INTEGRATED APPRAISAL OF A REGIONAL AFRICAN SATELLITE PROJECT

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Abstract

This paper reports on an integrated investment appraisal of a Pan African Development rural satellite projects. The project's main aim is to provide telecommunication services in rural areas of Africa on a large scale at very low costs by using appropriate technology. The objective is to complement the existing terrestrial fixed and mobile networks by providing satellite services to areas which cannot be served economically by terrestrial infrastructure. The project is expected to enhance inter-urban links within the borders of each African country and provide direct links between all African countries without exception. With the implementation of this project, the continent is expected to realize substantial savings of fees currently being paid out as transit charges for intra-African traffic. Another feature of the proposed satellite project is to facilitate television broadcasting, internet and other value-added services for telecoms, internet service providers, TV broadcasters and data content providers.

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APPRAISAL OF REGIONAL AFRICAN SATELLITE PROJECT (RASCOMSTAR-QAF)

PROJECT FEASIBILITY STUDY

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ABBREVIATIONS

ADSCR	=	Annual debt service coverage ratio
AfDB	=	African Development Bank, also “Bank”
BLS	=	Bandwidth lease service
CNS	=	Control and network station
CSM	=	Communication system monitoring
DSCR	=	Debt service coverage ratio
DVB	=	Digital video broadcasting
EIB	=	European Investment Bank
EIRR	=	Economic internal rate of return
EOCK	=	Economic cost of capital
EOCL	=	Economic cost of labor
FEP	=	Foreign exchange premium
FIRR	=	Financial internal rate of return
GDP	=	Gross domestic product
GPTC	=	General Post and Telecommunication Company
GSM	=	Global system of mobile communication
ICS	=	Integrated communication system
IOD	=	In-orbit delivery
IOT	=	In-orbit test
IsDB	=	Islamic Development Bank
LEOP	=	Low early orbit phase
LIBOR	=	London interbank lending rate
LAFB	=	Libyan Arab Foreign Bank
NPV	=	Net present value
MDG	=	Millennium development goal
MCC	=	Mission control center
O&M	=	Operation and maintenance
p.a.	=	Per annum
PTSN	=	Public switch telephone network
RASCOM	=	Regional African Satellite Communications Organization
RSQ	=	RascomStar-QAF
SCC	=	Satellite control center
SPNTO	=	Shadow price of non-tradable outlays
TES	=	Telephony service
TRS	=	Trunking service
VSAT	=	Very small aperture terminal

APPRAISAL OF REGIONAL AFRICAN SATELLITE PROJECT (RASCOMSTAR-QAF)

Project Feasibility Study

1. INTRODUCTION

Africa has a large disparity in per capita income, ranging from a high of over US$ 3,000 in South Africa and Mauritius to just US$ 80 in the neighbouring Mozambique. There is also a great disparity in basic telecommunication services on the continent. The services vary according to levels of sophistication, availability, and quality. While some countries witnessed progress in increasing telephone coverage in their respective countries, other countries such as Angola and Madagascar have experienced a decrease in teledensity in recent years. Due to lack of connectivity within and among African countries, compounded with its sparsely populated areas, Africa still pays one of the highest transit costs to foreign satellite operators for intra-African traffic. It is estimated that transit intra-continental telephone calls outside the continent cost African countries over US$ 900 million annually.[1]

There is also a great disparity in the public switch telephone network (PSTN), commonly referred to as "fixed telephony" in volume, availability, and quality. The fact that close to 80% of the population live in the rural areas where only 20% of the phones are installed illustrates just how seriously the telecommunication services are lacking for the majority of people in the region. Since early 1990s, the demand for both fixed and mobile telephone lines has been increasing rapidly. The average increase in annual demand for telephone services between 1995 and 2005 was about 22.47%. Telecom operators responded to this increase in demand by expanding their coverage but focused mainly on urban areas. Telephone service in rural communities has been neglected. In recent years many governments realized that they cannot achieve significant socio-economic developments without a good communication infrastructure, particularly in the rural areas. African governments and the development partners pledged to realize a sustainable information society by the year 2010 where every man and woman, school child, village, government office, business has access to information and knowledge resources through computers and telecommunications. Now five years into the millennium, this appears to be a largely unfulfilled dream.

In response to the problems facing African telecommunication operators in the late 1980's, it was proposed that a satellite-borne telecommunication infrastructure might be a partial solution. Hence the governments of Africa decided to join efforts and ordered a comprehensive feasibility study conducted by 600 African experts under the supervision of the International Telecommunication Union (ITU). The report adopted at the African telecommunication ministers' meeting in Abuja 1991 concluded that a dedicated satellite system is the best solution to meet the African requirement. In 1992, ministers responsible for telecommunication met in Abidjan, Ivory Coast and created the intergovernmental organization called Regional African Satellite Communications Organization (RASCOM). RASCOM is an inter-governmental organization created by 44 African countries to promote the development of telecommunications throughout the continent. RASCOM headquartered in Abidjan, Ivory Coast became operational in 1993. In 1997, following a notification and evaluation process, RASCOM identified a short list of four suitably qualified bidders for the

[1] International Federation of Library Associations and Institutions. Occasional Paper #7, 2000.

project: Alcatel S.A., Alenia Aerospazio, Comsat RSI and Hughes Space and Communications (now Boeing).

In 1998 Alcatel was selected as preferred bidder and began negotiating the Execution Agreement with RASCOM. The negotiations were successfully completed in 1999, when Alcatel started the development phase of the project and entered into discussions with a number of parties regarding the implementation of the project. In 2001, the RascomStar-QAF (RSQ) was created and registered in Mauritius. RascomStar-QAF (RSQ) is a "special purpose vehicle" company with the mission to provide interconnectivity and reliable services to all regions of the African continent. The services of the enterprise will be given to the existing and potential telecommunication companies on a commercial basis. Having access to the communication facilities provided by this proposed project, it is expected that the country telecoms will be able to expand their coverage and lower their transmission costs.

In carrying out its mission, RSQ has designed and ordered a geo-synchronous earth orbit satellite system to provide services throughout Africa from point to multipoint, including satellite trunking, broadcasting and telephony services. These services are designed to be fully integrated and complimentary to the existing PSTN. This would enable existing terrestrial operators to extend ground coverage at a low marginal cost, and to offer direct satellite communications where currently there is no ground infrastructure. RSQ will provide a combination of transponder lease and airtime capacity to ground operators who will, in turn, market and sell these services to the end users.

The project sponsors have submitted a request to the African Development Bank (AfDB) for financing the proposed project. This report presents the assessment of the proposed investment using an integrated approach that covers the evaluation of the financial, economic, stakeholder, and risk aspects of the project in a single consistent model. The evaluation of the satellite project is essentially the assessment of the incremental services provided only by this satellite and the substitution of services provided by other satellites that have higher transit cost to the African telecom operators.

As such, the proposed investment must be evaluated from the perspective of the RSQ as well as from the perspective of the telecom operators. From the RSQ's perspective, the approach allows us to examine the financial viability of the project and its ability to service its debt obligations. The analysis is further extended to evaluate the viability of the telecom operators' participation in the same satellite project.

The financial analysis of the proposed project is focused on the assessment of the role of the RSQ in providing satellite telecommunication services to the rural areas of Africa and savings in transits costs to the participating telecom operators. In addition, the financial model includes a projection of the RSQ's cash flows in order to examine its ability to service the debt repayments. Within the integrated appraisal framework, the economic analysis is built directly on the financial cash flows of the project and the telecom operators and the economic treatment of project benefits is measured by the savings in coping costs expressed in economic terms. This case-study report presents the analysis of the proposed project. Six specific questions need to be asked about the proposed RascomStar-QAF project:

1) Does the project ensure the least-cost way of expanding telecommunication services in Africa?
2) What is the magnitude of financial benefits realized by the RSQ and telecom operators?
3) What are the cash flow implications for the RSQ in terms of servicing its debt obligations?
4) To what extent does this project contribute to the African economy?
5) Who are the stakeholders and by how much do they benefit, or lose, as a consequence of this project?
6) What are the risk factors that affect the project and how can the uncertainty and risk exposure be mitigated?

2. PROJECT DESCRIPTION

The project's main aim is to provide telecommunication services in rural areas of Africa on a large scale at very low costs by using appropriate technology. The objective is to complement the existing terrestrial fixed and mobile networks by providing satellite services to areas which can not be served economically by terrestrial infrastructure. The project is expected to enhance inter-urban links within the borders of each African country and provide direct links between all African countries without exception. With the implementation of this project, the continent is expected to realize substantial savings of fees currently being paid out as transit charges for intra-African traffic. Another feature of the proposed satellite project is to facilitate television broadcasting, internet and other value-added services for telecoms, internet service providers, TV broadcasters and data content providers.

2.1 Project Components

The project consists of two components, the space segment and ground segment. The space segment component includes a geo-synchronous earth orbit satellite which will cover the entire African continent using two spot beams in Ku band and global coverage in C band; it also includes the associated ground control facilities, mission control center and communications facilities. The mission facilities consist of a mission control center (MCC) and communication system monitoring (CSMs). The mission center is used for planning, controlling and monitoring all customer services.

The ground segment includes centralized network stations, gateways and terminals. This network management system, operated by the RSQ, is in charge of the establishment of all communications (national, regional, continental and international). The centralized network station (CNS) establishes communication circuits between telecoms' terminals and gateways. They monitor the network elements and generate the data required for customer care and billing.

Gateways are owned and operated by the individual country telecom operators. They are generally installed near a PSTN switch and physically connect the space network to the operator's terrestrial network. Terminals are also owned by the telecom operators and deployed throughout the country. They provide the end-users with the integrated communication services. According to the needs, the satellite terminals may support only telephony service or also include internet access.

2.2 Project Costs

The construction of the satellite was started in 2003 and it is scheduled for launch in mid-2006. The total capital expenditure is approximately US$ 355.92 million. The components of the total costs and timing of expenditures are presented in Table 1. The cost of the satellite is US$ 119.8 million, the single largest component of project costs.

Table.1: Capital Expenditures by Category, Nominal (US$ million)

	Phase	2003	2004	2005	2006	2007	Total
Satellite	A	35.94	40.73	27.55	15.57	0.00	**119.80**
Launcher	B	0.00	0.00	2.00	46.50	7.00	**55.00**
Insurance	C	0.00	0.00	4.25	38.23	0.00	**42.48**
Ground control system	A	4.58	5.19	3.51	1.98	0.00	**15.26**
Launch campaign, LEOP, IOT/Scc/ttc (Ariane)	A	3.51	3.98	2.69	1.52	0.00	**11.70**
Ground design	D	1.06	3.18	0.00	0.00	0.00	**4.24**
Ground infrastructure development	E	0.00	0.00	10.21	32.99	0.00	**43.20**
Terminals	F	0.00	0.00	20.50	0.00	0.00	**20.50**
Other ICS and BLS development		0.00	0.00	4.69	1.56	0.00	**6.25**
Pre operating expenses		12.17	4.39	6.25	3.92	4.76	**31.49**
License fees		3.00	0.00	0.00	0.00	0.00	**3.00**
Contingencies		0.00	0.00	0.75	2.25	0.00	**3.00**
Total		**60.26**	**57.47**	**82.40**	**144.03**	**11.76**	**355.92**

Source: Analysys Consulting Limited, "Lenders' Model June 2nd 2005"

Satellite refers to the manufacture and delivery of the satellite into orbit by Alcatel Space, which will launch the satellite from a site in France.
Insurance is a contract signed with AON, an international insurance broker. It covers the cost of a replacement satellite in the event of failure of the first satellite during launch.
Ground Control System refers to the development and delivery of one satellite control center including spare parts and civil work.
Launch Campaign LEOP, IOT/Scct/ttc includes the cost of deploying equipment and engineers to sites under each beam prior to the in-orbit acceptance review.
Ground Design covers the development of the ground segment specifications prior to development.
Ground Infrastructure Development refers to Phase C/D contract with Alcatel. This includes the delivery of 1 network station, 20 rural terminals, and 2 gateways for field tests, a backup Network Station and training and other services.
Terminals refer to the purchase of 15,000 rural terminals to be provided free to telecom operators against an early commitment.
Other ICS and BLS Development covers the development of 2 control and service monitoring (CSM) stations for Bandwidth lease service.
Pre-operating expenses covers the right to occupy FT 3^0 orbit by the satellite.
A license fee refers to the execution agreement between RSQ and Rascom.
Contingencies are set aside to cover any unexpected cost during construction period.

2.3 Project Financing

Equity

Project sponsors include 44 African telecom operators, Alcatel Space, and General Post and Telecommunication Company (GPTC), a Libyan telecom operator. During the first round of financial completion in 2003, the shareholders raised US$ 86.27 million in equity. The second round of equity contribution was completed in 2005 amounting to US$ 65 million.

Libyan Arab Foreign Bank Loan

In addition to the equity contributed by the shareholders, RSQ requested a US$ 85 million loan from the Libyan Arab Foreign Bank (LAFB). The LAFB offered a 4-year grace period during which interest will be capitalized. After that the principal with the accumulated interest will be repaid in 6 annual installments.[2] It is assumed that an additional 2 years of grace period for the principal repayment is obtained and the actual principal repayments start in 2009.

Additional Loan

Additional loan facilities have been requested from the African Development Bank (AfDB), European Investment Bank (EIB), Islamic Development Bank (IsDB) and Proparco to complete the final phase of the project implementation. The AfDB, EIB, IsDB and Proparco together were asked to lend a total of US$ 126 million. The new loans will be repaid in 9 annual installments with a grace period of 3 years.[3]

Interest, Fees and Charges

A base interest rate of 3.40% real is to be charged on the loan from the LAFB and the additional loan facilities. A front-end fee amounting to 1% of loan amount is effectively deducted from the available loan amount at the time of signing the contract. Commitment charges, on the other hand, are 0.5% of the un-disbursed loan amount payable every year, even during the grace period. Table 2 provides the details of equity and debt financing for the RSQ project. [4]

Table 2: Equity and Debt Financing (US$ million)

Contribution				**Disbursement Schedule**						
Sponsor	**2003**	**2005**	**Total**	**Lender**	**2003**	**2004**	**2005**	**2006**	**2007**	**Total**
Rascom	25.00	5.00	**30.00**	LAFB	23.28	51.32	10.40			**85.00**
GPTC	43.52	7.00	**50.52**	AfDB				28.00	3.50	**31.50**
Alcatel	17.75	7.00	**24.75**	EIB				47.00	4.60	**51.60**
Others	00.00	46.00	**46.00**	IsDB				15.00	3.90	**18.90**
Total	**86.27**	**65.00**	**151.27**	Proparco				20.40	3.60	**24.00**

Source: Analysis Consulting Limited "Lenders' Final Model", Paris, France, June 2, 2005.

2.4. Satellite Services

The project will provide three categories of services to the whole of the African continent in which telecom operators play a critical element in the success of delivering services to the

[2] The assumption is subject change based on the results of the final negations with lenders.

[3] Analysys Consulting Limited, "Lenders' Final Model; Paris, France, June 2, 2005.

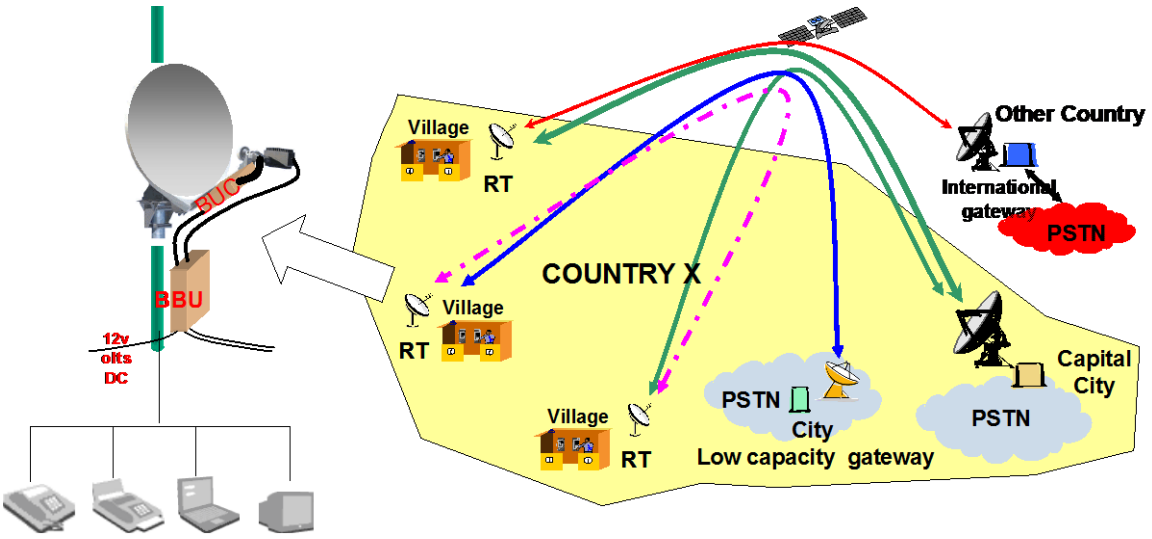
[4] Analysys Consulting Limited, "Lenders' Final Model, Paris, France, June 2, 2005.

end users. These three services are rural communication service, connectivity on-demand, and bandwidth leasing service.

2.4.1 Rural Communication (TES)

The satellite will allow the African telecom operators to expand their coverage over the hard-to-reach rural areas. Many rural regions are currently excluded from the network due to prohibitive cost of land-line linkage and sparse population density for wireless coverage. Telecom operators will deploy terminals in phone booths, tele-centers, private or residential sites in rural areas. The terminals will be interconnected through the satellite so that a phone call from one rural terminal goes directly to another rural terminal only passing through the satellite and gateway, hence avoiding completely the other public or private phone networks. In addition, gateways will provide an interface between terminals and the satellite, as well as link terminals to the existing public telephone networks. The scope of the services available to the end users through the terminal interface is the phone voice, TV, and internet access. Figure 1 illustrates the services provided by terminals and shows the link between the terminal and the existing networks. Any individual terminal in a remote rural area will be able not only link to the domestic phone network but also to establish a direct communication with any other country's network or any other rural terminal in Africa.[5]

Figure 1: Rural Communication Services (TES)



2.4.2 Connectivity On-Demand (TRS)

Through the satellite, participating African telecoms can link directly with each other, instead of resorting to costly international satellite facilities provided by third parties. This will allow direct interconnection of all calls between the existing PSTNs of African telecom operators and also with the outside world. In order to participate in the exchange, telecoms need to purchase and install gateways that will link their existing telephone networks with that of other countries via the satellite. Figure 2 illustrates the nature of the connectivity on-demand services. At present, telecoms have to route their international traffic through European and

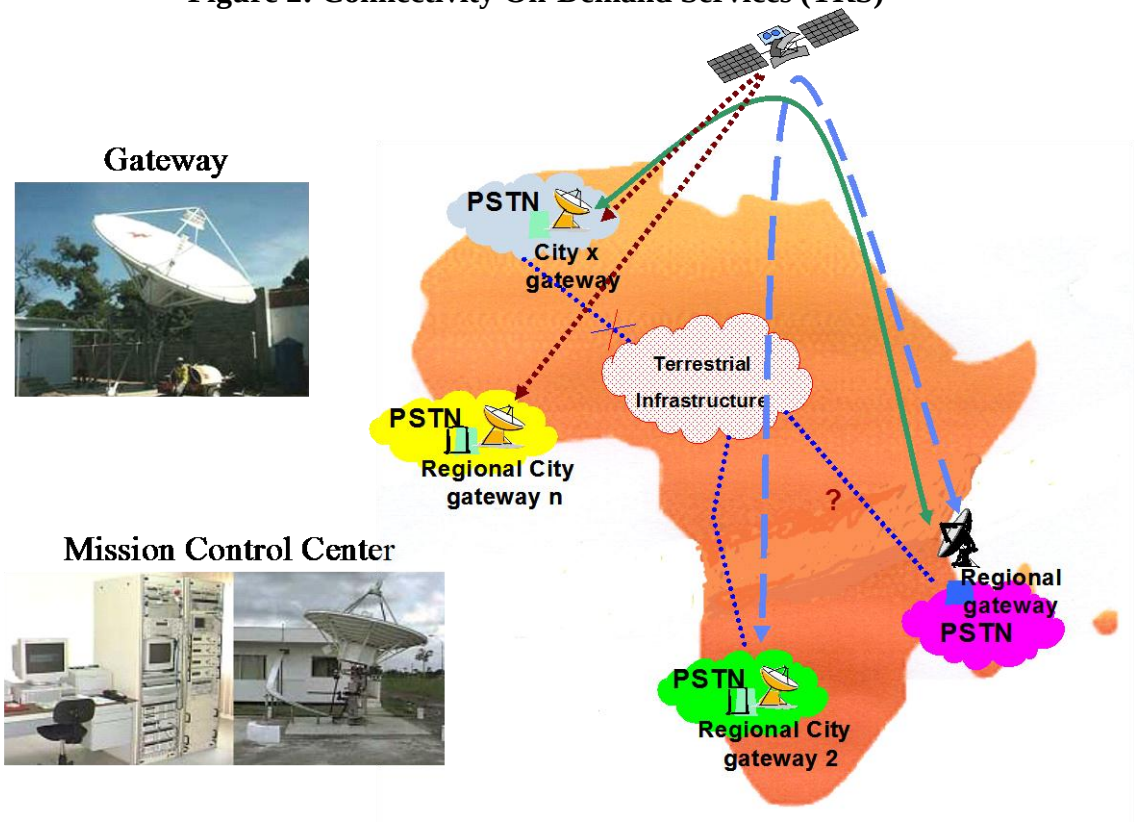
[5] International calls are possible provided that the two telecom operators have proper agreements to establish such calls.

US satellites, which results in a poor quality of service and high transmission costs to the operator and to the end users. No single existing satellite covers the whole surface of the African continent, and often an inter-African call has to go through two satellites.

2.4.3 Bandwidth Lease (BLS)

This service targets TV broadcasters, internet service providers (ISPs) and big corporations with fixed annual subscriptions. These services include trunking services for low and high rate links over the whole continent and also between Africa, Europe and Middle East, broadcasting, internet services, global system of mobile communication (GSM) backhauling, and other services such as very small aperture terminal (VSAT) for private or corporate networks and news gathering services. The satellite will provide a dedicated bandwidth for a period of time, and the customer will transmit the data from location to another. The satellite will be conveniently positioned for inter-continental transmission as well as for European and Middle East customers.

Figure 2: Connectivity On-Demand Services (TRS)



3. PROJECT REVENUES

The satellite will be equipped with 24 transponders that will transmit signals between the satellite and the ground networks. The allocation of the transponders among the three services is such that the priority is given to the TES transponders driven by demand from the telecoms. Then the TRS services are given a slot in the transponders according to the indicated demand by the telecom operators. Finally, the usage of TES and TRS transponders

will determine the capacity available for BLS. The number of transponders used for TES and TRS are projected and the remaining balance of transponders will be rented out to BLS subscribers. It is assumed that all transponders will be utilized at 85% of their capacity.[6]

3.1 TES Revenue

The gross revenue from TES services depends on the number of rural terminals and the average usage per terminal. The number of rural terminals to be deployed in the rural areas is based on the commitment expressed by telecom operators in each African country while the usage per terminal is estimated at 70 minutes per day in year one of operation, and 74 minutes thereafter.[7] The usage rate of terminals is not expected to increase more than 74 minutes per day for the rest of the project life. It is estimated that by 2008, the number of rural terminals deployed by telecoms will reach about 35,100 and gradually grow to 94,288 by 2012, and then will remain at this level throughout the project life. There are two rates for TES: domestic and international tariff. At the beginning of the operations, the real tariffs to telecoms are set at US$ 0.033 and US$ 0.086 per minute in 2007 for domestic and international calls, respectively.

3.2 TRS Revenue

The revenue from TRS is determined by the volume of traffic forwarded by the telecoms through the RSQ, which is expressed in minutes a year. The commitment from telecom operators is currently at a level of 103.8 million minutes for the first year of operation in 2007. It is assumed that by 2012, the demand for TRS will reach 559.0 million minutes a year. Then, the volume of traffic is assumed to grow by 20% between 2012 and 2021. The RSQ will charge telecoms US$ 0.051 real per minute for TRS transmission. It is assumed that the TRS tariff will also fall over time at a real rate of 7.32% a year.

3.3 BLS Revenue

The demand for BLS transponders in Africa has greatly increased in recent years. However, it is expected that in the near future the number of available transponders in Africa will actually fall because some of the existing satellites are reaching the end of their useful life and will not be replaced immediately. It is assumed that any excess transponders from TES and TRS can be sold to BLS subscribers on a short-term basis at a 15.0% discount. The transponders sold at a discount have an additional 5.0% loss of their useful capacity, as it is needed for switching of transponders from TES/TRS to BLS. Unlike TES and TRS, the revenue from BLS is determined by the number of transponders rented out to subscribers. The full rental charge for a BLS transponder is US$ 1.81 million in real (2005) prices per year. The discounted charge for the BLS transponders after switching from TES/TRS is US$ 1.54 million real a year. It is assumed that the real price of BLS transponders will fall at a rate of 2.5% per year.

3.4 Prices charged for TES and TRS and their movement over time

Due to technological advances and increased competition amongst the supplies of these services, over time, the prices of telephone communication services have been falling. It is estimated that the market or nominal price of TES and TRS expressed in US$ will fall at about annual rate of 5 percent a year.[8] If the general US price level increases at a rate of 2.5

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6 RSQ's Revised Business Plan April, 2005.

7 The data on the number of rural terminals and usage rate of the terminals are obtained from RSQ and Analysys Consulting Limited, "*Lender's Final Model, June 14 2005".*

8 Source: RSQ's Revised Business Plan 2005.

percent per annum due to inflation, thus the decrease in the real tariffs for TES and TRS will need to be 7.32 percent a year over the life of the project in order to yield the assumed 5 percent nominal decline.[9]

There is a high degree of uncertainty surrounding the rate of real price decline over time. If one considers the historical long distance telephone rates charged in the EU countries in the period 1991 to 2001, one finds that the annual reduction in these tariffs evaluated in real terms, have been more than 15 percent a year. In the same period, the local telephone rates (real) in Africa were falling at an annual rate of 6.2 percent. [10]

Increase competition in the telephone sector has tended to cause long distance telephone rates to fall while increasing the real rates for local services. In Africa however, even local telephone rates have been falling. Hence, the based case assumption of a fall in real tariff rates charged by the RSQ at a rate of 7.32 percent appears to be reasonable, but this issue is examined further in the sensitivity and risk analyses.

4. TELECOMS' INVESTMENT COST AND REVENUE

Telecom operators are an indispensable component of the project. Their commitment to the project is essential for the success of its implementation.

4.1 Investment Costs for Telecoms

To provide the intended services to the end users, telecom operators have to deploy ground infrastructure equipment to support the space segment. The ground segment includes rural terminals and gateways. Telecoms will purchase and install their own terminals and gateways directly from those suppliers approved by RSQ. Table 3 shows the unit cost estimates for a gateway and rural terminal.

Table 3: Unit Costs of Terminals and Gateways for Telecoms, 2004 Prices (US dollar)

Item	Unit Cost	Installation Cost	Transportation Cost
TES gateway	700,000	70,000	2,000
TRS gateway	300,000	30,000	2,000
Terminal	1,100	300	140

Source: RSQ,"Telecom Business Plan July 2004".

All terminals will have the basic telecenter equipment for recording call time and cost. Telecenter equipment costs US$ 288 each in 2004 prices. The final cost of a terminal depends on the additional equipment bundle installed on it. There are four options that are being offered to telecoms. The possible hardware configuration for terminals is as follows:

a) **Solar panel** allows the terminal to be powered independently from the electric grid. The additional cost is US$ 750 in 2004 prices per terminal. It is expected that 50% of the terminals will be equipped with this system.

[9] Source: RSQ's Revised Business Plan 2005.
[10] Source: World Bank Online Data www.devdta.worldbank.org

b) **BVD receiver** uses the second line for TV reception. The additional cost is US$ 150 in 2004 prices per terminal, and 25% of the terminals will have this feature.

c) **Fax and copier** can be added to the standard telephone equipment at an additional cost of US$ 500 in 2004 prices per terminal. It is expected that 12.5% of the terminals will use this option.

d) **Fax, copier and computer** is another possible combination that telecoms can select. The additional cost is US$ 1,500 in 2004 prices per terminal, and 12.5% of the terminals will have this option. [11]

4.2 Telecoms' Revenue

From the telecoms perspective, domestic TES services are treated differently for local calls and long-distance calls within the same country. The telecoms will charge the end users US$ 0.114 in 2005 prices per minute for local calls and US$ 0.152 per minute for long-distance calls. TES international calls will be charged to the end users at US$ 0.619 per minute. For TRS calls, telecoms will charge the users US$ 0.428 per minute at the start of operation in 2007. It is assumed that the real value of all tariffs to the end users will fall at a rate of 7.32% a year.

5 FINANCIAL APPRAISAL

5.1 Approach

The financial analysis constitutes the first part of the integrated analysis of this project. The prime focus of this analysis is to see whether the project is financially viable and bankable. The financial analysis of the project considers two perspectives, namely the total investment (banker's) perspective and the equity holder (owner's) perspective. For the equity holder, the appraisal examines the ability of the RSQ to generate enough cash to recover the investment costs and to provide a competitive return on equity. From the total investment, or banker's perspective, the analysis focuses on the capability of the RSQ to meet the debt repayment obligations. In addition to the stand-alone assessment of the project, it is necessary to evaluate the investment from the telecom operators' perspective. Since no debt financing of the telecoms' incremental costs is linked to the project financing of the RSQ, the analysis of the incremental impact on the participating telecoms is done only from the equity perspective of the operators. For the telecom operators, the appraisal looks into the telecoms ability to generate enough additional cash to recover their incremental capital and operating costs and to provide a target return on equity.

As the launching of the RSQ entails the expansion of telecommunication services into rural areas of Africa, the analysis accounts for revenues and expenditures relevant to the project that are incremental to what would have occurred "without the project". The central tool of the financial analysis is the cash flow statement, which projects the annual cash inflows and outflows over the life of the RSQ project from the perspective of its shareholders. The analysis serves to bring together the construction costs, operating costs, financial revenues and project financing into a single cash flow statement in order to determine whether the initial capital investment is justified from the owners' perspective. All cash flows are initially

[11] Source: Rascom,"Business plan for telecom operators".

estimated using nominal prices and then converted to real values using the price level of 2005 as the base year. Consistency is maintained between the rates of inflation used in the analysis and the annual interest rates. The financial viability of the RSQ is assessed by estimating the net present value (NPV) using the required rate of return on equity.

From the banker's perspective, the project's debt service ratios must be high enough so that even in adverse conditions there would be adequate cash flows to meet the scheduled debt service. Following the same logic, a cash flow statement for all participating telecoms is constructed including only incremental inflows and outflows relating to this project. Finally, the NPV of the net financial benefits is derived, using the appropriate target rate of return for the telecom operators.

5.2 Assumptions and Parameters

In order to conduct an effective financial analysis of the proposed project, a number of assumptions have to be made, based on the information obtained from the project sponsors.

RSQ Investment Costs

- The construction of the satellite began in 2003 and will be completed by mid-2006, as shown in Table 1.
- The total construction cost of the project is expected to amount to US$ 355.92 million in nominal prices; if expressed in 2005 prices, it is US$ 356.65 million.
- The project's life is considered to be 15 years after the launch of the satellite in 2006.

Investment Cost for Telecoms

- Telecoms are expected to start deploying terminals and gateways in 2007 when the satellite is launched.
- The total cost of terminals and gateways to all participating telecoms is estimated at US$ 298.1 million. Details of their unit costs are shown in Table 3 and number of terminals in Appendix A.
- Terminals donated by the RSQ are free to the telecom operators.
- All fixed assets for telecoms will be depreciated over 15 years based on their economic life.

RSQ Operating Costs

- Operation is expected to start in 2007 and last for 15 years. [12]
- Spare parts and equipment will cost US$ 2.26 million annually in 2005 prices.
- Marketing costs are estimated at US$ 0.65 million per year in 2005 prices.
- Annual manpower requirement starting from 2005 until 2021 is estimated to be 61 person-years.
- Annual insurance premium for the satellite is about 2.6% of the maximum value of either the outstanding debt or the satellite book value.
- Annual fee to Rascom is 1.2% of the annual gross revenue with a minimum of US$ 1.2 million.
- Bad debt is assumed at 1.4% of the accounts receivable held by RSQ at the beginning of each year

[12] Source: RSQ business plan and Analysys' report, "Lenders' Final Model Paris, France, 2005

Operating Cost for Telecoms

- Operation is expected to start in 2007 and last for 15 years.
- Maintenance cost is assumed at 15% of the capital cost.
- Manpower requirement is taken at 2 technicians for every 500 terminals deployed and 2 personnel for customer service of every 500 terminals.
- Bad debt for telecoms is assumed to be 10% of the accounts receivable annually.

RSQ's Working Capital

- Average collection time for bills from telecoms is assumed to be 12 weeks.
- Accounts payable are assumed to be 6 weeks of operating costs excluding labor expenses.
- Cash balance is assumed to be 15% of all the operating costs excluding labor.

Working Capital for Telecoms

- Average collection time for bills from the end users is assumed to be 12 weeks.
- Accounts payable are assumed to be equal to 12 weeks of the operating costs excluding labor expenses.
- The desired level of cash balances is assumed to be equal to 15% of all operating costs.

Taxation

- The corporate income tax for the RSQ will be 3.2% of the taxable income. There are no taxes or import duties on materials and equipment of the RSQ project.
- The average corporate income tax for telecoms in Africa is assumed to be 30% of taxable income.
- The average import duty on materials and equipment purchased by telecoms operators is assumed to be 25% of the cif prices of the items.

Inflation

- The annual US inflation is assumed to be 2.5% throughout the project's life.

Required Rates of Return

- The opportunity cost of capital for equity holders of the RSQ is assumed to be a real rate of 15%.
- The targeted return on equity for the telecoms is also taken as 15% real.

5.3 Feasibility of RSQ Project

Table 4 presents the projected cash flow statement for the project from the equity holder's point of view. The revenues of the project are basically the fees collected from the telecoms for TES, TRS and BLS provided. Some of the ground infrastructure will have a residual value at the end of operation. The change in the accounts receivable from the telecoms is also included in the cash inflow. On the expenditure side, the project has the initial investment costs of the satellite and the ground infrastructure, plus the operating costs of the project. The changes in the working capital are represented by the annual change in the stock of the payables and cash balance held. The project will pay income tax. The resulting net cash flow before financing is then compared with the scheduled debt service of all loans. The project's debt service rations are estimated at the bottom of Table 4.

The RSQ is a stand-alone project implying that the equity holders will expect to receive a rate of return on the project no less than their target real (net of inflation) rate of return on equity of 15 percent. In other words, the present value of the discounted net financial cash flow over the life of the project should not be less than zero. Table 4 shows that in the base case scenario the financial NPV of the project is US$ 72.6 million, using a real discount rate of 15%. The discounted net cash flows of the RSQ project for this case recover not only the investment costs of the project but also earn a return higher than 15% real. This is also shown by the financial internal rate of return (FIRR) of 20.6% real.

The annual debt service ratios of the proposed project shows that the annual net cash flows of the project before financing are above the debt repayments of the corresponding years.[13] The minimum net cash flow before financing is at least 178% of the scheduled debt payment. In all other periods, the project is expected to meet its debt repayment obligations. The debt service capacity ratios are all greater than one, indicating that the present value of the project's net cash flows over the period that there is outstanding debt are all greater than the present value of the interest and loan repayments.

[13] The annual debt service coverage ratios (ADSCR) are the ratios of the net cash flow of the project before financing over the amount of scheduled debt repayment in the current year. The debt service capacity ratio (DSCR) is defined as the present value of the cash flow before financing during the loan repayment period over the present value of the remaining debt obligations.

Table 4: Cash flow Statement: RSQ Equity Holder's Perspective, 2005 Prices (US$ million)

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
INFLOW																				
TES	-	-	-	-	1.9	29.6	57.9	67.8	66.7	62.3	57.7	53.5	49.6	45.9	42.6	39.5	36.6	33.9	31.4	-
TRS	-	-	-	-	5.3	8.8	16.3	19.7	19.6	19.5	19.3	18.4	17.4	16.4	15.5	14.6	13.6	12.7	11.8	-
BLS	-	-	-	-	38.2	34.0	28.3	25.0	23.5	22.5	21.5	20.7	20.1	19.5	18.9	18.3	17.8	17.3	16.8	-
Change in accounts receivable	-	-	-	-	-10.5	-6.6	-7.6	-3.2	-0.4	0.3	0.4	0.5	0.5	0.4	0.4	0.4	0.4	0.3	0.3	13.3
Residual value	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.0
Total Inflow	**-**	**-**	**-**	**-**	**34.9**	**65.8**	**94.9**	**109.2**	**109.5**	**104.6**	**98.9**	**93.1**	**87.5**	**82.2**	**77.3**	**72.7**	**68.3**	**64.2**	**60.4**	**18.3**
OUTFLOW																				
Investment Costs	63.1	59.2	82.4	140.5	11.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Operating Costs																				
General operating costs	-	-	-	-	13.1	12.9	12.9	11.9	10.8	9.7	8.6	7.6	6.6	6.0	5.5	5.0	4.8	4.6	4.5	-
Labor	-	-	2.7	2.7	2.7	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.9	2.9	2.9	2.9	2.9	2.9	2.9	-
Change in accounts payable	-	-	-	-	-1.5	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.5
Change in cash balance	-	-	-	-	2.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	-0.7
Income tax	-	-	-	-	0.0	1.0	1.7	2.1	2.1	2.1	2.0	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	-
Total Outflow	**63.1**	**59.2**	**85.1**	**143.2**	**27.8**	**16.7**	**17.4**	**16.8**	**15.7**	**14.5**	**13.4**	**12.3**	**11.3**	**10.6**	**10.0**	**9.4**	**9.1**	**8.9**	**8.6**	**-0.2**
NET CASH FLOW BEFORE FINANCING	**-63.1**	**-59.2**	**-85.1**	**-143.2**	**7.1**	**49.1**	**77.5**	**92.5**	**93.8**	**90.0**	**85.5**	**80.8**	**76.2**	**71.6**	**67.3**	**63.3**	**59.2**	**55.4**	**51.8**	**18.5**
Add: Loan disbursement	24.5	52.9	10.4	109.3	14.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Less: Loan repayment plus interest	1.2	0.1	0.0	1.3	3.2	2	43.4	40.6	37.9	35.3	32.8	30.4	14.0	13.0	12.0	-	-	-	-	-
NET CASH FLOW AFTER FINANCING	**-39.8**	**-6.4**	**-74.7**	**-35.3**	**18.8**	**47.4**	**34.1**	**51.8**	**55.9**	**54.7**	**52.7**	**50.4**	**62.2**	**58.6**	**55.3**	**63.3**	**59.2**	**55.4**	**51.8**	**18.5**

ADSCR	**-**	**-**	**-**	**-**	**-**	**-**	**1.78**	**2.28**	**2.47**	**2.55**	**2.60**	**2.66**	**5.44**	**5.52**	**5.62**	**-**	**-**	**-**	**-**	**-**
DSCR	**-**	**-**	**-**	**-**	**-**	**-**	**2.76**	**2.98**	**3.16**	**3.37**	**3.68**	**4.22**	**5.52**	**5.56**	**5.62**	**-**	**-**	**-**	**-**	**-**

FNPV @ ROE 15% Real: 72.6 US$ million
FIRR: 20.6% Real

5.4 Financial Impact on Telecoms Operators

The proposed project does not supply its services directly to the end users of the telecommunication services. Hence, the impact on the immediate customers of the RSQ, the participating African telecoms, must be examined in order to judge whether they would be willing to engage into the scheme. Table 5 presents the financial cash flow statement for all telecom operators participating in the project. This statement is based on the lenders' adopted conservative schedule of the telecoms' subscription to the RSQ. The inflows of the telecoms are essentially the incremental revenues from the resale of the services from the RSQ to the ultimate users. The change in the incremental accounts receivable is also added to the inflows as well as the residual value of the terminals and gateways. [14]

Among the incremental costs associated with this project, the telecoms would count the initial investment expenditures of gateway and terminal deployment and all operating and maintenance costs of running these facilities. The operators would also have to pay income tax on the net profit they earn from this activity. The resulting net cash flow represents the incremental net financial impact on all the participating telecom operators. The net present value, using a discount rate of 15% real, stands at US$ 89.4 million. In other words, there is substantial expected financial gain to the telecom operators who participate in the project. The financial rate of return of 37.7% real, resulting from using the services provided by the RSQ indicates a substantial return on the equity they need to contribute in order to use the services of the project.

5.5 Financial Sensitivity Analysis

Sensitivity tests carried out on key project variables indicated that the projected annual decrease in tariffs over the life of the project has a major impact on the project outcomes. Other variables that have a major impact on the project outcomes are: the initial tariff charged to telecoms for domestic TES, investment cost over-runs, the US inflation rate, daily traffic per terminal, the US$ real interest rate, the price of BLS transponders, and the number of rural terminals installed.

[14] The service life of both rural terminal and gateway is taken as 15 years, but the timing of installation will lead to a situation when the equipment installed after year 2007 will have some residual value at the end of the project in year 2021.

Table 5: Cash flow Statement: Telecoms Perspective, 2005 Prices (US$ million)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
INFLOWS																
Revenue																
TES	4.4	68.9	134.7	157.7	155.3	144.8	134.2	124.4	115.3	106.9	99.0	91.8	85.1	78.8	73.1	-
TRS	22.2	36.9	68.5	82.6	82.4	81.9	81.2	77.3	73.0	68.9	64.9	61.2	57.2	53.3	49.6	-
Total revenue	**26.7**	**105.8**	**203.2**	**240.3**	**237.7**	**226.7**	**215.4**	**201.8**	**188.3**	**175.7**	**164.0**	**153.0**	**142.3**	**132.1**	**122.6**	**-**
Change in accounts receivable	-6.2	-19.0	-25.5	-14.3	-6.2	-4.2	-3.8	-2.9	-2.6	-2.4	-2.2	-2.1	-1.8	-1.7	-1.5	24.8
Residual values	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50.6
Total Inflows	**20.5**	**86.8**	**177.8**	**226.0**	**231.5**	**222.6**	**211.6**	**198.9**	**185.7**	**173.3**	**161.7**	**150.9**	**140.5**	**130.5**	**121.1**	**75.5**
OUTFLOWS																
Investment Cost	20.0	41.2	107.3	54.1	16.3	2.5	0.8	0.4	0.2	0.2	0.2	0.2	0.1	0.1	0.0	-
Operating Cost																
Airtime cost	7.2	38.4	74.2	87.5	86.4	81.8	77.0	71.9	67.0	62.3	58.0	54.0	50.2	46.6	43.2	-
Operating & maintenance costs	3.0	9.1	25.0	32.5	34.1	33.7	33.0	32.2	31.5	30.8	30.0	29.3	28.6	28.0	27.3	-
Labor	1.5	3.8	8.0	10.2	10.9	11.0	11.1	11.1	11.2	11.3	11.3	11.4	11.4	11.5	11.5	-
Change in accounts payable	-2.7	-9.2	-13.2	-5.9	-1.0	0.4	0.5	0.7	0.7	0.6	0.6	0.5	0.5	0.5	0.4	18.5
Change in cash balance	1.8	6.0	8.6	3.8	0.7	-0.3	-0.3	-0.4	-0.4	-0.4	-0.4	-0.3	-0.3	-0.3	-0.3	-12.0
Income tax	4.5	16.2	28.1	31.7	30.3	28.5	26.8	24.5	22.2	20.1	18.2	16.4	14.6	12.9	11.3	-
Total Outflows	**35.2**	**105.4**	**238.1**	**213.8**	**177.6**	**157.6**	**148.9**	**140.4**	**132.3**	**124.9**	**118.0**	**111.5**	**105.1**	**99.1**	**93.5**	**6.5**
NET CASH FLOW	**-14.7**	**-18.6**	**-60.3**	**12.2**	**53.9**	**64.9**	**62.7**	**58.5**	**53.4**	**48.4**	**43.7**	**39.4**	**35.3**	**31.3**	**27.6**	**69.0**

FNPV ROE	**15%**	**Real:**	**89.4 US$ million**
FIRR:	**37.7%**	**Real**	

Annual Decrease in Real Tariff: TES and TRS tariffs to telecoms and end users are expected to decrease by 7.32% real per year, starting from the second year of operation. As shown in Table 6, the annual decrease in the tariffs has a major impact on both the RSQ and telecoms. If the real tariffs were to decrease by 10% real a year instead of 7.32% as expected, the RSQ's net present value will decline by US$ 37.1 million. This loss is equivalent to 10.2% of the investment value of the project.[15] The pace of tariff decrease has also an effect on the telecoms' NPV. With a 10.0% real annual decrease in the tariffs, telecoms' NPV drops by US$ 45.5 million, which is equivalent to 32.7% of the incremental investment value of telecoms participation.[16] This indicates that the RSQ's financial viability will be affected if tariffs decrease by more than the expected 7.32% real per annum. The annual debt service coverage ratios and the debt service capacity ratios are also sensitive to the pace of decrease in the tariffs rates.

Table 6: Sensitivity Test of Annual Decrease in Real Tariff Rates

Annual Decrease in Tariffs	FNPV RSQ (US$ m)	FIRR RSQ	ADSCR 2009	ADSCR 2010	ADSCR 2011	ADSCR 2012	ADSCR 2013	DSCR 2009	FNPV Telecoms (US$ m)
-2.00%	169.43	25.55%	1.94	2.61	2.98	3.23	3.46	3.61	208.94
-5.00%	110.50	22.80%	1.85	2.42	2.69	2.83	2.95	3.10	136.13
-7.32%	72.60	20.63%	1.78	2.28	2.47	2.55	2.60	2.76	89.42
-10.00%	35.47	18.05%	1.71	2.12	2.25	2.26	2.25	2.42	43.90
-15.00%	-18.80	13.05%	1.57	1.85	1.87	1.80	1.72	1.91	-23.81

Initial Tariff to Telecoms for Domestic TES: The impact of changes in the initial tariff rate for rural domestic TES on the project's the NPV, debt service ratios, and telecoms' NPV is presented in Table 7. Setting the right tariff for rural domestic communication service is important given the fact that tariffs are expected to decrease by 7.32% real per year. Another reason is that more than half of the RSQ's revenues are expected to come from this service. If the RSQ starts by charging telecoms below US$ 0.033 per minute, for example at US$ 0.030 per minute and tariffs decrease as expected, the project's NPV will fall by US$ 18.2 million, which is equivalent to a 5.0% loss of the investment value of the project. At the same time, there will be a boost in the telecoms' NPV by US$ 13.6 million.

Table 7: Sensitivity Test of Changes in Initial Tariff to Telecoms for Domestic TES

Initial Tariff Domestic TES (US$/minute)	FNPV RSQ (US$ m)	FIRR RSQ	ADSCR 2009	ADSCR 2010	ADSCR 2011	ADSCR 2012	ADSCR 2013	DSCR 2009	FNPV Telecoms (US$ m)
0.025	26.86	17.23%	1.54	1.94	2.10	2.17	2.23	2.36	123.56
0.030	54.43	19.33%	1.69	2.14	2.33	2.40	2.45	2.60	102.99
0.033	72.60	20.63%	1.78	2.28	2.47	2.55	2.60	2.76	89.42
0.040	109.47	23.07%	1.99	2.55	2.77	2.85	2.91	3.08	61.86
0.045	136.98	24.75%	2.14	2.75	3.00	3.08	3.14	3.32	41.29
0.050	164.48	26.32%	2.28	2.96	3.22	3.31	3.36	3.56	20.73

[15] The value of investment is equal to the present value of investment cost (initial asset value real). It is US$ 364.7 million for the base case.

[16] The value of invest for telecoms is the present value of incremental investment cost. It is approximately US$ 139.1 million for the base case.

Cost Over-runs: The sensitivity test on the investment cost over-runs in Table 8 shows that the financial viability of the RSQ and the telecoms are both affected by this parameter. A cost over-run of 5% will reduce the RSQ's NPV by US$ 7.7 million or 2.1% of the investment value of the project. An unexpected escalation in costs will also put the project financing in distress and reduce the value of the telecoms' investment in this satellite project. Thus, a 5% cost over-run in the investment costs of telecoms will make them lose US$ 10.9 million which is equivalent to 7.8% of their incremental value of project involvement. Table 8 shows the resulting financial outcomes under a range of possible cost over-runs. However, the high degree to which the cost of the satellite, the gateways and the rural terminals are now known due to fixed price contracts will greatly reduce the risk of there being large cost over-runs for the overall project.

Table 8: Sensitivity Test of Cost Over-runs

Cost Over-run Factor	FNPV RSQ (US$ m)	FIRR RSQ	ADSCR 2009	ADSCR 2010	ADSCR 2011	ADSCR 2012	ADSCR 2013	DSCR 2009	FNPV Telecoms (US$ m)
-10.00%	89.07	22.24%	1.78	2.28	2.47	2.55	2.60	2.76	111.19
-5.00%	80.78	21.40%	1.78	2.28	2.47	2.55	2.60	2.76	100.30
0.00%	72.60	20.63%	1.78	2.28	2.47	2.55	2.60	2.76	89.42
5.00%	64.92	19.95%	1.78	2.28	2.47	2.55	2.60	2.76	78.53
10.00%	57.25	19.29%	1.78	2.28	2.47	2.55	2.60	2.76	67.64
15.00%	49.57	18.66%	1.78	2.28	2.47	2.55	2.60	2.76	56.76
20.00%	41.90	18.04%	1.78	2.28	2.47	2.55	2.60	2.76	45.87
25.00%	34.22	17.44%	1.78	2.28	2.47	2.55	2.60	2.76	34.98

US Inflation Rate: The sensitivity test of the US inflation rate on the project and telecoms' financial outcome is presented in Table 9. An additional 1.0% increase in the rate of US inflation from 2.5% to 3.5% will decrease the RSQ's NPV by US$ 0.6 million, which is about 0.2% of the value of investment. A higher rate of US inflation will erode the debt service ratios of the project. Of course, the assumption about the interest rates charged on US$ loans are based on the assumption of the US having a rate of 2.5% annual inflation rate. In this analysis it assumed that the tariff rates charged by RSQ for the services, and the nominal interest rate charged on its debt will be fully adjusted for the change in the inflation rate. Any lag in the adjustment of tariffs for inflation will have a serious impact on its financial performance.

Table 9: Sensitivity Test of US Inflation Rate

US Inflation Rate	FNPV RSQ (US$ m)	FIRR RSQ	ADSCR 2009	ADSCR 2010	ADSCR 2011	ADSCR 2012	ADSCR 2013	DSCR 2009	FNPV Telecoms (US$ m)
1.00%	73.39	20.72%	1.90	2.37	2.51	2.53	2.52	2.74	89.44
1.50%	73.14	20.69%	1.86	2.34	2.50	2.53	2.55	2.75	89.48
2.00%	72.88	20.66%	1.82	2.31	2.49	2.54	2.58	2.75	89.47
2.50%	72.60	20.63%	1.78	2.28	2.47	2.55	2.60	2.76	89.42
3.00%	72.31	20.60%	1.75	2.25	2.46	2.56	2.63	2.76	89.32
3.50%	72.01	20.57%	1.72	2.22	2.45	2.57	2.66	2.77	89.19
4.00%	71.71	20.54%	1.69	2.20	2.44	2.58	2.70	2.78	89.03

Traffic per Terminal: The usage rate of rural terminals is a critical factor that has to be examined since about half of the total revenues are expected to come from TES. By observing the range of possible terminal utilization in Table 10, it is obvious that a drop in daily traffic from 70 to 60 minutes will result in a decrease in the project's NPV of US$ 25.8 million, which represents 7.1% of the investment value. The same reduction in traffic will result in US$ 23.2 million decrease in telecoms' NPV, which is equivalent to 16.7% of the incremental investment value for the participating telecoms.

Table 10: Sensitivity Test of Traffic per Terminal

Daily Traffic (minutes/terminal)	FNPV RSQ (US$ m)	FIRR RSQ	ADSCR 2009	ADSCR 2010	ADSCR 2011	ADSCR 2012	ADSCR 2013	DSCR 2009	FNPV Telecoms (US$ m)
50	20.90	16.75%	1.50	1.88	2.05	2.12	2.18	2.31	43.07
60	46.77	18.77%	1.64	2.08	2.26	2.33	2.39	2.53	66.24
70	72.60	20.63%	1.78	2.28	2.47	2.55	2.60	2.76	89.42
80	98.41	22.36%	1.93	2.47	2.69	2.77	2.82	2.98	112.59

Loan Interest Rate: Table 11 shows the results of a sensitivity test on the base interest rate for the additional loan requested from the project lenders. If the real interest rate charged is increased to 4.0%, the financial NPV of the RSQ will decline by about US$ 4.5 million from US$ 72.60 million to US$ 68.13 million. This represents a loss equivalent to 1.2% of the value of the investment in the project. The telecom operators are essentially not affected by this parameter as expected. A higher lending rate will reduce the debt service ratios for the RSQ, since a larger amount of the project's net cash flows have to be spent on loan repayments.

Table 11: Sensitivity Test of Real Interest Rate

Annual Real Interest Rate	FNPV RSQ (US$ m)	FIRR RSQ	ADSCR 2009	ADSCR 2010	ADSCR 2011	ADSCR 2012	ADSCR 2013	DSCR 2009
1.00%	89.53	21.88%	2.19	2.75	2.94	2.98	2.99	3.28
2.00%	82.65	21.37%	2.00	2.54	2.73	2.79	2.82	3.05
2.50%	79.12	21.11%	1.92	2.44	2.64	2.70	2.74	2.94
3.00%	75.52	20.85%	1.84	2.35	2.54	2.62	2.66	2.84
3.40%	72.60	20.63%	1.78	2.28	2.47	2.55	2.60	2.76
4.00%	68.13	20.29%	1.70	2.18	2.37	2.46	2.52	2.65
5.00%	60.47	19.72%	1.57	2.02	2.22	2.31	2.38	2.47

BLS Transponder Price: A sensitivity test on the price of a BLS transponder charged by the RSQ to institutional subscribers is carried out and the results are presented in Table 12. In the early years of operations, there is low demand for TES and TRS and the project will largely rely on the revenues from BLS transponders rented out to subscribers. If the price per BLS transponder were to fall, say from US$ 1.81 million per transponder to US$ 1.50 million nominal, the NPV of the project will decrease by about US$ 24.1 million. This loss represents about 6.6% of the value of the project's investment.

Table 12: Sensitivity Test of Rental Price per BLS Transponder

BLS Price (US$ million/transponder)	FNPV RSQ (US$ m)	FIRR RSQ	ADSCR 2009	ADSCR 2010	ADSCR 2011	ADSCR 2012	ADSCR 2013	DSCR 2009
0.75	0.21	15.02%	1.41	1.92	2.12	2.19	2.24	2.33
1.00	17.34	16.38%	1.50	2.01	2.21	2.28	2.32	2.43
1.50	51.46	19.03%	1.67	2.17	2.37	2.45	2.50	2.63
1.81	72.60	20.63%	1.78	2.28	2.47	2.55	2.60	2.76
2.00	85.55	21.59%	1.85	2.34	2.54	2.61	2.67	2.84
2.50	119.59	24.06%	2.03	2.50	2.70	2.78	2.84	3.04

Reduction in RSQ Total Revenue: The sensitivity test of a reduction of RSQ's gross revenue from all three types of services is presented in Table 13. If for any reason the RSQ's gross revenue falls by 5%, the NPV of the project will decrease by US$ 20.7 million which is equivalent to a 5.7% loss of the project's investment value. The project will have a negative NPV if the gross revenues decrease more than 18.0%. In terms of debt service, the RSQ will be able to pay off the debt repayments timely as long as it's expected gross revenues are not reduced below 20.0%.

Table 13: Sensitivity Test of Reduction in RSQ's Gross Revenue

Reduction in Gross Revenue	FNPV RSQ (US$ m)	FIRR RSQ	ADSCR 2009	ADSCR 2010	ADSCR 2011	ADSCR 2012	ADSCR 2013	DSCR 2009
0.00%	72.60	20.63%	1.78	2.28	2.47	2.55	2.60	2.76
5.00%	51.87	19.12%	1.68	2.14	2.33	2.40	2.45	2.60
10.00%	31.15	17.54%	1.57	2.01	2.19	2.25	2.30	2.44
15.00%	10.42	15.87%	1.46	1.87	2.04	2.11	2.15	2.28
18.00%	-2.02	14.83%	1.39	1.79	1.95	2.02	2.06	2.18
20.00%	-10.31	14.11%	1.35	1.74	1.90	1.96	2.00	2.12

Break-even Number of Terminals: In the base case of financial analysis, built on the conservative schedule of terminal deployment endorsed by the telecom operators, the expectation is that the maximum number of terminals will not exceed 94,288 terminals. This sensitivity test challenges this expectation by examining the ability of the project to withstand a possible reduction in the number of terminals installed and actually used. As Table 14 shows, for the project to break-even, assuming that all excess transponders from TES and TRS are not utilized by BLS subscribers, there has to be at least 52,051 terminals deployed. If the actual number of terminals installed and used is more than that, the project's NPV will become positive. For example, in a case telecoms were able to deploy 70,000 terminals; the NPV of the project will be US$ 42.48 million. The project will be able to make annual payments of its loans as long as the number of terminals installed is above 40,000. If the actual deployment is less than that level, ADCRS in year 2009 will be lower than one.

Table 14: Sensitivity Test for Number of Terminals Installed

Number of Terminals Installed	FNPV RSQ (US$ m)	FIRR RSQ	ADSCR 2009	ADSCR 2010	ADSCR 2011	ADSCR 2012	ADSCR 2013	DSCR 2009	FNPV Telecoms (US$ m)
40,000	-28.66	12.35%	1.35	1.50	1.57	1.64	1.71	1.85	13.51
45,000	-16.77	13.47%	1.43	1.58	1.65	1.72	1.79	1.95	24.30
52,051	0.00	15.00%	1.55	1.70	1.77	1.83	1.90	2.08	39.52
55,000	7.01	15.62%	1.60	1.75	1.82	1.88	1.95	2.13	45.88
65,000	30.71	17.63%	1.77	1.91	1.98	2.04	2.11	2.31	67.46
70,000	42.48	18.59%	1.85	1.99	2.06	2.12	2.19	2.41	78.25
75,000	54.25	19.52%	1.94	2.07	2.14	2.20	2.27	2.50	89.04
80,000	66.01	20.42%	2.02	2.16	2.23	2.28	2.35	2.59	99.83

Transponder Availability: The base case assumption about the availability of transponders in the satellite is 100 percent. In the sensitivity analysis, this assumption is challenged to determine the effect of possible ranges of transponder availability on the project outcome. The technical reliability of the satellite is very critical since the amount of revenues generated by the RSQ and telecoms are determined by the volume of services transmitted by the satellite. Table 15 presents the effects of possible ranges of transponder availability of the satellite on the RSQ and telecoms' financial outcomes. If there are technical failures in the satellite that cause transponder failures 5% of the time during the operation period, the NPV of the project will fall by US$ 19.9 million. This loss is equivalent to 5.4% of the value of the investment by the project. The same reduction in transponder availability will reduce the NPV of the participating telecoms by US$ 15.1 million which is equivalent to 10.9% of their investment value in this project.

Table 15: Sensitivity Test for the Availability of Satellite Transponders

Availability Factor (Satellite transponders)	FNPV RSQ (US$ m)	FIRR RSQ	ADSCR 2009	ADSCR 2010	ADSCR 2011	ADSCR 2012	ADSCR 2013	DSCR 2009	FNPV Telecoms (US$ m)
0.50	-126.92	1.64%	0.73	0.76	1.07	1.13	1.15	1.15	-61.63
0.65	-67.18	8.70%	1.06	1.37	1.50	1.55	1.59	1.68	-16.31
0.75	-27.05	12.61%	1.26	1.63	1.78	1.84	1.88	1.99	13.90
0.85	12.93	16.08%	1.47	1.89	2.06	2.12	2.17	2.30	44.10
0.95	52.73	19.18%	1.68	2.15	2.34	2.41	2.46	2.61	74.31
1.00	72.60	20.63%	1.78	2.28	2.47	2.55	2.60	2.76	89.42

Break Even Analysis: In addition to the sensitivity analysis that has been carried out above, a break-even analysis of some of the critical variables is also carried out on the RSQ and telecoms' financial outcomes. The financial NPV of the RSQ break even at the following levels: increase of investment cost overruns of +47%; traffic per terminal of 42 minutes/day, annual real decrease in tariffs of 13.1%. The financial break-even points for the telecoms taken together are: +41% cost over-runs, annual decrease in tariffs 13.1%, and a daily traffic of 31 minutes/terminal.

6. ECONOMIC APPARAISAL

6.1 Approach and Parameters

The economic analysis measures the economic impact of the proposed project on the economy as a whole. In the case of this particular project, the economic analysis is carried out from the point of view of the economy of the African continent rather than from the perspective of a single country. Since the RSQ is partly financed by external funds to Africa, any profits generated by the project and transferred out of the African continent would not accrue to African countries. The remaining profit is attributed to the share of the equity contributed by Rascom and GPTC. This share of the benefits, amounting to approximately 53 percent of the total should be accounted for as part of the economic net benefit to this project. The remaining 47 percent should be netted out of the economic benefits. The task of the evaluation is to examine if the RSQ project would generate a positive net economic benefits to the people of the African continent as a whole. The relevant discount rate for the economic resource flow statement is the economic opportunity cost of capital (EOCK) that was taken as 11% real. [17]

The prices of all outputs and inputs in the economic analysis are measured in economic terms. To ensure a consistent transformation from the financial model to the economic analysis, economic conversion factors for most of the cash flow items are calculated in order to arrive at the economic value of the corresponding item in the economic resource flow statement. The economic value of the project's output, telecommunication services, is estimated on the basis of the consumers' willingness to pay.

Project inputs belong to either international tradable goods or goods and services whose prices are determined only by the local market. For tradable goods, such as equipment, machinery, steel, and fuel, used by the project and telecoms, the value of foreign exchange premium has to be accounted for because the economic price of foreign exchange differs from the market price. Expenditures on non-tradable goods such as bricks, freight, and electricity are adjusted for a series of tax distortions as well as for the shadow price of non-tradable outlays (SPNTO). For Africa as a whole, the foreign exchange premium is estimated at 9% and the shadow price of non-tradable outlays (SPNTO) is taken at 1%.

6.2. Economic Value of Telecommunication Services

One of the most important considerations in the evaluation of this project is to measure the economic value of telecommunication services provided to the telecom operators, end users and bandwidth subscribers. The provision of satellite telecommunication services will affect largely three groups of users: rural communities who currently do not have access to telecommunication services, the users of existing public telephone services, and participating African telecom operators. An important element of the economic evaluation is the user's willingness to pay for the service which is used to measure the economic value of the three types of services provided by the RSQ. This is especially important as the project provides telecommunication services to rural areas

[17] While no specific analysis was done in regard to estimation of the economic opportunity cost of capital (EOCK) for Africa, a comprehensive study was carried out for South Africa. The EOCK for South Africa was estimated to be equal to a real rate of 11%. The same rate was used for the whole of Africa for the purpose of this analysis. See Kuo, C.Y., Jenkins, G. P. and Mphahlele, M.B. "The Economic Opportunity Cost of Capital in South Africa", South African Journal of Economics, September 2003.

which were never served before. Although even without this satellite, it is likely that sometime in the future they would get telephone services from another source. In the case of services that are currently provided to the users of the existing PSTN, both African telecoms and end users are going to benefit from cheaper intra-Africa and international connection tariff rates charged by the project. In the economic analysis, these benefits need to be properly accounted for, while converting the financial cash flow statement into the economic resource flow statement.

6.2.1 Telecom Operators (TRS)

At present, the telecoms purchase airtime from other satellites and resell them to the ultimate users. By implementing the project, the telecom subscribers to the RSQ will benefit as a result of a reduction in the costs they would have otherwise paid to other satellite service providers. In the case of TRS, the net economic benefits can be measured by the cost savings enjoyed by the telecoms because the RSQ is expected to charge them a price for the satellite service that is less than what they would have to pay elsewhere. Using Figure 3 as an illustration, it is clear that telecoms operators will witness a reduction in unit cost from P_0 (US$ 0.069 per minute in 2005 prices) to a level of P_1 (US$ 0.051 per minute) that would be charged by the project. As a result, the quantity demanded of international calls for PSTN users would increase from Q_0 to Q_1. The net economic benefits can be measured by the area P_1P_0DC.

The end users are, in fact, the driving force behind the demand for telecommunication services. The people who are currently connected to the existing PSTNs will benefit from the reduction in tariff rates due to the project. They will pay less for the existing services and may consume more services at a lower rate. This is assuming that the telecoms operate in enough of a competitive environment so that the cost reduction they achieve will be passed on fully to the end users. Telecoms now charge the end users a tariff T_0 per minute but as a result of this project, the price charged to the end users would be lower, T_1 per minute. One would expect that most of the cost savings by the telecoms would be passed through to end users by way of price reductions. The net economic benefit to the end users will be measured by T_1T_0FE, which is exactly the same amount as the gain by the telecoms.[18] This will occur during the same time period, say a year. The increase in demand for telecommunication services as a result of tariff reduction can be estimated by using an estimate of the elasticity of demand for the telephone services. The elasticity of demand for such telephone services is approximately -0.5.[19]

In a competitive market, a reduction of the tariff rates will take place over time, and so will alternative coping costs regardless to what happens to the RSQ project. As a result, all rates are expected to decline as the project is expected to improve the well-being of the African consumers. It is expected that new technologies will emerge in the future and therefore, the economic benefits that should be attributed to this project in terms of the cost savings enjoyed by the rural and PSTN users should be reduced as time passes.

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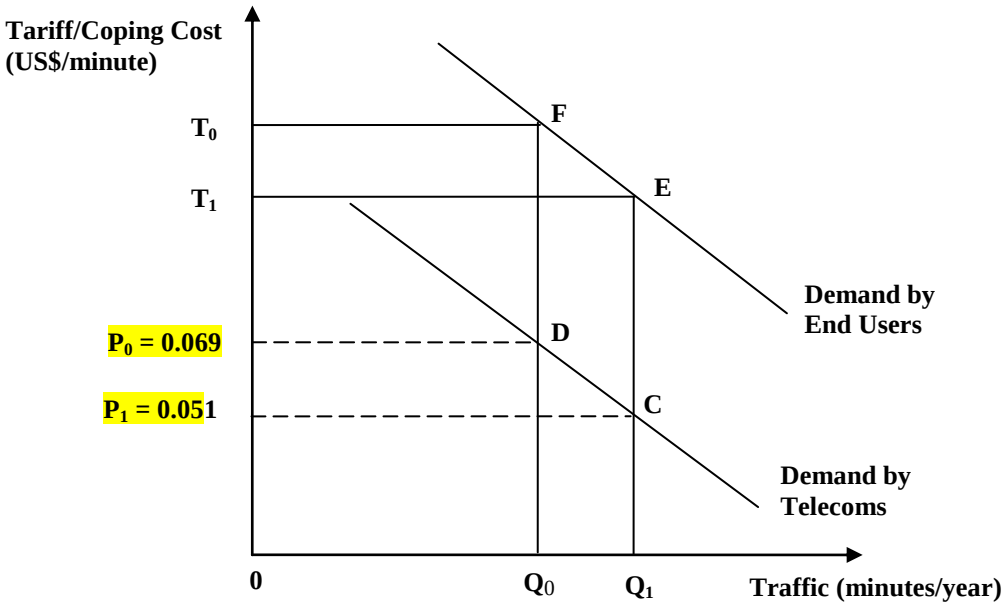
[18] In calculating the value of net economic benefits, the foreign exchange premium associated with the savings is accounted for.

[19] Vodaphone "Review of Price Elasticities of Demand for Fixed Line and Mobile Telecommunication Services" 2003. www.comcom.govt.nz/industryregulation/telecommunications/telecommunicationservicesobligations

Figure 3: Economic Value of TRS Service for Telecoms and End Users For a Given Year (2007)



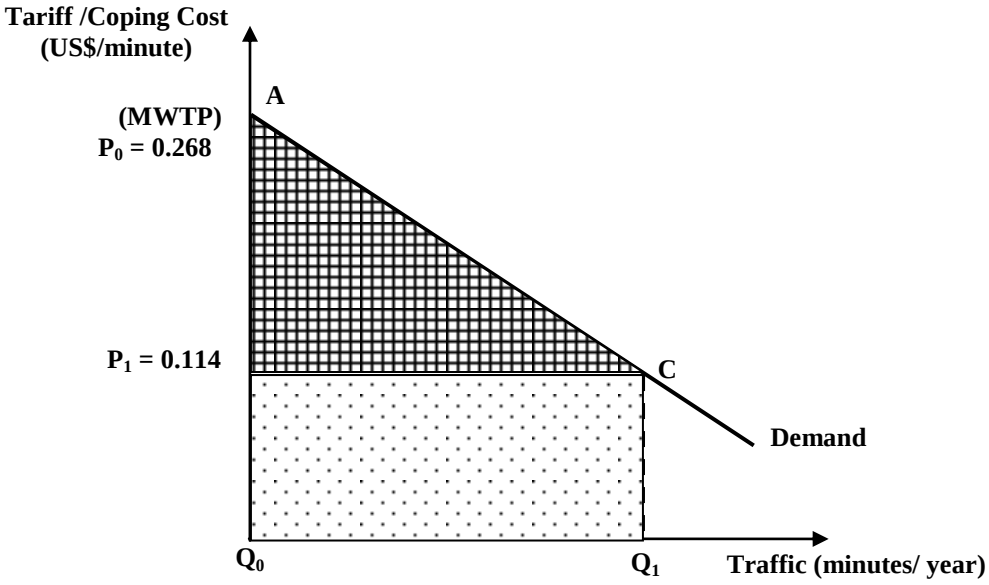
6.2.2 End Users (TES)

For the end users, the telecommunication services provided by the RSQ include both TES and TRS. In the case of TES, the services provided are domestic and international telephony. Since at present there is virtually no telephone service in rural areas at the moment, all telephone calls are a result of this project. The net economic benefits of incremental services to end users can be measured by the area ACP_1 as shown in Figure 4, in which A stands for the maximum willingness to pay (MWTP). In the absence of the project, people living in rural areas have to engage in costly means such as traveling or sending mail.[20] In the case of domestic calls, rural customers will pay a tariff of P_1 (e.g. US$ 0.114 per minute in 2007) to a local telecom operator. The volume of service demanded at this tariff level is Q_1. By paying tariff P_1 per minute, the end users enjoy a net gain which is measured by the area P_1AC. For international TES calls, the net economic benefits for rural customers are valued in a similar fashion, and the corresponding values for P_0 and P_1 are estimated at US$ 1.445 and US$ 0.619 per minute, respectively. New technologies are expected to emerge in the future and the reduction in coping cost would be greater than the reduction in tariffs charged by telecom operators. It is assumed that the coping cost will decline by 9% per year for TES and as a result, the

[20] To estimate the maximum willingness to pay or coping costs of telephone service for people in rural areas, it is typically examined what people in similar circumstances have shown what they are willing to pay. In carrying out this analysis a very conservative evaluation of what people are willing to pay is adopted. Let's begin by postulating that the wealthiest customers that will receive the telephone service now in the rural areas have approximately the same (or likely higher) income than the marginal users of telephone services elsewhere in the country had 10 years ago. Furthermore, we know that the local telephone rates 10 years ago were 2.35 times the rates that are going to be charged to the rural customers. Hence we set a value of the maximum willingness to pay equal to 2.35 times the tariff of US$ 0.114 per minute or US$ 0.268 per minute.

economic benefits attributed to this project in terms of cost savings will decline through time. All prices are expressed in terms of the 2005 price level.

Figure 4: Economic Value of TES Local Calls for Rural Customers



6.2.3 Bandwidth Subscribers (BLS)

A market survey for BLS has indicated that the supply of transponder capacity over Africa will be eroded gradually over the next five years since some of the satellites will reach the end of their useful life.[21] As a result, there is a strong demand for additional BLS transponders. With the project, there will be some additional transponders available because of relative low demand for both TES and TRS in the early stages of operation, and consequently the excess transponders can be used for BLS during that time. In terms of valuation of the additional capacity provided by the RSQ, it is all incremental to the existing transponder capacity in Africa. At the present time, the rental cost of a transponder in the market is US$ 2.38 million per year in 2007. The price to be charged by the RSQ is US$ 1.81 million per year. The real tariff rate for BLS is assumed to fall at a rate of 2.5% a year.

As it was pointed out earlier, the tariffs charged by RSQ for TES and TRS will decline over time at a rate of 7.32% real per year, which corresponds to a 5.0% nominal decline, in the presence of general the inflation rate of 2.5% per annum.[22] As a result of market competition, one would expect a decline in the coping costs of all services to telecoms and end users in the same proportion over time. Table 16 summarizes the tariff information related to the TES, TRS, and BLS provided by the RSQ.

[21] Analysis report, "Lenders' Model Paris, France, June 2, 2005.
[22] Analysys Consulting Limited "Lenders' Preliminary Report Paris, France, June 2, 2005.

Table 16: Tariffs and Coping Costs for Telecommunication Services, 2007

Service	Telecom Operators		End Users	
	Tariff Charged to Telecoms	Cost Savings of Telecoms	Tariff Charged to End Users	Coping Savings of End Users
TES: Domestic local	US$ 0.033	Not Applicable	US$ 0.114	US$ 0.268
TES: Long distance	US$ 0.033	Not Applicable	US$ 0.152	US$ 0.358
TES: International	US$ 0.086	Not Applicable	US$ 0.619	US$ 1.447
TRS	US$ 0.051	US$ 0.069	US$ 0.428	US$ 0.446
BLS	US$ 1.81 million	US$ 2.38 million	Not Applicable	Not Applicable

Source: RSQ management June 2005**.**

6.3 Economic Value of Cost Items

All financial investment and operating costs are converted to economic values using the principles of applied welfare economics. They are briefly discussed below.

Investment Costs: The investment cost items for this project and for telecom operators are mainly imported commodities with the exception of the ground control system, ground infrastructure development and ICS/BLS facilities. For this particular project, all imported inputs are exempted from import duties and other indirect taxes. For tradable items, the values of foreign exchange premium have to be incorporated. For the non-tradable components, such as the ground control system, ground infrastructure development and ICS and BLS facilities, the analysis looks at the distortions in the inputs markets (i.e., taxes and subsidies on the goods and services used in these items) and also accounts for the shadow price of non-tradable outlays.[23] Hence, tradable inputs attract both import duties and indirect taxes, while non-tradable inputs are only subject to indirect taxes.

RSQ Operation and Maintenance Costs: The main components of these expenditures are replacement parts and equipment necessary to ensure a smooth operation of the satellite monitoring and control centers and network stations of the project. Since there are no other distortions on the operating inputs, it is only the value of foreign exchange premium that has to be factored in the estimation of the economic cost of all these items.

Telecoms operating and Maintenance Costs: The main component of the telecoms' operating and maintenance cost are the airtime cost they pay to the RSQ and expenditures on the importation of spare parts for terminals and gateways. In the case of airtime cost, this is not counted as an economic resource cost to the continent because this payment is made to the RSQ. The value of foreign exchange premium is applied on all the other operating costs in order to derive their economic values.

[23] The detailed explanation for non-tradable goods can be found in Cambridge Resources International, Inc, Integrated Investment Appraisal: Concepts and Practices, prepared for the Department of Finance and Economic Development, Limpopo Provincial Government, Republic of South Africa, (2005), Appendix F.

Labor: The economic cost of labor (EOCL) employed by the project is estimated using the supply price approach. The approach starts with the wage paid by the project and adjusts for all applicable personal income taxes and social security contributions to arrive at the economic opportunity cost of labor. [24] The average rate of personal income tax and social security contributions are assumed to be 20% and 10%, respectively.

Summary of Economic Conversion Factors

The resulting economic conversion factors (CFs) are summarized in Table 17. Multiplying these conversion factors by the corresponding cash flow items in the financial statement of the project and telecoms will arrive at the economic values for the economic resource statement.

Table 17: Economic Conversion Factors

Item	CF
RSQ	
Satellite / Launcher / Insurance/ launch campaign / Ground design / Terminals / Pre-operating expenses / License fees / Contingencies	**1.090**
Ground control system/Ground infrastructure development / ICS & BLS development	**0.927**
Residual values RSQ	**0.927**
Maintenance & Miscellaneous Exp. / Marketing / Ground infrastructure & technical costs /	**1.090**
Change in cash balance	**1.000**
Labor	
Management/Engineers/ Marketing & Sales	**0.935**
Technicians/ Support staff	**0.892**
Telecoms	
Terminals equipped with solar panel	**0.958**
Terminals equipped with DVB receiver	**0.923**
Terminals equipped with telephone fax copier	**0.946**
Terminals equipped with telephone fax copier & computer	**0.986**
TES gateway/ TRS gateway	**0.876**
Residual values/ Maintenance cost	**0.940**
Labor	
Technical staff	**0.963**
Headquarters	**0.967**

[24] The EOCL is equal to the willingness of people to supply labor for the project activities, net of taxes and social security contributions: EOCL = Gross Income^{Project} – Soc.Security^{Project} – [Taxes^{Project} – (Taxes^{Alternative} * Share^{Alternative}) – Soc.Security^{Alternative}].

6.4 Economic Feasibility of Project

Once all items in the financial cash flow statement are adjusted to their corresponding economic values, the economic resource flow statement of the project is constructed and presented in Table 18. The economic benefits of the project services are basically the economic values of telecommunication services, TES, TRS, and BLS, presented in Section 6.2. In addition, the changes in the accounts receivable and residual values are counted as part of the project-related benefits. The economic costs are represented by the initial investment costs incurred by both the project and the participating telecoms operators. The labor, operating, and maintenance costs of both the project and telecoms are also included. Finally, the changes in the accounts payable and cash balance are added to the costs. These costs are all described in Section 6.3.

The resulting net resource flow indicates the net contribution of the project to the African economy. In order to estimate the economic NPV of the proposed project, the flow of annual net benefits is discounted by the economic cost of capital, taken as 11% real. The NPV of the net economic benefits yields US$ 2,285.2 million. This result indicates that the net economic impact accruing to the African users, telecoms and African population is significantly greater than the alternative use of the resources employed by the project for launching the satellite and maintaining the necessary ground infrastructure over time.

Table 18: Economic Resource Flow Statement, 2005 prices (US$ million)

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
BENEFITS																				
TES	-	-	-	-	14.9	227.8	439.7	508.2	494.1	455.2	416.7	381.5	349.2	319.7	292.7	268.1	245.5	224.8	205.9	-
TRS	-	-	-	-	50.4	83.6	155.2	187.0	186.7	185.4	183.9	175.2	165.3	156.0	147.1	138.7	129.6	120.7	112.3	-
BLS	-	-	-	-	48.4	42.8	36.8	33.3	31.7	30.6	58.7	85.8	111.6	136.0	159.1	181.0	24.2	23.5	22.9	-
Change in accounts receivable	-	-	-	-	-26.2	-55.5	-64.0	-22.4	3.7	9.5	2.8	3.9	3.8	3.3	2.9	2.6	43.5	7.0	6.5	78.7
Residual values	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52.3
Total Benefits	**-**	**-**	**-**	**-**	**87.4**	**298.7**	**567.7**	**706.2**	**716.3**	**680.8**	**662.1**	**646.3**	**629.9**	**615.0**	**601.9**	**590.3**	**442.7**	**376.0**	**347.5**	**131.0**
COSTS																				
INVESTMENT COSTS																				
RSQ	67.9	63.6	86.8	147.2	12.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Telecoms	-	-	-	-	18.9	38.5	101.4	51.0	15.4	2.3	0.7	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.0	-
OPERATING COSTS																				
RSQ																				
Operating & maintenance costs	-	-	-	-	14.3	14.1	14.1	13.0	11.8	10.5	9.4	8.3	7.2	6.6	6.0	5.4	5.2	5.1	4.9	-
Labor	-	-	2.5	2.5	2.5	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.7	2.7	2.7	2.7	2.7	2.7	-
Change in accounts payable	-	-	-	-	-1.6	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.6
Change in cash balance	-	-	-	-	2.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	-0.7
Telecoms																				
Operating & maintenance costs	-	-	-	-	2.8	8.6	23.5	30.6	32.2	31.7	31.1	30.4	29.7	29.0	28.3	27.6	27.0	26.3	25.7	-
Labor	-	-	-	-	1.5	3.7	7.8	9.9	10.5	10.6	10.7	10.8	10.8	10.9	10.9	11.0	11.0	11.1	11.1	-
Change in accounts payable	-	-	-	-	-0.7	-1.3	-3.5	-1.6	-0.4	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	5.9
Change in cash balance	-	-	-	-	1.8	6.0	8.6	3.8	0.7	-0.3	-0.3	-0.4	-0.4	-0.4	-0.4	-0.3	-0.3	-0.3	-0.3	-12.0
Net benefits flown out of the African continent	-	-	-	-	3.6	25.0	39.5	47.1	47.8	45.9	43.6	41.2	38.9	36.5	34.3	32.3	30.2	28.2	26.4	-
Total Costs	**67.9**	**63.6**	**89.3**	**149.8**	**57.6**	**97.1**	**194.0**	**156.4**	**120.6**	**103.6**	**97.9**	**93.3**	**89.1**	**85.6**	**82.2**	**79.0**	**76.1**	**73.3**	**70.8**	**-6.2**
NET RESOURCE FLOW	**-67.9**	**-63.6**	**-89.3**	**-149.8**	**29.9**	**201.6**	**373.6**	**549.8**	**595.7**	**577.1**	**564.1**	**553.1**	**540.7**	**529.4**	**519.6**	**511.3**	**366.7**	**302.7**	**276.8**	**137.2**

ENPV @ EOCK 11% Real: 2,285.2 US$ million
EIRR: 45.8% Real

6.5 Economic Sensitivity Analysis

Sensitivity analysis is carried out to identify the variables that are most likely to affect the economic outcomes of the project. The results of the sensitivity analysis are presented for selected variables.

Cost Over-runs: The project's economic viability is sensitive to the possible escalation of the project investment costs. Should costs for any reason rise by 5%, the economic NPV of the project will fall from US$ 2,285.3 million to US$ 2,261.8 million. This is equivalent to a loss of 4.4% of the investment value of the project in economic terms.[25] The impact of cost over-runs on the economic NPV of the project is presented in Table 19.

Table 19: Sensitivity Test of Cost Over-runs

Cost Over-run Factor	ENPV (US$ m)
-10.00%	2,331.96
-5.00%	2,308.61
0.00%	2,285.25
5.00%	2,261.79
10.00%	2,238.33
15.00%	2,214.87
20.00%	2,191.42
25.00%	2,167.96

Traffic per Terminal: The usage rate of terminals has a major impact on the economic outcome of the project because a substantial share of the project's economic benefits comes from rural telephony services TES. The viability of the project depends on the volume of traffic telecoms will receive from terminals installed in the rural areas. If the level of voice and data traffic on rural terminals declines from the expected 70 minutes to 60 minutes per day, the economic NPV will decrease by US$ 256.8 million which is equal to a loss of 48.0% of the investment value of the project in economic terms.

Table 20: Sensitivity Test of Traffic per Terminal

Daily Traffic (minutes/terminal)	ENPV (US$ m)
50	1,771.65
60	2,028.47
70	2,285.25
80	2,542.01

7. STAKEHOLDER ANALYSIS

The stakeholder analysis identifies the winners and losers of a project and also measures the magnitude of the gain or loss accruing to the project stakeholders. The financial and economic analysis of the integrated project analysis can provide the basic data for estimation of specific stakeholder impacts.

[25] The economic value is equal to the present value of investment cost (initial asset values) of the project. It is approximately US$ 534.5 million.

7.1 Identification of Externalities

The stakeholder analysis of the RSQ project is conducted to identify the beneficiaries of the project. The stakeholder analysis of any project is built on the following relationship:

$$P^e = P^f + (EXT_i)$$

Where: P^e is the economic value of an input or output,
P^f is the financial values of the same item, and
(EXT_i) is the sum of all the externalities that make the economic values of the item different from its financial value.

In other words, the economic value of an item is the sum of its financial price plus the value of externalities such as taxes, tariffs, subsidies and consumer or producer surplus. Taking the net present value of the benefits and costs over the life of the project can yield the following relationship:[26]

$$NPV^e_e = NPV^f_e + \sum PV_e (EXT_i)$$

Where: NPV^e_e is the PV of the net economic benefits discounted by the economic cost of capital,
NPV^f_e is the PV of the net financial cash flow discounted by the economic cost of capital, and
$\sum PV_e (EXT_i)$ is the sum of the present values of all the externalities generated by the project, also discounted by the economic cost of capital.

All projects generate two types of benefits: (a) financial benefits, which accrue directly to those who have a financial interest in the project; and (b) distributive impact or externalities, which are allocated to different segments of society. The stakeholder analysis requires the following steps:

- Identify the stakeholder impacts of the project item by item, by deducting the total investment cash flow statement from the economic statement of benefits and costs,
- Calculate the present value of each line item's flow of distributive impacts, using the economic cost of capital as the discount rate,
- Allocate the present value of externalities to the relevant groups in the economy.

Table 21 presents the reconciliation between the financial, economic and externalities of the proposed project, all discounted by economic cost of capital of 11% real. If the economic NPV is equal to the financial NPV plus the present value of distributional impacts, using a common discount rate, it indicates that the analysis was carried out in a consistent manner. The economic NPV is the same as the one shown in Table 18; however the financial NPV is not equal to the sum of the ones displayed in Tables 4 and 5 where the financial net cash flows were discounted at the required rate of return on equity of 15% real. The financial NPV of the satellite project is US$ 162.0 million (RSQ and telecoms combined) compared to the economic NPV of US$ 2,285.2 million. The difference between the financial NPV and the economic NPV, both discounted at the economic cost of capital of 11% real, is our base case estimation of the present value of all externalities created by the project.

[26] This relationship holds exactly only when the same rate of discount is applied to estimate the PV of the benefits and costs of all stakeholders. This usually holds. It is however, a very useful check in to see if the estimates have been made correctly.

Table 21: Reconciliation of Financial, Economic And Externality Flows, 2005 prices (US$ million)

CATEGORY	Financial @ EOCK	Externalities @ EOCK	Economic @ EOCK
BENEFITS			
TES	672.4	1,430.7	2,103.1
TRS	403.7	510.7	914.5
BLS	164.4	230.3	394.7
Change in accounts receivable	-16.9	-61.1	-78.0
Residual values	9.4	-0.6	8.9
Total Benefits	**1,233.1**	**2,110.1**	**3,343.1**
COSTS			
Investment Costs			
RSQ	361.7	22.2	383.9
Telecoms	159.9	-9.3	150.6
OPERATING COSTS			
RSQ			
General operating costs	62.8	5.7	68.5
Labor	23.4	-1.7	21.7
Change in accounts payable	-0.9	0.1	-0.8
Change in cash balance	1.1	0.0	1.1
Telecoms			
General operating costs	160.8	-9.3	151.5
Labor	56.6	-2.0	54.6
Change in accounts payable	-16.8	13.4	-3.5
Change in cash balance	10.9	0.0	10.9
Net benefits flown out of the African continent	202.6	16.6	219.2
Total Costs	**1,022.3**	**35.6**	**1,057.9**
NET BENEFITS	**210.8**	**2,074.4**	**2,285.2**

7.2 Distributive Analysis

In the distributive analysis, it is important to know what is the net contribution of the project to each of the stakeholders. While some of the stakeholders may gain due to the project's activities, others may incur a loss. The net impact on all the stakeholders created by the project is a sum of negative and positive externalities imposed on all the stakeholders. On the benefits side, for the base case scenario, the total amount of externalities is US$ 2,110.0 million. On the cost side, the amount of externalities amounts to US$ 35.6 million. These two sums up to a net amount of US$ 2,074.4 million that accrues to all the stakeholders of the project excluding those directly involved in the ownership of the satellite or the telecoms. The position of these two stakeholders are examined and evaluated in the financial analysis.

It is also necessary to assess the magnitude of any burden imposed on the stakeholders. This can be measured by the incremental net cash flows that are expected to be realized by each group. The question then becomes whether the project addresses the needs of the right group of stakeholders. Table 22 presents the allocation of economic externalities generated by this project among BLS subscribers, rural users, PSTN users, and African governments participating in the project. The figures are expressed in the present values of impacts,

discounted by the EOCK of 11%. The integrated appraisal framework allows the analyst to reconcile the total externalities with the gains and losses accruing to a particular group of stakeholders. In Table 21, the third column with externalities is the same as the net impact on the African economy in Table 22. The resulting net impact on the whole economy is US$ 2,074.4 million.

Table 22: Allocation of Externalities, 2005 prices (US$ million)

	Total Externalities	BLS Subscribers	Rural Users	PSTN Users	African Governments
BENEFITS					
TES	1,388.1		1,388.1		
TRS	492.2			451.6	40.6
BLS	230.3	211.3			19.0
Residual value (RSQ)	-0.1				-0.1
Residual value (telecoms)	-0.5				-0.5
Total Benefits	**2,110.1**	**211.3**	**1,388.1**	**451.6**	**59.1**
COSTS					
Investoment Costs					
RSQ	22.2				22.2
Telecoms	-9.3				-9.3
OPERATING COSTS					
RSQ					
General Operating Costs	5.7				5.7
Labor	-1.7				-1.7
Change in Working capital	0.1				0.1
Telecoms					
General Operating Costs	-9.3				-9.3
Labor	-2.0				-2.0
Change in Working capital	13.4				13.4
Net benefits flown out of the African continent	16.6				16.6
Total Costs	**35.6**				**35.6**
NET BENEFITS	**2,074.4**	**211.3**	**1,388.1**	**451.6**	**23.5**

The rural users, who are currently excluded from the PSTN and mobile coverage, appear to be the main beneficiaries of this project. The amount of consumer surplus created by the project for this stakeholder group is US$ 1,388.1 million. There are no additional costs to the rural users apart from the fixed tariffs that they will pay for making phone calls, and their current coping costs for communication is well above the financial price they will be required to pay. There is no substitution effect either, as the project provides telecommunication services to a market segment that was not being served before.

The PSTN users are largely represented by the users of the existing networks located in urban areas and already having access to the telecommunication services. The proposed project will deliver the same services cheaper, thus enabling this group of stakeholders to realize a reduction in their costs, which is expected to reach US$ 451.6 million. The project will substitute for higher cost foreign satellite providers that currently serve the telecom operators. These benefits could well be passed forward to the end users.

The BLS subscribers are another distinct group of stakeholders, mainly represented by internet service providers and TV broadcasters, large corporations from and outside of Africa. The combined impact on these users is a gain of US$ 211.3 million arising from consumer surplus generated by the project. The tariff rate charged by the RSQ for dedicated bandwidth

leasing is less than what these customers would pay elsewhere. All of the BLS capacity provided by the RSQ is incremental to the existing transponder market for Africa.

Finally, the governments of the participating countries stand to gain a marginal amount of US$ 23.5 million. This is the impact of net change in taxes and import duty collections from the project and all telecom operators, plus the change in the foreign exchange premium as a result of the flow of foreign exchange in and outside of the African continent. Given the huge magnitude of the benefits for the final consumers, especially in the rural areas, the governments are expected to support the whole project as it comes to them at a minimum possible cost. The implementation of the proposed project also enables a number of countries to move closer to the achievement of their millennium development goals (MDG). Most of the resulting net economic benefits accrue to the end users and BLS subscribers as a consequence of increase in consumer surplus for new rural users and cost saving for existing users.

7.3 Sensitivity Analysis of Stakeholder Impacts

The sensitivity analysis is conducted on the results of the externalities allocated to each group of the stakeholders in order to identify the critical parameters that affect the size and allocation of externalities.

Annual Decrease in Real Tariff: It is assumed that coping cost of TES to the rural users will fall by 9% per year. The coping cost for TRS to the end users is assumed to fall over time by 7.32% a year, the same rate as the fall in tariffs paid to the telecoms. A higher reduction in coping costs to the TES end users implies that there will be less cost in absolute value. That reduction in coping costs implies that the amount of benefits arising from cost saving diminishes over time. Table 23 presents the impact of decrease in tariffs on each stakeholder. In the case where tariffs decline by 10.0% real, the net externality accruing to the TES rural users increases. At the same time, the net externality accruing to the PSTN (TRS) users falls. The overall impact on stakeholders is such that 10.0% real tariff decrease would cause the PV of net externalities decrease by US$ 67.8 million which is equivalent to 12.7% of the investment value of the project.

Table 23: Sensitivity Test of Annual Decrease in Real Tariff Rates (US$ million)

Annual Decrease in Tariffs	Total Externalities	Rural Users	PSTN Users	BLS Subscribers	African Governments
-2.00%	2,257.50	1,384.77	630.97	211.30	30.45
-5.00%	2,145.19	1,386.83	520.95	211.30	26.11
-7.32%	2,074.43	1,388.09	451.57	211.30	23.47
-10.00%	2,006.65	1,389.25	385.10	211.30	21.00
-15.00%	1,910.72	1,390.82	290.96	211.30	17.63

Traffic per Terminal: The amount of economic benefits generated by TES services largely depends on the volume of traffic passing through the rural terminals. The rural users stand to gain as the level of traffic per terminal increases. At the same time, the economic benefits accruing to the BLS subscribers decrease because more transponders will be used by TES. On the other hand, if the usage of terminals declines from 70 to 60 minutes a day, the size of the net externalities drops by US$ 187.1 million. This is equivalent to a loss of 35.0% of the economic value of the investment in the project.

Table 24: Sensitivity Test of Traffic per Terminal
(US$ million)

Daily Traffic (minutes/terminal)	Total Externalities	Rural Users	PSTN Users	BLS Subscribers	African Governments
50	1,700.19	990.65	451.11	229.41	29.02
60	1,887.31	1,189.34	451.37	220.36	26.25
70	2,074.43	1,388.09	451.57	211.30	23.47
80	2,261.54	1,586.87	451.74	202.25	20.68

8. RISK ANALYSIS

The fourth component of the integrated appraisal framework considers the nature and impact of the risks associated with the project. The main problem of the deterministic analysis is that it appears that the present parameters are known with 100% certainty and therefore the estimated NPV of the project is 100% certain. Unfortunately, the cash flow projections are uncertain over the life of the project, and thus the static model of the financial and economic analyses do not account for the uncertainties and fluctuations of key project variables in the real world.

In order to overcome this weakness, a risk analysis is carried out in which a number of risk variables are identified based on the sensitivity analysis. In the analysis, the uncertainty associated with the critical variables of a project is expressed in terms of probability distributions. A Monte Carlo simulation, a form of risk analysis, provides one of the most practical methods to approximate the dynamics and uncertainties of the real world. The risk analysis repeats the simulation of the financial and economic analyses many times using distributions for the values of the most sensitive and uncertain variables that affect the project. This allows collecting and analyzing statistically the results of the simulations so as to arrive at a distribution of the possible outcomes of the project and the probabilities of their occurrence.

The simulations that are carried out as a part of the integrated appraisal approach are quite different from the traditional sensitivity analysis. Firstly, under a sensitivity analysis only one or two project parameters are altered at one time to test for the project outcomes. By its nature, risk analysis allows for modeling the uncertainty of multiple parameters and for testing their combined effect on the project returns. Secondly, the sensitivity analysis is mainly about testing the project outcomes under the assumption that no variation in the tested parameter is possible from one period to another. In contrast, risk analysis is flexible enough to have annual variations in the tested parameter. Also, it is possible to model a partial lagged response from one period to the next. Third, the impact of the correlation between the tested parameter and other parameters is not taken into account in the sensitivity analysis, while the risk analysis incorporates such relationships into the model. Fourth, the range of values over which a sensitivity test is carried out does not generally represent the actual scope of possible fluctuation of the tested parameter. Unless an additional inquiry into the nature and causes of the tested parameter is done, the range of values of the sensitivity tests is not realistic. Fifth, even if a range of values is chosen correctly, the sensitivity test does not assign any probability to the likelihood of getting a particular value in the range. Often, the very extreme points of the range have a very little probability of occurrence as compared to the values in the middle of the range. Any risk model collects this information about the likelihood of occurrence and builds it into the probability distribution of a risk assumption, while sensitivity analysis ignores this important issue altogether.

The range and distribution of values for risk variables are determined and the correlations between variables are specified as well. The expected values of the distributions of the risk variables form the base values of the assumptions used in the deterministic financial analysis. The result of the analysis is presented as a probability distribution of the key indicators of the project outcomes.

8.1 Selection of Risk Variables and Probability Distributions

The first step in conducting a risk analysis of a project is to identify the key risk variables using sensitivity analysis. The sensitivity analysis carried out as a part of financial and economic assessment has already helped find the critical parameters affecting the performance of the proposed project. The risk variables are identified based on the results of the sensitivity analysis, and the candidates for being risk variables are both sensitive and uncertain. The variations in the results such as in the FNPV, ENPV or standard deviation are affected by the changes not only in one year, but also from year–to–year over the life-span of the project. In addition, some of the parameters may be within management's control, while other parameters are beyond the purview of project management, but their variability affects the financial and economic results. Table 25 provides some examples of identified risk factors faced by the RSQ project. The risk analysis is done with the assumption that there is no tariff floor for the RSQ's revenue which means that the real rates of tariff could fall by 7.32% or more, annually throughout the project life.

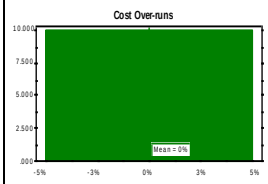
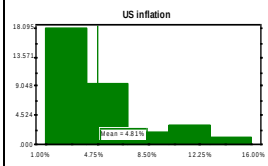
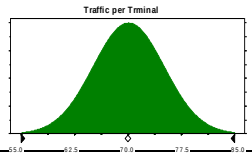
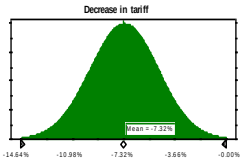
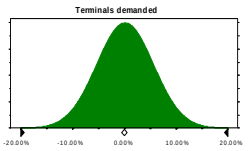
Table 25: Characteristics of Potential Risk Variables

Potential Risk Variables	Nature of Risk and Its Impact
Investment cost overruns	Direct increase of investment costs. Management can control it to a large extent.
US Inflation	Mainly affects the investment costs, operating costs, and loan repayment. Beyond RSQ's control; based on US monetary policy and economy.
Annual decrease in tariffs	Direct impact on RSQ's revenue. Depends on the trends in telecommunication and evolution of technology.
Usage of rural terminals	Direct impact on RSQ's revenue. Is determined by demand of end users. RSQ can influence this somehow by reducing tariffs but may not be sustainable.
Initial Tariffs	Tremendous impact on revenues and profitability. RSQ can change tariffs however, this may slow down demand.
Launch failure	Direct impact on revenue and the viability of the project. A launch failure would require building a new satellite which will delay the operation of the project by a few years. This risk is mitigated by a launch insurance but does not eliminate all the risk

The risk analysis will incorporate the impact of the factors identified in Table 25 on the project's outcomes. Some risk factors such as revenue collection and cost overruns can be controlled by project managers to a certain extent. The RSQ management can put in place a more efficient collection process that can minimize the loss of revenue and amount receivables. The growth of demand for telecommunication services is a factor dependent on the general growth of the economy, and the RSQ has no control over it. Foreign inflation is totally an exogenous factor that the RSQ has to face.

Once the risky variables are identified, the second step is to select an appropriate probability distribution and the likely range of values for each risk variable, based on historical observations of this variable. The probability distributions of each risk variable and the possible range of its values are presented in Table 26.

Table 26: Probability Distribution for Selected Risk Analysis Variables

Variable	Distribution Type		Range and Parameters			
			Min		Max.	Likelihood
Investment Cost Over-run Factor (%)	Step distribution Mean value 0% Base case 0%		-5% 0%	to To	0% 5%	0.50 0.50
US Inflation (%)	Step distribution Mean value 4.81% Base case 2.5%		Min 1% 4% 7% 10% 13%	 to to to to	Max. 4% 7% 10% 13% 16%	Likelihood 0.54 0.28 0.06 0.09 0.03
Daily Traffic Rural Terminals (minutes/days)	Normal Distribution Mean value 74 Base case 74		Mean 74			Std. 5.00
Reduction in Tariffs (%)	Normal Distribution Mean value -7.32% Base case -7.32%		Mearn -7.32%	.		Std. 2.44%
Demand for Terminals (%)	Normal Distribution Mean value 0% Base case 0%		Mean 0.0			Std. 5.5

Most of the investment cost items including the satellite, launcher, and network stations are turnkey fixed contracts. An agreement has also been reached with Alcatel Space in regards to the price of rural terminals not to exceed US$ 1,100 per terminal. In addition, the amount of US$ 3 million contingency is set aside to cover any unexpected cost over-runs. Hence the probability distribution of (+) (-) 5% cost over-runs seems reasonable. The mean for this distribution is 0% in the risk analysis. The mean for the base case is 0%.

In the case of US inflation rate the mean of the distribution used in the risk analysis is 4.81% based on the US consumer price index between the periods 1975 to 2005. The base case mean is 2.5%.

A Monte Carlo simulation generates a probability distribution of the outcome of the project including the NPV or debt service capacity ratio based on the underlying uncertainty surrounding each of the key risk variables specified in Table 26. During the risk simulation for this project, the following project indicators were monitored:

(i) RSQ's financial NPV;
(ii) RSQ's financial IRR;
(iii) RSQ's ADSCR in 2009/10/11/12/13/14/15;
(iv) RSQ's DSCR in 2008/9/10;

(v) Telecoms' NPV;
(vi) Economic NPV;
(vii) PV of net externalities;
(viii) PV of impact on each stakeholder.

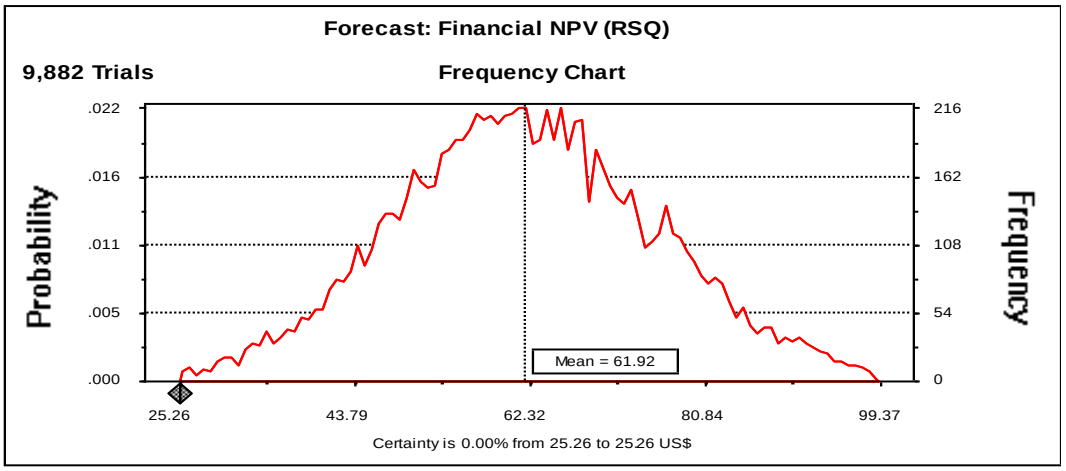
8.2 Interpretation of Results

A Monte-Carlo risk simulation was carried out over 10,000 trials with the help of Crystal Ball™ software. The results suggest that there is some risk of substandard financial and economic outcome of the project.

8.2.1 Project Financial Outcomes

The results of the risk analysis in Figure 1 show that the expected value of the project's financial NPV is US$ 61.9 million, which is somewhat lower than the computed deterministic value of US$ 72.6 million. Figure 5 also presents the range of possible values that the financial NPV can take and the likelihood of occurrence of these values. The minimum gain realized from this project is US$ 25.3 million, or 6.9% of the investment value of the project. The maximum gain is US$ 99.4 million, which is equivalent to 27.3% of the investment value. There is a degree of variability in the project outcomes, and the standard deviation is US$ 13.8 million. The cumulative probability of getting a negative NPV is nil. The probability distribution of the financial internal rate of return indicates that its expected value is 19.8% and cumulative probability of being below the 15% discount rate is 0.0%. At the same time, the minimum value of the FIRR recorded during the risk simulation is 17.1%.

Figure 5: Results of Risk Analysis: Financial NPV of RSQ



The risk simulation tested the ability of the RSQ to service its debt timely. The figures presented in Table 27 reveal that the expected value of the resulting outcomes are different from the deterministic debt service ratios, as shown in the first row of Table 27. The standard deviation indicates the dispersion of the results around their means. The minimum and maximum values indicate the points of the lowest and highest outcomes that might be achieved.

Table 27: Probability Distribution of Debt Service Ratios

	RSQ NPV (US$ m)	Annual Debt Service Coverage Ratio						Debt Service Capacity Ratio			
		2009	2010	2011	2012	2013	2014	2009	2010	2011	2012
Deterministic Value	**72.60**	1.78	2.28	2.47	2.55	2.60	2.66	2.76	2.98	3.16	3.37
Rsik Statistics											
Mean	61.92	1.63	2.13	2.39	2.55	2.70	2.85	2.72	2.99	3.26	3.55
Standard Deviation	13.77	0.19	0.25	0.29	0.29	0.31	0.31	0.13	0.17	0.24	0.29
Range Minimum	25.26	1.11	1.47	1.53	1.67	1.79	1.91	2.34	2.50	2.59	2.72
Range Maximum	99.37	2.13	2.79	3.58	3.87	4.20	4.35	3.08	3.46	4.45	4.97
Prob. Unacceptable	0%	0%	0%	0%	0%	0.1%	0%	0.1%	0%	0%	0%	0%

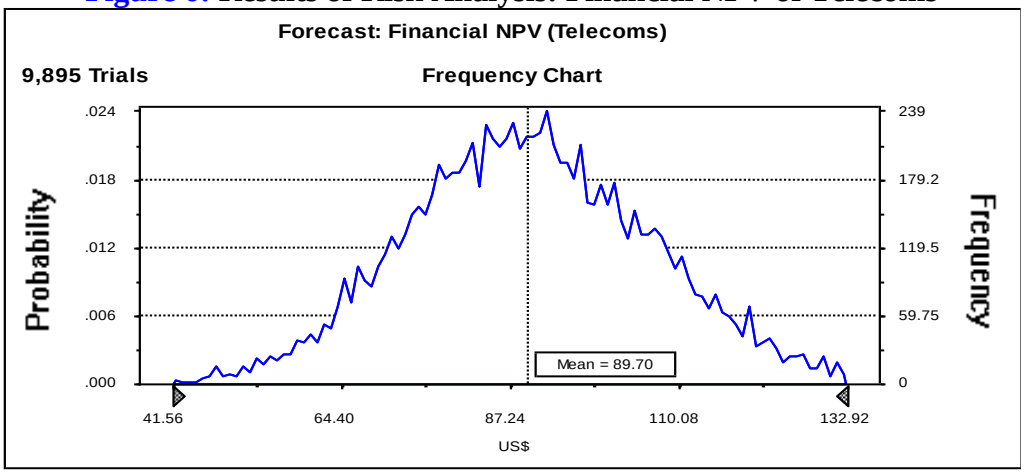
The lenders should be aware of what is the cumulative likelihood of having a sub-standard debt service ratio, when the cash flows of the project are not large enough to meet the scheduled debt repayments. The last row of Table 27 shows the proportion of all simulation outcomes that have a ratio of net cash flows to debt repayment being less than one. The terms of the loan agreements should be designed so that a shortfall the castle in 2009 does not result in financial crises for RSQ.

The value of the debt service capacity ratios indicates that the likelihood is low of having insufficient cash flow to cover the debt service obligations when we consider the entire period that the loans outstanding. These values of 2 or more imply that the amount of net castle available for debt servicing is comfortably above the total amount required.

8.2.2 Impact on Telecom Operators

The risk analysis included the telecoms' NPV as a performance indicator, and the expected value of the telecoms financial NPV is US$ 89.7 million, which is somewhat closer to the US$ 89.4 million in the financial analysis. Figure 6 displays the probability distribution of the NPV of telecom operators. There is some variation in the outcomes, as the standard deviation is equal to US$ 16.4 million. The minimum gain that telecom operators may get is US$ 41.6 million, which is equivalent to 29.9% of the incremental investment value for the participating telecoms. At the same time, the maximum gain is US$ 132.9 million, equivalent to 95.6% of the incremental investment value. There is zero probability of a negative NPV of the telecom operators. This is a project from which African telecoms stand to gain, with virtually no likelihood of loss.

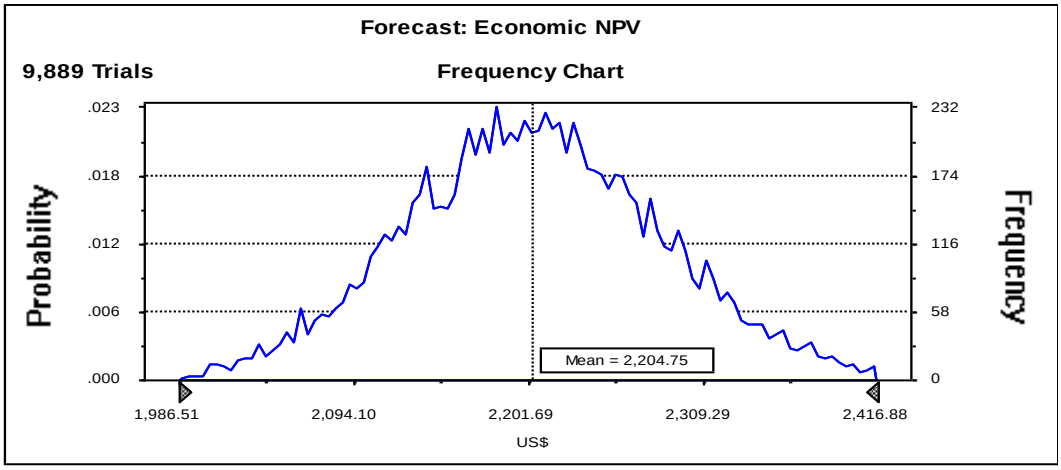
Figure 6: Results of Risk Analysis: Financial NPV of Telecoms



8.2.3 Economic Outcomes

Figure 7 presents the distribution of the economic outcomes from the risk simulation. The expected value of the economic NPV is US$ 2,204.8 million, which is close to the deterministic value of US$ 2,385.2 million. The standard deviation of the economic NPV is US$ 78.2 million. The minimum possible gain that the overall African economy stands to experience because of this project is US$ 1,986.5 million in economic terms. On the other hand, the maximum gain of US$ 2,416.9 million. The probability of the project having a negative economic NPV is zero.

Figure 7: Results of Risk Analysis: Economic NPV



8.2.4 Stakeholders' Impacts

The risk analysis suggests that the net impact on the end users (rural and PSTN users) and BLS subscribers is always a positive contribution. For the governments of participating African states, the outcome is expected to be a net gain due to additional tax collection and savings in foreign exchange premium. The expected value of that gain is US$ 20.8 million. Table 28 presents the distribution of stakeholder outcomes from the risk simulation.

Table 28: Results of Risk Analysis: Allocation of Stakeholder Impact.

	BLS Subscribers	Rural Users	PSTN Users	Governments
Deterministic Value	211.3	1,388.1	451.6	23.5
Risk Statistics				
Mean	209.98	1,311.58	452.09	20.76
Standard Deviation	3.03	35.31	21.81	1.52
Range Minimum	201.66	1,218.66	391.38	16.51
Range Maximum	217.86	1,408.58	512.30	24.62
Prob < 0	0.0%	0.0%	0.0%	0.0%

The BLS subscribers, represented by large phone and data service providers, corporations and TV broadcasters, should expect a net gain with a mean of US$ 210.0 million. This is the amount of saving accrued to these customers due to switching from other satellite providers to the RSQ. There is a little variation in these outcomes as the standard deviation stands at US$ 3.0 million. The existing PSTN users, mostly located in the urban areas and places covered by the existing net networks, should expect a net gain with a mean of US$ 452.1 million. This gain is subject to little variation, as the standard deviation is only US$ 21.8 million. The rural users stand to experience a substantial gain with the expected value of US$

1,311.6 million. These benefits arise due to the reduction in the coping costs delivered by the project and passed on to the final users by telecom operators. The standard deviation is US$ 35.3 million, indicating that the rural users are assured of a certain gain from the project.

9. CONCLUSION

9.1 Findings

The integrated investment appraisal methodology has been used in the evaluation of this project. The analysis has demonstrated how the appraisal of a project aimed at expanding and reducing the cost of telecommunication can be conducted from different perspectives. The role of this project is to expand and partially substitute some of the existing inter-African connections that currently pass through foreign satellites at higher costs to African telecoms.

The financial and economic analyses have confirmed that the project is a viable and sustainable investment for the African countries due to major savings in the transit costs for telecoms and substantial benefit attributed to the end users. The expected financial NPV of the project is US$ 61.9 million. The revenues for the project come from three sources: TES in rural areas accounts for 52% of the total revenues, TRS for 19% and BLS for 29%. Given the high demand for BLS capacity, the project is designed to allow for possible shift of the satellite transponders from TES/TRS to highly demanded BLS, when needed. In regard to the risk results for the equity holders, the simulation outcome suggests there is only a 0% of cumulative probability for the owners of the RSQ of falling short of the targeted return of 15% real. While the results show that the returns are never negative, the minimum financial internal rate of return is 17.1% real.

As the financial analysis suggests African telecoms should be interested in this project as the expected financial NPV for the African telecoms is US$ 89.7 million. While the participation in the project requires a telecom operator to subscribe to the RSQ and to install certain ground hardware, the financial benefits from using the proposed project instead of other satellite providers are substantial. The participating telecoms will not only recover their incremental investment and operating costs, but also achieve a robust return on equity. The project is a viable alternative that telecom operators are certain to realize a gain from this project.

The results of the economic assessment of the proposed project confirm the expectations that many African governments have vested on the Rascom initiative. The overall economic impact of the project on Africa is expected to be US$ 2,204.8 million using an EOCK of 11% real, The main economic benefits of the project come in the form of the incremental consumer surplus for rural users who never had access to the existing telecommunication services, and in the form of cost reduction for the end users and telecoms who had to use foreign satellites for inter-continental and international connection without the project. The risk analysis results show that if the project is able to succeed in financial terms, there is zero probability of it having an economic loss. The participating African countries stand to gain significantly from the proposed project.

In terms of stakeholder impacts, the main beneficiary group is the rural users who are not currently covered by the PSTN or mobile networks. The gain to this group amounts to US$ 1,311.6 million. The second beneficiary is the existing PSTN users mainly from urban African areas, who stand to gain US$ 452.1 million. The BLS subscribers, represented largely by TV and corporate institutions from Africa and outside will also gain an amount of

US$ 210.0 million due to reduction in the cost of bandwidth leasing. The governments of the participating countries will have a gain of US$ 20.8 million due to the net change in the taxes and foreign exchange flows. The risk results for the stakeholder benefit allocation suggest that there is a low variation in the expected outcomes for the project stakeholders.

9.2 Risks and Mitigating Measures

It is expected that the RSQ in collaboration with Alcatel Space can control the technical and implementation risks of this project using their experience in satellite manufacturing and management of procurement and construction activities. However, the performance of the project is dependent on the satellite's operational availability in order to generate revenue and cover its operational expenses and debt repayment obligations. The risk of satellite failure is addressed with the launch insurance package. Also, the insurance covers the cost of a replacement satellite in the case of a launch failure. The financial design and economic concept of the proposed project are subject to a risk exposure because the possibility of a satellite launch failure may make prospective telecoms subscribers hesitated to sign up for the services prior to its launch.

The demand risk for currently non-existing TES services is addressed through the flexible design of the satellite transponders which allows for dynamic reallocation of spare transponder units from TES/TRS to highly demanded BLS transponders.

Another aspect of risk facing this project is the technological risk. The technology in satellite industry is reaching a mature stage as there are so many satellites with different technological configurations and capacities. The project's strength lies in the new type of technology allowing more sophisticated integrated communication services combined in one satellite. The design of the satellite and ground facilities is such that it allows for upgrading of software protocols used in transmission and also for expanding the transmission capacity by increasing the density of the beam. Market risk associated with the demand for the TES service is a major component of the overall risk associated with this project.

The risk of competition should also be put into perspective because the telecommunication market in Africa is growing rapidly, which may attract me-to projects. As of now, there is no single satellite in space that has a full coverage of the African continent. In the next few years there is no plan for immediate satellite launch over Africa that could be a competitor to the project. It is important to mention the presence of yet-to-be launched Nigerian satellite which has no orbital spot in space at the moment. There is a high demand for transponder space in Africa, which neither the RSQ nor the Nigerian satellite can fully supply. The current supply of transponders for African users is about 300 units and they are fully allocated. The incremental supply of 24 transponders by the RSQ is expected to be demanded for such services in all circumstances.

This analysis should make the loan approval more comfortable for the AfDB. The proposed project has no government guarantee, as it is a commercial-oriented operation with a sizeable risk. The proposed financing structure of the RSQ ensures that the lenders have sufficient cash available for debt service, but there is a moderate risk for the project owners to have a return lower than expected. At the same time, this project is going to a have huge development impact, specifically on the poor areas of the African continent. This is a case when a commercial project provides the opportunity to significantly enhance the economic well-being of the participating countries and their people.

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APPENDIX A

SUBSCRIPTION OF TERMINALS BY TELECOM OPERATORS

APPENDIX A 1: OPTIMISTIC PROJECTION OF TERMINALS BASED ON EXPECTATIONS FROM TELECOMS

Projections for all countries			2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Country name	Operator	Wave															
Algeria		2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Angola	Angola Telecom	1	400	1,000	1,469	1,587	1,704	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782
Benin	OPT	1	400	1,000	2,500	2,875	3,250	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Botswana& Equatorial Guinea	France Telecom	3	400	1,000	3,430	4,038	4,645	5,050	5,050	5,050	5,050	5,050	5,050	5,050	5,050	5,050	5,050
Burkina Faso	Onatel	1	400	1,000	3,007	3,509	4,011	4,345	4,345	4,345	4,345	4,345	4,345	4,345	4,345	4,345	4,345
Burundi		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cameroon		3	100	250	700	813	925	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Cape Verde		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Central African Republic	Socatel	2	200	500	2,000	2,375	2,750	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Chad	Sotel Tchad	3	100	250	700	813	925	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Comoros		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Congo, Dem. Rep.		2	1,600	4,000	10,600	12,250	13,900	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Congo, Rep.	Sotelco	2	600	1,500	3,600	4,125	4,650	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Cote d'Ivoire		3	100	250	700	813	925	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Djibouti		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Egypt, Arab Rep.		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eritrea	Eritel	3	160	400	760	850	940	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Ethiopia	ETC	3	100	250	700	813	925	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Gabon	Gabon Telekom	1	200	500	908	1,010	1,112	1,180	1,180	1,180	1,180	1,180	1,180	1,180	1,180	1,180	1,180
Gambia, The	Gamtel	2	100	250	400	438	475	500	500	500	500	500	500	500	500	500	500
Ghana		3	100	250	400	438	475	500	500	500	500	500	500	500	500	500	500
Guinea	Sotelgui	2	100	250	700	813	925	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Guinea-Bissau		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kenya	Telkom Kenya	2	600	1,500	4,500	5,250	6,000	6,500	6,500	6,500	6,500	6,500	6,500	6,500	6,500	6,500	6,500
Lesotho	Econet	3	100	250	700	813	925	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Liberia	Investcom	3	100	250	700	813	925	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Libya	GPTC	2	400	1,000	2,800	3,250	3,700	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
Madagascar	France Telecom	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malawi		3	100	250	700	813	925	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Mali	Sotelma	1	600	1,500	6,000	7,125	8,250	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000
Mauritania	Mauritel	3	100	250	700	813	925	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Mauritius		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MTN Uganda	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Nigeria		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Orange	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Telkom	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mayotte		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morocco	Maroc Telecom	3	100	250	1,930	2,350	2,770	3,050	3,050	3,050	3,050	3,050	3,050	3,050	3,050	3,050	3,050
Mozambique	TDM	3	100	250	700	813	925	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Namibia		3	100	250	700	813	925	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Niger		2	100	250	700	813	925	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Nigeria	Nitel/Globacom	3	100	250	3,160	3,888	4,615	5,100	5,100	5,100	5,100	5,100	5,100	5,100	5,100	5,100	5,100
	Econet	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Investcom	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sentech	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Celtel	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rwanda		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sao Tome and Principe		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senegal	Sonatel	1	480	1,200	2,527	2,858	3,190	3,411	3,411	3,411	3,411	3,411	3,411	3,411	3,411	3,411	3,411
Seychelles		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sierra Leone		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Somalia		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South Africa	e-school project	3	200	500	13,520	16,775	20,030	22,200	22,200	22,200	22,200	22,200	22,200	22,200	22,200	22,200	22,200
	Globecast	3															
Sudan	Sudatel	2	400	1,000	3,007	3,509	4,011	4,345	4,345	4,345	4,345	4,345	4,345	4,345	4,345	4,345	4,345
Swaziland		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanzania	TTCL	2	500	1,250	2,000	2,188	2,375	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
Togo		3	100	250	700	813	925	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Tunisia		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Uunet	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vodacom	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uganda	Uganda Telecom	1	240	600	2,271	2,689	3,107	3,385	3,385	3,385	3,385	3,385	3,385	3,385	3,385	3,385	3,385
Zambia	Zamtel	3	100	250	700	813	925	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Zimbabwe	Zelone	1	560	1,400	3,080	3,500	3,920	4,200	4,200	4,200	4,200	4,200	4,200	4,200	4,200	4,200	4,200
Ikatel	Ikatel	3															
	Ground Support facility	3															
	e-Post project	3															
	Non incumbent telcos	3															
	Other rural licences	3															
		Total	**10,140**	**25,350**	**83,669**	**98,249**	**112,828**	**122,548**	**122,548**	**122,548**	**122,548**	**122,548**	**122,548**	**122,548**	**122,548**	**122,548**	**122,548**

APPENDIX A 2: PESSIMISTIC PROJECTION OF TERMINALS BASED ON EXPRESSED INTEREST FROM TELECOMS

				2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Country	Operator	Wave																
Algeria		2	Y	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Angola	Angola Telecom	1	Y	560	1,400	1,869	2,104	2,174	2,182	2,182	2,182	2,182	2,182	2,182	2,182	2,182	2,182	2,182
Benin	OPT	1	Y	800	2,000	3,500	4,250	4,475	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Botswana& Equatorial Guinea	France Telecom	3	N	400	1,000	1,100	1,150	1,165	1,167	1,167	1,167	1,167	1,167	1,167	1,167	1,167	1,167	1,167
Burkina Faso	Onatel	1	Y	560	1,400	3,407	4,411	4,712	4,745	4,745	4,745	4,745	4,745	4,745	4,745	4,745	4,745	4,745
Burundi		3	Y	0	0	293	439	483	488	488	488	488	488	488	488	488	488	488
Cameroon		3	Y	0	0	1,544	2,317	2,548	2,574	2,574	2,574	2,574	2,574	2,574	2,574	2,574	2,574	2,574
Cape Verde		3	N	0	0	106	158	174	176	176	176	176	176	176	176	176	176	176
Central African Republic	Socatel	2	Y	120	300	351	377	384	385	385	385	385	385	385	385	385	385	385
Chad	Sotel Tchad	3	Y	100	250	624	811	867	873	873	873	873	873	873	873	873	873	873
Comoros		3	N	0	0	74	111	122	123	123	123	123	123	123	123	123	123	123
Congo, Dem. Rep.		2	Y	800	2,000	3,131	3,697	3,866	3,885	3,885	3,885	3,885	3,885	3,885	3,885	3,885	3,885	3,885
Congo, Rep.	Sotelco	2	Y	480	1,200	1,290	1,335	1,349	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350
Cote d'Ivoire		3	Y	100	250	2,222	3,207	3,503	3,536	3,536	3,536	3,536	3,536	3,536	3,536	3,536	3,536	3,536
Djibouti		3	N	0	0	9	14	15	15	15	15	15	15	15	15	15	15	15
Egypt, Arab Rep.		3	N	0	0	16,804	25,205	27,726	28,006	28,006	28,006	28,006	28,006	28,006	28,006	28,006	28,006	28,006
Eritrea	Eritel	3	Y	120	300	325	338	342	342	342	342	342	342	342	342	342	342	342
Ethiopia	ETC	3	Y	100	250	2,876	4,188	4,582	4,626	4,626	4,626	4,626	4,626	4,626	4,626	4,626	4,626	4,626
Gabon	Gabon Telekom	1	Y	400	1,000	1,408	1,612	1,673	1,680	1,680	1,680	1,680	1,680	1,680	1,680	1,680	1,680	1,680
Gambia, The	Gamtel	2	Y	120	300	310	314	316	316	316	316	316	316	316	316	316	316	316
Ghana		3	Y	100	250	1,346	1,894	2,059	2,077	2,077	2,077	2,077	2,077	2,077	2,077	2,077	2,077	2,077
Guinea	Sotelgui	2	Y	540	1,350	1,375	1,388	1,392	1,392	1,392	1,392	1,392	1,392	1,392	1,392	1,392	1,392	1,392
Guinea-Bissau		3	Y	0	0	49	73	80	81	81	81	81	81	81	81	81	81	81
Kenya	Telkom Kenya	2	Y	1,200	3,000	4,379	5,069	5,276	5,299	5,299	5,299	5,299	5,299	5,299	5,299	5,299	5,299	5,299
Lesotho	Econet	3	N	100	250	378	442	461	463	463	463	463	463	463	463	463	463	463
Liberia	Investcom	3	N	28	70	86	93	96	96	96	96	96	96	96	96	96	96	96
Libya	GPTC	2	Y	60	150	181	197	201	202	202	202	202	202	202	202	202	202	202
Madagascar	France Telecom	3	N	0	0	1,375	2,063	2,269	2,292	2,292	2,292	2,292	2,292	2,292	2,292	2,292	2,292	2,292
Malawi		3	Y	100	250	643	840	898	905	905	905	905	905	905	905	905	905	905
Mali	Sotelma	1	Y	1,200	3,000	6,900	8,850	9,435	9,500	9,500	9,500	9,500	9,500	9,500	9,500	9,500	9,500	9,500
Mauritania	Mauritel	3	Y	60	150	161	166	168	168	168	168	168	168	168	168	168	168	168
Mauritius		3	Y	0	0	460	689	758	766	766	766	766	766	766	766	766	766	766
	MTN Uganda	3	Y	0	0	1,230	1,845	2,030	2,050	2,050	2,050	2,050	2,050	2,050	2,050	2,050	2,050	2,050

Nigeria		3	Y	100	250	700	925	993	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
	Orange	3	Y	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Telkom	3	Y	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mayotte		3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morocco	Maroc Telecom	3	Y	100	250	4,948	7,297	8,002	8,080	8,080	8,080	8,080	8,080	8,080	8,080	8,080	8,080	8,080
Mozambique	TDM	3	Y	100	250	1,092	1,513	1,639	1,653	1,653	1,653	1,653	1,653	1,653	1,653	1,653	1,653	1,653
Namibia		3	Y	100	250	524	660	701	706	706	706	706	706	706	706	706	706	706
Niger		2	Y	1,120	2,800	2,698	2,647	2,632	2,630	2,630	2,630	2,630	2,630	2,630	2,630	2,630	2,630	2,630
Nigeria	Nitel/Globacom	3	Y	100	250	700	925	993	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
	Econet	3	Y	0	0	1,230	1,845	2,030	2,050	2,050	2,050	2,050	2,050	2,050	2,050	2,050	2,050	2,050
	Investcom	3	Y	0	0	1,230	1,845	2,030	2,050	2,050	2,050	2,050	2,050	2,050	2,050	2,050	2,050	2,050
	Sentech	3	Y	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Celtel	3	Y	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rwanda		3	N	0	0	481	721	793	801	801	801	801	801	801	801	801	801	801
Sao Tome and Principe		3	N	0	0	7	10	11	11	11	11	11	11	11	11	11	11	11
Senegal	Sonatel	1	Y	760	1,900	2,177	2,315	2,356	2,361	2,361	2,361	2,361	2,361	2,361	2,361	2,361	2,361	2,361
Seychelles		3	N	0	0	50	76	83	84	84	84	84	84	84	84	84	84	84
Sierra Leone		3	N	0	0	131	197	217	219	219	219	219	219	219	219	219	219	219
Somalia		3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South Africa	e-school project	3	N	0	0	7,277	10,915	12,007	12,128	12,128	12,128	12,128	12,128	12,128	12,128	12,128	12,128	12,128
	Globecast	3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sudan	Sudatel	2	Y	720	1,800	3,694	4,641	4,925	4,957	4,957	4,957	4,957	4,957	4,957	4,957	4,957	4,957	4,957
Swaziland		3	N	0	0	387	581	639	645	645	645	645	645	645	645	645	645	645
Tanzania	TTCL	2	Y	668	1,670	2,356	2,699	2,802	2,813	2,813	2,813	2,813	2,813	2,813	2,813	2,813	2,813	2,813
Togo		3	Y	100	250	338	381	395	396	396	396	396	396	396	396	396	396	396
Tunisia		3	N	0	0	1,933	2,899	3,189	3,221	3,221	3,221	3,221	3,221	3,221	3,221	3,221	3,221	3,221
	Uunet	3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vodacom	3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uganda	Uganda Telecom	1	Y	432	1,080	1,521	1,742	1,808	1,815	1,815	1,815	1,815	1,815	1,815	1,815	1,815	1,815	1,815
Zambia	Zamtel	3	Y	100	250	853	1,155	1,245	1,255	1,255	1,255	1,255	1,255	1,255	1,255	1,255	1,255	1,255
Zimbabwe	Zelone	1	Y	1,120	2,800	4,480	5,320	5,572	5,600	5,600	5,600	5,600	5,600	5,600	5,600	5,600	5,600	5,600
Ikatel	Ikatel	3	Y	200	500	1,400	1,850	1,985	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
	Ground Support facility	3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	e-Post project	3	N	0	0	1,230	1,845	2,030	2,050	2,050	2,050	2,050	2,050	2,050	2,050	2,050	2,050	2,050
	Non incumbent telcos	3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Other rural licences	3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total			**13,768**	**34,420**	**101,239**	**134,649**	**144,671**	**145,785**	**145,785**	**145,785**	**145,785**	**145,785**	**145,785**	**145,785**	**145,785**	**145,785**	**145,785**

APPENDIX A 3: PESSIMISTIC PROJECTION OF TERMINALS BASED ON EXPRESSED INTEREST FROM SELECTED TELECOMS

Projections for selected countries				2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Country	Operator																	
Algeria		2	Y	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Angola	Angola Telecom	1	Y	560	1,400	1,869	2,104	2,174	2,182	2,182	2,182	2,182	2,182	2,182	2,182	2,182	2,182	2,182
Benin	OPT	1	Y	800	2,000	3,500	4,250	4,475	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Botswana& Equatorial Guinea	France Telecom	3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Burkina Faso	Onatel	1	Y	560	1,400	3,407	4,411	4,712	4,745	4,745	4,745	4,745	4,745	4,745	4,745	4,745	4,745	4,745
Burundi		3	Y	0	0	293	439	483	488	488	488	488	488	488	488	488	488	488
Cameroon		3	Y	0	0	1,544	2,317	2,548	2,574	2,574	2,574	2,574	2,574	2,574	2,574	2,574	2,574	2,574
Cape Verde		3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Central African Republic	Socatel	2	Y	120	300	351	377	384	385	385	385	385	385	385	385	385	385	385
Chad	Sotel Tchad	3	Y	100	250	624	811	867	873	873	873	873	873	873	873	873	873	873
Comoros		3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Congo, Dem. Rep.		2	Y	800	2,000	3,131	3,697	3,866	3,885	3,885	3,885	3,885	3,885	3,885	3,885	3,885	3,885	3,885
Congo, Rep.	Sotelco	2	Y	480	1,200	1,290	1,335	1,349	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350
Cote d'Ivoire		3	Y	100	250	2,222	3,207	3,503	3,536	3,536	3,536	3,536	3,536	3,536	3,536	3,536	3,536	3,536
Djibouti		3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Egypt, Arab Rep.		3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eritrea	Eritel	3	Y	120	300	325	338	342	342	342	342	342	342	342	342	342	342	342
Ethiopia	ETC	3	Y	100	250	2,876	4,188	4,582	4,626	4,626	4,626	4,626	4,626	4,626	4,626	4,626	4,626	4,626
Gabon	Gabon Telekom	1	Y	400	1,000	1,408	1,612	1,673	1,680	1,680	1,680	1,680	1,680	1,680	1,680	1,680	1,680	1,680
Gambia, The	Gamtel	2	Y	120	300	310	314	316	316	316	316	316	316	316	316	316	316	316
Ghana		3	Y	100	250	1,346	1,894	2,059	2,077	2,077	2,077	2,077	2,077	2,077	2,077	2,077	2,077	2,077
Guinea	Sotelgui	2	Y	540	1,350	1,375	1,388	1,392	1,392	1,392	1,392	1,392	1,392	1,392	1,392	1,392	1,392	1,392
Guinea-Bissau		3	Y	0	0	49	73	80	81	81	81	81	81	81	81	81	81	81
Kenya	Telkom Kenya	2	Y	1,200	3,000	4,379	5,069	5,276	5,299	5,299	5,299	5,299	5,299	5,299	5,299	5,299	5,299	5,299
Lesotho	Econet	3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Liberia	Investcom	3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Libya	GPTC	2	Y	60	150	181	197	201	202	202	202	202	202	202	202	202	202	202
Madagascar	France Telecom	3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malawi		3	Y	100	250	643	840	898	905	905	905	905	905	905	905	905	905	905
Mali	Sotelma	1	Y	1,200	3,000	6,900	8,850	9,435	9,500	9,500	9,500	9,500	9,500	9,500	9,500	9,500	9,500	9,500
Mauritania	Mauritel	3	Y	60	150	161	166	168	168	168	168	168	168	168	168	168	168	168
Mauritius		3	Y	0	0	460	689	758	766	766	766	766	766	766	766	766	766	766
	MTN Uganda	3	Y	0	0	1,230	1,845	2,030	2,050	2,050	2,050	2,050	2,050	2,050	2,050	2,050	2,050	2,050

Nigeria		3	Y	100	250	700	925	993	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
	Orange	3	Y	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Telkom	3	Y	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mayotte		3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morocco	Maroc Telecom	3	Y	100	250	4,948	7,297	8,002	8,080	8,080	8,080	8,080	8,080	8,080	8,080	8,080	8,080	8,080
Mozambique	TDM	3	Y	100	250	1,092	1,513	1,639	1,653	1,653	1,653	1,653	1,653	1,653	1,653	1,653	1,653	1,653
Namibia		3	Y	100	250	524	660	701	706	706	706	706	706	706	706	706	706	706
Niger		2	Y	1,120	2,800	2,698	2,647	2,632	2,630	2,630	2,630	2,630	2,630	2,630	2,630	2,630	2,630	2,630
Nigeria	Nitel/Globacom	3	Y	100	250	700	925	993	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
	Econet	3	Y	0	0	1,230	1,845	2,030	2,050	2,050	2,050	2,050	2,050	2,050	2,050	2,050	2,050	2,050
	Investcom	3	Y	0	0	1,230	1,845	2,030	2,050	2,050	2,050	2,050	2,050	2,050	2,050	2,050	2,050	2,050
	Sentech	3	Y	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Celtel	3	Y	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rwanda		3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sao Tome and Principe		3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senegal	Sonatel	1	Y	760	1,900	2,177	2,315	2,356	2,361	2,361	2,361	2,361	2,361	2,361	2,361	2,361	2,361	2,361
Seychelles		3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sierra Leone		3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Somalia		3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South Africa	e-school project	3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Globecast	3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sudan	Sudatel	2	Y	720	1,800	3,694	4,641	4,925	4,957	4,957	4,957	4,957	4,957	4,957	4,957	4,957	4,957	4,957
Swaziland		3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanzania	TTCL	2	Y	668	1,670	2,356	2,699	2,802	2,813	2,813	2,813	2,813	2,813	2,813	2,813	2,813	2,813	2,813
Togo		3	Y	100	250	338	381	395	396	396	396	396	396	396	396	396	396	396
Tunisia		3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Uunet	3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vodacom	3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uganda	Uganda Telecom	1	Y	432	1,080	1,521	1,742	1,808	1,815	1,815	1,815	1,815	1,815	1,815	1,815	1,815	1,815	1,815
Zambia	Zamtel	3	Y	100	250	853	1,155	1,245	1,255	1,255	1,255	1,255	1,255	1,255	1,255	1,255	1,255	1,255
Zimbabwe	Zelone	1	Y	1,120	2,800	4,480	5,320	5,572	5,600	5,600	5,600	5,600	5,600	5,600	5,600	5,600	5,600	5,600
Ikatel	Ikatel	3	Y	200	500	1,400	1,850	1,985	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
	Ground Support facility	3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	e-Post project	3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Non incumbent telcos	3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Other rural licences	3	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Total	**13,240**	**33,100**	**69,813**	**88,169**	**93,676**	**94,288**	**94,288**	**94,288**	**94,288**	**94,288**	**94,288**	**94,288**	**94,288**	**94,288**	**94,288**