THE AQUATICA PRINCIPLE - A NEW PARADIGM FOR CONNECTION TO THE GLOBAL VILLAGE

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ABSTRACT

Every once in a while, a new investment becomes a benchmark by which others can be measured. Like the 4600km Aquática Submarine Cable Network in Brazil, they can offer an unparalleled reach from population centres to the international gateways. But the prize cannot be delivered without creating an inter-company, multi-disciplinary team to deliver the proposition. The co-operation of companies such as Aquatica, Banco Santander and Cable & Wireless provides, along with the suppliers, the means to build a network infrastructure and an operator to sell it, in minimum time. The deregulation of the Brazilian Market is part of an increasing pace of deregulation across the world, and the Aquatica Network, which is conceived to convey long-distance traffic between the 14 major cities near the coast of Brazil and provide access both to local business traffic, and to international traffic gateways. Within a year, businesses serving 82% of Brazilian population can have access to this facility. At last, a market delivery mechanism to get the major ISP, dark fibre and MNC traffic out from these places and into the Global Village will exist in a form which can be replicated the world over. To get you going, some well chosen briefing notes are included in this paper.

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Brazil, this presents the best way to invest in national bandwidth infrastructure, and the efficient connection of distributed major economic centres is offered by the festoon submarine cable solution.

1. Introduction

The Aquatica System, first conceived by Schahin Engenharia of Brazil in 1999, is a 4600km national coastal festoon network with capacity to support 16 x 10 Gbps per fiber pair. Supported by companies like Santander for investment and technically by Cable & Wireless, Schahin has moved to realise a unique infrastructure investment in Brazil. Within 1 year, as a true carrier's carrier, it will exist to serve ISPs, multinationals and international carriers from dark fiber down to the STM-1 level. Brazil is a fine example of a country with good connections to the international traffic network, a growing economy but with pent-up demand within the national infrastructure. This demand, together with up-coming telecommunications deregulation, has made an opening for a network with broad national reach under independent ownership, offering capacity to the many competing carriers operating locally.

A festoon system like Aquática presents a very transferable model for investment in emerging markets. The aggressive growth potential lends itself to a solution that permits modularity with an evolutionary technology upgrade and investment potential. For a country like

2. Connecting to the Global Village

Brazil is favored with many connections to the international network. There will be several emerging Undersea Cables in South America with the arrival to Brazil of important international cables seeking domestic interconnection: SAC (South America Crossing), Americas-2, 360americas, Emergia, Americas 2000.

Aquatica's cable adopts the festoon topology, proven to be the most appropriate one for local needs. Unrepeatered cables offer the most cost-effective solution in this environment, eliminating underwater repeaters, and avoiding transmitting power through the cable. The technology adopted by Aquatica uses passive boosters that do not require energy supply other than light itself. This kind of solution permits easy capacity upgrades later.

When comparing Aquatica's system to other terrestrial cables it is important to point out relevant differences between the technologies involved. Marine cables tend to require longer spans than terrestrial ones. As a consequence, they require more powerful amplifiers and a more sophisticated technology that allows a higher capacity to be transmitted per fiber pair. On the other

hand, terrestrial cables tend to invest in a higher number of fibers, instead of investing in more powerful equipment, providing lower capacity per fiber pair. This relationship results in a more efficient cost per fiber pair for terrestrial cables, however it does not necessarily imply in an increased investment per Gbps for marine cables.

Furthermore, marine routes can minimise the amounts spent on rights of way. This has provided great benefit for Aquática.

Regarding optical-electronic equipment, from the demand evaluation made by Yankee Group, we conclude Aquatica should offer STM-1, STM-16 and dark fiber. The last one has no equipment other than the fiber and its supervision and has no further analysis; the other two belong to the Synchronous Digital Hierarchy (SDH) product family. The technology to be used foresees the installation of Dense Wavelength Division Multiplexing (DWDM) equipment that, supported by Aquatica wet plant, can achieve the transmission of 16 wavelengths(λ) of 10 Gbps in the same fiber pair.

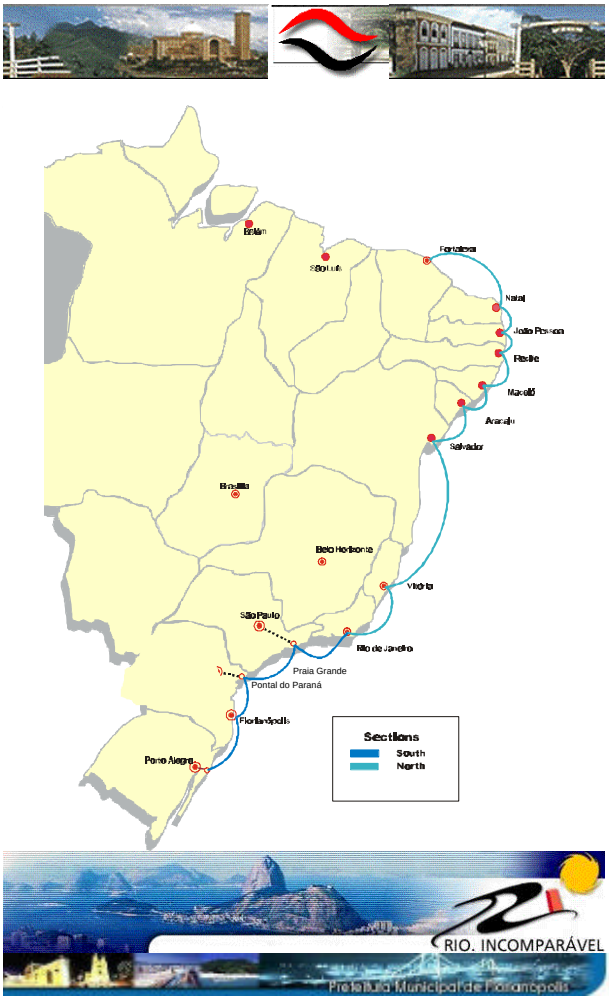


Fig. 1 - Brazil's growing national infrastructure demands a marine cable solution to match. 88% of Brazil GDP generation is concentrated at the coast.

Nowadays, there is equipment that allows the transmission of many more wavelengths per fiber pair with a capacity of 10 Gbps per wavelength. However, such technology is not yet available for the span lengths designed for Aquatica, due to technology limitations. Aquática's technology is dimensioned to suit the demand.

The system allows upgrades. Furthermore, as new opto-electronic equipment is developed, the system performance can be enhanced.

Aquatica, following its construction plan, will be serving the most important traffic concentrators of the 16 most economically developed Brazilian states, responsible for approximately 88% of Brazilian GDP and 82% of Brazilian population.

Most of Brazilian wholesale providers are concentrated in Tier 1 cities such as São Paulo, Rio de Janeiro and Belo Horizonte. Some of them reach some Tier 2 cities such as Curitiba, Brasília and Porto Alegre, but we believe Aquatica will face even less competition in Tier 3 cities (Aracaju, Natal and João Pessoa) where only the incumbents are currently present. There is a strong pent-up demand for bandwidth in these cities, where Aquatica's presence may become a strong competitive asset both in the short and long term.

The submarine path that Aquatica is pursuing allows the company to take advantage of the economic concentration in the coastal side of Brazil, but to meet the needs of other key areas, such as Brasília and Belo Horizonte, Aquatica will develop its own terrestrial infrastructure.

We deem Aquatica's focus on long-haul connectivity appropriate, especially considering the growth of national Internet content and the concentration of competitive players offering metropolitan access. However, in light of the fact that wholesale service providers are increasingly migrating their services to an end-to-end portfolio, we believe that Aquatica's competitiveness will be significantly determined by the agreements it forges with metropolitan access providers or utility companies networks to reach their customers' premises. Aquatica also forms a natural partner for international carriers to reach their distributed local clients.

This kind of solution, like the market it addresses, forms a model for other emerging markets facing the challenge

of liberalisation - **a true local connection to the global village.**

3. Constructing the Project

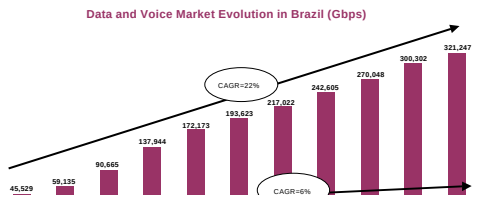
Aquática will be established as a Brazilian Special Purpose Company, owning all the assets and being an operational company. As the funding of the cost of the whole project will be 50% equity, 50% debt, the company is structured this way to satisfy the requirements of the debt sponsors. The vendors are providing the funding to finance the acquisition of their equipment, through a project financing, lead by a single bank that leads to syndicate the committed risk. This project financing is in accordance with usual conditions for such financing (security package, term, grace period, rates).

Considering that Aquatica will be the only pure wholesale carrier's carrier in Brazil, completely neutral, able to provide capacity to all kind of telecom players, we are structuring the equity as a financial consortium, where all the equity partners are jointly controlling the business. A complete shareholders agreement, regulating all the political relations between the sponsors, makes that possible. One of the items of such agreement takes into consideration the management of Aquatica and states that a professional team is constituted to run the business. All the equity sponsors will define the CEO of the company, who will assemble a team.

This professional team will manage the company with the support of Cable & Wireless Global Operations Engineering Services, who will provide training, implementation and operational support, project management, guidance and professional staff support services to permit Aquatica's staff to be able to operate successfully, in a relationship which it is intended will extend well beyond the basic implementation period

The Brazilian telecom market offers a growth potential significantly more attractive than the global average. According to Yankee Group, the Brazilian voice traffic is expected to grow at a 6% average rate a year, compared to world average of 3% to 4%. In terms of data traffic growth, Brazilian numbers are even more impressive: average growth rate of 22%, compared to a world average of 18%. The main reason for this is that the liberalization of this market is as yet embryonic.

Data traffic (Internet included) is the main contributor for the booming prospective market in the world. This is no different in Brazil. The following graph compares voice and data growth potentials in Brazil.



Market Analysis - Main Clients/Competitors of Aquatica's Project

Long Distance Carriers after liberalization of the market in 2002

- Proliferation after 2001 of new competitive **long distance carriers** that will demand high-speed, inexpensive transport solutions. The existing carriers will be focusing on achieving privatization requirements.

CAP´s and Wholesale-oriented Operators

- Proliferation of terrestrial **CAP's and wholesale-oriented networks** seeking full-ring redundancy and restoration capabilities:

CLEC's

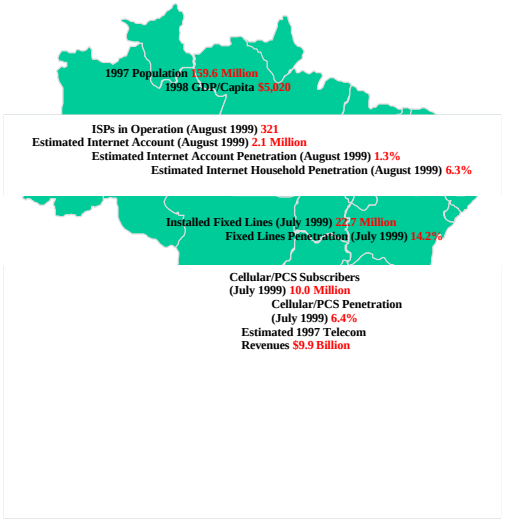
- Entry of regional **CLECs** and **CAPs** that seek to interconnect regional metropolitan networks:

Internet Service Providers

- Growth of the **Internet** creating enormous strain on existing fiber and satellite network:

Emerging Undersea Cables in South America

- Arrival to Brazil of important international cables seeking domestic interconnection:



4. Designing the Network

4.1 PROJECT OVERVIEW

AQUÁTICA is a carriers' carrier wholesale network capacity provider, based on a shallow-water festoon-type submarine cable, conceived to convey long-distance traffic between the 16 major cities in Brazil, including São Paulo, Rio de Janeiro, Belo Horizonte and Brasilia according to the figure showed below. Market demand among those cities where AQUÁTICA is providing

Points of Presence (POP) facilities is projected to be over 82% of the Long Distance Market.

The submarine network is 4,600-km long, extending from Porto Alegre to Fortaleza, allowing the interconnection with the international submarine cables linking Brazil to Europe, Americas and Caribe Region , Mercosul and Satellite gateways. Aquática Communicações/Schahin's deep knowledge and experience of Brazilian shallow waters contributes to the success of the project. Aquática is conceived to be the primary choice or at least a leg of a high performance transmission system along major Brazilian cities (Figure 2).

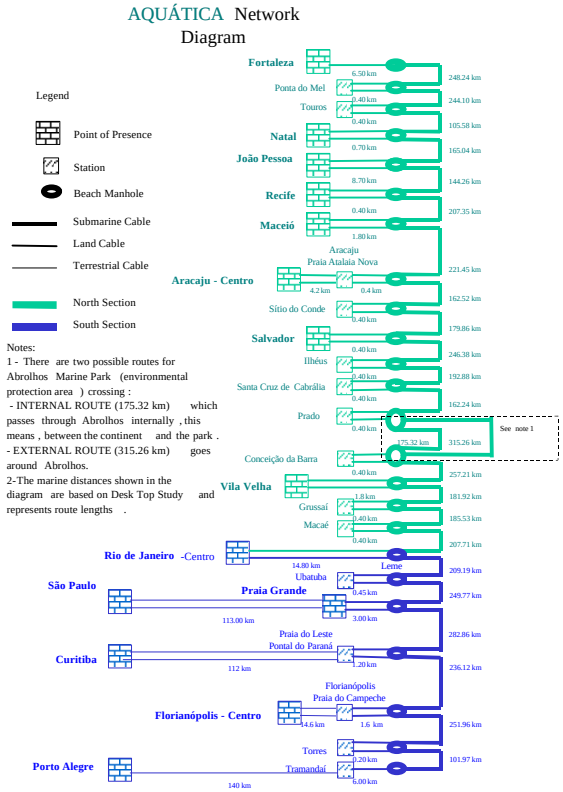


Fig.2 Aquatica links 16 cities, shown in this Aquatica Network Diagram

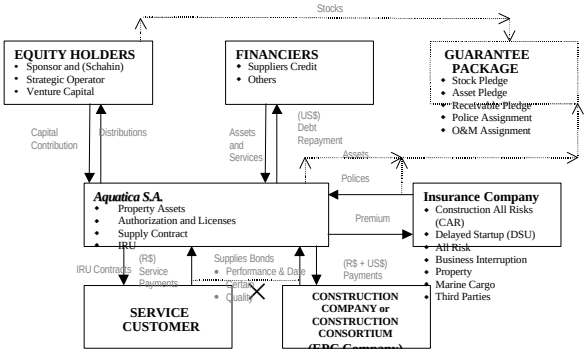
Some differentiators are unique to Aquatica:

- **Installation Time**
  - the installation of a submarine system is substantially faster than any other, which is relevant in the current setting of infrastructure shortage.
- **Right of Way**
  - all other long distance systems are associated with high annual cost due to the Right of Way payment, which does not exist for a submarine system.
- **Network Range**
  - the network reaches a large number of increased traffic potential points within the national territory;
- **Non-conflicting interests**
  - since Aquatica does not act in the corporate market, the carriers' key target, it enjoys the neutrality benefits in relation to its potential clients, unlike several competitors;
- **Seamless Network**

  Aquatica's architecture is very flexible and homogeneous. It can be tailored to the desired level of performance

5. Implementing the Investment

- In defining the best capital structure, we considered the following parameters:
  Debt/Equity ratio commonly used in similar telecom projects
  Maximum leverage of sponsors' capital
  Timing to implement
  Good coverage ratios
  Good Returns for investors, optimising the capitalisation structure
- We are assuming a 50% Debt/ 50% Equity ratio for Aquatica during construction period. This ratio shall be applied throughout the construction process. .
- All US$-denominated debt is expected to be provided together with the supply package with 100% commercial and political risk coverage by an Export Credit Agency (ECA).



Banks associated with the suppliers are expected to provide 7-year financing for 100% of the total value of US$-denominated capital expenditures, with a 2-year grace period. Local equipment (less than 10%) and services are expected to be financed by 7-year loans from BNDES with a 2-year grace period

5.1 FUNDING & VALUATION

Investments that will need financing from the sponsors and financial institutions are those until the beginning of operations. From then on, investments will be wholly financed by Aquatica's cash generation.

Total such investments are:

Investment Total : about US$ 400M.
Interest and Financial Charge during the construction period : about US$ 30M.

Investments** (US$ million)	Payback (Years)	I.R.R. (% p.a.)
c.400	c.3 years	Over 30

With regard to the table above, investments include those capital expenditures in submarine cables, equipment, terrestrial infrastructure, rights of way and pre-operating expenses. Within financing-related expenses, financing costs are flat payments, mostly equivalent to the commercial and political risk coverage - interest expenses are not included in this account. We consider that this investment has a natural hedge as prices in the telecom sector in Brazil are fixed following a dollar reference .

5.2 Capital Structure

Considering the contemporary telecom sector, and considering that the investment is taking place in a non investment grade country, we are assuming a very conservative Debt/Equity structure, 50%/50%. This ratio is applied throughout the construction process. As a festoon cable network, the capex of Aquática is very modular, and after the initial construction period the additional capex is financed by Aquática´s own cash flow. Brazil is one of the most aggressive emerging telecom markets, which means that Aquatica should need to adapt its offer of capacity year by year.

All US$-denominated debt is expected to be provided together with the supply package with 100% commercial and political risk coverage by an Export Credit Agency (ECA). Banks associated with the suppliers are expected to provide 7-year financing for 80% of the total value of US$-denominated capital expenditures, mostly cables and equipment, with a 2-year grace period –. Local equipment and services are expected to be financed by 7-year loans from BNDES with a 2-year grace period. Local financing will be less than 10% of total financing.

5.3 Players:

Financial Advisor: Banco Santander
Sponsor: Schahin Engenharia Ltda

Investors: Schahin+other investors being defined
International Operator: C&W

MOU Investors signature : end February 2001
Equity Purchase Agreement and financial closing: Spring 2001

The teams which apply to the different phases are as follows:

- Precontract - Schahin/Aquatica - Conception/Marketing, Santander - Funding, C&W Due Diligence
- Project Definition Phase - immediately prior to Infrastructure contract awards - Multi-Company transition team
- Implementation Phase - MOU (Santander) Implementation and Operational Support (C&W)

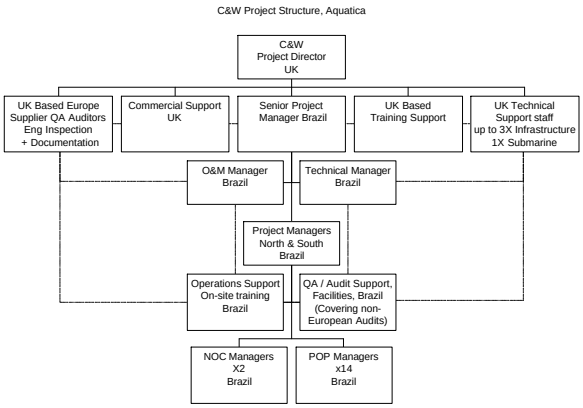
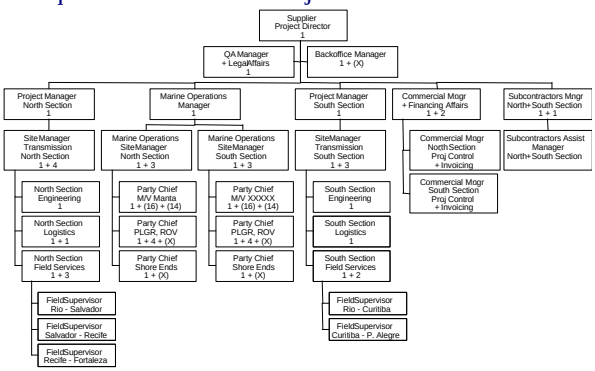
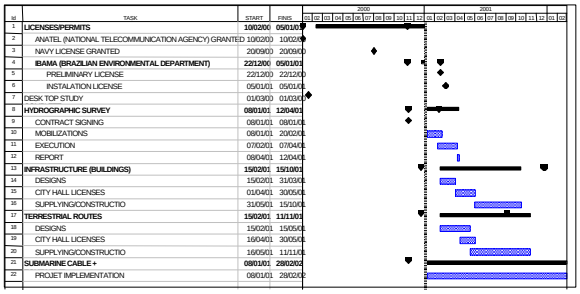


Fig. 2 - C&W Aquatica Implementation and Operational Support Structure

- Infrastructure (Schahin) and Aquatica building Special Purpose Company.
- Operation Phase - The following diagram illustrates Aquatica structure and objectives.



The Plan of work to be applied to the project is based on the following key activities:



Id	TASK	START	FINIS
1	**LICENSES/PERMITS**	**10/02/00**	**05/01/01**
2	ANATEL (NATIONAL TELECOMMUNICATION AGENCY) GRANTED	10/02/00	10/02/00
3	NAVY LICENSE GRANTED	20/09/00	20/09/00
4	**IBAMA (BRAZILIAN ENVIRONMENTAL DEPARTMENT)**	**22/12/00**	**05/01/01**
5	PRELIMINARY LICENSE	22/12/00	22/12/00
6	INSTALATION LICENSE	05/01/01	05/01/01
7	DESK TOP STUDY	01/03/00	01/03/00
8	**HYDROGRAPHIC SURVEY**	**08/01/01**	**12/04/01**
9	CONTRACT SIGNING	08/01/01	08/01/01
10	MOBILIZATIONS	09/01/01	20/02/01
11	EXECUTION	07/02/01	07/04/01
12	REPORT	08/04/01	12/04/01
13	**INFRASTRUCTURE (BUILDINGS)**	**15/02/01**	**15/10/01**
14	DESIGNS	15/02/01	31/03/01
15	CITY HALL LICENSES	01/04/01	30/05/01
16	SUPPLYING/CONSTRUCTIO	31/05/01	15/10/01
17	**TERRESTRIAL ROUTES**	**15/02/01**	**11/11/01**
18	DESIGNS	15/02/01	15/05/01
19	CITY HALL LICENSES	16/04/01	30/05/01
20	SUPPLYING/CONSTRUCTIO	16/05/01	11/11/01
21	**SUBMARINE CABLE +**	**08/01/01**	**28/02/02**
22	PROJET IMPLEMENTATION	08/01/01	28/02/02

The management Teams within Aquatica will be based around the following structure:

Top management is composed of professional executives and is expected to be chosen by Aquatica's Board of Directors soon after the selection of the

does not differ from that commonly used in this market. The structure fully dedicated to Aquatica's operations and maintenance was designed based on structures currently used by other telecom firms. Three main

- Execution and planning of operations and maintenance – through the Technical and Operational Management Division, and the departments subordinated to it;
- Strategic planning, financial management – through the Services and Planning Division, and the departments subordinated to it;
- Human resources, supply and outsourcing management – through the Logistical and Administrative Unit.

The Technical and Operational Management Diviosion is composed by:

- Technical and Operational Coordination Department;
- Technical and Operational Management Center of Northern Section (in Rio de Janeiro)
- Technical and Operational Management Center of Southern Section (in São Paulo)

Subordinated to each Technical and Operational Management Center, there is an O&M Management Department, a Network Administration Department, a Technical Support Department and Regional Points of Presence (POP).

Each Regional POP counts on an O&M Supervision Division, a Support, Supply Provision & Sales Division. In addition, Regional POPs are responsible for Local POPs supervision.

6. Recovering the investment

Aquatica's product portfolio is focused on low value-added services, mostly capacity provisioning. This may represent a competitive advantage when serving large clients that just need to upgrade their infrastructure, but may not attract potential clients such as ISPs, which may need more complete solutions, especially IP value-added.

The Brazilian market is expected to present price discrepancies compared to other countries' relations between lower and higher capacity circuits. This distortion will limit product segmentation in Brazil, as it will be an economic advantage from the customer perspective to acquire higher capacity circuits. For this reason Yankee have only considered STM1 and STM16 in Aquatica's portfolio analysis. Additionally, as the choice between offering lit fiber or dark fiber will be highly influenced by the cost of electronics and willingness to exercise more effective control over its network, it is up to the system operator to decide which of these two products should be offered. The demand was not divided between these two groups of products. Only dark fiber was considered, which makes our business plan more conservative.

Another important assumption Yankee made when converting capacity into equipment is Carrier Gross-Up: the market study demonstrates that, as bandwidth becomes more plentiful, network service providers will seek to provision their network by having a total available bandwidth greater than the demanded capacity. Moreover, for competitive reasons, many carriers seek to obtain capacity to satisfy their customer requirements for periods longer than the current year. These considerations result in a "grossing-up" of the core demand in the model that varies according to the product.

The Brazilian market currently lacks cost-efficient alternatives of low value-added wholesale capacity, especially dark fiber. In fact, with few exceptions, wholesale market players have not offered dark and lit fiber products. The offering of this type of product is expected to increase though, with upcoming competition in the carriers' carrier segment and the completion of infrastructure being developed at the moment.

For dark fiber demand estimates, the capacity provisioning, restoration, and diversification needs of the larger clients were computed. The premise that Aquatica's had a supply limitation of 40 Gbps per fiber pair was also assumed.

The project will be considered ready for commercial purposes on 1st quarter of 2002. Yankee has suggested including proportional revenues from dark fiber in 2001 and ignoring revenues from STM-1 and STM-16. To keep our analysis as conservative as possible, we decided not to include any revenues at all in 2001. As pre-sales efforts started in 2000, Yankee considers that dark fiber demand can be postponed until 2002.

The demand study is distinguished for its end-user-focus analysis and estimates based on main drivers of demand. Moreover, Yankee has taken part in similar projects, which consists of an important track record.

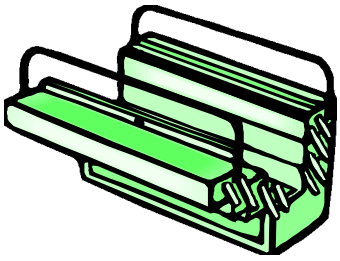
Regarding market share, an extensive competition analysis was made in each route to determine which demand Aquatica could possibly seize. An increasing market share of Aquatica could seem too aggressive at the first sight. It is justified, though, by assuming that Incumbents will set their focuses on retail, rather than competing aggressively in the wholesale. We agree with such arguments, as we understand that selling high capacity will increasingly be dependent on a player's neutrality.

However, it is important to point out that such market share considers an early entrance in the market, that makes project's timing to enter the market a key factor for success. Furthermore, pre-sales are strongly recommended.

Yankee believes that Brazil presents the potential to absorb from 2 to 3 long-haul wholesale providers. We have not identified any other project with similar coverage. This gives Aquatica the unique position of pioneer in the market. Moreover, Aquatica will be launched in time to benefit from market liberalization Yankee's report points to a greater attractiveness in offering a portfolio of products with higher added value.

Our overall analysis is that demand is appropriately estimated and, although we do not classify the numbers as conservative, we must stress at this point that we do not consider it necessary to build the whole infrastructure to reach Brasilia and Belo Horizonte which are not coastal cities. A capacity swap would make possible for Aquatica to seize part of inland-city demand.

7. Project Implementation Toolkit



- GET THE MARKET RIGHT
  Success depends on a good reading of the marketplace in the proposed environment for the infrastructure investment. Reading the market includes understanding the regulatory framework, addressing local needs, sizing demand, seizing market potential at the right time between opportunity and realisation.
- GET THE FUNDING RIGHT
  The funding structure for the project is a further critical success factor. Engaging a funding entity with experience in the marketplace and good regional funding knowledge, and supporting that entity with appropriate market studies and technical due diligence all contributes to achieving funding and building the appropriate level of confidence in the investment. These days, the suppliers are also engaging in this process.
- GET THE DESIGN RIGHT
  The Design of the network and cable/equipment components, together with the supporting infrastructure, are critical to project success.
- GET THE SUPPLIER RIGHT
  The commercial arrangements and the ability of the supplier to work together with the owner's team is an essential factor for achieving project success. Building in to the team the ability to deal with workarounds when problems are encountered can significantly protect the programme.
- GET THE INFRASTRUCTURE RIGHT
  The routes, buildings, co-location facilities and other infrastructure need to meet the needs of the market.
- GET THE SUPPORT RIGHT
  To set up a new investment in telecommunications network, the right balance of local knowledge, international experience and turnkey capability provides the necessary powerful combination to achieve project objectives.
- GET THE MARKETING RIGHT
  As soon as the Infrastructure is defined and the project is set up, the marketing effort must commence to match the customers to the infrastructure. Late entry risks early competition!
- GET THE BUSINESS RIGHT
  The right senior management team with contemporary and agile business processes guarantees the necessary level of responsiveness to the needs of the business and the market.
- GET THE IMPLEMENTATION RIGHT
  Preparing a good master project schedule containing the various interlinking parts of the project allows early warning of impending programme issues and an opportunity to be right on top of the management of them. Good training in preparation for operation provides smooth handover.
- GET THE OPERATION RIGHT
  Operational support starts at project conception, not project completion. Carry out refresher and remedial training, and review performance. Hire experienced operators where possible and ensure first class training.
- GET THE UPGRADE RIGHT

Design the network to permit upgrade. Be responsive to customer need and plan to upgrade ahead of that need.

8. Conclusion

The long distance carriers' carrier business has become one of the fastest growing segments of the telecommunications industry worldwide and Brazil is no exception to this trend. Moreover, considering the forthcoming market liberalization, Brazil's telecommunication market is considered to be at its earliest stage of development. The two key drivers of the demand for this market are currently deregulation and Internet. The first stage of a complete deregulation is already in place in Brazil, and the volume of Internet traffic is growing very fast. more data communications results, in a country where most of the sites are hosted in Brazil. Internet protocol traffic is forecast to equal voice traffic by 2003. So, to accommodate this traffic growth, many wholesale providers will turn to the carrier' carrier high capacity networks.

In this context, Aquatica provides a network covering the entire coast, linking the sixteen most important cities of the country. The first competitive advantage of Aquatica is that it is providing a network to the North region, making possible the connection of the main cities in this region with those in the South, where 60% of demand is concentrated. Less competition in the North region reinforces Aquatica's strategic position. Considering the important concentration of the traffic, most of the players are concerned in developing a strong infrastructure in the South region in this early stage of market liberalization. The other distinct competitive advantage of Aquatica is its neutrality, as it intends to position itself as a real carrier's carrier without any potential customer in its capital structure.

Finally, what we consider a key issue for the success of this project is its time-to-market. Aquatica is the first project in Brazil, at this stage of development that would offer a complete local network. And as the first network creates disincentives for new entrants by ample supply, this is an additional competitive advantage.

It is interesting to point out that in an aggressive emerging telecom market such the Brazilian one, all the current players are much more concerned by reaching customers, than by implementing a competitive network. Most of them are assuming that someone else will build up the network. Today Aquatica is the only project in Brazil that intends to be a real local backbone, a pure carrier's carrier, recognizing that a strategic asset in a country as big as Brazil is key.

In summary, the success of Aquática, the new paradigm for local connection to the global village, rests on its:

- **Independence**
- **Coverage**
- **Time to market, and**
- **Operator Capability**

In Aquática's view this will be a winning project as it consolidates a market position ahead of the conclusion of liberalization in the Brazilian telecommunications market.

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http://www.yankeegroup.com/

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