

Unusual parameters for DTS analysis

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Abstract

The constant growing use of the Internet, the need to provide telecommunication infrastructure in the Brazilian Northeast region with high standards of excellence and the economic potential on the Northeast coastal area, which concentrate the main part of the regional population led to the development of the construction of a new submarine cable system.

Festoon system although commercial since the nineties are becoming important part of telecom infrastructure. On the opposite, to repeater systems, festoon system has a much more land approach. In some cases, more than 20 land approaches. DTS (desktop study) for such kind of system is more complex than the usual used for repeater system. More interaction with local communities, shallow waters and their implication with fishing and navigation, connection to the local metro network for maximizing grooming efficiency, are some examples of nontraditional DTS parameters that must be analyzed once socio-economic and environmental impacts must be minimized.

In this paper we go through the unconventional DTS parameters and we show how important they are to choose the right RPL for a new festoon system.

1. Introduction

Festoon systems play an important role in the telecommunications infrastructure in countries where the concentration of economic activity on the coast is significant. Northeast Brazil has an important share in the country's GDP and its economy is significantly concentrated on the coast: one third of its population of 57 million inhabitants lives in capitals located on the coast and more than half of the regional GDP is generated in metropolitan regions from northeast. [1].

The average distance between the capitals is less than 300 km and the use of non-repeated systems brings a new panorama to the telecommunications infrastructure, complementing the terrestrial networks with low latency, high capacity, and future proof connectivity.

The choice of arrival points for cable terminations – beach manhole, BMH - as well as the location of cable stations, although strongly based on the work of DTS and environmental impact study, must also be guided by current socio-economic aspects and future perspectives.

The growing demand for real-time communication and high-speed data transfer originates from several possibilities for service uses available on the Internet: content, cloud service, 4.0 industry, among others.

According to the last annual Visual Networking Index (VNI) report from Cisco [2], worldwide IP traffic will triple between 2017 and 2022. This means that in 2022 there will be more traffic on global networks than in all previous years until 2016.

The most recent pandemic COVID-19 crisis has made people from all over the world use the Internet more, for different purposes: for entertainment, learning, work (home office), etc. This whole scenario demonstrates the need to an excellent telecommunication infrastructure to support the growth of IP traffic.

In the Northeast region of Brazil, there are opportunities for the implementation of a new telecommunication infrastructure, and, currently, most connections in this region are terrestrial [3]. However, terrestrial long haul networks are more vulnerable, resulting in less network availability than necessary.

It should be noted that the region has a festoon cable that was built in the second half of the 1990s. This cable plays an important role for the region's telecommunications. Given this scenario, it is consistent to consider the construction of a new festoon cable connecting Salvador, Aracaju, Maceió, Recife, João Pessoa, Natal, Mossoró and Fortaleza. The cable will be festoon-type, passive, without optical repeaters, thus eliminating the need for power infrastructure for regenerators, which is common with these types of systems.

This project will bring an additional benefit to the environment, since it will have an exclusive monitoring fiber that will allow checking the cable integrity, the ocean temperature and acoustic activities along its length.

2. Desktop Study (DTS) and Environmental Impact Analysis

The DTS is a planning and engineering set of activities for the preliminary route design of the subsea cable that will later be confirmed with a survey whose objective is to map, with data that has been collected at sea, the place where the cable will be effectively launched and landed. DTS is a well know processes.

The environmental impact analysis is critical for the region: environmental preservation areas, coral areas, urban beaches with sea turtle spawning and oil exploration regions near the coast form the boundary conditions to which other relevant aspects must be added, such as: ease of interconnection with metropolitan networks of different companies , land availability for building the CLS with minimal terrestrial cable, stability in the supply of electricity and minimal impact on construction with residents.

The initial phase of the DTS consists of a detailed study of the characteristics of the subsea bed in order to propose a safe and doable route for the cable. The entire result is well resumed by the RPL – rout positioning list.

Therefore, the additional list of parameters to be used in the part of the sea-land transition is significant as neither the traditional DTS nor the environmental impact analysis stops on these aspects.



Figure 2.1: Examples of urban beaches where the cable will be landed.

The analyzed parameters, in contrast to the well-known oceanographic parameters, are the result of extensive and complex economic, social analysis and adherence to the business strategy. Although these points are on land, they strongly impact the submarine cable sea route. Additionally, the necessary conditions for obtaining the various licenses for installing the cable were researched. With the information we obtained in the various port authorities, maritime information is not always updated and recorded in nautical charts, which highlights the importance of visiting these organizations.

3. Balancing Technical and Socio-Environmental Aspects

We can consider that the choice of the place where the cable will arrive as well as the CLS location are based on three pillars: technical with the knowledge of geoscience; environmental and its impact and socio-economic that we introduced in the analysis.

Assuming that the socio-economic aspects can be described by the following parameters: proximity to metropolitan telecommunications networks, compatibility with underground infrastructure, per capita income, digital development policies, availability and value of land and availability and stability in the supply of electricity, a numerical model was proposed that considers each of the factors in order to choose quantitatively the location of the CLS. The proposed model is summarized in the table 3.1.

Parameter	Importance ranging from 5 to 10	Weight ranging from 2 to 5	Total
<i>Land Availability</i>	10	5	50
<i>Per capita income</i>	10	4	40
<i>Digital development policies of the municipality</i>	10	4	40
<i>Underground infrastructure</i>	9	4	36
<i>Distance to Metro Network</i>	8	4	32
<i>Power stability</i>	7	4	28

Table 3.1: Socio-Economic complimentary parameters for choosing the CLS

BMH location is a choice based on a combination of suitability for the route and low environmental impact. The choice of the BMH site is strongly dominated by environmental aspects. The choice of the route has a strong contribution in the DTS although, as in the choice of the BMH site, it cannot compromise or violate the rules of low environmental impact.

4. Network Architecture

Subsea optical cable systems can be built either with optical repeaters inserted in the cable, or with repeaterless cables called passive cables.

The choice of the technology to be used depends fundamentally on the business strategy in which the investment is inserted in, besides, of course, the technological limitations.

The Northeast region of Brazil is characterized by significant economy on the coast. Except for Teresina, capital of the state of Piauí, the other capitals are coastal cities with populations of millions of inhabitants.

The international subsea optical cables that were built in the transition from the 20th century to the 21st century to connect Brazil to North America and Europe, utilized technologies that imposed the use of electronic regenerators (3R Regenerators) as a way to compensate chromatic dispersion. These regeneration units were built with a separation of less than 3,000 km. Fortaleza was chosen for the installation of these regenerators in the cables that came from North America. More recently, with the use of optical amplifiers with lower noise figure and with coherent detection systems, the limits of attenuation and the dispersion have increased substantially allowing, for example, the construction of systems as long as *Tokyo - Los Angeles* or *São Paulo - New York*, without the use of 3R regenerators. Even so, several recently built systems made use of the facilities in Fortaleza for signal regeneration, although for some fiber pairs used the express route without the use of electronic regenerators. The result is that connectivity in the Northeast has not improved with the new cables, and the development of the digital industry in the Northeast has not experienced the momentum it could have experienced. It is important to have a festoon-type project, with land-based regenerators that aims to integrate the Northeast region into the subsea cable arrival node in Fortaleza, through a system with extremely high transmission capacity and low latency.

This approach gives the region the means for the connectivity needed to effectively develop the local digital industry. Data Centers, automation, services, and cloud computing, as well as development and distribution of digital content are, at first, segments of the digital industry that will greatly benefit from this project.

Festoon optical systems have in their amplification chain the possibility to overcome distances greater than 400 km, which make them suitable for the objective of being the backbone of coastal regions where urban centers are separated by distances of the 300 km order, such as observed in Northeast Brazil.

5. Cable Route

The project will connect the cities of Salvador, Aracaju, Maceió, Recife, João Pessoa, Natal, Mossoró and Fortaleza. Even Mossoró, located about 50 km from the coast, will benefit from the project.

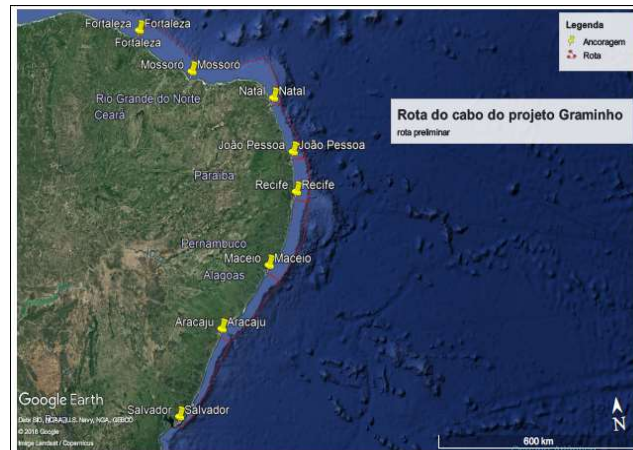


Figure 5.1: Cable route showing all the land points

The choice of an intermediate location between Natal and Mossoró was extensively studied to avoid environmental protection areas.

Land cable to connect BMH and CLS, for all the places, is shorter than 5 km matching the already mentioned characteristics.

6. Conclusion

Contrary to what we may suppose, DTS extends to field activities, through socioeconomic analysis on site as a relevant part of the conclusions for the preliminary version of the cable route.

This project conducted the fieldwork based on aspects such as proximity to metropolitan networks, availability of properties, minimization of environmental impacts and respect for communities located near the cable arrival.

A simple numerical model was proposed as a teaser to consider socio-economics parameters in the cable design, mainly in festoon cable system.

The festoon architecture brings together a set of features, both technically and economically, which are relevant to serve regions with the profile observed in Northeast Brazil: high urbanization and large cities located along the coast. Therefore, the execution of the project will have its risks minimized and the reach of the benefits to society maximized.

Acknowledgment

We thank Prisma Capital LLC for all support to Graminho Technologies, EGS Brasil hired to execute the DTS and Ecology Environmental also hired for the environmental impact study.

References

[1] <https://www.ibge.gov.br/en/home-eng.html>

[2] New Release, “Cisco Predicts More IP Traffic in the Next Five Years Than in the History of the Internet” Available: <https://newsroom.cisco.com/press-release-content?articleId=1955935>. Accessed November 27th 2020.

[3] Anatel, November 27th 2020 [online]. Available: <https://www.anatel.gov.br/institucional/>