SUBMARINE TELECOMS FORUM

ISSUE 119 | JULY 2021

REGIONAL SYSTEMS

EXORDIUM FROM THE PUBLISHER

WELCOME TO ISSUE 119, OUR REGIONAL SYSTEMS EDITION

It has been another interesting northern summer in our industry. Like last year we are still managing through with various COVID protocols, but the pace of activity is quite simply astounding. All the factories are busy; all the cableships, too. A slight delay in one program will ripple to others for weeks, and managers are busily reorganizing Gantts, plans, assets, and people as the latest realities dictate.

But the buzz of this industry machine is positive and forward-looking, and you feel like we are quickly moving beyond.

For our part in Virginia, we are starting to look at things anew and with clearer, refocused eyes - simple things at first like renovating our office. Not that things were so bad, but it had been about five years or more since the last time we even thought about walls and carpets and furniture, and we decided it would be nice for everything to have a good refresh. And so, we hired an interior designer who came to see our facility, then used her carte blanche control to suggest whatever, and now we will spend the rest of the summer dodging various workers, all the while working ourselves and projects at a breakneck pace.

Installing the video system in our conference room has been a godsend. Borrowing heavily from a fellow consortium member, we realized from recently meeting in their offices across town how we needed a system that would emancipate us from the multiple small screens of our laptops, as well as enable us to sit together around the table. And when we added this capability the rest of the office looked tired and dull and in need of a rejuvenation. We hope to have the dust settled before an all hands meeting in early September.

Borrowing heavily from a fellow consortium member, we realized from recently meeting in their offices across town how we needed a system that would emancipate us from the multiple small screens of our laptops, as well as enable us to sit together around the table.

If you give a mouse a cookie…

And of course, for most of the month of July the *Tour de France* has been blaring from the TV in the lounge just loud enough so that I can track the peloton from my desk in my office. I have been known to quietly leave meetings this month only to come back with an update on some rider cracking or virtual standings or something. I have been astounded to watch daily one particular rider who hadn't been picked for the previous two years' team squads and who was tapped just two weeks before this year's race who is at this

writing leading the Green jersey competition. Despite his advancing age (in peloton years), he is magical to watch.

Hats off to the French for giving us another memorable *Tour*.

Thanks to an especially capable bunch of authors, we have yet another awesome crop of articles this issue. It has become a genuine pleasure to review various commentaries as they arrive in the weeks leading up to publishing. It's the gift that just keeps giving.

Hats off to our authors for giving us another memorable issue. Of course, our ever popular "where in the world are all those pesky cableships" is included as well.

We hope this continues to find you well, productive, and positive for the days ahead.

Good reading and *Vive le Tour*, STF

Good reading and stay well,

Wayne Nielsen, Publisher

submarine telecoms
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NEXT ISSUE: September 2021 – Offshore Energy

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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 Pacific Telecommunications Conference in January each year.

VIDEO STREAMING AND TUTORIALS

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 the backhaul to interconnection services in order to maximize network efficiency throughout, 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 ENERGY: provides a detailed overview o 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. STF

ANALYTICS

BY KIERAN CLARK

Welcome to SubTel Forum's annual Regional Systems issue. This month, we will take a brief look at system progress around the world and talk a little bit about some of the challenges the submarine telecoms industry faces in the various regional markets. The data used in this article is obtained from the public domain and is tracked by the ever-evolving SubTel Forum Analytics database, where products like the Almanac, Cable Map, Online Cable Map and Industry Report find their roots.

BY THE NUMBERS

Over the past five years, AustralAsia has seen the bulk of new system activity with more than one-third of all new cable systems implemented in this region since 2016. The Americas have also observed significant new system activity with nearly one-quarter of all new systems being implemented in this region during the same time period while the EMEA region received nearly one-fifth of all new system activity. (Figure 1) This increase was almost certainly due to the rising importance of cloud services around the globe and especially due to the activity of Hyperscalers.

The period 2014-2016 saw an average of under 30 thousand kilometers added annually, with 2015 adding only 15.8 thousand kilometers. 2017 added nearly 100 thousand kilometers of cable and while this was a standout year, 2018 observed a slight decrease to just under 75 thousand kilometers and 2019 fell all the way to just under 35 thousand kilometers added. (Figure 2) This could simply be the result of the historically boom and bust nature of the submarine fiber market as multiple, very large projects were implemented in 2017 and 2018.

Fully 80 percent of system growth through 2023 will take place in the Americas, AustralAsia, EMEA and Transpacific regions.

Comparing to the previous figure, while there may be a high number of new, if smaller, systems each year, regional systems then total the kilometers of cables added for the year will stay low, as was the case in 2019.

However, despite the difficulties imposed around the world by the COVID-19 pandemic, 2020 observed an increase of just over 50 thousand kilometers of cable to the global network. This addition in cable kilometers was due to the implementation of several long-haul transoceanic systems, spanning thousands of kilometers each – specifically in the Transpacific, Transatlantic and AustraAsia regions. While this is a modest increase, it is a noticeable improvement over the previous year.

LOOKING AHEAD

Fully 80 percent of system growth through 2023 will take place in the Americas, AustralAsia, EMEA and Transpacific regions. This growth is spurred on by the infrastructure demands of Hyperscalers in Africa, Asia and Europe and is in addition to new routes to South America and throughout the Caribbean from local telecoms providers and governments. These new projects will provide both traffic diversity and connect growing markets in South America and Africa directly and work to meet increasing end-user demand for cloud services.

These days, the name of the game is connecting data center hubs rather than countries. As a result, expect to see the most activity between East Asia and the United States, Europe, and the United States and between North and South America due to the network demands of Hyperscalers. Additionally, routes in regions such as the Transatlantic and Transpacific are comprised of many cable systems that are older than 10 years and so are experiencing a resurgence of new system development to replace aging infrastructure.

Based on reported data and future capacity estimates, global capacity is estimated to increase up to 57 percent by the end of 2023. The Americas, EMEA and Indian Ocean regions in particular are projected to double their current capacity during this time while the AustralAsia, Transatlantic and Transpacific regions will receive comparatively small capacity additions as the Hyperscalers have recently finished several builds in these regions and moved on to oethers. So, while the AustralAsia and Transpacific regions are experiencing a similar amount of new system activity, the capacity from these new cables is comparatively small compared to those of the planned Americas and EMEA systems.

Additionally, the continued adoption of cloud services and the need to mirror content all over the world will continue to drive bandwidth demand – though it remains to be seen if that translates into additional new systems or route kilometers. With the advent of new upgrade technologies and equipment being implemented that can use far more channels than before, it is possible

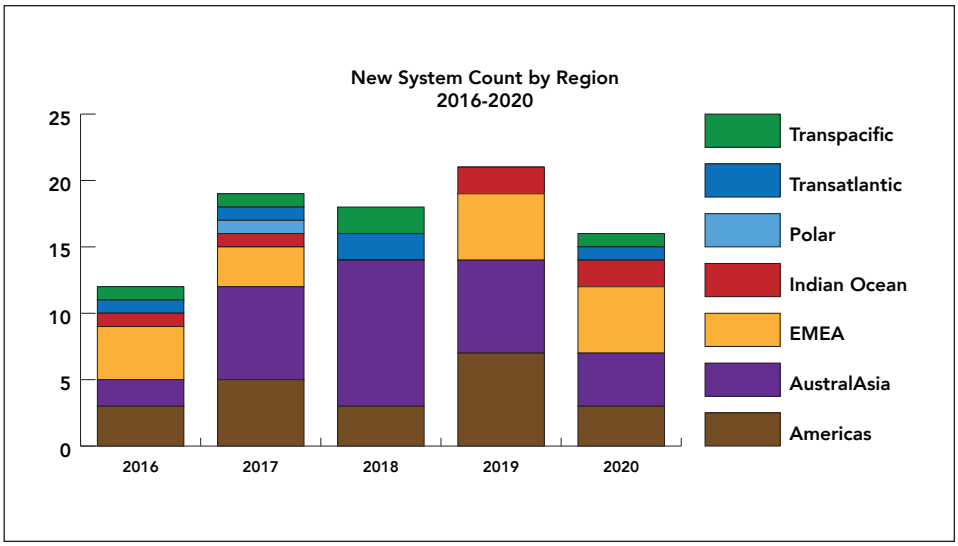

Figure 1: New System Count by Region, 2016-2020

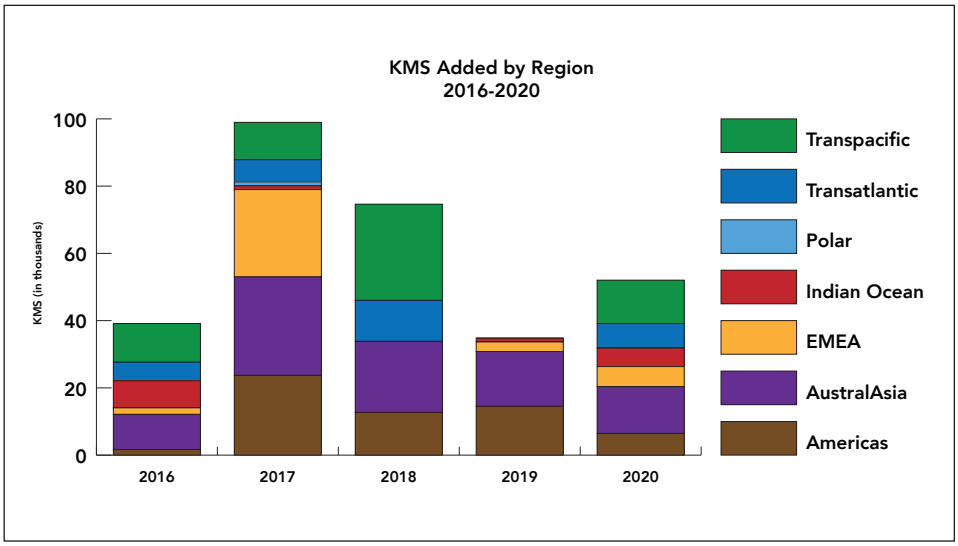

Figure 2: KMS Added by Region, 2016-2020

ANALYTICS

BY KIERAN CLARK

that fewer new systems will be required to address bandwidth demands.

THE BOTTOM LINE

Overall, the past five years have kept the industry at large busy. But there is one question that must surely be at the back of everyone's minds: "How long will this last?"

The long and short of it is: demand for data shows no signs of slowing down any time soon – especially as a result of the increase in cloud services and remote working brought about by the COVID-19 pandemic. Hyperscalers are practically scrambling to rise to the challenge of meeting demand, and that means more work for the submarine fiber industry. Across the globe, countries that manufacture cable and operate the cable ships that install them are beginning to come out of the grips of the COVID-19 pandemic and are getting back to business as usual.

However, while all this positive outlook is a good thing, there is always the risk that some sort of unforeseen market force might disrupt everything — as COVID-19 did to all markets in 2020 and 2021. Who knows what the next global pandemic or catastrophe might be? Additionally, there is still a lot of uncertainty around Hyperscaler activity and whether they will continue their rapid pace of system deployment indefinitely. It will be especially important to take the lessons of the past two years to heart and plan better for future market disruptions.

With all these data points in mind, while the positive outlook is very much deserved, it is always important to be smart and cautious. The submarine fiber industry is the foundation of our modern world and we have quite the responsibility to be a solid one. STF

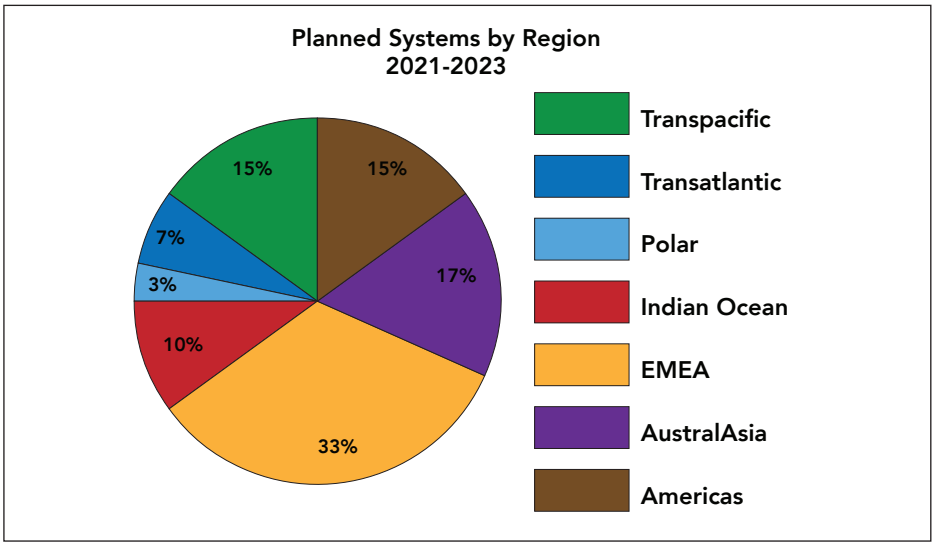

Figure 3: Planned Systems by Region, 2021-2023

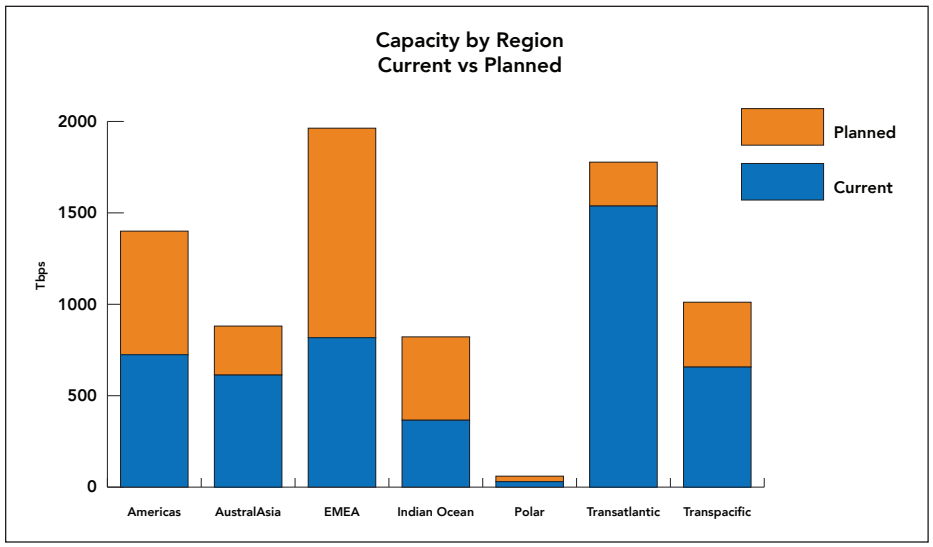

Figure 4: Capacity by Region, Current vs Planned

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.*

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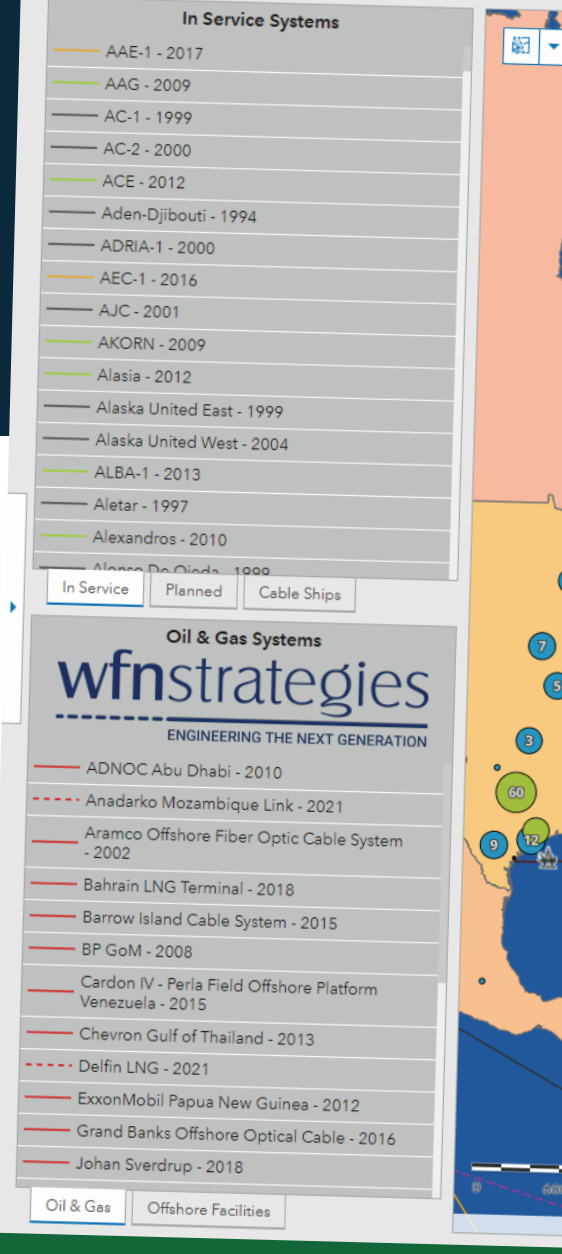


The SubTel Cable Map is built with the industry standard Esri ArcGIS platform and linked to the SubTel Forum Submarine Cable Database. It tracks the progress of over 400 current and planned cable systems, 45+ cable ships and over 950 landing points. Systems are also linked to SubTel Forum's News Now Feed, allowing viewing of current and archived news details.

This interactive map is a contin-ual work in 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.

The SubTel Cable Map makes use of the ArcGIS Dashboards platform. This allows users to see an array of key data points without having to dig through complicated menus and settings to drill down into the data that is important to you. For this update, the map has received a significant visual and organizational overhaul. The quick reference information and graphs have been moved into a separate dashboard below the map itself in order to keep the focus on what is important – the submarine cable systems themselves.

The item lists have been streamlined, removing visual and organizational clutter while the search feature in the top right corner of the map allows users to directly search for cable systems and landings by name. Additionally, be sure to check out the slide over panel on the left-hand side of the map to filter data based on Region, System Supplier, System Installer, System Owner or whether or not a system is Unrepeatered.

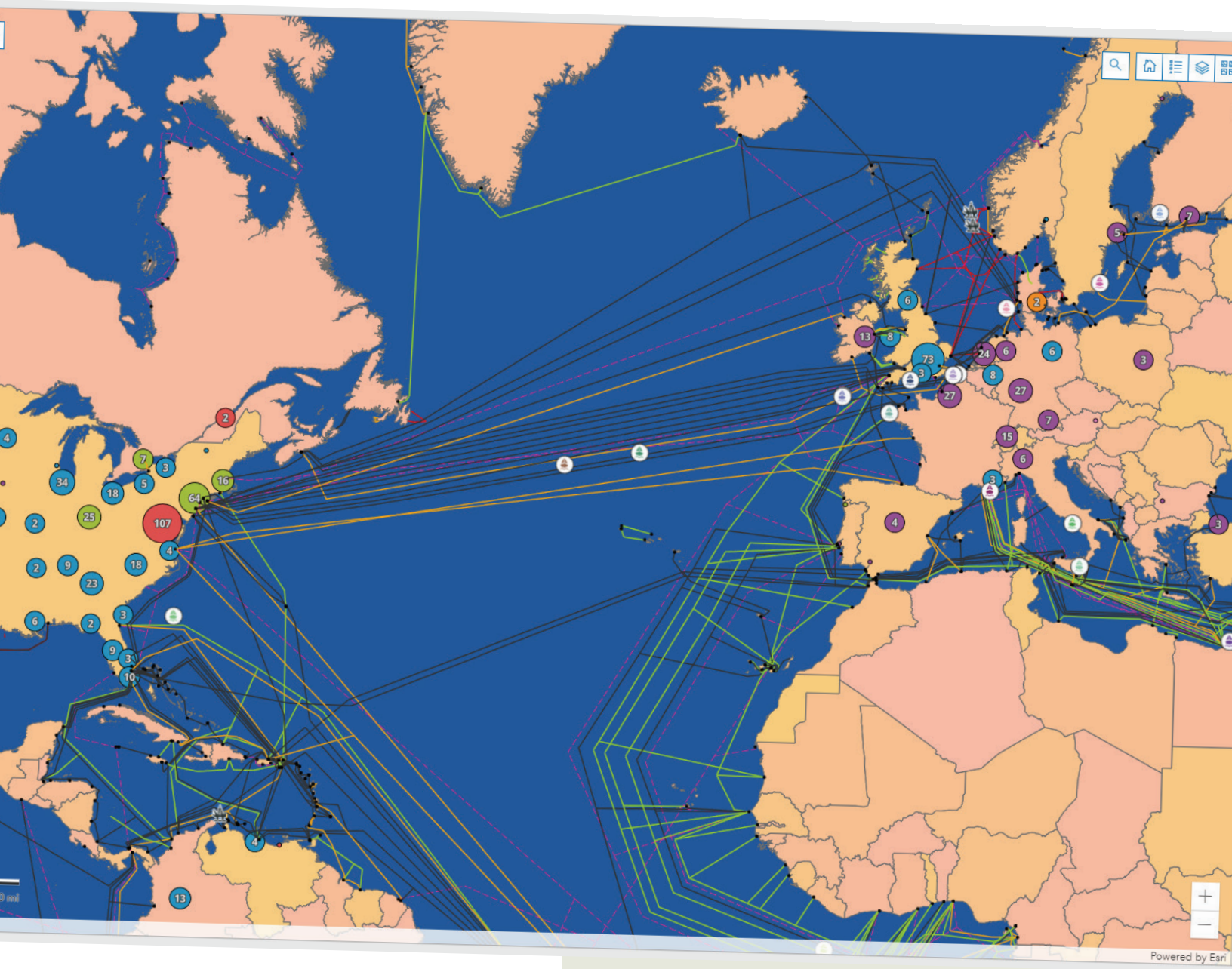
This interactive map is a continual work in progress and regularly updated with pertinent data captured by analysts at SubTel Forum and feedback from our users.

For those who still want the analytical data provided in the previous version of the map, this can be found just below the map on the same page. Want to know how much capacity is available along Transpacific routes or how many kilometers of cable a supplier has produced over the last five years? Now all it takes is couple simple clicks to see your data!

Finally, we have created an initial version of the Subma-

Since the last issue of the Magazine, we have continued working hard rolling out our brand-new database. This overhauled system now allows us to provide automated weekly updates moving forward and ensure the data is more accurate than ever. We are excited to keep expanding these capabilities – stay tuned for additional updates and improvements!

SUBTELFORUM.COM/CABLEMAP



rine Cable Industry Timeline Map. This brand-new map shows users the timeline of systems added to the global network from the year 2000 all the way to those planned through 2023. See just how far this industry has come and get an idea of where it is going with a single click of a button. Check out the brand-new Industry Timeline Map here: *https://subtelforum.com/industrytimeline*

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*. STF

THE FULL LIST OF UPDATED SYSTEMS ARE AS FOLLOWS: JULY 19, 2021

Systems Added
Africa-1
Firmina
HARP
HCS
IONIAN
KLI
Loukkos
NWCS
PC2
SPSC/Mistral
TOPAZ
WAF West Africa
Systems Updated
AAG
Bifrost
Columbus II
CrossChannel Fibre
GO-1
Italy-Malta
Malbec
NO-UK
PEACE
Prat
SING

WHERE IN THE WORLD ARE THOSE PESKY CABLESHIPS?

BY REBECCA SPENCE

What a difference a year makes! Last summer, very few announcements were made regarding submarine cable projects, and the first half of this year we've seen an outpouring of project milestones in the industry. In the last two months alone, the Decisive laid the final portion of SPCS/Mistral, Southern Cross NEXT touched down at Takapuna Beach, and the installation of NO-UK began. But Covid-19 is still affecting the industry's front-line workers and the companies they work for. For instance, the Ile de Re was forced to go to Malaysia instead of Singapore to receive its first cable load from the BBC Dolphin. A change that was not only costly, but logistically difficult due to covid regulations and quarantine requirements varying per country.

Currently the fleet has an average age of 27 years among the 47 vessels we track. With the number of cables that will start going out of service in the next several years, the current fleet will not be able to accommodate the number of projects needed to maintain the status quo.At present, most installers have booked their fleets through at least a few years out. As the demand for subsea links and capacity continues to increase, the need to replacethe aging cable ship fleet becomes even more significant, and installers are paying attention.

Orange Marine, for one, has ordered a new vessel dubbed the C/S Sophie Germain. The vessel will ease the pressure on cable installation vessels as her primary role will be the repair of power and optical fiber cable. She will also be designed to reduce its environmental footprint with 20% lower CO2 and 80% nitrogen oxide emissions, something that is very new to the industry's current fleet. Another big announcement in the last several

Figure 1: Ile de Re receiving cable from the BBC Dolphin

Figure 2: Prysmian Group's Leonardo Da Vinci

Figure 3: The Normand Clipper

weeks was from ASN, who will be converting two vessels for installation and repair of subsea cables. These additions are a huge step in the right direction for the future forward momentum of the industry. Though primarily power cable vessels, the addition of Prysmian Group's new vessel the Leonardo Da Vinci and the conversion of the Normand Clipper are important additions as they are capable of laying telecommunications cables.

Regarding the progress of the current fleet let's look at some data from of the last two months. As of the end of June when the data was obtained, 23 percent of the vessels were moving towards their subsequent destination. Of that 23 percent, four were only days away from reaching their next destination, three had at least a week, and one had a month.

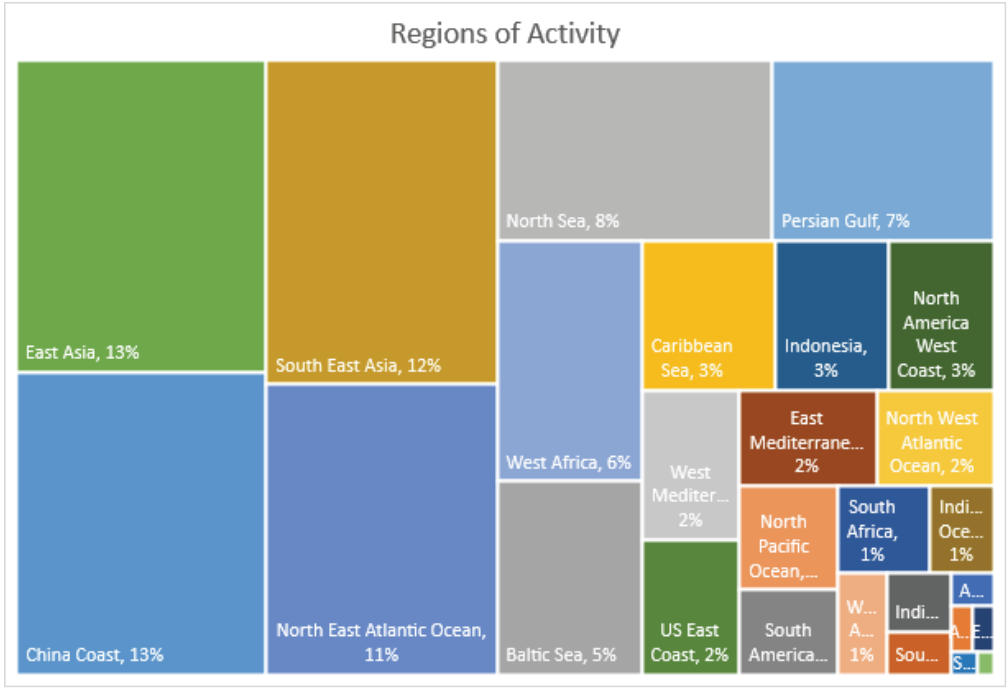
The regions of activity have not seen a large shift. East Asia, China Coast, and South East Asia were still in the top four most active regions. 12 vessels passed through both East Asia and China Coast, with Asean Protector and KDDI Ocean Link reporting their locations there the entire two month span. 10 vessels reported going through the North East Atlantic and another eight were in the North Sea and South East Asia.

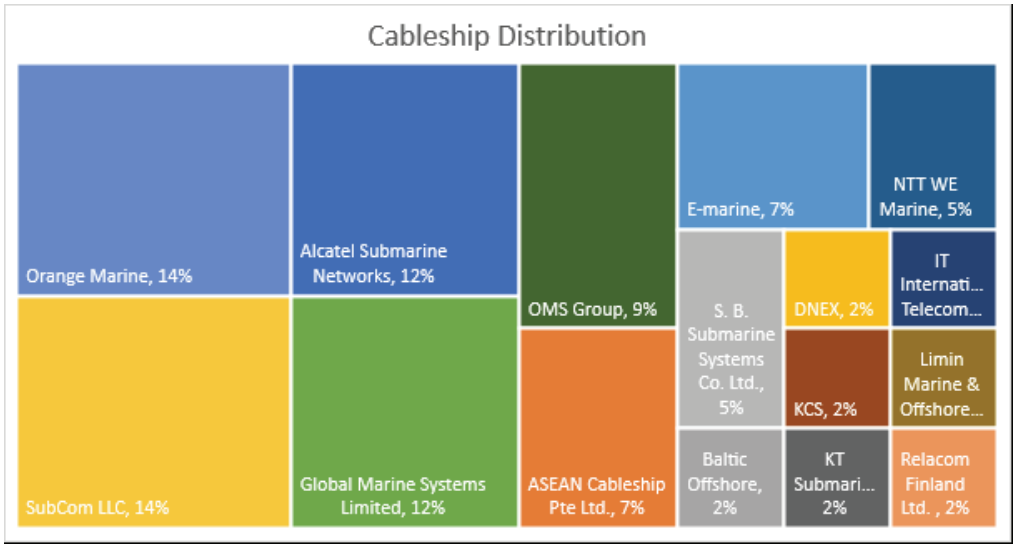
West Africa dropped out of the top four but with the Teliri currently heading to Africa to begin installation of the Equiano Cable System, that number should increase in the coming months.

As this article only actively tracks telecoms cableships, the addition of the Leonardo Da Vinci and the Normand Clipper have not changed the cableship distribution chart. But, with the other vessels that are set to join the fleet in the coming years, this will begin to shift.

Don't forget to reach out if you have vessel news to share and would like to see it in the next issue of Where in the World are Those Pesky Cable Ships! Until then, you can check out the status of the cableships we track on our Interactive Cable Map at *https://subtelforum.com/cablemap/*.STF

REBECCA SPENCE *is a Research Analyst from Submarine Telecoms Forum. Rebecca possessed more than 10 years' experience as an analyst and database manager including for the small business division of a prominent government contractor, General Dynamics. She is a regular contributor to SubTel Forum Magazine and is based out of Hillsborough, North Carlina USA. to design, construction, operation and maintenance of optical networks, terrestrial and submarine.*





FEATURE

6 QUESTIONS WITH SANJAI PARTHASARATHI:

Talking Technology Trends with II-VI Incorporated's Chief Marketing Officer

Sanjai Parthasarathi joined II-VI in 2013 and has been the Chief Marketing Officer since 2019. Previously, Dr. Parthasarathi was Vice President, Product Marketing and Strategy, for II-VI Photonics since 2015. Prior to II-VI, he served as Senior Director, Product Line Management, at Oclaro. With over 28 years of broad management and technical experience, Dr. Parthasarathi has held a variety of progressive roles in R&D, manufacturing, product line management, and marketing, including senior business and technical management positions at Avanex Corporation, Oplink Communications, TeraStor, Western Digital, and Concurrent Technologies Corporation. Dr. Parthasarathi graduated from the Indian Institute of Technology, Madras, with a B.S. degree in Mechanical Engineering, and holds an M.S. in Mechanical and Aerospace Engineering from the University of Virginia and a Ph.D. in Engineering Science from the Pennsylvania State University.

1. WHAT IS II-VI INCORPORATED'S MISSION?

The II-VI corporate mission is "Enabling the world to be safer, healthier, closer, and more efficient." Our continuous investments and innovations underpin many of the transformations that the world is experiencing today — that is, becoming more connected, intelligent, mobile, and electric.

2. HOW DOES II-VI INCORPORATED PARTICIPATE IN THE SUBMARINE CABLE MARKET?

II-VI supplies highly reliable components and subsystems that our customers integrate into their submarine cables.

Our market-leading products include:

- 980 nm pump lasers
- Wavelength selective switches (WSS)
- Photodetectors

3. IS II-VI INCORPORATED CURRENTLY INVOLVED WITH ANY NEW SUBMARINE CABLE PROJECTS?

II-VI provides several products and solutions used

in many of the new long-haul transatlantic and transpacific cables, as well as in some intra-regional submarine cable projects located off the coasts of the U.S., Canada, Europe, Africa, Asia, Oceania, the Middle East, and Latin America.

4. WHAT MAKES II-VI INCORPORATED UNIQUE IN THE SUBMARINE SYSTEM MARKET?

II-VI is a leading supplier of components and modules for optical networks and is one of a very few suppliers that meet the stringent reliability requirements for submarine systems.

5. WHAT ARE THE ELEMENTS OF II-VI INCORPORATED'S SUCCESS?

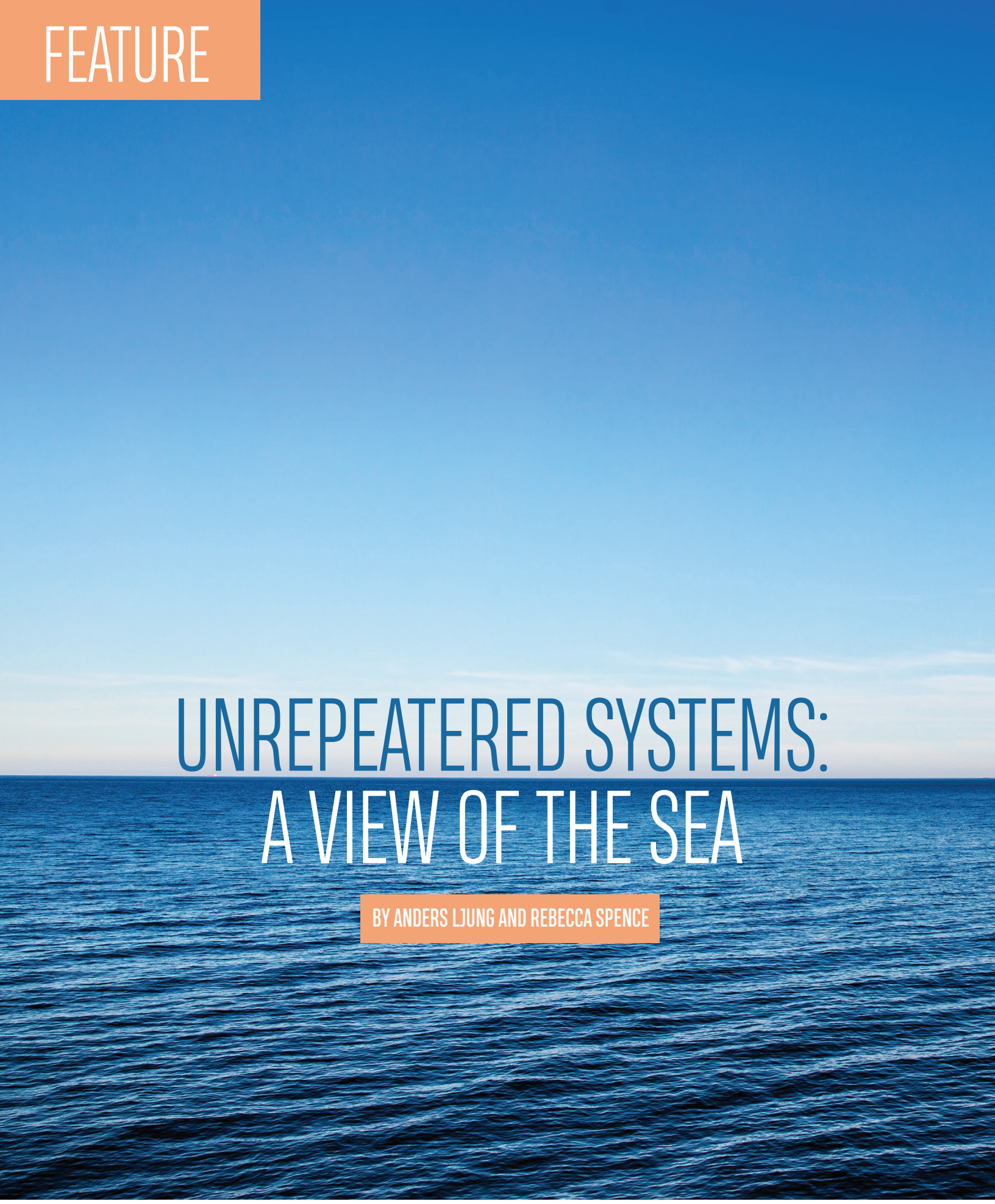
II-VI leverages its broad portfolio of products to work closely with its customers to provide highly integrated and highly reliable optimal solutions.

In addition, a long history of cross-functional expertise, coupled with a vertically integrated technology platform that extends from materials to devices, modules, and subsystems, enables II-VI to offer its customers the best solutions with high performance and reliability, high energy efficiency, and critical on-time deliveries.

Moreover, due to timely strategic investments, II-VI has proven that it can design and produce market-leading products to the exacting reliability standards of the submarine market.

6. WHAT IS NEXT FOR II-VI INCORPORATED?

II-VI will continue to develop innovative technologies and products to enable the needs of next-generation submarine systems, both with active, passive, and integrated solutions. STF



UNREPEATERED SYSTEMS: A VIEW OF THE SEA

BY ANDERS LJUNG AND REBECCA SPENCE

Unrepeatered cables form an important part of submarine connectivity, but have largely gone unscrutinised by the industry, mostly due to their simple design and distance limitations. Unrepeatered links were the original 'Open Systems' owing mainly to their passive nature, and they are often procured in a disaggregated manner largely due to the simplicity of their line design. They are used for different purposes in several markets. For pure telecoms, they typically form short point-to-point systems between neighbouring countries, regions and islands. They can add expand links to international connectivity by joining onto transoceanic systems at their landing points, and they are typically used to cross harbours, rivers and lakes.

Unrepeatered links are also used to provide connectivity to and between oil platforms, offshore wind farms and ocean observatories. They provide a telecoms path to power systems, either as an integral package or an outrider cable. Unrepeatered systems do away with the need for power feeding equipment, repeaters and line monitoring equipment, making them attractive for parts of the world where resources are limited, or locations where high -power equipment may not be desirable, such as oil platforms. We believe the role they play in both regional subsea connectivity and supporting telecoms infrastructure within sister networks such as oil & gas, renewables and power cables is too significant to go undiscussed. There will always be a requirement for short hop connectivity and the advantages it offers in terms of cost, timescales and complexity.

Figure 1 STF Map of Unrepeatered Systems

Earlier this year, SubTel Forum carried out a review of unrepeatered activity across the globe. The difficulty with studying this subject is that the majority of unrepeatered systems go unannounced, in particular those which support oil & gas networks and power cables. Many contract awards are directed and every supplier will not receive every tender. Based on Hexatronic internal sales data and an analysis of the market share of each of the cable suppliers, we estimate that the ratio of announced to installed systems is around 1:5. The information reported below is based solely on publicly announced telecommunications cable systems, and those that Hexatronic have specifically been involved with. We have tried to indicate where we believe the numbers are skewed by lack of available data and which trends we believe are valid and which we do not.

Based on publicly announced projects for the period between 2016 to 2020, there were a total of 97 unrepeatered systems put into service during this time, see Figure 2 below. We at Hexatronic estimate that a further ≈400 unrepeatered links were installed globally during this five-year period.

It is interesting to see the general trend of increasing demand over the last five years mirroring the pattern that we see in the repeatered market, with the slight slowdown in 2020 considered to be related to the impact of COVID-19 on delivery timescales. It is anticipated that figures for 2021 will reflect more closely the growth rate seen between 2016 and 2019.

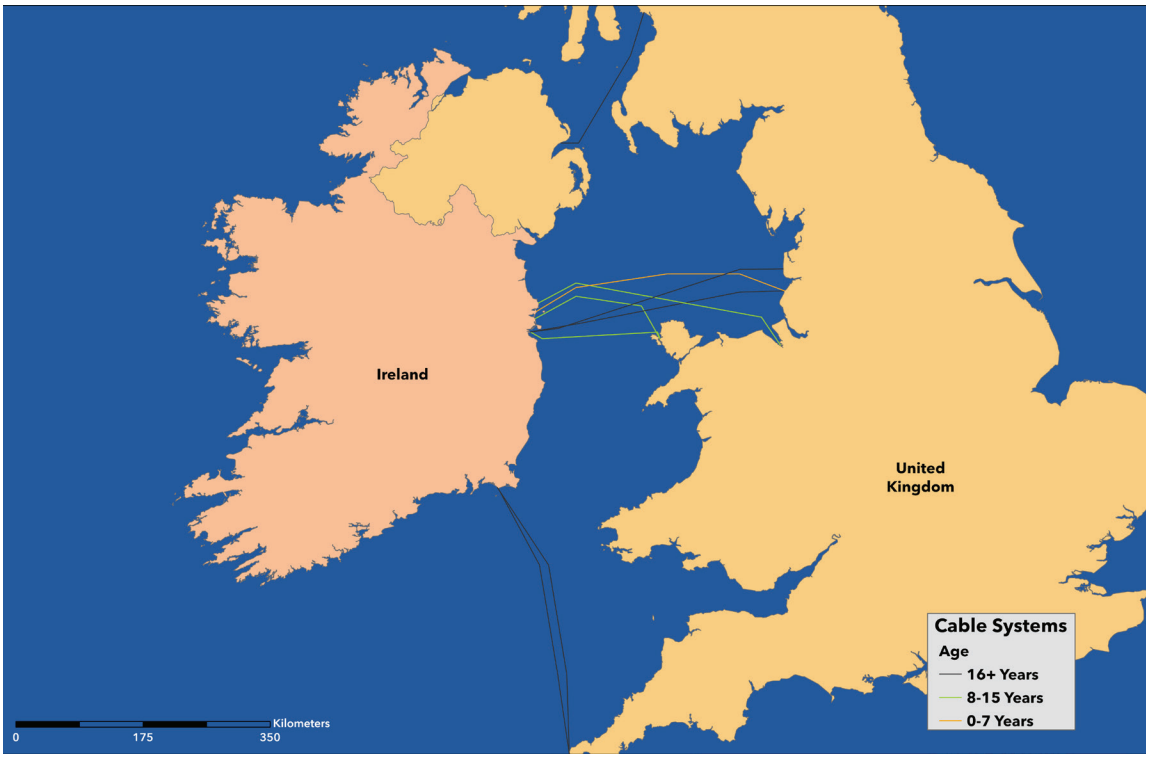


Figure 1 STF Map of Unrepeatered Systems

It is much harder to extrapolate the data when we start to delve into the length of unrepeatered cable that has been delivered during this period. Unrepeatered systems can range from one or two kilometres, up to, four hundred to four hundred and fifty kilometres, and although we can make some assumptions around the number of tenders that are released globally, it is difficult to put a figure to the scale of each project. Looking solely at public data, alongside Hexatronic's own delivery figures, we see fluctuating lengths of cable kilometres installed per year, see Figure 3. Taking 2016 and 2017 as an example, the same number of systems were announced as going live, but only half as much cable was produced in 2017. We see an average delivery per annum of around 2,200km and a total of over 11,000km. It is probably fair to say that this number could have been four-fold in reality, but it all depends on the purpose of each of these systems, 2,200km is a lot of lake crossings!

Diving a little deeper into the regional make up, we have a good understanding of the market in Europe but it is far harder to find public records of unrepeatered builds in other parts of the world, particularly in Asia and Oceania, hence the data below appears skewed. Although there has been a lot of activity in Europe in the last five years, particularly relating to power systems and oil & gas interconnects, we do believe that there has been more growth than depicted below in Southeast Asia and invite our international colleagues at ZTT and Heng Tong to comment on this aspect. Looking forwards, we can for example, expect to see increasing links to offshore wind farms as new developments in North America start to take off.

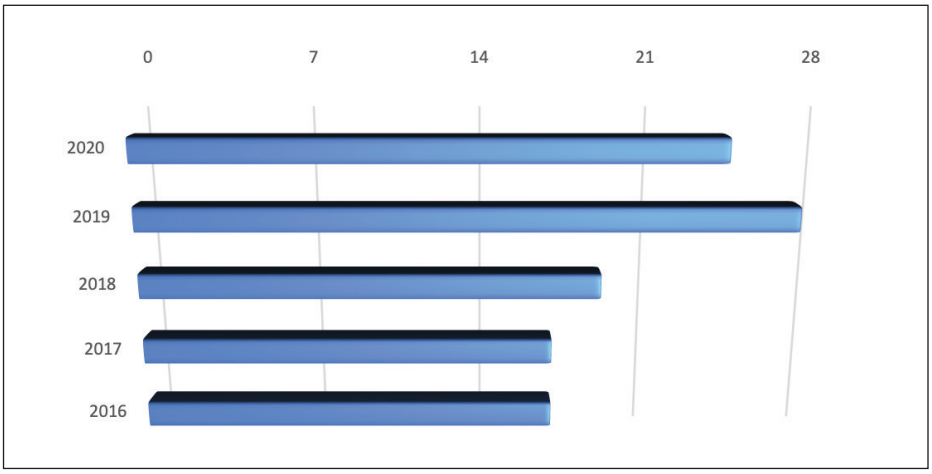


Figure 2 Publicly announced unrepeatered systems per year

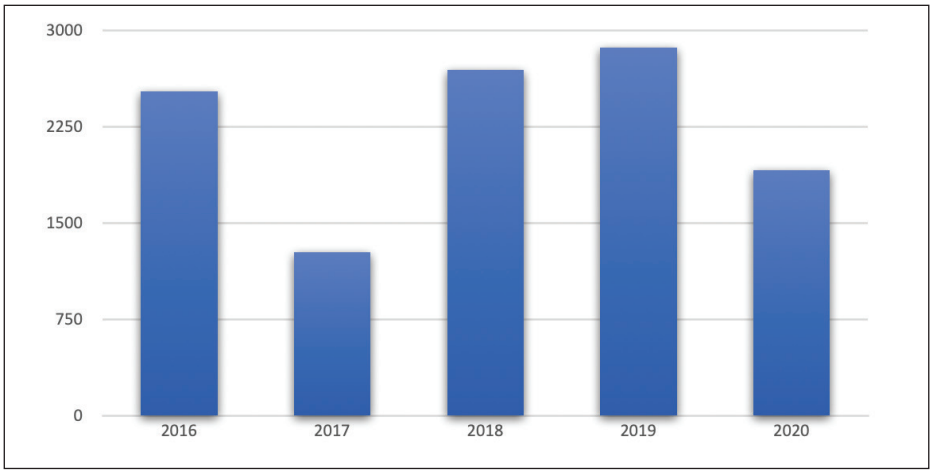


Figure 3 Publicly announced unrepeatered cable kilometres, 2016-2020

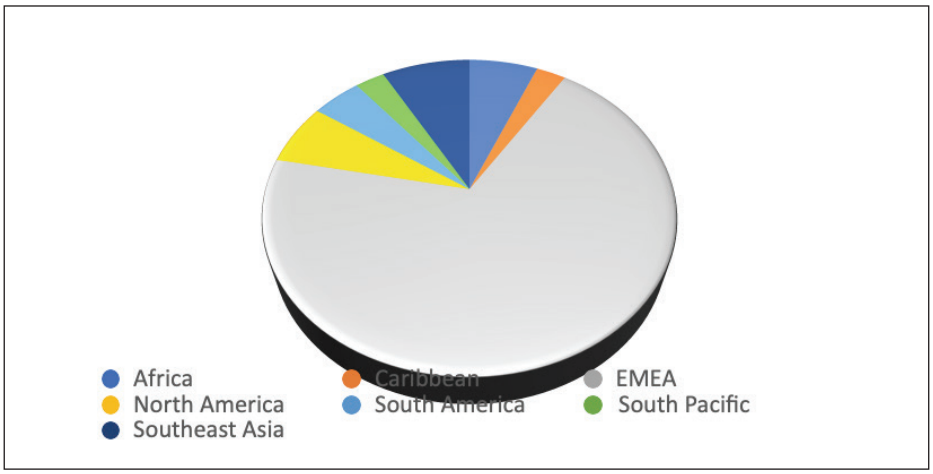


Figure 4 Publicly announced unrepeatered systems by region, 2016-2020

From an investment perspective STF's analysis is that unrepeatered cables have been responsible for an estimate of around $400 million total investment over the period from 2016-2020. This averages at $81.5 million a year with the most investment in Europe, Southeast Asia and Africa, and the least, of around $10.4 million in the Caribbean.

WHAT NEXT?

Looking forwards, new unrepeatered projects have been announced in Europe, North America, South America and the South Pacific, which we expect to be implemented in 2021. We do anticipate regional construction plans to differ compared to recent years. As more of the islands in the South Pacific have gained connectivity, we are likely to see less growth there, and a renewed focus in Europe and African countries as they start to replace ageing infrastructure and grow to meet increasing data demands. Emerging markets in South America are also likely to increase activity there.

What we also see, is that it is becoming the norm to build international point to point systems with large numbers of branching units or stub BUs into less developed regions and islands, which is likely to have some effect on the ratio of unrepeatered vs. repeatered telecoms systems. Similarly, for pure telecoms purposes, we may see the advent of Space Division Multiplexing (high fibre count SDM repeatered cables) having an effect on the unrepeatered market – although the cost, complexity and timescale disadvantages of repeatered vs. unrepeatered supply for short distances will still remain.

The fact that it is possible to buy unrepeatered cable directly from a number of manufacturers who do not typically supply turnkey telecoms systems, such as NSW, Nexans and Hexatronic, means that in this field the customer does not run the risk of project delay relating to other aspects of system delivery, such as repeater manufacture for example. Most repeatered systems suppliers are extremely busy for the foreseeable future, and the likelihood of them being able to prioritise a sub 300km project is very low, and for this reason we do still expect to see the numbers of publicly announced unrepeatered systems to continue to grow in the next three to five years.

As the early generation (2000s) transoceanic systems approach the end of their commercial life, there are also opportunities to provide local onward unrepeatered connectivity to the new international systems that replace them. And as alternative energy continues to grow, so do the unrepeatered connectivity opportunities that it brings. Power utilities companies installing new interconnect power cables or new offshore wind farms always include fibre cables for telecoms purposes. This has been quite a substantial part of the unrepeatered business for the past 20 years and we expect that this will continue together with the increasing need for energy.

AN AFTERTHOUGHT

It continues to be a challenge to understand the make-up of unrepeatered systems around the globe. Whereas transoceanic and regional repeatered systems are well documented in cable maps and databases, the details of most unrepeatered links remain largely unknown and therefore not able to be analysed in their entirety. We continue to encourage the subsea community to share data around this equally important infrastructure so that it can take its place in history alongside its larger siblings.

In conjunction with this article, SubTel Forum has added the exclusive feature to their online Cable Map which allows users to filter and view only unrepeatered cable systems. We hope this feature helps to foster further public discussion about the unrepeatered market. If you have additional data to add to this new feature, please reach out to *rspence@subtelforum.com*. STF

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FEATURE

FROM DREAMS TO REALITIES:

Surge in Subsea Cable Connectivity in the Pacific Islands

BY GEORGE SAMISONI

INTRODUCTION

The small Pacific Island nations of Niue, Tokelau and Christmas Island each have a population of less than 2000.

Niue is now connected to a subsea cable, whilst the Tokelau and Christmas Island will experience subsea cables with capacities in the gigabits for the first time, landing at their shores before the end of 2022.

What were only dreams have turned into realities.

The social and economic impact for the island nations would be enormous as they board the global subsea cable telecommunications bandwagon.

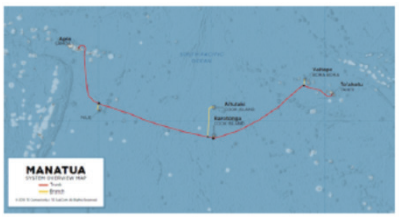
The international connectivity of small island developing states (SIDS) remains key to their economic development and creation of their own information society. Access to international subsea cable networks at reasonable costs, including submarine cable capacity is central to the realisation of universal broadband access policy goals in many Pacific island countries.

Most Pacific Island nations have attracted significant public and private investments in subsea cables for their sustainable network infrastructure and international internet bandwidth. Deployments of subsea cables have been rapid for the last four years.

Subsea cable investments are capital intensive. The multilateral development banks recognize the significant lack of capital in the Pacific Island nations for subsea cable connectivity, whereas the economic impact could be immense.

The lack of affordable, good quality internet access thus came to be identified as the principal constraint to further ICT diffusion and long term economic and social development more generally. This coincided with the recognition that greater integration of the island economies, both nationally and with the larger neighbouring economies, was essential to the sustainable development of the Pacific islands and overcoming the economic costs of distance.

Towards these ends official development assistance from multilateral development banks, has in recent years been directed towards the construction of submarine cables to the Pacific islands and, once landed, economic reforms to ensure the potential economic benefits are realised.



Manatua Cable System
(Samoa - Cook Island – Niue - French Polynesia)

Southern Cross Next Cable System
(Australia - New Zealand – Fiji – Kiribati – Tokelau - USA)

PACIFIC ISLAND ICT CHALLENGES

When the COVID pandemic hit at the turn of 2020, it challenged the foundations of social and economic normal of Pacific Island nations. The Internet infrastructure came under huge stress, though in general it remained resilient enough to respond to traffic spikes. However it is clear that this resilience has not been uniform, simply because Pacific Island nations are at varying levels of digital readiness.

Subsea Cables - 2020	International	Domestic
Commissioned	26	20
Under-Construction	19	8
Planning	1	0
Total	**46**	**28**

Subsea cable connectivity at end of 2020

Category	PICs	Percentage
Two or more international subsea cable connectivity	American Samoa, Northern Mariana Islands, Fiji, Guam, Samoa, French Polynesia, Papua New Guinea	30%
One international subsea cable connectivity	Federated States of Micronesia, New Caledonia, Palau, Marshall Islands, Tonga, Vanuatu, Wallis &Futuna, Solomon Is, Niue, Cook Islands	45%
International subsea cable connectivity under way	Kiribati, Tokelau, Nauru	14%
Subsea cable plans for connectivity	Tuvalu	5%
No subsea cable connectivity plan	Pitcairn Is	5%

Subsea cable connectivity by end of 2022

Amidst the pandemic, ICTs hold great hopes for recovery and helping the Pacific Island nations move forward with new approaches, which will also be essential for the fulfillment of the Sustainable Development Goals (SDGs).

ICTs are literally keeping the world stitched together in the midst of this pandemic.

Whilst the COVID crisis is serving as a catalyst for bringing about a paradigm shift in how the island nation communities use ICT, it is also starkly revealing the consequences of the digital divide amongst the Pacific Island nations.

A major learning from this COVID pandemic is the need for connectivity and the criticality of the Internet. The COVID crisis has highlighted the essential role that digital technologies play both during and after crisis. More widespread and affordable Internet access could make Pacific Island nations more resilient to future shocks.

Internet traffic patterns have shifted, and volumes surged, as the telecommunications industry responds to a new work-from-home landscape. It has changed the way Pacific Island nations live, work and connect.

The COVID has also shown the need for resilient networks, digital skills and awareness, the criticality of the Internet as well as opportunities presented for the industry and governments.

The Pacific Island nation population is around 12 million (excluding New Zealand and Australia). The number of Internet users in 2000 was around 200,000. In 2021, statistics indicate close to 3 million Internet users. This leaves 9 million Internet users unconnected, bulk of which is in Papua New Guinea.

Country	Currently active	Proposed additional	Country	Currently active	Proposed additional
American Samoa	2		Palau	1	1
CNMI	2	1	PNG	2	1
Cook Islands	1		RMI	1	0
FSM	1	2	Samoa	2	1
Fiji	5	2	Solomon Islands	1	1
French Polynesia	2		Tokelau		1
Guam	10	3	Tonga	1	1
Kiribati		2	Tuvalu		1
Nauru		1	Vanuatu	1	1
New Caledonia	1	1	Wallis and Futuna	1	
Niue	1	0			

Pacific Island subsea cable connectivity at end of 2020

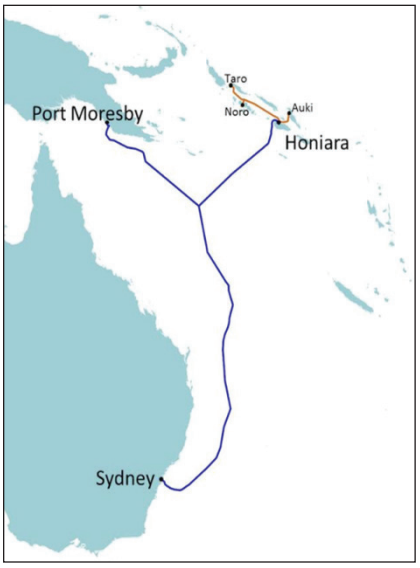
Internet penetration in the island nations is around 68%, though there are significant variances amongst the islands, especially those with reliable international connectivity.

Technology continues to deliver greater network capacity and reduce costs to consumers in the Pacific Islands.

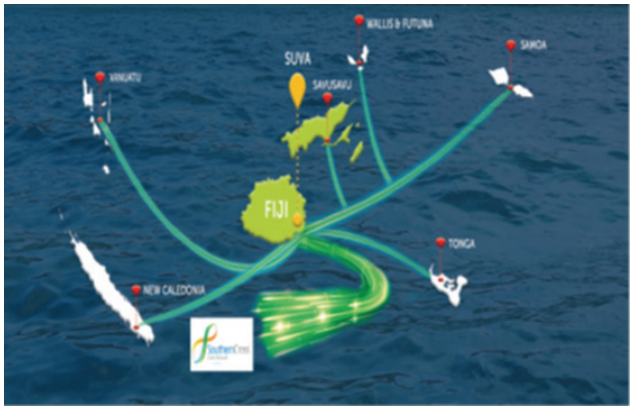
The surge in high capacity international subsea cables has prompted upgrades in domestic infrastructure, increase in penetration rates, new generation mobile technology and affordable consumer devices.

Mobile technology does play a pivotal role in the digital transformation of the Pacific Islands, proving a catalyst for innovation and economic growth, with the promise of new jobs.

The challenging natural environment and topography apart from low population densities are limiting factors on the provision of mobile coverage.



Coral Sea Cable System
(Solomon-PNG-Australia)



Subsea cable connectivity (Fiji)

THE CHANGING SITUATION – INTERNATIONAL CONNECTIVITY

International connectivity to the Pacific islands has improved significantly over the last decade. In 2007, only four Pacific islands were connected to an international submarine cable, Northern Marianas (CNMI), Guam, Fiji, and Papua New Guinea (PNG). Since then more international cable systems have been constructed bringing subsea cable connectivity for the first time to Pacific islands.

This is a remarkable development considering that for over a century submarine cables were only ever landed on a Pacific island to regenerate the communications signal so that it could complete its trans-Pacific journey.

Before the end of 2022, ninety-five percent of Pacific Island nations will be connected to subsea cables systems. The surge in connectivity has been particularly significant from 2019.

Pitcairn Island with a population of less than 100 may be the only exception.

Inclusive planning of recent regional networks have enabled the Island nations to obtain subsea cable connectivity through branching units (spurs), enabling inter-island and domestic connectivity.

THE FUTURE

To exploit fully the opportunities for economic and social development that are created by the landing of subsea cables, there is a need to develop the technical capacity of institutions and human resources in a number of key areas. This is distinct from and in addition to the need for the proposed cable landing station operator to develop the technical capacity to manage and operate the landing station and supply wholesale capacity services.

The development and implementation of appropriate ICT legislative and regulatory frameworks is a common early priority and will often comprise part of any development aid. Also important is the development of institutional knowledge and capacity for the development of ICT enabled policies and programs across the entire economy, in particular in areas of education, health, and government services.

These various capabilities need to be developed concurrently and the need for capacity development is often ongoing. They all have a bearing on the ultimate success of a cable project.

As the Pacific Island nations become more dependent on subsea cable systems, the growth in demand for capacities in the gigabits, apart from providing network resilience, there will be the need to secure a second international subsea cable.

Growth in investments in domestic subsea cables to link other islands will grow, for the realisation of universal broadband access policy goals, benefitting all communities and not only those in the urban centres.

As already seen from some island nations, the upgrade of existing international subsea cables systems will continue with the acceleration of digitisation. STF

GEORGE SAMISONI *is CEO of FINTEL and President of the Pacific Island Telecommunications Association (PITA). He possesses over 25 years of experience in international and regional telecommunications, including subsea cable and satellite commercial and technical management.*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FEATURE

THE MIDDLE EASTERN ADVANTAGE

Why the Region's Providers Are Best Suited to Support Global Connectivity

BY CENGIZ OZTELCAN

As organisations in all corners of the globe seek to pursue digital transformation, the importance of super-fast, super-reliable connectivity networks is at an all-time high. Businesses must be able to connect to different global locations both directly and seamlessly, ensuring that latency issues do not have a costly impact on customer and employee digital experiences.

Now that cloud technologies are maturing and the rollout of 5G is gathering pace, some may have lost sight of the vital role played by submarine and terrestrial cable networks in high-quality connectivity. The reality is that 98% of all international internet traffic travels through them, and they have become the essential enabler for business-critical services.

There are roughly 400 subsea cables functioning worldwide, offering varying levels of connectivity quality and capacity. Pick a point A and a point B on a global map and there is likely one or more subsea cables connecting them. These subsea cables serve as the information super-highways of the world. However, for global organisations looking for connectivity, it would be naive to believe that all routes are created equal.

For a moment, let's think about global shipping routes which provide an apt comparison for the importance of connectivity cable networks. The Suez Canal links the Red and Mediterranean seas, making it the shortest maritime route from Asia to Europe. In relatively recent history, the route has revolutionised the speed and reliability of shipping and has spurred global innovation. It completely removes the need to sail around the entirety of Africa, a route that will still get you from 'A' to 'B' but just in a much longer timeframe.

We don't have to go back too far to see what happens when one of these routes is taken out of action, even for a few days. In March 2021, the Suez Canal was blocked for five days after a container ship – the Ever Given – became stuck. The knock-on effects saw price rises as goods were unable to pass through causing delays and shortages to global supply chains. In order to keep moving, some ships took the Cape of Good Hope route around Africa (the route required before the Suez Canal was opened in 1869) which can add up to two weeks journey time.

Switching back to connectivity, longer route lengths have a direct impact on latency which in turn affects an organisations' performance. For those in Asia, the Middle East, or Europe looking to realise their digital transformation goals, latency is a considerable challenge and subsea cable routes that take data past South Africa should be an immediate red flag to potential performance.

That's why subsea cable providers based in the Middle East are uniquely equipped and situated to deliver intra-regional connectivity systems. Linking the three regions via numerous points of presence and cable landing stations, they provide the most direct route which contributes to lower latency and enhanced overall performance.

THE BACKBONE OF MODERN COMMUNICATION

Once driven by the need for access to low-cost connectivity, investment in submarine cables is now being driven by a demand for high volume, high-quality connectivity. Emerging technologies and services demand low latency as a minimum requirement, with society as a whole becoming increasingly dependent on digital devices, the internet of things, and connected technology.

Enterprises are also constantly calling for increased capacity and reduced latency in a bid to provide customers with innovative, differentiated digital services and experiences. A prime example is the growing deployment of augmented and virtual reality technologies (AR/VR), for the benefit of customers and staff alike in different sectors. The performances of these cutting-edge technologies hinge on connectivity quality, particularly in mission critical use cases.

Extensive subsea and terrestrial cable networks are vital to ensuring the availability of this kind of connectivity, particularly when reliable connectivity is required both ways on a single route. This is made apparent in the case of SD-WAN technology, software-defined networking within a wide area network. SD-WAN offers a range of benefits to organisations, including centralised manageability and reduced costs, but these can only be effectively unlocked through robust international connectivity.

Switching back to connectivity, longer route lengths have a direct impact on latency which in turn affects an organisations' performance.

THE MIDDLE EASTERN ADVANTAGE

To access the robust, high-quality connectivity necessary for the tech opportunities we have discussed above, carriers and enterprises cannot afford to compromise. In geographical terms, the Middle East is perfectly situated to serve as a bridge between the Eastern and Western worlds, so providers located in the region represent the ideal connectivity partner for global organisations looking to enhance their capabilities at scale.

As the Suez Canal quickly became the most important artery and waterway for world trade in 1869, subsea and overland cable networks in the Middle East are today's equivalent. One of the forces driving the global importance of Middle Eastern cable networks is China's growing Belt & Road Initiative (BRI), a transcontinental policy of infrastructure development and economic integration. Above all, it seeks to connect Asia with Europe and Africa via maritime and land networks, building on the concept of the ancient Silk Road.

Projects within the BRI potentially offer the opportunity for the expansion of trade and investment. In terms of trade specifically, some theorise that full implementation of the BRI could increase global trade by up to 6.2 per cent, potentially increasing global real income by as much as 2.9 per cent. While debate and discussion are ongoing around the progress and potential of the BRI, it is important that carriers and enterprises are appropriately equipped.

To maximise the potential opportunities presented by this strengthening connection between Asia and Europe, the first thing organisations must consider is connectivity.

In addition to emerging Eurasian business opportunities, it is expected that in the Middle East and North Africa (MENA)

regions alone there will be up to 93 million new mobile subscribers using the internet by 2025. This statistic represents a huge CAGR increase of 5.1% between 2019 and 2025, with North Africa set to account for a third of these new users.

It is clear that there is immense potential for carriers and enterprises to tap into a range of global business opportunities if they prioritise quality connectivity, but there is another important decision-making factor. It is essential that organisations choose to work with a single cable network provider that is highly experienced in operating across these three key global regions, in terms of cultural nuances as well as regulatory and geopolitical factors. Connectivity providers must also provide a solid foundation to support their customers' digital journeys, a foundation that can be built on and utilised to deliver an optimised end-user experience.

EXPERIENCE IS CRITICAL TO SUCCESS

Middle Eastern providers with an extensive understanding of cultural and regional business nuances have unparalleled knowledge of all surrounding key regions. This geographical positioning and expertise equip them far better than dislocated providers based in Europe or Asia. This extensive understanding of cultural and regional business nuances ensures that organisation can conduct effective global business.

To provide insight into the complexities of worldwide cultural nuances there are some key things to consider. For example, in the Middle East it is important to prioritise building trust and to avoid political discourse, in Asia business etiquette – such as treating business cards with the utmost respect – should be adhered to, and in Europe building relationships is key. This snapshot sample is indicative of the importance of working with a provider who can not only understand your organisation's culture but one that can help you successfully navigate the nuances within intraregional and the wider landscape.

While the business and cultural nuances across different regions pose a complex obstacle, so do their varying regulatory landscapes. Having a deep understanding of different regulatory processes is a distinct competitive advantage for providers in the Middle East. As they operate with landing points based in multiple countries and continents, they enter the remit of various regulatory bodies. This means they possess the know-how to keep associated organisations maintaining compliance as operations sprawl between nations, ensuring the smooth delivery of services.

Significant expertise is also required of providers to navigate the world's complex geopolitical landscape, particularly when it comes to engaging with countries across the Gulf. At this present moment in time, it is more important than ever to work with a provider that is experienced in the geopolitics of intra- and interregional cable networks, with issues on the subject hitting national headlines.

Reliance on subsea cables for connectivity has brought larger OTT players into geopolitical discussions. Recently, Facebook dropped out of a Hong Kong-Americas submarine cable project due to mounting pressure from the US. With submarine cables set to be essential for moving growing quantities of data, it is essential that organisations work with an expert provider that can understand and traverse geopolitical volatility.

THE ENABLERS OF FUTURE BUSINESS GROWTH

With worldwide data set to reach a towering 59 zettabytes in 2021, international internet bandwidth and traffic are simultaneously growing at a CAGR of 30%. Enterprises and societies more widely are becoming increasingly dependent on connectivity, while the need to move larger datasets become paramount. While satellites have been suggested as a means of managing this need, they simply cannot provide the business-critical speed and capacity required for digital transformation at a global scale.

Reliance on subsea cables for connectivity has brought larger OTT players into geopolitical discussions.

As carriers and enterprises experience this growing call for reliable, low latency connectivity, providers in the Middle East are uniquely positioned to provide an effective solution for the future. While offering unique and diverse connectivity opportunities, they also provide the crucial regulatory and geopolitical expertise that will be crucial to the future of global business and transformation.

This combined plethora of advantages is what makes Middle Eastern providers the foundation for future global business and innovation. In 1870, the Suez Canal saw 486 transits in its first year of operation, in 2019 there were nearly 19,000. With data volumes doubling every eighteen months, Middle Eastern networks stand to be the Suez Canal of the modern connectivity space that will link the East and West. STF

CENGIZ OZTELCAN *is CEO of GBI and has over 22 years of experience in sales, marketing, business and corporate development areas in telecommunications and IT sectors; building and managing large, diverse and geographically dispersed organizations. He has held a variety of senior management roles for multinational companies such as Boeing, Intel and Turk Telekom. He holds a BSc and MSc in Mechanical Engineering from Texas A&M University and an Executive MBA from the University of Washington.*

HOW DO SUBSEA CABLES IN FROZEN REGIONS WORK?

BY RACHEL JUSTIS

Subsea cables have been around for over 150 years as a technological means of communication across the globe. In their initial form, they were used for sending telegrams. Nowadays, they serve as connective transmitters for telecommunications. They are noted as crucial components for the modern economic market, because they are more reliable, have more capacity than satellites, and are responsible for transmitting 95% of all international data across continents.

Because they are often found thousands of meters deep into the water, one might wonder how they are placed and remain operational in frozen regions. We break that down here:

THE TECHNOLOGY BEHIND SUBSEA CABLES

Subsea cables work using fiber optic technology, which supports a higher bandwidth. In terms of data transmission, this means that subsea cables have less delay and can transfer terabytes of data at a time frame that satellites would only transfer megabytes. Developing technology has helped increase the efficiency of data transmission across new and future sea cables, thanks to innovations like optical amplifiers. These are complex components developed with 3D parts in a footprint library, which allows engineers to solve difficult design challenges when it comes to inaccurate data

Credit: Brocken Inaglory under CC BY-SA 3.0 License.

and layer-by-layer construction. This has greatly helped improve amplifiers over the years, allowing them to not only transmit data faster but also have a more durable build that can withstand the environment.

CHALLENGES IN FROZEN REGIONS

Naturally, cables are prone to damage from external force and erosion over time. This is increased by the presence of water all around, earthquakes, human exploration, and deep-sea creatures hitting the cabling. The temperature of water actually doesn't prevent subsea cables from being placed, but extreme cold makes them more prone to crack. The problem for particularly frozen areas is that engineers have to create a longer pathway to work around the less penetrable areas. This proves a more expensive excursion and also means a longer route for communications.

The bigger challenge is between major project heads, more so than a practical issue. As of late, the Arctic Connect project, which was meant to construct networks that link Europe to Asia, was put on hold because of stalled negotiations between partners.

The problem for particularly frozen areas is that engineers have to create a longer pathway to work around the less penetrable areas. This proves a more expensive excursion and also means a longer route for communications.

CABLES IN TOMORROW'S FROZEN SEAS

It should be noted that global warming, as problematic as it may be overall, has proven to be beneficial for the creation of shorter subsea cable networks. Previously hard-to-penetrate regions have now seen ice caps melt enough to make room for shorter cable networks. This is promising for internet connectivity and more efficient international communications. In an effort to not just profit off of global warming, many projects are also planning to make use of subsea cable data transmission to collect data that will help monitor sustainable practices.

The continued problem with frozen regions would have to be with moisture damage and the rate of corrosion because of seasonal changes in temperatures. However, because subsea cables are still cheaper and more efficient than satellites, it's likely that continued innovation will protect them from obsoletion any time soon. Currently, we are already seeing more efficient coating that protects them from stiffening and cracking easily, so that they may have a general lifespan of two and half decades.

Though there may be some fear that any cables in frozen regions will suddenly break or be removed, causing an outage, experts say this is an improbable scenario. Despite their vulnerability, a few line losses wouldn't majorly affect global transmissions. Apparently, ruptures are no new thing and it is estimated that one subsea cable in the world is damaged every 2 days.

With that in mind, it seems that we will be seeing many more cable networks in the deep sea for years to come – especially now that frozen regions are seeing a steady decline. STF

RACHEL JUSTIS *is a tech-enthusiast who enjoys reading about modern innovations. She works as a full-time business consultant and likes to blog during her free time.*

THE MISSING PACIFIC LINK

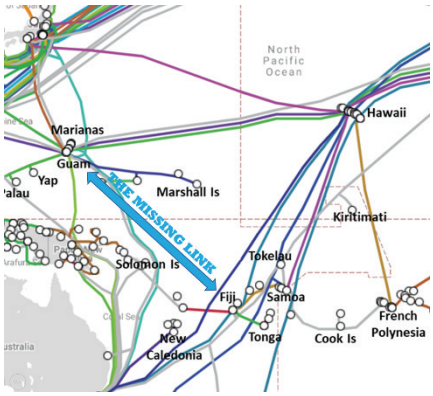
BY PAUL MCCANN

There are three primary island hubs for submarine cables in the Pacific Ocean – Hawaii, Guam and Fiji. Being centres for concentration and distribution of traffic, you might expect that these hubs would be linked together to provide the resiliency and connectivity to exploit the benefits of the submarine cables that connect to them. Certainly, Hawaii has a direct link to Guam, and Fiji is linked directly to Hawaii. However, there is no direct link between Fiji and Guam.

Is a submarine cable directly between Fiji and Guam the missing link of the Pacific?

Sure, there are circuitous cable connections between Fiji and Guam and there are already satellite connectivity options, but there is nothing remotely close to a direct submarine cable link to complete the "One-Pacific" triangle tying all three hubs together and achieving enhanced performance and security for the entire Pacific region, whilst also providing an ideal opportunity for cable connectivity with other currently "un-cabled" Pacific Islands.

So YES – a submarine cable directly linking Fiji and Guam completes the loop and is clearly the "missing link" for the Pacific Region!



THE FIJI-GUAM CABLE

The total population of the twenty-two Pacific Islands is forecast to grow from 11 million to 17.7 million or more than 60 per cent by 2050. Development in these island nations is characterised by growing levels of urbanisation, considerable "health challenges" for existing populations, a population "youth bulge", and a heavy reliance upon fisheries and tourism for economic growth -- all good reasons to underpin investment and focus on the development of telecommunications in the Pacific Regions.

For the people of the Pacific, the Pacific Ocean itself is their major economic, social, and cultural lifeline. Its coastal and marine environments sustain a multitude of important activities that fuel local, national, and international economies and provide livelihoods and food security for millions of islanders. Culturally, the people of the Pacific demonstrate a strong sense of national and regional identity (maintaining kin connection and demonstrating kin loyalty). Retaining regional communication or traffic within the region itself is thus culturally appropriate.

The economic disadvantages of isolation have been high in the Pacific, however regional initiatives that are culturally

acceptable and scaled correctly can be beneficial and sustainable. In the economic and trade fields, regional cooperation has been particularly notable across the region in the areas of fisheries, shipping, the environment, information exchange, and technical training – today we propose to add to this list an additional regional initiative: Pacific Regional Telecommunications! Today, the Pacific Islands Telecommunications Association (PITA) and the Pacific Telecommunications Council (PTC) to name just two, are organisations providing a close-knit regional forum for seeding telecommunications and network cooperation.

As the demand for telecommunications services grows in each and every island-based country across the Pacific – so too does the rationale for regional cooperation – delivering with it the benefits of regional sovereignty, market development and trading, and with these benefits there is the opportunity for a growing sense of regional responsibility, control and capability.

From a network planning, traffic performance and technical aspect – the time is right – the One Pacific Network needs to be hatched – to become a reality!

Fiji has a population of around one million and has direct cable connections to Tonga, Samoa, Wallis & Futuna, Vanuatu, Hawaii, and Australia. In the near future it will be directly connected to New Caledonia, Tokelau, Christmas Island (Kiribati), New Zealand and the US mainland.

Guam has a population of nearly 200,000 and has direct cable connections to Japan, Northern Marianas, Palau, Indonesia, Philippines, FSM, Marshall Is, Australia, Hawaii, Us Mainland and South Korea.

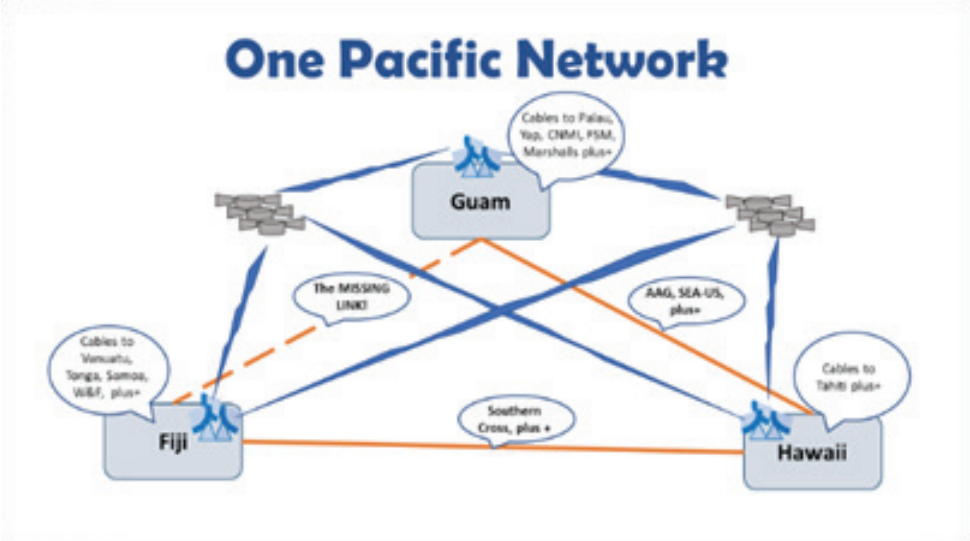
Hawaii has a population of 1.4M and has direct cable connections to US mainland, Japan, Guam, French Polynesia, Fiji, New Zealand, American Samoa, Australia

With all these direct connections within and around the Pacific, there is strong reason for the three hubs to be connected.

BENEFITS FOR PACIFIC ISLAND COUNTRIES – SERVING THE HAVE NOTS!

If you look at the map below, you can see that a cable from Fiji to Guam would pass in reasonable proximity to Rotuma, Tuvalu, Nauru, Kiribati (Tarawa) and Chuuk. Of these, currently Rotuma, Tuvalu, Nauru and the Kiribati capital on Tarawa have no cable connection.

Rotuma is the northern island of Fiji and some 500 kilometres from the rest of Fiji. For many years it has looked for a cable connection but the opportunity for a spur from a passing cable has never arisen!



Tuvalu is a nation of many islands but a small population of 12,000. The capital is Funafuti. There has been a significant amount of work and talk about getting a submarine cable into Tuvalu – however despite a number of years of effort – a cable has not been provided!

Nauru is one of the smallest island nations and involves only one populated island with 11,000 people. It was a planned landing point on the proposed East Micronesia Cable (EMC) from FSM to Nauru to Kiribati (Tarawa). EMC cable has stalled, and a new cable solution for Nauru needs consideration. One suggestion is for Nauru to install a new cable to Solomon Islands – and from there connecting via the Coral Sea Cable to Australia. This is certainly an option – it would be a 1260 kilometres (780 mile) direct cable servicing solely 11000 people, and requiring extension from Honiara to Australia at additional ongoing cost. Could Fiji-Guam provide a more cost-effective solution as the spur would be less than 300 kms?

Kiribati is an unusual country. It has an area of 3.5M square kilometres which is almost half the size of the USA – all contiguous 48 states. But Kiribati land area is a mere 800 sq kms spread more than 3000 kilometres across the Pacific Ocean. Of its population of 120,000, some 40,000

live in the capital of Tarawa. As mentioned, with the stalling of EMC system, Kiribati is looking for a new cable option for Tarawa!

Chuuk, the most populated atoll in the Federated States of Micronesia (50,000 people) has a domestic connection to the FSM capital of Pohnpei but could benefit from a more direct connection to Guam to where most of the traffic of FSM is directed. At the same it would provide FSM with cable diversity to its two main population centres.

In conclusion, establishing a Fiji-Guam Cable could provide highly reliable and abundant cable connectivity to many potential spur locations. For those of you keeping tabs – should the Fiji-Guam Cable proceed as detailed above – twenty-one (21) out of the total of twenty-two (22) Pacific Island Nations would have submarine cable connectivity! (Leaving only Pitcairn Island unconnected. As Pitcairn is 2500 kilometres from nearest significant land and a population of just 43 persons (at last count) and the least populated "country" in the world, it is unlikely to get a cable.)

So – from a Pacific Regional Connectivity aspect - there is a good argument for building the missing link – the Fiji to Guam Cable system!

- Additional Potential Benefit

The Hawaiki cable runs from Hawaii to Sydney and passes just south of Fiji. It is fitted with a branching unit for a Fiji connection but to date the spur connection has not been implemented.

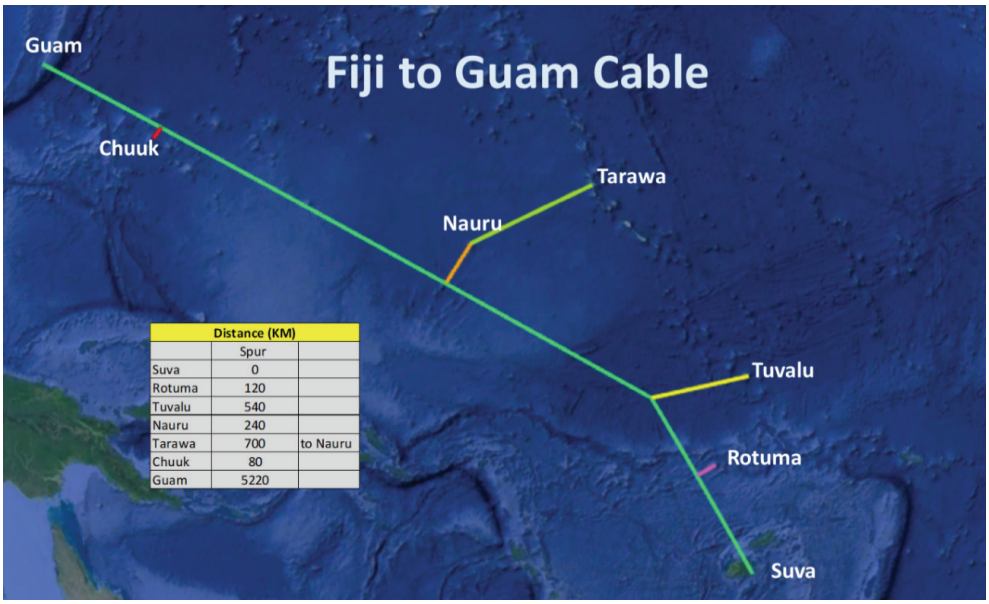
The opportunity presented by this branching unit is a connection to southern end of a Fiji-Guam cable to provide maximum connectivity and enable an additional connection Hawaii and Australia.

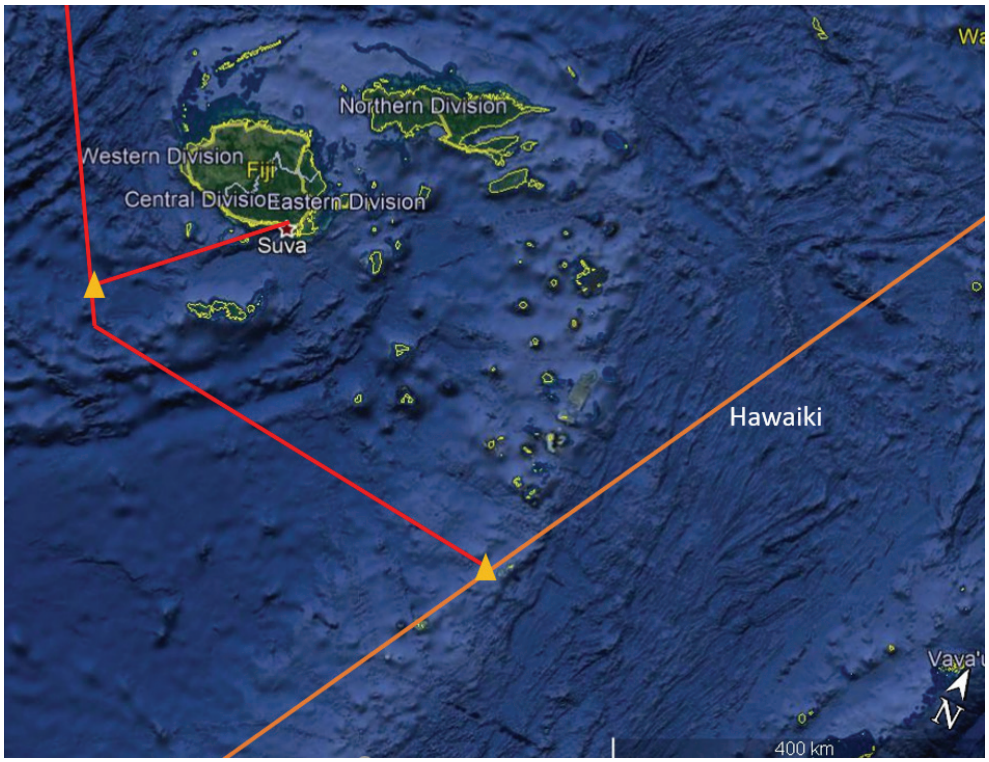
A configuration such as in the following diagram could be possible.

SO HOW DOES SATELLITE FIT-IN?

You will note from the One Pacific schematic shown above, that the concept refers to Satellite connectivity. Whilst submarine cable connectivity is key for the core backbone capability of the network, integrating satellite hubs at each of the three core Pacific hub locations has potential to provide the following:

- Each major node (namely Guam, Hawaii or Fiji) currently supports multiple regional cable systems. These

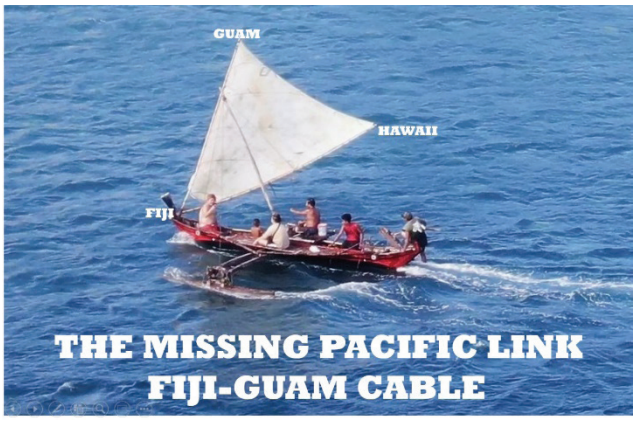




regional cables provide a single high-capacity umbilical for the respective country being served. In the event of cable failure Satellite remains the major "diversity" restoration service. Having Satellite Hubs at the three key locations simplifies "bridge the gap" restoration solutions and if deployed correctly can facilitate mutually beneficial and regionally cost-effective satellite deployment and capacity deployment solutions.

- Servicing small islands unserviceable via cable: as mentioned above countries like Tuvalu are nations comprising many small islands, many with small populations ideally suited to satellite connectivity. Providing strategically located regional satellite hubs as shown, allows the Pacific to keep Pacific peoples traffic within the Pacific – providing regional nations closer control and visibility over the traffic being generated.
- The One Pacific configuration as shown provides significant cable connectivity between the three major Satellite nodes – again this configuration optimises the need for satellite bandwidth – and optimises the number of antennae required to reliably service the many satellite providers!

Fiji-Guam Cable System			
	Spur	Est. $US	
Suva	0		
Rotuma	120	$ 3,000,000	
Tuvalu	540	$ 13,500,000	
Nauru	240	$ 6,000,000	
Tarawa	700	$ 17,500,000	to Nauru
Chuuk	80	$ 2,000,000	
Guam	5220		



FUNDING OF FIJI-GUAM CABLE

As with all submarine cable projects – despite all the good reasons, justifications and benefits that a new cable could bring – the bottom line is funding!

The estimated cost of the main trunk for a Fiji-Guam Cable (5220 kilometres long) is in the order of $130M. Estimated Spur costs are summarised as follows:

An allocation for cost of the spurs including landing point infrastructure is an additional $50M.

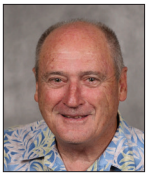
Noting the current market rates being provided by the key suppliers of recent times, a total project cost for the Fiji-Guam Cable System in the order of $US180-200M could be expected.

Clearly this cost is well beyond the budgets of the Pacific nations and hence such a project would require significant aid funding - whether from the aid agencies of nations such as Australia, New Zealand and USA or from the MDBs such as ADB or World Bank or quite possibly from a mixture of all of them. There is no doubt that there is a strong interest by all these agencies in connecting the Pacific nations, and this plan offers a way to address that requirement!

The possibility and attractiveness to commercial investment should not be excluded! As can be seen by the benefits from constructing such system – a direct cable path between Fiji and Guam provides express route traffic options for the countries of the Pacific region and excellent resilience opportunities. As a wild card – is Guam-Fiji potentially a missing link in any future cable route linking South America to North Asia? And finally, further potential benefit of the One Pacific Network worth considering is the potential to provide cable on cable restoration services for all the major cable running around the Pacific Region!

SUMMARY

The lack of a direct cable from Fiji to Guam appears to be a significant missing link in Pacific connectivity. The above scenario provides a suggestion of how this might be addressed and in doing so, serving the need for cable connectivity for a further five (5) Pacific Island Nations. STF



PAUL MCCANN *is Managing Director of McCann Consulting International Pty Ltd. Paul has over 40 years network planning & development experience in telecommunications both in international and domestic arenas. Prior to returning to consulting in 2012, Paul spent over 8 years with Verizon in Asia Pacific, driving growth of Verizon's network across Asia by developing & implementing plans delivering major operational cost reductions and improved service performance. Paul is now managing his own consulting business, specializing in development in the Pacific Region, where the core business focus is on "connectivity" with expertise spanning all aspects of planning and development for Satellite, Submarine cable and Domestic access technologies and business. Paul is well known for his personable nature, his rapport with customers and his ability to deliver on time.*

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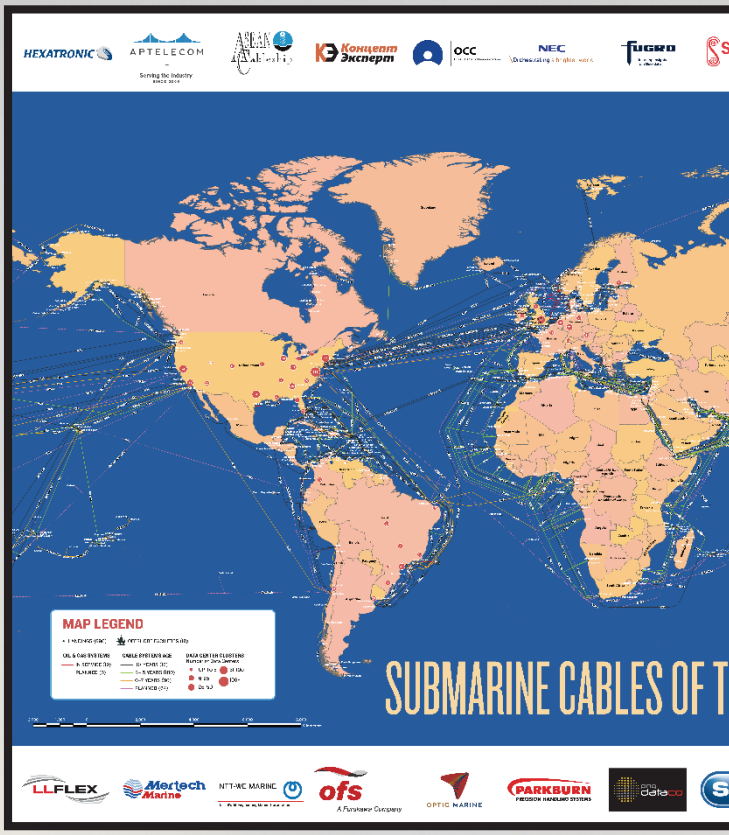

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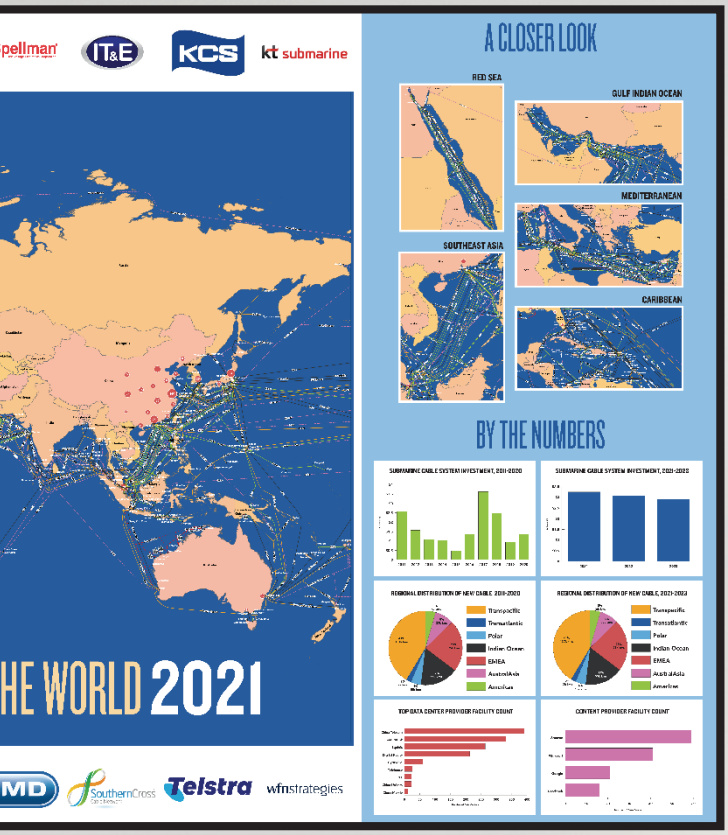

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FEATURE

REINVENTING INTERNATIONAL DARK FIBER

BY FREDRIK HANE

As anyone who reads this publication knows, the explosion in data traffic around the world is pushing many fiber backbones to their limits. However, the surging demand for dark fiber, both on short-haul and long-haul stretches, cannot be explained merely as a function of increasing traffic volumes. Of equal importance is the fact that a growing number of heavy users of data communication – not just carriers and hyperscalers but also major corporations and other types of organizations – have come to demand a level of security, independence and overall control that only comes from having your own dedicated dark fiber, on top of which you install your own active equipment of your own choice over which you have total control.

In many places today, dark fiber is abundant on the local level, but along international stretches there is much less fiber than most people think. For example, in the Nordic region, an enormous amount of fiber has been deployed over the last fifteen years, extending to companies and consumers in both cities and the countryside, but during the same period international fiber build-out has more or less stood still. When Eastern Light built its new sea cable between Sweden and Finland two years ago, it was the first cable between the countries to be built in more than a decade, and the situation is similar for most international stretches in the region.

Stockholm-based Eastern Light is one of the players that has assumed the role of correcting the lack of long-haul international dark fiber infrastructure in its part of the world. Eastern Light is a Swedish independent company that builds, owns and operates its own long-haul dark fiber infrastructure in northern Europe, and our expansion plans for the coming years include a number of new backbone stretches in this area, both on land and at sea, across the Nordic and Baltic countries, as well as Poland and Germany.

THE BALTIC RING

One of our currently ongoing projects is the "Baltic ring", the construction of a regional fiber optic sea cable system in and around the southern half of the Baltic Sea, built with the express purpose of providing international long-haul dark fiber along the most efficient routes between major data centers and key communication hubs in the region. The first part of this ring, Eastern Light's new sea cable system between Sweden and Finland in operation today, goes from Stockholm in the west, to Kotka in Finland, 600 km to the east, going on shore at a number of locations along the way, including several addresses in Helsinki. The rest of this ring will be built in stages over the coming three-year period, and includes a new sea cable system south from Stockholm along the Swedish east coast to Copenhagen in Denmark and Rostock in Germany, as well as a sea cable system going south from Kotka and Helsinki in Finland via a number of locations along the Baltic and Polish coasts to northern Germany, where the systems will join to complete the ring structure and connect further inland through Eastern Light's own land-based infrastructure.

BEING INNOVATIVE ON THE DARK FIBER LAYER

Eastern Light has chosen to narrowly focus on the pure physical fiber infrastructure, and leaves the active services to be handled by its customers, so one may naturally ask – just how innovative is it possible to be when you work with something as basic as dark fiber?

Quite a lot, we have come to realize. Many of the features that are now at the core of Eastern Light's business are things that were not obvious to us when the company was first started. Instead, they evolved step by step out of our discussions with our first customers, which include some of the world's largest Internet companies. Throughout the planning and construction of Eastern Light's Sweden-Finland sea cable system, several of our anchor customers had very specific wishes and requirements as to how a modern cable system specifically built for the purpose of providing international long-haul dark fiber should optimally be built and operated. We listened carefully and made many of these suggested features an integral part of our standard offering going forward. The story of how we found innovation at the most fundamental infrastructure level is what I would like to share more about below.

STAYING FOCUSED

One key insight was how important it was to stay really focused. In order to successfully build and operate long-haul international dark fiber infrastructure the optimal way, one has to have a razor-sharp focus and do only just that, and nothing else. For Eastern Light, the reasons behind this focus has been both technical and commercial. We wanted to build an infrastructure that was technically fully optimized for long-haul dark fiber, and we also did not want to get into a situation where we were competing with our operator customers by selling lit services to end customers.

TERRESTRIAL NETWORKS AT SEA

One result of our focus on dark fiber is that all our cable systems are passive, i.e. non-repeatered, and have a high fiber count (beginning at 144 fibers). Therefore, we build our sea cable systems so as to always go onshore at regular intervals, on average every 100 km, into the same type of ILA sites that are used on terrestrial routes, where our customers are free to install their own active equipment of their own choosing. In a sense, we are always building terrestrial networks, some of which just happen to go into the water from time to time between the ILA sites.

RESISTING THE TEMPTATION TO MAKE DETOURS

Another major decision was to focus exclusively on the long, international backbone stretches, and to deliberately stay away from everything in between the end-points as much as possible. This requires a lot of discipline and can be hard if you are used to building networks catering to a wide variety of customers distributed over extended geographical areas. In that case the ground rule is to always plan the route so as to pass by as many potential customers as possible on your way from A to B, but if your goal is to build the optimal long-haul system, you have to do the opposite and resist the temptation to make any local connections along your way. In the case of our cable between Sweden and Finland, our singular focus on creating the most efficient international route ended up cutting the fiber distance between Stockholm and Helsinki by around 20% compared to other existing routes.

REACHING THE BEACH IS NOT ENOUGH

When we first began the planning of our Sweden-Finland system, we thought of it as a pure sea cable system, traditionally built from one beach to another. Behind the beaches we would build cable landing stations and connect to existing local land infrastructure, which our customers could then use to reach their final destinations. However, our first customers wanted something different. They made clear that they did not want to be left on a beach somewhere, but that it was important that we could deliver a completely new independent fiber infrastructure not only at sea but also on land, the entire way into the inside of some key data centers and communication hubs both in Stockholm and Helsinki. As a result of this, we adapted the scope of our business to include the local terrestrial connections – in the form of deploying entirely new independent ducts and fiber from scratch – into key data centers in the cities that we connect. This so as to be able to provide our own dark fiber seamlessly all the way from the inside of one data center in one country to the inside of a different data center in another country, without being dependent on any other last-mile supplier.

TREATING PHYSICAL SEPARATION SERIOUSLY

Staying physically separated from other existing fiber infrastructure, for redundancy reasons, has always been an important matter of principle when building networks, but it is a principle that is in practice often difficult to live by every step of the way. Many new cables maintain separation for hundreds of kilometers along the main stretches, but then fail at the end by giving in to the temptation to share the canalization or trench with other cables the last little distance into the data center or in the pavement outside. Our experience is that these issues are becoming more of

a priority each year for demanding buyers of fiber infrastructure, and Eastern Light's customers encouraged us to go to extreme lengths to ensure full physical separation from other long-haul cable infrastructure, up to the last boreholes through the walls of the respective data centers. In Stockholm, the connection of our cable into one of the major data centers in this way – through a new and completely unique route – was only possible by digging through a neighboring property, which turned out to be a cemetery on the UNESCO world heritage list, something that gave us a whole new kind of challenge to navigate.

HOMOGENOUS ILA SITES

Another area where we believe that we have been able to differentiate ourselves is our ILA sites. In order to attain the highest level of security and control, all ILA sites are located in premises wholly owned by Eastern Light, and we do not sublease space anywhere. All ILA sites are brand new and adhere to the highest security standards, and the fact that they are homogenous and identically equipped does in itself serve to provide additional security and reliability as well as convenience for our customers.

NO CONNECTORS

Another way in which we have innovated over time is that we have completely gotten rid of all connectors and traditional ODFs. This is certainly nothing to recommend more generally, but for Eastern Light's purposes, as a pure long-haul dark fiber provider, this is both performance and reliability enhancing. For all the flexibility that comes from using long-haul fiber stretches made up of many separate parts stitched together through connectors and ODFs, every connector constitutes a potential source of error, and for the type of services that Eastern Light provides – long-haul dark fiber the most efficient way, point-to-point, between major international data centers – any connector along the way is just an unnecessary obstacle. We did not fully appreciate the importance of this issue until one of our first large customers asked for the total number of connectors between our sea cable landing points and the final delivery points inside the data centers. We were happy to answer that there would be no connectors anywhere, except for the usual ODFs in the ILA sites, from where each customer would use a short patch cable to their respective cabinets to connect to their own equipment. When this customer asked if it would be possible for us to take away also these last connectors and instead supply fully spliced fiber all the way to their equipment, we quickly decided to make this our new standard – no connectors anywhere, but only your own, fully spliced fiber – from your own equipment in one city to your own equipment in a different city.

FULLY SEPARATE INFRASTRUCTURE FOR ILA SITE OPERATIONS

Since Eastern Light is a pure provider of physical dark fiber infrastructure, most issues related to cyber security are handled by our customers themselves. However, one security aspect that we believe is often overlooked, and one that we have taken very seriously, is the security of our own internal data network that connects our NOC with the ILA sites. In other words, the internal data network that we use not just to passively monitor, but also to actively control the systems for power, HVAC, passage control, etc, in our ILA sites. Any outside malicious intrusion into such systems could have potentially disastrous consequences, and therefore we decided early on to have all such communication completely physically separated and disconnected from all other networks and systems. This means that we are using separate dark fiber pairs dedicated solely for the communication related to the monitoring and control of the ILA sites. Our systems to control them at our NOC are also physically separate and disconnected from other networks, meaning that there's an air-gap that makes it physically impossible for anyone to gain access to such systems from the outside.

What I have briefly outlined above are some of the basic principles that will guide Eastern Light's continued expansion in northern Europe going forward, of which the new sea cable ring in the Baltic sea is one part. Eastern Light foresees that the growth in demand for dark fiber will, on many routes, outpace the increase in bandwidth in the years to come, as a result of an increasing demand for control, security and independence which goes over and beyond the sheer traffic volumes. Eastern Light believes that a plurality of dark fiber routes, not just locally and nationally but internationally as well, is needed to enhance the robustness and security of the world's data networks and we are excited to continue to make our contribution to this development. STF

FREDRIK HANE *is the co-founder and CTO of Eastern Light, and is a pioneer within fiber optic infrastructure in the Nordic region. In 1995, he co-founded the telecom and internet operator Utfors which built the first large-scale private fiber network in Scandinavia, and in 1999 he co-founded fiber infrastructure company IP-Only. Fredrik has also worked for many years as an officer in the Swedish Defence within the area of satellite and telecommunication management systems, and in 2007 he was awarded by the Swedish king a silver medal as well as a monetary prize from the War Science Academy for his contributions in the telecommunication area for the country's defence.*

CONNECTING MORE PACIFIC ISLANDS DURING COVID

BY JOHN HIBBARD

The Pacific Ocean has a total of twenty-two (22) designated Pacific Island Nations/Countries (PICs). Of these five (5) do not yet have cable connections. With the development of the Southern Cross NEXT (SX NEXT) cable, the opportunity arose to provide two of these PICs with cable connections using spurs off the main SX NEXT cable from Australia to the USA. These two PICs are Kiribati and Tokelau.

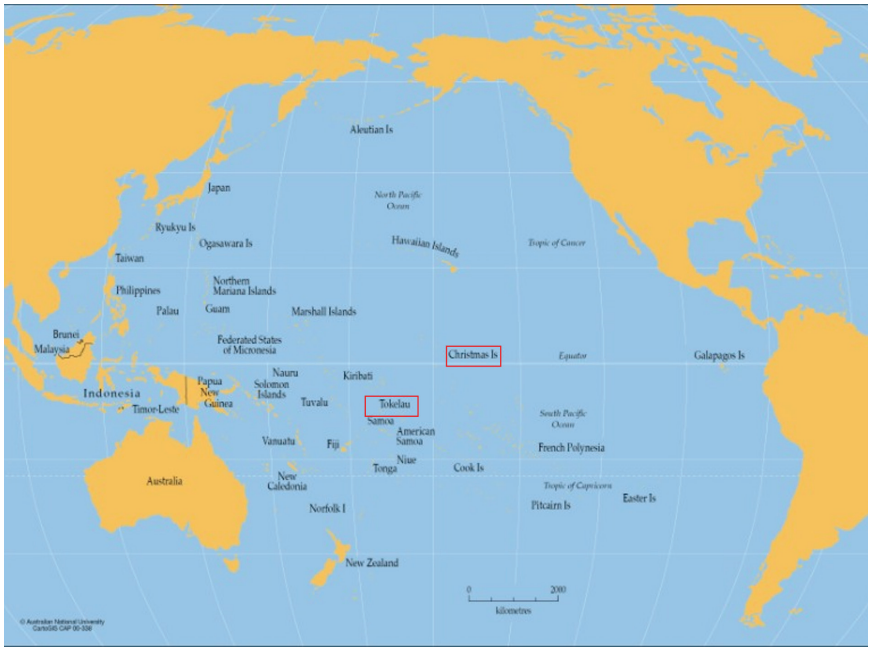
This paper outlines some of the challenges associated with providing cables to such places, particularly during the COVID pandemic.

KIRIBATI

In developing the arrangements for the Kiribati spur, particularly those associated with the terrestrial terminal, there have been some vital things that one has had to learn.

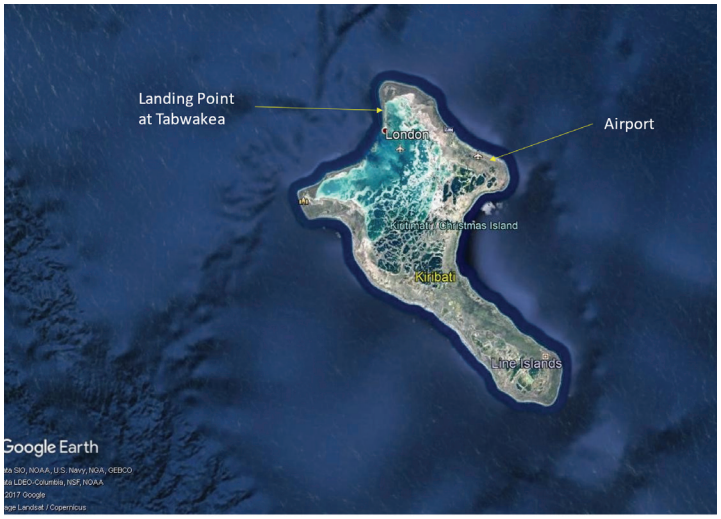
At the risk of sounding extremely basic, the first and particularly important one is how to correctly pronounce the various names written in local indigenous language. The Kiribati spur off SX NEXT lands at Kiritimati. These place names are words from the local Gilbertese language. In Gilbertese there is no 'S' in the alphabet, rather they use "TI" for "S" - not dissimilar to English such as in the word nation (pronounced as "naishon"). Hence Kiribati is pronounced Kiribas and Kiritimati is pronounced Krismas (yes that's right – Christmas!). Without knowing that, the locals can have significant issues relating to your needs!

Kiritimati (Christmas) Island is located midway between French Polynesia and Hawaii. It is 3000 km away from the



capital of Kiribati in Tarawa. So, it is extremely remote. Pre-COVID there was one flight per week into Kiritimati - since COVID there have been none. Kiritimati is the largest coral atoll in the world being some 50 kilometres from north to south. The population of 6000 people are located at the northern end. The southern end was where Britain conducted nuclear tests in the 1950s.

Quite fortuitously the Southern Cross cable will pass relatively close by Kiritimati Island enabling a spur of 375 km to provide the island with fibre-optic connectivity. It takes quite some serious reflection to put into perspective the challenges that arise with such remote locations. Apart from infrequent transport arrangements, where the island is served by the regional shipping line only every two or three months, there are limited stocks of materials on the island and limited numbers of skilled workers. For instance:



- You need to import your own cement!
- At present there is aggregate available, but this is not necessarily always the case.
- Of course, there is plenty of sand!
- Other construction materials need to be imported.
- Getting adequate water is another issue as local water is pumped from the aquifer beneath the sand on the island.

Communications during construction have also presented significant challenges. While there are two mobile operators these have significant service limitations due to the small amount of bandwidth on the satellite links out of the country. The current total satellite capacity is less than 50 Mbps. Once the cable is completed the island will have 50 Gbps which with good reason we describe as abundant capacity!!

The Kiribati Government established a telecommunications company called BNL (BwebwerikiNet Limited) which is the landing party for SX NEXT. BNL appointed experienced industry manager Ioane Koroivuki (who many will know from his time in Fiji's FINTEL). Ioane is supported by a team for two from Kiribati. With funding support from ADB, McCann Consulting International and Hibbard Consulting were selected as the Project Managers, and their role has been to assist BNL working with Southern Cross Cable Company team, and to ensure the delivery of cable landing facilities in Kiritimati as required under the terms of the Landing Party Agreement. As such, the Project Management Unit (PMU) has had the responsibility of organising the provision of all the civil works on the island which involved the beach manhole, the duct routes and the footings for the cable station. Southern Cross directly procured the cable station module from the Australian company DXN. The modular building was constructed in Western Australia and shipped to Kiritimati. This transport involved at least three vessels and took five months to get it to the island because of the infrequency of shipments. All this would have been reasonably straightforward had it not been for COVID. Due to COVID restrictions, all commercial flights were suspended into Kiritimati. Expensive Charter flights were possible, alternatively entry for personnel was also possible by ship, but both solutions required sometimes complex and prolonged quarantine arrangements.

The civil construction works were contracted to an Australian company - CCB Envico. This company had previously worked in Kiritimati establishing the new water works. As such CCB Envico possessed the essential local knowledge and also the local contacts in order to get the work done. Such experience allowed CCB to send only one expat person who having previously been in Kiritimati, in advance of his arrival rounded up a local team from the

past works to assist in doing the new work associated with submarine cable. The challenge here was to get the CCB Manager (Bill Newton) to the island from Australia and into Kiritimati during COVID!

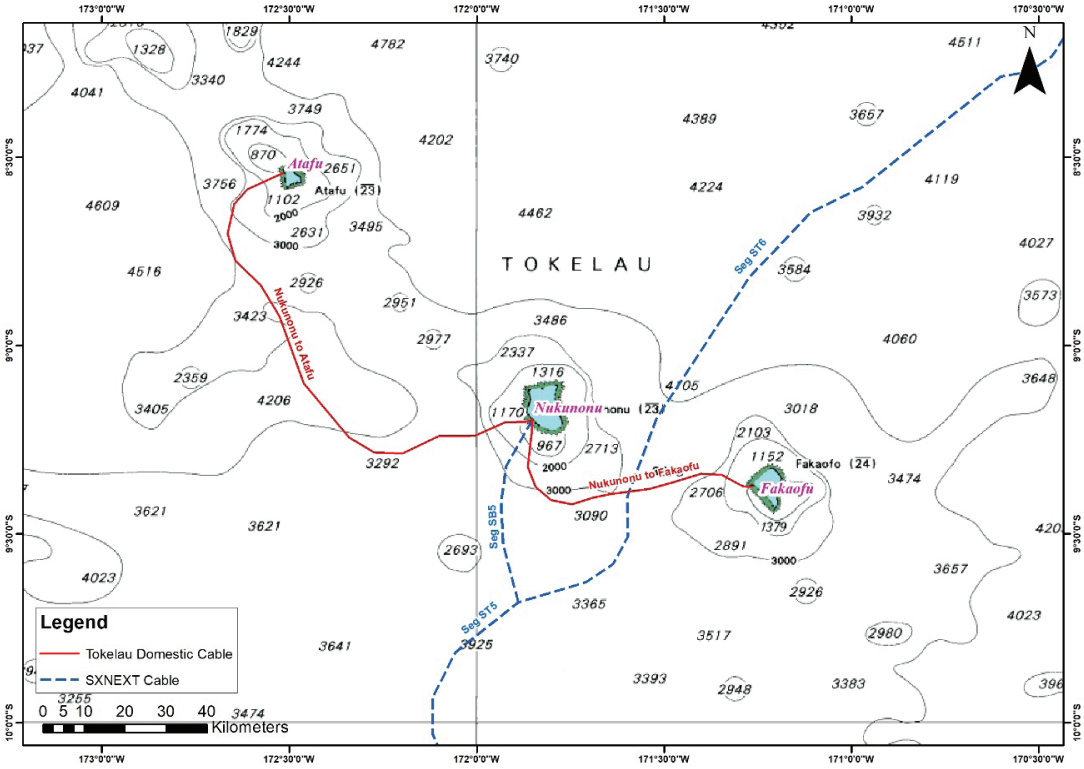
Flying out of Australia was very restricted and required special approvals from numerous Government departments. Once approved, the question then was how to get Bill to Kiritimati? Following an itinerary organised by the Southern Cross team, Bill took a flight from Melbourne via a 14 hour layover in the airport in Auckland to Nadi in Fiji. Bill then did two weeks quarantine in Nadi. After that, Bill was flown to Tarawa (Kiribati main island and capital) on a chartered emergency medical aircraft one of the very few which were pre-approved to enter Kiribati. Once in Tarawa, Bill then did a further two weeks of quarantine! You can appreciate that by now Bill was getting sick of quarantine – but further arrangements were required – how do we get Bill to Kiritimati Island some 3000 km away?

The Kiribati authorities required that the aircraft to be used must come from a COVID-free country. As such a charter plane from Fiji, Hawaii, NZ or Australia did not qualify. The aircraft had to come from Samoa. The only aircraft that could be chartered was a two-engine prop jet Commander. This aircraft has a range of 2000 kilometres but no toilet. Thus, it could not fly from Tarawa to Kiritimati Island directly but had to refuel at an intermediate location within Kiribati. The only island where this was possible was Canton Island. Go and take a look at Google Earth and find yourself Canton Island. Can you imagine somewhere so remote? So, the adventure began - the six seater Commander aircraft with Bill on board flew five hours to Canton Island to refuel from drums which had been delivered by ship some months before. After that was another five hour flight on to Kiritimati Island. What a journey - just to get our civils construction foreman onto the island to manage the whole suite of civil works necessary for station.

Many weeks prior to sending staff to Kiritimati, CCB had assembled all the materials needed and shipped them in five containers to Kiritimati so they were waiting for Bill's arrival. Because of the limitation of machinery on the island such items included in these materials was an excavator – this item proved to be invaluable and was used to dig the duct route, manholes, site works, and other trenching needed. The CCB planning had been done with precision and experience and fortunately everything required had been included – this was essential as very little can be procured on island (there is no Home Depot!). So, after Bill conducted the necessary OH&S induction, work started in November 2020 and was completed in May 2021, ready for the arrival of the cable station module in June 2021. Then Bill went back to Australia via Canton Island, Samoa and two weeks quarantine in New Zealand. Oh how a job which was always going to be quite difficult became an enormous logistical challenge!

TOKELAU

Tokelau is a Pacific Ocean nation located some 700 km north of Samoa. It comprises three atolls (Atafu, Nukunonu and



Fakaofo) spread over 200 km. Each atoll has a population of about 500 people. All three atolls are required by the Constitution to be treated equally, even to the extent that the capital rotates yearly among the atolls.

The planned route of the Southern Cross NEXT cable is between Nukunonu and Fakaofo and as such affords the scope for a short 50 km spur to connect to the central atoll Nukunonu. However, the required even-handedness dictates that all atolls must have equal access to the international capacity and as such a domestic festoon cable is required between the atolls.

It is an interesting question as to whether the logistics of Tokelau make it even more challenging for implementation than Kiritimati. Tokelau has no airport and no longer is there anywhere to land a seaplane. It is too far for a helicopter from anywhere so the only access even in emergencies is by a 30-hour boat trip to Samoa. The surrounding reefs do not permit large boats to come to a wharf and so everything, including small containers has to be unloaded using lighters. The weight limitations prevented the use of a modular stations to provide the CLS.

The landing party is the local carrier Teletok, led by Tealofi Enosa. Teletok has the responsibility to construct the stations for fit-out by DXN ready for equipment installation by ASN/SX. There are very limited resources on the island and staff need to come from offshore, primarily from Samoa. Teletok has been assisted by Project Manager McCann Consulting International and Samoan sub-contractor Telbac with the task of creating three new cable stations as well as beach manholes and duct routes and subsequent fit out by DXN. The atolls are serviced by a vessel from Samoa either weekly or fortnightly depending on the season. There is no scheduled boat across the 100kms between the atolls, but charters in glorified rubber duckies can be organised. All of the materials required for the project need to come from Samoa or New Zealand as the resources on the islands are minimal.

If these logistics did not present enough issues, they were greatly exacerbated due to COVID. As a nation without COVID, Tokelau applied severe limitations to travel to/from the islands and the regular vessels became less regular. Access required special visas underpinned with substantial detailed information and multiple levels of approval. This was compounded when a case of COVID was experienced in the previously COVID-free Samoa. Tokelau understandably restricted access to those from or via Samoa, the only established access route. As the civils contractor, Telbac, was based and resources from Samoa, their entry into Tokelau was considered by the respective authorities and whilst delays were experienced, their entry into Tokelau from Samoa was finessed. What was proving to be an even bigger issue was getting the SX/DXN personnel from New Zealand or Australia into Tokelau!

Once again, the Southern Cross logistics team came up with a miracle solution to get their personnel onto Tokelau along with their DXN subcontractor. The personnel quarantined in Fiji and chartered a private vessel (see photo: the Nai'a) which took some six days across 1500 kms of the Pacific Ocean to Tokelau. They were then unloaded in Tokelau using small craft avoiding making any contact between the team members and the locals before being quarantined for another two weeks in specially established quarters at Nukunonu, Tokelau. The Southern Cross and DXN staff then had to fit out the Nukunonu cable station where the Southern Cross cable lands.

After 2 very busy weeks the work in Nukunonu was completed and the team of Southern Cross and DXN were off to Kiritimati Island for the work there as mentioned earlier. But as might be expected, this was not straightforward. This involved a very rough 2000 km sea voyage of six days in the Nai'a to Tarawa where a further two weeks of quarantine were undertaken. From there the DXN and Southern Cross teams prepared for the long flight via Canton Island to Kiritimati to establish the modular table station which had now been delivered to Kiritimati. Following all this installation work, the SX and DXN team will have an arduous journey home no doubt with at least one period of quarantine! For Tokelau - the Atafu and Fakaofo cable landing stations will be fitted out later in the year when there is a second visit by DXN (SX are not involved in the Tokelau domestic festoon activity).

SUMMARY

Equipping Pacific Islands to be ready for the landing of a cable is major task. The combination of remoteness, limited resources of materials and people, the paucity and fragility of communications and difficulties at times with Government processes, make the execution of the work very challeng-

ing. Add to this the impact of COVID, with the consequential lack of flights, limited transport alternatives and great difficulties in getting visas, coupled with the lost time and inconvenience due to quarantine, and the formula for success relies solely upon persistence, communication and lateral thinking!

It is hard to say which of the two projects had more complications. In each case the process and paperwork associated with getting approval to land people on the island was enormously challenging. It is understandable, as these locations with no COVID are extremely sensitive to receiving people from countries where there is COVID. But so far so good for both Kiritimati and Tokelau - all the work has been proceeding and achieved with amazing efficiency. Overall, with all the quarantine required, only about 3 months has been added to completion dates. This is in no small way due to the great work of Southern Cross logistics team of Dan Testa and Rebecca Jacob who seemed to perform miracles to get the requisite approvals and arrange the transport which by any submarine cable project standard were extremely novel. Coupled with the willingness of the Southern Cross team and the various subcontractors to go through all the abnormal handicaps, it was a great credit to the folks of our industry. STF

JOHN HIBBARD *is CEO of Hibbard Consulting Pty Ltd. John has worked in the telecommunications industry for over 40 years, and for more than 30 has been associated with submarine cables. An Engineer by qualification, John worked for much of his career at Telstra finishing as Managing Director of Global Wholesale. John was the inaugural Chairman of Australia Japan Cable which he guided to a successful implementation.*

Since 2001, John has been an independent consultant in his own company, Hibbard Consulting, involved in strategic and commercial aspects associated with the development and/or implementation of many international submarine cable projects across the Pacific including French Polynesia, Samoa, American Samoa, Tonga, Vanuatu, Solomons, PNG, Palau, FSM, and CNMI. He was President of PTC from 2009 to 2012.

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FEATURE

PTC ACADEMY

Executive Insight for Exceptional Leaders

BY JACIE MATSUKAWA

Pacific Telecommunications Council (PTC) is excited to once again offer two live online training courses to help build the next generation of leaders in the ICT industry. The PTC Academy courses are designed to share key insights into business challenges and opportunities in the industry, delivered by a team of senior executives. The 2021 courses will run from 7 to 29 September and 4 to 27 October.

With coursework designed by PTC and accreditation provided in partnership with Submarine Telecoms Forum, participants will learn about the global telecom sector, strategies to identify and solve business challenges and opportunities, emerging technologies, and more. The three-week timeframe provides 10 distinct modules in 90-minute live sessions combining lectures followed by instructor Q&A and peer structured discussions, with the theme *Executive Insight for Exceptional Leaders*.

SEPTEMBER COURSE

7-29 September 2021
09:00-10:30 SGT (UTC+08:00)
Registration Deadline: 3 September 2021

OCTOBER COURSE

4-27 October 2021
09:00-10:30 FJT (UTC+12:00)
Registration deadline: 1 October 2021

"As a student, I fully enjoyed the PTC Academy sessions with invaluable insights shared by various executive presenters and workshops held with other students in the class," said Andrew Ng, Senior Product and Presales Manager at TransGrid. "I will have no hesitation to recommend anyone who might want to enhance their telco knowledge and advance his/her career further."

The 2021 PTC Academy courses will feature new presenters including Jim Poole, Vice President, Global Business Development, Equinix; Darren Yong, Asia Pacific Head of Telecom, Media, and Technology, KPMG Asia Pacific; and Joe Zhu, Founder and CEO, Zenlayer.

These presenters will add their wealth of industry experience to returning presenters Sean Bergin, Co-Founder and President, and Eric Handa, Co-Founder and CEO of APTelecom; Gary Kim, Consultant, IP Carrier; Tony Mosley, Director of Business Development, Ocean Specialists, Inc.; and Anthony Rossabi, Chief Executive Officer, Recovery Point Systems Group Holding Company.

"The PTC Academy offers students the opportunity to broaden horizons, enable personal growth, and network with new industry contacts," said APTelecom's Eric Handa. "It has been an honor to be associated with the program and meet so many students from a diverse background globally, and in particular the Asia-Pacific region making an immediate impact in continued education and development."

2021 PTC ACADEMY COURSE MODULES

INTRODUCTION TO TELECOM: KEY TRENDS AND CHANGES IN BUSINESS MODELS

Presenter: Gary Kim, Consultant, IP Carrier
Description: Provides an overview of the global telecom industry business drivers with special emphasis on key business challenges faced by C-level executives

5G AND BEYOND

Presenter: Gary Kim, Consultant, IP Carrier
Description: A closer look at mobile and wireless segments of the industry as they relate to fixed networks and overall business models

PIPES TO PLATFORMS: CLOUD AND DATA CENTERS

Presenter: Anthony Rossabi, Chief Executive Officer, Recovery Point Systems Group Holding Company
Description: Examines the role and importance of cloud computing and data centers in relationship to the connectivity business

HOW WOULD YOU DO IT?

Presenter: Sean Bergin, Co-Founder & President, APTelecom
Description: A workshop allowing students to grapple with C-level issues of revenue, competition, customer demand changes, cost, innovation challenges, and social responsibilities

DOING WELL WHILE DOING GOOD

Presenter: Eric Handa, Co-Founder & CEO, APTelecom
Description: Examines C-level challenges of balancing the interests of many stakeholders: owners, managers, employees, customers, partners, and society

YOUR CAREER, YOUR LADDER

Presenter: Anthony Rossabi, Chief Executive Officer, Recovery Point Systems Group Holding Company
Description: Explains how your skills, tasks, and knowledge will change as you move up the ladder to the C-suite

OTTS: OPPORTUNITIES AND THREATS TO TELCOS – TAKING ADVANTAGE OF BOTH

Presenter: Tony Mosley, Director of Business Development, Ocean Specialists, Inc.
Description: Over-the-top apps and services sometimes compete with, but can complement, connectivity provider strategies. What are the key challenges and opportunities?

WHAT REALLY IMPACTS YOUR MOBILE GAMEPLAY OR STREAMING VIDEO EXPERIENCE?

Presenter: Joe Zhu, Founder & CEO, Zenlayer
Description: A closer look at the critical elements affecting network latency and a discussion of how to reduce latency to deliver a better user experience

CONVERGENCE

Presenter: Darren Yong, Asia Pacific Head of Telecom, Media, and Technology, KPMG Asia Pacific
Description: Provides a broader view of how digital natives are operating, the convergence of sectors and data models, and how this may impact telecom operators over the coming years

DIGITAL TRANSFORMATION: HOW DATA CENTERS, NETWORKS, AND CLOUDS ARE CHANGING IT

Presenter: Jim Poole, Vice President, Global Business Development, Equinix
Description: A closer look at how data centers, networks, and clouds are changing the IT landscape, and how these companies come together to form the backbone of today's digital economy

MEET THE PRESENTERS

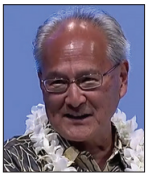
SEAN BERGIN, CO-FOUNDER & PRESIDENT, APTELECOM

Sean Bergin has been instrumental in building APTelecom into a globally recognized leader in telecom and fiber consulting, elevating from a start-up business to an award-winning global organization which has generated over USD 250 million in sales for clients. He is also the President and Chair of the Board of Governors for the Pacific Telecommunications Council.

ERIC HANDA, CO-FOUNDER & CEO, APTELECOM

As Co-Founder and CEO, Eric R. Handa has built APTelecom into a globally recognized leader in telecom consulting. Since launching in 2009, Handa has grown APTelecom from a start-up business to an award-winning global

organization which has generated over USD 315 million in sales for clients, and has been named the Sales Team of the Year by the Global Customer Sales and Service Awards, as well as a Silver Award winner of the 2014 Fastest Growing Company EMEA by the Best in Business Awards. Telecom Review Magazine awarded APTelecom the Best VAS Consulting Company in 2016 and 2017. He is also a judge for the PTC Awards.



GARY KIM, CONSULTANT, IP CARRIER

Gary Kim is a communications industry analyst of 30 years, and currently works as a telecom/Internet conference content developer, authoring white papers, articles, and marketing collateral for firms in the communications industry. He is the Chair of the PTC Advisory Council, founded the Spectrum Futures conference for PTC, and acts as an Annual Conference advisor.

TONY MOSLEY, DIRECTOR OF BUSINESS DEVELOPMENT, OCEAN SPECIALISTS, INC.

Tony Mosley specializes in telecommunications operations, specifically wireless, wireline, broadband, and wholesale markets. He is currently the Director of Business Development for Ocean Specialists, Inc. supporting several Pacific subsea cable builds. Tony has been a member of PTC and PITA since 1998 and 2001 respectively.

JIM POOLE, VICE PRESIDENT, GLOBAL BUSINESS DEVELOPMENT, EQUINIX

Jim Poole is Vice President of Global Business Development at Equinix, leading evolving edge strategies focused on 5G, private wireless, MEC, subsea cable, and SATCOM. His background spans more than 25 years in the IT, telecommunications, and content technologies industries.

ANTHONY ROSSABI, CHIEF EXECUTIVE OFFICER, RECOVERY POINT SYSTEMS GROUP HOLDING COMPANY

"Tony" Rossabi is the CEO of Recovery Point Systems Group Holding Company, where he focuses on the growth of recovery point systems, a leader in DRaaS, and other companies within the portfolio. A talented and seasoned executive, Rossabi brings over 20 years of experience in technology, communications, data center infrastructure sales, marketing, operations, and strategic planning.

DARREN YONG, ASIA PACIFIC HEAD OF TELECOM, MEDIA, AND TECHNOLOGY, KPMG ASIA PACIFIC

Darren Yong is the Head of Technology, Media, and Telecommunications at KPMG Asia Pacific. He heads client and market development for the region and is part of the Asia Pacific leadership team. A highly accomplished executive with over 20 years of experience in telecommunications and information technology, Darren is passionate about bringing emerging technology solutions to clients.

JOE ZHU, FOUNDER & CEO, ZENLAYER

Joe Zhu founded Zenlayer Inc – a global SDN network and service provider in 2014, with the goal of building a platform to power a better connected world. Joe is a telecom veteran with over 20 years of carrier experience in the U.S.

COURSES ARE ACCREDITED

PTC partnered with Submarine Telecoms Forum, an IACET-accredited continuing education provider, to bring PTC Academy into the next generation of industry training. With this partnership, PTC Academy provides Continuing Education Units to applicable learning event attendees. These credits are internationally accepted and can be used to satisfy a variety of professional requirements across a range of industries.

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For more information about the PTC Academy and to sign up junior executives from your organization, visit *PTC.ORG/ACADEMY*. STF

JACIE MATSUKAWA *is Meetings and Events Manager for Pacific Telecommunications Council, responsible for planning and implementing the PTC Academy as well as coordinating the PTC Annual Conference featured participants program.*

THE NEW UNREPEATERED LANDSCAPE

And How to Get the Most Out of Your Infrastructure

BY LUCA POSSIDENTE, DELPHINE ROUVILLAIN AND MAURIZIO PIZZI

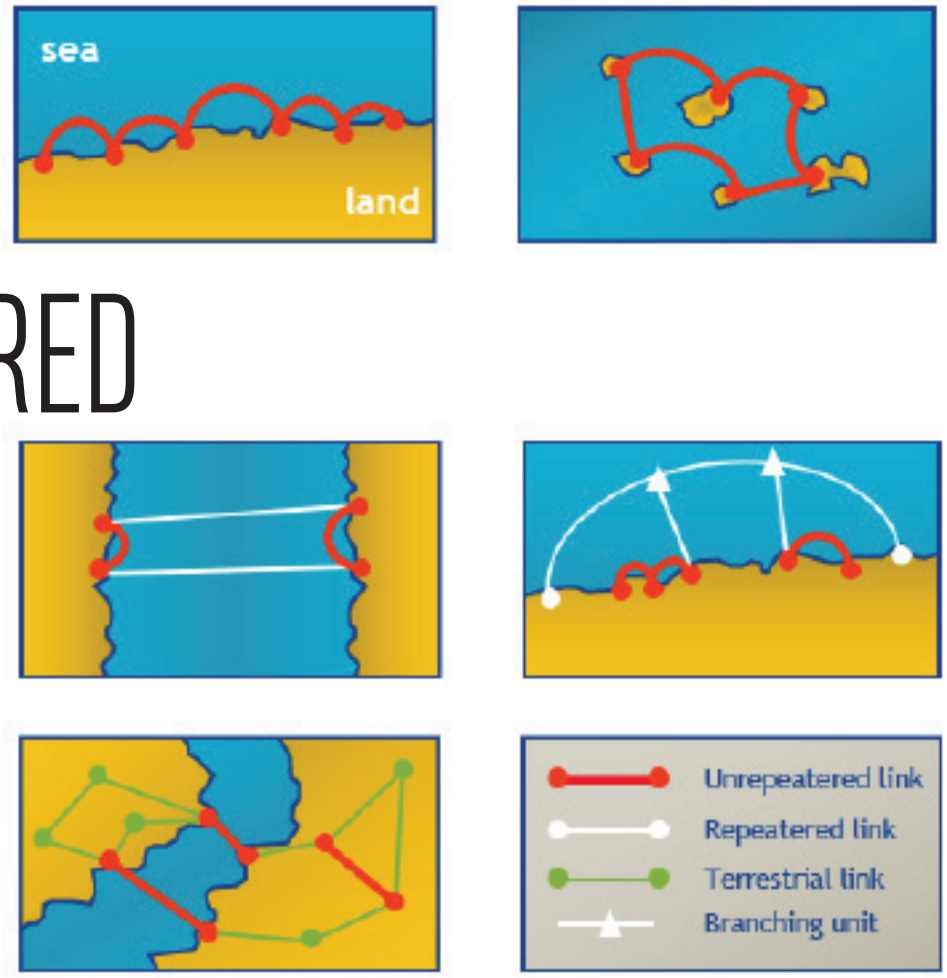


Figure 1 Applications of Unrepeatered cables

Unrepeatered optical networks are a key and vital infrastructure in today's global communication landscape, supporting local and international economic growth by providing regional connectivity across both terrestrial and subsea links. In addition, they also serve as interconnection with larger international subsea and terrestrial networks.

Unrepeatered links usually spans for hundreds of kilometres and in contrast with repeatered systems, they rely only on optical amplifiers at the terminal stations. No active components are inserted in the middle of the link. Consequently, no electrical power feeding is required.

To enable this, different combinations of High powered EDFAs amplifiers, backward and forward Raman based amplifiers are used to cover those long distances. On longer links, ROPAs (Remote Optically Pumped Amplifier) are inserted along the cable to provide supplementary amplification with the purpose of increasing reach and performances. Usually, a ROPA is inserted between 80Km to 130km from the terminal. Being a passive device, the required energy is provided remotely by ROPA pumps, installed at the terminal.

Unrepeatered links usually spans for hundreds of kilometres and in contrast with repeatered systems, they rely only on optical amplifiers at the terminal stations.

Unrepeatered systems are mostly used in subsea links to connect land masses across bodies of water that are smaller than traditional trans-oceanic networks. In these applications, their unpowered nature, makes unrepeatered cables an attractive and cost-effective solution. They keep CAPEX and OPEX low, they are simple to manage form an operational prospective, and they permit fast and flexible capacity upgrades.

For all the reasons mentioned above, it has also been possible for the industry to use a consolidated disaggregated approach, where subsea cable design and procurement is conducted independently from the transmission terminal equipment and associated amplifiers.

These attributes make unrepeatered submarine links the optimal choice for regional inter-country and intra-country systems, inter-island connections, costal festoons and for connecting offshore platforms. (See Figure 1.)

Often, they are also used to close transoceanic rings, providing a protection path between two repeatered submarine cables.

In addition, more and more operators are looking into unrepeatered solutions for purely terrestrial routes. A traditional use case has been power grid operators, where these systems are the optimal choice for connectivity over OPGW (Optical Ground Wire) infrastructures.

Unrepeatered optical links have been deployed and upgraded on routes where placement of intermediate sites is uneconomical, inconvenient, or impossible, such as desert crossings, areas with large forests, river crossing , or remote areas where human access is not possible for long periods of the year due to very low temperatures. Similarly, a wide use of unrepeatered systems is found on terrestrial routes where having intermediate sites is not always feasible due to environmental or political circumstances which are limiting access to electrical power supply for standard line amplifier at more frequent intervals

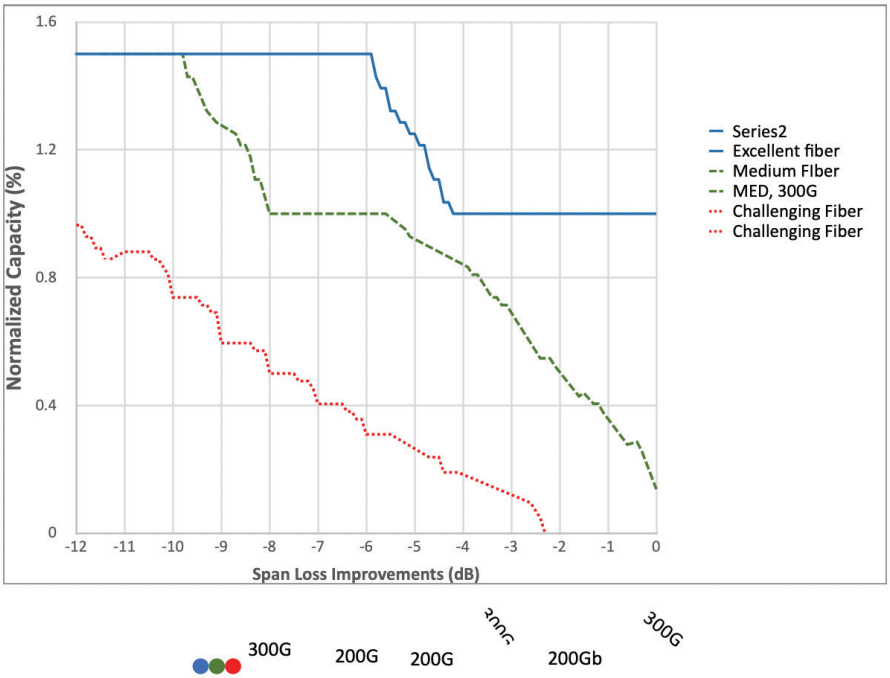


Figure 2 Performance comparison for different G.654C fiber categories

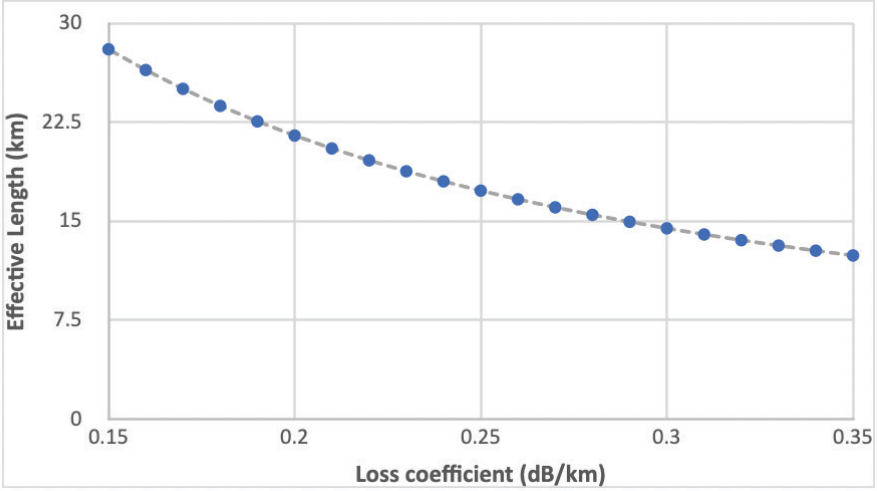


Figure 3 Effective length vs Loss coefficient

A NEW LANDSCAPE – THE CONVERGENCE OF UNREPEATERED AND TERRESTRIAL NETWORKS

The evolution of DSP technology and terminal equipment in recent years, and the increasing use of unrepeatered systems in terrestrial domains, have drastically accelerated the convergence between unrepeatered links and standard terrestrials networks. Repeatered and unrepeatered links are no longer seen as stand-alone point-to-point connections decoupled from the rest of the network which are only used to enable data transmission between two points.

Today, these links are fully integrated with large and sophisticated mesh networks and they are seen just as another available "pipeline" within a larger system. Therefore, talking about PoP to PoP, Datacentre to Datacentre or Multi-PoP to Multi-PoP has already become the new "normal" in the unrepeatered domain.

New deployment employ ROADM terminals at cable landing stations to enable end-to-end express services without requiring regeneration on the unrepeatered segment. This is complemented by the use of advanced terrestrial protections schemes on backhaul links to maximize network availability.

Network survivability can be enhanced by leveraging on network control plane features to seamlessly control and manage multiple unrepeatered links. Layer 0 GMPLS protection and service restoration can be used without restrictions on these systems while still considering specific in-service aspects of unrepeatered systems such as channel power levels, reduced operating bandwidth and special channel spacings.

IMPACT OF NEW GENERATION COHERENT OPTICS

The technological and architectural evolution of unrepeatered systems has been strongly driven by the increasing needs from network operators to offer flexible networks solutions and to increase link capacity at a lower price.

New coherent optic solutions with fully tuneable optical transponders allow the use of the same DWDM terminal hardware for both terrestrial and unrepeatered links. As a result, improved performance with reduced equipment footprint and low power consumption are possible, along with improved synergy on equipment sparing.

In comparison to what was possible in the past, the latest generations of coherent DSPs are enabling commercial deployments with higher channel line rates over greater distances, bringing benefits not only in terms of total cost per bit but also improving total fiber and cable capacity, and spectral efficiency

Advanced modulation schemes based on Probabilistic Constellation Shaping (PCS) allow for dynamic adjustments of baud rates to fine-tune channel data rate and channel spacing to maximise the performances of each unique cable system.

With the latest generation of coherent optics, it is possible to achieve 300Gb/s and 200Gb/s wavelengths over long spans. On some of the relatively short unrepeatered routes, 400Gb/s and 500Gb/s are also deployable. 100Gb/s waves are still employed for unrepeatered links over very long distances as with new DSPs the maximum achievable reach of a given line rate, has also significantly increased.

Complementing the advances of coherent optics and the re-shaping of the traditional unrepeatered use cases is the introduction of new fibre types now available in the market.

Complementing the advances of coherent optics and the re-shaping of the traditional unrepeatered use cases is the introduction of new fibre types now available in the market. For instance, ULL (Ultra Low Loss) G.652 or newer G.654 fibers are now offering attenuation coefficients less then, or equal to 0.17dB/km and 0.16dB/km , significantly reducing the overall span loss for a link at a given distance.

However, recently built cables using brand-new "state-of the-art" fibers are not the only infrastructures to enjoy the benefits brought by the advancements made with new generation transmission equipment. Significant improvements

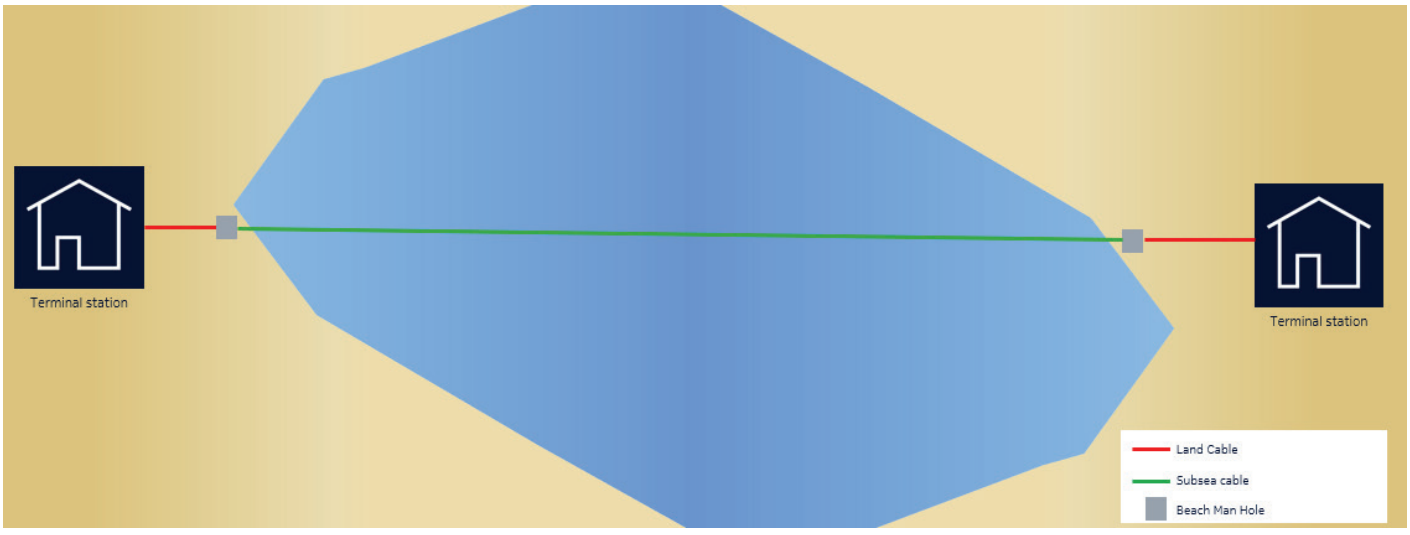


Figure 4 Terminal stations connected to a submarine cable via a land cable section.

are equally seen on legacy infrastructures which have been in services for over 10 or even 20 years. Many of these systems have also undergone multiple repair activities through their life. Fibre types used might be different than newer cables. G.654A/C, G.655, DSF fibers (G.653) and different G.652 types, are often found.

In addition, other tools are available today to ensure that on legacy or older cable systems all the potentially available performances are extracted. Advanced automations can optimally tune amplifiers used for different configurations and fully characterise already deployed ROPAs. This is often done in instances where original ROPA specifications are not available.

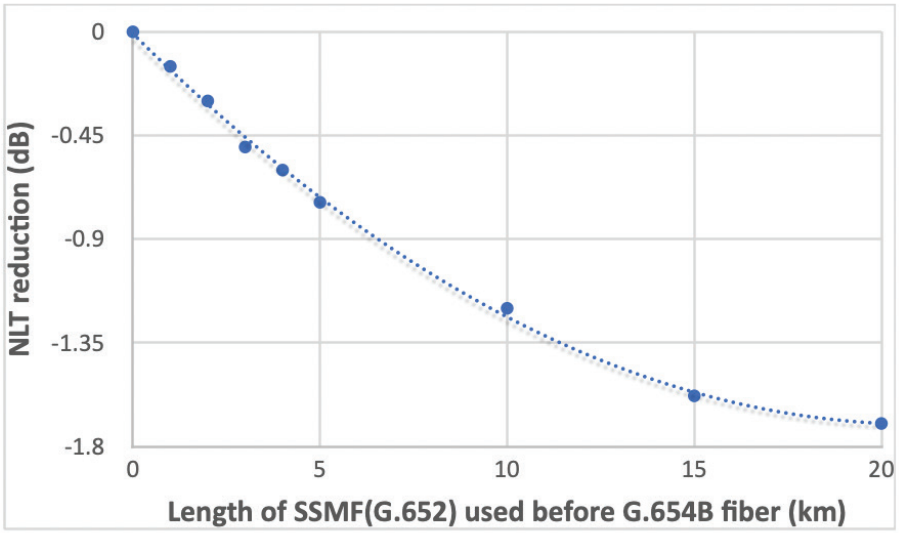


Figure 5 NLT reduction from the use of G.652 + G.654B instead of full G.654B

A KEY ASPECT FOR EXISTING INFRASTRUCTURES: FIBER CONDITIONS

When leasing, purchasing , operating or maintaining an existing link to be used for Unrepeatered applications it is important to ensure that the infrastructure used has been kept in the best possible condition, given its age, to provide the best return on investment when new DWDM terminal equipment is purchased.

Grouping fibers based on their conditions into generic categories, is never an easy task. Many elements must be considered and reviewed specifically for each link. The average attenuation per km is a key parameter. The distribution of cable repairs, and associated splice loss and their location along the cable are all equally important elements to consider, as they have significant effects on Raman gain and transmission performances.

However, a set of rules based on the average fiber attenuation coefficient and on conditions of the first 30km or 40km of the fiber link can be used to make an initial assessment and to be observed as a guideline for fibre maintenance.

During a study made for a network operator on the modernization of an existing legacy 100Gb/s per wavelength network on G.654C fibre, we defined three fiber categories , in order to differentiate the condition of the links already deployed and to be sourced:

- Under "Excellent", all links with a maximum average attenuation of 0.20dB/km have been grouped. Another pre-requisite of this group was for the first 40Km section (from both ends) not to present point of losses (losses lower than 0.1dB are excluded) in the first 10 km and to only have a small number of low attenuation point losses in the remaining 30 Km.
- In the second group, "Medium" fibres with a max average attenuation coefficient of 0.25dB/km have been included. In the first 30km fiber section only a small number of point losses with not particularly high attenuation are present
- The last group, Challenging fibers, present a high average attenuation coefficient and in many cases, a high number of point losses across the cable and in the first 30 km section. In this case, some restrictions for the amplification schemes used and the maximum allowed power, would have to be observed. Ideally, if the first 30 km section (from both ends) is maintained in good conditions, it is still possible to achieve good performances on these links. For this type of fibers it can be extremely helpful to conduct an ad-hoc assessment to identify a small number of point losses to be re-spliced within the first 30km section. This will ensure that precious capacity available on those links is not lost.

In Figure 2, we set a reference span loss (0dB) for this network, to be the maximum achievable span loss delivering maximum capacity with 200Gb/s waves using an excellent fiber. Then, improvements obtained from a reduction of span loss and different types of fiber conditions are analysed. As can be seen, at the reference span loss, an 80% capacity reduction is experienced with fiber in medium condition, implying the need for the operator to switch to 100Gb/s line rates.

As we move away from the reference point, the delta

between "Excellent" fiber and "Medium" fiber will start to dimmish. For instance, with a span loss reduction of -3dB from the reference, a "Medium fiber" will account for a 30% reduction in capacity. Finally, a challenging fiber will still allow 200Gb/s line rates to be transmitted but with an 85% reduction in capacity.

When span loss is reduced further by 2 dB (at -5dB in Figure 2), there will be a small difference between an "Excellent" and "Medium" fiber, with a challenging fiber delivering up to 30% the achievable maximum capacity. In this case, if an "Excellent fiber" is used and maintained,300Gb/s line rate can be deployed, further increasing link capacity from the original reference point by 20%.

From this data, it is evident that while the overall span loss of a link is a key criterion used to assess achievable performances, it is not a sufficient metric if used alone. Among fibers having the same span loss, there could be a significant difference in performances based on their overall condition and in particular on the different numbers of events in the first 30/40km section.

GETTING THE MOST OUT OF YOUR INFRASTRUCTURE

Unrepeatered cables are loss limited. The lower the fiber attenuation, the higher the OSNR. In addition, Raman gain improves with low fiber attenuation, resulting in better OSNR and Noise Figure(NF).

As previously mentioned, the condition of the first 30km or 40 km of a fiber (from both end) is extremely important. A good example that can be used to understand this requirement, is the relation between Effective length and fiber attenuation coefficient.

From a high level prospective, the effective length represents the minimum distance required to transfer power from the pump to the channel when Raman pumping is used. The higher the effective length, the deeper into the fiber the transfer will occur, resulting into better Gain and NF. It can be seen from figure 3 , how the effective length strongly decreases for higher loss coefficients.

Another important fiber parameter in the context of unrepeatered cable is the Effective Area, as Raman gain amplification is more efficient in fibers with low effective area. (The gain is approximately inversely proportional to the fiber effective area). In Large effective area fibres, higher power will therefore be required to reach the same gain.

Another important fiber parameter in the context of unrepeated cable is the Effective Area, as Raman gain amplification is more efficient in fibers with low effective area.

However, Large effective area fibers (110,130,150) are more tolerant to high lunched power and to non-linear effects for both signal and pump waves. Consequently, based on the overall operator requirements and the type of link to be built, both low and high effective area fibers can represent the best choice for an infrastructure.

Some operators might decide to invest into high effective area fibers for a subsea cable. This is to leverage on the advantages they have to offer when addressing certain use cases. When it comes to unrepeatered, some of these benefits can be partially lost due to the use of a different fiber for the land cable section connecting terminals to the BMH (Beach Manhole). Depending on where the terminal station is located, the land cable section can range from less than one kilometre to tens of kilometres. (See Figure 4.)

A common case found in some point-to-point subsea links is the use of G.652 fibers (having lower effective area) for the land cable, with a transition into a G.654B fiber (with larger effective area) on the Subsea link.

In this scenario, the difference between the effective area of the two fibers used is important as it will limit the maximum amount of power that can be launched onto the system.

Generally speaking, the higher the signal power, the longer the achievable transmission distance. The maximum amount of power that can be launched is determined by the fiber effective area and it will determine the Non-linear Threshold(NLT) for the given link. As discussed, high effective area fibers have the advantage of having a higher non-linear threshold compared to low effective area fibers

Non-linear interactions mostly occur in the first kilometres. Consequently, the length of the landing cable fiber having a different effective area than the subsea segment is an important factor to be considered.

In Figure 5 , the NLT reduction resulting from the use of mixed G.652 and G.654B instead of a single G.654B is provided. For a 200Gb/s transmission, different lengths of SSMF (G.652) fibers used before transitioning into a G.654B are represented. As it could be seen from the figure, NLT decreases with the increase in length of the SMF fiber used for the land cable. For very small quantity of SMF, the reduction can still be acceptable; but after few km the impact starts to be non-negligible and reduces some of the benefits brought by the use of a high effective area fiber

on the subsea segment. When the length of the SMF fiber starts to be greater than 20/30 km, from an NLT prospective, the link transmission profile will be strongly based on the G.652 characteristics.

For unrepeatered links, an ideal case scenario is to use the same fiber through the entire link from Terminal to Terminal. However, this is not always practical or possible. Often, infrastructures have already been built and access to different routes and fibers is not always easy due to the lack of cable infrastructures within a given region, complex permitting or high costs.

In this case, careful end-to-end planning, can significantly help with the selection of the most optimum fiber to be used and of the most appropriate optical amplification schemes within the terminal equipment.

MONITORING THE FIBER

When possible, it is good practise to qualify a fiber prior to an upgrade, even if historical measurements are available. This allows to perform accurate estimations and to identify the most suitable amplifier options for every link. It is also good practice to perform fibre measurements after cable repairs. This allows to monitor fiber conditions and ensure that a certain given fiber quality is met or maintained.

Usually, two main types of measurements are performed. The first, using a 1550nm laser source and a high sensitivity optical power meter in order to measure the overall span loss. The second is done using an Optical Time Domain Reflectometer (OTDR) to evaluate amount, loss, and distribution of events in the first 50Km section.

For OTDR measurements, at both 1310nm and 1550nm, two different settings are recommended to be used. The first is a high loss sensitivity (using a small pulse), high spatial resolution measurement to record losses in the crucial first 10 km of fiber from the terminal

The second measurement requires lower sensitivity (using a larger pulse) and lower resolution. It focuses primarily on fibre between 10 to 25 km away from the terminal.

In addition, a long trace is also recommended to be taken in order to cover as much fiber distance as possible and to track any further relevant events, including unexpected break point.

IN CONCLUSION

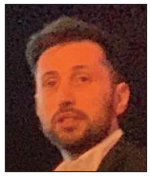
Unrepeatered solutions are an attractive option for regional systems where long distances are required to be covered on subsea or terrestrial routes.

Technological advancements and new operator's requirements have shaped a new landscape where unrepeatered links are fully integrated with larger terrestrial networks.

In an era and a market where operators are looking at all the available options at their disposal to deliver more capacity at a reduced cost, the convergence of terrestrial and unrepeatered subsea networks through a common platform and the advancements of new generation coherent optics are providing levels of flexibility never seen before.

When possible, it is good practise to qualify a fiber prior to an upgrade, even if historical measurements are available.

These benefits are not only seen on new recently built systems. A terminal equipment and capacity upgrade can provide new life to existing cables using any fibre type, under any different aging and overall conditions. In addition, accurate end-to-end planning and good fiber maintenance can significantly help in maximising the performances of legacy infrastructures and to allow to achieve the best return on investment when new transmission equipment is purchased. STF



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Prior to Nokia he has held various technical and commercial positions for Subsea network operators.

He started his career joining the Engineering and Operation department of Apollo-scs. He later transitioned into the Vodafone Group Submarine Systems Engineering team where he supported the procurement, delivery and management of terminal upgrades and new cable builds.

DELPHINE ROUVILLAIN *is a network architect having more than 20 years of experience in the optical domain. After several years of pure research activity on Soliton-based transmission systems in Alcatel Research Center, she moved to the Alcatel-Lucent R&D to work on the engineering rules of optical systems for metro applications. For 10 years, she actively contributed within Alcatel-Lucent and then Nokia to the design of unrepeatered transmission systems and she is currently in charge of the definition of their engineering rules.*

MAURIZIO PIZZI *Is a senior member of Nokia's Technical Excellence Center for Unrepeatered Optical Transmission. He has been leading all the most challenging unrepeatered subsea and terrestrial deployments that Nokia has delivered and continue to deliver across the world. Before joining the Technical Excellence Center, he was a member of the R&D team working on access network solutions. Maurizio has over 36 years' experience working in optics at Nokia, Alcatel-Lucent and Telettra.*

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FEATURE

CONNECTING AFRICA TO THE GLOBAL ECONOMY IS PARAMOUNT TO STRENGTHENING INTERNATIONAL TRADE

BY DAVID EURIN

Connecting Africa to the rest of the world and unleashing its workforce potential may just be the key to catapulting international trade and markets to a whole new level. This developing continent has the largest population of young people in the world – around 200 million aged between 15 and 24. These innovative young minds are eager for a seat at the global economic table, but how do we get them there?

Africa (as a whole) desperately needs to leapfrog into the digital future and catch up with the rest of the world. The continent is in need of world-class broadband infrastructure and connectivity to the global economy. The sooner the better as each country in Africa is developing digital skills (albeit at different rates) to offer the world.

TRADE WITH AFRICA

To give you an idea of how successful trade with Africa is, according to the UN, China is Africa's largest trading partner and in the year 2000, trade totalled US$10.5 billion. It grew exponentially from there and in 2005 it stood at US$40 billion. Six years later in 2011 this ballooned to US$166 billion. And by 2019, before the pandemic hit the global economy, China-Africa trade hit a peak of US$192 billion. This is a phenomenal growth and speaks volumes about the potential of this continent.

Regardless of the current circumstance, the exponential growth potential is still palpable. So, the time to invest is now. Given the economic impact of Covid-19, it is the ideal time to harness Africa's potential and mobilise its innovative young workforce. More developed countries should leverage off Africa through innovation.

WE ARE CONNECTING AFRICA

Liquid Intelligent Technologies recognises Africa's potential and connects it to the global economy. We created different fibre routes to transport data across the length and breadth of the continent and provided access to submarine cables. Guided by our vision we built Africa's largest independent fibre network, and with the East to West fibre connection, the routes are the most direct digital corridors across the southern hemisphere. These routes have set a new benchmark helping the organisation achieve historic milestones in its journey to create a more connected Africa.

The East-West fibre connectivity corridors offer a low latency path to connect Asia, Africa and the US as an alternative to busier routes via the Middle East. Our growth is a direct result of the increasing demand for infrastructure to support broadband internet on the African continent. Now more than ever before, local business needs reliable and extensive connectivity to ensure effective digital transformation.

With all of this in place, it is now possible for companies to expand their operations in Africa using a reliable and extensive network with access to over 100,000 kilometres of the fibre network. This includes access to Cloud, Cyber Security, IoT networks, and state-of-the-art data centres in Nairobi (Kenya), Johannesburg and Cape Town (South Africa), Lomé (Togo), and more being built in regions such as Lagos (Nigeria) – keeping Africa's data in Africa and meeting all required data regulations.

In the Democratic Republic of Congo, Liquid partnered with Facebook to build an extensive long haul and metro fibre network for more than 30 million people to help meet the growing demand for regional connectivity across Central Africa. This network creates a digital corridor from the Atlantic Ocean through the Congo Rainforest to East Africa, and onto the Indian Ocean. This corridor connects DRC to neighbouring countries including Angola, Congo Brazzaville, Rwanda, Tanzania, Uganda, and Zambia.

In the Democratic Republic of Congo, Liquid partnered with Facebook to build an extensive long haul and metro fibre network for more than 30 million people to help meet the growing demand for regional connectivity across Central Africa.

This kind of infrastructure not only enables new trade in and out of Africa, but also brings a variety of new benefits to a continent that has for far too long been in need of more global investment, infrastructure and support. This cross-border connectivity with high speed and access to public clouds allows the region to grow via digital services such as internet banking, access to international education, and the platform to connect hospitals to central databases. It also helps bring governments online and bolster e-government service delivery efforts.

Despite some challenges along the way, we connected Africa and continue to grow our footprint in the region. The likes of Google, Amazon, Facebook and Microsoft are also investing in Africa. One of the crucial advantages of Liquid's infrastructure is the ability to offer network redundancy and therefore service reliability. This essentially means that a network in Nairobi, for example, has three or four different route options. If one goes down, there are still others that can be used as a back-up. Multiple routes are important because you can never be reliant on a single route.

EMPOWERING AFRICA'S YOUTH

Although Africa is an emerging economy, it is home to some of the most innovative young minds in the world. There is a treasure trove of untapped potential lying in wait. Any move into this continent should aim to help bridge this digital gap by embracing the entire population across all countries – many of whom have never accessed the Internet before.

By simply enabling connectivity, citizens of Africa are empowered to use the internet and access a new world of information and possibilities. What they get is access - access to jobs, to an education, to unlock their entrepreneurial dreams, help their families, gather wealth and empower their communities.

At Liquid Intelligent Technologies, we believe in African potential. We believe we can change the face of the internet in Africa and create a level playing field for all Africans to compete globally.

How many countries can this fibre reach? For starters, we build networks where the demand is high – building around key town, cities and landing stations, and to support Mobile Network Operators. This means companies (small or large) will now be able to connect to colleagues across the world, put trade plans in motion, and bank on amplified returns on investment for generations to come and without delay. We then extend our network as it has become more affordable to reach surroundings towns and areas.

The time for African strength and economic power on the global stage is coming. The question is who is going to be first to take advantage of this as the continent's infrastructure quickly catches up to global standards. Who will be the first in line to unleash the potential of African youth? STF

DAVID EURIN *joined Liquid Intelligent Technologies in 2013. He is responsible for leading the Group's strategy in his role as Group Chief Strategy Officer as well as heading the International Wholesale division.*

Prior to Liquid he was a Partner and Head of Africa at Analysys Mason, a management consultancy specialising in TMT. David has extensive experience in the fixed and mobile telecommunications industry, gained in Europe, North Africa, the Middle East and sub-Saharan Africa where he advised senior management teams on strategic, regulatory, financial and commercial issues.

He has an MBA from the Collège des Ingénieurs (France), an MSc from the University of British Columbia (Canada), as well as an engineering degree from ParisTech (France). David was born in France and now lives in London.

FEATURE

THE NORDICS

Connecting Sustainability in an Expanding EMEA

BY MERETE CAUBET

Norway launched a strategy in 2018 toward becoming a data center destination market. Additional policy actions are expected this year through an update to the national strategy designed to increase investment in a rapidly expanding market. Vast surpluses of 100 percent renewable energy at significantly lower cost than the rest of the FLAPD markets are proving compelling factors in this growth.

Until recent years, Norway has trailed behind the rest of Europe in developing and deploying digital infrastructure. Affordable and abundant clean hydropower and direct policy actions by the Norwegian government have transformed the Nordic region into one of the fastest growing markets across EMEA. Norway is now equaling and surpassing neighboring states when it comes to connectivity, capacities and route diversity offerings in the region.

The digital role of the Nordics continues to gain prominence across Western Europe. Reducing costs in CAPEX and OPEX while meeting increasing expectations for sustainability are key drivers and expanding connectivity options add confidence that is enabling global investment. This infrastructure is transforming networking across EMEA.

BUILDING FOR BUSINESS

A recent white paper published by Invest in Norway lists four subsea cable systems in operation, two under construction, and three more planned. Table 1 lists the details of each of these systems.

In addition to the growing number of diverse and redundant routes into Norway, new terrestrial routes have been constructed, providing capacity between points of presence (POPs) in Norway and those in Frankfurt, London, Amsterdam, Paris and Dublin - the FLAPD markets - and to other key markets across Europe. Investments in and around Oslo continue to cement the capital city's position at the center of Norway's digital ecosystem.

LATENCY DISADVANTAGE A THING OF THE PAST

The idea that Norway and the Nordics are our off-the-grid friends to the north is gone. Construction of new, state-of-the-art systems to and from the major landing points across EMEA has transformed and expanded the region.

These investments have produced latency figures to and from POPs across Norway that are on par with Intra-Region latency figures between market hub city pairs across EMEA. For example, recently published 12-month city pair latency averages reported on the Global Performance

* Tampnet Offshore FOC Network
** Multiple Locations
Source: Update on Networks and Connectivity, Norway ; Invest in Norway; March 2021

Norway Subsea Cable Systems in Operation					
System Name	System Owner	From	To	Services	RFS
Havfrue	Bulk Fiber Networks	Kristiansand/ NO1	Wall Township, NJ, USA, Denmark (DK01), Ireland	Managed/Raw Spectrum	Q4 2020
Skagerrak-4	Statnett/Dansk Energinet	Kristiansand/ NO1	Bulbjerg, Denmark	Dark Fiber	2014
Tampnet Carrier*	Tampnet	Norway**	UK**	Dark Fiber, Waves, EoMPLS	Various
Skagenfiber West	Altibox Carrier	Larvik	Hirtshals, Denmark	Waves, Capacity, Dark Fiber	Q4 2020
Norway Subsea Cable Systems Under Construction					
System Name	System Owner	From	To	Services	RFS
NO-UK Cable System	Altibox Carrier	Stavanger	Newcastle, UK	Spectrum, Waves	Q4 2021
Havsil	Bulk Fiber Networks	Kristiansand/ NO1	Hanstholm and Esbjerg, Denmark	Dark Fiber	Q4 2021
Norway Subsea Cable Systems Planned					
System Name	System Owner	From	To	Services	RFS
Celtic-Norse	Celtic-Norse AS	Trondheim	Kilala, Ireland	Dark Fiber, Spectrum, Waves	2022
Arctic Connect	Cinia OY	Kirkenes	Hokkaido, Japan	TBD	Suspended
Leif Erikson	Bulk Fiber Networks	Husnes	Goose Bay, Canada	Dark Fiber, Managed/Raw Spectrum	Q4 2023

Reporting (GPR) website range from 10.21 milliseconds to 24.81 milliseconds for destinations like London, Paris, and Madrid. Latencies to and from Oslo are at or well below 20 milliseconds across all of the FLAPD hubs.

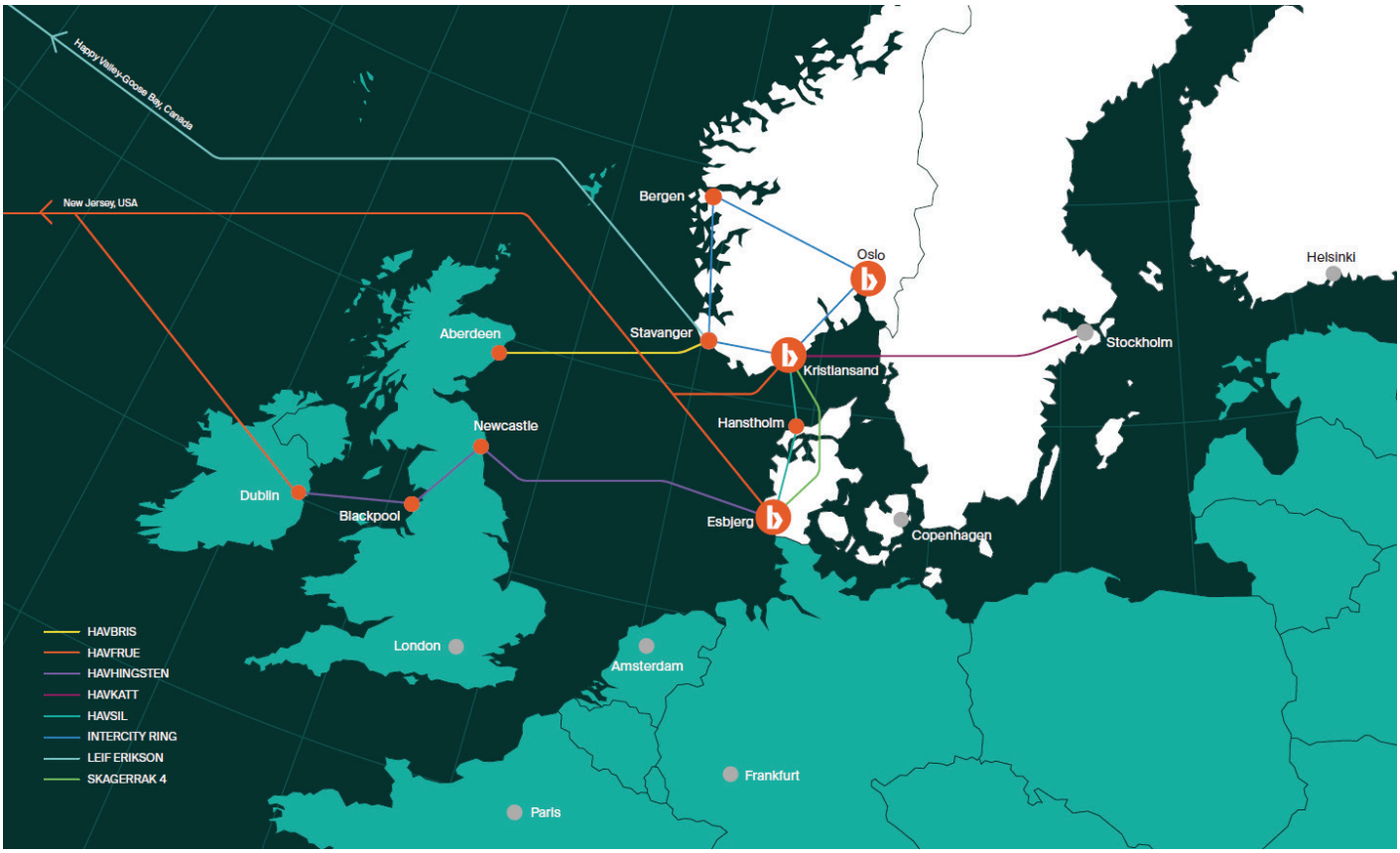
Opportunity in the Pure Infrastructure Play

Bulk Infrastructure is leading the race to bring sustainable infrastructure to a global audience. This innovative Oslo-based company focuses on industrial real estate, and digital infrastructure including data centers and fiber networks. The approach to all Bulk projects is predicated on four driving principles. It needs to be sustainable. It needs to be infrastructure. It needs to be able to scale internationally. And it needs to relate to the Nordics. Fiber networks projects are pure infrastructure for data transport without overlap services that may compete with carriers or customers.

The neutral terms of a pure infrastructure play in the region run somewhat counter to the trend toward vertical integration we are seeing in the emerging era of multicloud. Instead, the company focuses on state-of-the-art new-build systems at low latencies as alternatives to the growing costs and congestion that define the FLAPD markets. To unlock the massive stores of renewables in the Nordics, connectivity is opening new pathways and strategies in the region to address growing needs and rising costs.

PLANNING FOR GROWTH: HAVSIL, HAVHINGSTEN

The Havsil system has been selected by the Norwegian Communications Authority to serve as the new secure diverse fiber route between Norway and abroad. The new fiber route will increase geographical distribution of daily



internet traffic and add much needed diversity, as most Internet traffic from Norway follows two specific routes through Sweden.

Havsil will be the shortest route connecting Norway to continental Europe, improving diversity by avoiding the traditional fiber routes. The subsea cable system is an unrepeated, high capacity, express route between the data center campuses N01 in Kristiansand and DK01 in Esbjerg and will be ready for service later this year.

In addition to the new Havsil system, the Skagerrak 4 subsea system also connects Bulk N01 Campus to the Northern tip of Denmark and offers a high-confidence redundant route to Havsil. Bulk provides dark fiber for the subsea system and tele-housing for the terrestrial network in Norway and Denmark.

The Havhingsten subsea system is Bulk's second regional cable coming into service this year. Havhingsten connects Ireland and UK into the new connectivity hub at DK01 in Esbjerg providing direct connectivity to major European and Nordic cities. Havhingsten is a joint build between Bulk and partners and stretches 1.217 km between Dublin and Esbjerg through Newcastle. This will be the most efficient route between Dublin and the Nordic region.

A SEISMIC SHIFT FOR THE REGION

Expanded fiber routes between Norway and the rest of EMEA have permanently transformed the region, creating new markets and new opportunities for hyperscalers and enterprises. Robust interconnections and peering capabilities are opening up new audiences in Norway and the Nordics for carriers, CDNs and others. Investment trends show that this transformation is still in the early stages and shows strong promise for dramatic growth in the near future.

For workloads seeking to generate new value across the congested, expensive and carbon laden FLAPD, it has to be sustainable. It has to be infrastructure. It has to be scalable. It has to be in the Nordics. STF

MERETE CAUBET *is VP Sales and Business Development at Bulk Infrastructure focusing on development of fiber networks enabling the Nordics for large scale data processing on sustainable infrastructure.*

Mrs. Caubet leads the expansion of Bulk Fiber Networks into a key player connecting the world to the Nordics. Havfrue Cable System and Havhingsten are the most recent cable systems in Bulks portfolio, while several more are under development.

Merete has 20 years of leadership experience in the international marketplace, starting off in the pharmaceutical industry before moving on to Volvo Corporation and then into the Telecom Industry. Prior to Bulk, she was Director of Sales and Marketing for Subsea Telecom and Special Cables at Nexans. She holds a Master of Science from the University of Toulouse and University of Sydney, and a Master in Competitive Intelligence from the University of Toulouse.

FROM LOCAL CONNECTIVITY TO GLOBAL REACH

The New Age of Communication

BY DEREK CASSIDY

In today's economic environment and in the depths of a worldwide pandemic with home working now being the norm, the ability and need to stay connected is now more of a given need rather than a hope. However, in some places, even in Europe and America which are technological advanced parts of the world, connectivity can still be a bit of a problem.

However global connectivity is now a must and it relies on the regional connections to make sure that the local community stays connected to the wider world. Connecting to the network is just as easy as turning on your access devise, if it be a laptop, tablet of phone and immediately connecting to an internet devise or hub. In so many ways the act of internet connection has been made so simple that it is as easy as just turning the device on and your connectity to the internet is almost instantaneous? A lot of people would like to think that is all that is involved in internet connectivity. Some people cannot think beyond the Wi-Fi API or wired LAN connection and any connectivity issues relate to these points within the network. But it is not all that easy and with the tremendous pressure now being felt by the network operators, connectivity issues soon come to the fore. These connectivity have now become critical issues for some people and companies as they are sometimes the only link, for some people, to the outside world. As the home office became the norm, the domestic network, not designed to operate at an agreed up-time seen by the corporate/industrial connectivity networks, was now being used as the primary access without the full restorative or operational requirements and systems supporting them, just as the corporate network can avail off.

The ability to connect to the internet and communicate with someone or some entity the other side of the world relies on numerous factors that people take for granted but the industry already know is quite difficult to deliver.

Since last March there has been an enormous strain put on the local and national networks to keep connectivity always on. The previous month the web of internet connectivity was divided into two separate networks, the corporate and the domestic network. Both networks sharing the same available capacity but at different times but allowing for some small merging of the two when the corporate network was soon displaced by the domestic network. This was seen at the end of the working day when the domestic internet network took over as main connectivity driver.

It's the same for the provision of electricity where there are two peak periods in power consumption, early morning and evening periods when people and or Families gather together in a social setting consuming the electrical power for their own wants and needs, in a domestic environment. The transition between peak and normal electricity usage is well documented and the national electric grids design their networks in such a way as to meet these demands on consumption. However, the capacity provided and designed to meet the needs of internet connectivity does not have such design or network provisions in place. There was always a differential in the difference between corporate/industrial and domestic internet connectivity and the demands on the different networks were met in such a way that made the operation feasible.

However, that all changed in March 2020 when the world was faced with no option but to change the working habits of millions of people and create new home working environments, essentially overnight. This was to create havoc on the national and international networks as the divide between the two types of internet consumption, corporate and domestic, always separate but with some differentiated overlap of usage and consumption. But now the domestic and corporate/industrial consumption of internet content would be vying for the same capacity. Soon the need to meet these demands fell on the network operators to quickly mobilise network upgrades and even increase the speed of network builds and commissioning so that the capacity needed for such demands was provided.

In Ireland this coincided with a new programme of works that was being spearheaded by a new organisation, National Broadband Ireland (NBI) who have been tasked with designing, delivering and connecting Ireland; its communities, both urban and rural, to a new national broadband network independently run and delivering next generation services. During the onset of the working from home and home office environment the focus of NBI on its delivery strategy was tested and found to be applicable to the demands now seen on existing networks. By radically thinking and critically examining the existing network architectures NBI could see what models existed and could also evaluate their own design model. With these results they could incorporate them into their network planning framework from the ground upwards. This was also aided by using the latest design principles and next generation in transmission technologies to come up with a solution. This would help deliver a new era in broadband technology and connectivity across Ireland, offering a first-class operational network capable of operating and delivering within these challenging times.

NBI has come up with a solution that enables the local community to connect to the global community, bringing the network and especially the on-line content closer to the edge which would decrease latency, increase network speeds, and network capacity. But this new operational design was not just about broadband connectivity. The fact that NBI was designing and building a new broadband network, where in fact it was a fully functional telecommunication network in all but name, was not lost on the project team. NBI could and can complete with the best of the networks but their aim was to connect people who wanted broadband no matter the destination or locality, that is, NBI would enable the remotest part of Ireland to be high-speed broadband enabled. This would help create a new backbone for connectivity that would allow for both domestic and corporate internet and communication networks to work within the same space and spectrum. Any future demands on the network due to Government or Societal policies on remote working will allow the user to interact with the network from whatever or wherever they choose.

As already said, global connectivity is a must, but it also needs the support of the regional networks to supply the web of national and international submarine cable connectivity that aids in this global reach, a seamless link between nations. The regional networks themselves also rely on local and national connectivity, just like the national incumbents, competing network operators and other systems just like NBI, helping to create that connectivity. But it is only in the last year or so that the real reliance on this regional and global network has been put to the test. These regional and global networks responded to the challenge and met it face on, helping to keep global and regional connectivity operational.

As already said, global connectivity is a must, but it also needs the support of the regional networks to supply the web of national and international submarine cable connectivity that aids in this global reach, a seamless link between nations.

But if we look at the design and operational ownership of these regional and international submarine cable networks, we can see that for a long time they were owner operator systems offering managed bandwidth. However, over the last decade a new design has appeared on the stage of international connectivity. The carrier neutral system, a system that allows for other non-submarine system capable telecom operators to become a virtual system owner by leasing dark fibre on these systems. The carrier neutral network opened up the access to international connectivity and allowed other telecom and communication companies to expand their operational footprint.

The carrier neutral network has opened up the area of submarine cable connectivity and has allowed for increased investment by non-telecom operators who build the system and lease the available fibre capacity to other telecom operators. They can also assign the operational and maintenance responsibilities to a third party, who are a licenced telecom operator, can operate and maintain the

cable for the clients. This new chapter in regional connectivity has allowed for the opening up of new routes and in doing so the global submarine network picture has taken a new direction. New cable systems are being designed and installed which are for the sole use of the large ISPs and Hyperscalers so that they can bridge the gap between countries and continents. These new cable systems, built by one of the large cable laying firms and having a surrogate operator maintaining the system but not open for commercial business, being in effect a private leased line for a single entity. However, they do complete an objective and that's to increase to bring the content on the web closer to the consumer, bringing the network closer to the edge.

The impact of these new systems has seen the available capacity across the globe increase, following the demand curve that is needed in providing international connectivity, network capacity and increased bandwidth availability. This in effect allows for the increased numbers of consumers to consume more content and allow for greater connectivity.

However, it still comes back to the local and regional networks to knit all this together and their new alliance with the neutral, operator owned and hyperscale data centres to keep everything operational. For a long time data centres were locations used for data storage and over time they evolved into the sites dedicated for content provision just like a central ware house were on-line content could be sourced and delivered to its consumers via the web of network connectivity. The data centre still needs to take another evolutionary step to become a single entity were submarine cables connect, ISPs store and distribute content, facilities were telecom operators and consumers interconnect with each other. By following this example, which is slowly evolving and being incorporated into networks across the globe, the ability to reduce the distance between consume and content is vastly reduced and the speed of these connects is vastly increased. This allows for reduced latency and increased capacity which in turn would allow for higher bandwidths across the network.

With all these new designs, operational models and topologies coming together the many national and internation networks can see light at the end of the tunnel enabling them to increase capacity and capable of delivering for the corporate and domestic communication market at the same time. The need to segregate the corporate and domestic con-

sumption of on-line content, which was once the standard operating model can new be scrapped. This can be replaced with a new model where capacity and operational bandwidth are available for both models allowing for the new era of home working, remote schooling and an awful lot of Zoom and Teams interactivity.

But it does not stop there, in Ireland a new innovation in submarine cable connectivity is slowly taking place, this is the community driven connection. This new approach is being pursued by two Islands on Ireland's western seaboard, Claire Island and Valentia Island. The objective of both is the same, to connect the two islands to the mainland with anew submarine cable allowing for the provision of high-speed broadband in all environments. Microwave or MIMO radio technology can be used to provide high-speed broadband and is cheaper, easier to maintain and operate. However, it lacks one thing, the ability to keep the high-speed connection fully operational in all environments. The weather on the west coast of Ireland can be quite changeable storms, heavy rain and calm warn days all even in a single day will play havoc on any microwave link. Operating a microwave, of any technology design, in these environments comes with its hazards of service disruption for long periods. The need to overcome these challenges can only be achieved by a wired network and that's why these two Islands have turned to the community submarine cable system. This cable system is truly a local network, but it connects directly into the regional and national network allowing for high-speed connectivity across the globe, making an internet connect from Valentia to anywhere on the globe seamless without any disruption.

These two system designs are well inti their planning stages and submarine cable design has already been approved. The cable routes have been selected and the projects are well underway. However, there is also one surprising element in all of this. Valentia Island was the birthplace of long-haul submarine cable transmission stemming from the first successful trans-Atlantic cable, the 1866 trans-Atlantic telegraph submarine cable. This cable opened up the financial and commercial markets to international trade and soon the other long distance submarine telegraph cable systems developed with the Brest to Cape Cod submarine telegraph cable with many more to follow including the new submarine network linking Britain and India. Now Valentia is once again being connected with a submarine cable and the oldest submarine cable station will once again take on the reins of being an operational cable station taking its place amongst the other submarine cable stations across the globe.

Valentia is not only becoming a submarine cable station once again, but it is also going for world heritage status (WHS) with its links to the 1866 cable and the innovations and technological advances that were discovered during its long reign as telegraph gateway to the world. Its contributions to the world of communication cannot be overstated. The cable station is also evolving into a next generation innovation hub were research, idea creation and development with thrive side by side developing new technologies and designs. Valentia Island, celebrating its 164th year as a main player with the history of submarine telegraphy also celebrates the re-enactment of the first transmission across the 1866 telegraph cable. On the 27th July a team will re-enact the telegraph transmission via Morse code between Heart's Content and Valentia. This re-enactment is an annual event which has been taking place since 2016 and has received wide attention across the various communication networks.

Valentia is not only becoming a submarine cable station once again, but it is also going for world heritage status (WHS) with its links to the 1866 cable and the innovations and technological advances that were discovered during its long reign as telegraph gateway to the world.

Valentia and Claire Islands are now developing new high-speed connectivity via submarine cable transmission. They are looking to the future, becoming centres of excellence in innovation technology, they are truly becoming leaders in Local Connectivity with a Global Reach. They are entering the new age of communication. STF

DEREK CASSIDY *is doing a PhD in the field of Optical Engineering; Waveguide creation and Wavelength manipulation with UCD, Dublin. He is a Chartered Engineer with the IET and Past-Chair of IET Ireland. He is Chairman of the Irish Communications Research Group. He is also currently researching the Communication History of Ireland. He is a member of SPIE, OSA, IEEE and Engineers Ireland. He has patents in the area of Mechanical Engineering and author of over 30 papers on Optical Engineering. He has been working in the telecommunications industry for over 27 years. Derek holds the following Degrees; BSc (Physics/Optical Engineering), BSc (Engineering Design), BEng (Structural/Mechanical Engineering), MEng (Structural, Mechanical, and Forensic Engineering) and MSc (Optical Engineering).*

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FEATURE

WHAT ARE THE ODDS?

How to Manage Supplier Selection

BY KRISTIAN NIELSEN

In this booming industry, there is no shortage of developers with a dream. Every planned system comes from someone with a twinkle of innovation in their eye. They see an opportunity someone else has not. These innovators come from every corner of the world, some experienced and some branching into a new industry.

As consultants, it is our job to help identify and bridge the gaps organizations have in the industry —from providing third-party due diligence during the engineering of a system, to advocating the owners' interests during the physical survey or installation. The needs of owners are wide and varying, but the single most common need is providing expert support for the selection of the right supplier for the system.

The selection of the right supplier for a system is both complicated and simple. There are many moving parts to the process, but with adequate management, the selection and award of the supply contract is a smooth-moving machine.

WHERE DO I START?

As with all contract bidding efforts, a Request for Proposal (RFP) package is the first step. The RFP Package forms the cornerstone of the system development. The RFP package must include the purchaser's technical requirements, the terms and conditions of contract, scheduleand other essential parameters under which the supplier will deliver the system. The RFP package provides the basis from which a contract will be created and must fully represent the purchaser's requirements. A well-written RFP package with no contradictions between commercial, technicaland marine requirements makes the roles and responsibilities of all parties clear and facilitates a smooth, on-time delivery of the system.

The completed RFP package will include:

- Cover Letter
- Instructions to Tenderers
- Tenderers' Submission Check List
- Draft Terms and Conditions of Contract
- Technical Requirements
- Marine Requirements
- QA Requirements

- Provisional RPL
- Provisional SLD
- Provisioning (Pricing) Schedule
- Payment Profile (Billing Milestones) for payment of supplier invoices.
- Commercial Compliance Matrix
- Technical Compliance Matrix
- High Level Plan of Work
- Any Corporate Policy Documents deemed necessary

Prior to completing the RFP package, the consultant should contact potential suppliers and provide a "soft launch" for the RFP, gauging interest and executing non-disclosure agreements. The consultant should also prepare the specific instructions for tenderers, including the specific technical requirements, draft terms and conditions for the supply contract, quality requirements, permitting requirements and a provisional schedule and billing milestones.

The very last step before the RFP package is sent is for the consultant to prepare the compliance matrix and statement. The compliance matrix is the tool used to compare the RFP responses and will provide a quantified, fair judgement of the proposals provided.

SO, YOU HAVE PROPOSALS, WHAT COMES NEXT?

The consultant will act as the single point of contact with potential suppliers through the RFP process. After distributing the RFP package to potential suppliers, its recommended to give the suppliers threeto-five business days to respond with their intent to bid; this will enable the consultant and owner to manage the suppliers that do intend to respond without waiting for those who are undecided. Suppliers are customarily given four-to-five weeks to prepare a full proposal response.

DEVELOPING SUPPLIER RESPONSE EVALUATION CRITERIA

When the proposals are received, the consultant should perform a review and analysis to determine completeness of responses. Proposals with major omissions may be rejected immediately. Any minor clarification points will then be addressed through written questions to the suppliers. The consultant will then prepare a comparison of the proposals covering technical and commercial compliance, pricingand any particular advantages/disadvantages of each Proposal. Following the review, the consultant will provide a written analysis of the proposals, a cost benefit analysisand a recommendation on how to proceed.

During the analysis phase, the consultant will work with Client to discuss and refine the analysis of the supplier proposals and to work in detail on the draft supply contract. Discussions with the owner will also take place, as needed.

Supplier response evaluation criteria and matrices evaluate competing offers from vendors in a simple and objective manner, with a very visual output that ranks proposals according to various weighted criteria.

The analysis should calculate a system bidder's commercial and technical proposal against weighted RFP components, as well as considerations in light of pricing, thereby highlighting and comparing the relative risks and benefits of each proposal. It should be designed to be useful in a tender exercise whether for identifying areas to focus on in negotiation, for helping pick a preferred bidder or for reporting on the progress of negotiations to various stakeholders.

The supplier evaluation matrix provides a single, uniform, quantifiable comparison of all supplier responses.

In a competitive situation, bidders will always seek to differentiate their proposal from the others,and this may involve deviations from the original specification. This differentiation appears in many ways, but it is essential, as far as is practicable, that a fair and equalized comparison be made between the different Proposals. This will involve consideration and direct comparison of price, project schedule, payment profile, delivery, commercial/technical compliance, value added propositions and the like. It may also involve weighing one category against another.

While Proposal Evaluation Criteria will be prepared prior to the receipt of proposals, inevitably there will be factors that were unforeseen,and addressing these fairly will come down to experience, project priorities and, in some cases, owner and owner preferences.

Both commercial and technical components should receive subjective weights, placing specific focus on items of concern for the owner. Comparing the weighted responses, along with alignment with project budget, will provide the owner with a summarized analysis of the preferred proposal.

To reiterate, the consultant should make all variables easy to adjust, as each owners' requirements are different. For instance, some may have a higher concern for commercial terms —the weighting should reflect as appropriate.

Ref.	Category	Baseline	Company A	Company B	Company C
	Commercial Offer				
	Combined Commercial Score	*138*	125	125	138
	Technical Offer				
	Combined Technical Score	*771*	764	771	771
	Final Score:	*909*	889	896	909
1	**Base Price**		$ 100,000,000.00	$ 80,000,000.00	$ 70,000,000.00
1.1	Cost of mitigating any non-compliances			$ -	$ -
2	**Equalized Price**		$ 100,000,000.00	$ 80,000,000.00	$ 70,000,000.00
	Commercial Weight	*40%*			
	Technical Weight	*60%*			
	Combined Commercial/Technical Score		508.4	512.6	517.8
	Budget Compliance		0.89	1.11	1.22
Final Score			**451.91**	**569.56**	**632.87**

SUPPLIER SHORT LIST AND BAFO

Following the review of the proposals, clarification meetings and the equalization process, the consultant will provide the owner with a detailed report on each of the potential supplier's proposals, identifying strengths and weaknesses. Based on this analysis, it may be possible to select a single supplier (Preferred Supplier) to focus on, but the others should not be released until a contract is signed. Alternatively, a short list of potential suppliers may be selected. If two or more potential suppliers are considered highly responsive, the consultant will continue to liaise with those potential suppliers until a definitive selection can be made. Justifications for the selection, feedback and recommendations to the unsuccessful suppliers should be provided.

It is generally to the owner's advantage to ask for Best and Final Offers (BAFO); however, this adds time to the procurement process. One way of minimizing the timescale is to reduce the potential suppliers to a short list of two for the BAFO process. The consultant will advise the owner regarding the competitiveness of the offers to help determine whether a BAFO round of bidding is needed. BAFO proposals will need to be received, logged and forwarded to adjudication personnel.

The BAFO proposals can differ from the original Proposals in a number of ways; changes due to additional information; changes due to value engineering proposals; changes due to perceived weaknesses in the original Proposal; new differentiators; etc.

All these changes will need to be investigated fully during this process. Again, the potential supplier may have actions placed on it for further clarification prior to final Proposal Equalization.

This process will consider all the new factors introduced in the BAFO proposals. At this stage, the differences between the two proposals are likely to be small; there is rarely an outright winner. Weighing of the relative value of such things as price against delivery or technical enhancements against payment profile will need to be more precise than during the initial evaluation, to ensure the client receives the best value for its money.

The consultant will provide the owner with a recommendation as to the preferred supplier to bring forward for final contract negotiations, whether this is achieved from the initial Proposal Evaluation or a full BAFO process. To support this recommendation the consultant will provide a detailed report that sets out the reasons for the recommendation and, if appropriate, highlighting the changes in the proposals between the original and the BAFO proposals, evaluating their relative merits. The report can also provide recommended feedback to be given to the other supplier at the appropriate time.

Even though one potential supplier will be engaged in contract negotiations, there is no certainty that a contract can or will be formed. Therefore, it is important to keep the other supplier in reserve, if at all possible, to protect against negotiations breaking down. In the event a bid bond is required, it should be considered.

Once the client has reviewed the consultant's preferred supplier evaluation and recommendation report and selected a supplier, the consultant will meet with the owner to develop a final negotiation strategy and plan. Depending on the client's requirements, the consultant can either conduct final negotiations with the preferred supplier on behalf of the owner or assist with the negotiating process.

With preferred supplier selected, the consultant will then draft the contract and technical requirements and begin the negotiation effort. Thus the consultant can then pass the baton to the arbitration and adjudication team.

While selecting the right supplier can be a complex and lengthy process, the role of a consultant is key in smoothly moving a dream system into reality. STF

KRISTIAN NIELSEN *is the Quality & Fulfilment Director at WFN Strategies. He is a Project Management Professional (PMP™) and ISO 9001:2015 and ISO 27001:2013 auditor and possesses more than 13 years' experience and knowledge in submarine cable systems, including Polar and offshore Oil & Gas submarine fiber systems. As Quality & Fulfilment Director, he reviews subcontracts and monitors the clients and vendors, and is the final check on all delivered WFN products. He is responsible for contract administration, as well as supports financial monitoring and in-field logistics. He has worked in-field, at-desk and everywhere in between.*

ON THE MOVE

SUNIL KISHORE was welcomed by NTT as the new Senior Executive Vice President of Managed Network & Collaboration Services mid-June. Previously Sunil spend 10 years as a partner at Global Advisory Firm McKinsey & Company. "I'm delighted to be leading NTT's Managed Network & Collaboration Services division. The network fabric underpins every service and technology experience and it is a powerful enabler of change and business outcomes," said Kishire.

Recovery Point Systems was joined by new CFO **MATTHEW GAVENJIAN** in June of this year. "We're delighted to announce that Matthew Gavejian has joined Recovery Point Systems," said Tony Rossabi. "His financial expertise, analytic thinking and creative mindset will serve us well as the company grows." He will be responsible for RPS' financial functions, including financial reporting, tax, financial planning and analysis, as well as asset management operations. Gavejian holds a Bachelor of Science degree in finance from Villanova University and previously worked for Digital Realty as the Vice President.

At the beginning of June, Bulk Infrastructure announced the appointment of **INGER GLØERSEN FOLKESON**. Inger will serve as Chief Operating Officer, Bulk Infrastructure Group and Executive Vice President, Bulk Fiber Networks, beginning in August of this year. Bulk believes "This strategic hire will strengthen the execution of Bulk's mission to develop and extend sustainable business models in the digital infrastructure and industrial real estate space. Bulk has a clear strategy to play a leadership role in the Nordics infrastructure services market through data center solutions, fiber networks and industrial real estate."

"I look forward to this opportunity to advance and develop the sustainable business model taking strong hold, especially in the Nordics," says Inger Gløersen Folkeson. "Bulk is a young organization and has achieved so much."

Seaborn Networks chose **ERIC BROOKS** as Senior Vice President of Sales and Marketing for North America as well in June. Eric's 7 year history with Zayo Group as the Senior Vice President for sales makes him an excellent addition to the Seaborn Networks team. "I have known Eric over the last 10 years and am excited to add him in a critical role to our executive team," said Steve Orlando, Seaborn's CEO. "Eric's strategic leadership, business acumen and market reputation will be an invaluable addition to Seaborn as we continue to grow our world class subsea networks and global IP peering relationships."

HAVE EXCITING EMPLOYMENT NEWS TO SHARE WITH THE INDUSTRY? LET US KNOW!
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BACK REFLECTION

THE FIRST CABLE SHIP IN NORTH AMERICA: 1852 PRINCE EDWARD ISLAND - NEW BRUNSWICK, CANADA

BY PHILIP PILGRIM

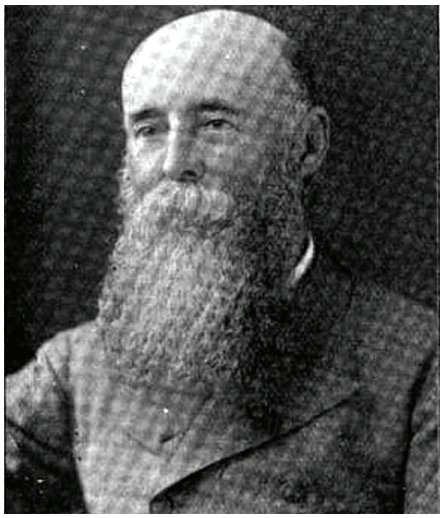
In alignment with this issue's topic of "Regional Systems", here is an account of the first regional submarine system in North America:

1852 Submarine Cable, Terrestrial Backhauls, and line to NYC

Nearly 170 years ago, in November 1852, the first submarine cable was laid in North America. It spanned the Northumberland Strait between the Canadian provinces of Prince Edward and New Brunswick. Although its length was only 10 miles, it stood as a proof of concept and would become the first subsea step leading to the eventual 6,000km telegraphic connection between NYC to London only six years later.

This cable is close to my heart, and to my location on the planet, as it was laid only 158km away from where I live in Nova Scotia.

The research leading to this article began in 2014, when an interest in subsea history became a hobby. I guess after working so long in the subsea sector, it was time to "learn my roots". Thanks to Google Maps, Google Earth, Google Books, and Google Newspapers, (BIG THANKS GOOGLE!) it became easier to gather more information about this cable. Discussions and sharing data with Bill Burns, of the great Atlantic-Cable.com website as well as meetings with many of the kind people now living near the landing sites, helped form a picture. A few trips walking the scenic beaches and using a metal detector, specially designed for iron, helped find many of the early cables that landed in this area. The metal detector did not find the 1852 cable, but I am nearly positive that I did find a section of it so please read on to learn more.



Frederic Newton Gisborne (1824-1892)

I'll try to present this subject by dividing it into sections similar to those of a modern subsea-terrestrial project. This should hopefully make contrasting easy and show that very little has changed over time.

THE PROJECTOR:

The genius, engineer, explorer, network builder, businessman, inventor, who led the endeavor was Frederic Newton Gisborne. An Englishman who, at age 18, with his uncle, traveled the world for three years. As a twist of fate, the journey included their attempt to grow Gutta Percha plants and starting a plantation in Tahiti. Gutta

Percha's latex sap was the newly discovered thermo-plastic material that would eventually become the insulation needed for subsea cables (when they were invented ~ 6 years later).

Gisborne relocated to Canada after the journey in 1845. In 1847, he was trained in telegraphy by Orrin Wood, Samuel Morse's first pupil. Wood operated the very first telegraph line in North America in 1844. Wood was recruited to be the president of the Montreal Telegraph Company (MTC) in 1847, the same year that Gisborne joined and became their Chief Operator. By 1847, MTC had secured all the telegraph lines in Canada. These extended from the US border near Hamilton, Ontario to Montreal, Quebec. Gisborne led the effort to expand the lines further east to Halifax and the Atlantic Ocean.

By 1849, Gisborne, now working for the Nova Scotia Government, was spearheading the "high speed" telegraph network connecting Halifax to NYC. This was the last segment of the news service between London and New York. The efficiency of the service was hampered by the middle segment of this network, ships slowly steaming across the Atlantic Ocean.

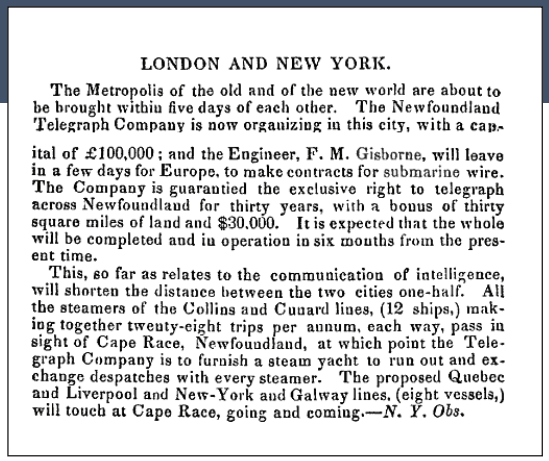
One must remember that in 1849, the only information and communication services were the newspapers and the post. This new fledgling global network was becoming the equivalent of the Internet and its content. It was as huge a business then as it is today.

CONCEPT (1850):

Having been involved in telegraphy since nearly its inception and seeing the great demand for the latest international news, Gisborne knew that extending the telegraph system even further east from Halifax was required.

When Gisborne learned of the first submarine telegraph cable in late 1850, he realized this new technology would allow him to push the telegraph line to the eastern most point in North America, and then onwards to Ireland. The solution would be a combined terrestrial and subsea solution. "Connecting the Old World with the New World" was the term coined at the time.

Gisborne, by 1850, having travelled the world by ship as well as building and surveying hundreds of kilometers of telegraph pole lines, surely would have been an expert at reading maps and understood the economy of shortest distances. So, it should be no surprise that the path of the subsea terrestrial system he was conceiving closely followed the great circle route from London to New York. Even with today's cable routes, his route would be in the running for the lowest latency path.



LONDON AND NEW YORK.

The Metropolis of the old and of the new world are about to be brought within five days of each other. The Newfoundland Telegraph Company is now organizing in this city, with a capital of £100,000; and the Engineer, F. M. Gisborne, will leave in a few days for Europe, to make contracts for submarine wire. The Company is guarantied the exclusive right to telegraph across Newfoundland for thirty years, with a bonus of thirty square miles of land and $30,000. It is expected that the whole will be completed and in operation in six months from the present time.

This, so far as relates to the communication of intelligence, will shorten the distance between the two cities one-half. All the steamers of the Collins and Cunard lines, (12 ships,) making together twenty-eight trips per annum, each way, pass in sight of Cape Race, Newfoundland, at which point the Telegraph Company is to furnish a steam yacht to run out and exchange despatches with every steamer. The proposed Quebec and Liverpool and New-York and Galway lines, (eight vessels,) will touch at Cape Race, going and coming.—*N. Y. Obs.*

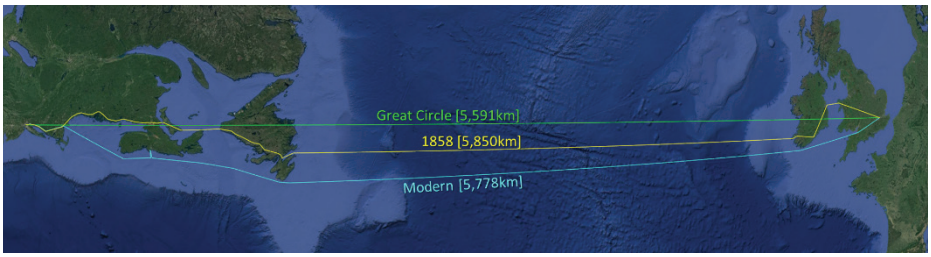
Virginia Newspaper Article, May 1852

ROUTE PLANNING (1850/51):

The NYC to London route would follow the telegraph pole lines along the Atlantic coast of New England, proceed through the maritime provinces, cross to the island of Newfoundland via a submarine cable, transit Newfoundland over a mixed pole & subterranean (buried) line, bridge the Atlantic Ocean over another submarine cable, traverse Ireland on a buried line, cross the Irish Sea through a third submarine cable then span the UK through buried line.

Of course, at the early stage, Gisborne's focus was first reaching the east-most point of North America.

To complete this first stage of the project, Gisborne had hoped to use the existing network in Nova Scotia, reach Newfoundland via a submarine cable, and transit the island of Newfoundland with buried cable (as was the trend in Ireland and the UK in 1851). Unfortunately, when Gisborne requested permission to land a submarine cable in Nova Scotia and use the terrestrial network, he was blocked. Members of the government did not want to see their lucrative telecom



Low Latency in 1858

BACK REFLECTION

business move east to St. John's. This political roadblock was no obstacle to Gisborne's project. He cleverly re-designed the route to bypass Nova Scotia and reduce the network's total length. This was relatively easy as he had entered into agreements with the Provinces of Prince Edward Island and Newfoundland, which included exclusive cable landing rights in exchange for developing networks in those regions. Likewise, New Brunswick also granted cable landing rights to Gisborne. The new route of the first submarine cable (and related backhaul) in North America would be:

- Terrestrial Backhaul in New Brunswick: 60km (36mi.)
- Submarine Cable: New Brunswick to Prince Edward Island: 15km (10mi.)
- Terrestrial Backhaul in Prince Edward Island: 70km (42mi)

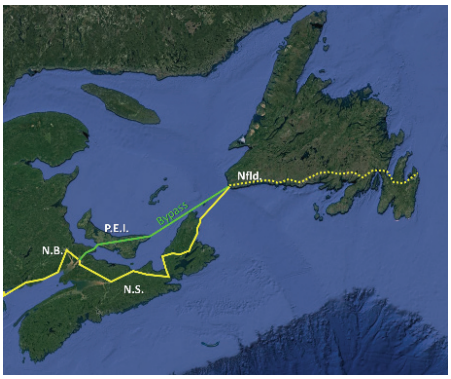
The plan also included a terrestrial extension in P.E.I. (100km); a second submarine cable from P.E.I. to Newfoundland (250km); and a terrestrial network across Newfoundland (500km).

PROJECT SCHEDULE:

1852 Q1/Q2

- Ordering of vessel
- Ordering/ manufacturing of materials:
  - Submarine cable
  - Insulators
  - Wire
  - Poles
- Hiring support vessel
- Desktop study

1852 Q3



N.S. Bypass

- Vessel transit from shipyards, commissioning, familiarization
- Transport of materials
- Human resources
  - Station operators
  - Pole line labourers
  - Cable ship support
  - Landing site support

1852 Q4

- Terrestrial network builds
- Cable lay
- Commissioning
- Network integration

1853 Q1

- Network operations
- Marketing
- Advertising
- Network expansion

BUSINESS OPPORTUNITY:

From his direct involvement, it was clear to Gisborne that the business of newspapers was lucrative and growing. Shortly after telegraphy began just 7 years earlier in North America, the Associated Press quickly made use of the technology. In 1849 they opened their first international news bureau in Halifax Nova Scotia. It transmitted news, arriving by ship from Europe to NYC and vice versa.

Private business and the financial sector were also among the first to make use of the new technology. Paul Julius Reuter set up "Submarine Telegraph Offices", in October 1851, to link stock markets in London with those in Europe over the first successful cable system across the English Channel.

In 1850, the business of telegraph communications was exploding in a similar way to that of the internet in the 1990's. The various governments throughout the world were setting up terrestrial telegraph networks in their regions for intra-government communications and the general public was also making use of the service.

As telegraph technology was new and exciting, governments were keen to have experts set up networks in their regions. Bringing governments onboard generally took very little persuading. Agreements included charters for exclusive cable landing rights, land grants, cash investments, and contracts to build networks.

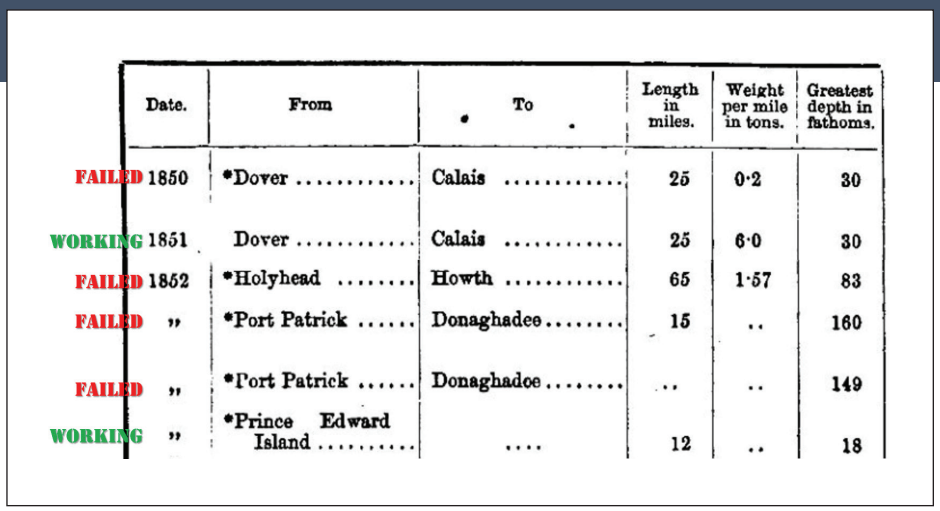
Gisborne was able to obtain charters in P.E.I. & Newfoundland, and approval in New Brunswick for his network.

RISKS:

As with all projects come risks. The key risks faced by Gisborne were technology failure, obtaining operating rights, and obtaining financing.

The risk of cable failure was great when the project was first conceived in late 1850. The idea was based on one cable across the English Channel that operated for only a day, Sept 28, 1850. It was an unarmoured cable.

Success Rate [1850-1852]



	Date.	From	To	Length in miles.	Weight per mile in tons.	Greatest depth in fathoms.
FAILED	1850	*Dover	Calais	25	0·2	30
WORKING	1851	Dover	Calais	25	6·0	30
FAILED	1852	*Holyhead	Howth	65	1·57	83
FAILED	,,	*Port Patrick	Donaghadee	15	..	160
FAILED	,,	*Port Patrick	Donaghadee	..	..	149
WORKING	,,	*Prince Edward Island	....	12	..	18

The second Channel attempt, in the fall of 1851, used newly armored cable and was a success. This gave Gisborne confidence to move forward.

Gisborne was lucky in avoiding one risk. The "old boys club", within the Government of Nova Scotia, tried to stop his network build but he was able to bypass their province and obtain charters to reroute through the neighboring provinces. It is interesting to note that when Gisborne worked as the superintendent of the lines for the Government of N.S. he became aware of some government individuals and their skullduggery. In early 1851, they managed to transfer the government's telegraph lines to themselves. This was another motivating force for Gisborne to leave N.S. and work for the more progressive, and more open provinces of Nfld and P.E.I.

Financing was always a challenge for Gisborne. He established the Newfoundland Electric Telegraph Co. and obtained financing from backers in the USA. These, along with government concessions and contracts, enabled the work to progress… *for the moment*.

MARKETING:

Telegraphy was man's first practical exploitation of electrical energy. Gisborne's contemporaries included Samuel Morse, the Siemens brothers, Michael Faraday, Georg Ohm, Charles Wheatstone, and William Thomson. All were pioneers in the early days of man's understanding and application of DC energy from batteries.

Telegraphy would be the first technology leveraging electricity to be seen by the general public and members of governments. To many it must have been magical; and that in itself marketed the product.

Just as Steve Jobs peddled his iPhones through carefully constructed demonstrations in 2007, Gisborne did the same 159 years earlier to the government and public of New Brunswick, Nova Scotia and P.E.I. He demonstrated electric current, electromagnetic attraction, telegraphic principals, and paper-tape recording of messages (transmission and data storage). He discussed security, how the technology will employ the youth, how shrewd people could squeeze long messages down to 10 words, how telegraph operators would make jokes and laugh together 600 miles apart (LOL.-.. --- .-..), how the Earth acted as a conductor and how the "electric fluid" always took the shortest path. He also discussed the costs to build, operate, and maintain a telegraphic system, and the expected revenue from "traffic" estimates.

Later in the project's development, when in England purchasing the cable, insulators, and terrestrial wires, Gisborne would send letters back to eastern Canada to keep the public abreast of the progress. These were published in newspapers throughout North America for all to read.

PERMITTING & LICENCES:

It is understandable that formal permitting did not exist in the early days of submarine cables as these systems were new for governments and laws have not been made to regulate them, however; charters and acts giving EXCLUSIVE cable landing rights of 30, 50, and 90 years to a single company certainly made for interesting times in the years following and would form the path towards permitting and licencing.

The Government of N.S. did not block Gisborne from gaining permission to land cable on their shores but in 1851, this was moot as the privatized telegraph system's owners set exorbitant transit prices to try to block Gisborne's network from reaching NYC.

As cables were new, there were no objections from the local fishing industries recorded. *(A dream for some readers no doubt!)*

FUNDING:

Funding for the system was provided by government contracts, company shares, investors in the USA, and by the investment of the Brett brothers in the UK who laid the first cables there. They, like Gisborne, held exclusive

BACK REFLECTION

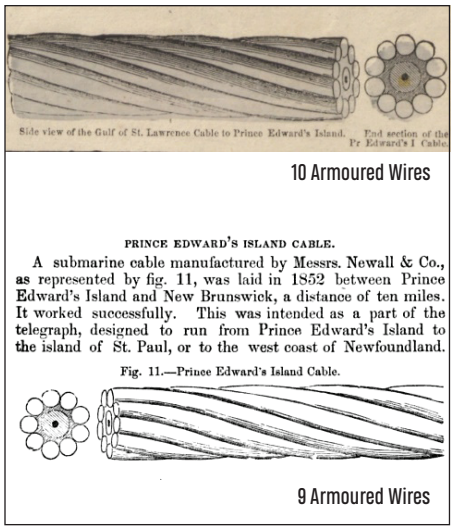
landing rights granted by the governments, which were very valuable.

TECHNOLOGY:

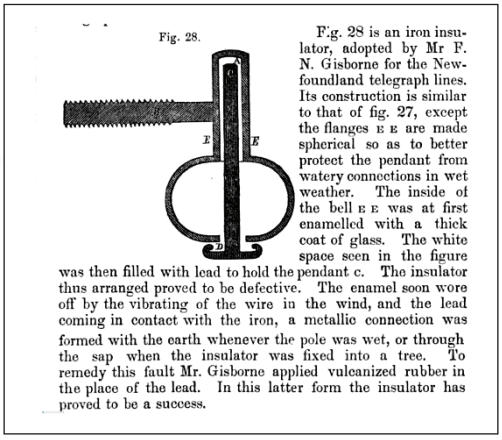
The system was mostly manufactured in England: the submarine cable, the aerial telegraph wire, and the insulators. The wooden poles, needed for the terrestrial line, would have been procured locally.

The submarine cable was manufactured by R. S. Newall & Company. It is shown as having 10 armored wires in some drawings and 9 in others. The centre conductor was a single strand of copper (the 7-wire twisted copper conductor had not yet been invented). Gutta percha, jute, and bitumen-based paste formed the insulation between the center conductor and the single outer layer of armor. Being only the second successful submarine cable to be laid in the world, cable design was still in its infancy. The general cable structure was sound and similar to cables of today, but the amount of armoring was lacking for the location.

A newspaper report on October 7, 1852 states 330 coils of telegraph aerial wire arrived from Liverpool on the bark Closina. These would be used to construct a new pole line connecting Charlottetown, P.E.I. to Sackville, N.B. From Sackville, signals would be carried to NYC over the existing network.



Technical Detail of Gisborne's Insulator



Gisborne's Metal and Glass Insulator from the 1852 Build (Recovered in P.E.I.)

It is interesting to note that telegraph wire and insulators could have been easily procured in North America so Gisborne must have secured favourable terms to purchase in England and ship.

The telegraph insulators used were designed by Gisborne and had a unique iron casing which protected the insulating glass inside and acted like an umbrella. The wire connected to a hook protruding underneath. The concept was to prevent conductive water from dissipating "the electric fluid" along the line, from which the electrical term "leakage" comes from. The iron insulator's shell and glass interior concept continued on well into the late 1860's and a variation, developed by David Brooks, was used to upgrade the St John's to Amherst, N.S. pole line in 1866. With respect to the hobby of insulator collecting, it is thought that the early insulators were beautifully formed glass shapes with a key trait of a threadless hole but in fact, most were ugly upside-down iron pots with the glass hidden inside and sometimes even sulphur! As Gisborne procured the insulators from England, the supplier was most likely the Reid brothers or Edwin Clark, as both made metal/porcelain insulators in 1851. A very similar insulator to Gisborne's was patented in October 1851 by Batchelder of the USA.

BACKHAUL:

The ten-mile submarine cable, in the middle of "nowhere", required a new backhaul to be constructed at each end. It was ~36 miles in length from the cable landing at the remote Money Point, N.B. to the town of Sackville, were it connected to the

NYC line. It was ~45 miles in length from the cable landing site of Amherst Head, P.E.I. to the capital city of Charlottetown.

- The pole line specification was:
- 20' poles
- 5" minimum top diameter
- 40 poles per mile (132' spacing)
- 5' burial
- Tamarack or Spruce
- #9 Birmingham Wire Gauge (BWG) Black Iron Galvanized Wire (3.76mm dia.)

The backhaul in N.B. was completed two days after the cable was laid. The backhaul in P.E.I. was completed two weeks after the cable was laid.

DESKTOP STUDY:

The cable route was well mapped and sounded prior to 1852. Maps as early as 1776 show the landing site in P.E.I. and water depth soundings.

This area was also a fishing ground and a route for passenger ferry and mail boat service (including the famous "iceboat" service). Local fishermen and boatsmen most likely would have been consulted prior to the lay.

The cable was planned to land on the doorstep of hotel owner/postman Tom Allen at Money Point, N.B. and he became the "cable station" operator for many years.

It was also planned to land on the doorstep of hotel owner/ferry Serviceman Lewis Muttart at Cape Traverse, P.E.I. and he eventually became the "cable station" operator for many years.

SURVEY:

There are two interesting telegraph-related entries in the diary of Captain Henry Wolsey Bayfield, a surveyor for the Royal Navy, who surveyed most of the waters surrounding the Atlantic Provinces and the St. Lawrence River:

1. In October 1851, Bayfield is in Halifax using the telegraph system to accurately measure the latitude difference between Boston and Halifax.
2. In June 1853 Bayfield sends depth soundings taken between P.E.I. and Newfoundland to Gisborne for his planning of the longer 250km submarine cable.

Bayfield's diaries, going back to 1840, show that he conducted mappings and depth soundings on the cable ground numerous times. Several entries include the local hazards: "Cape Tormentine Reef", a shipwreck on it, and the "Cape Jourimain Shoals".

One week prior to the lay, Gisborne surveys the cable grounds with the cable ship.

CABLE SHIP:

The Ellen Gisborne was purchased new in 1852 to lay the cable. She was a schooner-rigged steam yacht out of the Philadelphia shipyards. Propulsion was twin masts, a 50HP engine and a screw (propeller) drive. Her registry was 33955.

Note: SubTel Forum Magazine Issue #118 (May 2021) contains an article on the "CS" Ellen Gisborne.

LAY MACHINERY:

No details of the machinery used onboard has been found. This equipment would have been used to handle the cable and pay it out. Records of the lay indicate that Gisborne had this equipment onboard and it was machinery of his design. For pulling the cable ashore, a kedge-anchor was used to turn the pulling rope 90˚ at the beach to allow the horse and oxen to run up the beach rather than into the woods.

TECHNICAL GUIDANCE:

Up to this point in history, the only cable laying experts in the world were the Brett brothers of England. They had laid the only successful cable system (Q4 1851). Gisborne visited England in early 1852 to consult with them. He received guidance on purchasing and constructing a system. He maintained correspondence with the Bretts for many years. This included planning to build a cable across the Atlantic.

PURCHASE OF CABLE:

Gisborne's correspondence, reported though the newspapers, shows him again in England in late May 1852 to contract the cable, aerial wire, and insulators in England.

TRANSPORT OF CABLE:

The brigantine Henrietta arrived in P.E.I. on September 29, 1852 with the submarine cable on board.

The bark Closina arrived in P.E.I. on October 7th, with the aerial wires.

LAY:

The first attempt to lay the cable was on November 12, 1842. Gisborne encountered difficulties on the Tormentine Reef and had to return to Charlottetown on Nov. 14 for repairs.

A second attempt commenced on Nov 19 and the cable is successfully laid on Nov 21/22, 1852.

The direction of the lay was northward from Money Point in New Brunswick towards Cape Traverse in P.E.I. The weather was unfavourable with

high winds and blowing snow making visibility poor. As the lay proceeded into the night, visibility became very poor!

The lay took around 12 hours starting at 5pm on the 21st. Small boats carried the cable to shore in New Brunswick where a battery was connected to energize the cable during the lay. With the help of small boats, the cable was pulled ashore in P.E.I. The cable landed further west than planned at Amherst Head rather than at Cape Traverse. An excess of 3/4mi of cable was pulled onshore.

CABLE COMMISSIONING:

Once landed in P.E.I. testing the cable in the early morning of Nov 22 was merely connecting an electromagnet to the cable's center conductor and earth. The battery at the far end and the resistance of the cable determined the strength of the magnetic force. The force was measured by how far a metallic lever could be separated from the electromagnet and still be acted upon. Gisborne reported it to be in perfect working order.

TERRESTRIAL BACKHAUL COMMISSIONING:

The terrestrial backhauls would have first been commissioned separately using the standard methods at the time. Newspaper reports show Gisborne's brother Hartley looked after both the P.E.I. and N.B. backhauls. In Jan. 1853, newspapers report the line was tested from Amherst Head to Sackville (75km) using "an old sand battery" in P.E.I. and it worked well. It says the signal was so strong that the Sackville telegraph operator did not believe he was connected to the long-distance circuit.

Charlottetown papers mention the system to be operating by Dec 25th for communications with North America, but the system was not opened for public usage until January 26th, when advertised in the local press.

OPERATORS & CABLE STATIONS:

Gisborne must have held meetings and made agreements with the local residents near the cable landing site to be trained as operators. The landing point in N.B. was at the residence of Tom Allen. He had a hotel close to the shore and was engaged in mail transport from Sackville to the P.E.I. He also conducted a ferry service to P.E.I. His home became the cable station and a depression of its basement is still visible to this day.

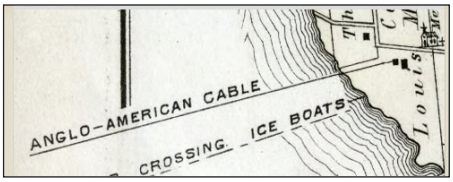
On the P.E.I. end, the cable landed further west than planned, so the cable head was extended by pole line to the home of Lewis Muttart in Cape Traverse. Like Tom Allen, his home was also a hotel and he engaged in the ferry and mail service across the Northumberland Strait. Lewis eventually became the operator of the P.E.I. station but the first was Michael Quinlan, of N.S. who transferred to P.E.I. in Dec 1852, and was stationed in Lewis's hotel.

Remnants of the first Cable Station in North America, Tom Allen's Home, Cape Jourimain, N.B.

The second Cable Station in North America, Lewis Muttart's House, Cape Traverse, P.E.I.

TRAFFIC:

The majority of traffic across the early telegraph systems was heavily monopolized by newspapers and the government however, public usage became very common. One early message on Dec. 11 was the announcement of the birth of Harriet Muttart to Tom Allen. Lewis' wife was Susan Jane Allen, Tom Allen's sister. Another important usage of the system was for the exchange of weather and sea-state information across the strait, for it was the main route to and from the island for passengers and mail.



The later 1856 cable landing next to Lewis Muttart's House

The Ice Boat Launch Next to Lewis Muttart's House

NY Times Report of Cable Lay Jan.4, 1853

It is stated that Mr. Gisborne has put down a sub-marine telegraph from Cape Tormentine, in New-Brunswick, across Northumberland Strait, a distance of fourteen miles, to Cape Traverse, in Prince Edward Island, and that it works perfectly well. It is intended to form a part of this line to connect Newfoundland with the continent.

EXPANSION:

Once the cable was tested to be good, and the terrestrial networks were progressing well, Gisborne steamed to Newfoundland to commence the next part of the network: the 850km connection from St. John's to Charlottetown.

FAULTS/REPAIRS/END OF LIFE:

The cable was laid in a treacherous area; high winds, strong currents, ice flows, and reefs were the main hazards.

Records show the cable to have operated for one year and 10 months, until August 18, 1854, when a fault occurred 2 miles off N.B. No immediate attempt was made to repair it as the re-planned route of the NYC-LON line now excluded P.E.I. in favour of N.S. At the time of the failure Gisborne, was busy re-starting the project with a new financial backer, Cyrus Field. His original backers failed him and left him destitute in Q3 1853, less than one year of the laying of this cable.

REPLACEMENT CABLES:

In September 1856, Gisborne and Field's new company laid a new cable to P.E.I. on the same route. Services were re-established to the island. This new cable served two purposes: to fulfil a government of P.E.I. tender for a new cable and, to act as a back-pocket alternate path for the planned transatlantic system, in case N.S. causes problems again. The 1856 cable is identical to the one Gisborne and Field laid across the Cabot Strait connecting Nfld to Nova Scotia, in August 1856

In 1866, Field laid another cable from N.B. to P.E.I. Again, it was the same cable type as was laid between Cape Aspy, N.S. and Cape Ray, Nfld.

CABLE TODAY:

The 13km Confederation Bridge, constructed in 1993, nearly follows the exact path of the 1852 cable. It departs N.B. at "Money Point", Cape Jourimain.

Looking towards P.E.I. from Cape Jourimain

The waters are heavily fished for crab and scallops. Power cables present and past as well as fibre optic, co-axial and copper conductor telephone and telegraph cable also pass, and have passed, through the same area.

The landing site in New Brunswick is in the middle of a beautiful 2km sandy beach. The area is now a bird sanctuary and tourist information center. From an observation tower, one can see the outline of Tom Allen's home near the shore. His hotel's location is just a few hundred meters further inland.

The landing site in Prince Edward Island was razed in 1993 to make a construction and staging ground for the bridge. Aerial photos from the 1930's, 1970's and early 1990's show the large acreage along the shore where the cable landed. Testimony to the Canadian Government by Lewis Muttart, in 1879, says the cable landed between Carleton and Amherst, which is where the abandoned construction site sits.

In visiting this site, we met the current resident, Mr. George Read, whose brother sold the family acreage for the bridge project. He still lives in the farmhouse where he grew up. George is a wonderful man who lived his whole life in this beautiful part of the world. He is now retired and had worked as the head engineer operating the machinery at the nearby dairy facility. George also volunteers at the local museum in Bedeque, for those of us in the cable industry, George is a most extraordinary individual as he saw the original 1852 submarine cable in situ, as placed by Gisborne on the morning of Nov. 22, 1852. George recalls as a boy in the 1940's

Map Showing Carleton Point and Amherst Point (Cable Landed Between)

BACK REFLECTION

that he was on the acreage with his father and queried "What is that pile of metal cable for?" His father said, "It is the submarine cable". George mentioned his father had loved horse racing, so I showed him a 1933 areal photo of his land that showed the horse track his father made. George pointed to where the cable was located (and later buried). George says the cable seemed to have been spare cable and it would have been dug up when constructing the staging area for the bridge. He says it would have been disposed of as scrap metal.

A modern house now stands where Lewis Muttart's house had been however, a similar aged (and styled) house is occupied nearby. In exploring the area, we found Muttart's grave outside of a church he helped construct with his father. We visited the church during its restoration and my eagle-eyed wife, who always finds the cables first, also saw Muttart's name and date penciled ~ 20' above us in the bell tower. Besides these achievements in life, Muttart is better known as being a significant mariner who led the iceboat service across the strait. They used special lightweight boats with steel runners to ferry passengers and mail back-and-forth across the treacherous route that claimed many lives. Sometimes the boats could be pulled across the flat ice however, it often piled high and had to be climbed with the boat in tow. Cold open waters would also need to be traversed. The hotels, where the cable landed, were for the comfort and often rehabilitation of travelers.

In August 2017, Janet and I explored many of the cable landing sites in the region. When returning from P.E.I. we stopped at the Cape Jourimain bird sanctuary to have a walk on the beach. The tide was very low. No luck in finding anything but, when climbing on the breakwater boulders at the base of the bridge's first pier, we noticed a long straight eight-foot section of armoured submarine cable wires with no internal insulation or conductor in place. We took the "empty" cable home and carefully reconstructed and analyzed it. The cable would have been ~ 18mm in diameter with armored wires of 5.2mm (BWG 5 or 6) diameter. The number of armored wires would be 10. I only have found two drawings of the 1852 cable. One shows ten armored wires and the other shows nine. We guess the eight-foot sample of cable was cut by scallop draggers. STF

Mr. George Read "saw the cable"

The Read's Farm with Horse Track, 1933

First Pier of Confederation Bridge, Cape Jourimain

Cable Specimens: Wires of 1852 Cable (Probable) next to the 1856 cable and 1866 Cable

Janet and the 1873 cable which she found in P.E.I. near Muttart's House (rusty cylinder and black Gutta Percha core next to the metal detector). Note: concrete blocks are to prevent erosion

PHILIP PILGRIM *is the Subsea Business Development Leader for Nokia's North American Region. 2021 marks his is 30th year working in the subsea sector. His hobbies include "Subsea Archaeology" and locating the long lost subsea cable and telegraph routes (and infrastructure). Philip is based in Nova Scotia, Canada.*

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Stay safe,

Terri Jones, Sales Manager, SubTel Forum
tjones@subtelforum.com

TERRI JONES *is Sales Manager for Submarine Telecoms Forum, Inc. For over 20 years, she was in the business of buying… media that is. Terri was managing million dollar buys with a variety of advertising agencies, such as Media Reactions and Time Life, buying time on radio and television for client advertising. She first joined SubTel Forum in 2018 to support sales of the SubOptic 2019 Conference in New Orleans , which was managed by STF Events. Since then, she has been responsible for sales in all of the SubTel Forum products and publications such as the Magazine, Submarine Cable Almanac, Cable Map and Industry Report.*

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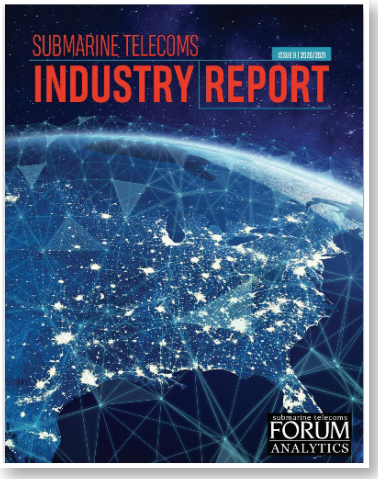

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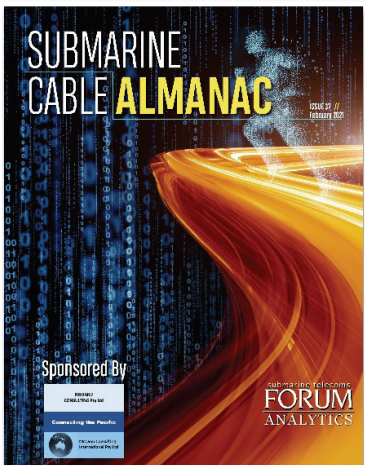

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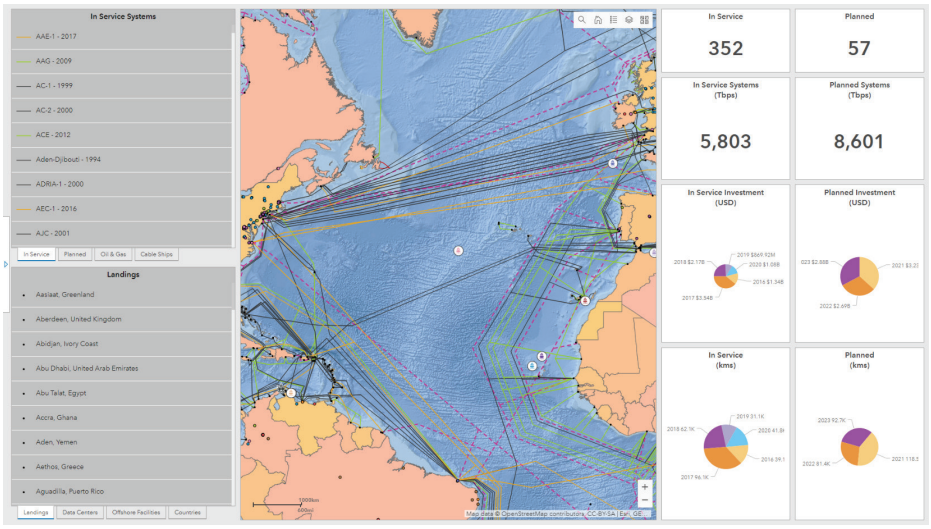

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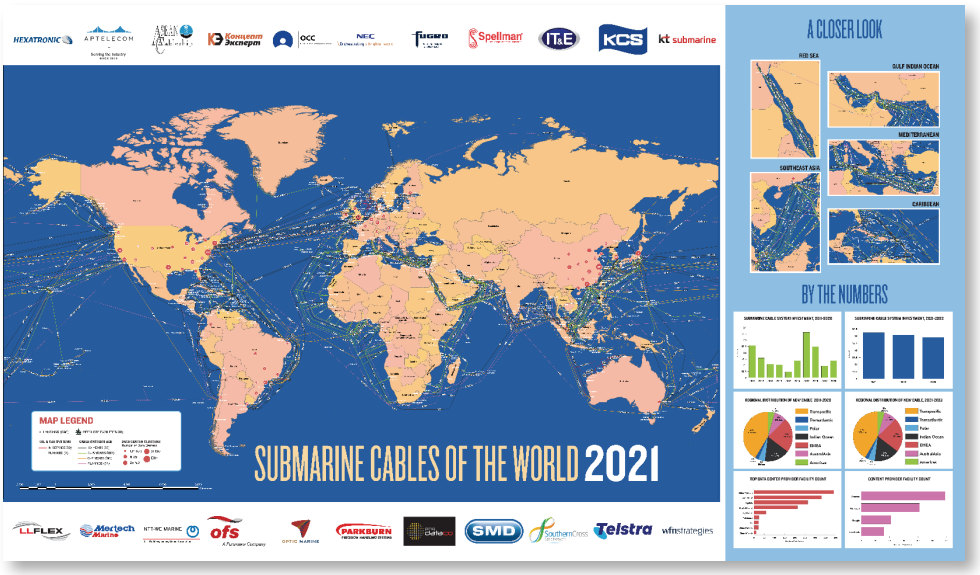

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