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Connecting the World: The Physical Platform of International Telecommunication

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CONNECTING THE WORLD: THE PHYSICAL PLATFORM OF INTERNATIONAL TELECOMMUNICATION

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Abstract: This paper aims to give an overview on a very specific field in telecommunication which is the submarine cables industry. It covers some statistics on the used international bandwidth, historical milestones and information on the submarine cables' construction, geography, ownership evolvement, challenges and their remedies. The paper provides specific information on the international cables geography of key players in the MENA region.

Information presented in the paper are a combination of reliable sources of information such as Telegeography and ICPC (reference below), hands on experience and common practices in the international data wholesale and the subsea cables industry.

Few may think that satellites are responsible for carrying international traffic, but the cables have proven to offer much larger capacity for far less cost. It is the pipes on the ocean floor that form the backbone of the world's modern economy (source: policyexchange.org.uk). The traffic running on international cables accounts for 99% whether they are terrestrial inter-borders or laid underwater. The international traffic exchanged globally is not only used for internet traffic, which makes up for 90% but also, 5% for enterprise traffic, 3% for research and education related traffic and 0.01% for voice traffic. These portions may vary from one route to another. As per telegeography, the used international bandwidth globally as by 2017 approaches 700 Tbps with a forecasted CAGR of 45% to reach 10Pbps in 2024. The first successful attempt ever to build a submarine telegraph cable was in 1850. And many more has followed, today there are several hundreds of subsea cables in service globally. Almost most coastal countries are connected to submarine cable systems.

To construct a submarine cable, there are many aspects that should be considered one of which the capacity needed, the landing stations to connect to, the shortest route, the number of fibre pairs, the length, the cost, the ownership model and the vendor that will be contracted. Telecom operators are conventionally the owners of the submarine cables and the ones who sell the capacities in bulk to one another and to content providers. Today, large content providers, such as Amazon, Google, Microsoft and Facebook are involved in constructing their own cables to meet their increasing internal demand volumes for international traffic. They have no intend yet to become sellers and take over the role of the telecommunication operators. On the other hand, the rising demand for more bandwidth fuels the submarine cables owners to consider upgrades to their subsea cables in order to meet the explosion.

Submarine cable faults are common as there are around 100 yearly, as per telegeography. Two-thirds of the cable faults are caused by unintentional damage from fishing vessels and

ship anchors and these can be mostly at sea depth lower than 200 meters. 10% of the faults can be attributed to environmental causes which are more likely when sea depth exceeds one kilometre. Depending on the seabed nature and sea depth, types of submarine cable protection are often considered (whether armoured or unarmoured). In depth less than 150 metres and closer to the beaches, the submarine cables are buried in the seabed to depths ranging from 1 to 3 metres. These installations are often used to prevent the cable from being damaged. More recently, it is quite rarer to hear about these cable faults because most companies that use cables follow a “safety in numbers” approach, by spreading their networks' capacity over multiple cables so that if one breaks, their network will run smoothly over other cables while service is restored on the damaged one. The submarine cable damages can be diagnosed either as fibre fault, shunt fault or complete break. When the fibre optic is affected while the electrical cable is intact, then this is called fibre fault. Shunt fault happens when the insulation breaks causing the electrical power to leak and shunt to the water. In this case, the fibre is not affected. Whereas when both the electrical and fibre cables are affected, it is then called a complete break. Resiliency is no longer an option it has become a necessity.

Key References:

Telegeography (<https://www.telegeography.com/>): TeleGeography is a telecommunications market research and consulting firm. It conducts in-depth research, compiles large data sets, and presents this information clearly in online reports and databases. Since 1989, its data has provided guidance to thousands of clients, including service providers, equipment makers, investors, and governments.

ICPC (<https://www.iscpc.org/>): The International Cable Protection Committee is dedicated to the sharing of information for the common interest of all seabed users. ICPC represents all who operate, maintain and work in every aspect of both the telecommunication and power cable industry. ICPC has been representing the undersea cable industry since it was founded in 1958 with the vision to be the premier international submarine cable authority, providing leadership and guidance on issues related to submarine cable security and reliability. The ICPC provides a forum in which relevant technical, legal and environmental information is exchanged among its international members.

1. Introduction

"It is not satellites in the sky, but pipes on the ocean floor that form the backbone of the world's economy." Quote from Admiral James Stavridis, a former US Navy officer and ex-Nato supreme allied commander [1]. Cables have proven to offer much larger capacity for far less cost. Even though communication satellites' coverage spans over wide areas regardless of the geography and its geological nature, the energy needed to transfer an acceptable internet speed and capacity over satellite is beyond the available technology [2][3]. One fibre with DWDM (Dense Wavelength Division Multiplexing) can offer the corresponding of all the capacities of all traditional satellite in operation combined [3]. Besides limited capacity, satellites suffer from high latency. The distance from Earth to the satellite and back creates delays which make real-time communication more challenging than over fibre [2].

The traffic running on international cables accounts for 99% of the global international telecom traffic whether they are terrestrial inter-borders or laid underwater [4]. These cables travel and connect between continents carrying terabits of data [5]. Since it is a physical connection, deployment of international fibre optic links is enormously expensive and time consuming but once built, it is very flexible and reliable [3] [5]. Once in the oceans and seas, there are a few threats that may face undersea cables like fishing nets and ship anchors. This is why protective and preventive measures are to be taken into account in order to make sure that if any cable fault occurs, then the end user will not be affected [5].

2. International Telecommunication Traffic

The international traffic exchanged globally is not only used for internet traffic, which makes up for 90% of the global international used bandwidth but also, 5% for enterprise traffic, 3% for research and education related traffic and 0.01% for voice traffic. These portions may vary from one route to another. As per Telegeography, the used international bandwidth globally as by 2017 approaches 700 Tbps with a forecasted CAGR (Compound Annual growth) of 45% to reach 10 Pbps in 2024. Figure (1) shows the used international bandwidth by Region in 2017, having Europe with the largest used international bandwidth (504 Tbps), followed by US & Canada (204 Tbps), then Asia (127 Tbps), Latin America (47 Tbps), the Middle East (21 Tbps), Africa (7 Tbps) and lastly the Oceania region (6 Tbps). While internet backbone providers have accounted for the majority of international bandwidth usage for well over a decade, content providers now add capacity at a more rapid pace. On the trans-Atlantic route, content provider network bandwidth exceeded internet bandwidth for the first time in 2014. In 2017, content providers accounted for the majority of overall international bandwidth usage. From a macro view, both traffic of internet backbone providers and content providers are considered as Internet Traffic. Based on that, the total internet traffic of Europe accounts for 91% (39% + 52%) of its international used bandwidth, US & Canada for 95%, Asia for 95%, Latin America for 92%, Middle East for 91%, Africa for 90% and Oceania for 88%. Figure (2) shows the forecasted used international bandwidth

growth by region from 2017-2024, where US & Canada are expected to grow the highest by 50%, followed by Asia by 49%, then Europe by 41%, Africa and Oceania at 41%, then Latin America by 36% and lastly the Middle East by 32% [6]. The rising demand for more bandwidth fuels upgrades of current submarine cables and constructions of new cable projects.

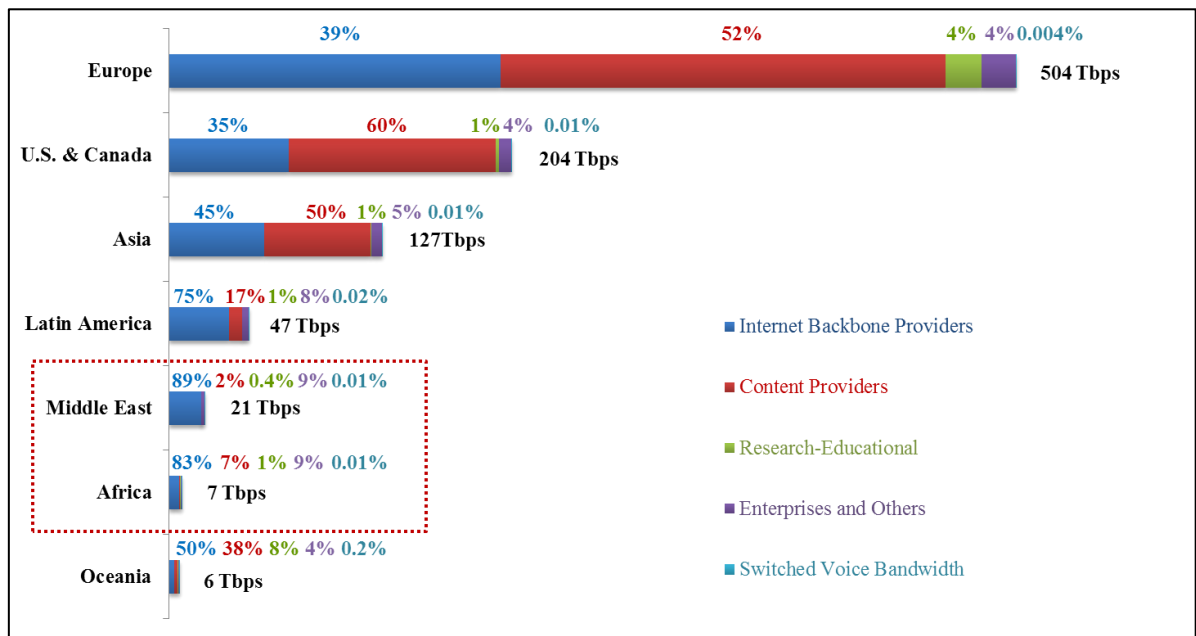


Figure (1): Used International Bandwidth in 2017 by Region

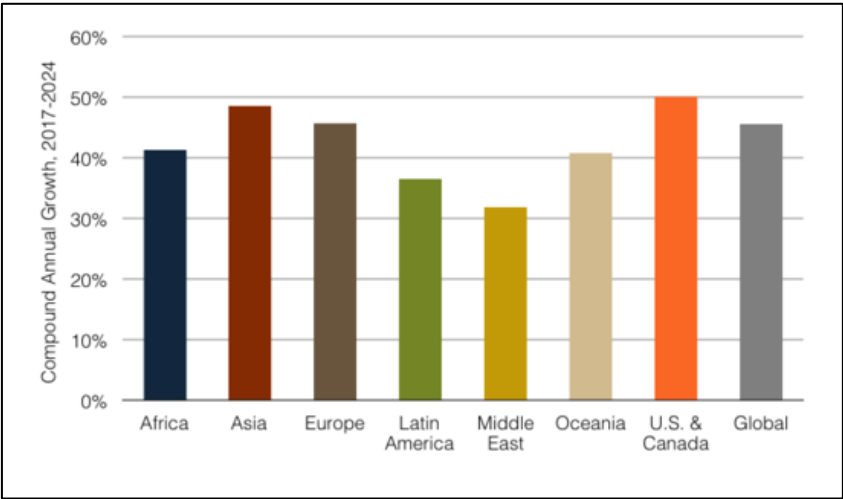


Figure (2): Used International Bandwidth Growth by Region from 2017-2024

3. Submarine Cables

It is worth noting that telecommunication is not the only industry that uses undersea cables, but there are also submarine power cables that is used for bulk import and export of electricity, also, oil and gas offshore uses their own submarine cables, furthermore very few

scientific institutes are using submarine cables for geophysical research and natural hazard mitigation like for early warning of disastrous subsea earthquakes [7] [8].

For most of its journey across the ocean, a subsea telecommunication cable is typically as wide as a garden hose. The filaments that carry light signals are extremely thin — roughly the diameter of a human hair. These fibres are sheathed in a few layers of insulation and protection. Figure (3) shows a cross section of the shore-end of a submarine communications cable and its components [9] [10]. Cables laid nearer to shore use extra layers of armoring for enhanced protection [9].

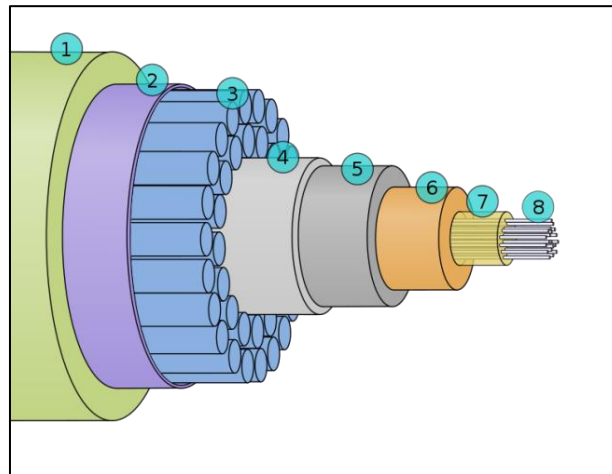
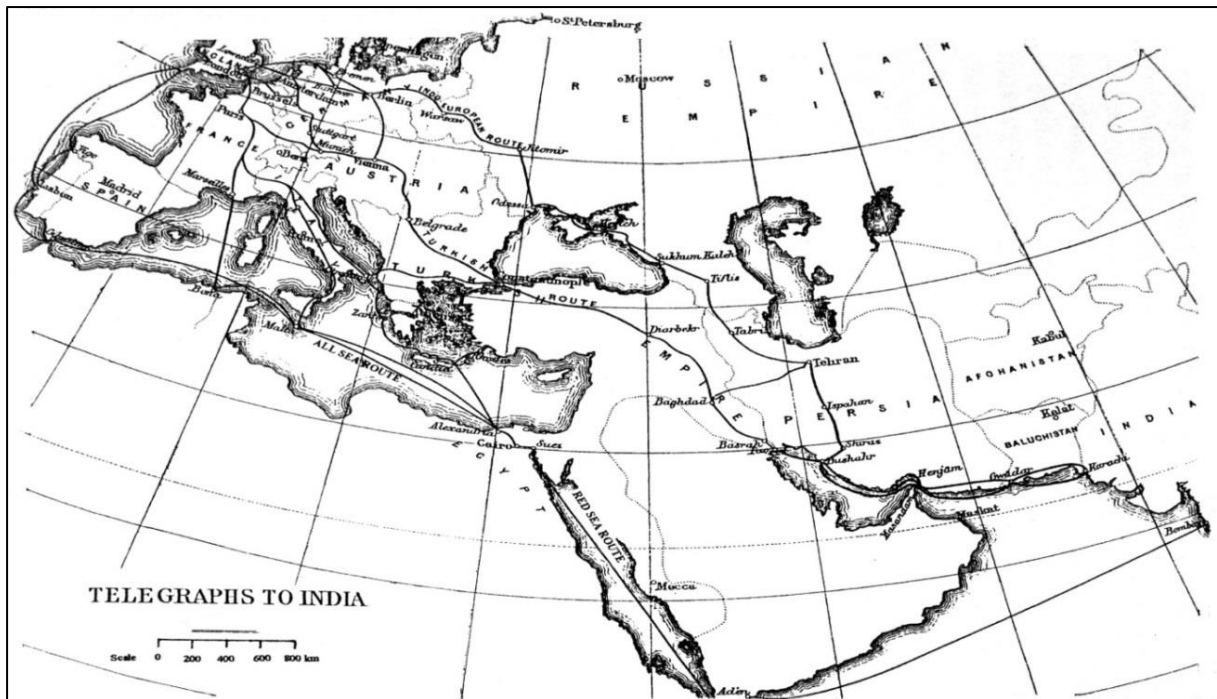


Figure (3): A cross section of the shore-end of a submarine communications cable and its components.

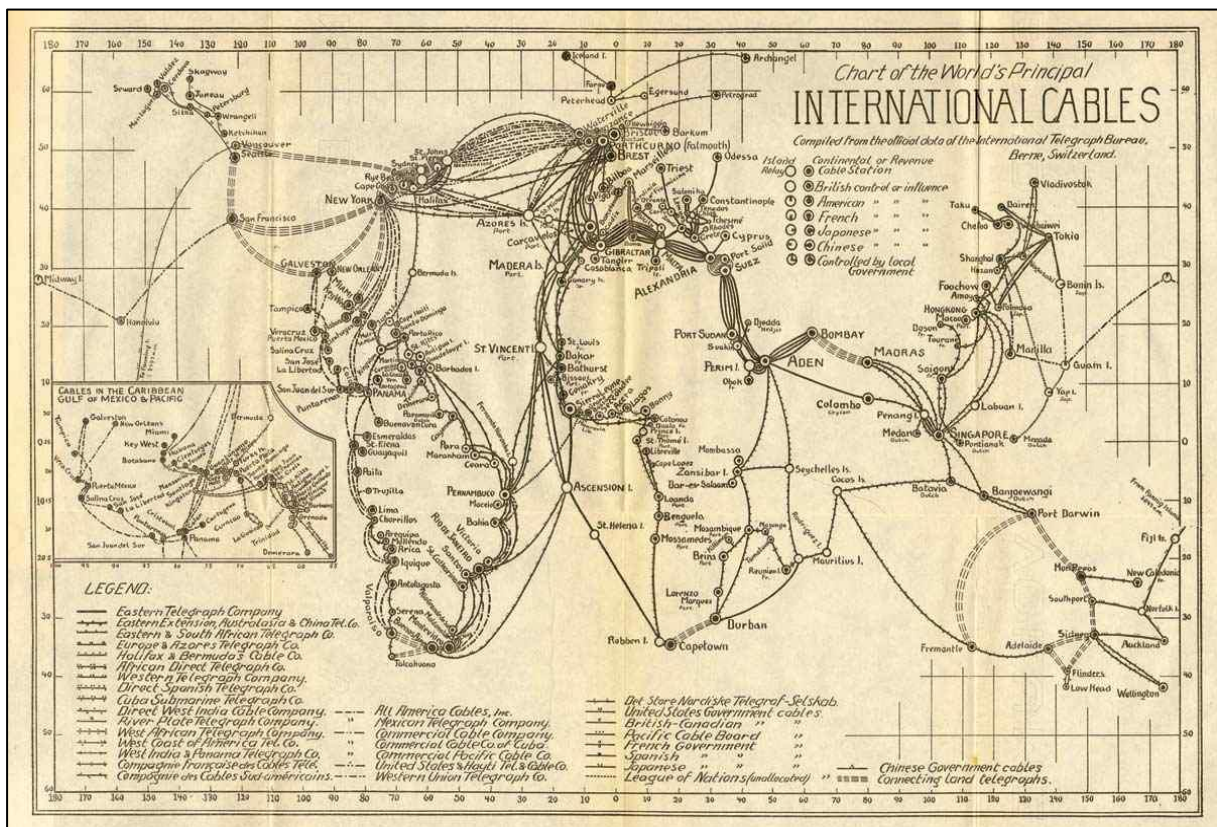
- | | |
|----------------------------|-----------------------------|
| 1. Polyethylene | 5. Polycarbonate |
| 2. Mylar tape | 6. Copper or aluminium tube |
| 3. Stranded steel wires | 7. Petroleum jelly |
| 4. Aluminium water barrier | 8. Optical fibres |

3.1. History of Submarine Cables

The first successful attempt ever to build a submarine telegraph cable was in the 1850s. And many more has followed but with a very slow pace. Map (1) shows the route of telegraph cables from the United Kingdom to India via Egypt and other cables between Egypt and Europe in the late 19th century. Map (2a) and (2b) shows the chart of the world's principal international cables compiled from the official data of the telegraph bureau, in Switzerland in the late 19th century to the early 20th century with a focus on the ones crossing Egypt. In the 1980s, the introduction of fibre optics has revolutionized telecommunication over undersea cables [11]. Today, there are several hundreds of subsea cables in service globally thanks to the internet and also to the increasing need for more content [9].



Map (1): Telegraph Cables in the Late 19th Century



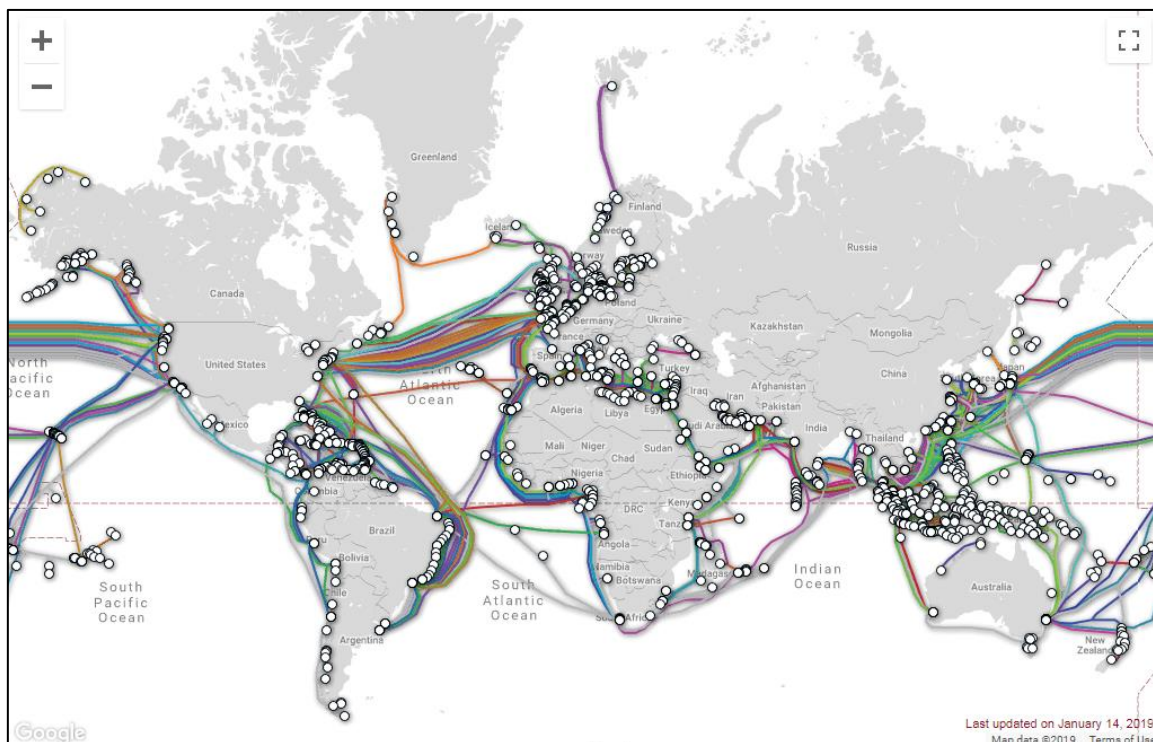
Map (2a): Chart of the World's Principal International Cables in the Late 19th Century to the Early 20th Century



Map (2b): Chart of the World's Principal International Cables in the Late 19th Century to the Early 20th Century crossing Egypt

3.2. Geography of Submarine Cables

As per Telegeography, there are approximately 448 subsea cables in service globally as of 2018. Almost most coastal countries are connected to submarine cable systems [9]. Map (3) shows a screenshot of the interactive map of Telegeography with the world's submarine cable in service and the planned ones as of January 2019 [12].



Map (3): Submarine Cable Map

3.3. Ownership Structure

Telecom operators are conventionally the owners of the submarine cable systems and the ones who sell the capacities in bulk to one another and to content providers. The models of ownership of the submarine cable systems are either private or consortium. Consortium ownership of submarine is like a club of telecom operators and/ or content providers that have shares in the cable and the capacity of the cable which is associated with the amount of investment they made into the system. Both the consortium and private cable models still exist today, but one of the biggest changes in the past few years is the type of companies involved in building cables. Today, large content providers, such as Amazon, Google, Microsoft and Facebook are involved in constructing their own cables to meet their increasing internal demand volumes for international traffic [9]. They have no intend yet to become sellers and take over the role of the telecommunication operators.

3.4. Construction

To construct a submarine cable, there are many aspects that should be considered: the capacity needed, the landing stations to connect to, the shortest route, the number of fibre pairs, the length, the cost and the ownership model and the vendor that will be contracted. The vendor is a provider of turnkey submarine network solutions that submarine cable owners contract to handle route selection and surveying, system design, manufacturing, installation and maintenance. The company providing these services runs a fleet of specially–modified ships, also known as, cable laying ships [13]. Renowned providers of such builds are: Alcatel Submarine Networks –ASN- (United kingdom-based company), SubCom (American based company), NEC (Japanese based company) and Huawei Marine (Chinese provider).

Once all is decided, the cable laying preparations should be in place, starting with the marine survey. It consists of mapping the route of the cable by identifying the seabed specifications using survey sensors and equipment for geophysical / hydrographic investigations. Detailed surveys and assessments of the seabed are a critical prerequisite to the cost-effective design of marine structures and sub-sea installations [13]. Depending on the seabed nature and sea depth, types of submarine cable protection are often considered (whether armoured or unarmoured). In depth less than 150 metres and closer to the beaches, the submarine cables are buried in the seabed to depths ranging from 1 to 3 metres. These installations are often used to prevent the cable from being damaged. In these shallow waters, if cables are not buried, it is more likely that they would be picked up during fisheries activities or anchor dragging [9][14]. After the laying plan is executed, it is now possible to determine the type and quantity of the cable needed. Once the cable is manufactured, it is loaded in the cargo hold of the cable laying ship. The coiling of thousands of kilometres of cable in the specially–modified ship takes between three to four weeks [14]. Submarine cable laying process starts from the landing station, where a long cable section is connected to the landing point and then extended out to a few miles in the sea; this end is connected to the

cable on the ship and then the ship starts its cable laying process. The cable laying ship slowly lays the cable down on the seabed as per the laying plans. Depending on the equipment on-board the cable-ship, the type of plough used, the sea conditions and the ocean-bed where the cable is being laid down, cable ships can do anywhere from 100-150km of cable laying per day. Newer ships and ploughs now do about 200 kilometres of cable laying per day. The process also involves a plough. The cable is not simply left to sit on the ocean bed, but is actually being fed into a plough, that lays the cable into a trench. When reaching the other side, the cable is pulled offshore for connection to the destination landing station [13] [14].

3.5. Maintenance

The responsibility of wet segment's maintenance of submarine cable system is governed by what is known as "maintenance agreements". Some are consortium based and others are private. The owners of the submarine systems are either part of the consortium or consortia maintenance agreements, or they contract the private ones depending on the areas where the cable runs. Their main responsibility is the maintenance and repair of telecommunication submarine cable systems in precise areas worldwide. They have access to a fleet of cable ships operated by them or by subcontracting others who have the relevant human and technical resources aboard. Some of these cable ships may also be used for laying of undersea cables [15].

The zone maintenance agreements -the consortium based ones- present globally are:

- 2OCMA (2 Oceans Cable Maintenance Agreement) covering the south of Atlantic and Indian oceans.
- ACMA (Atlantic Cable Maintenance repair Agreement) covering the Atlantic and the south east of Pacific oceans.
- MECMA (Mediterranean Cable Maintenance Agreement) covering the Mediterranean, Black and Red seas.
- NAZ (North America Zone) covering the north east of Pacific Ocean.
- SEAIOCMA (South East Asia and Indian Ocean Cable Maintenance Agreement) covering the Indian and south west of Pacific oceans.
- YZ (Yokohama Zone) covering the north west of Pacific Ocean.

As for the private maintenance agreements present globally, they are:

- APMA (Atlantic Private Maintenance Agreement, including Med) covering the Atlantic Ocean and Mediterranean Sea.
- AMMSA (Asia Pacific Marine Maintenance Service Agreement) covering the Indian and south west of Pacific oceans.
- E-Marine covering the Red Sea, Arabian Gulf and Indian Arabian Sea
- NPMMSA (Northern Pacific Marine Maintenance Service Agreement) covering the north east of Pacific Ocean.
- SPMA (South Pacific Maintenance Agreement) covering the south of Pacific [15].

When cables are damaged, the cable stations and the technicians aboard the maintenance ships perform measurements in order to localize the fault. After this, either divers or specialised small submersibles with cameras and lights are sent down to the seabed to investigate where the cuts are. Then, the damaged section is cut, and the two ends of the cable are brought on board, where the damaged section is replaced [13] [15].

3.6. Challenges and Remedies

Submarine cable faults are common as there are around 100 yearly, as per Telegeography. Two-thirds of the cable faults are caused by unintentional damage from fishing vessels and ship anchors and these can be mostly at sea depth lower than 200 meters. 10% of the faults can be attributed to environmental causes which are more likely when sea depth exceeds one kilometre. It is less likely that the submarine cable equipment fail. As for intentional sabotage or shark bites, they are extremely rare unlike what it is rumoured and are considered a myth. Figure (4) shows the causes that are attributed to submarine cable faults and cuts [9]. The submarine cable damages can be diagnosed either as fibre fault, shunt fault or complete break. When the fibre optic is affected while the electrical cable is intact, then this is called fibre fault. Shunt fault happens when the insulation breaks causing the electrical power to leak and shunt to the water. In this case, the fibre is not affected. Whereas when both the electrical and fibre cables are affected, it is then called a complete break. Resiliency is no longer an option it has become a necessity. Depending on the seabed nature and sea depth, types of submarine cable protection are often considered (whether armoured or unarmoured). In depth less than 150 metres and closer to the beaches, the submarine cables are buried in the seabed to depths ranging from 1 to 3 metres. These installations are often used to prevent the cable from being damaged. More recently, it is quite rarer to hear about these cable faults because most companies that use cables follow a “safety in numbers” approach, by spreading their networks' capacity over multiple cables so that if one breaks, their network will run smoothly over other cables until service is restored on the repaired one [9] [16].

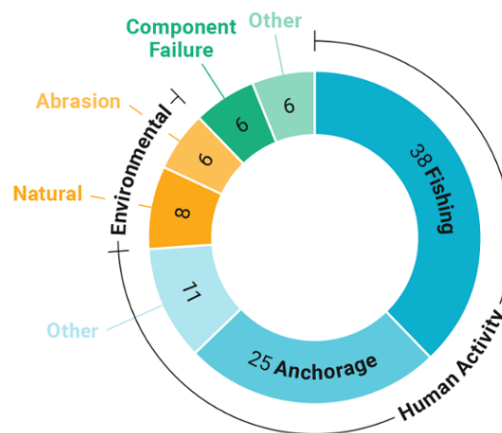


Figure (4): Causes of Submarine cable faults (%)

3.7. Decommissioning

Why do submarine cables retire? Well, undersea cables' minimum design life is 25 years, but they can be decommissioned simply because they are no longer economically feasible to keep running. Not only does the construction of undersea cables incur hundreds of millions of dollars but also the running costs annually reach millions of dollars. So at some point when annual costs exceed revenues, then, they are said to have reached the end of their "economic life". In the case of commercial retirement, the cable remains operational, but not actively selling capacity or engaging in additional upgrades. On the other hand, partial retirement happens when only specific portions or branches are decommissioned. Another type of cable retirement is "soft" decommissioning where the maintenance contract is cancelled, but the cable remains in service until the next fault. As for the full decommissioning, it is self-explanatory and this happens when it is time to pull the plug [13] [17].

The economic life of a subsea cable is influenced by many factors, some are: rising competition, price declines, frequent faults and capacity exhaustion. Introducing new subsea cables to the market reduces the market share of older competitor cables and leads also to declining global capacity price trends. In some cases, frequent repairs may also incur extra costs which will also accelerate the end of life of the cable. Nevertheless, running out of capacity does not mean immediate end of economic life, but does start the countdown [17].

Now that the submarine cable has retired and went out of service, most would recover it for scrapping or recycling. "Why incur more expenses?" One may ask, well, submarine cable owners pay fees for the occupation of the public maritime domain in the territorial waters as long as their systems are in place. It is therefore of great interest for them to have these cables recovered when the system is at end-of-life [13]. Systems at end-of-life may be recovered for destruction or recycling. Others may be re-positioned along new routes. The old co-axial technology was used from about 1958 to around 1988, and these cables and repeaters contained much more metal than current ones, so these are more attractive for recovery and recycling from the economic point of view. However, the early optical cables still used metal and polyethylene which are more than the modern ones, so even some of these have been recovered for recycling. But for those installed from the mid-1990s onwards, not many have been recovered except for some inshore areas to open up corridors for new cables and this is where the armoured section are in any case (i.e. more metal). Very few decommissioned cables may be reassigned to scientific institutions. Since it is a costly business, most of the scientific institutions don't have the sufficient funding to buy, run, maintain or repurpose the undersea cables for scientific use. An example of a telecommunication cable which has been sold after retirement and repurposed is the University of Hawaii's "Aloha Cabled Observatory" which uses the former HAW-4 cable acquired from AT&T for only one dollar (\$1) [18]. There are very few cases of scientific institutes actually building and funding a new dedicated subsea cable observatory, one of the

bigger ones is the NEPTUNE Cabled Observatory off the west coast of Canada. The project was initiated by the University of Victoria, and the network is now run by Ocean Networks Canada [19]. There are others such as the one off the coast of California, a specific infrastructure around Japan (DONET) aimed at detecting earthquakes and tsunamis, and a couple of smaller scale systems in the Mediterranean (e.g. Antares, NEMO) [20][21].

4. Telecom Egypt: A Key Player in the MENA Region

Telecom Egypt is the first integrated telecom operator in Egypt providing all telecom services to its customers including fixed and mobile voice and data services. Telecom Egypt has a long history serving Egyptian customers for over 160 years maintaining a leadership position in the Egyptian telecom market by offering the most advanced technology, reliable infrastructure solutions and the widest network of submarine cables. TE's international state-of-the-art services portfolio includes a complete range of International Telecom Services through submarine cables including Voice, Data, Dark fibre, Managed Bandwidth, X Connection, IP Transit, MPLS, Colocation and tailored data solutions designed to meet the requirements of private or consortium of submarines cables, Telecom Operators, ISPs, media and content providers and enterprise customers. Sky is the limit to what Telecom Egypt can offer to the international community.

Egypt is blessed with its location in the heart of the world between three continents: Africa, Asia and Europe. Since the early installations of the first telegraph submarine cables worldwide in the 1850s, Egypt always was and still is a pivotal enabler of the international telecom evolution. Map (1) shows the route of telegraph cables from the United Kingdom to India via Egypt and other cables between Egypt and Europe in the late 19th century. Map (2a) and (2b) shows the chart of the world's principal international cables compiled from the official data of the telegraph bureau, Switzerland in the late 19th century to the early 20th century with a focus on the ones crossing Egypt. Capitalizing on Egypt's distinctive geography, Telecom Egypt offers the world a variety of international services that is of a unique feature. Evolving into an international hub entitles Telecom Egypt to be the partner of choice for Euro-Asian and Euro-African transit traffic with tens of Tbps of lit capacity, serving a wide variety of customers across the globe. Telecom Egypt international network footprint covers east Africa, Asia and Europe with thirteen in service international submarine cable systems connecting more than 60 countries worldwide through more than 145 landing points globally, spanning from Japan & Australia from the east all the way to Germany in the north and South Africa in the south. Table (1) and Map (4) show the network of current submarine cable systems of Telecom Egypt [12]. With Egypt's unique geographic location spanning a thousand kilometres on the Red Sea and another thousand kilometres Mediterranean Sea, Telecom Egypt played a prominent role as an international traffic corridor and an efficient crossing between east and west over six diversified routes across Egypt.

Telecom Egypt is an active consortium member in: ALETAR, SEA-ME-WE-3, SEA-ME-WE-4, SEA-ME-WE-5, IMEWE, EIG, AAE-1. Moreover, the company owns and operates the 1st 100G submarine cable system in the Mediterranean, namely TE North which links Abu Talat in Egypt to Marseille in France. TE North provides connectivity from the Red Sea to Europe for SEACOM and Tata Communications (as part of the TGN-Eurasia system). Likewise, the Cypriote incumbent operator, CYTA, rides its own “Alexandros” submarine cable system which is a separate sub-system on TE North with a branch to Cyprus. This express cable system, TE North, has the potential to branch to various Mediterranean countries.

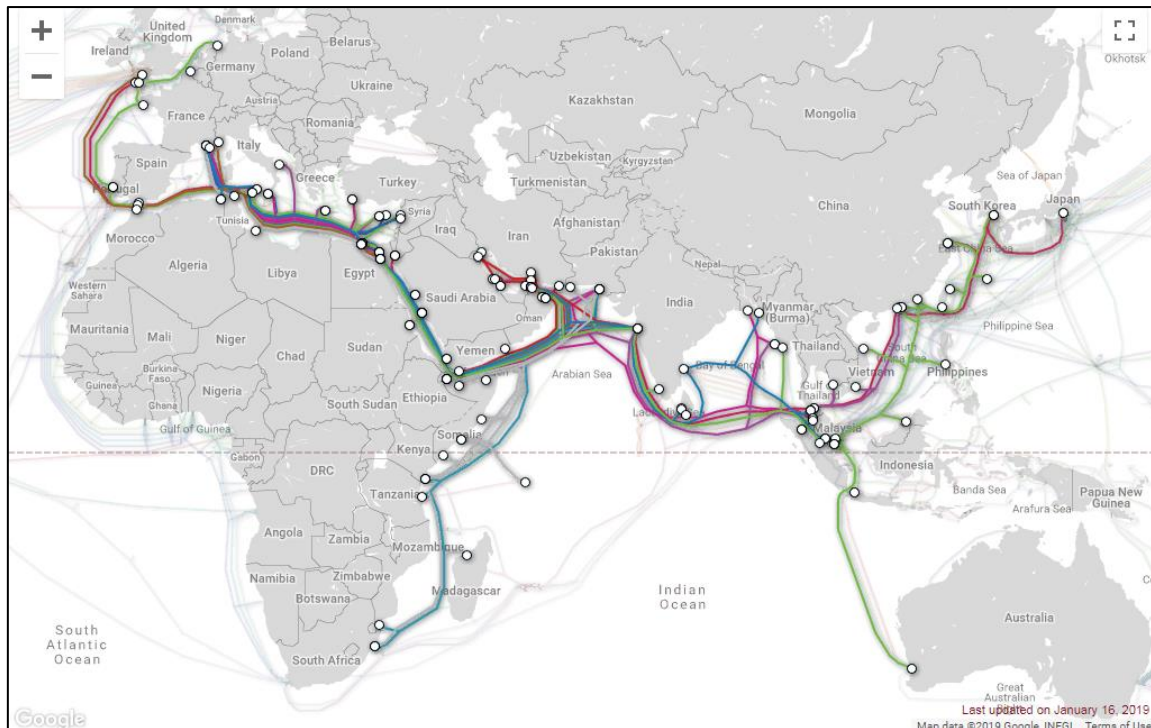
On the regional level, Telecom Egypt has extended its network reach to be also connected to its neighbouring countries, such as Sudan, Libya and Jordan.

On top of these historic investments, Telecom Egypt just acquired the Middle East North Africa (MENA) Cable System, in 2018. The 8,000 km submarine cable system spans from Italy all the way to India, crossing three continents (Europe, Africa and Asia) and four seas (the Mediterranean Sea, the Red Sea, the Arabian Sea and the Indian Ocean). MENA is a -six fibre pair- 100G submarine cable system that lands in: Mazara del Vallo in Italy, both Abu Talat and Zafarana in Egypt, Jeddah in Saudi Arabia, Al Seeb in Oman and Mumbai in India. The trans-Egypt crossing of the cable is running on two diverse terrestrial routes. This remarkable addition to TE’s submarine cables will foster the company’s reachability in Africa, Asia and Europe through its existing landing points and its potential extensions to other countries such as Greece, Sudan and Djibouti. Telecom Egypt owns and operates six landing stations, three of which are on the Mediterranean – one in Alexandria & two in Abu Talat- and the other three – one in Suez and two in Zaafarana- are on the Red Sea.

Since Telecom Egypt provides a critical transit corridor for international data traffic connecting Asia & Africa to Europe, it felt responsible to offer its partners and customers with another exceptional layer of reliable, robust and manageable services. To achieve so and benefiting from its extensive investments in the submarine cable systems, Telecom Egypt worked with Ciena –a global supplier of telecommunications networking equipment, software, and services- for the establishment of a next-generation optical mesh network, spanning over three portions of its network: (1) Across Egypt, (2) in the Mediterranean, from Egypt to France, additionally, (3) from Egypt to Singapore. The mesh network allows the traffic to be rerouted dynamically in the event of failure or even multiple fibre cuts in just 50 milliseconds, leading to stable and uninterrupted customer’s experience [22].

Table (1): In service Submarine Cable Systems Landing with Telecom Egypt

RFS Date	Cable Name	Length (Km)	Number of Landing points	Network Description
1997	ALETAR (ALExandria TARtous)	787	2	Egypt to Syria and Lebanon
1997	FEA (Flag Europe Asia)	28,000	16	Japan to UK
1999	SEAMEWE-3 (South East Asia Middle East West Europe 3)	39,000	39	Japan and Australia to Germany
2005	SEAMEWE-4 (South East Asia Middle East West Europe 4)	20,000	14	Singapore to France
2006	FALCON	10,300	16	Egypt to India
2008	Taba-Aqaba	13	2	Egypt to Jordan
2009	SEACOM/ TATA TGN-Eurasia	15,000	8	India and on the eastern coast of Africa and from South Africa to France
2010	IMEWE (India Middle East West Europe)	12,000	9	India to France
2011	TE-North (Telecom Egypt North)	3,600	3	Egypt to Marseille
2011	EIG (Europe India Gateway)	15,000	11	India to UK
2011	HAWK (extension of FALCON)	3,400	3	Egypt to Marseille
2014	MENA (Middle East North Africa)	8,000	9	India to Italy
2016	SEAMEWE-5 (South East Asia Middle East West Europe 5)	20,000	18	Singapore to France
2017	AAE-1 (Asia Africa Europe 1)	25,000	20	China to France



Map (4): The Current Submarine Cable Systems' Network of Telecom Egypt

5. Conclusion

In the era of digital revolution, telecom operators globally have to keep up with the exploding demand for international bandwidth by ensuring that their network nationally, inter-border and internationally is up to the level of what to come. Based on Telecom Egypt's experience and what was displayed in this paper, the submarine cable stakeholders are working together to make sure that current subsea cables are upgraded and new builds are in place, paving the way for a more protected, reliable and robust network enhancing the performance of the backbone of the world's economy.

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