EGYPT'S COMMITMENT FOR COLOSSAL INFRASTRUCTURE AND REGULATIONS REFURBISHMENT

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Abstract: Egypt plays a prominent role in connecting continents. Critical international data traffic crosses Egypt to and from Asia, Africa and Europe; consequently it is a priority to establish diversity, reliability and resiliency. Many challenges were faced and were overcome, so that today the solutions are keeping pace with the increasing demands for international connectivity, quality and affordability. Operators along with regulators and governments have shown collaborative intend to improve or rather eliminate the detrimental economic impact on the global telecom community. This has been displayed in Egypt by the National Telecommunications Regulatory Authority with Telecom Egypt in the backstage striving to reduce the transiting traffic regulatory fees significantly. Eventually, the rise in the submarine cables construction has also led to more creative and drastic measures to provide the industry with. Two of which is the establishment of new and diverse landing stations and route segments in Egypt. Another exceptional layer of reliability, resiliency and manageable services has been crafted by establishing of a next-generation optical mesh network, spanning across Egypt, in the Mediterranean, and all the way to Singapore. This mesh network allows the traffic to be rerouted dynamically and seamlessly in the event of a failure or even multiple fibre cuts in just 50 milliseconds, leading to a stable and uninterrupted customer's experience. The convergence of terrestrial links and submarine cables serves the demands of both international and regional connectivity for landlocked countries and others with poor international connectivity. This paper will explain the accomplishments and the plans that take diversity, reliability and resiliency to a whole new level.

1. INTRODUCTION

Since the early installations of the first telegraph submarine cable systems worldwide in the 1850s, Egypt always was and still is a pivotal enabler of the international telecom evolution. Being in the crossroad between three continents: Africa, Asia and Europe, Egypt plays a prominent role in connecting them. Egypt's northern coast spans over 1,000 Km on the Mediterranean Sea, also its eastern coast stretches over 1,000 Km on the Red Sea. Today, Telecom Egypt is the first integrated telecom operator in Egypt providing a complete range of international telecommunications services.

Moreover, Telecom Egypt commitments to the international community have been boosted year over year, and the new firm plans that are currently being developed will cater for the new wave of subsea infrastructure crossing the country.

2. EGYPT: CONNECTING CONTINENTS

Since critical international traffic crosses Egypt, ultimately, Telecom Egypt took on the responsibility to build, maintain and upgrade its transit routes with growing diversity, reliability and resiliency, in addition to assorted innovative international solutions. In 2018, the international transiting traffic exceeded 28 Tbps. Today, we are looking at a more promising

empowering environment to keep up with the increasing demand for global capacity.

The Eurasia route serves the Middle East, Sub-Saharan Africa and Asia. Eurasia is considered as one of the most dynamic routes globally [1].

The Map in figure 1 illustrates the current and planned subsea systems connected to Egypt, as per Telegeography interactive map [2].

In this section, we shall shed the light on the international used capacity in the region, the share of lit vs potential capacity and lastly, on the other initiatives in the region.

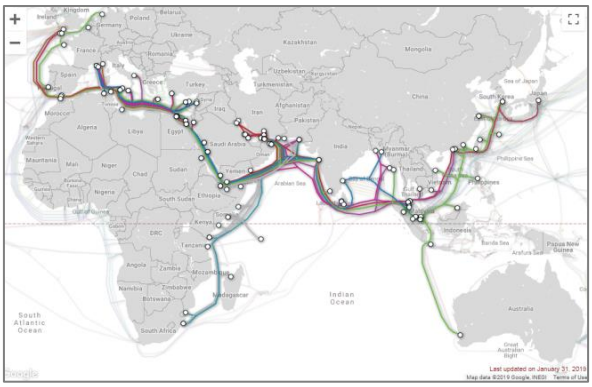

Figure 1: Map of Current and Planned Subsea Systems Connected to Egypt [2]

2.1. AFRICAN INTERNATIONAL USED CAPACITY

International bandwidth usage by African countries has more than quadrupled between 2013 and 2017 to reach 7.3 Tbps in 2017. Even though the intra African bandwidth has seen a spike lately, 82% of international African bandwidth demand remains to Europe. About 60% of the African used international bandwidth comes from four countries (South Africa, Egypt, Morocco, and Algeria) led by Egypt accounting for 14% of the continent's international capacity usage [1].

2.2. EURASIAN INTERNATIONAL USED CAPACITY

Figure 2 displays the rising trend of used international capacity for the routes of Europe-Africa, Europe-Asia, and Europe-Middle East, along with the forecasted compounded annual growth rate (CAGR) from 2017-2024. The Europe-Middle East route is expected to rise from 18 Tbps in 2017 to 122 Tbps in 2024 with a CAGR +32%. The Europe-Asia route is expected to rise from 14 Tbps in 2017 to 170 Tbps in 2024 with a CAGR +43%. Also, the Europe-Africa route is forecasted to increase from 6 Tbps in 2017 to 70 Tbps in 2024 with a CAGR +42%. With this amount of traffic, this will call for more submarine cable systems to be built in the near future, even more than the ones already planned [1].

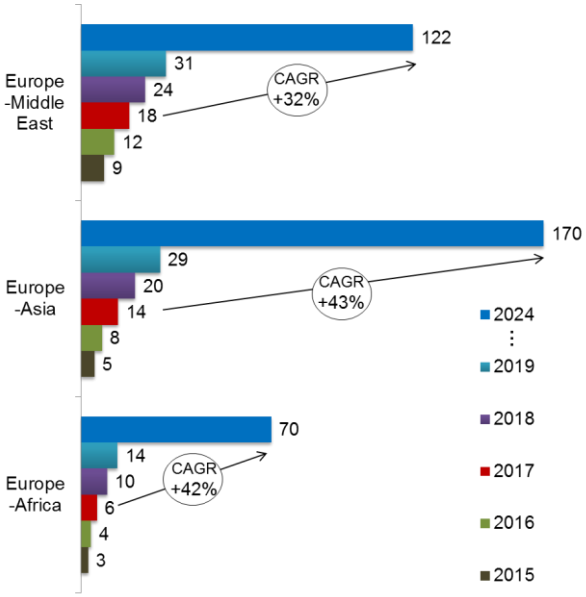

Figure 2: Forecasted Region to Region Bandwidth Usage (Tbps) & CAGR (2017-2024)

2.3. EURASIAN LIT TO POTENTIAL CAPACITY

In 2009, Eurasia route was running out of bandwidth with 75% of potential capacity lit. Many new subsea systems have seen the light in the past decade.

Between 2009 and 2012, the introduction of IMEWE, TATA/SEACOM, EIG, HAWK and TE North systems hailed the route with more capacity. Again in 2016 and 2017, the introduction of both SEA-ME-WE-5 and AAE-1 systems to the industry, have

strengthened further this route, and have added to the Eurasian supply of capacity.

In addition to the capacity supplied by new subsea systems, most if not all Eurasian subsea systems are now upgraded or in the process of being upgraded to 100G technology, increasing the supply of capacity. From 2013 to 2017, lit capacity on the Eurasia route increased by more than 4.5 folds to touch about 58 Tbps. Unexpectedly, the lit capacity increased from 11% potential capacity lit in 2013 to 25% potential capacity lit in 2017 in the presence of more subsea systems in the region. In 2017, the share of potential capacity that is lit over the Eurasia route is considered average compared to the other routes which ranged from 12% on the US-LATAM route to 30% on the Trans-Atlantic route (Figure 3) [1].

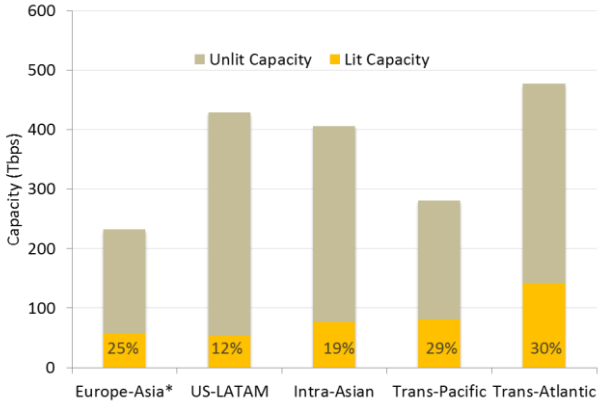

Figure 3: Lit and Potential Capacity on different routes in 2017

*(*Europe-Asia route via Egypt)*

2.4. OTHER INITIATIVES

Over the last 10 years many initiatives have been explored in order to build parallel terrestrial routes to Egypt, with different concepts in mind. Some of those initiatives have seen the light, others are still struggling due to many reasons that can be classified either due to political or economic concerns.

It is a matter of fact that the telecommunication industry always seeks two main parameters: latency and diversity, especially due to the pressure exerted by end users for time sensitive online applications.

Investors implementing these "alternative" routes are actually facing challenges when it comes to:

- System operations: where the recent demand for higher system utilization mandates a shorter span length between terrestrial amplifiers "ILAs".
- Maintenance: direct effect on Mean Time to Repair (MTTR) where difficulties arises in managing and allocating the teams on the cable paths through many urban jurisdictions.

In addition to the above constraints, security becomes another recent parameter that is of concern to the investors and to their customers whether they are enterprise or content owners.

Despite the fact that global players have explored and, some have executed alternative routes, the preference of the Egypt route was highlighted to the global community, since the above mentioned concerns have been resolved by Telecom Egypt; as it will be illustrated in this paper later on.

3. TRENDS OF SUBMARINE TECHNOLOGY AND THEIR IMPACT ON THE DESIGN

The introduction of 100G wavelength technology encouraged cable owners to upgrade and push more traffic on the newly built cable systems, which will lead to approaching the fibre design capacity threshold. Nonetheless, the oldest cable systems are expected to stagnate few years from now, where technical manoeuvre mechanisms have been introduced to increase the planned threshold of system design capacity. Figure 4 illustrates a forecast of the used capacity over existing subsea systems and the forecasted takeover of the new comers' subsea systems in few years from now.

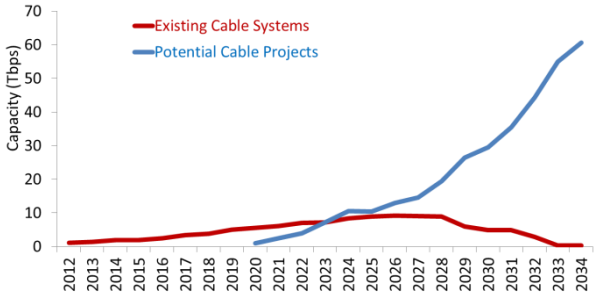

Figure 4: Used Capacity over Existing vs Forecasted Potential Cable Systems

Recently, the increasing demand on 100G waves end to end solutions drives the operators to think of a new model of capacity ownership on the planned subsea projects, where the demand has shifted from the traditional Minimum Investment Unit (MIU.Km) to Digital Line Section (DLS). Both models have their pros and cons. Newly planned cable projects consortia are thinking to take advantage of both models by combining the flexibility provided by MIU.Km and the efficiency provided by DLS. Through these ownership models, consortium owners will satisfy their need to maximize the resources and the outcome from their investments. With supplier's introduction of subsea systems that can accommodate up to twelve and even more fibre pairs, the model has been shifted in some regions globally to dedicated fibre link systems.

The decreased unit cost driven by these fibre pairs per system shall initiate an unhealthy competition between new planned cable projects. Where in some underdeveloped regions, the provision of submarine fibres will lead to a massive supply of high speed capacities than the in-country terrestrial and infrastructure development cannot support. So the formula has been shifted from supply to cater for future demand, to massive supply in order to reach minimal unit cost to attract more investors.

Moreover, it is expected that with this technology adaptation to consumer requirements, the submarine cable build model in the Gulf and South-East Asia may be a single country to Europe multiple fibre pairs cable system.

Being in the heart of it all, this new model will exert more commitments on Telecom Egypt to provide diverse transEgypt routes and landing stations and routes that shall complement these new projects with the diversity needed.

4. EGYPT'S INFRASTRUCTURE REFURBISHMENTS

A decade ago, Egypt had only six in service subsea systems, two landing stations and diverse routes connecting between them. Ten years later, Egypt added another seven new subsea cable systems, five new landing points and more diverse routes connecting them. Telecom Egypt strives to run continuous enhancements to its national and international infrastructure on all levels such as on the cable landing stations, transEgypt routes, its international network reach and more.

4.1. SUBSEA NETWORK PROGRESSION

Being an active investor and collaborator in the submarine cable industry, Egypt provides access to eleven subsea systems to cross from Asia and Africa to Europe. In addition, there are two more systems that are connected to its northern landing stations, namely ALETAR and TE North, mounting for thirteen subsea systems in total connected to Egypt. Egypt, also, retains inter-borders connectivity to its neighbouring countries such as Jordan over the Taba-Aqaba link, and terrestrially to Libya and Sudan. Eventually, the exploding demand for international bandwidth will lead to the growth in the amount of new submarine cable systems build not only regionally but also globally.

4.2. CABLE LANDING STATIONS PROGRESSION

The two landing stations that were only present before ten years ago were the

Alexandria cable station on the Mediterranean Sea and the Suez Cable Station on the Red Sea. Over the past ten years period, two new landing points were added: one in Abu Talat on the Mediterranean and another in Zafarana on the Red Sea. In 2018, three more landing sites were added, on the coasts of the:

- Mediterranean Sea: another one in Abu Talat (Egypt), and one in Mazara del Vallo (Italy)
- Red Sea: another one in Zafarana (Egypt)

The presence of the new Abu Talat and Zafarana cable landing stations, which are 3-7 Kilometres apart from the existing Abu Talat and Zafarana cable landing stations respectively, will give the new cable projects a new option of an extra layer of diversity.

Besides the data centers facilities that are present in Cairo, a new well established data center designed according to Tier III standards, was constructed in the Alexandria landing station. The new state-of-the-art hosting facility paves the way to content providers to start establishing their servers and caching nodes in Egypt and easily crossconnect to all the subsea systems touching Egypt.

4.3. TRANSEGYPT NETWORK PROGRESSION

Submarine cable landing stations on the north and east coasts are connected via diverse routes in Egypt, where Telecom Egypt operates a total of seven diversified fibre routes crossing from Red to Mediterranean seas to avoid single point of failure.

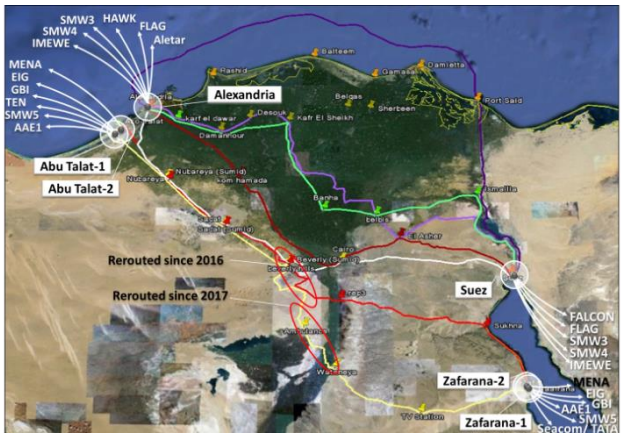

Figure 5: Existing TransEgypt Routes* and Landing Sites
*(*illustrating rerouted segments)*

On the other hand, over the years, Telecom Egypt demonstrated its capabilities to serve the international telecommunications market in a reliable manner, and provide solutions that retain the confidence of its longstanding carrier partners by re-routing the few segments that have suffered from failures on other brand new segments.

Based on the entire aforementioned network's revamping, service availability and reduced mean time to repair (MTTR) were enhanced.

4.4. OUT-OF-EGYPT NETWORK EXPANSION

In addition to the investments made in the subsea systems, Egypt is connected to Jordan, and terrestrially to Libya and Sudan, allowing Egypt to connect to more African landlocked countries and others with poor international connectivity.

In order to make sure that its landing points outside of Egypt are also protected and crossconnected to other systems and networks in their respective cities, Telecom Egypt has connected them as follows:

- The Marseille Network: Through its subsidiary in France (TE France), Telecom Egypt landed TE North system in interxion's MRS1-open access data centre-previously known as SFR Netcentre. Telecom Egypt has deployed a protected

terrestrial link between MRS1 and Verizon's Bauxite, where the SEA-ME-WE-4 and EIG subsea systems land. This network was further expanded to Jaguar datacentre over a protected ring. The Marseille network doesn't only provide access to the other subsea systems landing in Marseille but also to the pan European network.

Furthermore, the TE North landing point houses an MPLS POP that connects to major MPLS providers present in Europe.

- The Singapore Network: Through its subsidiary in Singapore (TE Globe), Telecom Egypt is present in the Equinix Data Center SG1 which is also connected to Tuas cable landing station over protected terrestrial segment. This network is connected to Egypt's landing stations in the Red Sea over different diverse wet routes between Singapore and Egypt, complementing the other meshed routes from Singapore to Marseille.

4.5. THE GEOMESH

To maintain the high level of service availability, Telecom Egypt has developed its meshed network solutions across its diverse International Cable TransEgypt routes to offer the same to new, existing, and potential partners. This next-generation optical mesh network, spans in the Mediterranean, across Egypt, and all the way to Singapore. Having integrated terrestrial and subsea networks, this mesh network can survive unexpected hardware and fiber route failures. This is done by rerouting traffic dynamically and seamlessly in the event of a failure or even multiple fibre cuts in just 50 milliseconds, leading to maintained network reliability and uninterrupted user's experience. The built-in fault detection tools allow detecting exactly where a fibre break has occurred. This kind of network intelligence means that compelling SLAs for lit fibre services is now in place, with an SLA portal that shows exactly how links are performing at all times. Also, the network functions virtualization (NFV) function is also integrated into the mesh. This meshing diversity is achieved on the path level, cable level and on the wavelength level.

The Mesh network is currently been developed to accommodate more terrestrial routes from the existing and the future ones. These routes will connect the Mesh nodes together to form a robust backbone at an unprecedented level of availability in addition to maximizing the transmission capability to tens of terabits level. This last phase is planned to be ready by 3rd Quarter, 2019.

The mesh network is equipped with a network management solution, called "One Control", which is designed to allow provisioning of the network equipment and services connecting Europe, Africa and Asia (Figure 6).

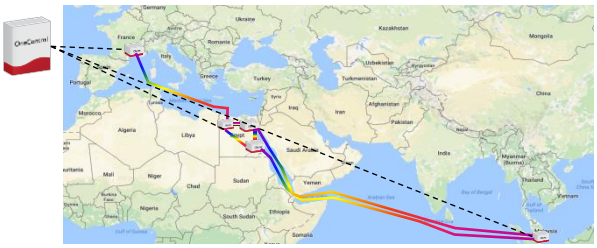

Figure 6: One Control Management Solution

5. EGYPT'S REGULATIONS REFURBISHMENTS

Globally, regulatory issues are important considerations while planning a subsea system built. Governments worldwide impose regulations and permitting systems that influence the evolution of subsea systems. It is their duty to raise financial benefits from the exploitation of the country's resources, environment and national security in favour of the development, deployment and usage of subsea systems through charges gained from customs and duties that are applied on the equipment's needed and territorial waters occupancy [3]. To ensure that these legislative charges do not have a detrimental

impact on stakeholders in the community, the regulating entities, globally, need to be updated constantly with the new technologies used in the industry.

This exercise has been witnessed in Egypt by Telecom Egypt that has been in talks for more than a year with the National Telecommunications Regulatory Authority (NTRA), striving to reduce the transiting traffic regulatory fees significantly. The talks have resulted in major fee reduction of more than 68% in early 2018. Notably, this has encouraged more traffic to cross Egypt in line with the growing demand for capacity where most of the existing systems crossing the country went through a next level of upgrades. Furthermore, this reduction will have a significant effect on the regional wholesale prices which will inturn have a positive effect on to the end users price and level of service. Lowering these challenges facing new cable construction projects, together with the planned and existing routes with enhanced efficiency and resiliency will form a solid basis for the crossing of more future international cables through the region.

Some industry players are discussing the option of having this payment done as one time charge, instead of paying per capacity activation.

The NTRA is aware of the importance of the subsea industry and actually encourages the concerned entities with their endeavour in improving the investment environment in the field of subsea systems. The NTRA understands that the impact that the subsea system has on the global economy, in order to meet the growing demand for bandwidth nationally, regionally and globally.

The Egyptian government paid a closer attention to the submarine cable industry and permitting process and frameworks become well introduced and supported.

Currently, the government of Egypt makes the environment more predictable from the planning point of view to the projects that are approved to land in Egypt. With clarity on the permit process moving forward, Egypt continues with plans to make the networks that transit Egypt more reliable and attractive.

6. FUTURE PLANS

With new subsea projects around the corner, new landing stations on the Mediterranean and the Red seas are planned to be built. These new landing points will also be connected with each other and with the current ones via brand-new diverse crossings, terrestrially and over subsea links. These new routes will further improve the latency, reliability, diversity and robustness of the network.

6.1. PLANNED LANDING SITES

A new location for a new landing station on the Red Sea is planned to be located south of Zafarana landing station where most of the existing systems land. This allows reducing the build cost by landing in the planned location and avoiding the shallow waters of the Suez gulf and the busy marine proximity areas.

Also, a new landing station -located west of Abu Talat landing station- in Sidi Krir, on the Mediterranean Sea, is built and available for new cable systems to land.

Another landing station is planned to be located east of Abu Talat station, the location is selected carefully to meet the demand of the OTTs with a predefined technical requirements and tailored specifications. The planned landing facilities will be designed with growth in mind. Sites have been selected to allow footprints expansion as well as the possibility of additional floors.

The above plans for landing stations locations will give the new systems more resiliencies on the marine side and generally improving the much sought diversity quality in international infrastructure.

Figure 7: Planned TransEgypt Routes and Landing Stations

6.2. PLANNED NETWORKS AND REACH

The convergence of terrestrial links and subsea systems serves the demands of both international and regional connectivity for land locked countries and others with poor international connectivity. Through its connectivity to Sudan, Egypt plans to connect beyond to landlocked African countries, which in turn will have access to Telecom Egypt's Mediterranean assets of cables and also to its IP transit nodes.

Moreover, the fiber connectivity between existing and new cable stations, and their cross-connection to the existing facilities, is being developed with sufficient excess fiber connectivity to support the massive requirements for many cable systems to come.

The development extended to the establishing of a new route that has been selected over the coastal line of Egypt "International Coastal Road" to connect with the current and planned landing stations. The future expansions will further include new innovative routes that best fit the new requirements and mandates of the new subsea system comers.

6.3. EGYPTIAN GOVERNMENT INITIATIVE

With the Egypt government's new initiative for Digital transformation program that entails a radical rethinking of how technology, resources and processes are used to change the traditional business model of a telco. Such change requires moving away from providing basic connectivity to application development models.

The strategy aims at encouraging the digital content to be located and hosted inside Egypt and enabling the data center models to have a new level of success. Capitalizing on Egypt's assets, the strategy is mainly driven by:

(1)the size of the Egyptian market and its young population,
(2)the resilient fibre infrastructure and the diverse landing stations across Egypt,
(3)the wide international infrastructure reach through terrestrial and subsea systems, and
(4)the huge land bank.

The government focus will not build data centers as only storage facilities. It aims to develop cloud platforms to accommodate for the rise in the Internet of Things (IoT) as a major driver for the digital revolution as its expected increase in demand for machine-to-machine and cloud services.

To achieve this objective, Egypt embarked on the consortium concept to enable a speedy transformation combining the capabilities of consortium members when developing a solution or business opportunity. The approach allows greater economies of scale, efficiency and effectiveness.

Through this initiative, the government will facilitate and encourage the content owners, OTTs, global cloud-based digital service providers, Cloud computing and global IXPs to have their main node to be hosted and served from Egypt and to the Egyptian market.

Telecom Egypt's role is to support the government initiatives using the immense international infrastructure and its connectivity to the landing stations, by creating national and international transit zones for such connectivity.

7. CONCLUSION

Egypt truly sits at the heart of the African and Eurasian telecommunication markets. By believing that resiliency is no longer an option, and that it has become a necessity, Telecom Egypt is determined to keep refurbishing its infrastructure, resiliency, diversity and services to better serve the global community.

Making available to the public clear information that this platform is here to drive the economic reform, will make the job of building new subsea projects much easier by raising awareness about the importance of the subsea industry and its impact on the global economy to share with all stakeholders such as governments and even end users.

8. REFERENCES

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[2] Submarine Cable Map, Telegeography.
[3] N. Smith, Regulatory Challenges of Project Implementation –India Case Study, SubOptic 2016.