Project Preparation Consultancy for the Malawi Communication Infrastructure Project (MCIP)

FINAL REPORT
19 OCTOBER 2009

ANDERS ENGVALL

1 Executive Summary

1.1 Introduction

The Government of the Republic of Malawi (GoM) is formulating activities to be financed through a grant under the World Bank Regional Communications Infrastructure Program (RCIP). The specific objective of the RCIP in Malawi is to promote the availability and usage of affordable broadband services across the country. In particular, the project will make low-cost international connectivity available to the market. The services will be provided through the private sector, hence stimulating private investment, competition and overall sector development.

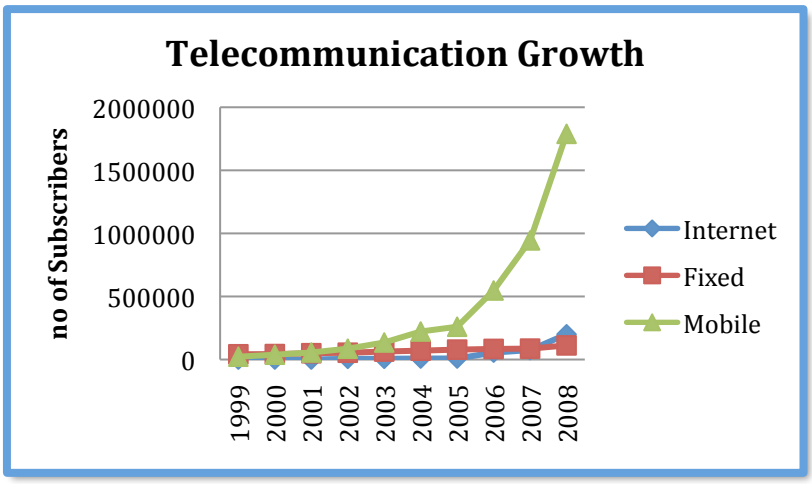
The GoM decided to procure consultant services to help in preparing the MCIP, with the objective to analyse:

- Technical alternatives for access to submarine cables
- Financial analysis of proposed routes
- Suggesting options for ownership, operation, regulation and enforcing of open-access to the proposed network

1.2 Present Situation

The telecommunications sector has developed rapidly over the last two years and by the end of 2009, 95 percent of the population will be in the coverage areas of both voice and Internet services (at speeds below 100 Kbps). The use of broadband services will remain very limited, however, due to high costs of international bandwidth, and the majority of the population cannot afford the cost of Internet services.

Thanks to competition in the market, there is no longer any lack of domestic backbone infrastructure. There are several parallel backbone links across Malawi and backbone networks from most operators serve all major cities.

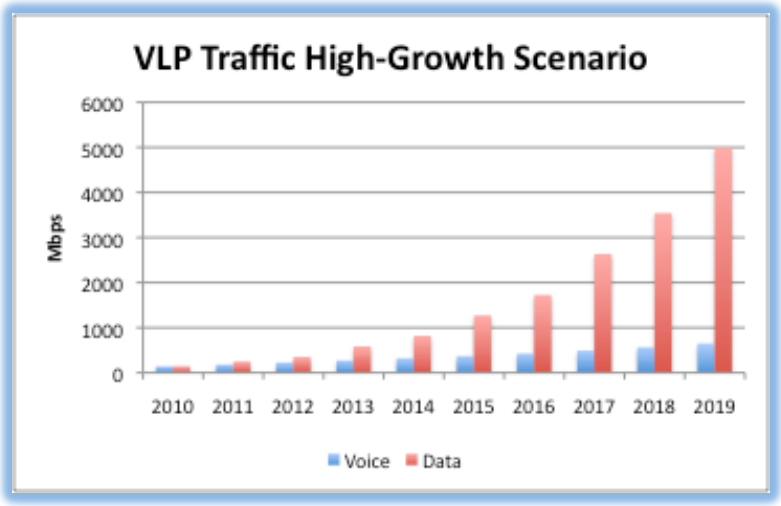


In summary, Malawi is well braced for the introduction of data services on a large scale and Internet services will take off once low-cost international bandwidth becomes available.

1.3 Traffic Forecasts

Two traffic scenarios are presented in the report; a low-growth and high-growth scenario. Assumptions on the price of international bandwidth are the main difference between them.

A comparison of the high and low growth scenarios clearly demonstrates that data services are very price elastic and that low cost bandwidth is necessary for the data services to take off on a large scale. International voice services are far less price sensitive and there is hardly any difference between the two scenarios.



Recent studies by Scanbi-Invest on backbone networks showed that lack of backbone facilities have had very limited impact on the development of voice services. In Sub-Saharan Africa, the mobile industry has completely captured the voice market, in urban as well as in rural areas. With modern soft switching, the cost of the transmission component is very small in relation to total operating costs of a mobile operator. This situation applies even to international calls via satellite links.

1.4 Alternatives International Connectivity

The main challenge for Malawi is obtain international bandwidth capacity at low prices. One way of achieving this would be to establish a "virtual landing point" in Malawi jointly by the operators. The principle of a virtual landing point (VLP) is essentially an international access point open to all licensed operators on transparent and equal terms. The virtual landing point would for all commercial purposes be equal to an actual physical landing point of the submarine cable.

Technically, the most feasible alternative would be to use TDM's fibre link to Maputo in Mozambique. It is, however, expected that TDM's rates will be prohibitively expensive, mainly due to its need to earn a financial return on its extensive investments in backbone networks. This means that alternatives need to be sought to the TDM route in order to be in a better negotiating position. A route to Dar-es-Salaam would be an ideal complement to the Maputo landing station.

1.4.1 VLP Connection to Maputo

This alternative would have a very short implementation time. Most of the fibre routs are already operational and the ready for service dates would be even before SECOM has commissioned its Mombasa landing point. In addition, TDM is an efficient operator that has extensive experience of operating fibre networks, both terrestrial and submarine cables.

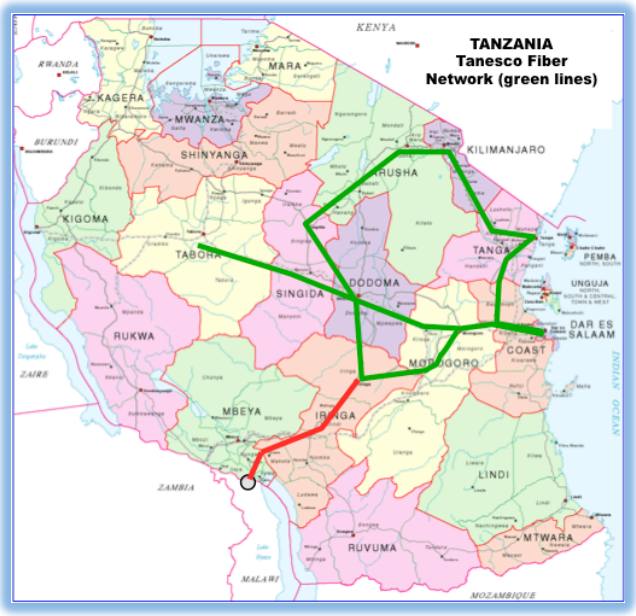
The route Blantyre – Tete needs to be secured via geographic diversity with another independent fibre link to the landing points. An interesting solution for securing the VLP South alternative is to construct a fibre link from Mangochi to Lichinga, a distance of 190 km. TDM

has no security for its fibre network for the area north of Qelimane, representing almost half of Mozambique. The Mangochi-Lichinga route would reduce the unprotected area by half, and thus be very attractive to TDM.

1.4.2 VLP Connection to Dar-es-Salaam

There is optical fibre on the Tanesco power lines from Iringa to Dar-es-Salaam. This line is operational and the Government of Tanzania recently decided that the Tanesco network should be part of the national backbone network. The Government has embarked on a major expansion of the Tanzanian backbone network financed by China. Priority has been placed on interconnection to neighbouring countries.

The preliminary maps received from the Tanzanian authorities show a spur route from Iringa to the Malawi border and that this link is included in the phase 1 of the project. The ready for service date was indicated to June 2009 during our Tanzania visit.



The main issue for the VLP North Alternative will be how to obtain geographic diversity for a connection to Dar-es-Salaam. Since full security would be very expensive, it is proposed that temporary solutions are sought until Tanzania eventually constructs a national backbone fibre network.

To make the VLP North alternative available earlier, some temporary solutions could be taken by focusing on the initial years only. The bandwidth demand for international data services is expected be below 300 Mbps until the end of 2011. This capacity can be provided by microwave, since it only represents two STM1 channels. Considering that 300 Mbps satellite capacity would cost around USD 10 million per year, it is obvious that this temporary microwave solution would pay off very quickly and be extremely profitable. There are microwave links in Tanzania that could be upgraded to enable Malawi to reach the landing point in Dar-es-Salaam.

1.4.3 Cost Estimates

The cost estimates for the three studied alternatives are based on recent tenders in the region and are summarized in this table. Two VLPs are proposed for redundancy purposes and are the same for all alternatives.

USD '000	*VLP South*	*VLP North with Tanesco fibre*
Costs 2 VLPs	2,530	2,530
Fibre costs	11,410	13,810
Mirowave costs	0	2,030
Total costs	13,940	18,370

1.5 Financial Analysis

The financial analysis has been carried out by comparing the alternate costs of staying on satellite with the costs of the VLP solutions. This will give a margin between the two solutions that can be used as an indication on the profitability of the VLP alternatives.

The table below shows the costs of being land-locked – the shown bandwidth costs represents the necessary mark-up for reaching the coast and to make the VLP commercially identical to a physical landing point.

Alternative:	*VLP South*		*VLP North with Tanesco fibre*	
Traffic:	*Low*	*High*	*Low*	*High*
Bandwidth costs in USD per Mbps/month	**288**	**163**	**380**	**215**

A financial evaluation was made to establish the margin (expressed in Mbps/month) for the different alternatives. The competition with three submarine cable operators have resulted in low bandwidth costs at the landing stations.

Alternative	*VLP South*		*VLP North with Tanesco fibre*	
Traffic estimates	*Low*	*High*	*Low*	*High*
Satellite	**3,000**	**3,000**	**3,000**	**3,000**
VLP to Landing point	*288*	*163*	*380*	*215*
Landing point	*250*	*250*	*250*	*250*
Price VLP	**538**	**413**	**630**	**465**
Price difference	**2,462**	**2,587**	**2,370**	**2,535**

The table above shows that savings in satellite bills (expressed in Mbps/month) for consumed bandwidth would be substantial. Investment costs are a fraction of the savings over time and the key focus should be to find a solution as soon as possible.

The results from the financial analysis clearly show that there is much room for manoeuvre, which would provide profits for all parties involved (both the bandwidth suppliers and the VLP customers). The main beneficiaries, however, would be the public at large that would get access to the international Internet cloud at reasonable prices.

1.6 Project structure

The Government of Tanzania is considering creating one national backbone network that is fibre based and operated on a monopoly basis. In the first phase, the core of this network is the existing fibre on Tanesco's power lines, plus new buried fibre links to its neighbouring countries.

Before launching the tender for international bandwidth recommended in this report, we suggest that the Malawi Government enter into bilateral discussions with their Tanzanian counterparts to explore whether a mutually beneficial solution could be reached.

The report recommends that the Government launch a tender for the supply of broadband capacity from the landing points to be offered at two VLPs in Blantyre and Lilongwe. The tender should be for a specified minimum capacity over the next three to five years, which would correspond to the total market requirement in Malawi. The Government would sign a long-term purchasing agreement with the winning bidder for its own needs only. The winner would have to find its own customers for the remaining capacity.

The tender would awarded to the bidder offering the lowest bandwidth price, but subject to the bid meeting a number of conditions specified in the tender documents; the price will be for all potential customers, not only the Government. The winning bidder would own the infrastructure and be fully responsible for operations.

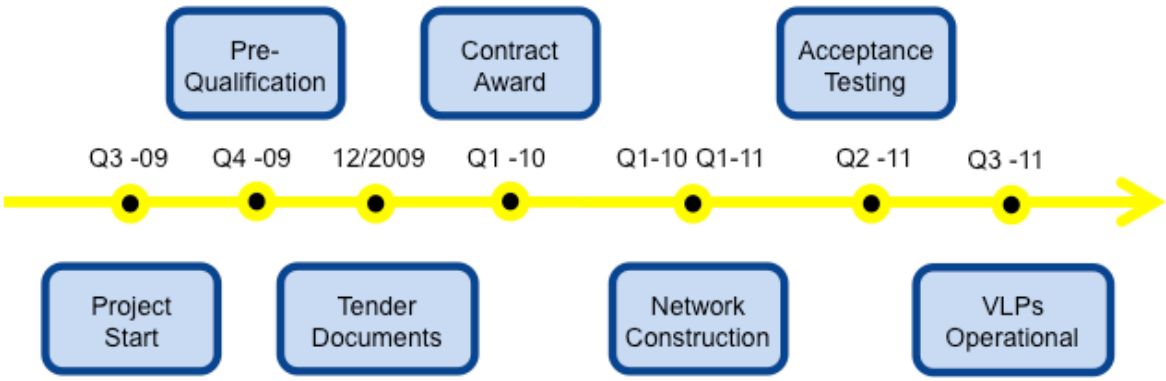
The tender documents should include all licensing conditions that should be approved by MACRA in advance of issuing the tender. MACRA will represent the Government in supervising that the bidder implements the project in accordance with the tender conditions as well as operates within the limits of the VLP license.

If the national operators set up jointly the VLP, there is a risk that this will result in reduced competition. One VLP will become a de-facto monopoly. In order to avoid this risk, it is recommended that the MCIP project be constructed as to set up the ***first*** VLP in Malawi. This can be achieved by making the tender both for the connectivity and for the VLP function. In this way, the VLP does not get a monopoly position since other consortia of telecom and submarine cable operators can easily implement competing solutions. There will be a strong supply driven market over the next few years in East Africa, where each one of the submarine cable companies will be striving to capture the traffic from the land-locked countries.

1.7 Project timing

The tender described in this document is relatively complex. It involves both the construction of a major fibre cable link between two countries, and the operations of the facilities.

It is recommended that a pre-qualification procedure be used to ensure the bidders are capable of meeting the tender conditions. In addition, a pre-qualification procedure will provide important feedback on the bidders' preferred approach to the project – there are many different ways in which the tender can be structured. A tentative time schedule for the project is shown below.



1.8 Conclusion

Unless a bilateral agreement could be reached with Tanzania, we believe that the proposed tendering approach is the best possible way for Malawi to introduce competition for the provision of international connectivity.

A main issue is that there are very few potential bidders. In the short-term, TTCL in Tanzania and TDM in Mozambique are the only companies having fibre cables. It is therefore recommended that the tender documents be flexible as regards the physical media for achieving the connection. A preference for fibre should be expressed, or alternatively a

requirement of fibre could be placed after a certain date (e.g. by end-2011). This way, the number of possible bidders is increased, and it would be possible for a bidder to offer microwave initially using existing tower infrastructure.

The project should aim at establishing the first VLP by the proposed tender process, to be followed by competing VLPs using different arrangements for the international connectivity. Competition has already shown positive results at the physical landing points and there is every indication that the proposed approach would result in a similar situation at the VLPs in Malawi.

2 Introduction

2.1 History

The Government of the Republic of Malawi GoM recently decided to use part of the Business Environment Strengthening Technical Assistance Project (BESTAP) proceeds to support the preparation of an ambitious project to provide advanced telecommunications services across the country. In this context the Government is formulating activities to be financed through a grant under the World Bank Regional Communications Infrastructure Program (RCIP). RCIP is a regional program designed to improve the development and use of regional communications networks.

The specific objective of the RCIP in Malawi, herewith referred to as the Malawi Communication Infrastructure Project (MCIP), is to promote the availability and usage of affordable broadband services across the country. In particular, the project will make low-cost international connectivity available to the market. The services will be provided through the private sector, hence stimulating private investment, competition and overall sector development.

The GoM decided in January 2009 to engage a consultant to help in preparing the MCIP. After a procurement process, it awarded the assignment to Mr. Anders Engvall and the contract was signed on 26th February 2009.

2.2 Main Objectives

The specific objective of the Project Preparation Consultancy was to provide analysis to support the detailed project design for the MCIP. This analysis would cover:

- Study technical alternatives for access to submarine cables
- Financial analysis of proposed routes
- Suggesting options for ownership, operation, regulation and enforcing of open-access to the proposed network

2.3 Implementation Approach

Considering the short duration of this assignment, it was decided to review the Country Report for Malawi of 28th June 2007 by the Swedtel Group (Country Report) and discuss sector developments over the last two years with the various Malawian stakeholders in order to update the report.

Mr. Engvall visited Malawi from 2nd to 6th March and interviewed all stakeholders. Focus was placed in the discussions on their views on the proposal for a Virtual Landing Point (VLP) in Blantyre or Lilongwe and on the prospects of operator cooperation for realizing the VLP. A short questionnaire was given to the main operators.

Answers to the questionnaire have been much delayed. However, after BESTAP intervened, information was received from the most important operators.

A high-level workshop was organized by BESTAP in co-operation with the World Bank on 12th March 2009, with the aim to keep key stakeholders in the ICT sector informed of the RCIP program, with particular emphasis on the MCIP.

Once the GoM agencies concerned and the World Bank have reviewed this draft report, it had been planned to hold a follow-up workshop. However, considering the positive outcome of the BESTAP/World Bank workshop, it was decided that another workshop on similar subjects would add little value. Instead it was agreed to use the budgeted resources for exploring more in detail the North Route alternative for international connectivity via the landing station in Dar es Salaam. Mr. Engvall visited Nairobi and Dar-es-Salaam in October 2009 and held discussions with various organizations.

The draft report from 22nd April 2009 has been updated to reflect the findings from the discussions in Kenya and Tanzania.

3 Present Situation

3.1 Market Development

Malawi has experienced an impressive growth in telecommunications over the last couple of years, as shown by Figure 1[1].

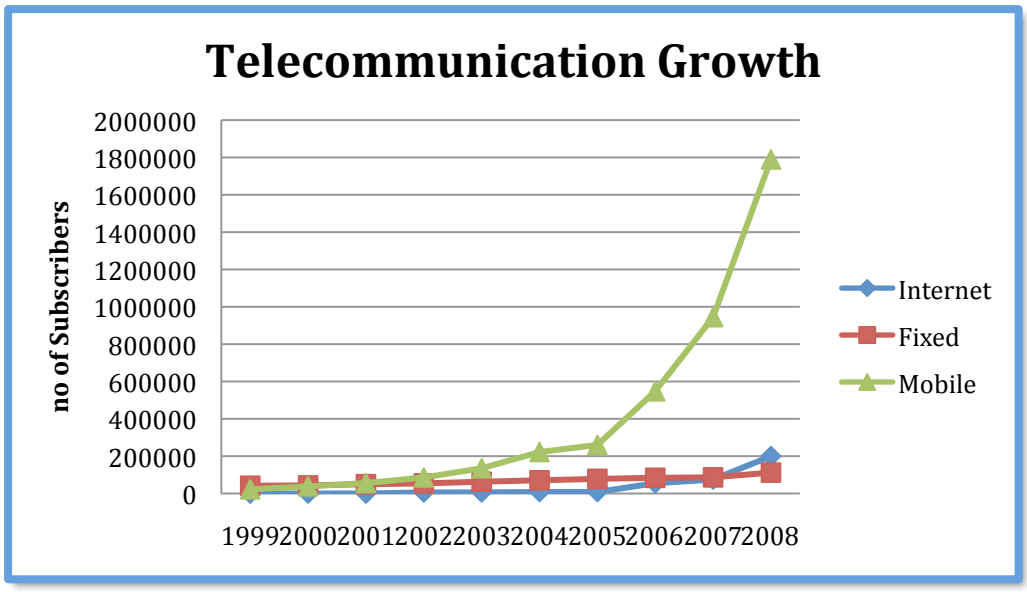


Figure 1. Market Growth

The mobile sector has been the major catalyst for the rapid market development, while increased sector competition has been an important driver for the recent growth.

Due to this rapid growth, the telephone density has increased and Malawi is quickly catching up with other countries in East Africa. This is demonstrated by Figure 2.

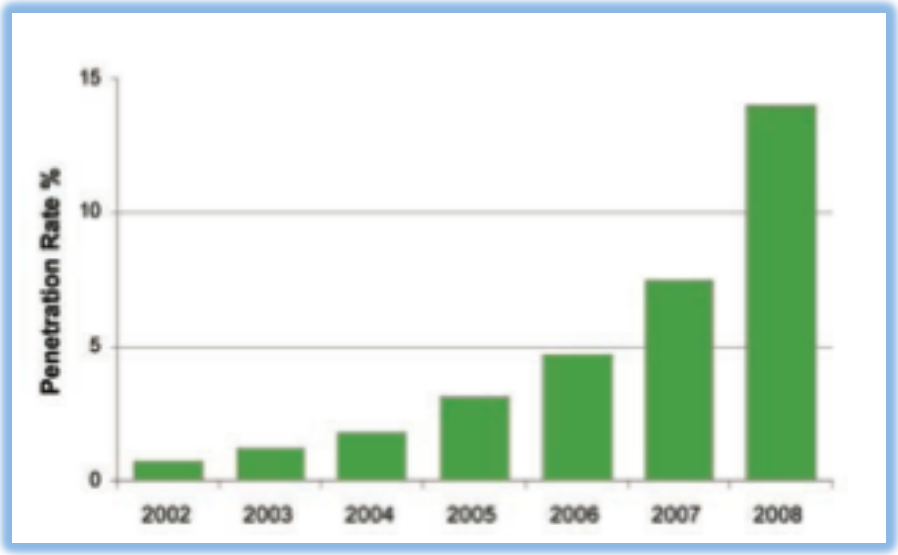


Figure 2. Teledensity in Malawi

[1] Source Zain Malawi

Considering the relatively small size of Malawi, with its extremely high population density, telecom access is almost universal in the country. The population is well spread over the land surface and there are no vast areas with sparse population. This is the main reason why mobile networks already cover most of the country (mainly by Zain, but TNM is rapidly expanding its network in rural areas as well). Zain has already over 95 percent population coverage.

As shown in Figure 1, Malawi has not experienced a similar growth in number of Internet subscribers. There are clear signs, however, that Internet traffic will soon take off, even if it will be at a slower pace than for mobile voice telephony. Both Zain and TNM are in the process of offering countrywide GPRS/EDGE services on their GSM networks. In addition, MTL is promoting the data services on its CDMA network.

Once these upgrades for data services are completed, Malawi will be in a unique situation in East Africa of having data access for 95 percent of its population; wherever you can make a mobile phone call, you have also access to data services (at low bandwidth or data speeds)[2]. It should be noted, however, that the cost of connectivity remains high and is prohibitively expensive for the ordinary consumer.

3.2 Market Competition

Market competition is starting to have a very positive effect on the ICT sector. There is already strong competition between the two mobile operators, both of which have experienced very strong growth in the last two years. Zain having good geographical coverage has shown the largest increase in number of subscribers, but TNM is expected to catch up when it moves more into the rural areas. In addition, there is a new operator – Globally Advanced Integrated Networks – that will launch GSM services in the four largest cities by the end of 2009.

A similar development is taking place for wireline or fixed services. MTL is rapidly replacing its obsolete equipment and replacing it with modern, future proof facilities, including a nationwide fiber network. The results are already shown by a strong uptake in the number of new subscribers as well as for new products offered like Internet services. Data services are also showing rapid growth, but MTL is constrained by capacity limitations on its CDMA network.

MTL will soon face new competition, when Access Communications Ltd launches its CDMA services. This is the Second National Operator (SNO) for fixed services. The SNO is likely to target the data market and provide service levels with speeds that are above what the GSM network can provide with GPRS/EDGE. A key for their success would be cheap international bandwidth; the SNO is probably the operator being most dependent on cheap international bandwidth for the success of their business.

On the infrastructure level, ESCOM is a major supplier of fiber capacity on its power lines between Lilongwe and Blantyre. It has not been able to expand its fiber network as planned, and it seems uncertain when the links to the north will be completed. It will, however, have fiber connections to Mozambique.

Unlike other countries in East Africa, there is probably less competition on the ISP market. Skyband is the dominant ISP with a market share around 50 percent. The market is severely

[2] In 2006, Scanbi-Invest published the report "Internet for Everyone in African GSM Networks" and Malawi is one of the first countries that is making this a reality.

restricted by the high costs of international bandwidth via satellite. It is likely that competition will increase if and when bandwidth prices come down.

3.3 Backbone Networks

In 2007 we wrote in the Country Report, "due to the increased attention by all operators to investment in backbone facilities, there are good prospects that there would be adequate transmission capacity of the area of Malawi that is south of Mzuzu". These predictions have clearly materialized; not only will there be sufficient capacity, but also competing service provides enabling ISPs and telecom operators to get capacity from several competing backbone providers.

Since ESCOM received its telecom license, it has emerged as a major provider of backbone capacity on its fibers on the power lines; it sells capacity to several ISPs as well as to the major telecom operators. ESCOM will soon get competition from MTL, when it completes its large, ongoing, fiber project.

MTL expects to inaugurate its Blantyre-Lilongwe fiber cable during 2009, which includes the connection to TDM in Mozambique via Zobue. They will soon thereafter complete that fiber link Lilongwe-Mzuzu.

These fiber networks will be complemented by high-capacity microwave links across the country. Zain has one major SDH microwave ring in the South that is operational. In addition, it is planning a SDH (3 x STM1) ring in the North to Mzuzu. The capacity of these rings is far beyond what is needed for voice.

At the time of the stakeholder interviews, TNM was carrying out surveys across Malawi to build new microwave links – the extent of their coverage is not known. According to TNM, they are only building capacity for their own needs and do not plan to be in the business of selling backbone capacity.

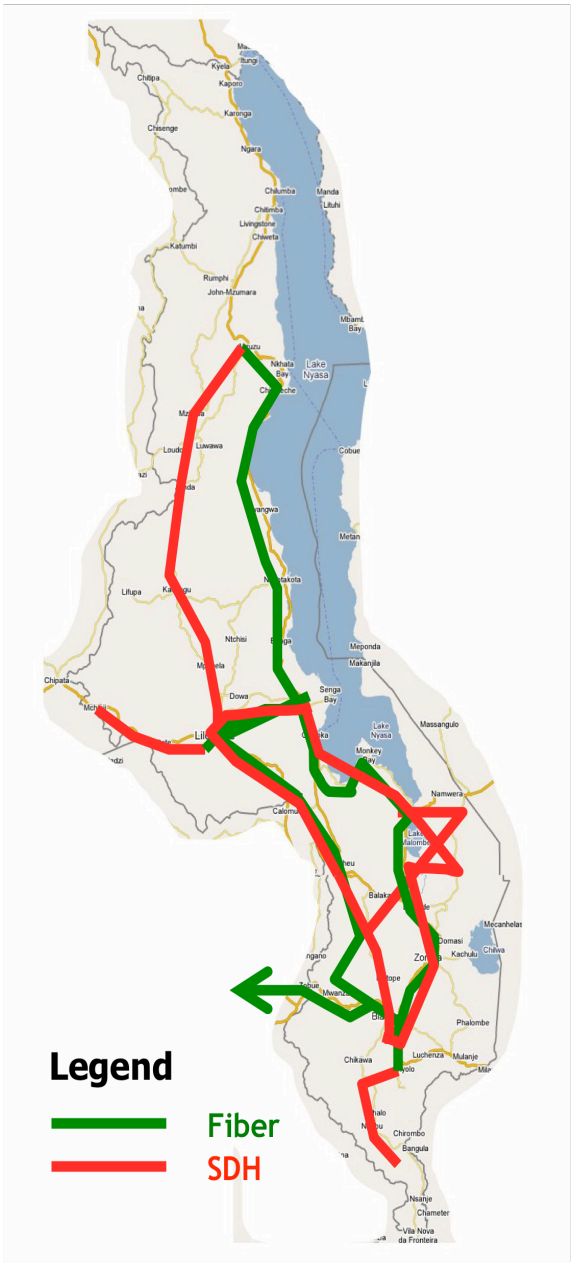


Figure to the right does not show any transmission links for the area North of Mzuzu. However, both Zain and MTL stated in the interviews that they are planning to put in SDH microwave links from Mzuzu via Karonga to the border with Tanzania. The indication was that these links were already part of the current investment programs and the links would most likely be operational in 2010, if not earlier.

In conclusion, Malawi is very well positioned when it comes to national backbone networks with several network links in parallel owned by different telecom operators (including

ESCOM). Once ongoing investment programs are completed, the capacity of the national backbone networks will cover all voice demand for at least 10 years and would be sufficient also for data services until the latter take off on a large scale.

3.4 International Networks

The most serious shortcoming for Malawi is the lack of access to the planned submarine cables along Africa's East coast. Both the SEACOM and the EASSy submarine cables will have landing points in Maputo and Dar-es-Salaam. SEACOM will be commissioned for service in the middle of 2009, while EASSy will probably become operational one year later.

The World Bank is financing an ESCOM power line to interconnect to the electricity grid in Mozambique, with ready for service date end 2009. As stated above, MTL should be able to complete interconnection agreements with TDM in Mozambique to connect to the TDM fiber network already in 2009.

It should be emphasized that these two projects would only interconnect to the TDM network (the electricity company EDM does not have a telecom license), but not solve the issue of reaching the landing point in Maputo at reasonable costs. The distance is approximately 1400 km and TDM's domestic leased line rates are prohibitive for Malawi. In the interviews with the main telecom operators, they said that they were in discussions with TDM, but had not yet received any price indications.

In the Country Report, we recommended that the Malawi operators jointly negotiated with TDM to find a reasonable price for using their fibre network to the landing point in Maputo. We did not think that any of the three main operators would have sufficient international traffic to justify renting a dark fibre pair on TDM's fiber network. In addition, we believed that the operators in Malawi would have a much better negotiating position if they would work together and use their combined international traffic as the base for negotiations; we considered this to be the only feasible solution for avoiding lengthy and difficult price negotiations.

We furthermore proposed a "virtual landing point" in Blantyre. The principles of a virtual landing point (VLP) are given in Annex A - Virtual Landing Points, but essentially it would be an international access point in Blantyre, open to all licensed operators on transparent and equal terms. The virtual landing point would for all commercial purposes be equal to an actual physical landing point of the submarine cable. The VLP will be further discussed in Chapter 6 below.

For regional traffic, there will be adequate cross-border links to both Zambia and Tanzania. There are planned, high-capacity SDH microwave links both to Zambia via Mchinji and to Tanzania via Karonga. Their capacity will be sufficient for carrying both regional data and voice traffic, but not for international data connectivity which requires much higher bandwidth.

Zambia is a special case, since it is also landlocked and without connections to the submarine cables. The priority landing point for Zambia would most likely be Dar-es-Salaam. It would be beneficial for Zambia to route its traffic via Malawi and participate in the joint effort for establishing a VLP; Zambia would thereby reduce its overall costs for reaching the coast.

3.5 Summary Present Situation

The telecommunications sector has developed rapidly over the last two years and by the end of 2009, 95 percent of the population will be in the coverage areas of both voice and Internet services (at speeds below 100 Kbps). The use of broadband services will remain very limited, however, due to high costs of international bandwidth, and the majority of the population cannot afford the cost of Internet services.

Thanks to competition in the market, there is no longer any lack of domestic backbone infrastructure. There are several parallel backbone links across Malawi and backbone networks from most operators serve all major cities.

In summary, Malawi is well braced for the introduction of data services on a large scale and Internet services will take off once low-cost international bandwidth becomes available.

4 Traffic Forecasts

Both voice and data traffic is growing much faster that projected in 2007. The forecasts of the Country Report therefore need to be updated, taking into account recent growth figures as well as the increased market competition. Using the same methodology as in the Country Report, two forecasts will be made: a high-growth scenario and a low-growth scenario. Since there are already adequate national backbone networks in Malawi, only the international traffic will be estimated and there is no need to update the traffic flows in the domestic networks.

The high-growth traffic forecasts will be made on the assumption that leased line rates will be substantially reduced due to competition and that ample broadband capacity would be available throughout all population centres in Malawi. Furthermore, it will be assumed that there will be a VLP established in Blantyre (and Lilongwe) with low-cost international bandwidth at around USD 700 /Mbps/month, which of course can only be achieved with fibre transmission links to a submarine cable. These assumptions are believed to be realistic, since there is already swap agreements in place for E1 circuits (2 Mbps) on the microwave networks and competition is bound to bring leased line rates down towards the operators' self-provisioning costs. The high-growth scenario is further described in Chapter 5 below.

In the low-growth scenario, it will be assumed that the fibre connections to the landing point of the submarine cables will not materialize or rather not be financially attractive. In this scenario, the operators prefer to continue to use satellite for their international traffic. The growth of voice subscribers will not be significantly affected since most calls are domestic and the costs of satellite links for an operator are insignificant in relation to the total costs of providing countrywide voice services. Data services, however, have very high price elasticity and will grow much slower when the satellite services will be retained. In addition, very little content is local on the Internet and most data traffic will be international. This scenario will not result in any World Bank operation, but is presented for reference purposes and for comparing the effects of high bandwidth prices.

4.1 Data Market Growth

In the Country Report we used a simulation models to analyze the various growth scenarios for Malawi. The same model was used for the forecast updates.

The main reason for expecting increased data growth is that all operators in Malawi have started focusing on providing data services. The GSM operators are offering GPRS/EDGE services on their complete networks. The new mobile operator is in addition licensed to provide 3G services that offer much higher data speeds. Also data services on the CDMA networks are showing strong growth. These services are rapidly being expanded by MTL and the SNO will soon launch an additional CDMA network.

Skyband and other ISPs are adopting the WiMAX technology, which enables the provision of Internet services to new areas at moderate speeds. The demand for non-internet based domestic data services is strong and increasing, e.g. banking systems.

The base line data for our data traffic model are presented in Table 1. The number of Internet users is divided into a number of categories, each with its separate usage pattern. This table was generated by the model inputs for Malawi, and shows the expected number of users and their capacity requirements at the first year of our forecast period – 2010. The number of users is shown for each class of users. For each class, the number of institutions is given together

with the number of users for each instance (company, agency, family, etc.). A user is associated with a workstation. For some classes one user is equivalent to one person, but especially for educational classes and for Internet cafes where many people share each workstation, the number of individuals per workstation is much greater than one. Such sharing leads to more intensive use of the terminals/PCs. The Throughput per User parameter allows us to adjust for this by entering the monthly network throughput in Megabytes.

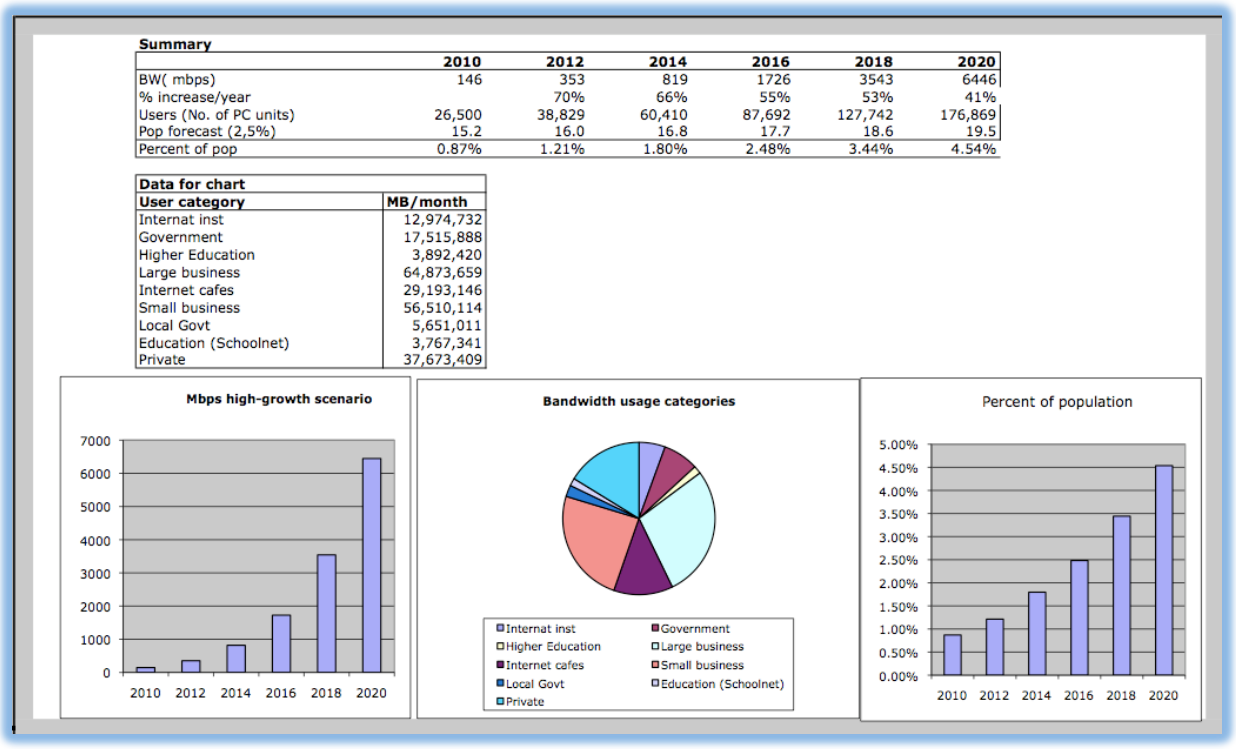
Results

	No institutions	Users/ org	No of users	MB/ month	MB/month	Bandw need
Larger institutions						Kbps per org.
Internat inst	208	10	2,083	200	416,667	56
Government	375	10	3,750	150	562,500	42
Higher Education	13	20	250	500	125,000	278
Large business	417	20	8,333	250	2,083,333	139
Internet cafes	63	15	938	1000	937,500	417
Total corporate	1,075		14,417		4,125,000	160
Smaller customers						
Small business	2,083	2	3,125	200	625,000	8
Local Govt	208	2	417	150	62,500	8
Education (Schoolnet)	42	5	208	200	41,667	28
Private	8,333	1	8,333	50	416,667	1
Total smaller	10,667		12,083		1,145,833	
Total					5,270,833	
No companies			11,742	TOTAL BW (Mbps):		146
Total no. of users			26,500	No E1:		71

Table 1. Baseline data for the forecasts

The column Throughput per Institution shows the total calculated throughput per institution or company. This is converted to a calculated average bandwidth need for each customer class, allowing for a moderate congestion factor. This could be considered as the minimum dedicated bandwidth per institution, where congestion would not be a great issue. The low values in this column should not be mistaken for the bandwidth offers from today's ISPs in Malawi. High contention factors mean that the bandwidth sold to an institution is not dedicated to one customer, but instead shared by many. The congestion thus occurs outside the customer's own LAN.

The result of our data forecast for the high-growth scenario for Malawi is given in the following Table 2. The results are based on input data reflecting the number of potential data users over the next decade. The case showed in the table is using the assumption of low price levels for international connectivity as well as access to data networks throughout the country.



Summary

	2010	2012	2014	2016	2018	2020
BW(mbps)	146	353	819	1726	3543	6446
% increase/year		70%	66%	55%	53%	41%
Users (No. of PC units)	26,500	38,829	60,410	87,692	127,742	176,869
Pop forecast (2,5%)	15.2	16.0	16.8	17.7	18.6	19.5
Percent of pop	0.87%	1.21%	1.80%	2.48%	3.44%	4.54%

Data for chart

User category	MB/month
Internat inst	12,974,732
Government	17,515,888
Higher Education	3,892,420
Large business	64,873,659
Internet cafes	29,193,146
Small business	56,510,114
Local Govt	5,651,011
Education (Schoolnet)	3,767,341
Private	37,673,409

Table 2. Malawi data forecast – High Growth Scenario

4.2 Voice Market Growth

In the Country Report, our voice traffic forecast was based on a growth forecast made by EMC for mobile subscribers and based on ITU statistics for fixed subscribers. Both sources are considered the most accurate for mobile and fixed telephony, respectively.

Actual demand has been much stronger than the predictions made using these two sources. The subsidized, low-cost handsets have led to a surge in mobile subscriptions and MTL's promotion activities has resulted in a rapid take up of fixed line services. Increased competition and the two new entrants should result in continued strong growth.

In this updated report, we are only interested in the international traffic and this represents a very small percentage of all voice traffic. When there was a large increase in the number of subscribers due to subsidized handsets, this probably had little effect on the volume of international traffic. Due to very weak correlation between the number of subscribers and the international traffic minutes, it was decided to use another method for the forecast of international traffic.

The actual number of minutes of international voice traffic (both incoming and outgoing) was used as the base for the projections. As a rule of thumb, an international voice circuit would carry about 100,000 minutes per year. Since satellite services are expensive, compression techniques were assumed at a rate of 8:1. The results are shown in Table 2.

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Low-Growth Scenario										
International Minutes ('000000)	1,528	1,803	2,092	2,385	2,671	2,938	3,232	3,555	3,911	4,302
International Bandwidth (Mbps)	122	144	167	191	214	235	259	284	313	344
Annual Growth	20%	18%	16%	14%	12%	10%	10%	10%	10%	10%
High-Growth Scenario										
International Minutes ('000000)	1,794	2,278	2,824	3,418	4,033	4,638	5,333	6,133	7,053	8,111
International Bandwidth (Mbps)	143	182	226	273	323	371	427	491	564	649
Annual Growth	30%	27%	24%	21%	18%	15%	15%	15%	15%	15%

Table 3. Forecast growth of international voice traffic

For the high-growth scenario, the growth rates have been increased by 50 percent across the board.

4.3 Summary Traffic Forecasts

Figure 3 below shows the summary of our traffic forecast for the High-Growth Scenario. It should be noted that the forecast represents total international traffic volumes for Malawi and it assumes that the percentage of local data traffic remains relatively low. In later year, local content will increase and some data traffic will be routed domestically via IXPs. This has been accounted for by reducing the growth rates in the later years. It is therefore an indication of total estimated traffic that will pass through the VLP for the period 2010 – 2020.

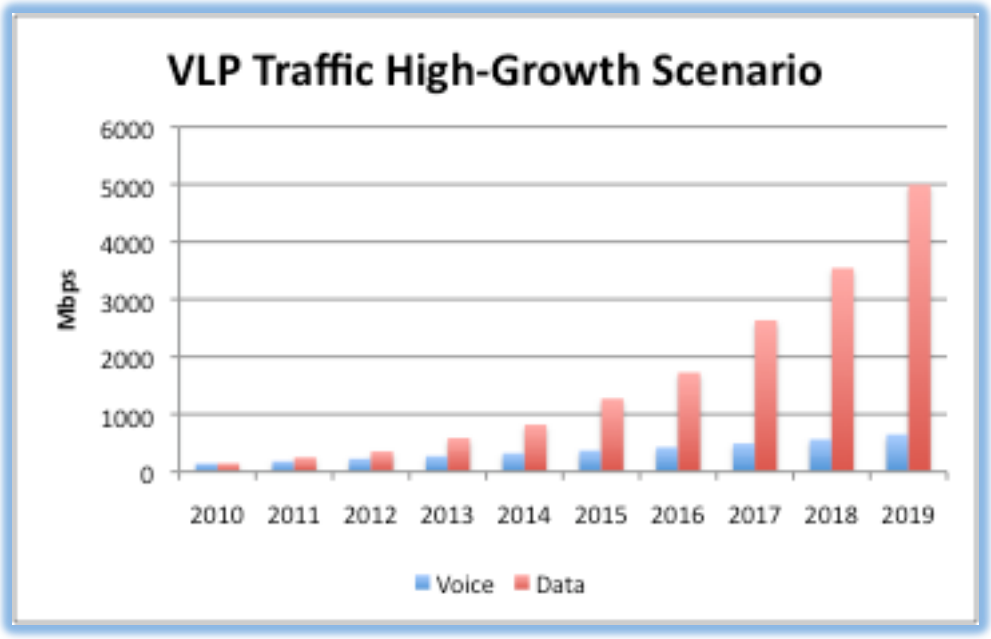


Figure 3. VLP international traffic for High-Growth Scenario

A comparison of the high and low growth scenarios clearly demonstrates that data services are very price elastic and that low cost bandwidth is necessary for the data services to take off

on a large scale. This is shown if Figure 4. International voice services are far less price sensitive and there is hardly any difference between the two scenarios.

Recent studies by Scanbi-Invest on backbone networks showed that lack of backbone facilities have had very limited impact on the development of voice services. In Sub-Saharan Africa, the mobile industry has completely captured the voice market, in urban as well as in rural areas. Even the mobile industry has been surprised at the high financial viability of voice services in low-income rural areas. With modern soft switching, the cost of the transmission component is very small in relation to total operating costs of a mobile operator. This situation applies even to international calls via satellite links; for a medium size mobile operator the cost of a satellite call is less than USD 0.02 per minute, which is below the current local interconnection rates in Malawi.

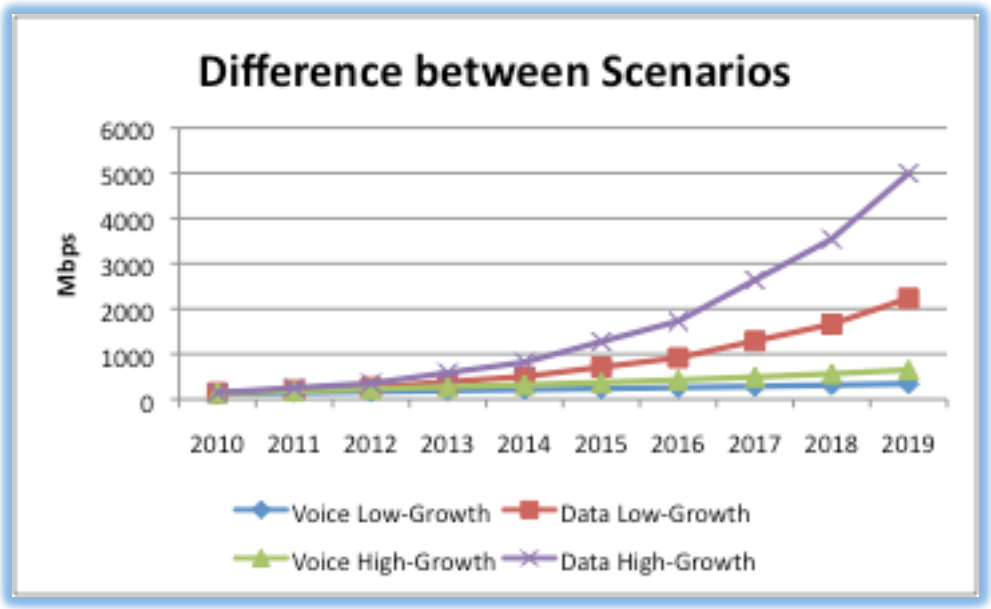


Figure 4. Comparison between High- and Low-Growth Scenarios

5 Description High-Growth Scenario

The high-growth scenario represents an aggressive approach for removing the main bottlenecks for ICT development in Malawi and to ensure that the country can benefit from the submarine cables in spite of being landlocked. The forecasts project an increase in international bandwidth requirement from 290 Mbps in 2010 to 5600 in 2019, i.e. an increase by twenty times. Even if international voice traffic will continue to grow, its effect on bandwidth demand is very small. Internet growth is driving the demand for bandwidth at the VLP and will overtake voice traffic already in 2010.

Both the SEACOM and EASSy submarine cables will both have landing points in Maputo and Dar es Salaam, which are the closest connections points for Malawi. The operators in Malawi would have a much better negotiating position if they work together and use their combined international traffic as the base for negotiations with the operators in Mozambique and Tanzania with the aim of reaching the landing stations.

The Country Report proposed a virtual landing point in Blantyre. A VLP is of course of no use, unless it has access to cheap bandwidth that can only be obtained from the new submarine cables. The possibilities of connecting the VLP to the landing points will be explored in the following Chapter 6.

Briefly, the high growth scenario is based on the following assumptions:

- that all main stakeholders in Malawi co-operate to establish a VLP in Blantyre (or Lilongwe) and agree on a joint approach for connecting the VLP to the landing stations;
- that a terrestrial connection for Malawi to a submarine cable is established no later than by the end of 2010;
- that the operators further strengthen their co-operation in swapping transmission capacity when needed
- that the resale of transmission capacity is not legally prevented;
- that ISPs and new licensed operators are given access throughout the country to transmission capacity at reasonable rates;
- that GPRS/EDGE continue to be rolled out nationwide according to plans;
- that new licenses for 3G services are issued no later than by the end of 2009;
- that WíMax and/or other wireless solutions are offered on a broad scale across the country by 2010; and
- that the market price level for domestic transmission services is dramatically reduced in order to stimulate demand for data services.

The high-growth scenario assumes a bandwidth prices at around USD 700/month. The discussions in Kenya confirm that this assumption is very realistic. Kenya Data Networks already offers a flat rate at USD 600/month that is distance independent. The currently offer services at this price not only throughout Kenya, but also in Kampala in Uganda and Kigali in Rwanda.

6 Alternatives International Connectivity

The main challenge for the VLP is obtain international bandwidth capacity at low prices, without which it has no raisons d'être. As already stated, it is expected that TDM's rates will be prohibitively expensive, mainly due to its need to earn a financial return on its extensive investments in backbone networks. This means that alternatives need to be sought to the TDM route in order to be in a better negotiating position. A route to Dar-es-Salaam would be an ideal complement to the Maputo landing station.

Unfortunately, our discussions in Kenya and Tanzania indicate that the Tanzanian Government is taking a similar position to the Government of Mozambique and are giving the incumbent fixed line operator the monopoly rights for fibre optic backbone networks.

6.1 Cost Estimates

6.1.1 General Principles

The costing being applied in this study is based on recent market trends in East Africa for competitive tendering and quotations sought from different vendors. However, considering the recent fluctuations in international currencies and the general downturn in the global economy, we would like to point out that there is very high degree of uncertainty in any cost estimates at the present time.

It should be noted that there are large variances in unit costs, not only between different countries but also from the same supplier. This can partly be explained by factors such as size of the purchase, bilateral arrangements and finance sources. As a general comment, we have found that price levels are lowest when international competitive bidding (ICB) is applied and that direct negotiations with concessionary financing normally results in much higher costs. Final costs will be dependent upon purchasing and financing arrangements to be decided in the financial arrangements for the proposed international links.

In making the cost estimates for shared fibre cables between operators, the same principles has been used as in the Terrestrial Connectivity Study for the World Bank, and which was also used for the EABS feasibility study of the Eastern Loop. Costs estimates for fibre cables are based on a 24-core cable, providing 12 pairs. This is the cost for a "dark cable" that needs to be "illuminated", which means equipping it with electronic equipment. The electronic equipment i normally not shared between operators.

For existing fibre cables, or new fibre cables to be shared between operators, the project would only be burdened with the costs of 2 pairs, i.e. USD 4/24 or USD 1/6 of the cost per km of existing or new fibre cable. This costing would in principle provide a 100 percent mark-up on the cost of constructing the cable, if all fibre pairs were to be utilized. Of course, this is rarely the case, but an upfront payment of 1/6 of the investment is valuable to the owner of the fiber cable. However, this cost estimate should be considered to reflect only the investment costs and not the commercial price for a healthy return of investment in fibre networks.

Regarding infrastructure sharing, it should be noted that network information from Tanzania and Mozambique is two years old and comes from the respective Country Reports. It normally takes two years to implement planned networks, why the information should be reasonably accurate. However, before final network design is made, the exact state and location of shared networks should be verified.

6.1.2 Cost Estimates for Fibre Cables

Scanbi-Invest cost figures for the ongoing Burundi Backbone Study have been used when making the cost estimates and are considered relevant also for the MICP project in Malawi.

There are a number of fibre optic cable projects currently being implemented or planned in the East African countries, which enables cost comparisons. The cost estimates are for buried cable with 12 fibre pairs. By international comparison, there have been relatively few fibre projects in East Africa. This has resulted in some fibre projects with poor quality of service. Fibre cables are often cut during house construction and the telecom service is frequently interrupted in urban areas. Most operators experience better quality of service in rural than in urban areas, due to less construction activities. Fibre optic systems in East Africa have overall much shorter mean-time-between-faults than in developed countries.

We are basing our cost estimates on fibre cables buried at a depth of 1.20 m. This will reduce the risk of accidental cable damage during construction as well as of sabotage and deliberate tampering with the cable. The prices used for fibre and fibre burying are dependent on the type of terrain in the areas for cable laying. In Burundi, Scanbi-Invest used USD 10,000 per km for the low-cost routes, USD 12,500 per km for medium-cost routes, and USD 15,000 per km for high-cost routes. Not knowing the terrain for the MCIP project, USD 12,500 per km has been used as a representative overall cost for the fibre; if Tazara railway line could be used for the Northern route in Tanzania to Dar-es-Salaam, this cost estimate would be on the high side.

All terminal equipment shall meet the specifications of international organizations like ITU, ETSI and IETF as applicable to each equipment type. Most major telecommunications equipment vendors in East Africa adhere to these standards. A more detailed study is required for an accurate cost estimate for terminal equipment; such a study should include an evaluation whether modern Gigabit Ethernet technology should be used rather than the traditional SDH technology. The telecom industry is rapidly moving toward IP based standards for its core network.

EABS report used USD 2,000 per km for illuminating the cable, which is reasonable when there are long distances between add-drop points. To allow for Gigabit Ethernet standards being slightly more expensive, USD 2,500 per km has been used for the MCIP project. The Burundi network is of low capacity and its cost estimates are therefore not applicable to the Malawi case.

6.2 The VLP

The VLP is essentially a high capacity multiservice router consisting of Line Terminating Equipment (LTE), which contains both optical and digital units. On the service side it is equipped with line cards of different types to enable connection of operator equipment, including fibre optic cables. Figure 5 shows typical equipment that would be suitable for the VLPs.

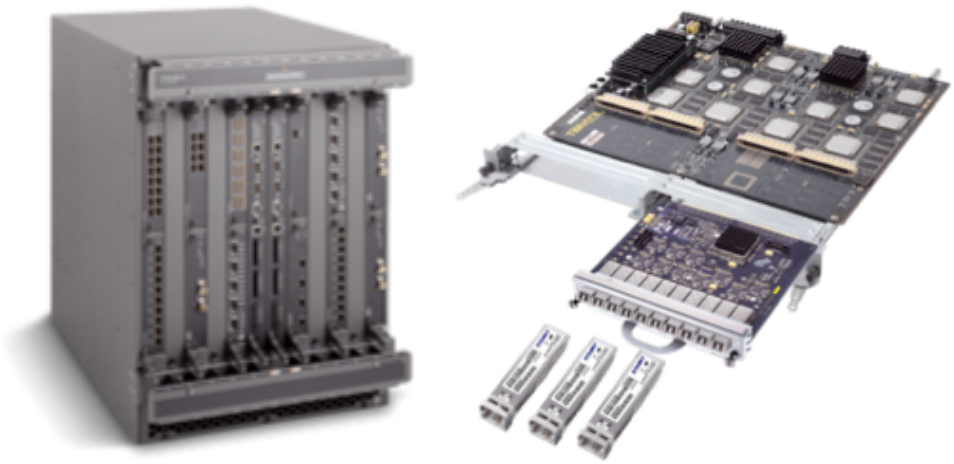


Figure 5. Example of VLP equipment

The cost estimates for the VLP equipment include all components for meeting the capacity needs as forecast in this study, like cabinets, line cards, and pluggable optics. Cabinets are chosen with very low utilization initially to ensure ample expansion possibilities. The cost estimate is taken from the Burundi study, modified for the higher capacity requirements in Malawi.

The VLP is Malawi's telecommunications gateway to the international data networks. Any interruption in VLP operations will not only cut off Malawi from the international network but also result in large revenue losses for the operators. The equipment itself is very reliable, but the physical environment always poses dangers[3]. It is recommended that the VLP should be duplicated with one unit in Lilongwe and one in Blantyre.

In making the cost estimates for the VLP function, they are based on the assumption that fibre pairs in a ring formation between Lilongwe and Blantyre interconnect the two units.

Item	*Length (km) or No. of units*	*Cost/km or Cost /Unit (USD)*	*Category Costs (USD '000)*
Costs Dark Fibre			
Domestic fibre ring	777	2,085	1,620
Equipment Costs			
Cabinets	2	31,200	60
Service boards	28	9,370	260
Long Distance connectivity boards	6	20,300	120
Optical modules	48	1,080	50
Sub-total			**2,110**
Various costs (%)		20.0%	420
Total Cost			**2,530**

[3] Zain Malawi recently experienced how dramatic such effects can be when its MSC was destroyed by fire.

Table 4. Cost Estimates for the two VLPs in Lilongwe and Blantyre[4]

6.3 VLP Connection to Maputo

This alternative is the most feasible from a technical point of view. It only transfers via one backbone operator – TDM – in Mozambique directly to the landing point in Mombasa. Most of the fibre routs are already operational and the ready for service dates would be even before SECOM has commissioned its Mombasa landing point. In addition, TDM is an efficient operator that has extensive experience of operating fibre networks, both terrestrial and submarine cables; they commissioned the first submarine cable in East Africa between Maputo and Beira already in 2002. This alternative (VLP South) is illustrated in Figure 6.

[4] Installation costs and test equipment (10%), site adaptations (5%), and contingencies (5%)

Figure 6. VLP South Alternative

6.3.1 Description VLP South

As shown in Figure 6, the fibre linke from Tete to Maputo is already operational and includes the route Beira – Maputo on the domestic submarine cable. In a joint project, TDM and MTL are about to complete the link Tete – Blantyre via Zobue with ready for service date before mid-2009.

The route Blantyre – Tete needs to be secured via geographic diversity with another independent fibre link to the landing points. Since the proposed VLP will carry all international traffic to and from Malawi, it cannot be dependent on one single fibre cable; if the cable is cut, Malawi will lose most of its broadband capacity to the rest of the world. Even if Satellite capacity can serve as a backup initially, its capacity will soon be grossly insufficient for the VLP traffic (see traffic projections in Figures 3 and 4 above).

An interesting solution for securing the VLP South alternative is to construct a fibre link from Mangochi to Lichinga, a distance of 190 km. TDM has no security for its fibre network for the area north of Qelimane, representing almost half of Mozambique[5]. The Mangochi-Lichinga route would reduce the unprotected area by half, and thus be very interesting to TDM; at least until it has connected to the landing point in Dar-es-Salaam via Pemba in the North.

The VLP South alternative would give Malawi international connectivity to the landing point in Maputo which could be operational at the time with the submarine cable services are available. Backup capacity would be satellite until the Mangochi-Lichinga route is completed that could be end 2010. It would also get terrestrial access to the second landing point in Dar-es-Salaam once TDM has made fibre connections to Tanzania in the North[6].

6.3.2 Cost estimates VLP South

The cost estimates have been developed based on the description in Section 6.1 above; leasing of dark fibre pairs on all existing or soon to be commissioned fibre links, while the whole costs are included for the Mangochi-Lichinga route. The latter could, of course, be a shared cost between TDM, but the full costs are shown here for ease of comparison and for showing the total financing requirements for the links.

[5] Figure 6 is based on TDM's development plans in mid-2007. Since most of the planned links have been built, it is assumed that the dotted red link in western Mozambique has been finished. It is possible that they are planning new links to increase the security of the backbone network also in the North.

[6] The reason for the uncertainty regarding timing of this link are delays and lack of commitment on the Tanzanian side

Route	*Length (km)*	*Cost/km (USD)*	*Route Cost (USD '000)*
Costs Dark Fibre			
Domestic Links	384	2,085	800
Mangochi - Lichinga	190	12,500	2,380
TDM Links	1,480	2,085	3,090
Sub-Total			**6,270**
Fibre Illumination			
Equipment costs	2,054	2,500	5,140
Total			**11,410**

Table 5. Cost Estimates VLP South

6.4 VLP Connection to Dar-es-Salaam

This alternative represents the highest investment costs – in fact, there are no operational telecommunications fibre networks to connect to in Tanzania. There is optical fibre on the Tanesco power lines from Iringa to Dar-es-Salaam, but so far Tanesco has been unable to receive a telecommunications license[7].

Our visit to Tanzania revealed that the Government of Tanzania has recently decided that the Tanesco fibre should be part of the national backbone network. The Government has contracted Chinese suppliers to build a complete national network in Tanzania under financing arrangements with the Chinese. Annex B gives a more detailed account of the situation in Tanzania regarding backbone networks.

The Tanesco network is already operational with connections to the SEACOM landing station. Therefore, the only link required for the route to Dar-es-Salaam (VLP North) is the connection from the Malawi networks to Iringa, which is the closest point on the Tanesco network. This alternative is illustrated in Figure 7.

[7] One argument put forward by the Government for blocking Tanesco's license request has been that it does not want two parastatal organizations to compete on the telecom market.

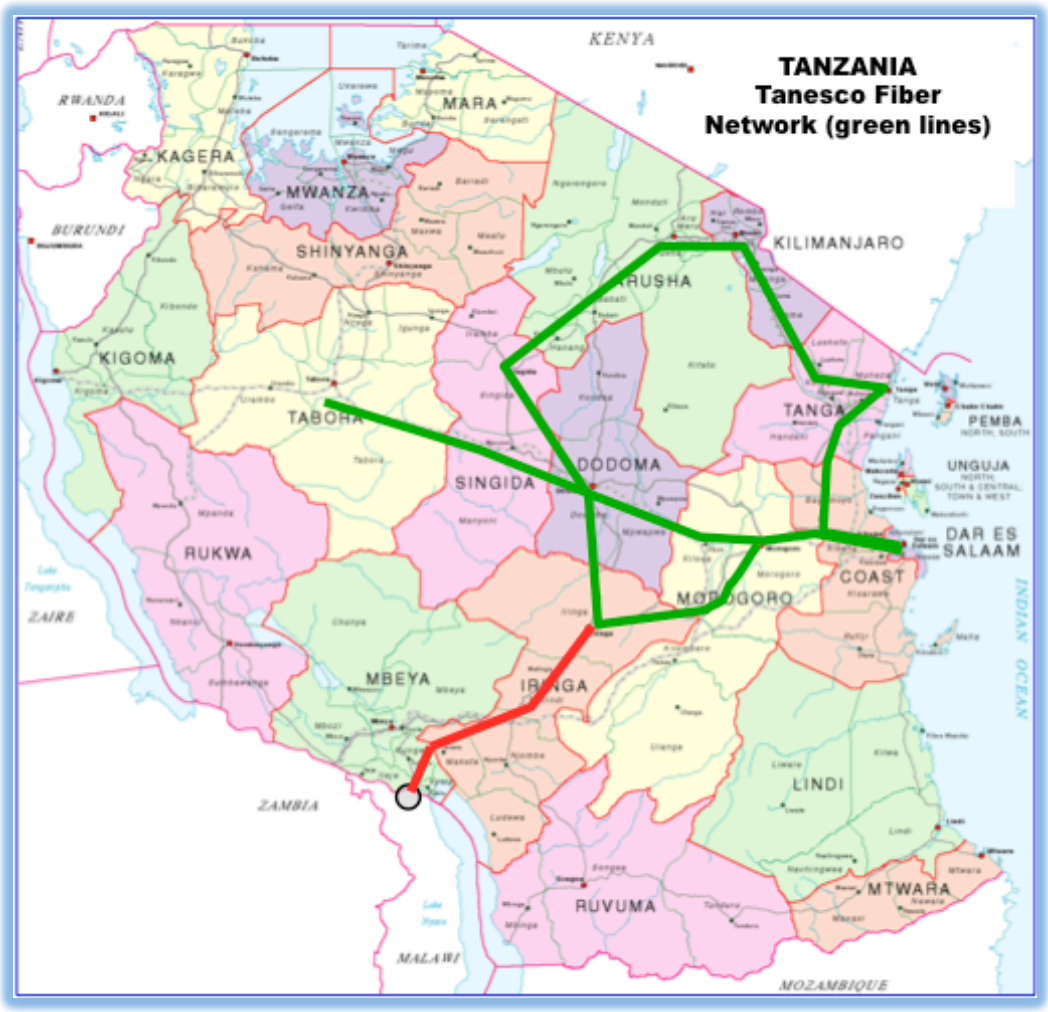


Figure 7. VLP North Alternative

6.4.1 Description VLP North

As shown in Figure 7, the distances from the Malawi border to Dar-es-Salaam are rather long and in addition, there is need for a domestic fibre cable from Mzuzu to the border. Another negative issue is that there is very little telecom demand in the area between the Malawi border and Iringa (shown by the red line). The Tanzanian operators have therefore very little incentive for building the fibre links in this area and don't have any need for fibre capacity for their own traffic. The main traffic needs in Tanzania are north of a line from the Dar-es-Salaam – Dodoma – Mwanza at Lake Victoria, which is the priority area for the domestic fibre network in Tanzania.

The preliminary maps received from the Tanzanian authorities show a spur route from Iringa to the Malawi border and that this link is included in the phase 1 of the project. The ready for service date was indicated to June 2009. Figure 8 shows that map of the planned backbone network in Tanzania.

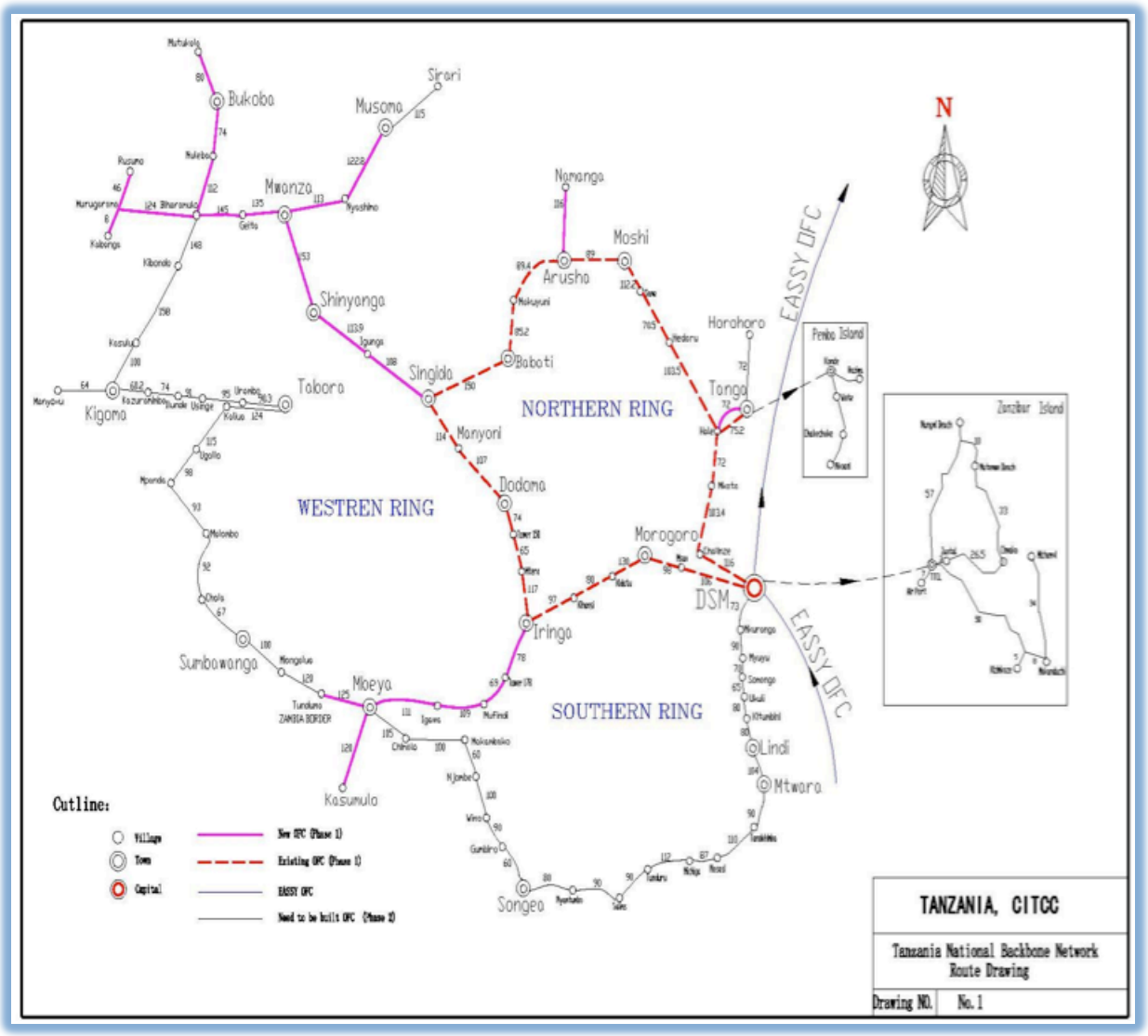


Figure 8. Tanzania's existing and planned fibre network

The main issue for the VLP North Alternative will be how to obtain geographic diversity for a connection to Dar-es-Salaam. To achieve this as an isolated project for Malawi is not realistic. However, as shown in Figure 8, there are provisions in the Tanzania project for building a link along the southern border in later phases of the project. Once such a link is built, adequate security can be achieved with geographic diversity. It is only required to construct a short fibre link in the Northeast of Malawi to a new interconnection point on such new links in Tanzania.

A major drawback for the VLP North Alternative is that it cannot be completed quickly to make use of the services of the SEACOM cable that is already in operation in Dar-es-Salaam. A major fibre project involving two countries will have a long implementation time.

6.4.2 Cost estimates VLP North

In the VLP North Alternative there would be leasing of fibre pairs from Lilingwe to Mzuzu and now construction from Mzuzu to the border north of Karonga. Like in the VLP South case, the complete costs of the links in Tanzania are included in the cost estimates.

Due to the difficulties mentioned above regarding geographic diversity, no such costs are included in the cost estimates shown in Table 6.

Route	*Length (km)*	*Cost/km (USD)*	*Route Cost (USD '000)*
Costs Dark Fibre			
Domestic Links	350	2,085	730
Muzuzu – border N. Karonga	225	12,500	2,810
Malawi border - Iringa	436	12,500	5,450
Tanesco Iringa- DAR	500	2,085	1,040
Sub-Total			**10,030**
Fibre Illumination			
Equipment costs	1,511	2,500	3,780
Total			**13,810**

Table 6. Cost Estimates VLP North using Tanesco fibre

6.5 Comparison of the two VLP Alternatives

6.5.1 Point by point comparison

The VLP South alternative is better than the VLP North alternative on most counts:

- The investment costs are USD 2.4 million lower (or USD 7.6 million without Tanesco fibre)
- It can be ready in time for the SEACOM landing point in Maputo
- It will have good geographic diversity almost from day one
- It will be maintained by the most experienced fibre operator in East Africa
- There are virtually no project implementation uncertainties

The only drawback, which is of course a major one, is that TDM is expected to charge very high rates for dark fibre capacity, making the VLP South alternative not financially viable. A financial analysis is shown in Chapter 7 below.

The characteristics of the VLP North alternative are:

- Investment costs are USD 2.4 million
- It will be at least one behind SEACOM's commissioning of the submarine cable, seriously hampering the development of data services in Malawi
- Not possible to obtain satisfactory geographic diversity and thus service security for the first year of operation
- Many project uncertainties including operational responsibility and efficiency (there is no experience of fibre network operations in Tanzania)

In spite of these major disadvantages, it is not unlikely that the VLP North alternative is the most realistic one and which could be used for breaking the deadlock for reaching an agreement with TDM. As shown in Chapter 7 below, it would be financially very viable (all alternatives show strong financial viability).

6.5.2 Means of improving VLP North ready for service date

One key objective of studying the VLP North alternative is to increase competition for international broadband capacity and thus achieve lower costs. In other words, the VLP North alternative might actually become a complement to the VLP South solution, not necessarily be an either or situation. With this in mind, there are certain possibilities that should be considered for improving the chances of success of the VLP North alternative.

To make the VLP North alternative available earlier, some temporary solutions could be taken by focusing on the initial years only. If international voice services stay on satellite (as stated above this will have negligible effect on market growth), the bandwidth demand for international services is expected be below 300 Mbps until the end of 2011. This capacity can be provided by microwave, since it only represents two STM1 channels.

Zain Malawi is planning to set up a SDH STM1 link to the border north of Karonga. Both Zain Tanzania and Vodacom offer GSM services in the Mbeya area in Tanzania, which is very close to the Malawi border. Therefore, it is most likely that both of them have SDH microwave links to from Dar-es-Salaam to Mbeya. There might be a few hops missing, but with minimal investments Malawi could benefit from the SEACOM services from the inauguration of the landing point until end of 2011 if not longer. The SDH microwave links in Tanzania are only a couple of years old and would thus meet modern specifications on mean-time-between-failure and service quality. Even though the routes are long (1,500 km), the microwave links would offer services of satisfactory standard.

Considering that 300 Mbps satellite capacity would cost around USD 10 million per year, it is obvious that this temporary microwave solution would pay off very quickly and be extremely profitable. Even a completely new microwave route at STM 3+1 capacity would cost about USD 4.5 million (while a new link on existing tower would cost less than half this amount) and would be paid off already in the first year. However, a new microwave link would not be ready in time and is therefore not a feasible alternative.

6.5.3 Improved network security for VLP North

Most of the operators in Malawi have long-term contracts for their satellite capacity that cannot be terminated immediately. They are therefore expected to keep their connections for some time, and at least until they see how secure and reliable the VLP operations will be.

Similarly as for the ready for service proposal, one could compromise on the geographical diversity for the first years when the capacity requirements are low and satellite backup would be possible.

The VLP South route would, of course, be an ideal backup route, even if no agreement can be reached for carrying the bulk of the VLP traffic. This can be arranged via swap arrangements with TDM, since Malawi has something to offer in return.

It is quite common that telecom operators swap capacity between each other for security reason, even when they are fierce competitors. Once the VLP North alternative is operational, it would be much cheaper for TDM to use this route via Malawi than to construct a fibre link along the coast from the Mozambique border in the north to Dar-es-Salaam; the latter would not be revenue earning but only be a cost item for securing international connectivity.

7 Financial Analysis

7.1 Introduction

The uncertainties regarding the VLP alternatives, particularly VLP South, makes normal cost benefit analysis rather meaningless. Another approach has been taken, by comparing the alternate costs of staying on satellite with the costs of the VLP solutions. This will give a margin between the two solutions that can be used as an indication on the profitability of the VLP alternatives. Of course, this profit might not be transferred to the Malawi operators but could be kept by the link owners in Mozambique (TDM) and Tanzania. However, it is a clear indication of the price span that needs to be settled between the bandwidth suppliers and the VLP customers.

The traffic input for staying on satellite is the low-growth scenario – without low-cost international bandwidth there will be limited growth in data services severely hampered by the high price level. For the VLP analysis, both the low and high growth scenarios will be used; the low-growth implying that the transit operators will keep most of the traffic and bandwidth prices will remain relatively high, while in the high-growth scenario, the operators will achieve reasonable costs for the VLP connections and thus benefit from substantially lower bandwidth prices.

The main reason for the chosen analytical model is that the projected traffic is very price sensitive. This fact will not be as apparent in a standard NPV calculation.

The traffic flows from the model in Figure 3 above in Chapter 4 have been used as input and discounted back to the base year using 15 percent discount factor. The price in Mbps/month as finally been established as the equilibrium price which gives a NPV of zero.

The cost estimates are taken from Chapter 6 above and are summarized in Table 7. The costs of the temporary microwave link to Dar-es-Salaam, estimated at USD 2.0 million, have been added in order to get early access to the landing point and for making the alternatives fully comparable.

USD '000	*VLP South*	*VLP North with Tanesco fibre*
Costs 2 VLPs	**2,530**	**2,530**
Fibre costs	**11,410**	**13,810**
Mirowave costs	**0**	**2,030**
Total costs	**13,940**	**18,370**

Table 7. Total costs for the various VLP alternatives

7.2 Results financial analysis

The results of the analysis are shown in Table 8.

Alternative:	*VLP South*		*VLP North with Tanesco fibre*	
Traffic:	*Low*	*High*	*Low*	*High*
Bandwidth costs in USD per Mbps/month	**288**	**163**	**380**	**215**

Table 8. Bandwidth costs for the various VLP alternatives.

The table above shows the costs of being landlocked – the shown bandwidth costs represents the necessary mark-up for reaching the coast and to make the VLP commercially identical to a physical landing point. It would be accessible for all licensed operators on equal, transparent terms. An additional advantage of the VLP is that all traffic costs at the VLP will be distant independent.

The final part of the analysis is to establish the margin (expressed in Mbps/month) for the different alternatives. The competition with three submarine cable operators have resulted in much lower bandwidth costs at the landing stations that what was shown in the Malawi Country Report. To stay competitive, the EASSy consortium has been forced to reduce their prices substantially.

Once all three submarine cables are operational, it is likely that the bandwidth prices will be around USD 200 to 300 per Mbps/month for bulk purchases (which is the case for the VLP) – a value between has been used for the analysis. Also satellite prices have come down and are between USD 2,000 – 3,000 per Mbps/month[8]. Here the higher value of USD 3,000 has been used, since each operator would continue using its own satellite earth station and thus not benefit from volume discounts.

Alternative	*VLP South*		*VLP North with Tanesco fibre*	
Traffic estimates	*Low*	*High*	*Low*	*High*
Satellite	**3,000**	**3,000**	**3,000**	**3,000**
VLP to Landing point	*288*	*163*	*380*	*215*
Landing point	*250*	*250*	*250*	*250*
Price VLP	**538**	**413**	**630**	**465**
Price difference	**2,462**	**2,587**	**2,370**	**2,535**

Table 9. Comparison between satellite and VLP alternatives

[8] It is likely that the satellite prices will be drastically reduced in the next few years, with the arrival of new satellite technology. A study of this alternative is, however, beyond the scope of this study.

Another way of showing these results is to calculate the NPV value of the price difference taking traffic volume into account and to compare this to the total investment costs for each alternative. This is shown in Table 10.

Alternative	*VLP South*		*VLP North with Tanesco fibre*	
Traffic estimates	*Low*	*High*	*Low*	*High*
Investment costs	**13,940**	**13,940**	**18,370**	**18,370**
NPV of price difference	**91,320**	**180,106**	**83,616**	**172,402**
Investment costs / Price difference in %	**15%**	**8%**	**22%**	**11%**

Table 10. Investment costs related to price difference

The savings in satellite bills for consumed bandwidth are substantial, which is illustrated in Figure 9. Investment costs are a fraction of the savings over time and the key focus should be to start negotiations with neighbouring countries in order to find a solution as soon as possible.

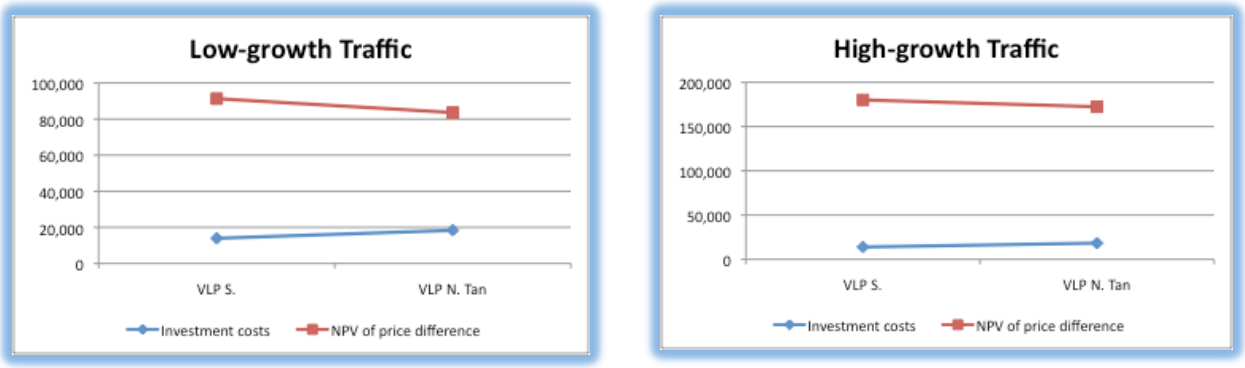


Figure 9. Price difference and Investment costs at different traffic forecasts

7.3 Conclusion financial analysis

The results from the financial analysis clearly show that there is much room for manoeuvre, which would provide profits for all parties involved (both the bandwidth suppliers and the VLP customers). The main beneficiaries, however, would be the public at large that would get access to the international Internet cloud at reasonable prices.

8 Implementation approach

8.1 The Backbone Setup in Tanzania

As explained in Annex B, the Government of Tanzania is considering creating one national backbone network that is fibre based and operated on a monopoly basis. In the first phase, the core of this network is the existing fibre on Tanesco's power lines, plus new buried fibre links to Rwanda and Malawi. The project team for this first phase is presently working on a pricing structure for selling bandwidth capacity and is planning to be ready by the end of 2009.

It should be noted that the Government of Rwanda has already entered into agreements with the operators in Uganda for reaching the landing stations in Mombasa. The exact terms of these agreements are not publicly disclosed, but the price level in Kigali of backbone capacity would be around USD 600/MB and month. This implies that the Tanzanians must more or less provide its bandwidth capacity at this price; otherwise they will not be able to sell capacity in Rwanda.

In the spirit of good neighbouring relations, Malawi should logically have a possibility to purchase bandwidth to Dar-es-Salaam at the same price as will be offered to Rwanda. The distance from Iringa to the Malawi border via Mbeya is about the same as from Mwanza to the Rwanda border, why the construction costs should be about the same. However, Malawi would offer a much higher demand for capacity than Rwanda.

Before launching the implementation approach recommended below in this chapter, we recommend that the Malawi Government enter into bilateral discussions with their Tanzanian counterparts to explore whether a mutually beneficial solution could be reached. After all, there would be little use to construct the spur link to Malawi without an agreement on the price level. We would expect, however, that the Tanzanians have an unrealistic view on market prices on backbone networks.

8.2 Market development for broadband capacity

Scanbi-Invest developed the VLP concept three years ago in connection with the Terrestrial Connectivity Study covering 8 countries; the World Bank financed the study with the objective that it would form the base for the RCIP program. At that time, there was only the EASSy submarine cable and the objective of the VLP was to put the landlocked countries on equal footing with their neighbouring countries having direct access to EASSy.

Since all major operators in East Africa were shareholders in EASSy, it was logical to foresee that the VLP would be setup as a joint project by the national operators.

By co-operation between operators, economies of scale would be achieved with the VLP and this would also benefit smaller players like the ISPs and WiMAX operators. Transparency on pricing and open access principles would ensure that the VLP would operate on non-discriminatory bases.

The East African market for broadband capacity has evolved rapidly in the last three years. There will now be three submarine cables (Seacom, TEAMS and EASSy) along the East African coast with several landing stations. Even before these cables are operational, the competition has reduced the prices at the landing stations and the original pricing level discussed in the EASSy consortium is no longer competitive.

A similar development can be expected for the landlocked countries. They have large, unsatisfied demand and at the same time, there is excess, low cost capacity at the landing points. Obviously, solutions will be developed for connecting these supply and demand points and letting the market forces decide the capacity price.

8.3 Risk of VLP jointly owned by the operators

The RCIP project was presented to the stakeholders in Malawi at a high-level workshop on 2009-03-12. It was then foreseen that the international capacity would be tendered to licensed operators in both countries, while the VLP would be treated separately and be setup jointly by the operators in Malawi.

A VLP controlled by all operators in Malawi is a de facto monopoly. Arguments can be put forward that there are no restrictions for new broadband players to enter the market. However, experience from the carriers' of carrier business shows that this is normally not a valid argument. When the international carrier business became exposed to gross overcapacity, the independent carriers all went out of business, while many operator-owned carriers survived. The reason is very simple, the operators made sure they channelled their traffic to their own carriers even if their prices were higher. For the same reason, EASSy will be more or less guaranteed to get traffic from its owners even if it charges higher prices than the competition.

Had EASSy continued to be the only submarine cable on the East African coast, the bandwidth prices would have been considerably higher than today. It is therefore important that the VLP in Malawi is not implemented in a manner that it reduces competition.

The objective of proposing the VLP concept was to put the landlocked countries on equal footing with their neighbouring countries having direct access to EASSy; in other words, the EASSy would have a VLP in each landlocked country. We will now have three submarine cables in Eastern and Southern Africa, which would imply that ***each of them should have a VLP*** in the landlocked countries. This is necessary if the objective is to achieve identical conditions for the landlocked countries to the countries that have landing stations (in this case Mozambique and Tanzania).

If the national operators set up jointly only one VLP, there is a risk that this will result in reduced competition. They will feel committed to this VLP and new regional carriers will have difficulties in attracting their interest, even if they can supply bandwidth at lower prices.

In order to avoid this dilemma, it is recommended that the MCIP project be constructed as to set up the ***first*** VLP in Malawi. This can be achieved by making the tender both for the connectivity and for the VLP function. In this way, the VLP does not get a monopoly position since other consortia of telecom and submarine cable operators can easily implement competing solutions. There will be a strong supply driven market over the next few years in East Africa, where each one of the submarine cable companies will be striving to capture the traffic from the land-locked countries.

8.4 Operator co-operation

There are several positive signs of increased operator co-operation in Malawi when it comes to infrastructure sharing. This is only to be expected; when operators have achieved almost complete country coverage, then the cost reducing measures became a higher priority.

One-to-one swapping is becoming routine, and infrastructure lease arrangements are being discussed among several operators. It should be noted that all operators voiced strong agreement with infrastructure sharing during interviews.

Co-operation on business solutions is a completely different matter. In this area, there are many good initiatives being very slow or never materializing. EASSy is a good example of this. It was the first consortium formed for an international sub-marine cable, but will be operational long after the other two. The EABs Eastern Loop project is a similar initiative for connecting the landlocked countries of Burundi, Rwanda and Uganda to EASSy. It has experienced many delays and is very uncertain at present, even if failure to reach agreements between competing backbone operators have resulted in renewed interest.

If the VLP is created as a co-operate project, it will be between operators that compete on a daily basis, and this is far more difficult then the regional examples of EASSy and EABs. It would involve sharing confidential information, like international traffic statistics and projections.

These examples on operator co-operation is another clear indication that a VLP jointly set-up by the operators in Malawi should be avoided.

8.5 The role of the Government

The Government of Malawi is getting a credit from the World Bank's Regional program (RCIP), which is aimed at supporting development and use of broadband networks in Eastern and Southern Africa. The RCIP funds will be channelled to the private sector in order to obtain international connectivity via the sub-marine landing stations at considerably lower prices than today.

The main role of the Government is to act as a catalyst for starting competition in the international bandwidth market in Malawi. Since mid-2009 there is cheap bandwidth available in Mombasa and Dar-es-Salaam, which Malawi does not have access to. A solution is therefore urgently needed to ensure that Malawi can participate when East Africa gets access to cheap international bandwidth that is estimated to cost about 1/10 of the satellite alternatives.

The proposed approach is to leverage the fact that the Government is a major customer for bandwidth capacity. The Government would issue a tender for international capacity that would include a number of conditions, not only for meeting the direct service demands but also for meeting the Government's overall objective of making bandwidth capacity available across Malawi to stimulate economic development.

The Government would sign a service contract with the winning bidder, which probably has to be a consortium of telecom operators having licenses in the countries concerned. The winner would be subject to local telecom regulation in Malawi and would need a new carriers' carrier license.

The long-term objective of this approach is to get real competition in Malawi for international bandwidth offerings; it is foreseen that in the not too distant future each of the submarine cable suppliers in Dar-es-Salaam and Maputo would have service offerings in Lilongwe and Bujumbura. The Government need only leverage its purchasing power for the first VLP, the others will follow if competing operators see a business case for alternate offerings.

8.6 The role of the regulator

In a meeting with MACRA, they did not see any obstacles for licensing a VLP operator in Malawi. They stated that in principle, there would not be a monopoly, since the operators still

had their gateway licenses and could transfer traffic via satellite. The VLP license would not be non-exclusive.

The VLP operator would need a carrier of carriers license, like is the case of ESCOM. This license blocks ESCOM for providing last mile service and in addition regulates the wholesale prices.

The license principles should comply to the current EC directives for an operator having significant market power (SMP), and as such would be subject to regulation. The VLP Company would initially be the only one being able to offer access to the submarine landing points and would therefore have SMP. Under the EC directives, a SMP firm must regularly produce a document for regulatory approval that describes the terms and conditions at which it will provide access to specified services. These conditions are often referred to as reference interconnection offer (RIO).

These arrangements would ensure that the services would be offered following open access principles and with fully transparent prices.

8.7 Summary implementation approach

The proposed approach would be compatible with the RCIP principles for supporting the Government to stimulate ICT development:

- Private-ownership of network infrastructure
- Full competition between networks and businesses
- Redundancy/diversity of routes, cables and landing stations
- Operating within existing regulatory frameworks
- Open-access to any PPP infrastructure

9 The Project Concept

9.1 Project structure

The Government launches a tender for the supply of broadband capacity from the landing points (Dar-es-Salaam or Maputo) to be offered at two VLPs in Blantyre and Lilongwe. The tender should be for a specified minimum capacity over the next three to five years, which would correspond to the total market requirement in Malawi. The Government would sign a long-term purchasing agreement with the winning bidder for its own needs only. The winner would have to find its own customers for the remaining capacity.

The tender would awarded to the bidder offering the lowest bandwidth price, but subject to the bid meeting a number of conditions specified in the tender documents; the price will be for all potential customers, not only the Government[9]. The winning bidder would own the infrastructure and be fully responsible for operations.

The tender documents should include all licensing conditions that should be approved by MACRA in advance of issuing the tender. MACRA will represent the Government in supervising that the bidder implements the project in accordance with the tender conditions as well as operates within the limits of the VLP license.

9.2 Tender outline

The biggest challenge in designing the tender is (i) to specify the way the capacity should be provided at the VLP and (ii) to ensure that RCIP can channel the funds to the project in accordance with World Bank rules. A main issue is that there are very few potential bidders. In the short-term, TTCL in Tanzania and TDM in Mozambique are the only companies having fibre cables, and therefore need to be included in all bids.The tender should in addition include terms and conditions for supply of bandwidth capacity that are common and standard in the carrier business.

9.2.1 Capacity provisioning

In view of the limited number of fibre alternatives in the short term, it is recommended that the tender documents are flexible as regards the physical media for achieving the connection. A preference for fibre should be expressed, or alternatively a requirement of fibre could be placed after a certain date (e.g. by end-2011). This way, it would be possible for a bidder to offer microwave initially using existing tower infrastructure.

As in the case with fibre, there are very few operators that can bid for providing microwave for 2010 and 2011 (there are probably only two operators in Tanzania that have the necessary infrastructure in place). The tender must therefore be issued to ensure that the short-term microwave solution can be purchased separately from the long-term fibre solution if desirable.

Then there is the issue of capacity purchase versus lease of dark fibre pairs. The use of Indefeasible Right of Use (IRU) is quite common in the submarine fibre cable industry, while it is quite rare in the terrestrial carrier business. The latter normally lease dark fibre on long-term basis, but is normally unwilling to give up the right of use indefinitely. As a rule of thumb, the price of an IRU represents 40 times the monthly lease cost.

[9] It would be allowed to offer volume discounts, price differentiations according to Quality of Service levels, etc , but such conditions would have to be transparent and regulated by MACRA.

The alternative of leasing dark fibre is complicated to implement when the Government goes for tender of for establishment and operations of two VLPs in Malawi. It would be far simpler to tender for bandwidth capacity instead that includes all equipment for illuminating the fibre as well as for connecting the customers at the VLPs. It also makes the evaluation of fibre versus microwave bids much simpler.

Considering the expected increase in competition in the regional carrier business over the next couple of years, it is recommended to use a five-year time frame for the tender of backbone capacity. The time is sufficiently long to attract bidders, but not too long to prevent the Government of using more attractive offerings should they materialize.

9.2.2 The RCIP funding

In recent projects in RCIP, funding has been provided for Government's pre-purchase of capacity. In the Malawi case, the Government's bandwidth consumption would correspond to about 10 percent of the total estimated traffic. As stated above, the tendered capacity should be for the total country need, even though the Government would pre-purchase only 10 percent. It is uncertain whether this amount is sufficient for the operators to form consortia and take the financial risk of investing in a new fibre link from Mzuze to Iringa.

If a tender is made for an IRU of a dark fibre pair and equipping it at the required capacity for the initial 5 years, the financing from the RCIP could be substantially increased. The tender would then have to be structured as two components: one for the Government's purchase of an IRU for a dark fibre pair, and the other to illuminate and equip the fibre pair as well as the VLPs and operate them for the initial 5 years.

If a tender is issued in accordance with the World Bank rules for International Competitive Bidding (ICB), it should be possible for RCIP to channel the funds via the Government to the successful bidder. The RCIP funds would be for the dark fibre pair, and equipping the total solution. To this could be added the funds for pre-purchase of Government capacity.

At this stage, it is very difficult to assess how many potential bidders there could be. It should be noted that even if there will be only two submarine landing stations in Dar-es-Salaam (TEAMs has so far only a landing point in Mombasa), the number of operators that can sell capacity is many times higher; e.g. most major operators in East Africa are members of EASSy or WIOCC[10]. Tanzania has a competitive ICT market, but unfortunately the Government is interfering and severely restricting competition on the backbone fibre market; in fact, the present plans seems to give TTCL a complete monopoly.

The operators that already have microwave links form Mbeya to Dar-es-Salaam are the only ones that can realize the short-term microwave solution for the VLP North alternative.

9.2.3 Standard tender conditions

The tender should aim at receiving the lowest possible price for international bandwidth at the VLPs in Blantyre and Lilongwe. There obviously has to be a number of safeguards to ensure that the bidder is capable of living up to its commitments and deliver satisfactory service quality.

Most of these conditions are standard for the carrier industry and include:

- Service Level Agreements stating;

[10] West Indian Ocean Cable Company, the EASSy outlet for the smaller operators in the region. It was earlier referred to as the Special Project Vehicle (SPV).

  - Quality of service
  - Guaranteed mean time between failures
  - Repair times
  - Service provisioning times
- Open access principles
- Service definitions, including tariff levels and structure
- Interconnection arrangements

Since the tender will involve the construction of a major fibre project, there should be a number of milestones included to ensure that the project follows an agreed implementation plan, there are adequate procedures in place of work supervision (particularly as regards cable laying and splicing).

It should be noted that the bidders are consortia of telecom operators in Malawi, Tanzania and Mozambique, who in turn would need to subcontract the construction of the fibre cable and VLP network to an international equipment supplier.

Finally, the tender should include specification of the regulatory environment and the conditions of a carriers' carrier license.

9.2.4 The tender process

The tender as described above is relatively complex. It involves both the construction of a major fibre cable link between two countries, and the operations of the facilities.

It is recommended that a pre-qualification procedure be used to ensure the bidders are capable of meeting the tender conditions. In addition, a pre-qualification procedure will provide important feedback on the bidders' preferred approach to the project – there are many different ways in which the tender can be structured.

A tentative time schedule for the project is shown in Figure 10.

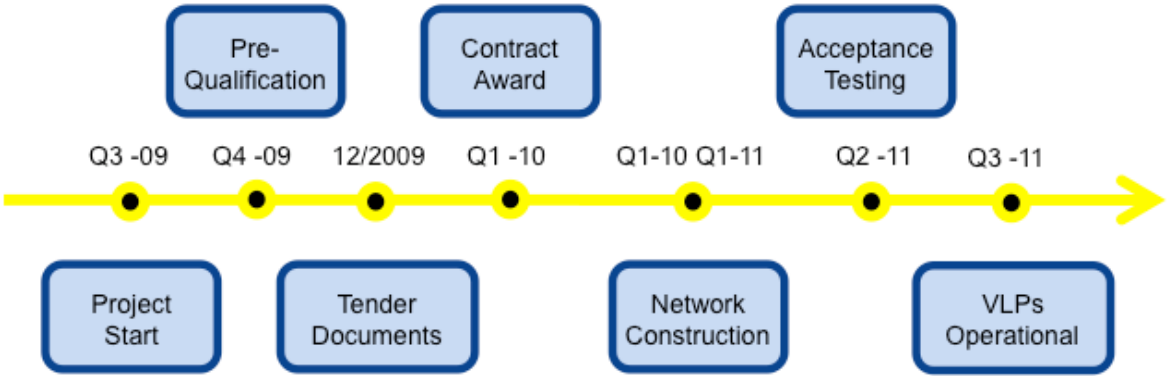


Figure 10. Tentative time schedule

The payment schedule would relate to the project milestones, which should be defined in a manner that they are easy to verify.

The Government has no organization that has experience of acquiring a complex fibre project of this nature. It would therefore need to hire consultants for the tender process that would start with tender specifications and end with acceptance testing.

Once the project moves into the operational stage, MACRA would regulate and supervise the entity operating the VLPs.

9.3 Summary project approach

Unless a bilateral agreement could be reached with Tanzania, we believe that the proposed tendering approach is the best possible way for Malawi to introduce competition for the provision of international connectivity.

A main issue is that there are very few potential bidders. In the short-term, TTCL in Tanzania and TDM in Mozambique are the only companies having fibre cables. It is therefore recommended that the tender documents be flexible as regards the physical media for achieving the connection. A preference for fibre should be expressed, or alternatively a requirement of fibre could be placed after a certain date (e.g. by end-2011). This way, the number of possible bidders is increased, and it would be possible for a bidder to offer microwave initially using existing tower infrastructure.

Experience from recent initiatives in the East African region shows that it is very difficult to achieve co-operation and a common approach between competing operators. Both EASSy and EABs ran into serious delays, even though both projects were addressing an area where the operators would not be competing. For this reason, it is recommended that no common VLP be established based on co-operation between the Malawi operators.

The project should aim at establishing the first VLP by the proposed tender process, to be followed by competing VLPs using different arrangements for the international connectivity. Competition has already shown positive results at the physical landing points and there is every indication that the proposed approach would result in a similar situation at the VLPs in Malawi.

The project challenges were presented at the workshop on 2009-03-12 as:

- To get a link built to Dar-Es-Salaam to complement existing/planned routes to Mozambique
- To ensure that the network is operated efficiently and effectively
- To ensure that the route competes effectively with other networks to provide redundancy, quality and lower prices
- To ensure that access to it is available to all users in Malawi

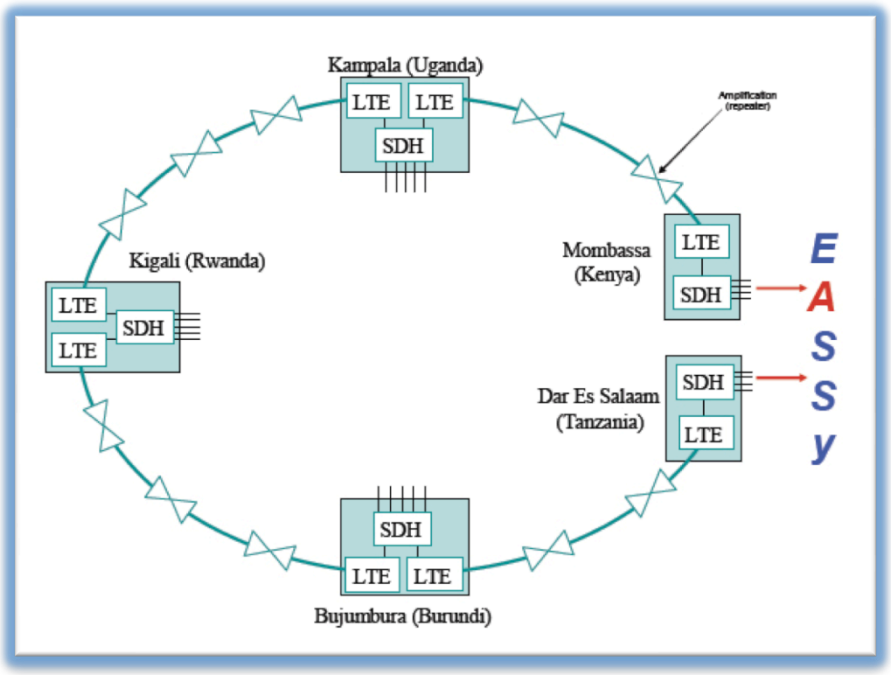
The proposed project approach is believed to be the best possible way of meeting those challenges and the most realistic alternative for getting low-cost international bandwidth in Malawi in a timely manner.

10 Annex A Virtual Landing Point (VLP)

10.1 International Connections

The landlocked countries will all be connected to the submarine cable either directly or via the Eastern Loop (the EABs project or another project constellation), as is the case for Burundi, Rwanda and Uganda. In the EABs report, Axiom also proposes that Kenya and Tanzania use the Eastern Loop for backup purposes, thus connecting to the Eastern Loop in Mombasa and Dar.

The layout of the Eastern Loop is shown in the following picture:

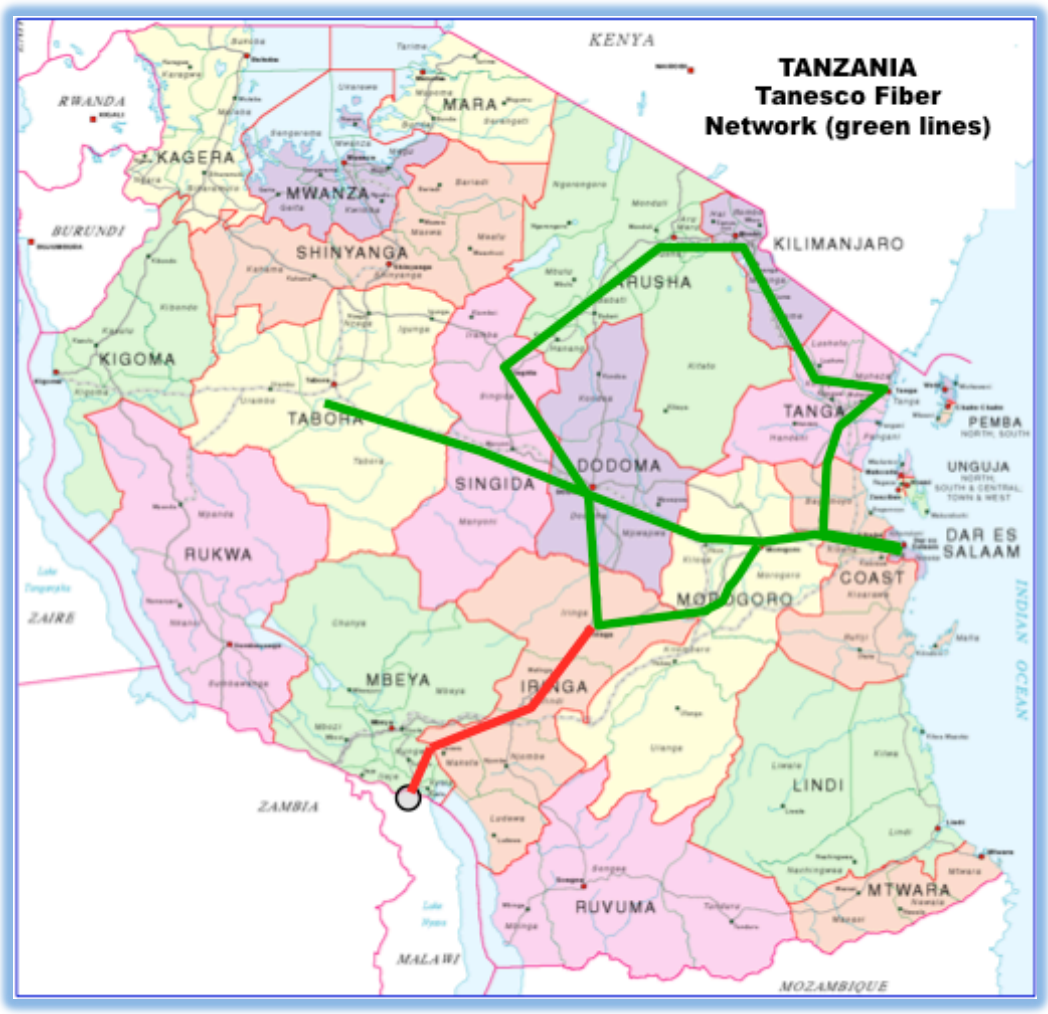


For the landlocked countries, we are proposing that the connecting point should be a virtual landing point (VLP), more or less making it identical to the physical landing points for a submarine connection. For all commercial purposes, the virtual landing point would be accessible by all licensed operators in the individual countries and on equal, transparent terms. What is important is that no single operator should have exclusive rights of any kind that may block others from directly accessing the VLP connection.

In practical terms, an operator in e.g. Malawi who wants access to a submarine connection will lease or purchase capacity at the multiplexer at the VLP. The price charged per capacity unit (Mbps) includes the routes to Maputo or Dar-es-Salaam with international access. The prices in each country are transparent and the same for all operators. The only difference from being directly connected at a physical landing point is the extra cost of the terrestrial link to the landing stations. The cost of the connections should be the same for all operators and be distance independent.

11 Annex B The Backbone Network Status in Tanzania

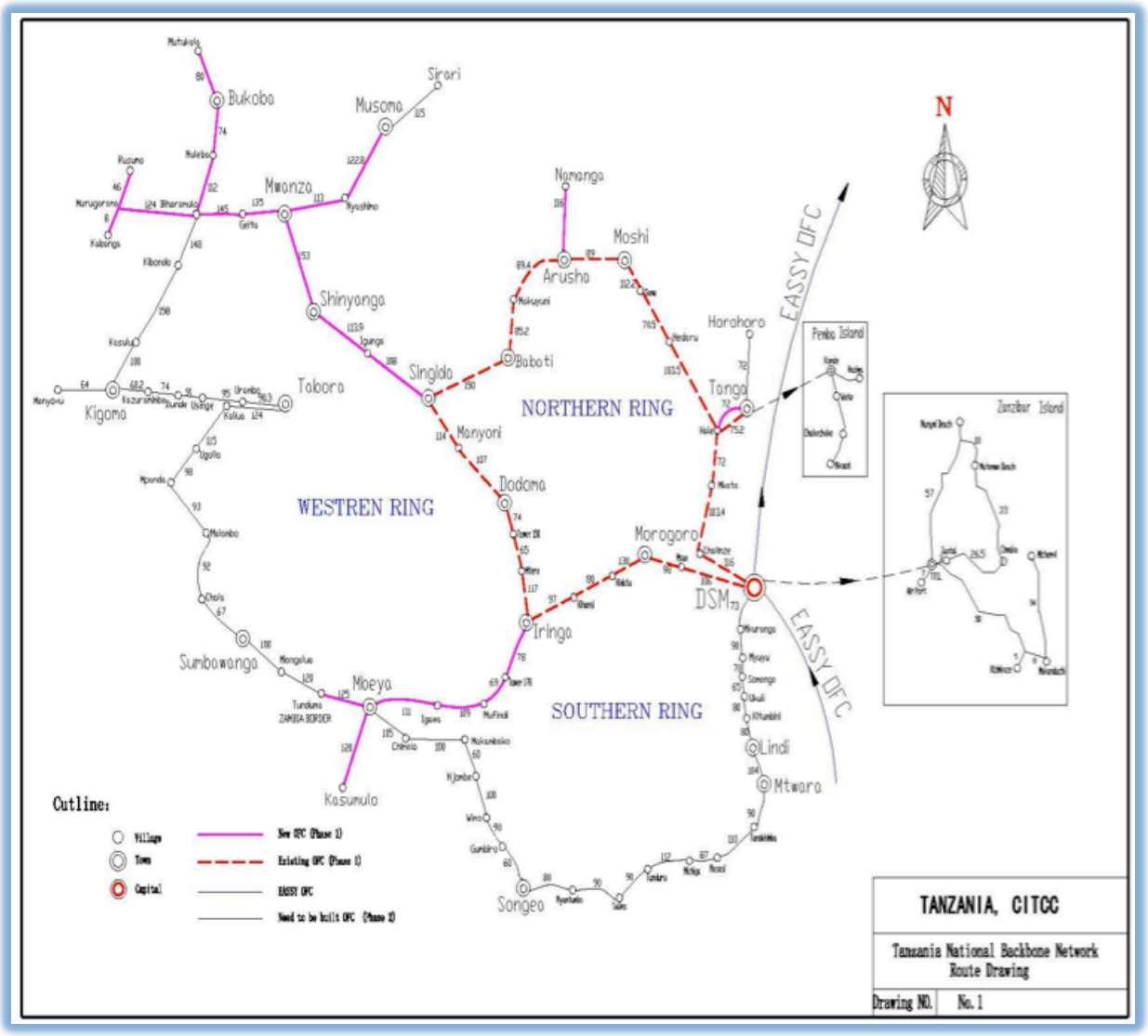
In our draft report, we showed the fibre network of the national power company – Tanesco – and indicated that it was operational from Iringa to Dar-es-Salaam. However, Tanesco had been allowed to offer public telecommunications services on its fibre network since it was unable to obtain a telecommunications license. The green lines in the following figure show the Tanesco network:



Our visit to Tanzania revealed that the Government of Tanzania recently decided to create one single national backbone network, and at the same time severely limiting competition by not allowing the mobile operators to construct their own fibre links. They also decided that the Tanesco fibre should be part of the national backbone network, and be complemented by new underground fibre cables across the country. The Government contracted Chinese suppliers to build these new fibre links in Tanzania under financing arrangements with the Chinese. It is not yet officially announced which organization will operate the national backbone network, but it is widely expected that TTCL – the Government controlled incumbent operator – will be entrusted with all operational tasks.

The Tanesco network has now been connected to the SEACOM landing station. Therefore, the only link required for the route to Dar-es-Salaam (VLP North) is the connection from the Malawi networks to Iringa, which is the closest point on the Tanesco network. This alternative is illustrated by the red link in the figure above.

In discussions with the Tanzanian authorities, they indicated that they prioritize links to connect their neighbouring countries in order to facilitate connections to the landing stations in Dar-es-Salaam; SEACOM is already operational and EASSy is scheduled for mid-2010. The preliminary maps received from the Tanzanian authorities confirm this priority, since it shows connections to Kenya, Uganda, Rwanda, Burundi and Malawi in Phase 1 of the project. Mozambique is not included, but this is probably due to TDM in Mozambique having its own landing stations. The map below illustrates the Tanesco network that is the Northern Ring that is operational. It also shows the spur route from Iringa to the Malawi border via Moeya. The ready for service date was indicated to June 2010.



We were unable to obtain prices for bandwidth capacity or any details on what type of backbone products they would be willing to provide. Our recommendations for Malawi are to acquire dark fibre pairs (as IRU's or long-term lease agreements), but we are very doubtful

that the Tanzanian's are willing to sell dark fibres. We were informed that the project team for the backbone network is presently working on a pricing structure for selling bandwidth capacity and is planning to be ready by the end of 2009.

The Government of Rwanda is in the process of building a nationwide backbone fibre network. We understand that they have already entered into agreements with the operators in Uganda for reaching the landing stations in Mombasa. The exact terms of these agreements are not publicly disclosed, but the price level in Kigali of backbone capacity would be around USD 600/MB and month. This implies that the Tanzanians must more or less provide its bandwidth capacity at this price; otherwise they will not be able to sell capacity in Rwanda.

In the spirit of good neighbouring relations, Malawi should logically have a possibility to purchase bandwidth to Dar-es-Salaam at the same price as will be offered to Rwanda. The distance from Iringa to the Malawi border via Mbeya is about the same as from Mwanza to the Rwanda border, why the construction costs should be about the same. However, Malawi would offer a much higher demand for capacity than Rwanda.