APS 1020 : INTERNATIONAL BUSINESS FOR ENGINEERS

An analysis of the Asia-America Gateway Project

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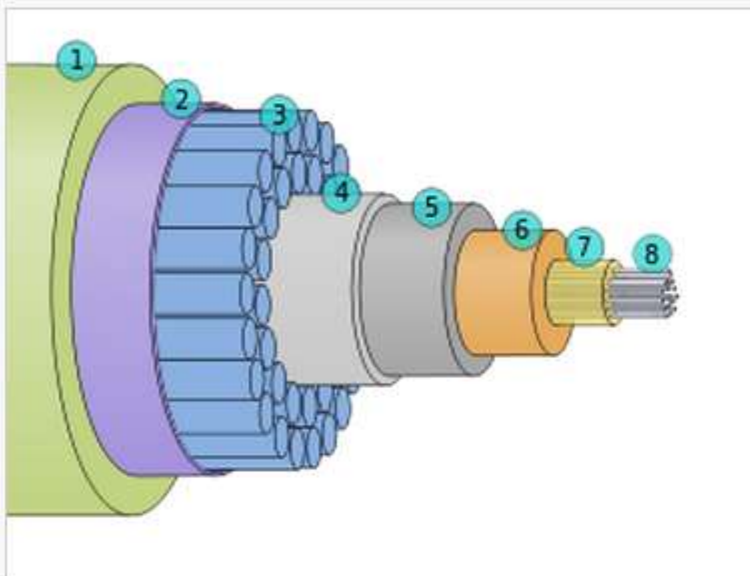
TABLE OF CONTENTS

1. 0 Introduction:

Subsea cable systems are networks of fibre-optic cables that are designed to provide connectivity over long distances. These cables carry signals of different wavelengths from one point to another. Modern cables are typically 69 millimetres (2.7 in) in diameter and weigh around 10 kilograms per metre (7 lb/ft), although thinner and lighter cables are used for deep-water sections. As of 2010, submarine cables link all the world's continents except Antarctica. Repeaters are often used for signal amplification over long distances, as the quality of the signal reduces significantly due to external forces. A cross-section of the modern submarine communications cable is shown below:



A cross section of a modern submarine communications cable.
1 – Polyethylene
2 – Mylar tape
3 – Stranded steel wires
4 – Aluminium water barrier
5 – Polycarbonate
6 – Copper or aluminium tube
7 – Petroleum jelly
8 – Optical fibers

Fig 1.1. Cross-section of a modern submarine communications cable [1]

The Asia-America Gateway is an example of a submarine communications cable that was the first to link Southeast Asia directly with the United States of America. Spearheaded by TM, an MoU was signed by TM and 16 other members in May 2007 to construct the AAG (it was eventually expanded to include 2 new members). It serves as an alternative to the traditional trans-Pacific routes via the North Pacific region, and avoids the quake-prone areas near Taiwan, since seismic and other natural calamities have often resulted in damages to undersea cable systems causing network disruptions.

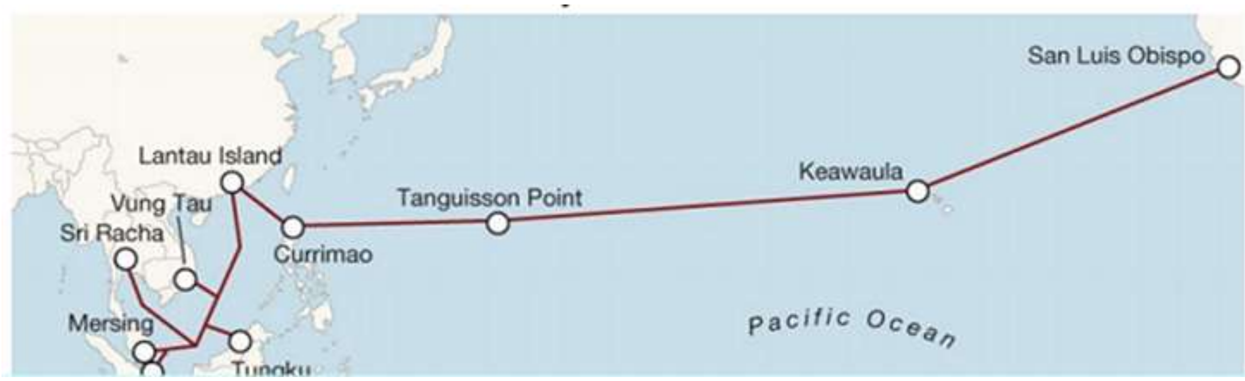


Fig 1.2 Map showing the Asia-America Gateway

The cable system uses Dense Wavelength Division Multiplexing (DWDM), which is a system that allows encoding data at different wavelengths and transporting it over the same fibre-optic cable, to carry data with a minimum design capacity of 1.28 Tbps. The map above shows that the cable provides direct access and diverse routing between Southeast Asia and the United States. Fig 1.3 below summarizes the basic information regarding the technical specifications of the AAG system:

Length	20,000 km	
RFS date	10th November 2009	
Available capacity at RFS	500Gbps (2 fiber pairs x 25 wavelengths x 10 Gbps)	
Maximum available capacity	1920Gbps (2 fiber pairs x 96 wavelengths x 10 Gbps)	
Available products (SONET/SDH, Wavelength and Ethernet)	STM-1	STM-16
	STM-4	STM-64
	Wavelengths: 2.5Gbps and 10Gbps	
	Ethernet over DWDM	

Fig 1.3 Technical specifications of the Asia-America Gateway project

SDH (given in the above table) is a transport hierarchy based on multiples of 155.52 Mbit/s [2]. The basic unit of SDH is STM-1.

Different SDH rates are given below:

STM-1 = 155.520 Mbit/s

STM-4 = 622.080 Mbit/s

STM-16 = 2,488.320 Mbit/s (~2.5 Gbit/s)

STM-64 = 9,953.280 Mbit/s (~10 Gbit/s)

Each rate is an exact multiple of the lower rate, therefore the hierarchy is synchronous.

SONET [3] is similar to SDH and together, they form a set of transport containers that allow for delivery of a variety of protocols, including traditional telephony, ATM, Ethernet, and TCP/IP traffic.

The AAG is a consortium of members spread over 19 countries. Since different countries require access to different content, landing stations are often used that can be thought of as '*interchanges*' on this high-speed Internet highway. The job of these landing stations (which are often owned and operated by telecommunication corporations that differ on a regional basis), is to monitor and control the Internet traffic bound for their region, as well as fix any bottlenecks that arise as a result of the same. The actual content is delivered to the homes of users via specialized Content-Delivery Networks (CDN's) that are managed by local IP providers. Fig. 1.4 below shows the different landing stations and the respective owners:

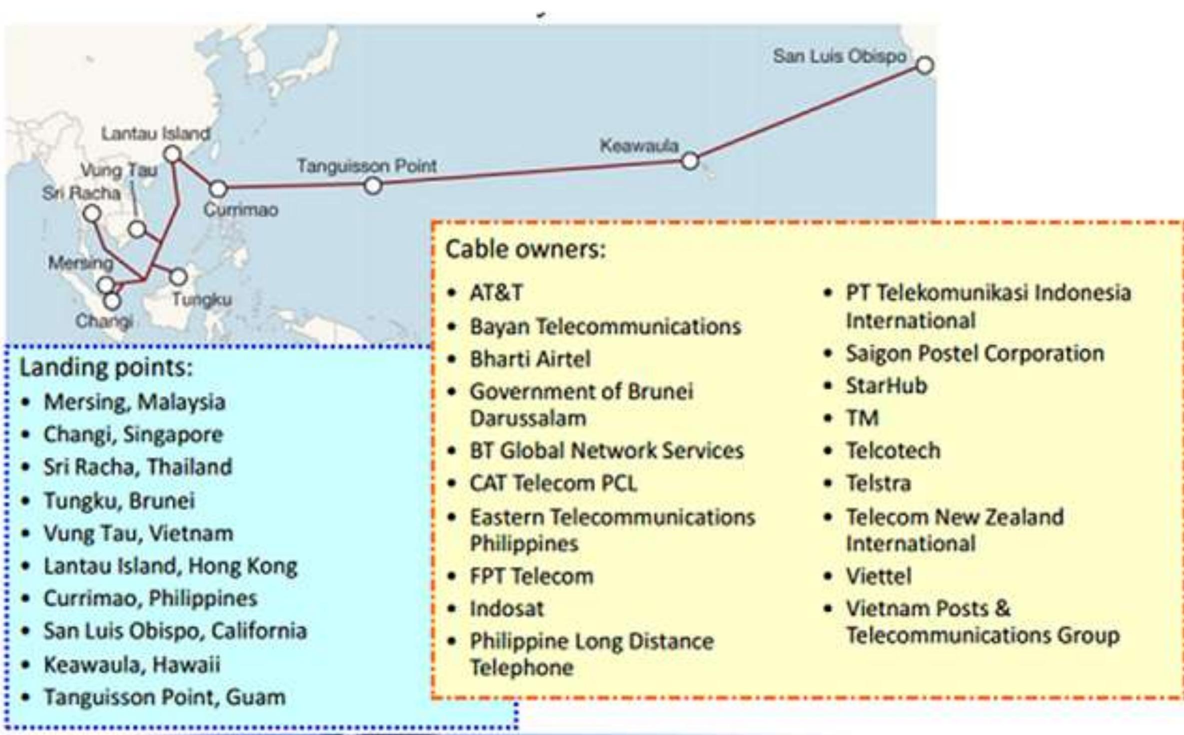


Fig 1.4 Landing points and cable owners of the AAG project

It is hoped that the traffic generated by the AAG can be supplied to users via the TPSDA 2.0 [4] framework created by Alcatel-Lucent. TPSDA 2.0 allows for real-time video and audio to be streamed with applications, creating the *triple-play-service-delivery* architecture. It also integrates network, service and subscriber management into one bundle, making it easier for IP providers to address the needs of their consumers. The AAG Gateway can be connected to CDN's via terrestrial cables. These CDN's are then connected to IP providers and end users via terrestrial fibre-optic cables. Fig 1.5 below shows the block diagram of the TPSDA 2.0 system:

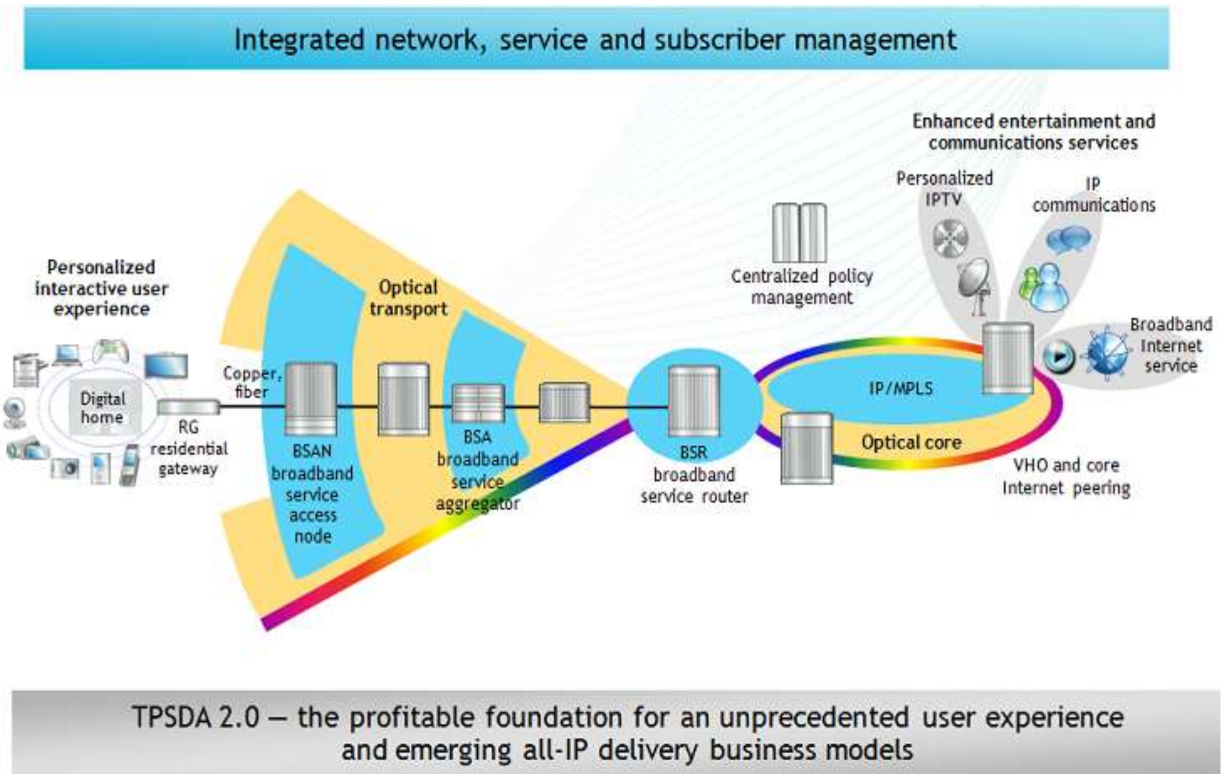


Fig 1.5 TPSDA 2.0 from Alcatel-Lucent

The next section goes on to describe the mission statement of the project, followed by the vision statement.

2.0 Mission Statement:

The AAG is a 20,000-km, high-bandwidth fiber optic submarine cable system that will connect Southeast Asia to the United States. It will provide connectivity between Malaysia, Singapore, Thailand, Brunei Darussalam, Vietnam, Hong Kong SAR, Philippines, Guam, Hawaii and the US West Coast and seamless interconnection with other major cable systems connecting Europe, Australia, other parts of Asia and Africa and will utilize the field-proven Dense Wavelength Division Multiplexing (DWDM) technology to provide upgradeable, future-proof transmission facilities for telecommunications traffic.

3.0 Vision Statement:

The birth of the AAG will revolutionize high bandwidth delivery between Asia and the USA. Designed for broadband traffic, it will provide much-needed diversity in traditional routes to the US and ensure alternate routes, expanded capacity and high levels of service during potential disasters. Coupled with other trans-continental gateways, the AAG will help to promote the Asia-Pacific region as a bustling business corridor, and as one of the busiest highways in the world with regards to Internet traffic.

The next section performs a business-model canvas analysis of the project.

4.0 Business model canvas analysis:

4.1 Customer segments:

The customer segments of the AAG possess the following characteristics:

- **Segmented** - The segments are spread over 19 consortiums as described previously, and each one of them is operated locally, as the needs and problems of each region vary extensively. Fig 4.1.1 shows the activated capacity for major undersea routes including the Trans-Pacific region from 2007-2013. As can be seen, the CAGR (Compound Annual Growth Rate) for capacity varies greatly, with the Trans-Pacific region seeing an estimated CAGR of 35% over this 7 year period.

	2007	2008	2009	2010	2011	2012	2013	CAGR, 2007-2013
Transatlantic	6	8	11	13	15	19	23	25%
Transpacific	3	7	8	12	12	14	20	35%
Pan-East Asian	2	2	6	8	10	12	17	46%
South Asia & Middle East Inter-continental	1	2	3	3	4	8	12	42%
North America-South America	1	1	3	4	6	7	9	52%
Australia & New Zealand Intercontinental	1	1	2	2	2	3	5	40%
Sub-Saharan African Intercontinental	0	0	0	1	1	2	2	57%
Global Transoceanic Bandwidth (Tbps)	14	22	33	43	51	65	87	36%
Percent Change		57%	49%	32%	19%	26%	35%	

Fig 4.1.1 Activated capacity on major undersea routes, 2007-2013

- **Multi-sided platforms** - For smooth operation, the multi-tier hierarchy of the AAG requires input from customers (whose bandwidth needs vary), providers (whose pricing schemes and routing protocols vary) and construction crew (different types of materials need to be used depending on where cables are placed) All these stakeholders need to be managed correctly to ensure success at the highest levels.

4.2 Value propositions:

The value propositions of the AAG are as follows:

- **Newness** - The first transoceanic cable was laid down in 1988, and more than 160 new projects have been proposed since then, with a value totalling $22.6 billion. Figs. 4.2.1 and 4.2.2 show the existing and planned cables (worldwide and Trans-Pacific) respectively.

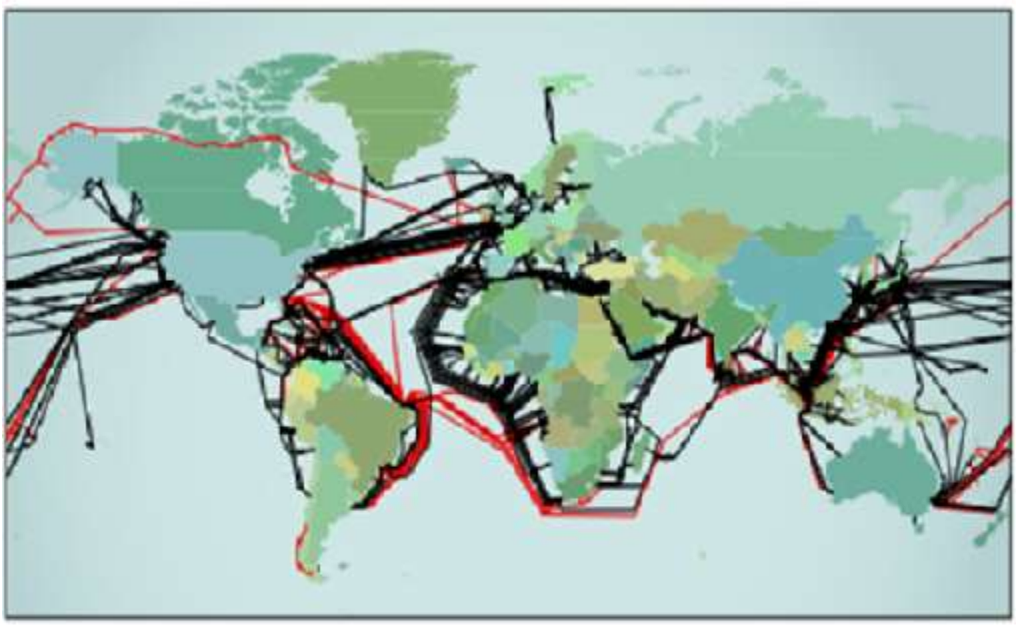


Fig 4.2.1 Existing (black) and planned (red) cables (worldwide)

See the next page for Fig 4.2.2.

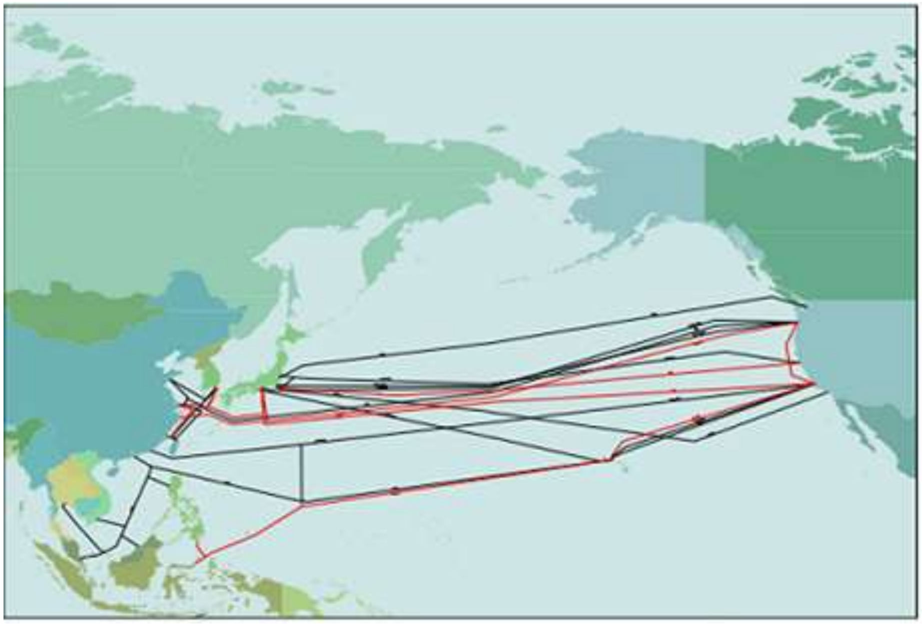


Fig 4.2.2 Existing (black) and planned (red) cables (Trans-Pacific)

- **Performance** - Successful implementations of 100G wavelengths, using fibre-optic lit pairs, have already been accomplished on transoceanic routes. This implies that the theoretical limit of 400 Tbps could be accomplished via the coupling of 58 such pairs. Figs. 4.2.3 and 4,2,4 show further detail on the existing and planned projects in the Trans-Pacific region and a summary of the capacity that would be achieved on completion of the same is shown in Fig 4.2.5

RFS	System	Owner(s)
2000	Pacific Crossing-1 (PC-1)	NTT
2001	China-US Cable Network	International consortium of carriers
2001	Japan-US Cable Network	International consortium of carriers
2002	TGN-Pacific	Tata Communications
2008	Trans Pacific Express (TPE)	International consortium of carriers
2010	Asia-America Gateway (AAG)	International consortium of carriers
2010	Unity / EAC Pacific	Pacnet / Google / Bharti / Global Transit (Time dotCom) / KDDI / Singtel

Fig 4.2.3 Existing Trans-Pacific cables

See the next page for Fig. 4.2.4 and the summary of capacity requirements in Fig 4.2.5

System	Owner(s)
Faster	China Mobile, China Telecom, Global Transit, Google, KDDI, and Singtel
New Cross Pacific (NCP)	China Mobile, China Telecom, China Unicom, Chunghwa Telecom, and KT (also an unnamed US operator)
Pacific Cloud Xchange (PCX)	Global Cloud Xchange (Reliance Globalcom)
SEA-US	Globe Telecom, GTI Corporation, Hawaiian Telecom, Teleguam Holdings, RAM Telecom International, and PT Telekomunikasi

Fig 4.2.4 Planned Trans-Pacific cables

System Types	Number	Capacity (Tbps)
Current	7	20
Planned	4	~100

Fig 4.2.5 Summary of existing and planned systems (Trans-Pacific)

Of particular interest is the *Faster* project, since Google is one of the prime owners of the project, and has an entire section of the Pacific region called '*B4*' allocated for performance based improvements which would help its business.

- **Customization** - Investment in submarine cable projects often differs on a regional basis. As seen in Fig 4.2.6, nearly 54% of the investment on fibre-optic projects from 2008-2014 has been focused on the Trans-Pacific region, making the latter a dominant player in the field of Internet traffic and e-commerce.

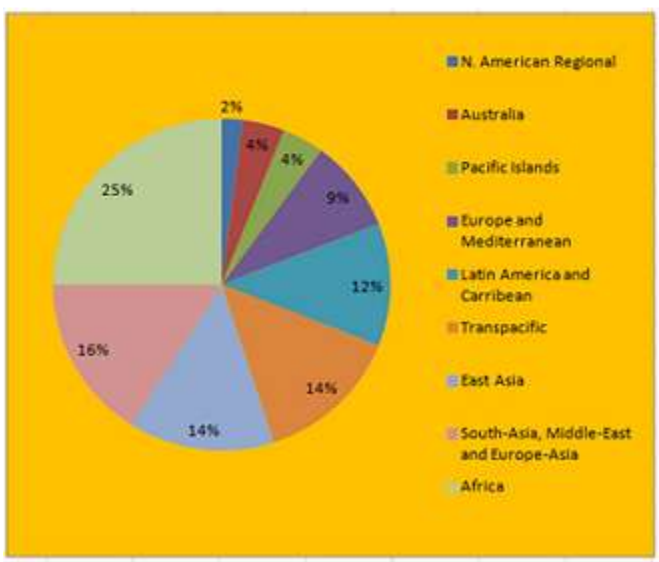


Fig 4.2.6 Investment in fibre-optic projects by region, 2008-2014

4.3 Channels:

The channels of communication used by the AAG to reach out to its customers are as follows:

- **Partners** - Alliance partners (in the 19 member consortium) are often entrusted with the task of reaching out to customers via IP providers.
- **Indirect channels** - Indirect channels of communication are often used to promote products that showcase the efficiency of the AAG in terms of increased bandwidth, improved speed, lower costs etc. These are often put forth via the sale of products such as routers, modems etc in partner stores, retail outlets and wholesale distribution of electronic products.

4.4 Customer relationships:

The means by which customer relationships are forged and maintained by the AAG are listed below:

- **Personal Assistance** - Dedicated regional call centers are often used to address customer-specific issues.
- **Automated self-services** - Customers can check their accounts and pay their monthly bills via the websites affiliated to their regional IP providers.
- **Communities** - User communities are also present on many IP provider websites. These are platforms created by users themselves, and can be used to share, collaborate and suggest fixes to commonly encountered problems.
- **Co-creation** - Based on customer requirements, sophisticated data mining algorithms can derive inferences and suggest recommendations on other products that may be of interest to the former. These are often referred to as '*Recommender*' systems in the field of machine learning. In addition, since the network of users to be reached is often huge for such projects, the division and testing of networks on a regional basis is often necessary to ensure customer satisfaction. This can be accomplished via link training, which often involves computers talking to each other and negotiating bandwidth and speed requirements to match performance specifications. This is accomplished at the '*Link*' and '*Physical*' layers in computer network architectures. Further information on how this is done at the PCI Express level can be found here [5]

4.5 Revenue Stream:

The revenue stream for the AAG consists of all sources who finance the operation and maintenance of the same. In the case of the AAG, these consist of the following four candidates:

- **Government and semi-government companies,**
- **Landing partners,**
- **Cable users, and**

- **Investment funds.**

4.6 Key Resources:

The key resources of the AAG are those that require investment in terms of materials and human resources. These consist of the following:

- **Physical** - This consists of the supply of raw materials for cable systems and for the construction of the landing points. Since the cables are often dispersed across various locations, each with its own environmental challenges, the physical specifications and the material used for making the same often vary. Fig 1.1 is a generalized version of the cable used across all regions.
- **Intellectual** - The transmission of data using different STM schemes often requires investment in R & D. Code modulation schemes also need to be developed in order to avoid loss of data packets during high-speed transmission. All of these result in the creation of proprietary technology, which are often christened as '*Intellectual Property*' or '*IP*'.
- **Human** - The laying of cables is often carried out by specialized ships and submarines, and involves expert personnel with years of experience. The human component, therefore, includes submarine operators and ship operators. In addition, the employees involved in various sectors identified in Sec 4.4 above, often come under the category of '*human resources*' as well.
- **Financial** - The financial resources of any project consist of capital expenditures (CAPEX), and operating expenditures (OPEX). CAPEX is the most intensive portion, and is raised during the early stages of the project, and is a one-time expenditure in most cases. OPEX, on the other hand, is raised during the project lifecycle and is a recurring expenditure. In the case of the AAG, CAPEX is raised via long-term credits or equity, while OPEX is raised via short-term facilities. In addition, project financing is also provided by Development Financial Institutions (DFIs), Government Export Credit Agencies or conventional banks. Vendor financing is also available in the form of short term favourable payment terms to long term loans which are backed by the vendor's financial institution. Documentary credits, which are debts provided by a bank or a financial institution for the sole purpose of the acquisition of a specific good, are also provided, with payments from the bank directly going to the vendor Lastly, down payments from the pre-RFS and IRU sales are used, and therefore reduce the need for other forms of financing. The most important thing is that the need and quantity for different forms of financing must be estimated very early on in the project.

4.7 Key Activities:

The key activities of the AAG include all those tasks which are required for the development and maintenance of subsea cable systems. They are:

- **Identification** - Suitable routes need to be identified prior to laying undersea cables. This will ensure proper operation in the face of natural disasters like earthquakes or storms.
- **Manufacturing** - As the needs of customers coupled with environmental conditions vary, a variety of materials need to be used when manufacturing the same. The manufacturing processes, therefore, need to be catered towards the development of these specific cable products.
- **Collaboration with alliance partners** - The AAG needs to collaborate with various alliance partners, both prior to the RFS (Request for Service) date, and post-RFS for ensuring that the interfaces required to transport and carry signals from the landing points to the houses of customers are properly verified and are configurable to support the need for load balancing.
- **Hardware/software interface creation** - Changes in bandwidth/speed often require improvements in hardware architecture of various devices, as well as software changes to make these changes available to end users.
- **Buying market shares** - Equity can be raised via the provision of market shares to shareholders. In addition, corporate alliances can be forged amongst competitors, and cross-market share buying as well as cross-company share purchasing methods can be adopted by smaller companies.
- **Repeater technology development** - As mentioned previously, repeaters are used for signal amplification over long distances. Repeaters are costly, and therefore, projects must be judicious when deciding their placement. Too many repeaters can involve huge upfront costs, while too little can result in reduced customer satisfaction. Hence, the number of repeaters per square kilometre is often a important figure of merit in determining how well subsea cable systems work. In addition, significant R &D is required for developing the technology used to manufacture such repeaters.
- **Capacity upgrades and redeployments** - Due to external factors, upgrades and redeployments are often required due to service outages that occur in various parts of the world. These could be due to changes in customer requirements, or broken cables.

4.8 Key Partnerships:

The key partnerships of the AAG involve interactions with various levels of hierarchy in various forms. The primary partnerships are:

- **Systems suppliers** - This relationship between the consortium members and the suppliers of various hardware/software system suppliers is of type *'buyer-*

supplier'. Fig 4.8.1 shows the market share for supply of new systems over the year 2004-2014. As can be seen, Alcatel-Lucent controls nearly 46% of the market share, followed by TE SubCom (30%) and NEC (12%).

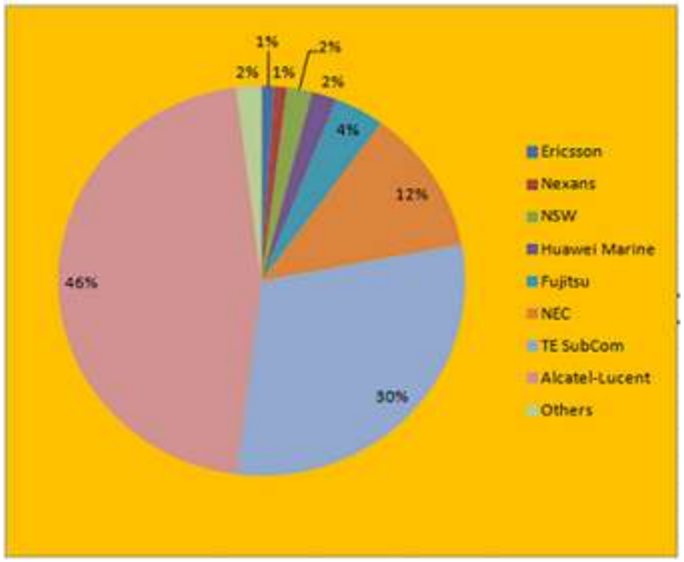


Fig 4.8.1 Market share for supply of new systems, 2004-2014 (Primary contractors only, excluding subcontractors)

- **Upgrades suppliers** - This relationship between the consortium members and the suppliers of upgrades to various hardware/software systems at various levels is also of type *'buyer-supplier*'.
- **Telecom companies** - The relationship between the AAG members and telecom companies is one of collaboration consisting of service-level agreements (SLA's) and can be therefore be categorized as *'joint ventures*'.
- **Service providers** - The relationship between the AAG members and service providers is one of co-opetition, wherein the latter try to bid for winning contracts with the consortium members through discounted deals that cater to the requirements/product specifications of specific AAG members.
- **Corporations** - Strategic partnerships have been formed with various corporations such as Google, Facebook, Microsoft etc, so as to initiate investment from the latter into subsea cable systems. In return, these corporations get the added flexibility of controlling these projects and tailoring them to meet the performance specifications and demands of their cloud-based services and datacenters.

In order to properly analyze the various stakeholders and hence the key partnerships that need to be forged, another approach called a *'Power/Interest'* grid [6] is often used. This helps to categorize stakeholders based on their power/interests in a particular project, and proves to be extremely useful in determining how much effort needs to be put in attending to their needs. Fig 4.8.2 shows the P/I grid used for analysis, while Fig 4.8.3 shows an example P/I grid that was used in the analysis of telecom projects in Lesotho.

High Power – Low Interest Stakeholders whose actions can affect the project's ability to meet its objectives but who do not stand to lose or gain much from the project	**High Power – High Interest** Stakeholders whose actions can affect the project's ability to meet its objectives and who stand to lose or gain significantly from the project
Low Power – Low Interest Stakeholders whose actions cannot affect the project's ability to meet its objectives and who do not stand to lose or gain much from the project	**Low Power – High Interest** Stakeholders whose actions cannot affect the project's ability to meet its objectives but who stand to lose or gain significantly from the project

Fig 4.8.2 Power/Interest grid

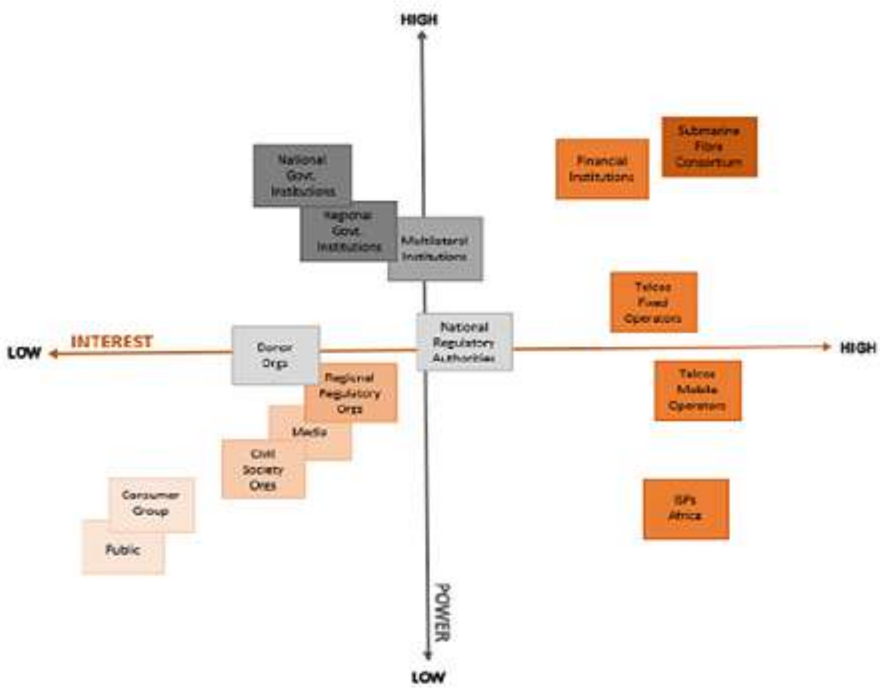


Fig 4.8.3 P/I used for telecom projects in Lesotho

Of particular interest in Fig 4.8.3 are the positions of the telecom operators (high interest/high power), the public (low power/low interest), the government (high power/low interest) and the regulatory authorities (medium power/medium interest).

The other important aspect, in terms of partnership, is determining the type of ownership that each entity would have in a project, which in turn determines the cost structure as well. Typically, subsea cable systems consist of the following ownership types [7]:

- **Private ownership** - In this structure, investment is made by one or several strategic investors (such as sovereign funds) to profit on the commercial opportunity created by underserved growing demand in the specific region or countries. More importantly the investment enables wider strategic development of other vertical sectors (e.g. Telecom, ICT, Education) that depend on availability of reliable fair-priced international connectivity. The investors involved usually have a wider portfolio of regional investments and are looking at a cable investment to support some of their other interests. The interests here could range from development of specific industry such as education and R&D as in the case of the Qatar Foundation with GBI, to protecting national and regional interests by creating secure and reliable communication links with the particular country or region. In the case of the direct shareholders being Investment Funds, the cable does not generally allow for direct investment by an operator nor provide exclusivity to specific operators. These are non-discriminatory and provide open and fair access to the cable capacity for all access seekers. The investment vehicle might also be directly owned by an operator or telecom group that sees direct synergies in owning a subsea cable. The decision making procedures are similar with the other private cables enabling quick and efficient decisions to be made – with the added influence of preserving the strategic wider aims of its investors and enablement of adjacent markets. In this case the decision to expand or upgrade might be based on a strategic direction for development of the region or specific enablement of industry sector in the region. As these cables base their business case on overall demand projections and underserved market need, they do not require any customer's pre-commitment. The initial cost is borne by the raising capital exercise and the cable products will be offered and sold to all operators without (usually) exclusivity given to specific entity.
- **Consortium** - Historically, this type of arrangement for building and operating submarine cables has been established to help interconnecting the incumbent state-owned telecommunication networks in order to enable international voice and data services. More recently, private operators and groups have also teamed up into consortiums, with the view of either owning international broadband access for their own operations, or to be able to offer competitive wholesale solutions. In essence operators establish a need for data links between a number of international points and then group together (in a consortium) to satisfy that need by jointly building and operating a submarine cable. Capital costs are entirely borne by the consortium members, in accordance with their

ownership agreement, usually referenced to Construction and Maintenance Agreement (C&MA). Each member is allocated units of capacity in Minimum Investment Units (MIUs) or Minimum Assignable Unit (MAUs), according to their participation. In short, the overall cost of the system is divided by the investors with some mutually agreed volume discount matrix to factor the actual money paid by each investor. In order to illustrate this, a typical case of a cable consortium is given below in Fig 4.8.4. The C&MA gives the total investment split into MIUs and all network segments are allocated a distance related number of MIUs. The table below shows the agreed MIUs allocation table between all landing stations of the cable. Each operator according to its financial contribution is allocated a given quantity of MIUs.

CLS	2	3	4	5	6	7	8	9	10	11	12	13
1	400	2,025	2,363	3,997	4,294	5,673	6,241	7,452	8,771	12,004	12,254	12,049
2		1,625	1,963	3,597	3,154	5,273	5,841	7,052	8,371	11,604	11,854	11,649
3			670	2,304	1,861	3,980	4,548	5,759	7,077	10,310	10,560	10,355
4				1,656	1,213	3,332	3,900	5,111	6,430	9,663	9,913	9,708
5					857	2,976	3,544	4,755	6,074	9,307	9,557	9,352
6						1,793	2,361	3,572	4,891	8,124	8,374	8,169
7							568	1,779	3,098	6,331	6,581	6,376
8								1,211	2,530	5,763	6,013	5,808
9									1,429	4,662	4,912	4,707
10										3,441	3,691	3,486
11											250	1,955
12												2,205

Fig 4.8.4 MIU's Allocation Table

According to the level of contribution each consortium member is classified as Tier A, B, C, D or E and given an agreed discount. Fig 4.8.5 below gives an example of how discounts can be structured, in order to incentivise a bigger group to maximise their contribution.

Tier	Initial Investments (USDm)	Price Ratio	Cost per STM1 End-to-end (USDk)
Tier A	> 50	1.0	214
Tier B	40 to 50	1.2	256
Tier C	30 to 40	1.4	299
Tier D	15 to 30	1.7	363
Tier E	< 15	2.0	428

Fig 4.8.5 Consortium's tier structure

This is to say that capacity unit cost for a Tier C member would result 1.4 times (i.e. 40%) higher than what a Tier A member would pay. In addition to the initial investment, each operator shall contribute to the O&M expenses, at cost, according to its personal share of the cable. Each operator can activate its allocated MIUs/MAUs upon request to the consortium central office. By doing so it will need to use some of the landing stations, leading to additional rental charges, pre-agreed within the C&MA. These landing stations are not included within the total cable investment. Landing partners are generally the consortium members and they incur the total cost of building and operating the landing stations. These costs are then retrieved from the consortium either in one shot upon RFS or along the life time of the cable. The Central Billing Party, representing consortium's body in charge of the finance side of the cable deployment, is putting in place complex mechanism to ensure total investment recovery for the landing partners. In some cases, landing partners are reimbursed along the lifetime of the asset, as each connected operator is charged with a monthly contribution towards the landing station it uses. Lastly, a consortium rarely has a legal structure as it only represents a cost sharing agreement where each member owns part of a major asset. If necessary consortium members can seek financing separately, but the consortium itself cannot incur any debt.

- **Public-Private Partnership (PPP)** - As per the World Bank's ICT organisation, "*a Public Private Partnership (PPP) is an agreement between the government and private organisations to develop, operate, maintain and market a network by sharing risks and rewards*". The involvement of public entities within private projects, in particular complex international telecom projects generates benefits for the whole value chain. Providing that government's incentives relate to public welfare rather than personal profit PPPs tend to enable higher risk projects with lower return expectations to be feasible. The involvement of private players also impacts and decreases the project risk for the public sector, as it ensures higher quality of service and some anchor customers. Additionally, the combination of private player's purchasing power and the security of public support lead to much lower TCOs of the project. For the public sector, it is also interesting to trade influence with private financing. Indeed, the direct involvement of public entities often results in shorter lead time and critical project speed. There are many forms of PPP that have been used in the telecom sector such as:
  - **Consortium** type where one or more government entities take direct part in the consortium is probably the most commonly used in submarine cable ventures.
  - **Pre-sale Commitment**, where a public entity commits to buy in advance a major chunk of the available capacity, could also be found. This generates some initial positive cash flow, and facilitates further financing.
  - **Management Contract or Build, Operate and Transfer (BOT)** type of agreement, where the public sectors gives a private player the responsibility for deploying and operating the network on its behalf against annual fees or following a revenue sharing agreement.
  - **Subsidisation**: Governments can also subsidise the deployment of an infrastructure that they believe is essential to the welfare of the citizens. In this scenario, just like for the

pre-sale commitment, there is no ownership of the project nor control over the project, from the public sector.

Fig 4.8.6 summarizes the pros and cons of each type of ownership. Typically, all projects including the AAG adopt a mix of ownerships, so as to combine the advantages and null the malefic effects associated with individual ownership schema.

Structure	Pros	Cons
Private Cable	Faster decision making process	Higher financial risk
	Capacity at cost for owners	Landing complexities abroad
	Clear accountability	Lower political influence
	Easier alignment between shareholders	Commercially challenging
	Higher competitive edge	
Consortium	Low/shared risk	Inefficient & inflexible
	Capacity at cost for owners	Lack of single accountability
	Predictable	Slow & bureaucratic approval processes
	Guaranteed access	Conflicts of interest between owners
	Ease of permitting and landing rights	Compromises in decision making
	Control for owners	Lack of competitive edge
PPP	Lower risk	Inefficient & inflexible
	Capacity at cost for owners	Slower decision making process
	Higher political influence	Could prove bureaucratic
	Ease of permitting and landing rights	Difficult alignment between parties
	Easier funding	Burdensome covenants
	Commercial upsides	Lower returns

Fig 4.8.6 Pros/Cons of each Ownership Type in the subsea cable industry

5.0 Inputs, Processes and Outputs:

The Inputs, Processes and Outputs for every hierarchy of the AAG have been described in the previous sections, and therefore will not be touched upon here.

6.0 Value Chain:

The value chain for a subsea cable project consists of all those activities that would be performed by the firms involved in the project in order to bring the products developed to market. In the case of the AAG, the value chain can be described using the following flowchart:

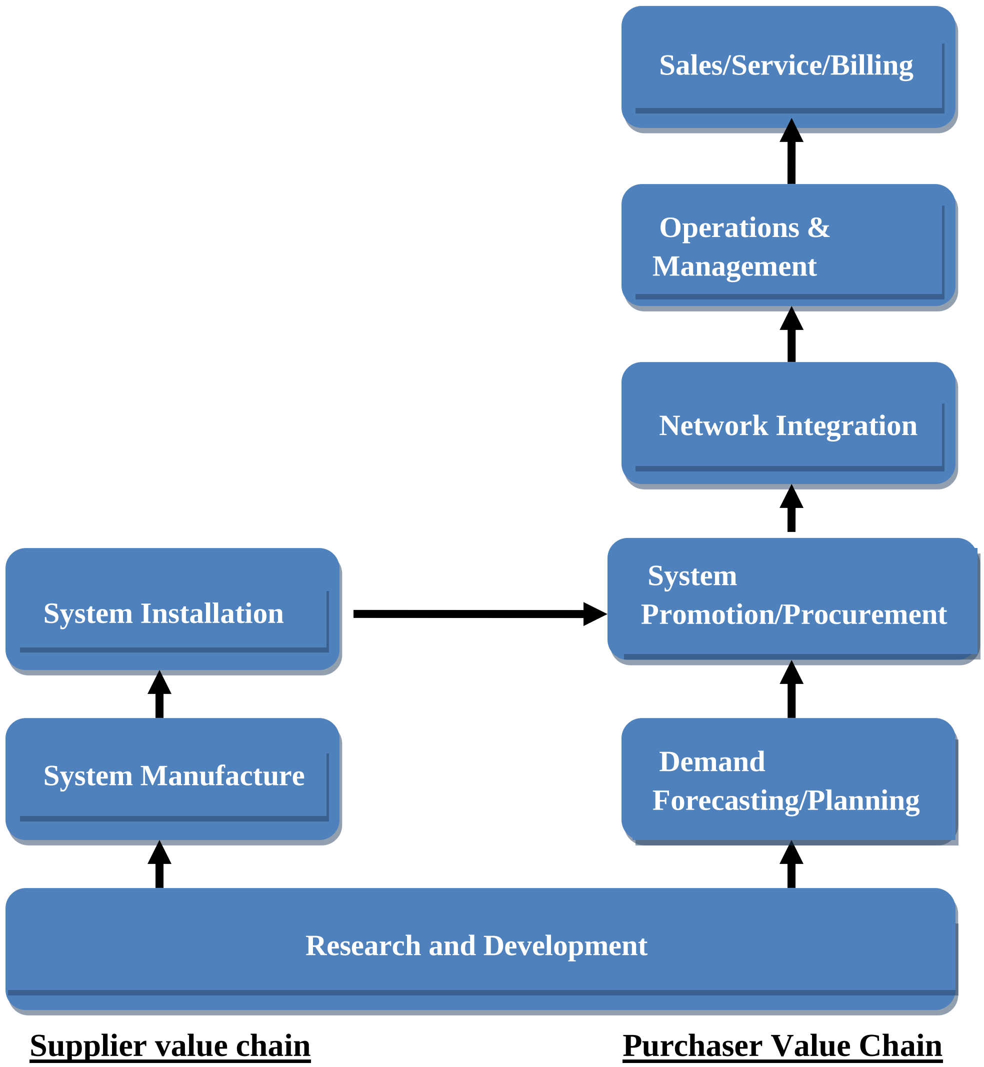


Fig 6.1 Value chain for the Asia-America Gateway project

The value chain for the AAG project shows two parts: a) Supplier value chain and b) Purchaser Value Chain. The former consists of system manufacturing followed by system installation, while the latter consists of demand forecasting/planning, followed by system promotion/procurement, network integration, operations and management, and finally sales/service and billing. Each one of these activities is implemented by members at the respective hierarchy of the AAG tier.

7.0 Key Players, Key Goal Indicators (KGI) and Key Performance Indicators (KPI):

The key players, goal indicators and performance indicators are summarized in Fig 7.1 below:

Key players	Key Goal Indicators (KGI)	Key Performance Indicators (KPI)
Governments	Meeting regulatory specifications	Certifications
Telecom companies	Meeting technical specifications	Running tests / benchmarking
Corporations	Using input to improve performance and undertake new projects	Comparing expected vs actual results
End Users	Ensure customer satisfaction in terms of bandwidth/speed	Identifying/removing performance bottlenecks
NGO's	Satisfying environmental/social constraints	CSR compliance

Fig 7.1 Key players, goal and performance indicators for the AAG project

Thus, we see that the key players are governments, telecom companies, corporations, end users and NGO's. In the case of the government, the key goal indicators for AAG include meeting the regulatory specifications set out by the former. Whether they have met these specifications can be measured via gaining certifications such as ISO 9001, ISO 14001 etc. Telecom companies would need the AAG to meet the technical specifications set out by them, and the performance would be measured by running tests and benchmarking the expected and actual results. Corporations such as Google, Facebook, Microsoft would prefer to see the AAG consortium use their input as much as possible, due to the significant investments they have poured into the project. To assess whether their investments were indeed viable, they would try comparing the expected vs actual results for their cloud based services. End users would like their needs for bandwidth/speed to be met, and this can be accomplished via the identification and removal of performance bottlenecks by IP providers. Non-Governmental Organizations (NGO's) are often concerned with corporations attending to the environmental and social constraints put forth by them. This can be accomplished via the creation and implementation of CSR policies within all AAG consortiums, and comparing the goals set out by the NGO's with those of the organization.

8.0 Strengths, Weaknesses, Opportunities, Threats (SWOT) analysis:

The SWOT analysis for the AAG is shown in Fig 8.1 below, along with a description of the same:

Strengths	Weaknesses	Opportunities	Threats
Market Leadership	Extremely strong competition resulting in limited market share	Increasing demands in emerging markets	Competitive markets
Growing customer base	Production of fibre-optic cables	Increase in demand of fibre-optic cables	Sabotage /damage
Geographic Diversity	Severe price competition affecting strategies	Growth in Chinese markets	Stringent subsidiary regulations
Product Diversity	Disparity in supplier capabilities	Aggressive investments /acquisitions	Interruptions in supply/volatility in prices
Operational efficiency via timely launches and upgrades	Cyclical demand	Positive global outlook	Foreign country risk

Fig 8.1 SWOT analysis of the AAG project

- **Strengths**:
  - **Market Leadership** - Alcatel Lucent has held 46% of the market share from 2004-2014 and is a dominant leader in the production of subsea cables.
  - **Growing customer base -** The Chinese, Australian and Singapore portions of the AAG have seen a steady increase in the demand for high-speed Internet ever since 2010. The governments, too, are extremely interested in financing the respective portions of the AAG in order to better serve the needs of their citizens.
  - **Geographic Diversity** - The AAG consortium is spread over 19 countries and is therefore geographically diverse.
  - **Product Diversity** - Different kinds of technology such as high-speed routers, repeaters, switching fabric etc are required in order to transport data at such high speeds over long distances. This allows for diversity in the products used in day-to-day operation.
  - **Operational efficiency** - Timely and efficient delivery of data packets calls for state-of the art cables and maintenance procedures that allow for the system to

work even in times of disaster. This can be accomplished via timely launches and upgrades to the AAG system while ensuring minimal disruption.

- **Weaknesses**:
  - **Strong Competition** - Strong competition amongst consortiums results in limited market share for each player, and is especially the case for weak players such as Vietnam.
  - **Production of fibre-optic cables** - Production of fibre-optic cables that support speeds in excess of 100 Tbps and work reliably in the toughest conditions requires specialized knowledge and is extremely challenging.
  - **Price competition** - Co-opetition amongst IP providers results in massive fluctuation of prices..
  - **Disparity in supplier capabilities** - Supplier capabilities are often determined by their country's GDP, their access to resources, the investment that they have put in etc. This often varies from place to place, and results in much disparity.
  - **Cyclical demand** - The demand for increase bandwidth is often cyclical and not periodic, and during downtimes is felt most acutely. This results in a spike in terms of resources, investment and materials during these times, and is relative quiet during other times.

- **Opportunities**:
  - **Emerging Markets** - Emerging markets such as Central Asia and Europe offer opportunities for strategic expansion of the AAG into these areas.
  - **Demand for fibre-optic cables** - The demand for fibre-optic cables has also seen an increase due to the need for higher speeds.
  - **Growth in Chinese markets** - Existing markets such as China have seen an unprecedented growth due to growing populations and improving economies.
  - **Aggressive investments/acquisitions** - Aggressive investments and acquisitions have often taken place amongst corporations and telecom companies to improve their strategic position in the market.
  - **Positive global outlook** - The outlook for global submarine cable market in general is positive due to advancements in technology and rise of the digital age.

- **Threats**:
  - **Competitive markets** - Competition amongst service providers and telecom companies who try to penetrate into non-native markets is a massive threat in most areas.
  - **Sabotage/damage** - Portions of the cable near Vietnam were damaged due to storms in the Pacific during the first three years of operation. Additionally, there

have been cases wherein portions of the cable have been bitten by sharks or have been cut by smugglers.

- **Stringent subsidiary regulations** - Countries such as China, Saudi Arabia often impose strict regulations with regards to advertisements and the content that can be streamed to users in their countries. This requires special effort on part of service providers to make sure that they adhere to these regulations.
- **Interruptions in supply/volatility in prices** - As mentioned previously, interruptions in supply due to sabotage or damage as well as cyclical demand may lead to ups/downs in performance.
- **Foreign country risk** - Consortium members often run the risk of public aversion and lack of government support when undertaking projects in foreign countries.

9.0 Value, Rarity, Imitability, Organizational structure for exploit (VRIO) analysis:

The VRIO analysis for the AAG is shown in Fig 9.1 below, along with a description of the same:

Resource or Capability	Valuable	Rare	Inimitable/ non-substitutable	Organized to Exploit	Impact on Competitive Advantage
Market Leadership	Yes	Yes	Yes	Yes	Sustained
Growing customer base	Yes	No	No	Yes	Parity
Geographic/ Product Diversity	Yes	Yes	Yes	Yes	Sustained
Operational Efficiency	Yes	Yes	Yes	Yes	Sustained
Cable production/ Suppliers	Yes	No	No	No	Disadvantage

Fig 9.1 VRIO analysis of the AAG project

- **Market Leadership** - Market leadership proves to be a virtue due to the fact that it is valuable, rare, inability to be imitated and the fact that it allows an organization that is a market leader to exploit market conditions. This results in a sustained competitive advantage.

- **Growing customer base** - A growing customer base proves to be a virtue due to the fact that it is valuable and the fact that it allows an organization that is a market leader to have access to a larger customer base. However, since it is not rare and can be easily imitated, it puts every member on the same pedestal and results in parity as far as competitive advantage is concerned.
- **Geographic/Product Diversity** - Geographical and product diversity proves to be a virtue as well due to the fact that it is valuable, rare, inability to be imitated and the fact that it allows an organization that is a market leader to exploit market conditions. This results in a sustained competitive advantage.
- **Operational efficiency** - Operational efficiency proves to be a virtue due to the fact that it is valuable, rare, inability to be imitated and the fact that it allows an organization that is a market leader to quickly respond to the needs of its customers and thus exploit market conditions. This results in a sustained competitive advantage.
- **Cable production/suppliers** - The production of high-quality cables, though valuable, is not unique, and can be easily imitated. Thus, it does not offer any organization the chance to exploit the market easily, and results in major competitive disadvantage for any consortium member.

10.0 Porter analysis:

The Porter analysis for the AAG is shown in Fig 10.1 on the next page, along with a description of the same:

Competitor Analysis (high)	Buyer Power (high)	Supplier Power (low)	Threat of substitutes (low)	Threat of entry (moderate)
Lots of players (large, small)	Cost of product relative to total cost	Bargaining power/price wars	Buyer propensity to substitute	Capital requirements (cost per sq. Km)
Market structure (leaders, challengers, followers)	Product differentiation	Low forward integration	Relative prices	Access to Optical Fibre Network
Increasing CAGR (China)	Buyer switching cost/ power		Quality of substitute	Low retaliation by established players
Future projects	Buyer info/ backward integration			Government regulations

Fig 10.1 Porter analysis of the AAG project

- **Competitor analysis (high)**:
  - **Lots of players** - The players in the telecommunications and subsea cable market are numerous and differing in size, from very small to very large entities.
  - **Market structure** - The structure of the market consists of leaders, who spearhead efforts in terms of R & D and investment, followed by challengers, who strive to set goals and achieve them and promote competition, followed by followers, who simply serve to do the work for the leaders and challengers.
  - **Increasing CAGR** - As Fig 10.2 shows, the CAGR for the total activated Trans-Pacific capacity has increased by 35.4% from 2007-2013. Fig 10.3 also shows that the CAGR for international internet bandwidth in the Chinese market has increased by 62% in the years 2003-2013.

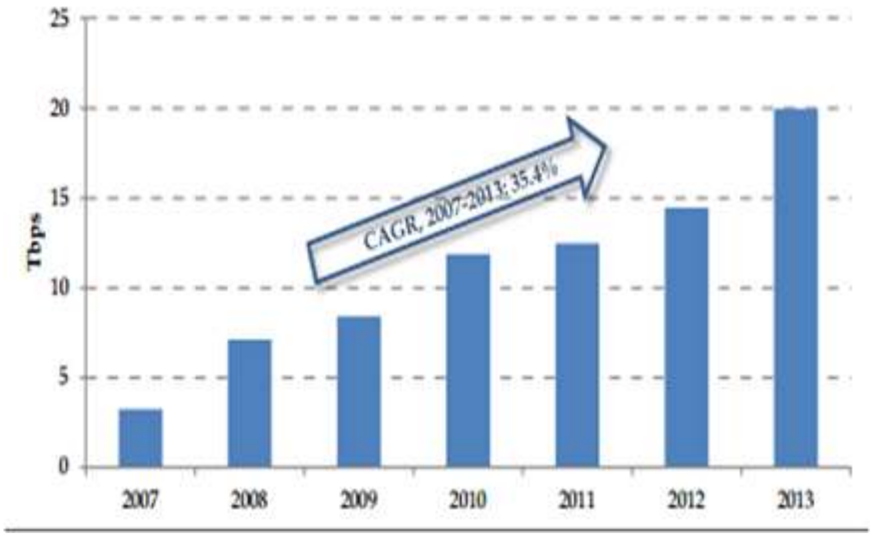


Fig 10.2 Total activated Trans-Pacific capacity (2007-2013)

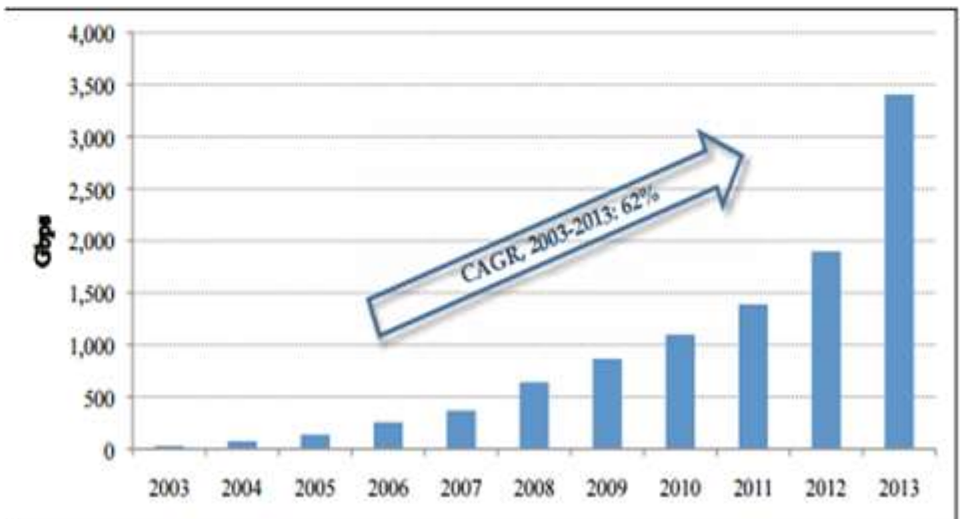


Fig 10.3 Chinese international internet bandwidth (2003-2013)

- **Future projects** - As indicated in previous sections, increasing investment, R & D, growing populations and demand for high bandwidth and speed bode well for future projects in the Trans-Pacific region.

- **Buyer power (high)** :
    - **Cost of product relative to total cost** - The cost of the end product is relatively low when compared to the cost of laying cables and setting up network infrastructure, which allows for buyers to afford these services easily.
    - **Product differentiation** - The nature and type of products offered by various telecom companies to their users varies widely in terms of features and cost.

- **Buyer cost/switching power** - Due to the variety in the products offered coupled with the costs and offers associated with the same, buyers have more options when it comes to switching between different products and companies, which increases their purchasing power.
- **Buyer info/backward integration** - Access to more options and informed buyers leads to the demand for products that easily integrate into existing devices that customers possess, while offering the services that are advertised.

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- **Supplier power (low)**:
  - **Bargaining price/price wars** - Increased buyer info and switching power have resulted in customers demanding more for lesser costs, which prompt companies to encourage in price wars and artificially increase/lower costs to stifle competition.
  - **Low forward integration** - Products from different suppliers do not work with each other for the end consumer, which forces the latter to stick to one supplier only.

- **Threat of substitutes (low)**:
  - **Buyer propensity to substitute** - Increased buyer info and wide range of prices leads to the threat of buyers looking for cheaper alternatives to meet their demands.
  - **Relative prices** - The relative prices of the internet and content streamed on the same widely differ between the small and big players, but are almost similar within these levels.
  - **Quality of substitute** - Although many options are available, the quality of service offered for the same as well as their reliability is often subject to question and can prove to be a deterrent when switching from large players to smaller ones.

- **Threat of entry (moderate)**:
  - **Capital requirements** - The cost of laying cables per square kilometre varies greatly, and is often more in areas closer to the Pacific, where environmental threats are the greatest and call for more reliability in services
  - **Access to Optical Fibre Network** - Access to the network could be denied due to sabotage or attacks as identified previously. This could also be undertaken by competitors within or across consortiums in a manner similar to DoS (*Denial-of-Service*) attacks.
  - **Low retaliation by established players** - Larger players would prefer to not waste their resources on preventing smaller players from entering the market. This could arise due to complacency (they are confident that they cannot be

overthrown easily) or due to the fact that they continually innovate via R&D. Fig 10.4 shows the dominant players in the Chinese Internet market in 2014, and we see that the two major players (China Telecom and China Unicom) control nearly 89% of the market share.

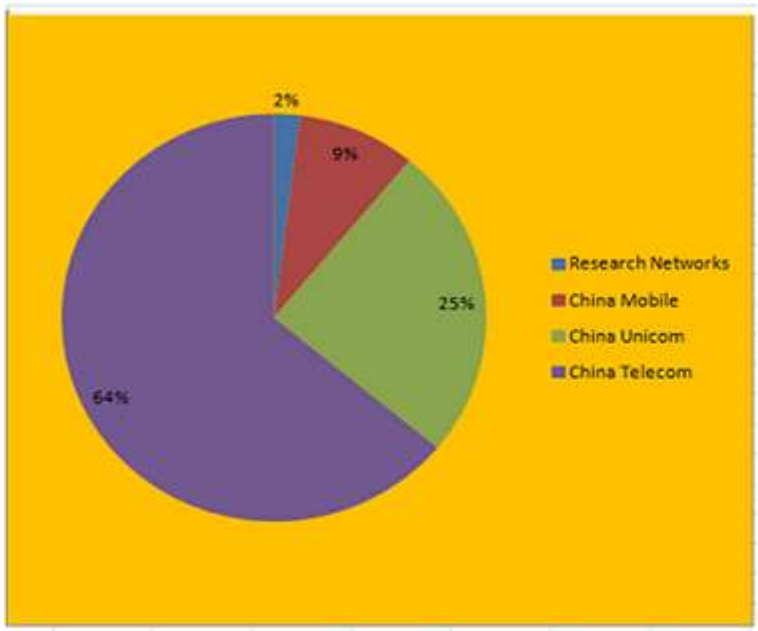

Fig 10.4 Chinese operator's share of Chinese international bandwidth, 2014

- **Government regulations** - As identified previously, various governments can enforce regulations with regards to pricing, content as well as the nature of business activities conducted by consortium members and their affiliates.

11.0 Marketing mix:

The marketing mix analysis for the AAG is shown in Fig 11.1 below, along with a description of the same:

Product	Price	Promotion	Place
SONET/SDH	Competitive /Skimming	Advertising	Channel marketing (sales and service dealers, modern retail and distributors)
Wavelength	Competitive /Skimming	Sales tactics (festive/non-festive)	Showrooms
Ethernet	Competitive /Skimming	Offers/discounts to trade partners to sell above competition	Regional distributors
Fibre optic cables/bandwidth/ speed/cloud solutions	Competitive /Skimming	Push/Pull	Emerging markets consulting
Protocols (Link, Physical)	Fixed		

Fig 11.1 Marketing mix analysis of the AAG project

- **Product** - The product line of AAG includes SONET/SDH, as well was wavelength and Ethernet based products. In addition, cloud solutions as well as different protocols that operate at the link and physical layers are also available.
- **Price** - Three different pricing strategies are followed by the AAG's members. Fixed pricing is used when the cost of products is estimated upfront and usually does not change during the life-cycle of the project. Competitive pricing is used when service providers and telecom companies compete with each other. Skimming is used mostly by market leaders and consists of raising the prices when a product initially enters the market. The price is lowered if the product becomes old, or when competitors introduce their own products into the market.
- **Promotion** - A variety of tactics are used for product promotions. They include advertising, special offers during festive or non-festive times, discounts to trade partners to sell above competition, as well as push/pull strategies.
- **Place** - The marketing of products is conducted at various locations. These included showrooms, regional, sales and factory distribution outlets amongst others. Consulting for emerging markets in Central Asia and Europe has also opened up avenues for setting up offices and conducting business operations in these regions.

12.0 International strategies:

The international strategies adopted in the major transit hubs of the AAG system are described in Sec. 19 below.

13.0 Political systems:

The effects of the political systems in the countries which have the major transit hubs is described in Sec 19. below

14.0 Legal systems:

The legal systems of countries do not have any bearing on the operations of the AAG and are therefore not touched upon here

15.0 Accounting and tax treatments:

The accounting and tax systems of countries do not have any major bearing on the operations of the AAG i.e customers pay taxes on the services they use, which is the standard practice all over the world. It is therefore not described here.

16.0 Economic systems:

The economics behind pricing and the reasons for the same in the major transit hubs of the AAG system are described in Sec. 19 below.

17.0 Culture, Ethics and norms:

The culture, ethics and norms of countries do not have any bearing on the operations of the AAG and are therefore not touched upon here

18.0 Exit Strategy:

In the case of project failures and the inability to recover losses, the exit strategy for the AAG would involve the following:

- Deciding whether to scale/cut down operations,
- If transfer of control is necessary, who should it be given to,
- Deciding on which assets should be sold/withheld,
- Resolution of pending disputes/court cases, if any
- Negotiations with the government in the country where operations have suffered
- Backup plans for new operations in potential countries or regions of interest to cover losses.

19.0 Advantages/Disadvantages of having presence in countries :

Since the AAG is a global operation which spans more than 19 countries, it is important to assess the advantages or disadvantages of providing services early on. The key areas of interest are often the transit hubs , which is where traffic flows across the boundaries demarcated by geographical, political, social and economic factors. To this end, four countries (China, India, Australia and Singapore) have been chosen as potential candidates for the analysis of the above. The results for the same are shown in Fig 19.1 below:

Country	Demand	Pricing	Advantages	Disadvantages
China	High	$17.8/month	Government intent on lowering broadband prices, robust FTTx market of 25m	DSL dominant, trailing Japan (1.4 Tbps vs 2 Tbps)
India	High	$6.1/month	Strong middle-class	Regulatory uncertainty, weak coverage, costs
Australia	Moderate	$39.3/month	Disruptive technology	Limited carriers
Singapore	High	$59.90/month	Next-gen NBN technology	Mixed demand

Fig 19.1 Advantages/Disadvantages of having presence in certain countries

:In China, India and Singapore for example, the demand is high due to the growing population. The pricing strategy, however, varies widely. The cost per month is $17.8 in China and $6.1 in India, while it is almost 3x as much in Singapore ($59.90) when compared to China and 15x when compared to India due to the fact that Singapore serves as a major traffic hub for traffic headed west to Asia and traffic headed east to Australia, New Zealand and the United States. The cost for setting up a cross-transportation is therefore very high in Singapore. In China, the main advantages are that the government has a lot of interest in lowering broadband prices, coupled with the fact that China has a robust FTTx market of 25 million. The disadvantage in China is that fact that DSL is more dominant in China presently than broadband, which results in China trailing its neighbor Japan when it comes to network speed (1.4 Tbps in China vs 2 Tbps in Japan). In India for example, the growth on fibre-optic networks has been fuelled by the presence of a strong middle-class, which can afford the costs associated with the former, The disadvantages are the uncertainty in regulations proposed by the governments (state and central), followed by weak coverage and high transmission costs imposed by government and telecom authorities. The advantages in Singapore, on the other hand, are easy access to next generation NBN (National Broadband Network) technologies created by emerging companies. The major disadvantage, as identified earlier, is the mixed demand for Internet content, that results in more emphasis being placed on external rather than internal markets, making the availability of NBN technologies which could be used to improve internal infrastructure relatively useless. Australia, on the other hand, poses a different set of challenges. The demand is moderate due to its sparse population, as well as the closed outlook of the Australians when it comes to adopting new technologies. The pricing is relatively high for such a small population ($39.3 per month) which is a major sore point for most Australians. Furthermore, there are a limited number of carriers in Australia who can support the need for high-speed Internet. However, as this is a disruptive technology, the hope is that it would be better accepted in the future and that there would be room for growth in the Australian markets.

20.0 Financial numbers, needs and capital structure of the AAG:

As in any large infrastructure project, submarine cable projects require heavy upfront CAPEX investment with the ongoing operational expenditure being relatively low (usually less than 6% of the CAPEX per annum) which should be funded by cash inflows generated by the project. In general the funding requirement for this type of project could be split into two categories:

Pre Ready For Service (RFS) date:

- **Cable build CAPEX**, payable to the main manufacture and cable installation supplier and other contractors involved in project management of the build
- **Operational and team costs** during the cable build phase, including any presales and marketing expense during the build phase
- **Payments required to secure IRU onward capacity** needed for the end to end circuits (if applicable)

Post RFS date:

- **Ongoing operational costs** until the cash-flow from the capacity sales covers the OPEX of the company.

The typical build timeframes for submarine cables would be in the region of one to three years depending on the cable length and the complexity of the marine operations. The actual payment curve could widely differentiate from the planned payment schedule. Fig's 20.1 and 20.2 below show the difference between the planned and the actual cumulative cable build CAPEX profile for the AAG, as well as OPEX projections as a percentage of cumulative CAPEX. The cable OPEX is dependent on a number of factors such as technical choices, operational and restoration strategy.

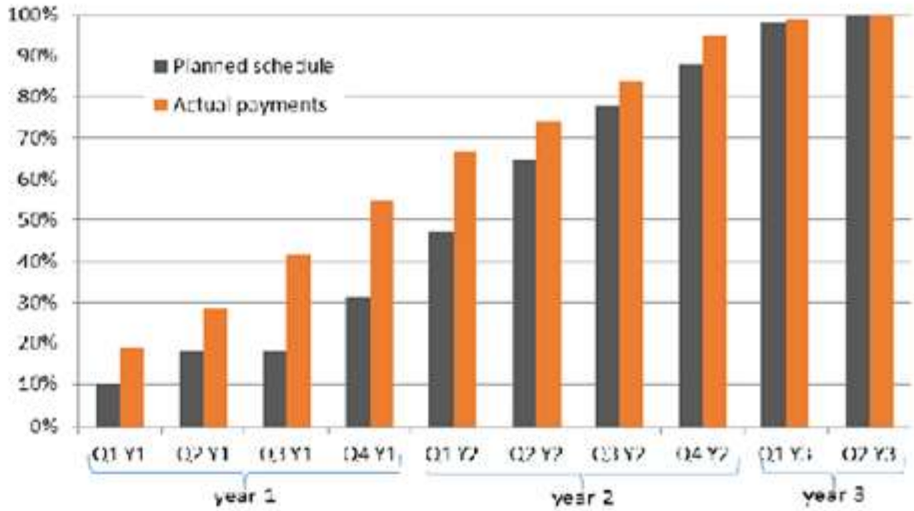

Fig 20.1 Cumulative CAPEX build schedule for the AAG

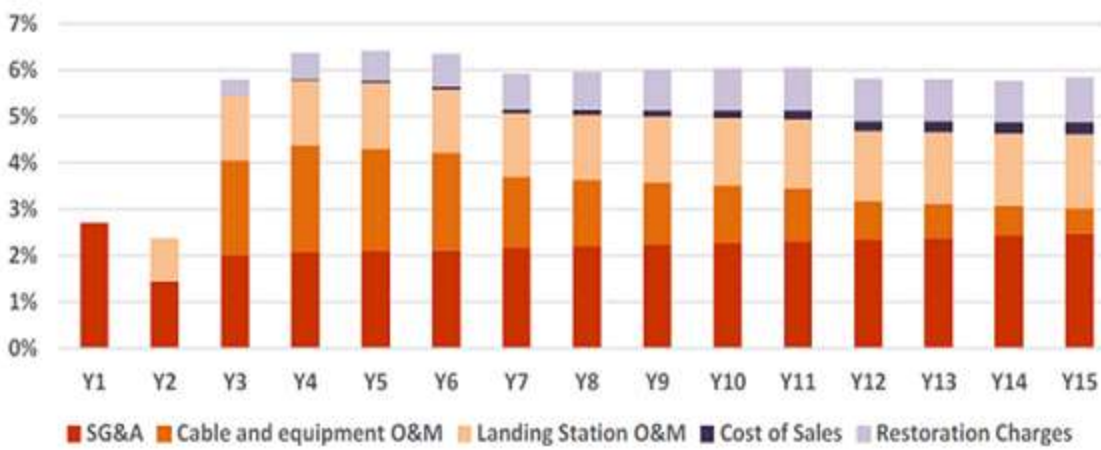

Fig 20.2 OPEX projections for the AAG as a percentage of cumulative CAPEX

Based on the above, any new submarine cable venture will need significant funding well before generating any revenues, as RFS date could be fairly far from initial rollout. Some of these funds might come from a pre-sales activity and down-payments of landing partners and some need to be secured through other means. Figs 20.3 and 20.4 below show traditional and new forms of ownership financing for the AAG project. It is heartening to note for prospective investors that private-investor led financing increased from 7% to 21% in recent times (a 3x increase) which bodes well for the industry as well as for corporations and individuals who have or will invest in these projects in the future.

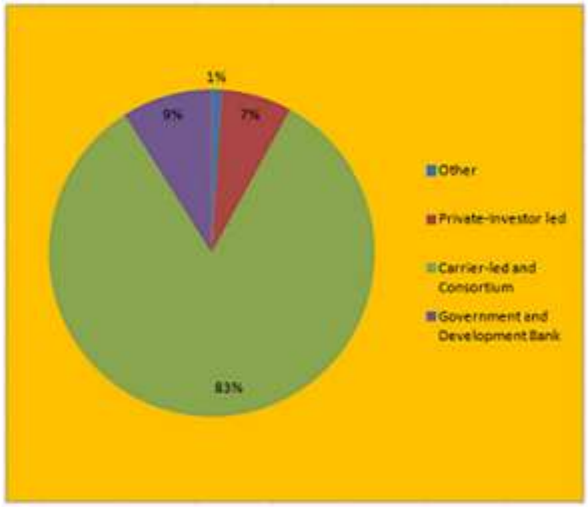

Fig 20.3 Ownership financing for the AAG (traditional)

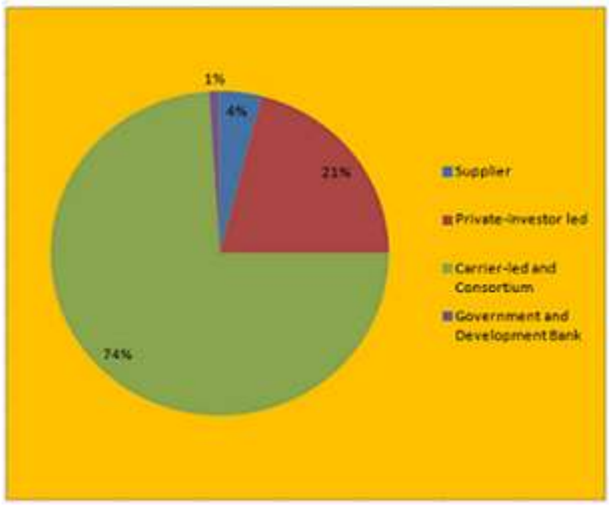

Fig 20.4 Ownership financing for the AAG (recent)

A look at the financial statements of Alcatel-Lucent, the market leader in the subsea cable industry reveals that its breakeven point is generally accomplished five years after initial investments. The year-to-returns for 2013 also indicate that the returns for Alcatel-Lucent are more (2.24x) when compared to its nearest competitor (Nokia). This shows that it is necessary for established players to have a strong footing when entering the market to ensure continued success. Fig 20.5 shows the financial statement for Alcatel-Lucent for 2014, while Fig 20.6 shows the operating cash flow for 2014. Fig 20.7 shows the year-to-date returns for the four major players in the subsea cable market for the year 2013.

Fiscal year is Jan - Dec.	2014	2013	2012	2011	2010	2009 »
Alcatel Lucent Net Income Cash Flow	**-156.85M**	**-1.8B**	**-1.81B**	**1.42B**	**-443M**	**-730.98M**
Depreciation Depletion Amortization Cash-Flow	-	-	-	-	-	-
Net Increase (Decrease) in Assets Liabilities	-218M	-26M	215M	-229M	13M	657.04M
Cash From (used in) Discontinued Operations	45.19M	-16M	-	122M	-	160.42M
Other Adjustments Net	543.68M	1.64B	1.47B	-1.29B	263M	66.96M
Alcatel Lucent Net Cash from (used by) Operating Activities	**214.02M**	**-202M**	**-128M**	**25M**	**-167M**	**153.45M**
Increase (Decrease) in Prop Plant And Equipment	-735.09M	-728M	-767M	-660M	-918M	-929.07M
Acquisition Disposition of Subsidiaires	178.12M	5M	39M	-21M	-	-15.34M
Increase (Decrease) in Investments	820.17M	25M	17M	-363M	-	-1.48B
Other Cash Inflow (Outflow) from Investment Activities	147.55M	-946M	-746M	9M	2.12B	2.46B
Alcatel Lucent Net Cash from (used by) Invesment Activities	**406.76M**	**-1.64B**	**-1.46B**	**-1.04B**	**1.2B**	**37.66M**
Issuance (Purchase) of Equity Shares	39.87M	-	-	-	-	-
Issuance (Repayment) of Debt Securities	-1.9B	2.79B	-143M	-1.13B	183M	-220.41M
Increase (Decrease) in Bank & Other Borrowings	155.52M	-914M	-62M	3M	390M	-118.57M
Payment of Dividends & Other Cash Distributions	-15.95M	-14M	-49M	-107M	-5M	-5.58M
Other Cash from (used by) Financing Activities	-59.81M	1.34B	257M	-85M	-5M	-
Alcatel Lucent Net Cash from (used by) Financing Activities	**-1.78B**	**3.21B**	**3M**	**-1.32B**	**563M**	**-344.56M**
Effect of Exchange Rate Changes on Cash	-	-401M	30M	269M	348M	-
Alcatel Lucent Net Change in Cash & Cash Equivalents	**-289.78M**	**958M**	**-188M**	**-1.95B**	**1.94B**	**-153.45M**
Cash & Equivalents at Beginning of Year	5.44B	4.69B	4.67B	6.54B	4.75B	5.14B

Fig 20.5 Financial statement of Alcatel-Lucent from 2014

Fig 20.6 Operating Cash Flows (Alcatel-Lucent) from 2014

Fig 20.7 Year-to-date returns for major subsea cable industry players for 2013

There are various options for ownership and funding structures that could be considered as explained above. Each new subsea venture that is undertaken in the AAG should seek to balance the following strategic levers according to the objectives it aims to achieve:

- Maximise financial returns for the initial shareholders
- Minimise upfront funding commitments
- Manage the right level of management control
- Limit exposure and gain early solution of various regulatory limitations
- Gather appropriate political influence
- De-risk the business case by achieving some pre-commitment from landing partners and down payment for the pre-commitment
- Partner with a transit capacity provider SPV for onward routes
- Leverage by debt funding, calculating optimal leverage through financial engineering
- Balance leveraging of the project versus leveraging shareholders/consortium members

The specific analysis that each project initiator will have to go through could results in a hybrid model where ownership is split between an SPV of private/public investors and indirect users of capacity. Additional partners can be brought to the project following different types of agreements:

- Landing parties with minority equity in the project
- Large accounts with preferential rates against commitment and upfront payments
- Financial institutions as passive investors
- Government entities for local support

In any case, the structure of the project, as well as its financing must be addressed very early, as these are keys to the success of a submarine cable venture, even before a stable business plan, as history has shown in the major project failures.

21.0 Risk Assessment and Allocation:

The following section describes various methods of risk assessment and allocation using the appropriate contingency measures [8]:

Cable faults:

- **Causes:**
  - ➢ Fishing gear types that contact the sea bed are the primary sources of cable faults.
  - ➢ Recent developments in AIS and vessel tracking show that ship anchors are a more significant cause of cable faults that previously thought.
  - ➢ Dredging operations, seismic activity, catastrophic weather, theft, abrasion from cable movement due to hard sea bed and strong undersea currents also result in cable faults.

- **Contingency measures:**
  - ➢ A strategic, multi-layer adaptive approach needs to be adopted.
  - ➢ Prevention - concentration on what causes majority of problems.
  - ➢ Regulatory approach.
  - ➢ Generate awareness of problems
  - ➢ Resilient networks (system view & response)
  - ➢ Collaboration between industry, government and university
  - ➢ Strategic maintenance approach.

Fig 21.1 below shows a risk assessment factor template used for the AAG.

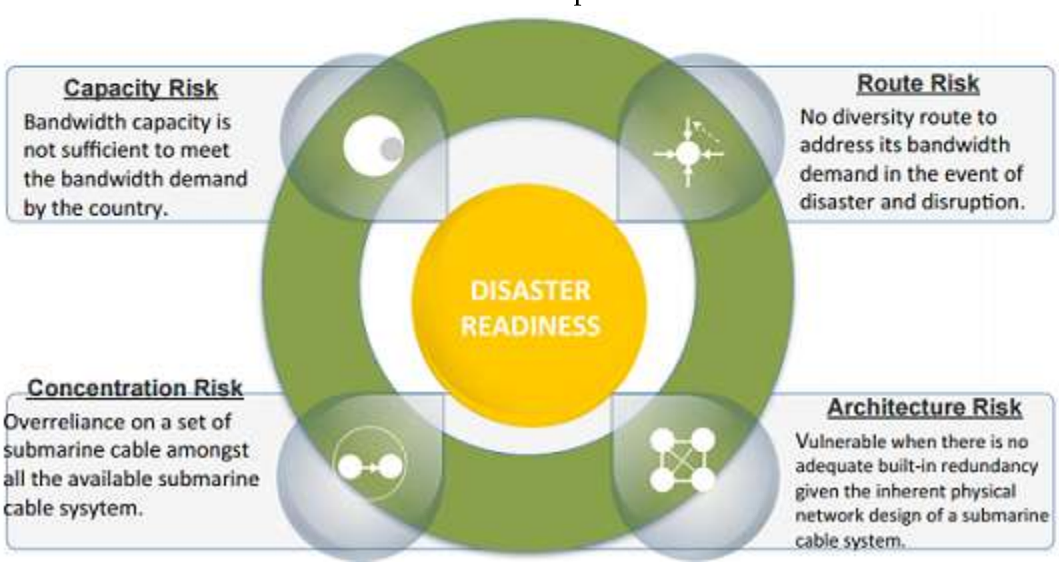

Fig 21.1 Risk Assessment template used for the AAG

A proper risk assessment also involves estimating the level of risk and determining the action that needs to be taken for the same. Fig 21.2 shows the same for the AAG:

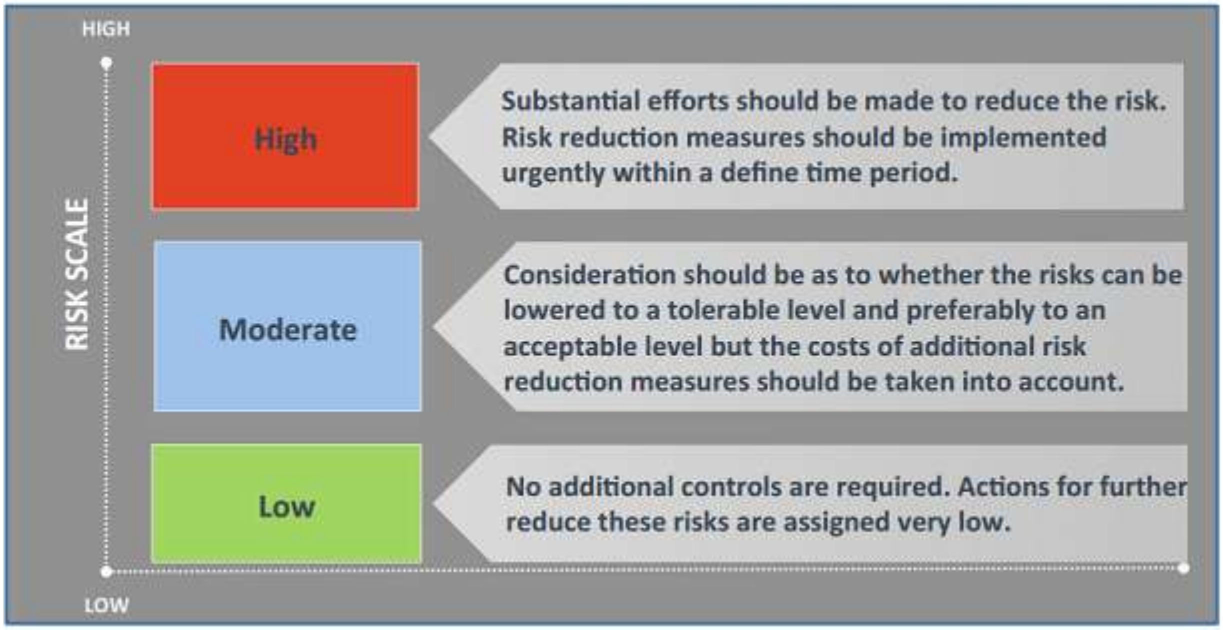

Fig 21.2 Assessment of risk levels for various types or risk for the AAG

Fig 21.3 shows an assessment of the risk levels for years 2008 to 2013 and beyond for the AAG.

YEAR	CAPACITY RISK	ROUTE RISK	CONCENTRATI ON RISK	ARCHITECTUR E RISK
2008	Low	Low	Moderate	Moderate
2009	Low	Low	Moderate	Moderate
2010	Low	Low	Moderate	Moderate
2011	Moderate	Low	Moderate	Moderate
2012	High	Low	Moderate	Moderate
2013 and beyond	Moderate	Low	Low	Moderate

Fig 21.3 Risk Assessment from 2008 to 2013 and beyond for the AAG

Risk prevention in general consists of a combination of risk reduction, preparedness and response to recovery. This can be accomplished via the creation of a risk reduction framework which allows for the identification and resolution of risk at various levels of the project and from various stakeholders. Fig 21.4 shows the risk prevention framework adopted for the AAG project.

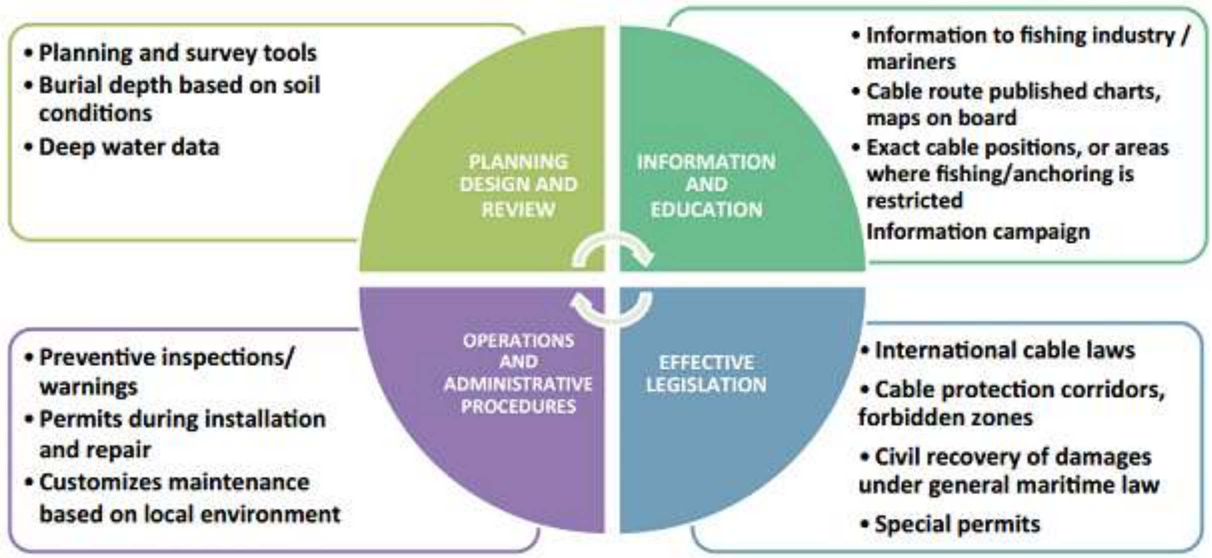

Fig 21.4 Risk prevention framework adopted for the AAG project

Another risk evaluation technique that is adopted is risk mitigation, This technique tries to simultaneously evaluate the probability and impact of risk at the same time so as to classify the risk levels. Fig 21.5 shows a risk impact/probability chart template used for the AAG:

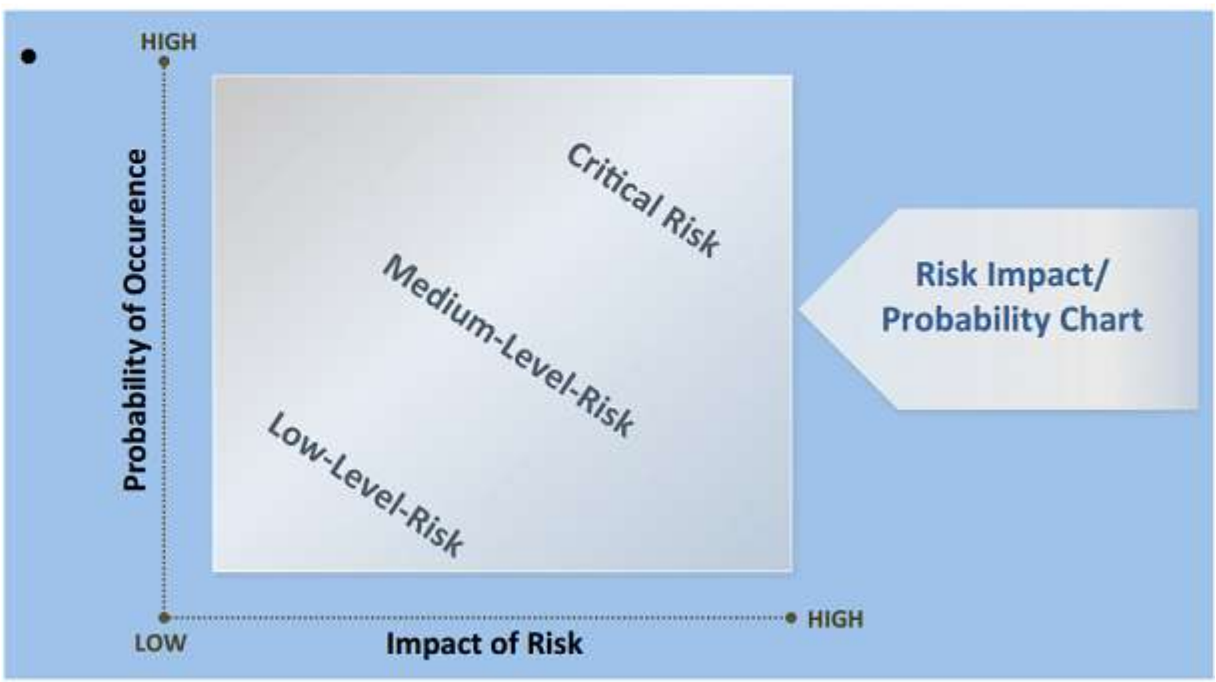

Fig 21.5 Risk Impact/Probability Chart for risk mitigation analysis

Based on all the above approaches, here are the rules that the government and the regulators have put forth for themselves and the consortium members for smooth operation of the AAG:

- Eliminating permit requirements for repairs to international cables beyond territorial seas jurisdictional claims
- Expediting the permitting process inside territorial seas to an agreed-upon regional or international protocol
- According cable repair ships innocent passage status for the purpose of undertaking repairs in territorial seas & flexibility in operational area after repair has begun
- Educating fishermen and mariners to avoid interference during cable operations and to comply with international law requiring 1-mile clearance from working cable ships
- Ensuring that laws and regulations protecting cable security are enforced
- Facilitating repair of international cables in a spirit of cooperation for the mutual benefit of all nations and users of communication infrastructure.

In addition, the following rules have been enforced on cable operators as well as submarine operators who are involved in the laying of undersea cables for the AAG project:

- Correct information about the cable route (cable record) must be collected and stored by the cable operator.
- Information about all submarine cables must be given to the institute responsible for updating charts
- Updated charts must be present on vessels
- Marine officers and pilots must be familiar with local conditions and who to contact in case of emergency conditions.
- Fishermen must have updated charts on board their vessels and must know the location of submarine cables.
- Fishermen must act correctly when it comes to forbidden zones
- Fishermen must know whom to contact in case they hit a submarine cable.
- The cable operator must know how to act when the submarine cable has been hit by an anchor or fishing gear.

Fig 21.6 on the next page shows an example of contingency planning adopted by the consortium members in the AAG project based on the risk management concepts explained above:

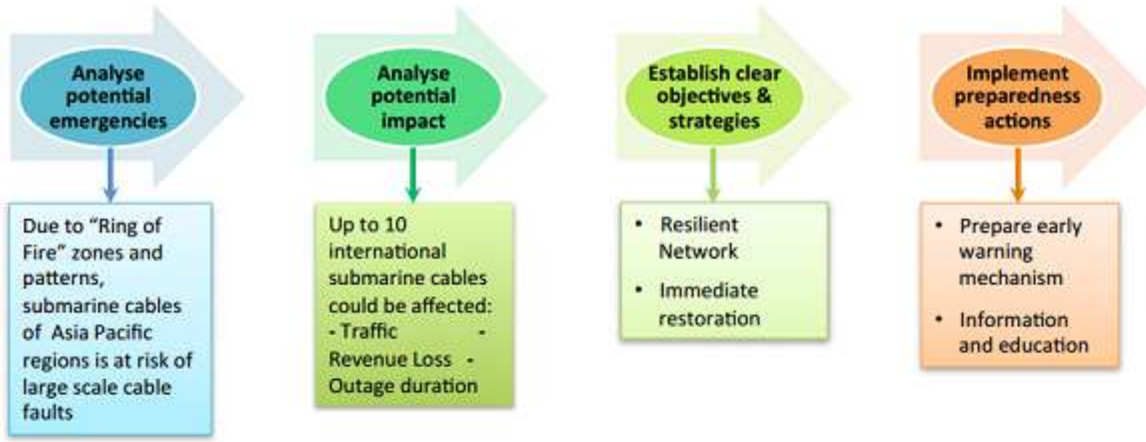

Fig 21.6 Example contingency planning adopted by members of the AAG project

Financial and expropriation risks are encountered at specific levels in the project and vary from country to country. The decisions that are taken when these situations are encountered are similar to those identified in Sec 18.0 above.

22. Conclusion:

After a quarter-century of linking continents, the transoceanic fiber optic communications industry has seemingly found its comfort zone. It is unlikely to ever return to the $10 billion levels of annual investment that accompanied the dot-com bubble, but it is also unlikely to encounter the widespread bankruptcies, fire sales, and shuttering of cable factories that followed the bubble's burst. Instead, having learned from the not-so-distant past, the submarine communications industry is one that is well-informed, innovative, and versatile, implementing practical solutions in a marketplace that has proven to be increasingly demanding in terms of connectivity, reliability, and cost-effectiveness. Slowly but surely, the submarine communications industry has linked almost all of the world's coastal nations, with fewer than 15 of the world's countries and territories lacking international fiber connections. And as the submarine industry has risen to the challenge of providing near-ubiquitous international connectivity, the industry's partners, both public and private, have also made greater strides in democratizing end-users' access to bandwidth, through better regulation of international gateways, competitive backhaul networks, and stronger broadband access infrastructure. Although challenges remain, the efficiencies offered by the submarine communications industry continue to improve the lives of communities in all regions of the globe. Submarine cables play an integral role in international economic cooperation and social development, providing terabits of reliable capacity between the world's major economies while also enabling critical applications in developing countries including telemedicine and e-learning. And with the industry in the process of implementing 100-gigabit wavelengths across nearly all of its transoceanic routes, a new era of connectivity based development may be imminent. Hence, the submarine communications industry is uniquely positioned to rise to the occasion.

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