligations on one cable, freeing funds to invest in new cables. The way it works is that secure long-term capacity contracts (or IRUs - indefeasible rights of use) generate invoices or accounts receivable and these are monetized, providing revenue sooner than would otherwise be possible.

The core purpose of working capital finance is to unlock capital by enabling businesses to get paid ahead of schedule and to secure funding at a lower cost than traditional asset-based lending.

LEVERAGING CUSTOMERS' CREDIT RATINGS

The working capital finance provider buys invoices (called receivables) and packages them into short-term bonds which it sells to investors. Sophisticated risk analysis soft-

FAST FACTS ON SUBSEA CABLE:

- Approximately 99% of global telecoms traffic is carried via subsea cable
- Around 378 subsea cables worldwide span a total of 1.2 million kilometers
- Subsea cables transmit data relating to $10 trillion worth of transactions every day
- The first subsea cables were installed in the 1850s to c reate telegraph networks
- In 1858 it took 16 hours for a telegram from Queen Victoria to reach US President James Buchanan via Transatlantic cable
- In 2020 Google's Dunant cable will begin transmitting data at 250 terabits per second
- Dunant could transmit the entire US Library of Congress content 3 times per second
- Big tech/hyperscale businesses account for more than 50% of new cable demand
- Google was the first non-telecom operator to invest in a major intercontinental cable
- Google has invested in 14 subsea cables including 3 major new ones as solo investor

(Sources include: Reliability of Global Undersea Cable Communications Infrastructure report, Ciena, Global Marine Systems, Google Blog)

ware is used to assess credit-worthiness. Companies supplying goods or services to customers with strong credit ratings can gain by having their risk rating based on the credit-worthiness of their customers. They can then leverage their customers' credit rating in a way that lowers funding costs.

Rates for working capital financing can be as low as 1% of the outstanding invoice, which is two to three times lower than traditional asset-based lending, making them a competitive element in a refinancing package. There is also scope for off-balance sheet treatment of receivables that can sit alongside other debt structures, giving a company greater financial flexibility. That is the principle in a nutshell. It is an industry in which Greensill is a global leader, providing $150 billion of working capital in the last year to more than 8 million customers and suppliers in more than 175 countries.

HYPERSCALE IMPACT

Taking a wider look at the factors driving cable demand and reshaping the sector can help create a roadmap for future investment.

A key fact is that, directly, jointly and through consortia collaboration, hyperscale players now account for more than 50% of new cable construction and their influence is set to grow. Next year more than 60 new subsea cables are planned to enter service, according to research firm TeleGeography. Based on plans announced, single ownership cables (the preserve of hyperscales) are forecast to account for 67% of new builds by 2022.

Hyperscales want to harness booming demand for rich content and e-commerce as well as opportunities created by the Internet of Things (IoT) and rollout of 5G services – and for all of these subsea cables is a conduit to riches.

Subsea cables already transmit data relating to $10 trillion worth of transactions every day. With around 99% of the world's internet traffic now transmitted across oceans, subsea cable has become the cardiovascular system of the internet. They need a vibrant cable industry to keep the heart of the internet beating.

SHAKE-UP IN FUNDING MODELS

The relentless march of hyperscale companies into cable has prompted a major shake-up in funding models. Historically the industry was dominated by consortium-style investment with as many as 20 members. This model arose when build costs were higher and transmission revenues lower and wider cost-sharing was needed to get the green light for projects. Consortiums have been effective but have downsides such as protracted negotiations to get unanimous votes on expenditure plans.

Telecom companies were in the driving seat in commissioning projects until the arrival of the tech giants. Telecom companies are still very important to the industry but the balance of power in terms of opening big new intercontinental routes has tipped towards hyperscale players.

However, a hybrid joint build model has emerged with more flexibility on project decisions and varying types of partners and projects. Hyperscale companies are also active in this space. There is still a requirement for collaboration, but joint builds are viewed as less rigid than consortia. Development banks get involved in funding cable too, but are not a major influence.

While hyperscale companies have been involved in both consortia and joint builds, they are increasingly looking to fund solo projects. Their motivation is not only to secure the lowest cost per bit, but also to dictate routing, enhance security, ensure the lowest latency, increase speed of transmission and achieve better point-to-point connectedness.

Google is in the vanguard and has invested in a total of 14 subsea cables, starting in 2010. It has ramped up activity recently by funding three major multi-million dollar

DATA BOOM DRIVING DEMAND

An upsurge in subsea cable construction is being fueled by rapid growth in global data traffic. Modern cables are transmitting more data than ever before, but exponential growth forecasts mean more cables are needed to keep pace with demand.

KEY FACTS ON DATA GROWTH

- 30 billion devices are connected to the internet – it will more than double in 4 years
- 500 million Tweets are sent in a single day
- 65 billion WhatsApp messages are sent every day
- 294 billion emails are sent worldwide every day
- Capital spend in cloud and related infrastructure is $100 billion per annum
- Today there are 500 hyperscale data centers worldwide
- By 2025 data centers will consume 20% of the world's power
- Subsea cable demand is outstripping capacity today
- Capital spend on submarine cable currently is around $5 billion per annum
- Cable capacity demand is growing at between 40% and 70% year-on-year

(Sources include: Greensill, World Economic Forum, Synergy Research)

projects: the Curie cable linking the US and Chile, Equiano linking western Europe and west coast US, and Dunant, the first hyperscale-funded transatlantic cable.

CHANGING OF THE GUARD

Besides hyperscale developments, merger and acquisition activity among the principal turnkey companies is reshaping the sector. SubCom was acquired by private equity firm Cerberus Capital in 2018, Huawei Submarine Networks was sold to China's Hengtong in 2019 and Global Marine (where I was a board member for 10 years) was acquired by US private equity firm J F Lehman in January 2020. The acquirers clearly scent profits to be made in the cable sector.

At the same time, new entrants have emerged, bringing different perspectives. Some are pursuing niche strategies such as a regional focus. Newer players include wholesalers such as StrataNet which is acquiring broadband capacity across Asia; Irish firm Aqua Comms, Seaborn, Crosslake Fibre and Deep Blue Cable. Previously, I was CEO of Deep Blue which is developing cable linking the Caribbean islands and the United States.

Some of these entrants have focused on greater connectedness, tying up deals with onshore data centers adjacent to strategic cable landing points. The dots are beginning to be joined up between different parts of the data traffic system, but how this will play out is as yet unclear.

INNOVATION DRIVING RECORD DATA SPEEDS

Of new cables coming into service this year, Google's Dunant is particularly interesting for several reasons, not least because it is going to be big – very big. It will transmit data at 250 terabits per second, using 12 fibre pairs. To give an idea of what that means - Dunant is capable of transmitting the entire digitized content of the US Library of Congress (the world's largest library) three times per second.

I've been in the industry a long time, including nine years as commercial director of Global Marine, the company that laid the very first subsea telegraph cable in the 1850s. I began as a Royal Navy engineer and it is impressive what engineering brilliance and prescient investment have achieved in the sector.

In 1858 it took 16 hours for a telegraph message from Queen Victoria to reach the US President James Buchanan - it was only 99 words, but it was considered miraculous as to send it by ship would have taken 10 days.

The sector is characterized by a constant striving to do better and go faster but that takes capital as well as a pioneering attitude and superlative engineering skills. Back in 1994, subsea capacity between Europe and the US could be measured in megabytes of data – over the coming decade that could multiply by a billion or even a thousand billion.

The push to achieve ever-increasing data capacity is relentless and solutions include adding many more fibre pairs in a single cable. Older cables may have two or four pairs, Google's Dunant has 12 and designs have already been drawn up for cable with 24 fibre pairs. Sophisticated technology known as Space Division Multiplexing has also been introduced to achieve higher data speeds.

However, the sector is now knocking its head up against a limit imposed by the laws of physics and identified by Professor Claude Shannon, thus known as 'Shannon's Limit'. In simple terms it says that there is a finite point at which the capacity available over a single fibre-optic pair cannot be increased without a degradation in signal clarity. Some of our finest engineering minds are working on potential workarounds, but this type of research and development work also requires capital.

DASH FOR SPEED

Growth forecasts are staggering. Data in the digital universe will expand to reach 44 zettabytes this year - it's hard to comprehend what that means, but according to the World Economic Forum, that is 40 times more bytes than stars in the observable universe.

As well there are 30 billion devices connected to the internet today and that will double in four years. An astonishing 294 billion emails and 65 billion WhatsApp messages are sent every single day. Considering that is just a fragment of daily data traffic, and that half the world is still without internet access, it is easy to see why the race to build more cable is urgent and requires significant investment.

To the outside world, the sector may appear to be sitting pretty, with big buyers, burgeoning demand and secure forward capacity sales. In reality, it is at a pivotal point, with exciting opportunities ahead, but requiring affordable funding to capitalize on those opportunities. In the finest tradition of the sector, a partnership approach to funding is likely to be the most effective, with working capital finance entering the picture as a new supportive funder. **STF**

STEVE SCOTT *is Managing Director and Industry Specialist in Data Centre and Subsea Cables at Greensill Capital, the global market-leader in providing working capital finance to companies. His career spans senior roles in investment banking and private equity as well as running data center and subsea cable companies, giving him a deep understanding of financial issues affecting the subsea sector and the dynamics of global data traffic. Former roles include COO of Bridgehouse Capital, CEO of Deep Blue Cable which is developing cable between the Caribbean islands and the United States, Commercial Director and board member of leading subsea cable company Global Marine Systems and Sales Director of Global Switch, which owns, operates and develops large scale data centers. He began his career as a Royal Navy Engineering Officer.*

FEATURE

MANAGING UNDERUTILIZED ASSETS

Embarking On a Path of Seeking Out Project-Based Opportunities

BY CHRIS DE JOSSELIN

The StrataNet business continues to evolve in line with its strategy plan to become the Global Telecom Infrastructure Company of the future. StrataNet's strategy of acquiring distressed subsea assets from those carriers streamlining their international business units and wanting to off-load significant levels of capacity is resonating well within the industry.

StrataNet has hit the new year running hard and continues its subsea network expansion, now with over 20 terabits of subsea cable spanning some eight different cable systems on its books. Predominantly, these assets are Asia based and plans are afoot to further build on its network in the Asia Pacific region to capitalize on the significant demand that StrataNet is experiencing for its services on the capacity buy-side. StrataNet is also exploring opportunities beyond Asia in other emerging markets such as Africa, South America and the Caribbean on a similar model.

With today's hot topics being- AI, IoT, ML, autonomous cars and 5G – we will continue to see insatiable demand for subsea capacity. With more than three billion people - roughly half of the world's population - in emerging world markets which we are focussed on, there is a high demand for connectivity that can only be delivered through subsea cables. These are the markets of our future.

With more than three billion people - roughly half of the world's population - in emerging world markets which we are focussed on, there is a high demand for connectivity that can only be delivered through subsea cables.

Our global economy will continue to be brought closer together through advances in technology - technology that can only be delivered through subsea cables. To put things in perspective, $10 trillion of daily transactions takes place across the subsea cables of the world. The e-commerce and finance industries are highly dependent on subsea cables - making them even more critical to a global economy.

Interestingly, across Asia, we know that roughly 50% of the capacity that exists on already deployed cable systems remains unused, yet we continue to see CAGR exceeding 40% year on year. Whilst the industry continues to build and in some cases over-build, StrataNet sees intrinsic value in the systems already in use, yet underutilized and is focused on extracting value from what already exists.

Many operators (globally) are saddled with a large number of underutilized assets on existing sub-sea routes. Efforts at recovering the initial often significant capital outlay have been hampered by under-equipped sales teams with limited experience selling fragmented sub-sea systems. Furthermore, the constant erosion of market prices means it is increasingly difficult to sell these assets as individual components at levels to recover the initial investment.

Operators of Sub-sea Systems have endeavored to get ahead of the demand and a number of new systems are scheduled to deploy in 2020-2024 across Asia and Trans-Pacific.

An interesting point to consider is, with the amount of new capacity coming into service, Trans Pac potential capacity will be massively disproportional to the amount of Inter Asia capacity between Singapore, Hong Kong, and Japan, which in our opinion, is currently under-served. It is these underserved intra-Asian routes which have great appeal to StrataNet and is where our inventory 'build up' currently is focussed on.

New planned transpacific systems will be contributing close to 700Tbps of capacity over the next two to three years and will positively address the ever-rising demand for faster throughput but will also greatly contribute to price decline in the Pacific. Based on these new systems we anticipate a number of significantly underutilised (possibly distressed) systems on that route by the mid 2020's which will force operators to look at alternate commercialisation models to break even on the investments. This is something that StrataNet firmly has its eye on and is poised to capitalize on as these assets become 'available'.

This trans-Pac overbuild should also spur on additional investment in new systems on the thickest routes in Asia: the 'triangle' between Singapore, Hong Kong, and Japan. With the current Asia–US forecast demand and the current

moves being made by Chinese content players reaching into South East Asia to grow their businesses, intra-Asia is a long way from being over-serviced with capacity so we are seeing excellent opportunity to sweat these existing cable system assets to service demand due to the planned build schedules not being aligned (trans-Pac systems will come on line much sooner than new intra-Asia systems to provide 'matched' new end to end capacity.

OPERATOR PARTICIPATION WITH STRATANET

Selected Asian operators are being extended the option to monetize their available underutilized inventory and participate with Stratanet as a strategic partner. By doing so, they solve an immediate problem of missed revenue on existing assets, offset ongoing Operations and Maintenance costs, enter a commercial framework that address future increases in costs from system upgrades and have a potential to receive a share of profits as Stratanet successfully sell the capacity to their global customer base.

UNDERSERVED MARKETS WILL EXPEDITE GROWTH

Beyond large-scale capacity acquisition and sales, Stratanet has also embarked on a path of seeking out project-based opportunities which are congruent with StrataNet's existing asset base, such as new subsea and terrestrial builds which will complement the undersea assets held by StrataNet. Currently in play, are some ~$200m worth of projects ranging from Thailand to the Caribbean which are in development phase.

As a consequence of this project-based activity and to support the continued growth of the core business, StrataNet has just commenced its series B capital raise and will also establish a dedicated project finance facility exceeding $250m to progress selected capital projects and other strategic asset acquisitions.

Growing the business is not without challenges and having the right resources in place to further execute on this ambitious strategy has resulted in StrataNet building out its management team. Recent new hires include our new CEO, Chris Wilson. Chris is well known in the telecommunications industry and has over thirty years of experience in building and growing telecom and data centre businesses across the Asia Pacific region. With Chris Wilson moving into this role, I stepped aside as CEO and commenced in the newly created role of Chief Commercial Officer. In the function, Chris will focus on strategic supply, project, M&A and capital raise initiatives working closely with the incoming CEO on the continual growth of the business. Chris will remain an active and a key member of the senior management team and will retain his position on the Stratanet Board.

With the current Asia–US forecast demand and the current moves being made by Chinese content players reaching into South East Asia to grow their businesses, intra-Asia is a long way from being over-serviced with capacity

Additionally, Steve Scott has formally stepped in as Chairman. Steve has been working as a strategic advisor on a part time basis to Stratanet for the past 18 months and we are now pleased to confirm his appointment to the board of directors in the role of Chair. With these new additions, plus others, we have the utmost confidence that our skill set on the M&A side of the business is well and truly in safe hands.

With our new leadership team in place, StrataNet's strategy for 2020 encompasses:

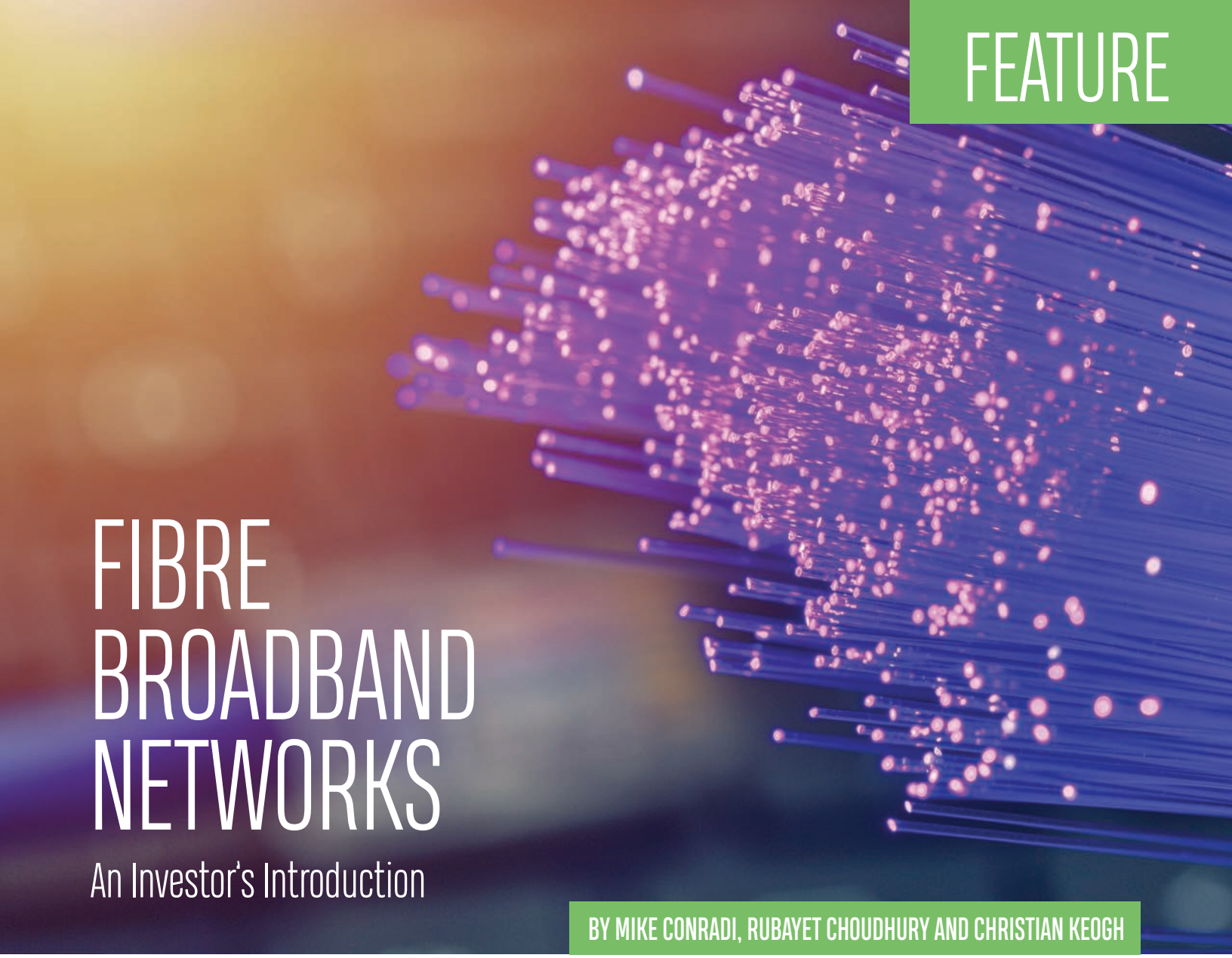
- Acquiring additional distressed assets from telecom players looking to exit the international wholesale market
- Further developing key projects such as subsea and terrestrial builds along with cable station and data centre developments in emerging markets.

StrataNet sees a bright telecom infrastructure future ahead indeed. STF

CHRIS DE JOSSELIN *is Executive Director and former CEO of StrataNet Group Limited, Hong Kong based subsea fiber business focused identifying, acquiring and integrating various telecommunications assets to create a highly resilient and expansive network across Asia and into the USA.*

Chris has over 20 years of ICT sector experience covering sales, operations and corporate strategy he gained working across a mix of tech start-ups and large multinational companies.

After kicking off his career as an electronic engineer in the Royal Australian Navy, Chris spent a few interesting years implementing some of Australia's most secure networks for the Australian Government before successfully launching numerous technology solution businesses supporting Defence and Intelligence, Oil & Gas and Healthcare sectors.



FIBRE BROADBAND NETWORKS

An Investor's Introduction

BY MIKE CONRADI, RUBAYET CHOUDHURY AND CHRISTIAN KEOGH

Infrastructure and institutional investors are increasingly turning their attention to digital infrastructure assets and the global rollout of fibre broadband. Fibre-to-the-home in particular is seen as an essential component of digital transformation and as providing a large pool of investment opportunities.

Though the sector has traditionally been dominated by telecoms players, recent years have seen more interest and deal activity from infrastructure investors and their lenders.

Investments can take a number of forms, such as individual projects underpinned by project finance structures and bank debt, or through equity investments in specialist fibre developers. This has led to buoyant M&A activity. Recent examples include:

- the sale of a 50% stake in Covage (an owner of 45 European networks) by Cube Infrastructure to Altice Europe (which comprises several infrastructure funds managed by AXA Investment Managers, Allianz Capital Partners and OMERS Infrastructure); and
- the sale by TalkTalk of its subsidiary FibreNation (owner of UK networks) to CityFibre (owned by funds managed by Goldman Sachs infrastructure fund and Antin Infrastructure Partners).

DLA Piper acted for Cube Infrastructure and TalkTalk on those deals.

All this activity is unsurprising. Infrastructure investors are increasingly categorising this asset class as „core" infrastructure (in the case of PPP deals where payments are paid or guaranteed by government) or, at the very least, as „core+" where there are elements of market risk. Depending on how a project is structured, this asset class could satisfy many of the criteria investors are looking for, such as:

- high barriers to entry;
- long-term and stable returns;
- recognised and established technology; and
- transparent and stable regulatory environments.

Various rollout strategies and business models can be used for the build and rollout of a fibre network. For example:

- a mass residential build v enterprise-focused builds covering metro areas or business parks;
- targeting defined coverage areas where there is less competition v taking a more widespread coverage strategy; and
- a rollout done on an entirely commercial basis v with public support of some kind.

KEY ISSUES FOR A NETWORK ROLLOUT

The strategy for network rollout and the inherent characteristics of fibre-to-the-home builds can affect whether an investor can achieve a stable long-term income stream. Here are some of the issues:

- **Timing considerations.** It takes time to build a fibre network, including building out network coverage to scale to reach more customers. The rollout of a mass residential fibre network can take longer, delaying the provision of access to customers, and also the realisation of investment. On the other hand, a more targeted enterprise build or a business park rollout can be more self-contained and speed up realisation of your investment. Perhaps easiest of all is to incorporate a fibre build into a new residential or business development.

- **1520 year payback periods.** Fibre networks typically have a lengthy payback period given the high construction costs - perhaps 1520 years.

- **Asset life.** The expected useful life of the typical optic fibre asset is as much as 20 years or more. Such a long tenure leads to the possibility that equity investors could seek to maximise the upside after the repayment of bank debt. Though fibre is generally more reliable than the copper alternative, this can still mean that repairs might be needed over time, and it's also likely that significant technology upgrades will be required during the period.

  Usually, these upgrades can be achieved without needing major new civil engineering works (because the equipment used to „light" the fibres can be upgraded without the need for work on the fibre) and this should be modelled as part of the overall project costs.

- **Market Risk and Subsidies.** Depending on the type of rollout, there may be significant market risk - i.e. no assured base of customers for the network after the build is complete - especially if building out a fibre network in areas already covered by incumbent (or other) providers of fibre, where there may be competition. This means that investors will typically have to accept a significant degree of risk when compared with other types of infrastructure asset, such as a power station, where very long-term offtake agreements can be reached.

  More targeted fibre network builds - such as rollouts to business parks, new developments or specific enterprise locations like supermarkets and retail sites - may mean more certainty of income after the build is complete. It may be possible in these cases to get large enterprise customers to sign up for at least medium-term contracts as pre-sales in advance, in order to guarantee some income stream that may improve the bankability of a project for lenders. If the build is in a remote or rural area it may also be possible to obtain a public subsidy of some kind - subject to state aid rules - which can mitigate this risk significantly.

- **Retail competition among fibre providers is based largely on price.** Competition in the retail fibre market is largely commoditised: based on price, and retail prices for the same amount of bandwidth can change, perhaps quite significantly over the life of the asset. Due to long-term payback periods, this can increase the uncertainty of

More targeted fibre network builds - such as rollouts to business parks, new developments or specific enterprise locations like supermarkets and retail sites - may mean more certainty of income after the build is complete.

returns. Despite this, the average revenue per user for fibre broadband in Europe has been roughly stable at an average of EUR22 per month over 2011-2018.[1] As technology improves, customers expect greater bandwidths, meaning there will be a need for upgrades to the network infrastructure - but they also appear willing to keep paying a roughly constant amount.

- **Technology obsolescence risk and 5G.** Fibre is the current gold standard, and the current focus in many markets is on upgrading networks to full fibre (i.e. fibre to the home, from the exchange all the way to the end user's premises, rather than fibre to a street cabinet and then legacy copper for the last stretch).[2] It seems unlikely that a newer and better technology will be developed in the next 1020 years to replace it. That said, 5G mobile technology may represent a threat to elements of the retail broadband market - customers may find they can use 5G instead of a fixed connection to their homes. Although this is a risk to some fibre business models (especially those focusing on the residential market), even 5G will still require much more fibre to be built,[3] albeit to serve multiple 5G base stations rather than homes. It's also possible that the global trend in recent years of rapid increase in demand for fixed bandwidth to homes and offices will mean that even 5G will not be a suitable substitute for a fixed connection (which will likely always be faster and more reliable than wireless ones).
- **Regulatory dynamics.** The regulatory background is critical to a successful investment and investors will need to understand thoroughly both the position and likely changes over time. In the UK, for example, OFCOM has indicated it will, in most areas of the country (those said to be "potentially competitive"), require Openreach to offer a basic "anchor" broadband service at a regulated price (see our blog on fibre regulation in the UK). The level of this price and the areas in which it applies could have a significant impact on a competing provider's business case.

  Regulation can also assist with build costs - for example, where an incumbent is obliged to offer access to its ducts and poles at a regulated price, this can mean a new fibre company can build out their network more cost-effectively and quickly. Of course, this also reduces costs for competing networks too, reducing the advantage that would otherwise be obtained by building a new network. In the EU, it may also be possible to take advantage of the (very complex) rules on „co-investment" so as to enter into a partnership with an incumbent operator to build a new fibre network and then have that new network protected from access regulation (see our blog on co-investment models for broadband infrastructure).
- **Wholesale/retail.** The owners of a fibre network will need to decide whether to offer wholesale or retail services, or both. If they offer retail services, they will need to engage a sales and marketing team and invest in customer support. It could be difficult to do this successfully, especially if they're trying to do so over a large area of the country. Offering wholesale services, on the other hand, can eliminate the need for these elements, and can reduce market risk (especially if combined with a medium-term financial commitment from a retail partner) - but naturally this is likely to mean lower returns overall, because some of the value will be captured by the retailer.

Though some of these features could be new to some investors into the sector, we expect that the increasing sophistication among infrastructure investors coupled with the growing demand for rapid internet speeds to power the digital transformation will mean that an increasing number of infrastructure investors will seek to enter the market or consolidate their existing interests, particularly through M&A transactions. **STF**

MIKE CONRADI *is Partner at DLA Piper and co-chair of the international telecoms practice. He is rated as one of the leading telecoms lawyers globally by all the various guides and is the editor of the Communications Law Handbook.*

Mike has worked on more than 60 engagements concerning submarine cables over more than 20 years.

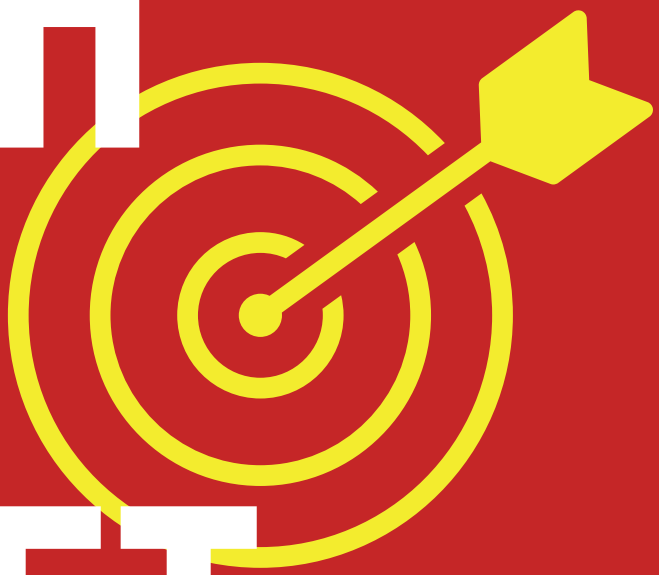
RUBAYET CHOUDHURY *is Legal Director at DLA Piper and an experienced lawyer advising on high-profile energy and infrastructure projects globally. Whilst he has substantial experience of advising on project finance, PPP transactions in a range of sectors, he currently focuses on the development, financing and acquisition of renewable energy, energy efficiency and infrastructure projects which involve cutting-edge technology.*

CHRISTIAN KEOGH *is Associate at DLA Piper and has experience in outsourcing and procurement projects for technology and telecommunications clients on the customer and supplier side, including for Stulz Australia and NBN Co Limited.*

NOTES

1. Statistica (2019), average revenue per user of fixed broadband in Europe from 2011 to 2018
2. For example, the UK government has set a goal of achieving full fibre coverage by 2033
3. Ciena, 5G Wireless Needs Fibre, and Lots of It

REACH YOUR TARGET



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SO, YOU WANT TO LAY A CABLE

Going from Proposal to Permitted

A FABLE BY STEPHEN NIELSEN

I had a bit of a windfall lately. A new, previously absolutely untapped market to the submarine cable industry became open to the possibility of a new cable route in the Atlantic Ocean; the lost city of Atlantis is finally ready for hi-speed internet.

I won't lie. I'm fairly new to the installer side of the industry, as I've mostly just reported on it as a SubTel Forum journalist. That said, I'm not going to look a gift horse in the mouth, so I immediately began taking all the steps necessary to get my first new cable project underway.

So, here I am, my system is designed. I have a tentative landing sight to link with a terrestrial system that feeds Atlantis' largest city, the Council of Elders has my award ceremony scheduled, and I even have some real prospects for financing. Things are going about as smoothly as I could have possibly imagined and I'm hoping my new cable could hit the water in under 12 months. Then, suddenly, I hit the unique install challenge known as "Permitting."

Now, I won't dive into the minutia of the various departments of the Atlantean Oligarchy this ultimately involved. Instead, let's talk about how this led me to finding out that my experience was hardly unique (besides the hitherto lost civilization).

In the international industry of submarine cables, each country like Atlantis has its own set of permits required for the many situations that can arise when planning a new system. Some environmental, some territorial, others financial. The big take away is that organizing all of the permits to allow a project to progress can take significantly longer than you would expect. In fact, system suppliers might agree that permitting is one of the most time intensive aspects of installing a new cable, even if it can be done concurrently with other aspects of the project.

The big take away is that organizing all of the permits to allow a project to progress can take significantly longer than you would expect.

The permitting for a new system can be time consuming and costly, even beyond the Pillars of Heracles. It needs to be included very early in the planning stages of a project to properly avoid any issues down the line. For instance, cables in the U.S. can be subject to multiple government agencies, including, but not limited to, the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, the EPA, NOAA, state departments of Environmental Quality/Protection, archeological or cultural preservation bureaus, or other local agencies. That's in addition to occasions where new system projects are under the scrutiny of non-governmental groups, like environmental activists, or representatives of local populations.

As preliminary planning is completed, identifying possible landing points, additional research must be done to identify any local agencies and any possible permits required in that area. Construction plans must be kept flexible as these are identified so that adjustments can be made. Collecting all this technical, commercial, and regulatory data is generally referred to as the feasibility study.

The second step in this permitting process is the, sometimes complex, process of the actual paperwork needed for the permits, navigating the bureaucracies of multiple agencies. First must come the desktop study, to identify the agencies' jurisdiction, regulatory requirements, and any seabed user requirements. This will also determine more accurate time and cost estimates for the project budget and scheduling. At this point, any restricted areas for cultural or environmental reasons will come to light, allowing re-engineering of the system to work around them. This is the point where you'd contact local Atlantean agencies to find out which permits, licensing agreements, zoning waivers are required.

It's worth mentioning, however, that even the most comprehensive desktop study will only give a rough estimate of total costs and what permits will be required. Again, each agency has its own bureaucracy and each country has its own laundry list of authorities that will have requirements.

To give an idea of the kinds of agencies we're talking about, many countries have four general categories of necessary permitting:

1. **Operator's License** – the license to operate a submarine cable system
2. **Permits in Principle** – the permissions or approvals to install a cable system within a country's territorial waters, possibly its EEZ, and along a terrestrial route to the Terminal Station
3. **Operational Permits** – those permits necessary for survey, installation, and maintenance operations by the installer/contractor who is employed onsite (whether marine or terrestrial) to accomplish day-to-day operations
4. **Permission from other Marine Users** – includes crossing permissions from other cable and pipeline owners.

Having successfully received my permits from the Atlantean Oligarchy, re-engineered my planned system to avoid their National Kelp forest, and negotiated permissions with the local Kraken Ranchers' Association, my system is ready for install. When all is said and done, permitting took more than a year.

After checking around, I've found that a year or more is about the average, highlighting exactly why planning for it from the beginning is absolutely necessary, and my mistake by not doing so added at least six months to my entire project. It's a mistake I absolutely won't make when planning my next system.

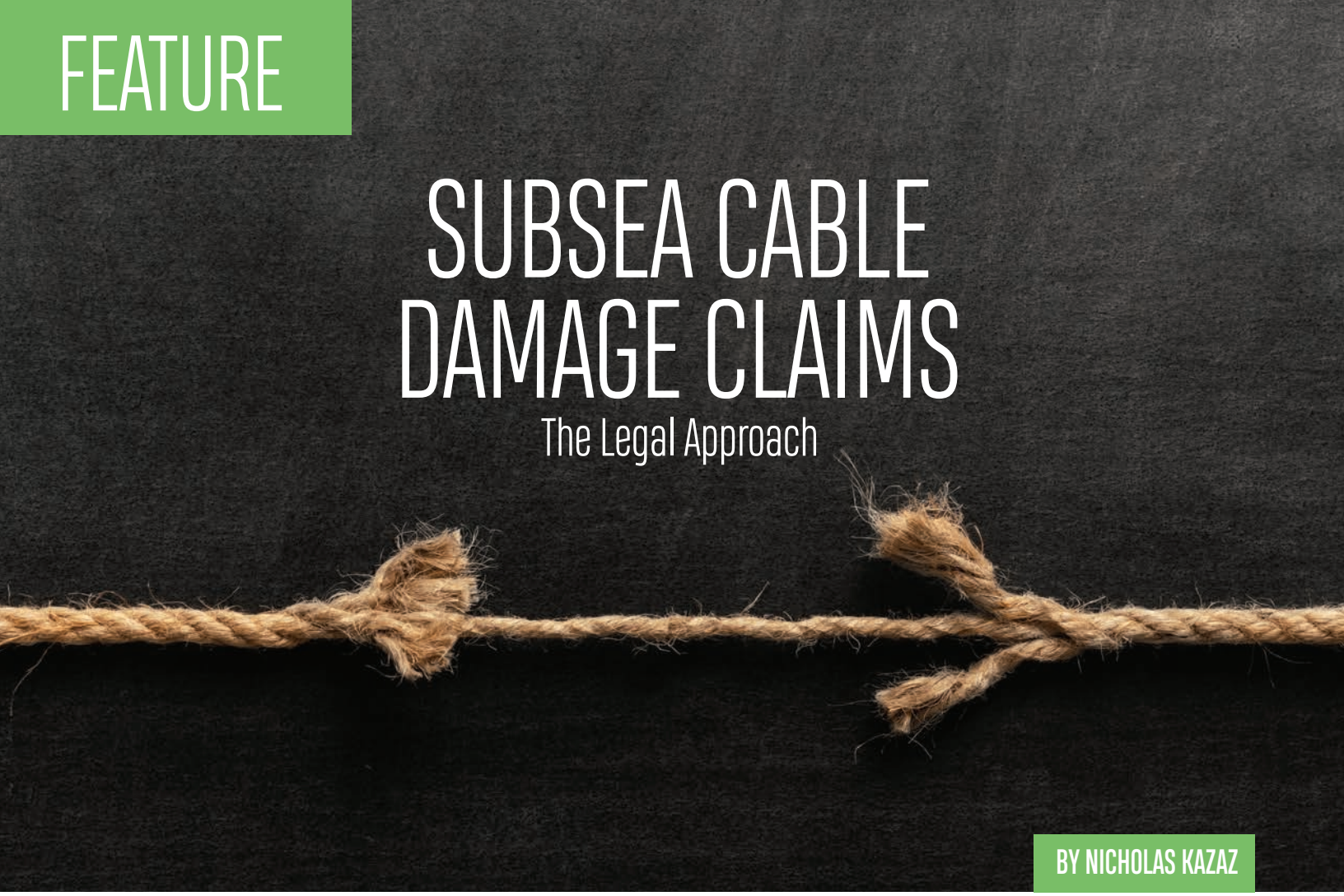
I hear Avalon is looking to move to a fiber optic cable! STF

A graduate of the Virginia Commonwealth University School of Mass Communications, **STEPHEN NIELSEN** *has been a Staff Journalist for Submarine Telecoms Forum since 2012. He was the Life Section Reporter for Winchester Star in 2014 to 2015, and Staff Writer for Capital News Services in 2013. He was a Finalist for Society of Professional Journalism's Mark of Excellence Award and has supported blogging and streaming at multiple PTC and SubOptic conferences. Of late, he is a 6th grade English teacher for young budding scholars in Loudoun County, Virginia.*

FEATURE

SUBSEA CABLE DAMAGE CLAIMS

The Legal Approach



BY NICHOLAS KAZAZ

Subsea cables have a long history reaching back almost two centuries, starting with the first international subsea cable, which was laid across the English Channel in 1850. Over recent years, the number of cables has considerably increased. In a world which relies heavily on digital telephony, internet, and the transmission of electricity, subsea cables have gained an important and essential role. 97% of global communications are transmitted by subsea cables, and there is no alternative to using them as satellite technology cannot effectively handle the communication requirements of the modern digital economy and society. Financially, the cables are essential, carrying over US$10 trillion of financial transfers and processing some 15 million transactions daily[1].

Whilst the majority of recently installed cables are buried beneath the seabed, a percentage of them are unburied, which risk being scoured out by tides and currents, or being snagged by fishing gear or ship anchors. Crucially, in recent years there have been an increasing number of claims for cable breaks, which can be expensive and disruptive. This article focuses on why those claims arise, and how a cable owner or operator may pursue those claims.

HOW ARE SUBSEA CABLES DAMAGED?

FISHING VESSELS

Fishing vessels with towed gear, bottom and beam trawls, and dredges are one of the most common causes of damage to subsea cables, and account for over a third of all cable damage[2]. Although there was no damage to a subsea cable in this case, the loss of the trawler WESTHAVEN in 1997[3] remains a stark illustration of the risk posed by obstructions on the seabed. One of the WESTHAVEN's trawl doors passed under, and subsequently became snagged on, an oil pipeline in the North Sea. Whilst attempting to free the net, the vessel capsized, and all four crewmembers lost their lives. This casualty followed a succession of fishing vessels sinking in the late 1980s including GAYLORD, MHARI L and GREY FLAMINGO, which were lost when their gear became fouled on subsea cables, and resulted in damage to the cable systems themselves.

SHIP ANCHORS

A large proportion of reported accidents that have resulted in damage to subsea cables relate to anchors, including from fishing vessels, and other merchant vessels such as tugs and anchor handlers. Statistics show that anchors account for nearly a fourth of subsea cable damage.[4] Most of these accidents tend to be caused by fishing or merchant vessels anchoring outside the designated areas, and recent fault records show that merchant ships often fail to secure their anchors securely during short passages.

INTENTIONAL AND MISTAKEN CUT

In the 2014 Canadian case of The REALICE[5], a fishing vessel's nets snagged on a fibre-optic subsea cable. Thinking that the cable was non-functioning, and intending on freeing the gear, the skipper raised the cable to the surface and cut it with a chainsaw. The skipper was found liable for damages of almost US$1 million.

There was also an instance of intentional cut in 2013, when the Egyptian navy arrested three scuba divers alleged to have attempted to cut the SeaMeWe-4 subsea cable off the port of Alexandria, which provided one-third of all internet capacity between Europe and Egypt.[6] The cut reportedly caused a drop of 75% to internet speeds across Egypt.[7]

NATURAL CAUSES

Other typical causes of damage to cables include the scraping of cables against rocky surfaces, natural disasters, and seabed movement.

SHARK BITES

Although an uncommon cause of damage, there have been instances where sharks have damaged unburied subsea cables. It is understood that sharks are attracted by the cables' electromagnetic fields, which they confuse with fish or other prey. Several of these attacks have been recorded by subsea monitor cameras. Despite the fact that attacks are infrequent, to limit the risk of damage, it has been reported that companies, including Google, are choosing to reinforce their cables as a precautionary measure.

THE CONSEQUENCES

The financial consequences of a subsea cable break can be serious and very expensive for all parties involved. The cost of repairing a subsea telecoms cable averages US$1 million[8] and can be up to US$13 million for a power cable.[9] Given their importance, the consequential losses resulting from cable breaks are equally significant. For instance, in 2017 a cable break led to loss of power to the Isles of Scilly, while in 2016 a break severed Britain's main power link with France. If a ship is the cause of such damage, and the cable operator can prove negligence of that ship, then the operator may well succeed in recovering substantial sums in damages from the shipowner.

Loss of connectivity and data access, or reduced connectivity, is a typical consequence of a cable break to a fibre optic or telecoms systems cable. This can affect entire continents, as mentioned in the example above and is a reasonably common occurrence. Most recently, in January 2020, a breakage occurred to the West Africa Cable System (WACS) due to dense and heavy sediment. WACS runs along the coast from South Africa to the UK, and major outages were caused, leaving the majority of South Africa with slower access speeds for over a month until the system was finally repaired.

As demonstrated by the WESTHAVEN sinking, at worst, where a ship's fishing gear snags on subsea infrastructure, it can result in loss of life and of the ship itself.[10] In the case of the WESTHAVEN, the Marine Accident Investigation Board concluded that attempting to pull the gear free, rather than the snag itself, caused a loss of stability and ultimately the capsize of the vessel. The consequences can therefore be very serious.

THE IMPORTANCE OF EVIDENCE

When a cable has been damaged, it is essential for the cable operator to ensure that all precautionary steps are taken to preserve and collect evidence. Should the operator decide to bring a claim against the party that has caused damage to a cable, such evidence will be extremely valuable for the purpose of establishing the factual background to the case. The starting point is to collect real-time shore side signal monitoring to establish exactly when and where the break occurred.

Typically, following an incident, the cable will be inspected and/or repaired with the assistance of Remotely Operated Underwater Vehicles (ROVs). All footage taken by the ROV should be retained and preserved as the ROV footage will be relevant if a claim is issued against the party that damaged the cable. Images will show where the cable was positioned when the damage occurred and such information may be crucial in cases where the location of the cable is in dispute (e.g. where a cable is not in the position stated on the relevant charts). Accurate plotting data should also be included in the video.

Similarly, vessel tracking information is extremely valuable to determine which ships were present in the area when the damage occurred. To this end, cable operators should, where possible, gather Automatic Identification System (AIS) data as it may enable them to identify the party responsible for the damage. It is important to note that not all ships keep their AIS on and some vessels smaller than 15m are not equipped with AIS systems.[11] In the case of UK flagged fishing vessels, even if they are not transmitting AIS data, they will be transmitting Vessel Monitoring System data to the Marine Management Organisation. We have in appropriate cases obtained data from them by way of Freedom of Information[12] requests.

Once the potential culprit ship has been identified, the cable operator will need to seek disclosure of the navigational data held by the ship and the shipowner, such as data located on the

Electronic Chart Display and Information System (ECDIS), the Voyage Data Recorder (VDR), and in the case of a fishing vessel, on the fishing plotter (also an electronic system).

HOW CAN A CABLE OPERATOR BRING A CLAIM AGAINST A SHIPOWNER FOR CABLE DAMAGE?

WHERE TO BRING A CLAIM?

Where a party wishes to issue proceedings against a prospective defendant shipowner, the first step will be to determine which country has jurisdiction to hear the dispute. The question as to whether a specific country will have jurisdiction has to be considered in accordance with private international law.[13]

Where the prospective defendant is domiciled in an EU member state, or in a state that is a party to the Lugano Convention, the general rule is that the defendant should be sued in the country where it is domiciled. As a derogation to this rule, pursuant to Article 7(2) of the Brussels Regulation Recast[14] and Article 5(3) of the Lugano Convention[15], the defendant may be sued in the place where the cable damage has occurred.[16] However, some jurisdictions are reluctant to derogate from the general rule. For example, the English courts have interpreted the derogation narrowly, and the Court will have jurisdiction to hear the matter only where the damage has occurred within UK territorial waters.[17] In those circumstances, claims relating to subsea cable damage are within the jurisdiction of the English Admiralty court. However, even if the damage occurs within the UK's Exclusive Economic Zone, the jurisdiction of the English courts will not necessarily be engaged and the defendant's domicile rule will apply. Brexit is likely to affect the legal framework in the future.

If the prospective defendant is domiciled outside of the EU or in a state that is not a counterparty to the Lugano Convention, the English Admiralty court will not have jurisdiction unless the parties intend to rely on in rem jurisdiction, or some Act of Parliament or other regulation, which explicitly gives jurisdiction to the English courts. Accordingly, to engage the jurisdiction of the Admiralty court, the damage must occur within the UK territorial waters, alternatively, the claim must be brought on an *in rem* basis.

Finally, it always remains open to the parties to agree to English jurisdiction.

LIMITATION OF LIABILITY

Tonnage limitation is a form of limitation of liability, which is designed to limit the shipowner's liability based on the gross tonnage of the vessel.[18] Where a vessel causes damage to a subsea cable, the maximum liability of a shipowner will be calculated on the basis of Article 9 of the LLMC 1996, which provides that *"the limits of liability…shall apply to the aggregate of all claims which arise on any distinct occasion."* In order to determine the extent of the limitation of liability, it is essential to ascertain whether the damage to the cable has been caused by a "distinct occasion". The answer to this question will depend on whether the damage was the result of separate events, which will vary on a case-by-case basis.

A cable operator may find it very difficult to avoid the consequences of tonnage limitation and the effect it will have on their ability to seek compensation following damage to a subsea cable. It is extremely difficult to break limits, and there are only limited occasions on which this has been possible previously.

ARREST

Where a cable operator has suffered damage to its subsea cable, it may be able to arrest the ship responsible in order to obtain security for its claim. This is available at the outset of the claim and avoids the uncertainty and potential difficulty of eventual enforcement of a court judgment against a defendant in a foreign jurisdiction.

A cable operator wishing to arrest a vessel should be mindful of the potential costs that the arrest may involve. For example, the arresting party will be responsible for the costs of keeping the vessel arrested and those costs would most likely only be recouped upon the judicial sale of the vessel, which may take place at a later stage, leaving the operator liable for the costs.

However, it is usually unnecessary to carry out an arrest, as a shipowner's insurers (their Protection and Indemnity Club, known as a "P&I Club") may put up a letter of undertaking on the basis that the operator agrees not to arrest the ship.

CIVIL LIABILITY

Civil proceedings may be brought against the party allegedly responsible for the damage to the subsea cable. To be successful, the claimant operator will have to show the owner of the ship failed to comply with its duty of care causing losses that were reasonably foreseeable. As suggested above, it is likely that in order to demonstrate the breach of duty occurred, a considerable amount of evidence will be required. From the shipowner's perspective, a possible defence would be to claim that the cable operator failed adequately to bury or protect the cable, in other words, that it contributed to the negligence.

A civil liability claim is likely to rely heavily on factual and expert evidence. It is essential that where damage has occurred and that claim is reasonably contemplated, the ca-

ble operator takes all the precautionary steps to ensure that evidence is preserved and that the evidence gathering process is carried out adequately. The English courts can order a shipowner to provide access to the ship for a survey to be undertaken and to preserve contemporaneous documents.

CRIMINAL LIABILITY?

Aside from civil liability, damage to subsea cables can expose a shipowner to criminal liability. Under English law, the Submarine and Telegraph Act 1885 permits the prosecution of persons who deliberately or negligently damage cables. The high burden of proof has meant that few, if any, reported prosecutions have been brought.[19] However, in light of substantive technological advances allowing for the identification of accused ships, and the scale of damage caused by breaks, we may see future prosecutions brought against shipowners.

THE FUTURE

Although this article has focussed predominantly on claims a cable operator may bring against a shipowner, it is worth considering briefly that there may, in the future, be potential claims against individuals, in particular cyber hackers.

In a Policy Exchange report in 2017, Rishi Sunak MP outlined the considerable risk in cyberspace of attacks on network management systems, quoting Michael Sechrist, a former International Relations Associate at the Harvard Kennedy School:[20]

> *"An attack on the cables' control systems could devastate the world's economies – presenting a different kind of internet 'kill switch' altogether – shutting down world commerce, and doing it all with the click of a mouse."*

In this modern age, subsea cable systems are vulnerable to interference by hackers, who could effectively shut down large portions of data traffic in multiple states causing mass disruption. The legal implications of such claims are beyond the scope of this paper, but it is anticipated that a cable operator would be entitled to sue the hacker for damage caused.

As for the three scuba divers who allegedly damaged the SeaMeWe-4 cable in Egypt, it is unknown whether civil claims were brought by the cable operators against those individuals, and the case remains shrouded in mystery.

Cable damage claims are by their nature multi-jurisdictional, and require a strategic approach to be taken by the parties involved and their lawyers, bearing in mind the various jurisdictions potentially involved. As the number of incidents of cable damage increase, cable operators should ensure at the outset of any claim that they adequately collate the relevant evidence as contemporaneously as possible. STF

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REFERENCES

1. Rishi Sunak MP, 'Undersea Cables: Indispensable, insecure', a Policy Exchange Report, 2017.
2. 'The various threats to subsea cables' (Ultramap) <www.ultra-map.org/news/the-various-threats-to-subsea-cables> accessed 9 March 2020.
3. Marine Accident Report 4/98, Report of the Inspector's Inquiry into the loss of the Fishing Vessel WESTHAVEN AH 190 with four lives on 10 March 1997 in the North Sea, November 1998.
4. 'The biggest threat to subsea cables and what to do about it' (Ultramap) <http://www.ultra-map.org/news/the-biggest-threat-to-subsea-cables-and-what-to-do-about-it > accessed 4 March 2020.
5. Peracomo Inc & Ors v TELUS Communications Co & Ors (The Realice) [2014] 2 Lloyd's Rep. 315.
6. Charles Arthur, 'Undersea internet cables off Egypt disrupted as navy arrests three', The Guardian (28 March 2013).
7. Ian Thomson, 'Egyptian navy captures divers trying to cut undersea internet cables' (The Register, 27 March 2013) <https://www.theregister.co.uk/2013/03/27/egypt_cables_cut_arrest/> accessed 9 March 2020
8. Converted from GBP 750,000. See Nicholas Kazaz, 'Subsea cable damage claims – a legal perspective' (IUMI Eye Newsletter, June 2018) <https://iumi.com/news/iumi-eye-newsletter-june-2018 > accessed 6 March 2020
9. Converted from GBP 10 million to USD. See Mike McLachlan, 'Subsea cable and damage claims', (IUMI Eye Newsletter, March 2018) <https://iumi.com/news/iumi-eye-newsletter-march-2018/subsea-cable-and-damage-claims> accessed 9 March 2020
10. Marine Accident Report 4/98 (n 3).
11. Kazaz, 'Subsea cable damage claims – a legal perspective' (n 8).
12. A request made to a public authority under the Freedom of Information Act 2000.
13. S. Derrington, and J. M. Turner, The Law and Practice of Admiralty Matters, (2nd edition, Oxford University Press 2016) at para. 6.32.
14. Regulation (EU) No. 1215/2012 of the European Parliament and of the Council of 12 December 2012 on jurisdiction and the recognition and enforcement of judgments in civil and commercial matters (recast).
15. Convention on jurisdiction and the enforcement of judgments in civil and commercial matters signed in Lugano on 30 October 2007 and published in the Official Journal on 21 December 2007 (L339/3).
16. "A person domiciled in a Member State may be sued in another Member State...in matters relating to tort, delict or quasi-delict, in the courts for the place where the harmful event occurred or may occur."
17. Virgin Media Ltd v Joseph Whelan T/A M & J Fish [2017] EWHC 1380.
18. This was introduced by the Convention on Limitation of Liability for Maritime Claims 1976, as amended by the 1996 Protocol (LLMC 1996) and was incorporated into English law by the Merchant Shipping Act 1995.
19. It is suggested that the "insignificant maximum criminal penalty provides little incentive for enforcement authorities to assign full-time legal and investigative personnel to prosecute vessel owners caught damaging a submarine [cable]". See R. Beckman, 'Protecting Submarine Cables from Intentional Damage – The Security Gap' in D. Burnett (ed.), 'Submarine Cables: The Handbook of Law and Policy', (Martinus Nijhoff, 2014), p. 287, quoting S. Coffen-Smout and G. J. Herbert, 'Submarine Cables: A Challenge for Ocean Management' (2000) 24 Marine Policy at 444. See also I. Bantekas, International Criminal Law, (Cavendish, 2003), p. 102.
20. Rishi Sunak MP, 'Undersea Cables: Indispensable, insecure', (n 1) p. 26.

THE RED SEA LINE

The 1870 Cable from England to India

BY BILL BURNS AND STEWART ASH

150 years ago this summer, on 6 June 1870, the final section of the first submarine cable from England to India, known as the Red Sea Line, was landed at Porth Curnow cove in Cornwall. In continuous use as a cable landing site ever since, this is also the home of the PK Porthcurno Museum of Global Communications, pkporthcurno.com, which is celebrating the anniversary of the inauguration of this cable with a number of special events in 2020.

The genesis of the project was in December 1866, when shortly after its successful completion of two Atlantic cables in September that year, the Telegraph Construction & Maintenance Company (Telcon) had proposed to the Secretary of State for India, "That the telegraph line from Susa to Suez shall be continued from Suez to Bombay (Mumbai) by a submarine cable from Suez, or other point in the Red Sea to Aden, from Aden to Kooria Mooria, and thence, in a direct line, to Bombay."

Figure 1: John Pender in 1870

The British Government was not inclined to fund this proposal, but in 1868, John Pender (1816-96), who had been largely instrumental in organizing Telcon to lay the Atlantic cables and was at that time its Chairman, resigned from Telcon in favour of his close friend Sir Daniel Gooch (1816-89) and began to form a number of companies to manage various parts of the route to India. He retained his large stock holdings in Telcon, which then undertook to manufacture and lay the lines for the new companies upon terms which gave them a large portion of the pecuniary responsibility.

This was the beginning of Pender's cable empire, which by 1902 had grown into the Eastern & Associated Telegraph Companies (EATC). From the start, he diversified his financial risk by having each new cable project funded and managed by a different limited liability company, which he later combined into various groupings; these all came together eventually under the umbrella of the EATC. For the cable to India, the route was split into three parts: The Anglo-Mediterranean Telegraph Company (founded 18 May 1868) would link Italy, Malta and Egypt; the British-Indian Submarine Telegraph Company (October 1869) would connect Bombay to Aden and then Suez; and the Falmouth, Gibraltar and Malta Telegraph Company (16 June 1869) would complete the line to England. The complete route is shown in Figure 2.

Paying out for the Malta - Alexandria cable, manufactured by Telcon, began on 26 September 1868 from Malta by Scanderia, which carried a total of 890 nautical miles (nm) of cable. Chiltern carried an additional 55 nm of cable and completed the laying into Alexandria on October 3rd. The cable consisted of seven copper wires insulated by three layers of gutta percha and finished with a layer of hemp as bedding for 18 armouring wires. The overall length of the installed system was 943 nm.

The main section of the route, from Bombay to Aden and on to Suez, was the longest and most complex part of the project, and required the services of the Great Eastern, which had laid the 1865 and 1866 Atlantic cables as well as the first French Atlantic cable, completed in August 1869. To complete this section she was supported by four other ships, We have a detailed description of this part of

the project, as J.C Parkinson sailed on Great Eastern and kept a journal of the expedition which was published in 1870 in book form as "The Ocean Telegraph to India."

On 6 November 1869 Great Eastern left England's Portland Harbour destined for Bombay, carrying 2,375 nautical miles of cable. Her companion ships, the Hibernia, Chiltern, and Hawk, held a further 1,225nm, making a total of 3,600 nautical, or about 4,140 statute miles. Great Eastern alone had on board 5,512 tons of cable, 3,824 tons of fuel, 6499 tons of coal, and apparatus and appliances, making up a freight of 21,000 tons in weight, and including the ship, a total value of about £2 million. The route to India was via Madeira, St Vincent, Cape Town, Assumption Island, and past the Seychelles to Bombay, where the ships of the expedition arrived on 26 January 1870 after a voyage of almost three months. It is reported that the ship burned an average of 200 tons of coal per day, having taken on an additional 3,000 tons at Cape Town.

Figure 2: Map showing the full route from Porthcurno to Bombay


Figure 3: Scanderia laying the Malta-Alexandria cable

On her previous cable expedition, the ship had been painted white to reduce the heat reaching the cable stowed in her three tanks, and this had the effect of lowering the below-deck temperature by eight degrees Fahrenheit. The whitewash was renewed by her commander, Captain Robert Halpin (1836-94), shortly before their arrival at Bombay.

As had often been the case, many people wanted to visit the great ship, and Captain Halpin announced in the local press specific days on which sight-seers would be admitted by tickets purchased for a small fee, the revenues to be divided among the ship's company on the Great Eastern's return to England as a small bonus.

While at Bombay a further 8,000 tons of coal were taken on board, and Parkinson spent almost three pages describing the ill effects of loading this vast amount of fuel, of which the following is just a sample:

"It was remarked by all of us, when the Great Eastern arrived at Bombay, that she had never looked better, nor

smarter, nor cleaner since our respective acquaintanceship with her commenced; and what is she now -- a floating coal-hole. The rather obtrusive whiteness of her sides has given way to a dirty hue like the face of a miller who has been up a chimney."

He also complained about the sulphurous fumes generated by the combination of silica and mineral pitch which coated the outside of the cable to discourage the teredo navalis (or "shipworm") from boring through the hemp covering and gutta percha insulation and compromising the insulation integrity of the cable. The spiral-wound "teredo tape" of thin brass would not be invented for another ten years.

On 7 February 1870 Chiltern laid the shore end at Bombay with the aid of a local Government steam-tug towing a barge, which carried 2.5 miles of heavy double armour cable from the ship as close to the landing point as possible in the shallows. From there it was dragged ashore by barge-men waist-deep in water and installed in a trench leading up to the cable house, then tested back to the ship and proved good. Parkinson provides this description of Chiltern's machinery:

Figure 4: Great Eastern painted white, leaving Portland Harbour with the British Indian cable

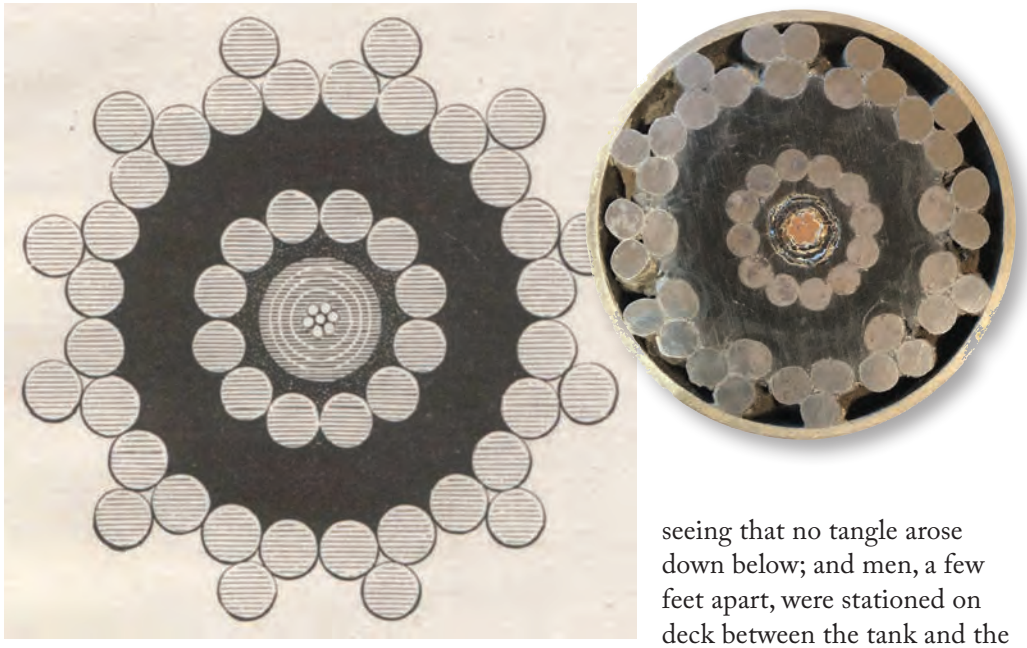


Figure 5: Shore end cable diagram and cross-section

"The cable had been passed through all the huge staples that direct its course from the fore-tank to the wheel at the stern; it had been passed under a wheel here, over a wheel there, which straightened and confined it, lest it should go out too rapidly; it had been passed three times round the drum, which controls the paying out, while a man stood ready at the wheel, a few rapid turns of which bring the gear to a complete stand-still should mishap threaten or arise. In the fore-tank were eight men, guiding each coil of the cable carefully, and seeing that no tangle arose down below; and men, a few feet apart, were stationed on deck between the tank and the stern, to watch every foot of the cable as it passed, and to give the alarm should anything go wrong. By means of the pneumatic compasses with which both the Chiltern and Great Eastern are fitted up, instructions as to the steering of the ship, and to the engine-room, can be conveyed instantaneously from the bridge. Moreover, the person superintending the paying out can, whenever it is necessary, communicate directly with the engine-room by the same means, when the engines are stopped and reversed long before the message could be conveyed in the ordinary manner."

On 14 February Great Eastern finished coaling, and prepared to splice on to the shore end:

"It was determined to effect the splice on the Chiltern, which was lying by the shore-end buoy, some 200 yards astern; and the delicate operation was proceeded with at once. After the heavy shore end was picked up from the buoy, and a portion of the cable on the Great Eastern passed over her stern and on to the Chiltern's deck, the laying each line open, the fusing the two slender copper cores, the melting and smoothing down by hand the layers of gutta-percha, the application of Chatterton's compound, and the final closing up and re-twisting of the thick protective coil, occupied some hours, and it was a quarter past four P.M. before Mr London pronounced the splice complete. The chief of the Telegraph Construction Company's electrical staff on board the Great Eastern, Mr Laws, sent messages through the entire line and to the shore long before this, and within a few minutes of the two copper wires being fused."

Just after five in the afternoon, accompanied by Chiltern, Great Eastern left Bombay, and after paying out a further ten miles of shore end cable, laid the transition to the intermediate cable type E. This was followed 96 nm later by the transition to intermediate cable type B, and subsequently the deep-sea section. The line to Aden would need 2,375 nm of cable, with an average slack of 10%. As was usual, the electrical staff on board ship were in regular contact with the station staff in Bombay, conducting tests to make sure the cable was functioning perfectly as it was being laid.

The changeover from one cable tank to the next (which today is standard practice) was at that time a cause for anxiety:

"It will be readily understood that the line coming from the tank, and which was nearly all expended, had to be paid out, and the bight connecting it with the other tank passed through the ring and so to the wheels without a moment's delay. Although the ship's speed is slackened, and her engines stopped, the cable would by its own weight continue to run on into the sea if the "stoppers" were not put on and its impetuosity checked. These stoppers consist of stout hempen ropes, which have been unlaid and plaited, as well as tailed-in and tapered down to a fine point at each end by hand, so as to give the maximum of holding power while insuring a soft surface, and avoiding all risk to the cable. These plaited stoppers are at the appointed time wrapped round the passing coil by men standing on each side of the "lead" or cable-pathway, and close to the final wheel at the ship's stern. The fastenings of these hempen stays are so arranged that they can be tightened or made loose by a turn of the hand. The brakes are put on as well; but it would be hazardous to apply mechanical checks only, and it is by hand that the final orders are carried out. The speed of the cable's fall into the sea is thus checked with the greatest nicety, or permitted to have full play, as the word is given by Captain Halpin, who is crouched under the paying-out gear, and on watch at the tank's mouth. Within the tank the cable has reduced itself steadily, and with three turns left the ship's engines are reversed, and her way stopped. The canvas coverings in which the bight or loop from the fore-tank has been swathed have been removed some time before, as well as all other obstructions. The bight is then passed through the framework, so that both sides of it are in the ring. This is the supreme moment, and as the bight passes gently from hand to hand, each man on the telescopic frame doing his part to prevent the two portions of it touching, it is impossible to avoid speculating upon what would happen if a single link in the complex chain of cause and effect were to fail. Suppose one of the brakes were to give way, or the men at the stoppers to misunderstand an order, or the ship's engines to be given play too soon, or the bight to slip from one of its guardians, and to overlap itself, a twist, a tangled kink, injury to the cable, destroyed insulation, and, at the best, delay for cutting-out and re-splicing, would all follow. As it is, it pursues its course gently into the long trough, and the cable from the fore-tank is being paid out without the delay of an instant. The stoppers and brakes are applied again a few minutes afterwards, but for an ordinary bit of work. The "knife" of the large drum which keeps the cable in its place is partly worn by friction, and an opportunity is given to

Figure 6: Landing the Aden shore end cable

renew it, the ship being again stopped and the paying-out checked. In twenty minutes, and after two or three trials, the new "knife" -- which is not the least like what its name suggests, being a heavy piece of metal like a section of the outer ring of a locomotive's wheel—which is fastened to the side of the drum, for the double purpose of protecting the latter, and of preventing the ascending cable from overlapping, is pronounced complete, and the paying-out is going on as regularly as ever"

It should be noted that because of the difficulty of switching payout from one tank to another, the Great Eastern emptied each tank completely. Today tank transfers occur more often, in order to spread the reduction in weight more evenly, reducing the stresses on the hull and better maintaining the ship's stability. Once the first of Great Eastern's first tank was emptied the spare cable was uncovered and the tank was flooded with water. Again, this would never happen today, as the amount of 'free surface' arising from a flooded cable tank, would be considered extremely dangerous!

On 27 February Great Eastern rendezvoused with Chiltern off Aden, where the deep-sea cable end was spliced to the heavier inshore section ready for the shore end landing, then buoyed off. Because of rough weather the landing had to be delayed, and overnight the cable broke loose from its buoys and fell to the bottom of the ocean. After about seven hours of grappling on the 28th, the cable was finally recovered, but again had to be buoyed as it was too late in the evening for the landing operation to commence. On 1 March the cable was tested all the way back to Bombay and found to be electrically perfect, and on the 2nd the shore end operation was completed, finally connecting the Aden station to Bombay, and messages of congratulation were sent through the cable.

It was then time for Chiltern to lay the outbound shore end ready for the run to Suez, but this did not start out well. While Chiltern was paying out the shore end, the turn of cable paying out from the tank caught under two turns of the lower flake, "and in an instant the three were twisted together in an inextricable knot." This tangle, known as 'a riding turn', tore away the bell mouth and part of the wooden framework leading to the cable trough, and the test room reported loss of continuity at the same time. After cutting out the damage and re-splicing the cable, the electricians found that while the cable on board ship had good continuity, there was a total loss of insulation to the shore. While they were trying to determine the cause, a boat from shore brought a message that, "At five minutes past eight A.M. (Greenwich), the cable suddenly disappeared through aperture, and has not been seen since." [Note: The ship's logs were maintained in GMT throughout the voyage] Before the Chiltern could be brought to a halt, the massive increase in tension caused by the cable jam had resulted in the end of the cable being dragged out of the cable house. A boatload of men was sent on shore, whereby digging three feet deep into the sand and towards the sea they discovered the missing end sixty feet from the cable house.

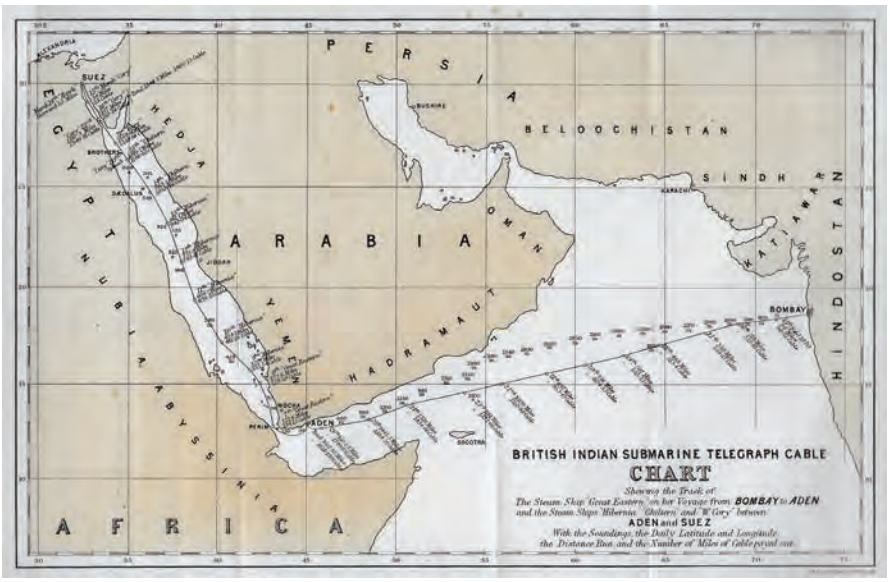


Figure 7: The Suez-Bombay cable route showing date and position of the cableships

Fortunately, it had not yet been attached to the fixtures and instruments and there was no damage, so the men sealed the end and re-buried it in the sand, ready for the gap to be filled with a spliced-on section of cable later.

Chiltern completed the lay of the shore end then buoyed the cable about nine miles offshore, and the ships of the cable fleet regrouped ready for Great Eastern to begin laying the first part of the main run to Suez. This commenced three days later, on 6 March. This section used a special cable designed for the shallow waters of the Red Sea in that region, which Parkinson described as "less like a cable than so much flexible bar-iron. It is slightly less in diameter than the deep-sea line, but is closed in with galvanised wires, over which is a single covering of jute-yarn, and a coating of Clark's compound. Its weight is 3¾ tons to the mile, while that of the Bombay main cable was but 1¾ tons."

This was the end of Great Eastern's work, and the cable staff, together with Captain Halpin, who was in overall command of the expedition, transferred to Hibernia, which would lay the 600 miles of standard deep-sea cable, stored in her two cable tanks, while Great Eastern set out for Aden to load coal for the long voyage back to England via the Cape of Good Hope.

Life on board Hibernia was not quite the same as on Great Eastern:

"The Hibernia is crowded. Every cabin is occupied; her still fine saloon has been curtailed to make way for a cable-tank; her bathroom is filled with ice, a useful commodity for lowering the temperature of cables while joints are made, and a supply of which was manufactured in the Great Eastern, and sent to the Hibernia on the morning we joined her; and at night every available sofa in the saloon is filled with weary electricians and engineers, sleeping soundly during their four hours' turn of rest."

Figure 8: Landing Cable at Porth Curnow Bay

After Hibernia had laid the 600 nm, Chiltern would take over and lay another 250 nm, and the two ships would then rendezvous with Hawk and William Cory, which were bringing more cable out from England via the recently opened Suez Canal. Parkinson had some philosophical thoughts about cable ships:

"Sunday, 13th March. —A cable-ship, on active duty, is an infallible, if not a very minute, self-acting register of its own work. … The drums and wheels rotate, as they have done ever since the start; the bell marking the revolutions of the drum performs its tinkling work unceasingly; the words "mile mark," or "splice," are called out at intervals by those on watch; the apparently endless iron rope continues to drop into the sea; the dynamometer registers every change in straining power -- all without variation. It is only when you look down into the tank and see the cable hands twenty feet off, and at the bottom of a deep dry well, instead of having to stoop to prevent striking their heads against the deck, or on looking from your cabin-window, that the vastness of the alteration in the condition of the ship comes home."

On 13 March the staff transferred to Chiltern, ready for the last leg of this part of the expedition. The next day they received this message over the cable from Aden: "Line opened to-day to the public from Aden to Bombay." When Chiltern's cable ran out the end was buoyed, Chiltern remained on station, and the staff transferred to Hibernia to sail for Suez and meet the other two ships, so that the cable could be laid from there back to Chiltern. However, at 110 miles from Suez they encountered William Cory already laying cable, accompanied by Hawk. The Hawk had laid the Suez shore end and, not knowing where Chiltern and Hibernia were, they had decided that the Cory should splice onto the shore end and commencing laying her cable. Under the circumstances, it was decided to cut and buoy Cory's cable and have Cory sail to meet Chiltern, accompanied by Hibernia, and proceed with the lay from there back to the buoy.

On 17 March the two ships reached Chiltern, and on the morning of 18 March Captain Halpin and some of the cable staff transferred from Hibernia to William Cory to prepare to make the splice. In squally weather, William Cory recovered the Aden cable end and began to haul it in, but the squall worsened, and as the ship pitched the cable parted. It took another day for the bad weather to abate, and it was not until the evening of 20 March that the cable was grappled and recovered.

After a successful test to Aden that night, the splice was made the following morning and the three ships set out for Suez, with William Cory laying the cable. On the afternoon of 22 March, after the cable from Aden was spliced to the section already laid from Suez, although not without

some difficulty due to strong winds and currents, the lay was complete. Parkinson concludes his account as follows:

"I may add that the cable was opened to the public at six A.M., on the morning of the 26th of March, or four days after the final splice in the Gulf of Suez, and that many messages had passed through 'from each end' — namely, from London and from Bombay, when I called at the Alexandria Telegraph Office at ten A.M. the same day."

With this major section of the cable to India completed, it remained only for the somewhat misnamed Falmouth, Gibraltar and Malta Telegraph Company to lay the final cable from Malta to Porth Curnow via Gibraltar and Carcavelos (near Lisbon, Portugal). Telcon was again awarded the contract for manufacture and laying; however, to meet the promised timescales they sub-contracted much of the cable manufacture to W.T. Henley, while carrying out the laying themselves. This started at Malta on 14 May 1870 with cableships Hawk, Edinburgh and Scanderia laying the 1,150 nm cable to Gibraltar. Scanderia and Investigator then laid the 366 nm cable from Gibraltar to Carcavelos, Portugal, and the last section, Carcavelos to Porthcurno, Cornwall, 824 nm long, was laid by Hibernia, starting from Carcavelos on 2 June 1870 and arriving at Porthcurno six days later. On 6 June, Investigator laid the shore ends of what was the first cable into what is now Porthcurno. The final splice was completed by Hibernia on 8 June.

The service to India went into commercial operation on 23 June. Between the forming of the Anglo-Mediterranean Telegraph Co and the opening of this telegraph service, just over two years had passed. This was an incredible achievement even by modern-day standards, and it was largely accomplished through the effort, skill and business acumen of John Pender.

That evening, to celebrate his remarkable success, John Pender hosted a soirée at 18 Arlington Street to mark the inauguration of the first London to India telegraph service. The guest of honour was His Royal Highness Albert Edward, the Prince of Wales, whose presence had been arranged by Pender's wife Emma. The entertainment included demonstrations of modern telegraphy by Cromwell Fleetwood Varley, in which the guests were invited to have messages telegraphed to Bombay, Calcutta (Kolkata) and New York, receiving replies in less than fifteen minutes. As a talking point, the grapnel that had been used to recover the 1865 Atlantic

Figure 9: John Pender's Telegraphic Soirée

Figure 10: Eastern Telegraph Company system map, 1901

cable was suspended from a balcony above the guests. The guest list included over one hundred dignitaries and the entire event was captured in a 68-page souvenir booklet. It was also covered a week later in the Illustrated London News, whose article included a detailed engraving of the gathering, which was held in Pender's main reception room.

Following this triumph, Pender continued to expand his network, with its main station remaining at Porthcurno, which also became the training centre for cable engineers and operators. Pender died in 1896, and just five years later, in 1901, his many companies were finally consolidated into the EATC, with the extensive network shown in Figure 10.

In 1928 the EATC merged with the Marconi Wireless Telegraph Company and other related entities to form Imperial & International Communications Ltd, and in 1934 this became Cable & Wireless. Four generations of the Pender family ran the company until 1965, even after it was nationalised by the Labour Government in 1946. Porthcurno continued to be one of the world's largest cable stations, an important communications hub and training centre, until the closure of the station in 1970 and the engineering college in 1983. Celebrating its 150th anniversary this year, PK Porthcurno is now a world-class communications museum and archive. **STF**

BILL BURNS *is an English electronics engineer who worked for the BBC in London after graduation before moving to New York in 1971. There he spent a number of years in the high-end audio industry, during which time he wrote many audio, video, and computer equipment reviews, along with magazine articles on subjects as diverse as electronic music instruments and the history of computing. His research for these articles led to a general interest in early technology, and in the 1980s he began collecting instruments and artifacts from the fields of electricity and communications.*

In 1994 a chance find of a section of the 1857 Atlantic cable inspired a special interest in undersea cable history, and soon after he set up the first version of the Atlantic Cable website <https://atlantic-cable.com>, which now has over a thousand pages on all aspect of undersea communications from 1850 until the present.

Bill's interest in cable history has taken him to all of the surviving telegraph cable stations around the world, and to archives and museums in North America and Europe. He has presented papers on subsea cable history at a number of conferences, and in 2008 he instigated and helped organize the 150th Anniversary Celebration for the 1858 Atlantic cable at the New-York Historical Society. Most recently, in 2016 he was involved with the celebrations in London, Ireland and Newfoundland to mark the 150th anniversary of the 1866 Atlantic cable.

Since graduating in 1970, **STEWART ASH** *has spent his entire career in the submarine cable industry. He joined STC Submarine Systems as a development engineer, working on coaxial transmission equipment and submarine repeater design. He then transferred onto field engineering, installing coaxial submarine cable systems around the world, attaining the role of Shipboard Installation Manager. In 1986, he set up a new installation division to install fibre optic submarine systems. In 1993, he joined Cable & Wireless Marine, as a business development manager and then move to an account director role responsible for, among others the parent company, C&W. When Cable & Wireless Marine became Global Marine Systems Ltd in 1999, he became General Manager of the engineering division, responsible for system testing, jointing technology and ROV operation. As part of this role he was chairman of the UJ Consortium. He left Global Marine in 2005 to become an independent consultant, assisting system purchasers and owners in all aspects of system procurement, operations, maintenance and repair.*

Stewart's interest in the history of submarine cables began in 2000, when he project managed a celebration of the 150th anniversary of the submarine cable industry. As part of this project he co-authored and edited From Elektron to 'e' Commerce. Since then he has written and lectured extensively on the history of the submarine cable industry. From March 2009 to November 2015 he wrote Back Reflection articles for SubTel Forum. In 2013 he was invited to contribute the opening chapter to Submarine Cables: The Handbook of Law and Policy, which covered the early development of the submarine cable industry. To support the campaign to save Enderby House—a Grade II listed building—from demolition, in 2015 he wrote two books about the history of the Telcon site at Enderby Wharf on the Greenwich Peninsula in London. The first was The Story of Subsea Telecommunications and its Association with Enderby House, and the second was The Eponymous Enderby's of Greenwich. His biography of Sir John Pender GCMG The Cable King was published by Amazon in April 2018.

THE 150TH ANNIVERSARY CELEBRATION SCHEDULE

June this year will be the 150th anniversary of the inauguration of the telegraph to India, and to mark this milestone, PK Porthcurno is planning a series of events to celebrate. These will include a re-enactment of the landing of the cable on 10 June, an exhibition on "The Cable King" and "The 1870 Landing" that will open early in June. In addition, there will be a performance of a newly commissioned play, at the neighbouring Minack Theatre on 22 June.

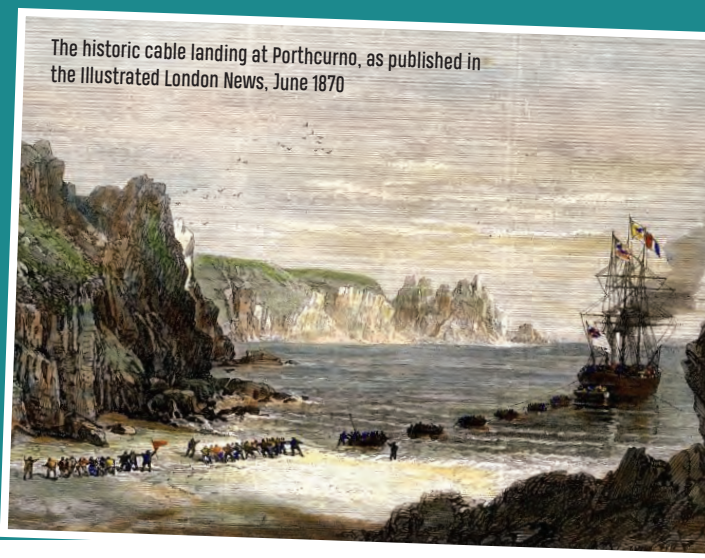
More details will be available on the website (*www.pkporthcurno.com*) and in the next addition of SubTel Forum, in which this feature section will be include an article on the installation of the 1870 cable system to India.

PK PORTHCURNO

Porthcurno 150 CELEBRATING THE CONNECTED WORLD

150TH ANNIVERSARY EVENTS FOR JUNE

Celebrating the very first telegraph cable landing at Porthcurno in 1870



The historic cable landing at Porthcurno, as published in the Illustrated London News, June 1870

This June, PK Porthcurno (previously Telegraph Museum Porthcurno) presents a series of events and exhibitions to celebrate the 150th anniversary of a moment that marked the beginning of our modern global communications network. In June 1870, the final section of a telegraph cable was landed on the beach at Porthcurno in Cornwall, enabling telegraphic communication between London and Bombay, with intermediate connections in Portugal, Gibraltar, Malta and Egypt. From this time forwards, messages that might have taken weeks, or even months to arrive, could be sent in minutes. This landmark development was the brainchild of visionary entrepreneur John Pender, founder of The Falmouth, Gibraltar and Malta Telegraph Company. English and Indian Royalty celebrated the event at Pender's home in Piccadilly, London, recognising the huge significance of this achievement.

The telegraphy network rapidly spread around the world, making Porthcurno the world's first global communication hub, and by the 1920s Porthcurno was home to largest telegraph station in the world. In time, telegraph cables were replaced by co-axial cables and co-axial cables replaced by fibre optic cables. The Porthcurno Telegraph Station, known by its call sign 'PK', became an international specialist training college operated by Cable and Wireless. Known collectively as 'The Exiles', engineering students from around the world came to this remote coastal valley to study together before taking their skills to far flung locations. Today the college is gone, but the fibre optic cables still come ashore at Porthcurno, and other Cornish beaches, carrying over 97% of all communications between the UK and the rest of the world.

PK Porthcurno now occupies the site of the former station and college, and that single cable landed 150 years ago has been transformed into a global communications network for internet, email, telephone and television traffic. To mark this historic anniversary, 2020 events and activities will include:

TALL SHIP EVENT AND HISTORIC RE-ENACTMENT

On June 10th, in collaboration with Adventure Under Sail, the Minack Theatre, Carefree Cornwall and other partners, we will produce a re-enactment on Porthcurno beach to commemorate the laying of the first cable in 1870. The Cableship 'Investigator' will be represented by the tall ship 'Pelican of London', which will be moored at Porthcurno especially for the event, with a crew of young people from Cornwall. Our Cornish recruits will join the crew of

Sunset at PK Porthcurno, which stands on the site of what was once the world's largest telegraph station

the training ship when it drops anchor in Porthcurno on June 10th for the re-enactment, before sailing on Falmouth for the Sea Shanty Festival, and then on to France before returning to Cornwall. As part of the re-enactment, local gig rowing clubs will be invited to attend and will race out to the Pelican to bring the cable ashore.

A handful of paid places are available on the crew of The Pelican, for anyone who wants to experience the thrill of sailing a tall ship from Cornwall to France and back. Contact PK Porthcurno to enquire.

AT THE MUSEUM

During June we bring the PK Porthcurno museum site alive with a range of exhibitions, activities and entertainment. A bespoke set of silk flags, designed by Cornwall-based textile artist Lucy Birbeck, will decorate the museum gardens. In association with Portuguese/Italian design collective Moradavaga, our museum gardens will play host to 'Morgy' the giant squid, an interactive sound-experience, which explores ideas of human connectedness. As part of the Coastal Communities wAVE (Augmented & Virtual Experiences) project, visitors can download Morgy's adventure app, and follow a digital undersea trail around Porthcurno valley. Complete the trail and win prizes including discounted entry to the museum.

'CABLE KING' EXHIBITION

This new exhibition tells the story of the life and work of John Pender, the entrepreneur whose pioneering vision to connect the world changed the way we communicate forever. Pender and his wife Emma Denison-Pender were among the first people to recognize the potential of undersea cable telegraphy, and Pender invested his considerable business skill and large amounts of money in their vision to create a worldwide submarine cable system.

UNIQUE 'LEGO' COMMISSION

Lego designer Warren Elsmore Studio will create a scale model of the Cableship 'Investigator' and an imagined scene of the historic cable landing of 1870, complete with mini figures. The construction will be filmed and shared online, and the completed Lego model will be displayed in the museum from May half term onwards.

MINACK THEATRE PRODUCTION

Working with the Minack Theatre, we have commissioned a new play from playwright David Lane which draws on the history of the Porthcurno valley as a hub of global communication.

David's play, The Valley, begins in 1870 just hours after the first telegraph cable linking Britain to India has been laid in Porthcurno, when a farmer finds an abandoned child on his doorstep. 150 years later, her great-great-great-granddaughter returns to the valley. This brilliant new story spans two centuries and is about seeking a place in the world when nowhere feels like home, and a submarine network intertwining power and politics.

The play will be presented on the Minack stage throughout the week of June 22nd.

GOLOWAN FESTIVAL 'GETS CONNECTED'

Between 23rd and 28th June 2020 we join forces with the annual Golowan Festival, Penzance, for 'Golowan Gets Connected', marking both the 150th anniversary of the cable landing in Porthcurno. Local schools will be invited to create processional images based on the theme of communications, and local artists Graham Jobbins will create a 3D processional piece, Mercury, Messenger of the Gods, for the event.

PLANET PK | JUNE 2020 AND BEYOND

Planet PK is our ongoing environmental programme which looks to the future of Porthcurno valley and recognises our shared responsibility as residents and visitors in caring for this Area of Outstanding Natural Beauty. Working with the Eden Project, we have replanted our carpark borders and beds with pollen producing wildflowers that support biodiversity. These will flower for the first time in 2020 and will then be an established feature of Porthcurno to be enjoyed by all.

For further information on these celebratory events see *www.porthcurno150.com*. STF

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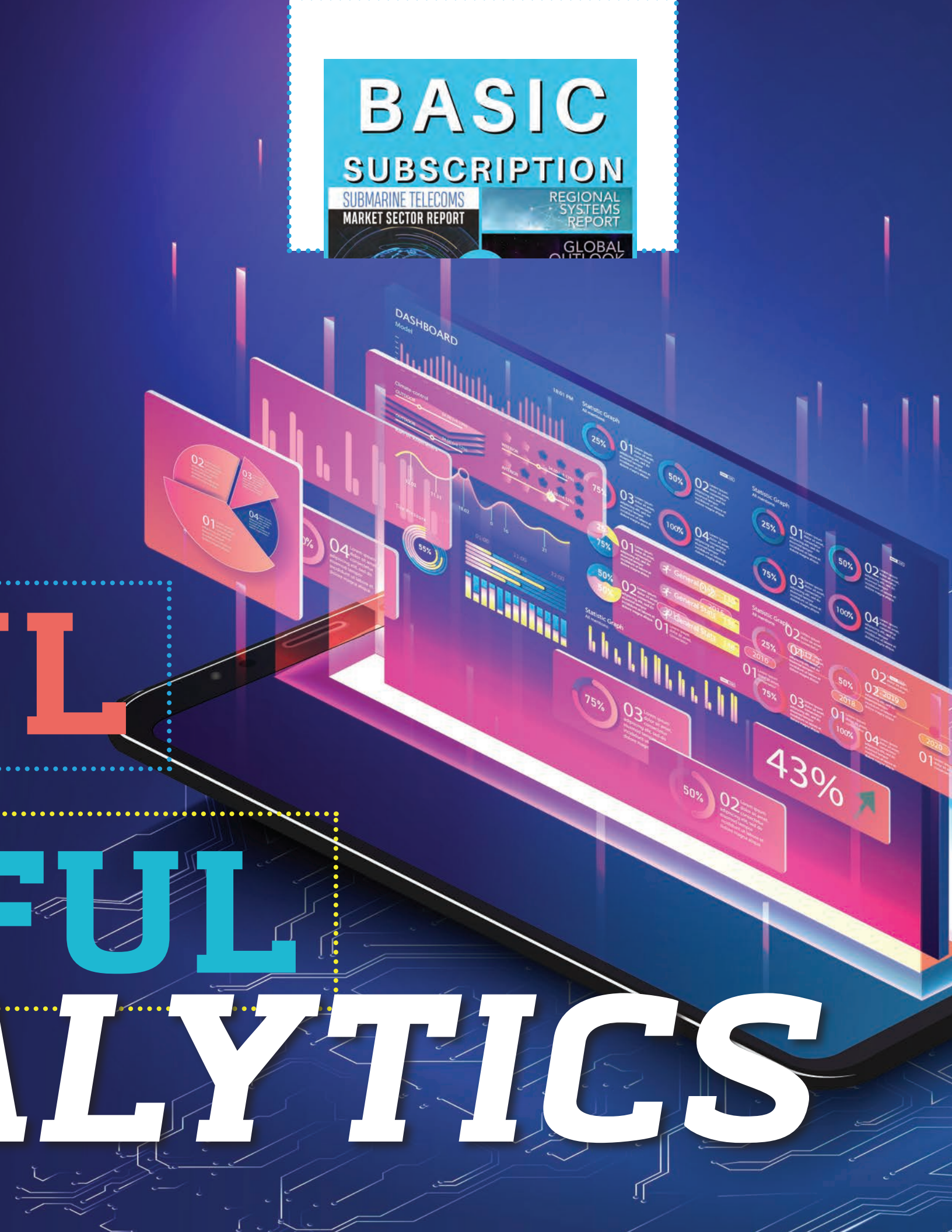

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ALYTICS

BACK REFLECTION

BY JOSÉ CHESNOY

SUBMARINE CABLE POSITIONING

From Astronavigation to GPS

The precise cable position on the sea bottom is fundamental for route optimization (optimum length and bypass of obstacles), cable protection, and for an easier future recovery for repair.

GPS (Global Positioning System) is now present in our lives, and it looks so easy that one barely thinks about life before this marvelous GPS (and the related Galileo and Glonass) that has replaced all previous positioning systems for all applications.

Indeed, presently all cable ships use GPS to position the cable ship with a precision of a few meters and it permits then to lay the cable very fast and accurately based on a sophisticated software processing since the cable is touching the sea bottom far away from the cable ship itself.

But GPS is not so old, and its global use is more recent that the first optical cables. It is quite relevant to review how the cable ships were always at the forefront of available technologies to position the cables in a predictable way [Reference 1].

CABLE LAYING AT THE EARLY TIME OF TELEGRAPHIC CABLES

The route plan itself of the first Transatlantic cable in 1857 was comparatively optimal as illustrated in Figure 1 from Reference 2. We note in particular that the orthodromic route was targeted rather than a loxodrome.

But the practical cable ship positioning itself was an incredible challenge. Close to the coast, the positioning was not so bad by using the visual aid of positioning by identified monuments or lighthouses, but positioning was becoming more challenging when the coast was no longer visible, which was the case most of the time when laying the first Atlantic cables. The cable ship positioning had to use astronomical positioning from time to time (in calm weather conditions with good visibility). One has to realize that a 1-degree error for measurement of the angle of the sun or star above the horizon means an error of 60 nautical miles, i.e. more than 100 km and an error of 4 minutes (absolute) time means 100 km as well! I invite you to try to use a sextant during your holidays to make your opinion! Then, between scarce astronomical measurements, the position had to be interpolated, taking into account imprecise records of the direction and speed of the cable ship not to mention the impact of the sea currents. Ultimately, errors of cable position in the range of 100km or more are far from surprising.

For the first transatlantic telegraphic cables, the approximate positioning led to excess post-lay route lengths up to 30% versus plan when reaching the opposite coast which, in some cases resulted in unsuccessful installations because of cable shortage. One can understand how the improvements of cable ship positioning was a top priority for the submarine cable industry and progress came quickly in the first decades.

Common sense implied to add a limited 3%-slack -still considered today as a reasonable value- to the

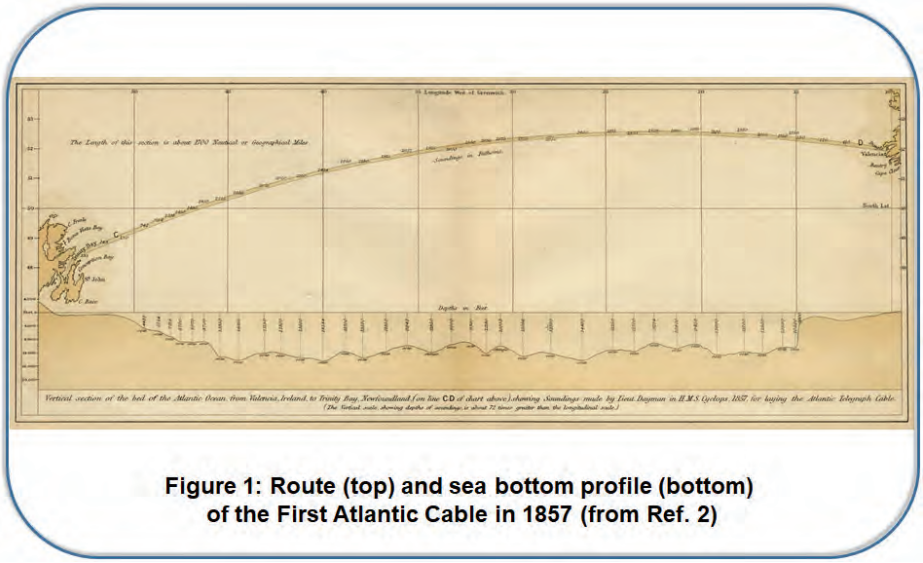


Figure 1: Route (top) and sea bottom profile (bottom) of the First Atlantic Cable in 1857 (from Ref. 2)

cable delivery speed above the cable ship speed so the cable can smoothly follow the bottom asperities. But in practice, the cable ship speed is measured only relative to the water surface and not to the sea bottom and the number of cable breaks during lay was unacceptably high.

The idea was very soon to launch in parallel to the submarine cable a slack free "taut wire" to get the accurate longitudinal position over the sea bottom.

The difference between the cable and the taut wire pay out indicated the amount of cable slack. The so-called "Cable laying machines with taut wire" [figure 2] were installed as early as 1873 on the first large cable ship equipped for cable laying Faraday1 and this technique was maintained in use for more than a century, abandoned only after GPS positioning.

For decades, progress was slow, by better cable ship positioning with improvements of angle measurements by sextant along with clock and speed precision. Less than 10% extra length of cable became common and then things changed smoothly first by making progress in positioning of cable ships and then in laying methodology of cable and wet equipment. Finally, modelling was done on board the cable ship with all maps and laying parameters.

We summarize below how we reached the present status where the cable is laid within a few meters of the target route with a controlled slack to smoothly follow the sea bottom.

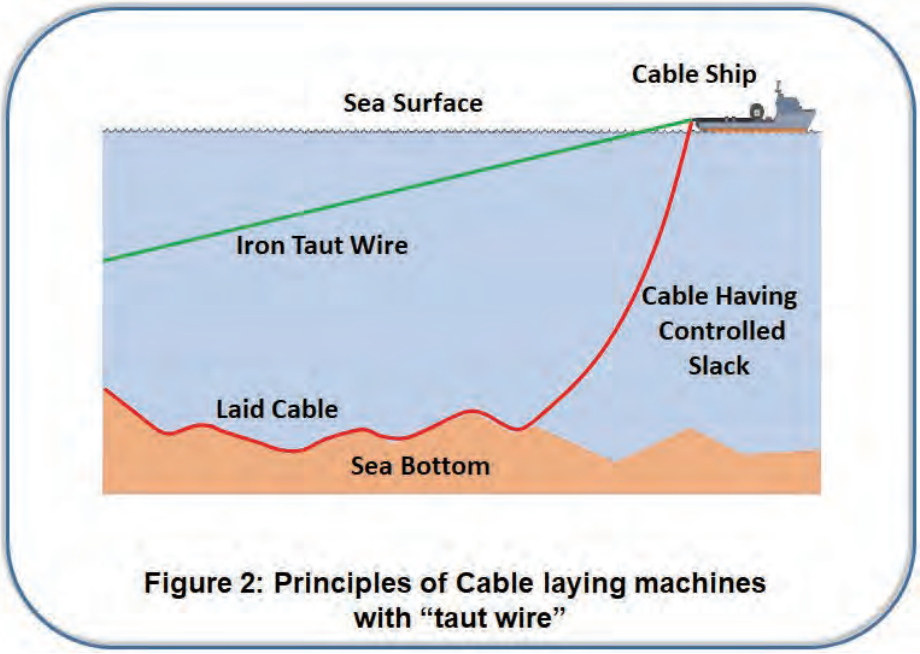


Figure 2: Principles of Cable laying machines with "taut wire"

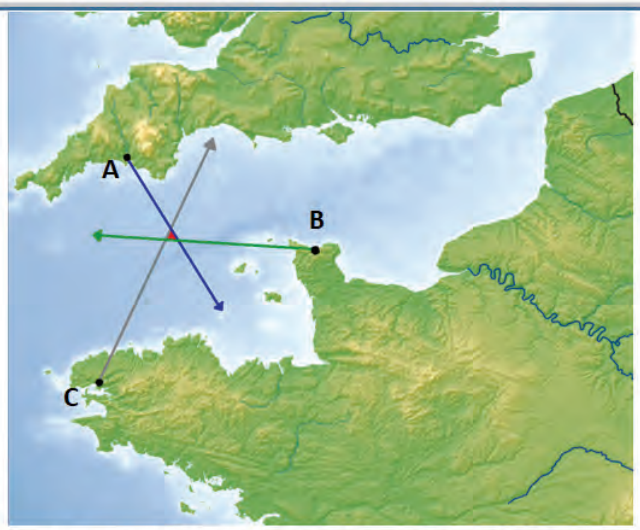


Figure 3: Positioning by Triangulation
2 directions of reference points to get position
And a 3rd angle measurement to check

IMPROVEMENT IN POSITIONING OF CABLE SHIPS BY RADIO WAVES

Navigation close to the coast can be precise when based on triangulation. The principle is simple [Figure 3]: The angle between 2 identified landmarks is measured. Usually a third landmark is used for consistency checking and to evaluate the precision.

The position of the ship can be identified precisely, with accuracy decreasing when distance increases. This technique is straightforward with direct visibility but limited to dozens of km from the coast, and it was used

BACK REFLECTION

BY JOSÉ CHESNOY

for the early deployment of festoons cables. But it cannot be used in the ocean or with bad visibility.

The range was then extended by radio, still based on triangulation. The use of radio waves as an aid to navigation was triggered by the discovery of directional frame antennas and associated direction finding. The radio-goniometer was used to assist ships in the North Atlantic before being used in aviation. Stimulated by the preparation of World War 1, in the 1910s, direction-finding stations on the 450-meter wavelength determined the position of ships, airships and planes that requested it. The benefit of the radio technology was that it could be used at night and in bad weather but for cable laying, it was limited again to coastal areas.

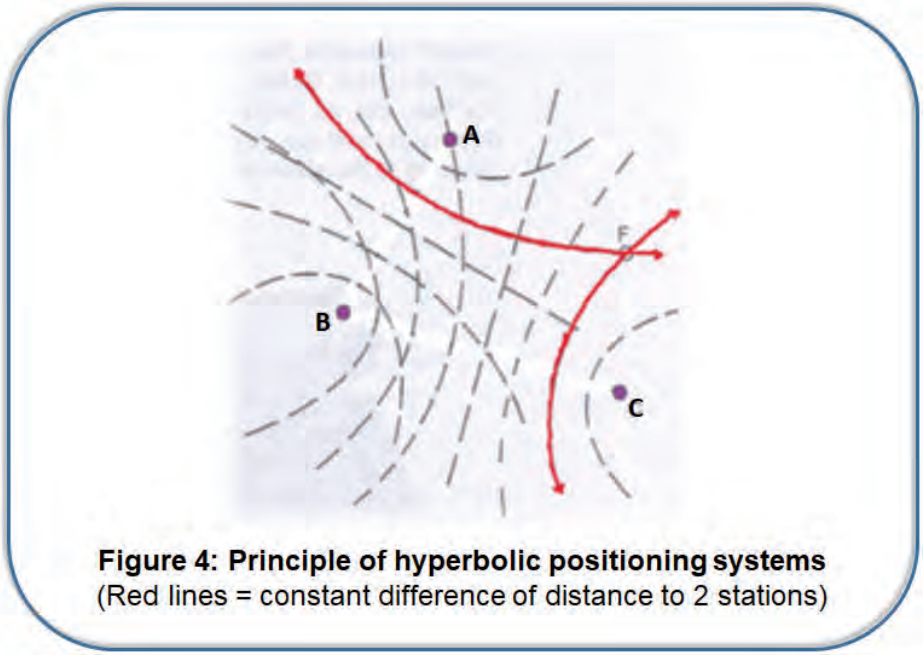


Figure 4: Principle of hyperbolic positioning systems
(Red lines = constant difference of distance to 2 stations)

The improvement of precision and range came with the so called "hyperbolic radio systems". Hyperbolic systems determine the position by measuring the difference in propagation time between two transmitters (at least), the location of the points with equal difference is a hyperbola on the map. Two transmitters are necessary for a point (intersection of hyperbolas) and a third one for consistency checking.

In the 1940s, World War II fueled the development in UK and US of hyperbolic systems. UK had developed the GEE system before USA for coastal precise military landing. It was adopted by USA that developed in its turn their own system for long range, the LORAN (LOng RAnge Navigation) where the distance could be extended by using low frequency MHz waves reflecting over the high atmosphere and able to cover a large part of the North Atlantic. Nevertheless, precision was moderate and definitely not sufficient for the Pacific Ocean. The names of LORAN-C and DECCA systems are still etched in everybody's memory.

In the 1960s, two systems with worldwide coverage were developed in parallel: OMEGA, the last terrestrial hyperbolic system mainly for civilian applications, and TRANSIT, the first precise satellite-based positioning system primarily for the US army.

The last hyperbolic system OMEGA reached a global earth coverage, achieving a precision of a few kilometers as of 1971, using atomic clocks for the first time. It included nine very high power transmitters in the 10 to 14 kHz frequency band, those VLF waves having the property of propagating through the Earth-Ionosphere "waveguide" The first operational satellite system was TRANSIT. It used the Doppler Effect, which varies the reception frequency of a satellite according to its relative speed. Six satellites with polar orbits were sufficient, and in 1964 with a dozen satellites it was possible to get a position approximately every hour, with a precision of a fraction of a kilometer.

The global positioning systems such as LORAN, or TRANSIT and then GPS were primarily developed for the US army. The other users had to wait several years to get access to them. Submarine cables were the first civilian users of all new techniques, including the civilian OMEGA system. But what is noticeable is that submarine cable ships have been also privileged to access military US positioning systems. This was first the case for the TRANSIT system that was installed on the France Telecom CS Marcel

Bayard early 1970.

Then GPS satellite system based on time measurement of radio pulses from a constellation of satellites was progressively introduced from 1978 for the US army, open to civilian applications in 1989 (after the decision by Ronald Reagan in 1983) with a reduced accuracy (100 to 300 meters), completed in 1993 with 24 satellites, but available for civilian applications with the 10 meters accuracy only in 2000. In order to be independent, Europe has developed later the Galileo system compatible with GPS, and the Russian satellite system has also developed Glonass.

But again, the CS Vercors was the first non-US civilian ship to get a GPS to lay TAT-8 transatlantic cable in 1987 before any civilian equipment could be available.

All the previous systems (LORAN, TRANSIT, DECCA) were decommissioned in 1996 and 1997 and replaced by GPS, Galileo and Glonass. That was the end of a period started in 1970 when "integrated navigation" meant collating in real time on board the cableship vast quantities of fragmented information coming from different sources.

IMPROVEMENT OF LAYING TECHNIQUES

Positioning the cable ship is not everything since at the end what is important is to know the position of the cable and repeaters on the sea bottom.

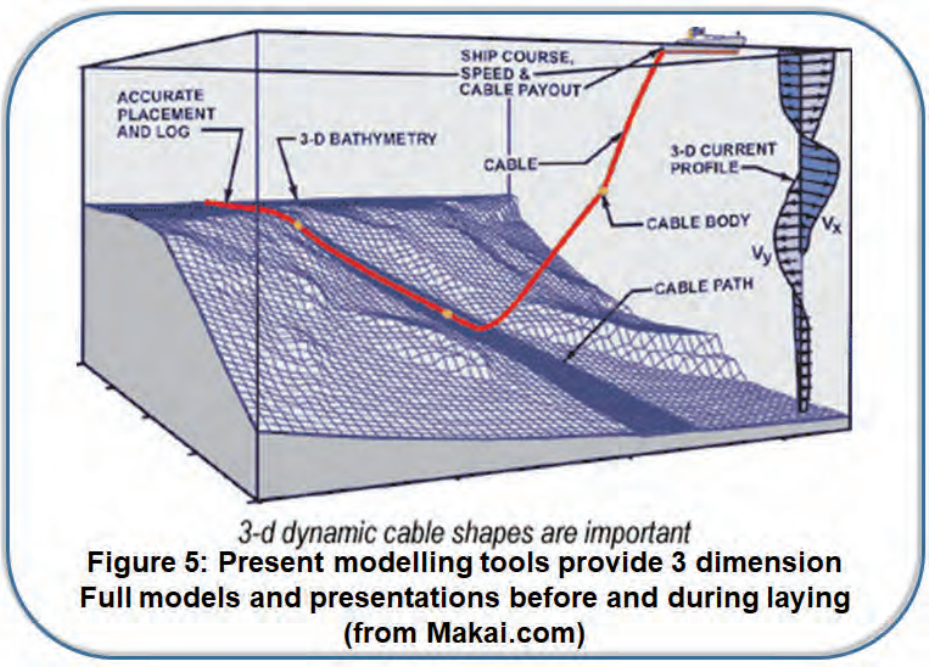
The taut wire machines were manufactured under UK monopoly for one century up to the1970s when each independent submarine cable fleet progressed to reduce the number of cable breaks and improve the measurement accuracy of the cableship speed relative to the sea bottom.

Cable laying remained a pragmatic qualitative technique up to the 1960s. Things changed when AT&T developed the SD system, a 1 inch coaxial cable introduced in the Atlantic for TAT-4 and also in the Pacific for TPC-1, put into service in 1964-65 [Reference 3].

First AT&T developed and installed on the CS Long Lines in 1963 the first "Linear Cable Engine" that costed itself alone as much as a full-fledged cable ship before. The equipment permitted to lay the repeaters at the same constant 6 knots speed as the cable, thus faster, but also in a more predictive and repeatable way.

In parallel, the Bell Labs studied and put in place a rigorous methodology not only to model the cable itself, but also to lay the cable and its wet equipment, taking into account all parameters of the cable ship (relative speeds vs water surface and sea bottom), of the sea bottom (flat, rising or descending slopes), and mechanical and hydrodynamic characteristics of the cable and wet equipment. C. Roden published in 1964 in Bell Labs Review the reference article "Submarine cable mechanics and recommended laying procedures" that was re-edited in 1974 as an independent book authored by C.E. Roden and A.G. Richardson [Reference 4]

Then every successive generation of submarine cable was accompanied by an update of the recommended laying procedures. But the real time complete modelling of cable laying could only be effective with the advent of on-board microcomputer equipment in the 1970s with the advent of integrated navigation.



3-d dynamic cable shapes are important

Figure 5: Present modelling tools provide 3 dimension Full models and presentations before and during laying (from Makai.com)

BACK REFLECTION

BY JOSÉ CHESNOY

THE TIME OF "INTEGRATED NAVIGATION"

The first global positioning systems were available for cable ships in the 1970s: 1971 for OMEGA and soon after for TRANSIT. In the same years the Bell Lab. engineering model of cable and its laying was available, and the fast progress of mini-computers started at the same time. The time of "Integrated Navigation" was thus between the early 1970's and year 2000 when GPS providing continuous meter precision became fully available [Reference 5]

With OMEGA and TRANSIT, position measurements were done from time to time (1 hour for TRANSIT) and the first problem was to keep a precise position of the cable ship between two precise position measurements. The improvement of intermediate position interpolation came first by the Doppler radar velocimeter able to measure the speed by reflection on the ground, associated with Gyroscopes.

Another improvement of the intermediate position measurement was done using Syledis (SYstem LEger pour mesure la DIStance) developed by the French company Sercel. It was based on the principle of an active radar for distance up to 200 kilometers with fixed stations, but it was light enough to be deployed on buoys along the route path to extend the range.

The mini-computer on board had to calculate the cable ship position and then to take into account the cable and repeater characteristics, and the sea floor map. Soon, the system took control of the cable ship itself as well as the laying machine. The software development became quite effort consuming. Each company laying cables had to devote significant and costly efforts to build and maintain their own tool. France Telecom developed Espadon, still in use (with the same name but a different content!). AT&T, C&W and others decided during the first Suboptic convention in 1986 to support the development of a common software that gave birth to Makai, used now for the majority of route designs and on most cable ships, and providing 3 dimension modeling at all stages of the project (from route design to cable lay). See Figure 5.

The full-fledged GPS solution was not built in a day. At the beginning, because of the limited number of satellites, there were blind periods between two measurements. Software on cable ship had to continue using interpolations. It should also be noticed that the precision down to the meter was delivered only in year 2000. Up to that time, the precision was limited to 100 meters because of the signal scrambling; as a result, cableships had to use differential GPS on board, correcting the position by using a fixed known station.

EPILOGUE

A wrong picture is that cable laying did not change since the first telegraphic cables were deployed 150 years ago In fact, cable laying became with time extremely precise using indeed positioning by satellite GPS, but also extremely sophisticated software to model the position of the cable within a few meters, while it is laid at full 6 knots speed of the cable ship.

Submarine cables and satellites have long been fighting to the death for long haul telecommunications and cable was the winner with the optical fiber technology [Reference 6], but they are now the best friends for their complementarity in many areas, and GPS is not the least of the satellite applications. STF

JOSÉ CHESNOY, PHD, *is an independent expert in the field of submarine cable technology. After Ecole Polytechnique and a first 10 years academic career in the French CNRS, he joined Alcatel's research organization in 1989, leading the advent of amplified submarine cables in the company. After several positions in R&D and sales, he became CTO of Alcatel-Lucent Submarine Networks until the end of 2014.*

He was member of several Suboptic Program Committees, then chaired the program committee for SubOptic 2004, and was nominated Bell Labs Fellow in 2010.

José Chesnoy is the editor of the reference book "Undersea Fiber Communication Systems" (Elsevier/ Academic Press) having a new revised edition published end 2015.

He was co-chairman of the OSA summer school subseaOFC in 2019.

The author José Chesnoy is grateful to Alain VAN OUDHEUSDEN, president of the AACSM, for his helpful comments, and to Michel MARTIN for fruitful proof reading.

REFERENCES :

1. Du Morse à l'Internet, R. Salvador, G. Fouchard, Y. Rolland, A.P. Leclerc, Edition Association des Amis des Câbles Sous Marins, 2006 (book)

2. Site Atlantic Cable https://atlantic-cable.com/Maps/index.htm

3. José Chesnoy, The origin of the submarine cable, SubTel Forum magazine 92, page 56, https://issuu.com/subtelforum/docs/stf-92

4. C.E. Roden, Submarine cable mechanics and recommended laying procedures" Bell Labs Review, November 14th, 1964, re-edited in 1974 as an independent book authored by C.E. Roden and A.G. Richardson

5. Michel Lauger-Hache, L'Espadon: la navigation et le positionnement des navires câbliers, Bulletin de l'AACSM, N°57, 2019 (in French)

6. Undersea Fiber Communication Systems, Ed.2, José Chesnoy ed., Elsevier/Academic Press ISBN: 978-0-12-804269-4 (book)

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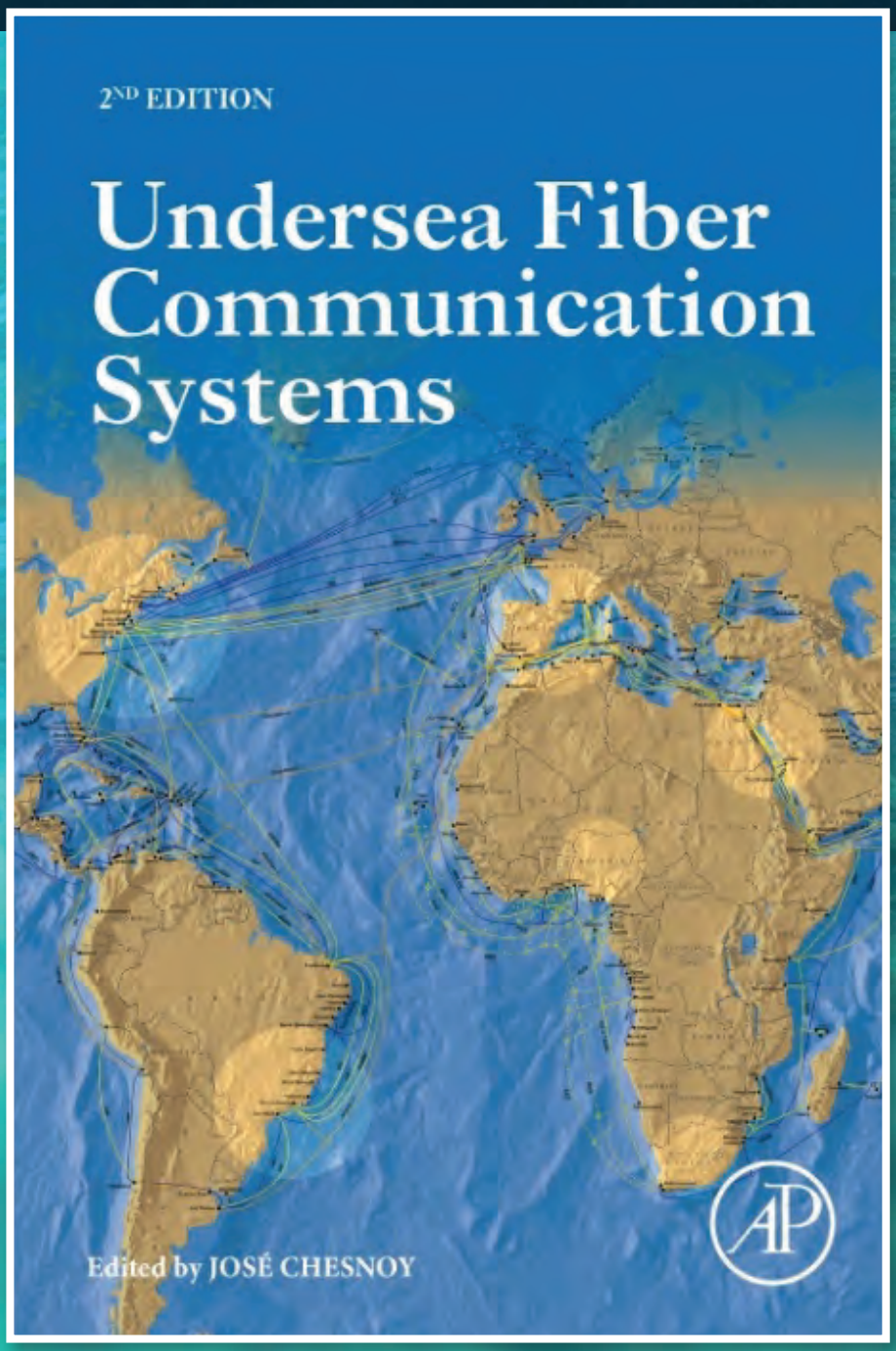

Undersea Fiber Communication Systems, 2e

EDITED BY JOSÉ CHESNOY

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ACCREDITED TRAINING FOR THE NEXT GENERATION

Partnering with PTC for a new generation of telecoms professionals

BY KRISTIAN NIELSEN

2019 was a transformative year, the SubTel Forum team accomplished a number of industry firsts, ranging from successful conferences to publication readership records – one of the greatest accomplishments was becoming an IACET accredited continuing education provider.

WHAT MAKES IACET SO SPECIAL?

IACET Accredited Providers are a group of educators dedicated to quality in continuing education and training. All approved providers follow the ANSI/IACET Standard for Continuing Education and Training and have been thoroughly assessed by a third party, providing quality standard for their education.

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"We believe this may a first for our international industry; where accredited continuing education can be offered on any continent to industry personnel. As such, we are developing new training opportunities beginning in early 2020," said Nielsen. "Since 2001, it has been our goal to provide education to the submarine cable industry, and now with IACET accreditation, we are taking a leap forward to that end."

Using this new accreditation, we intend to design educational courses that can then appear at industry conferences around the world. Classes will be on a variety of topics dealing with key industry issues. Our aim, as with so many other avenues of SubTel Forum, is to bring another opportunity for education to market.

What differentiates this new training will be official, internationally recognized credits.

SubTel Forum has been pursuing relationships within the industry to bring the highest quality content in training to market. To that end, we are pleased to announce that we have formalized an agreement with the Pacific Telecommunications Council to formally accredit training sessions developed with SubTel Forum and presented during the PTC Academy.

The SubTel Forum Continuing Education team will work directly with subject matter experts and industry magnates to develop and deliver the highest quality training programs available.

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Nokia, Angola Cables Trial First Direct Connection Between USA and Africa

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Investors Prepare for Data Center Growth in East Africa

Colt Reduces Latency Between Tokyo, Hong Kong

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FUTURE SYSTEMS

Liquid Telecom Receives CLS Permit for DR Congo

East Africa's Largest Submarine Cable Lands in Mombasa

Oman Australia Cable (OAC) Contract in Force

Kumul Submarine Cable Network Lands in PNG's Vanimo

DARE1 Cables Land in Mogadishu and Bossaso, Somalia

PEACE Cable to Land in Seychelles in July 2021

SubSea Networks Supports NO-UK Submarine Cable

Construction Begins for Norway-UK Fiber Cable

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Orange, Telxius to Support the Google Dunant Cable

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Dear Readers,

Spring is upon us, it's time to open the windows again and blow off the dust from the past few months.

We've been undergoing some heavy changes to the literal and theoretical design of SubTel Forum since the beginning of the year, you may have noticed some of the changes already.

So, what's new?

You can now sponsor individual layers on the **SubTel Cable Map**. Our online map launched almost one year ago, since then it sees almost 10,000 users every month visit for the most up-to-date cable system information available.

That's nice, but what is the **SubTel Cable Map**?

The online **SubTel Cable Map** is built with the industry standard Esri ArcGIS platform and linked to the SubTel Forum Submarine Cable Database. It tracks the progress of some 300+ current and planned cable systems, more than 800 landing points, over 1,700 data centers, 46 cable ships as well as mobile subscriptions and internet accessibility data for 254 countries. Systems are also linked to SubTel Forum's News Now Feed, allowing viewing of current and archived news details.

If you haven't yet, I highly recommend you check it out: *subtelforum.com/cablemap*

What else is new?

We've revamped how SubTel Forum Analytics Members can purchase and access **Market Sector Reports (MSRs)**.

Building on our lessons learned from splitting the websites up, *SubTelForum.com* is now the proverbial mothership for *all* of the SubTel Forum publications. All of them, yes really. Starting with the MSRs, you will be able to access all of the favorite Analytics reports, datasets and tools directly from a new Member's Section of the SubTel Forum main site.

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- **Global Capacity Pricing –** historic and current capacity pricing for regional routes (Transatlantic, Transpacific, Americas, Intra-Asia and EMEA), delivering a comprehensive look at the global capacity pricing status of the submarine fiber industry. Capacity pricing trends and forecasting, simplified.
- **Global Outlook –** dive into the health and wellness of the global submarine telecoms market, with regional analysis and forecasting. This MSR gives an overview of planned systems, CIF and project completion rates, state of supplier activity and potential disruptive factors facing the market.
- **Offshore Oil & Gas –** provides a detailed overview of the offshore oil & gas sector of the submarine fiber industry and covers system owners, system suppliers and various market trends. This MSR details how the industry is focusing on trends and new technologies to increase efficiency and automation as a key strategy to reduce cost and maintain margins, and its impact on the demand for new offshore fiber systems.
- **Regional Systems –** drill down into the Regional Systems market, including focused analysis on the Transatlantic, Transpacific, EMEA, AustralAsia, Indian Ocean Pan-East Asian and Arctic regions. This MSR details the impact of increasing capacity demands on regional routes and contrasts potential overbuild concerns with the rapid pace of system development and the factors driving development demand.
- **Submarine Cable Dataset** - details 400+ fiber optic cable systems, including physical aspects, cost, owners, suppliers, landings, financiers, component manufacturers, marine contractors, etc.
- **Coming Soon –** Cable Analysis Toolbox, Cable Planner's Toolbox, Mapping Tools, and more features into 2021!

These Market Sector Reports are available in a variety of subscription options and are updated every quarter.

These delivery changes are part of our larger website rollout which, by summer, will include a complete redesign of the entire Submarine Telecoms Forum site.

But in the meantime, pardon the dust. STF

Yours Sincerely,

Kristian Nielsen
Vice President


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