Mauritius "Telecommunication Expansion Project"

Report Date: March 1999

Field Survey: December 1998

Project Summary

Borrower:	Government of the Republic of Mauritius
Executing Agency:	Mauritius Telecom (MT) (The Telecommunications Department of the Ministry of Energy and Internal Communications: MTD, at the time of appraisal)
Exchange of Notes:	January 1988
Date of Loan Agreement:	April 1988
Final Disbursement Date:	May 1993
Loan Amount:	¥1,674 million
Loan Disbursed Amount:	¥1,422 million
Procurement Conditions:	General Untied
Loan Conditions:	Interest: 3.75%
	Repayment Period: 30 years (10 years grace period)

Reference

(1) Currency: Mauritius Rupee (Rs)

(2) Exchange Rate:(IFS annual average market rate)

Year		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Rate	MRs/US$	13.5	12.8	13.4	15.3	14.9	15.7	15.6	17.7	18.0	17.4	17.9
	¥/US$	168.5	144.6	128.2	138.0	144.8	134.7	126.7	111.2	102.2	94.1	108.8
	¥/MRs	12.48	11.30	9.57	9.02	9.72	8.58	8.12	6.28	5.68	5.41	6.08
CPI (1990 = 100)		71	72	78	88	100	107	112	124	133	141	150

(3) Rate at the time of appraisal: US$1 = Rs12.8 = ¥143 (Rs1.0 = ¥11.2)

(4) Fiscal Year: July 1 of previous year – June 30 of reporting year

(5) Abbreviation:

① MTD The Telecommunications Department of the Ministry of Energy and Internal Communications. (Executing agency at the time of project commencement)

② MTS Mauritius Telecommunication Services Ltd. (established in April 1988)

③ MT Mauritius Telecom (change of name following transfer in July 1992 of international telecommunications services from Overseas Telecommunications Services Co. Ltd. to MTS)

④ ITU International Telecommunication Union
International special organization

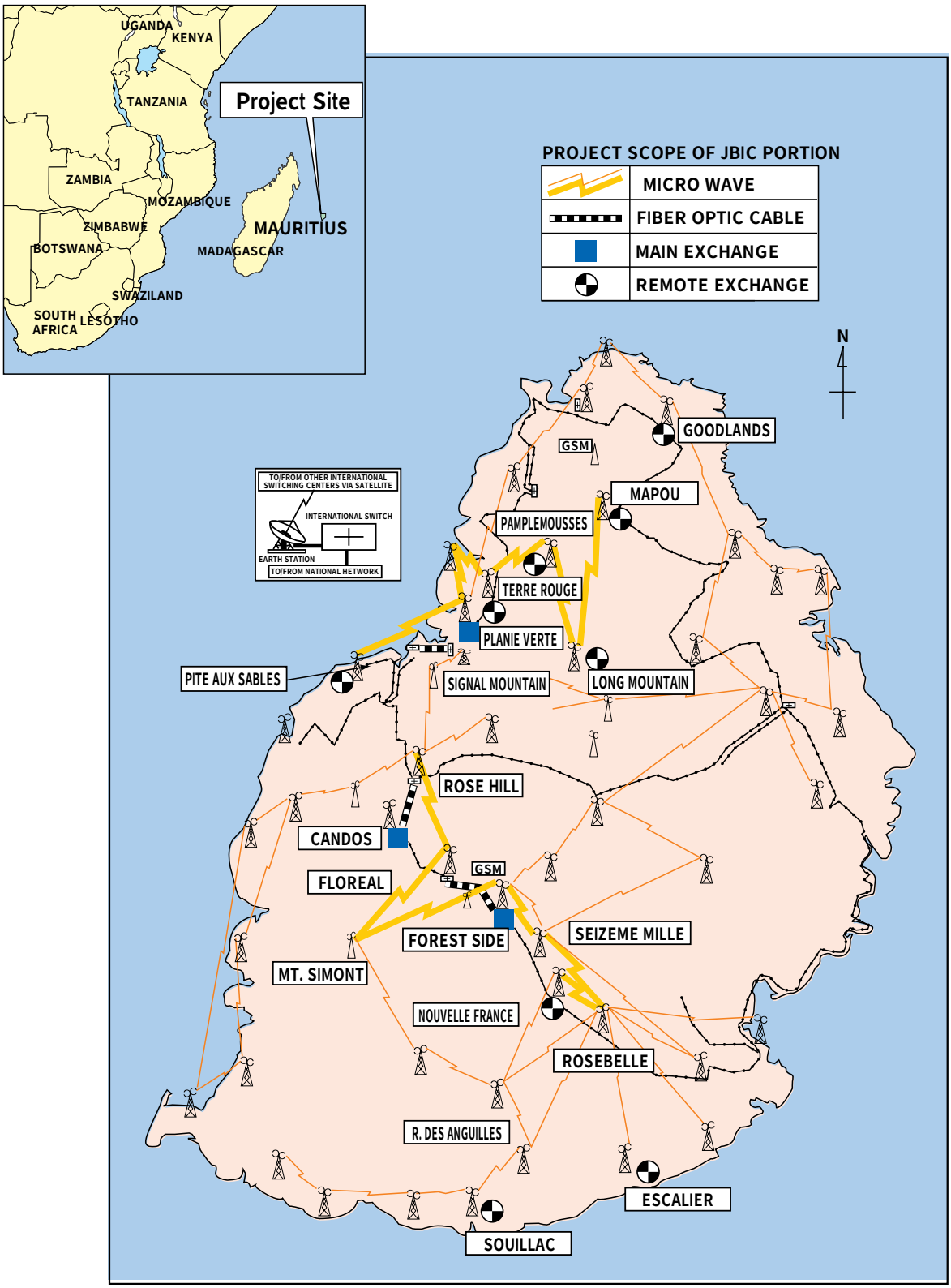
⑤ SADC Southern African Development Community
Change of name from “Conference” to “Community” at summit of the SADCC (Southern African Development Coordination Conference) in 1992. The Community currently has twelve members: Angola, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia, Zimbabwe, Namibia, South Africa and the Republic of Mauritius.

⑥ SAFE South Africa Far East (Submarine Cable Project) – Plan to link South Africa and Malaysia via a submarine cable (fiber optic) passing through the Republic of Mauritius.

(6) Terminology

① Main exchange	(Master Switching Unit: MSU) Exchange housing subscriber lines, with control and charging functions.
② Remote exchange	(Remote Switching Unit: RSU) Exchange housing subscriber lines, but without control or charging functions. Because all control and charging functions are carried out at the main exchanges, switching/transmission functions go through MSUs.
③ Digital switching system	Switching system that switches and connects digital signals via software installed in the switching system. Features include compact size compared to mechanical switchboards, ease of maintenance and large switching capacity.
④ Subscriber cable (line)	Telecommunication cable linking exchange to home of subscriber. When copper cable is employed, two cables are used in a pair and cable length expressed in “pair km”.
⑤ Fiber optic cable	Telecommunication cable using glass fibers of a high degree of purity or plastic as a medium, with minimal deterioration in the optic signal even in long distance transmission, wide frequency band, and resistance to external static interference.
⑥ Mb/s	Unit of digital signal transmission speed (Megabit/sec)
⑦ Telephone density	Number of subscriber lines per 100 inhabitants. The terms main telephone lines and DEL (direct exchange lines) also used for number of subscriber lines.
⑧ Unmet demand	Number of applicants waiting for telephone installation (waiting applicants).
⑨ Ratio of unmet demand	Unmet demand/subscriber lines
⑩ Switching capacity	Number of subscriber lines able to be connected to switching system.
⑪ ISDN	Integrated Services Digital Network

Project Location



1. Project Summary and Comparison of Original Plan and Actual

1.1 Project Summary and JBIC Portion

This project is a response to the inadequacy of communication resources resulting from demand over the whole of Mauritius Island, the main island of the Republic of Mauritius, with the additional aim of improving the quality of communications on the island. The project involves the installation of the country's first digital communications equipment in the form of digital switchboards (30,000 lines), and the construction of fiber optic systems (4 sections), digital micro systems (13 sections) and a subscriber cable system.

ODA loan covers the entire foreign currency portion for the supply and installation of the switchboard and transmission facilities and training in the operation of the equipment.

1.2 Background

The Republic of Mauritius is an island nation approximately 2,040km² in area situated in the western part of the Indian Ocean 800km to the east of Madagascar, with a population of 1.16 million (1998)[1]. Since the 1980s Mauritius has worked toward the development of its economy by encouraging industry and tourism and the manufacture of processed goods for export, mainly textiles. A high GDP growth level of approximately 7% was recorded in both 1985 and 1986, and the country experienced a balance-of-payments surplus in 1986.

Table 1.1 National Development Plans and Objectives

National Development Plan	Period of plan	Objective
1st	1971～1975	Increase in employment
2nd	1975～1980	Increase in employment
3rd	1980～1982	Improved productivity
4th	1984～1986	Improved productivity
5th	**1988～1990**	**Continuing economic growth**
6th	1992～1994	Continuing economic growth Increased exports

(Source): National Development Plan 1988-1990, 1992-1994, Ministry of Economic Planning and Development
(Note): The planning and execution period of this project corresponds to the period of the 5th National Development Plan.

The 5th National Development Plan predicted growing demand for local and international communications as a result of industrialization and an increase in tourism, and recognized the urgent need

[1] The area of the island of Mauritius (the largest and main island in the Republic) at approximately 1,865km² is roughly that of Tokyo.

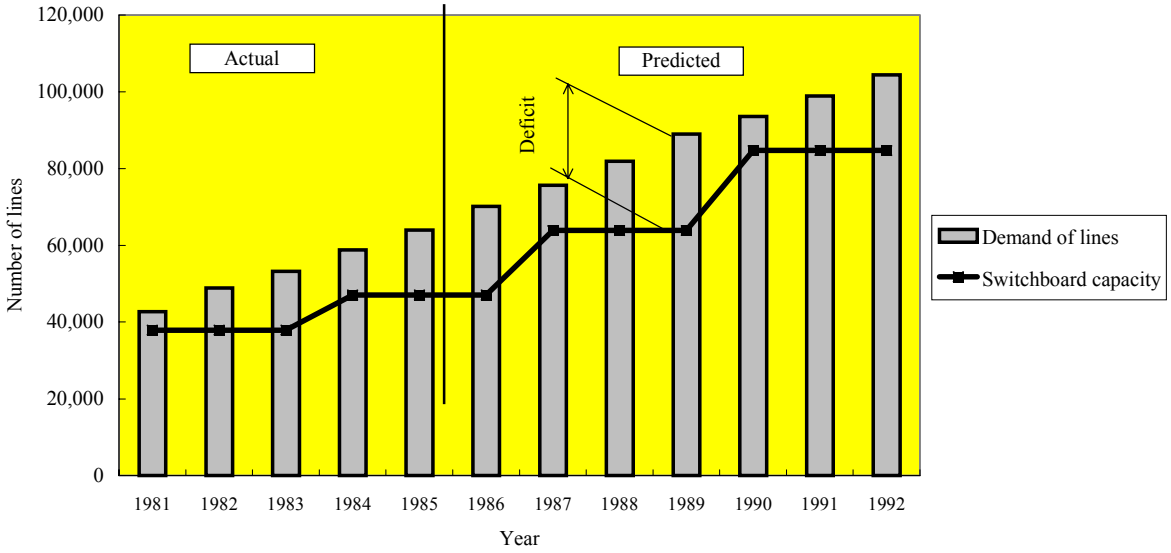
to expand communications facilities. Therefore, separate goals were set for the development of these communications facilities. The following provides a clear indication of the inclusion of this project in national development objectives.

5th National Development Plan Objectives in the Communications Sector
① Installation via this project of 30,000 new lines and a digital communications network
② Removal of the existing switchboards with the introduction of new switchboards
③ Installation, ownership and management of mobile communications facilities by private sector

1.3.1 Telecommunications in the Republic of Mauritius and the necessity for this project

Telephone density in the Republic of Mauritius was approximately 4.1 (1986), low even compared to countries with approximately the same GNP per capita (US$1090, 1984) such as Turkey (7.1) and Colombia (6.6). Domestic telecommunications facilities in 1986 consisted of 30 exchanges with a switchboard capacity of 45,050 lines, however around half of the switchboards were of the old mechanical type. Furthermore despite an average annual increase of approximately 11% in switchboard capacity since 1980, construction has been unable to meet the increased demand, and in 1986 there were 26,562 unmet demand. This number did fall slightly with the completion of switchboard facilities for 22,500 lines in May 1987, however taking into account the predicted annual increase in demand (6.9%), the number of lines was still believed to be inadequate (a deficit of approximately 8,800 lines was expected even after the completion of this project). There were also other problems such as reduction in the reliability of the communications network due to deterioration of equipment with the passage of time.

Figure 1.1 Predicted Supply and Demand at the Time of Appraisal



(Source): Appraisal materials

1.3 Project History

1986 December Official notice of PQ for this project by the Telecommunications Department of the Ministry of Energy and Internal Communications, the Government of the Republic of Mauritius

1987 January Closing of PQ

March Official request of ODA loan for this project to the Japanese government by the Government of the Republic of Mauritius (switchboards, transmission facilities, subscriber's cables are covered by ODA loan)

May Official notice of bidding for this project

June Dispatch of JBIC appraisal mission

July Closing of bidding

August Prior-Notification of ODA loan for this project by Japanese government

December MTS decision on tender
Japanese government accepts request from government of the Republic of Mauritius citing the rising yen to limit scope of ODA loan project to switching systems and transmission facilities, and reduce the amount of the loan from that indicated in the advance notice (in addition the government of Mauritius will fund itself the subscriber cable work etc. included in the ODA loan at the time of the advance notice)

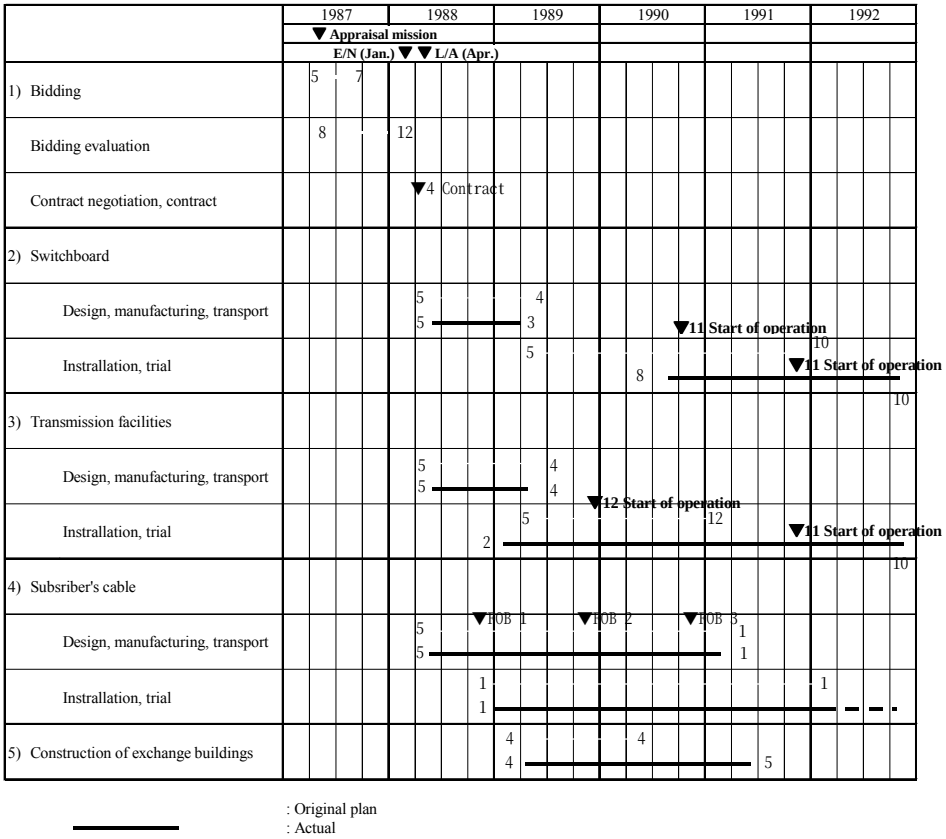
1988	January	Exchange of Notes Both government agreed that ODA loan amount will be 60% (¥16.74 billion) of the advancely noticed amount
	April	Loan Agreement (content of request in December 1987) The executing agency concludes the project contract with Japanese company
	May	Approval of project contract by JBIC (change of project scope for the 1st time, microwave transmission route etc.)
	July	Establishment of Mauritius Telecommunication Services Ltd. and transfer of this project
1989	March	Approval of 2nd contract change by JBIC (content of changes: ① executing agency, ② integration of exchanges, ③ microwave transmission route, ④ pylon, ⑤ fiber optic transmission capacity)
	April	Change of Loan Agreement in accordance with the change of executing agency (July 1988)
	November	Commencement of microwave transmission by different project other than ODA loan at microwave transmission route (Port Louis – Rose Hill, Rose Hill – Floreal) of this project
1991	June	Notification to JBIC by the executing agency concerning the change of contract (the 3rd)
	August	Dispatch of Interim Monitoring Mission by JBIC concerning change of contract
	September	Approval of the 3rd contract change by JBIC (content of changes: microwave transmission route etc.)
	November	Start of operation for installed equipment
1993	May	Final disbursement from JBIC

1.4 Comparison of Original Plan and Actual

1.4.1 Project Scope

Contents of facilities		Plan	Actual	Difference
1) Digital switchboard				
	Established	4 stations 22,000 lines	4 stations 22,000 lines	
	Renovated	8 stations 8,000 lines	8 stations 8,000 lines	No difference
	Total	12 stations 30,000 lines	12 stations 30,000 lines	
	Removal	3 stations 7,050 lines	3 stations 7,050 lines	
2) Transmission facilities				
Optical fiber	Established	2 sections 140 Mb/s	2 sections 140 Mb/s	No difference
	Established	2 sections 34 Mb/s	2 sections 140 Mb/s	Increase of capacity
Micro circuit	Established	10 sections 140 Mb/s	10 sections 140 Mb/s	Change of sections
	Transferred (extension)	3 sections 34 Mb/s	1 section 140 Mb/s	Elimination of 2 sections, increase of capacity for one section
3) Subscriber's cable				
1st cable		86,766 pair km	86,766 pair km	No difference
2nd cable		5,166 pair km	5,166 pair km	No difference

1.4.2 Implementation Schedule



1.4.3 Project Cost

	At the time of Prior-Notification (A)		At the time of Loan Agreement (B)		Actual (C)		Difference (C) - (B)	
	Foreign currency (¥ million)	Local currency (Rs. million)	Foreign currency (¥ million)	Local currency (Rs. million)	Foreign currency (¥ million)	Local currency (Rs. million)	Foreign currency (¥ million)	Local currency (Rs. million)
Switchboard	**1,276.6**	6.2	↓	↓	↓	↓	↓	↓
Transmission facilities	**732.5**	0.0	**1,466.0**	6.0	**1,422.3**	6.0	**-43.7**	0.0
Exchange building	**0.0**	26.5	0.0	27.0	0.0	88.3	0.0	61.3
Subscriber's cable	**655.9**	147.0	852.0	147.0	806.7	3.0	-45.3	-144.0
Training	**124.6**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Reserve fund	**0.0**	9.0	**208.0**	9.0	0.0	0.0	**-208.0**	-9.0
Sub-total	2,789.6	188.7	2,526.0	189.0	2,229.0	97.3	-297.0	-91.7
ODA loan (¥ million)	2,789.6	0.0	1,674.0	0.0	1,422.3	0.0	-251.7	0.0
Total (¥ million)	4,902.9		4,642.8		3,075.5		-1,567.3	

Note: - (A) is when Prior-Notification of Japanese government was made in August 1987 (after bidding was closed).
- In case of (B) at the time of loan agreement and actual (C), training costs are included in the equipment costs.
- The project scope covered by ODA loan is in the shaded area.

Exchange Rate Plan: US$1 = Rs.12.8 = ¥143 → Rs.1 = ¥ 11.2
Actual: US$1 = Rs.15.31= ¥133.94 → Rs.1 = ¥ 8.7

	At the time of loan agreement		Actual		
	Foreign currency (¥ million)	Local currency (Rs. million)	Total of foreign currency (¥ million)	OECF portion of foreign currency (¥ million)	Local currency (Rs. million)
1988	1,581.0	45.0	290.7	129.0	-
1989	440.0	94.0	1,032.7	877.3	1.0
1990	505.0	50.0	327.6	40.5	52.6
1991	-	-	254.2	259.2	30.6
1992	-	-	211.2	27.8	8.4
1993	-	-	102.6	88.5	4.7
Total	2,526.0	189.0	2,219.0	1,422.3	97.3

Exchange Rate Plan: US$1 = Rs.12.8= ¥143 → Rs.1 = ¥ 11.2
Actual: US$1 = Rs.12.8= ¥133.94 → Rs.1 = ¥ 8.7

2. Analysis and Evaluation

2.1 Evaluation on Project Implementation

2.1.1 Project Scope

1) Digital switchboard

The improvement of 30,000 lines and removal of 7,050 lines in the original plan have been completed with almost no modification.

However, because Port Louis I Exchange was consolidated into Plaine Verte Exchange (new name of former Port Louis III Exchange) during the implementation of the project, 6,000 lines scheduled to be installed in Port Louis I Exchange were added to the number of lines to be installed in Plaine Verte Exchange. Thus, the actual number of lines installed in Plaine Verte Exchange was 12,000, in contrast to 6,000 lines in the original plan.

In the original plan, Port Louis I Exchange was positioned as a remote switching unit of Port Louis III Exchange (master switching unit). However, because the effects become significant if a failure occurs in data transmission facilities between both exchanges, the alteration was made to avoid this concern. Since both the exchanges handle the same exchange area before and after the alteration, it is assumed to present no problem.

2) Optical fiber transmission facilities

For two out of the four sections that were intended to be improved in the original plan, the transmission capacity was increased from 34 Mb/s to 140 Mb/s, and in actual results, all four sections were completed with a transmission capacity of 140 Mb/s. No change was made on the installation routes for those four sections.

As a result of the completion of the master plan that was under preparation at the time of drawing up the original plan, the transmission capacity was increased to suit to the forecast that communication demands between Port Louis IV (former Port Louis II) and ITSC (former OTS)[2] and between Rose Hill 4 (former Rose Hill 2) and Candos (former Quatre Bornes) would increase. Thus, the change of the transmission capacity is assumed to be necessary from the operational viewpoint of the entire network.

3) Microwave Line Transmission Facilities

The installation route specified in the initial plan underwent three-time changes, once when the equipment procurement and installation agreement (hereinafter referred to as the "procurement agreement") was made after the appraisal of ODA loan and twice thereafter in stages of performance of the procurement agreement, before being completed. These changes, though many, are considered to be unavoidable in consideration of the necessity to be compliant with the nationwide network configuration being improved while the project was being carried out. Details of these changes are described below. JBIC approved each

[2] International Telecommunication Switching Center (former OTS: Overseas Telecommunications Service).

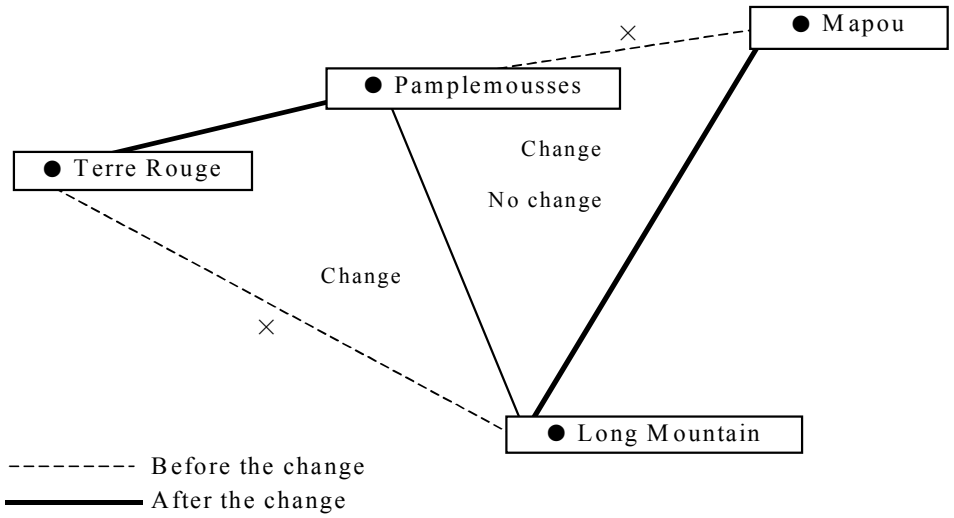
of these three changes in May 1988, March 1989, and September 1991, respectively.

(1) First modification

The first change (in May 1988) was concerned with the routes shown below.

The results of detailed design carried out in this project revealed that the planned height of pylons was restricted by the height regulation around the airport. If we complied with this requirement, it became evident that we could find no alternatives to implement the microwave line project. Hence, the first change. This change also resulted in the change in the route between Long Mountain and Terre Rouge.

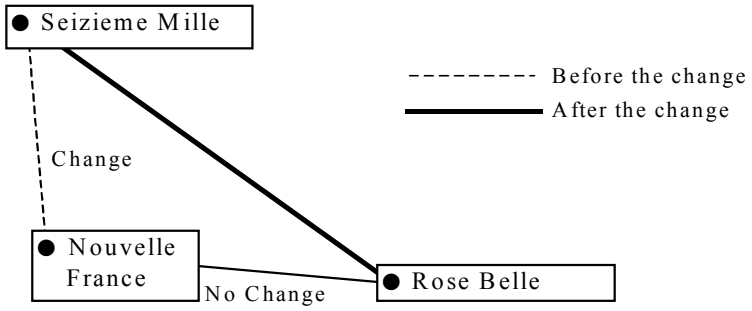
Figure 2.1 First Route Change



(2) Second modification

Next, a second modification (March 1989) was made to the routing shown in the diagram below. As with the first modification, when detailed design was drawn up in the project, it became apparent that between Seizieme and Nouvelle France pylon height would be limited by the height regulation around the airport, precluding microwave transmission. The modification was carried out as a means of solving this problem.

Figure 2.2 Second Route Change

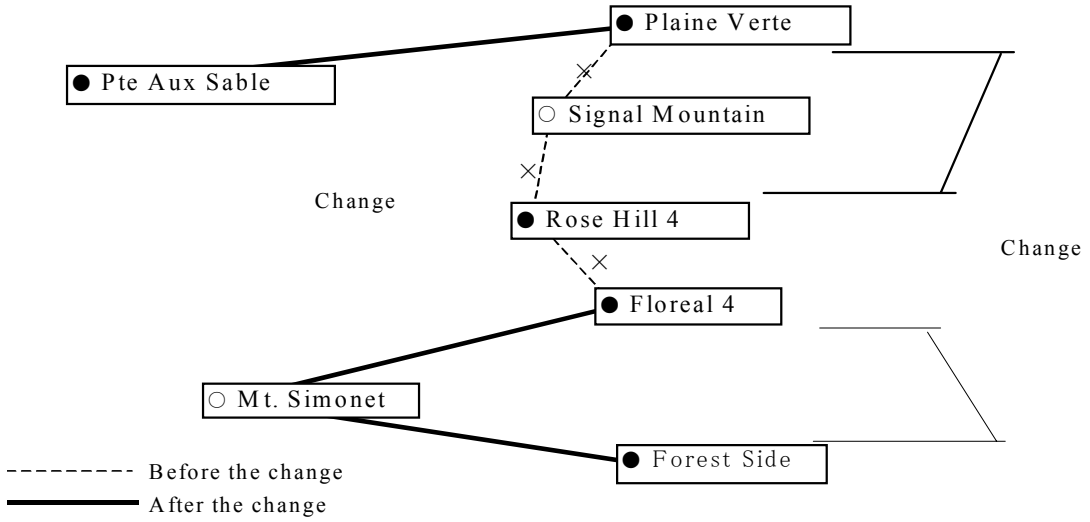


(3) Third modification

Following this, a third modification (September 1991) was made to the routing shown in the diagram below. Modifications to the original plan were made in three sections because MTS installed micro transmission gear (commencing operation in November 1989) in this section under a contract separate from that in the ODA loan, resulting in the ODA loan equipment in the original plan becoming surplus to requirements. When JBIC realized this change had taken place, because the equipment procured for the project had not yet been installed, as a result of discussions with the executing agency it was determined that the equipment would be installed by the contractors in three other sectors as indicated in the diagram below.

The executing agency had failed to inform JBIC in advance of these modifications. JBIC agreed to the modifications because (1) There were no obvious technical problems in terms of the condition of future telecommunications in Mauritius or compatibility with the master plan, and the modified routing was appropriate in terms of the destination of the diversions and, (2) the executing agency had unfamiliarity caused by privatization. In future, even in such cases that executing agencies (countries) receive ODA loan for the first time, JBIC needs to construct a system (including employment of consultants) in order to obtain timely information about the progress of the project, and to ensure comprehensive supervision.

Figure 2.3 Third Route Change



(4) Current situation

Following the completion of the project after the above three modifications, frequent communication errors in transmission between Floreal – Mt. Simonet – Forest Side prompted MT to request an investigation by the contractors. This investigation was carried out in September 1993. The Floreal and Forest Side sites had transmission towers built on flat urban areas, and Mt. Simonet a passive repeater situated on its summit. The investigation concluded that the transmitter-receivers at Floreal and Forest Side were operating normally, but that the effect of multipass was causing errors to occur. In this instance of multipass, waves originally supposed to reflect off the Mt. Simonet passive repeater and enter the receiver directly were seriously affected by waves arriving at the receiver via a different route having been scattered as a result of the mountain's surface etc., and the wave form of the input waves synthesized in the receiver was being greatly distorted in comparison to those of the original waves.

It was determined that MT could possibly have avoided the multipass problem in this section if its advance survey had been sufficiently thorough. JBIC, when approving MT's modifications, may have had the opportunity to point out to MT the possibility of this type of problem occurring, and encourage MT to carry out its surveys more thoroughly.

To solve the problem, in the aforementioned survey report, the contractors suggested that MT either install an active repeater on Mt. Simonet, or alter the routing of transmissions. Five months later in March 1994 a cyclone hit the region damaging the passive repeater built in a separate project on Signal Mountain (see above diagram), and as a result MT under its own initiative moved the passive repeater on Mt. Simonet to Signal Mountain and restored the lines. MT has also shifted the transmitter-receivers no longer required at Floreal and Forest Side to the R.Des Anguilles – Souillac section, commencing operations of the equipment in October 1998. All the micro line transmission facilities installed in the project between Floreal – Mt. Simonet – Forest Side therefore had as of 1998 been shifted and are now operating.

4) Exchange buildings and subscriber cables

Exchange buildings and subscriber cable work were completed, within the scope of the project, largely as planned. No problems of a serious nature have been identified.

2.1.2 Implementation schedule

Installation of equipment commenced in May 1988 in accordance with the original plan, however the commencement of operations scheduled in November 1990 was delayed by one year. This delay in the overall implementation schedule can mainly be attributed to a delay in the construction of exchange buildings.

In the case of this type of projects which consists mainly of the procurement of equipment, progress in the construction of buildings to install the equipment obviously has a major influence on implementation of the project as a whole, therefore the executing agency should have been more careful in its management of the project's progress. The following is an analysis and evaluation of the implementation schedule for each of the items supplied.

1) Switching systems

The design, manufacture and transport of switching systems were implemented largely as planned. Delays in the construction of the exchange buildings to install the equipment, however, resulted in the installation of switching systems commencing approximately fifteen months behind schedule. Delivery trials of the equipment then commenced in July 1991 and were completed in November of the same year. Operation of the equipment (start of O/M assist) commenced twelve months behind schedule.

2) Transmission facilities

The design, manufacture and transport of transmission facilities were also implemented largely as planned. The start of construction of transmitting towers situated on the roofs of exchange buildings was delayed owing to delays in construction of the buildings themselves, however, construction of stand-alone towers situated independently of the exchange buildings commenced three months earlier than the original plan. Delivery trials, however, ultimately commenced in July 1991 in conjunction with those for the switching systems, and were completed in November of the same year. Therefore, operation of the equipment (start of O/M assist) commenced twenty-two months behind schedule.

3) Subscriber cables

The design, manufacture and transport of subscriber cables were implemented largely as planned. However, as a consequence of delays in construction of the exchange buildings to install cables, a delay of seven months also occurred in the start of cable-laying operations. Delivery trials commenced in

conjunction with other equipment in July 1991. Operation of subscriber cables commenced in stages from November of the same year.

4) Exchange buildings

As explained, the exchange buildings were the source of delays in the overall implementation schedule. Construction of exchange buildings was the responsibility of local contractors. According to the executing agency, the main reason for the delays was a shortage of materials and equipment owing to the construction boom in the Republic of Mauritius in 1990 (in 1990 the construction sector share of GDP grew 12.5% in comparison with the previous year).

2.1.3 Project Cost

1) Overall project cost

The following is a comparative analysis of the project cost between the original plan. at the time of L/A and the actual cost. Of the project's foreign currency portion, the ODA loan covered the cost of switching systems and transmission facilities, while the remaining foreign currency and local currency costs for cables etc. were covered by the budget of the government of the Republic of Mauritius.

While the figure provided in the original plan was ¥4,642.8 million, the actual overall project cost came out at ¥3,075.5 million, a cost under-run of approximately 34%. The original plan, however, includes ¥308.8 million (¥208 million in foreign currency and 9 million rupees in local currency) set aside as a contingency for the project, and if this is discounted the project comes out approximately 29% below the budget. The factors causing a cost under-run are mainly in local currency portion, foreign currency portion being almost the same as planned.

2) Foreign currency portion

Because all contracts for the procurement and installation of equipment were concluded by the executing agency MT in US dollars, figures here are cited on a US dollar basis.

In the original plan, the foreign currency portion covered by both the ODA loan and self-financing, was $17.664 million (¥2,526.0 million, exchange rate US$1 = 143 yen), however the actual result was a slight cost under-run (approx. –5.8%) at $16.642 million (¥2,229.0 million, exchange rate US$1 = 133.94 yen). However, as indicated above in the overall project cost, a contingency was estimated of $1.455 million (¥208 million, US$1 = 143 yen) and if this amount is deducted the cost of the original plan becomes $16.210 million, and actual result is almost the same as planned (approx. +2.7%).

Furthermore even if only the portion covered by ODA loan is taken into account, while project cost (yen basis) appears to have been reduced (¥1,674.0 million → ¥1,422.3 million), on a US dollar basis actual cost was $10,503,118,45 as opposed to the cost in the original plan of $10,253,064,30 (both amounts exclude charges) i.e. virtually the same as the plan (+2.4%). Increased costs were the extra costs involved in the modifications detailed in [2.1.1 Project Scope], and were deemed to be appropriate increases.

3) Local currency portion

The actual local currency portion was 97.3 million rupees, compared to 189.0 million rupees in the original plan (a cost under-run of approximately 49%). In terms of the cost of individual items, the cost of exchange buildings was up at 88.3 million rupees compared to 27.0 million rupees in the original plan; while the actual cost involved in subscriber cables was 3.0 million rupees as opposed to 147.0 million rupees of the original plan. The figure for actual cost may be considered to cover only costs related to the importing of cable such as taxes, and do not include the costs of installation estimated in the original plan, however, no clear explanation of the discrepancy was provided by the executing agency.

2.1.4 Implementation Scheme

1) Executing agency

The project executing agency was originally the Telecommunications Department of the Ministry of Energy and Internal Communication (MTD). Then in April 1988 MTD was privatized (corporatized), becoming Mauritius Telecommunication Services Ltd., (known hereunder as MTS), with responsibility for assets and liabilities including this project transferred to MTS in July of the same year. In July 1992 the international telecommunications business operated by Overseas Telecommunications Service Co. Ltd. (OTS) was transferred to MTS, prompting another change in identity, this time to Mauritius Telecom (MT).

The government of the Republic of Mauritius submitted an application to JBIC to change the above executing agency in March 1989, approximately eleven months after the changeover had actually taken place (the borrower in the loan agreement for the project remaining the government of Mauritius). Regarding this delay in reporting the change of executing agency, JBIC concurred to the change after the fact, taking into account the fact that the project was the first ODA loan agreement entered into by the Republic of Mauritius, and consequently the government was unfamiliar with loan procedures.

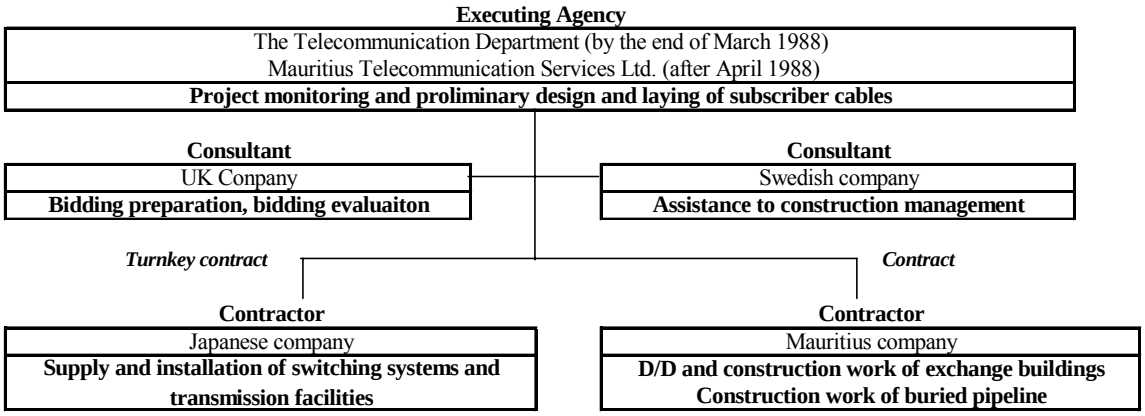
For the sake of future loan arrangements, there is a need for JBIC to explore further ways of ensuring that countries and executing agencies receiving ODA loan assistance for the first time (in particular countries not the subject of annual-based or without JBIC representative offices) have a proper understanding of such matters as the ODA loan system and procedures (not only for new loans, but also for alterations to loan arrangements).

In terms of the implementation of the project, procurement and installation of switching systems and transmission facilities (turnkey) and the construction of exchange buildings were supervised by MTD's Planning and Development Switching and Transmission Department. Another department of MTD, Planning and Development External Plant, had previous similar experience in carrying out work of the subscriber cables, and was therefore given direct responsibility for the preliminary design, procurement and laying of the subscriber cables.

The number of staff employed by the executing agency altered little following the changeover to MTS, i.e. senior management 6; middle management 16; engineers 30; technicians 90; and 800 other staff - a total

of 942 personnel. The same organizational structure also remained in place, and the project was carried out mainly by a project implementation manager with a team of five engineers assigned exclusively to the project.

Figure 2.4 Project Implementation Scheme



2) Consultants

Consultants for the project were employed by MTS. Two consultancy firms were enlisted to assist the executing agency: a British firm for the drawing up of tender documentation and evaluation of bids, and a Swedish firm to supervise the construction work. No particular problems were reported with the performance of either firm.

3) Contractors

The contract for the procurement and installation of equipment covered by the ODA loan went to a Japanese company, following international bidding with pre-qualification (P/Q), while the contracts for the exchange buildings and buried pipeline covered by MT's own funds were won by local companies.

The Japanese company which carried out the procurement and installation of switching systems and transmission facilities under a turnkey contract deserves praise since there were no delays, despite repeated modifications to the project scope. The manufacturers supplying the equipment, in addition, trained MT staff in the management of operations and maintenance (in both Japan and in the Republic of Mauritius itself). Five of the six staff who received this training (one has left the company) are currently still responsible for divisions (equipment) related to the content of their training. This training is therefore manifesting itself in their work and the staff may be assumed, by now, to have built up considerable experience in their respective areas. At interviews conducted directly with the five staff during this post-evaluation, they commended the training, stating that the training carried out as part of the project had proven indispensable for proper operation of the equipment.

There were, on the other hand, delays in the construction of exchange buildings contracted out to local

companies, however as explained in [2.1.2 Implementation Schedule] these can be attributed mainly to a construction boom at the time and were therefore unavoidable.

2.2 Evaluation on Operations and Maintenance

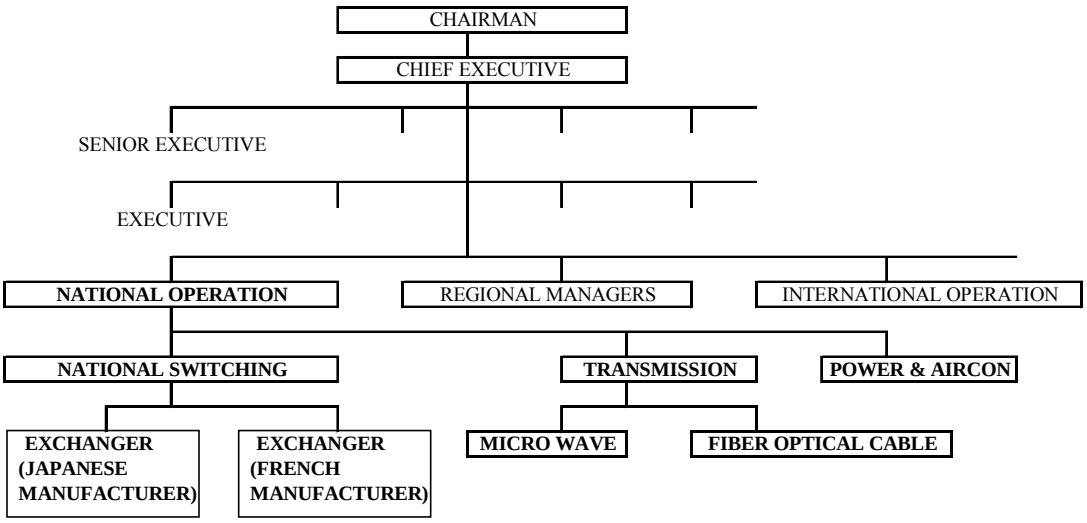
2.2.1 Operations and Maintenance Scheme

1) Organizational structure

The present domestic telecommunications network is a two-tiered structure (two-tiered network) consisting of nine master switching units and 54 remote switching units.

Project operations and maintenance are carried out by MT. The diagram below shows organization of MT for operations and maintenance. The MT has separate operations and maintenance scheme for domestic and international telecommunications facilities.

Figure 2.5 Operations and Maintenance Organization of MT



(Source): Mauritius Telecom

The division of MT responsible for operations and maintenance is composed of three sections involved in switching systems, transmission facilities, and power and air-conditioning equipment. Each section divides Mauritius Island into three regions: North Region, Central Region and South Region, and also divides operations and maintenance activities according to the manufacturer of the equipment concerned.

Separate staff assigned in the main exchanges are responsible for the different French and Japanese switching equipment. Transmission facilities also have separate sections assigned exclusively to maintenance, for microwave and fiber optic cable. Power and air-conditioning in exchanges are essential elements in the stable operation of switching systems and have their own separate division responsible for maintenance.

2) System for dealing with customer complaints

As explained, exchanges are divided broadly between housing equipment from Japanese companies and housing equipment from French companies. Customer complaints therefore are also dealt with by each manufacturer. The following is an overview of the customer complaints system as it relates to the equipment installed in the project.

MT has set up IMCC (Installation and Maintenance Control Centers) in each of the three regions,[3] and uses a computer-based service to deal with complaints related to subscriber lines etc. from customers, and to manage customer information.

If there is an actual fault with a telephone or fax, users dial 92 and report the fault to the IMCC in their area. Rudimentary problems such as incorrect use able to be dealt with by the IMCC operators are solved on the spot by explaining to the customer how they can be fixed, however faults in communications equipment or subscriber lines are dealt with by issuing a repair order to the OSP Section (Outside Plant Section) once the fault has been confirmed on the IMCC terminal. Upon receipt of this order the OSP dispatches maintenance staff to find the source of the fault and repair it. When the cause of the fault has been eliminated, maintenance staff submit a repair completion report to the IMCC and the repair process is completed.

3) Subscriber line monitoring and control system

Each exchange has a system in place to facilitate early detection of line faults, involving daily automatic monitoring of all lines by computer early in the morning when switching activity is relatively low. If an irregularity is found in a switching system during this automatic monitoring, the line is automatically locked out, generating a Lockout Report (a list of lockout subscribers). Staff at the exchanges then immediately investigate the location of the irregularity and forward a Lockout Report to the IMCC.

The monitoring and control system at the Plaine Verte master switching unit (main exchange), which was built as part of the project, has been in use for almost ten years now, and there are plans to introduce a new system. When this system is completed there will be an Operation and Maintenance Center (OMC) located in the Plaine Verte exchange, and it will be possible to operate the switching systems of other main exchanges from the OMC by remote control, identifying faults and implementing recovery measures.

[3] IMCCs for the three regions are located in the exchanges at Plaine Verte (North), Forest Side (South) and Candos (Center).

4) Personnel development and training

In the telecommunications industry, the quick pace of technical innovation in particular makes it vital that staff posse sufficient technical skill to efficiently operate the facilities installed. MT organizes training courses both locally and overseas for each type of facility for which staff are responsible,[4] and these were attended by 323 staff between 1991 and 1997. JICA also received a trainee to study digital telecommunications technology in 1994, 1995 and 1997 for approximately a month and a half on each occasion.

5) Year 2000 readiness

It has been said that the so-called "computer year 2000" problem (hereunder the "Y2K problem"), i.e. the potential for chaos in computer systems from the year 2000 onward arising from misreading of dates, owing to years in computer systems being comprised of only two digits, will have a major impact on the activities of organizations all over the world that use computers. Companies like MT in the telecommunications industry are particularly reliant on computers, and will consequently be required to take particular care to ensure Y2K readiness.

In 1997, in accordance with the recommendations of the British Standards Institute (BSI)[5] MT formed a project team for dealing with the Y2K issue, which proceeded to conduct an inventory of all systems and begin practical work on the problem. The project team consists of six staff from the Planning Department, Finance Department and IT (Information Technology) Department working under a director assigned to the project team fulltime. According to MT, minor adjustments to the systems installed in the project have been completed in accordance with manufacturer instructions[6], and trials to confirm actual operational status conducted from September 1997, before those of MT equipment supplied by other manufacturers.

The National Computer Board (NCB)[7], which has as its objective the advancement of the information and telecommunication industries in the Republic of Mauritius, is involved in bringing the Y2K issue to the attention of government bodies and the private sector, and is tackling Y2K concerns by centralized measures such as an enquiry service. A Y2K Task Force has been set up within the NCB, and under this a number of work groups divided according to their areas of involvement have been established. The Y2K assigned MT director is part of this task force in the capacity of representative of the public infrastructure work group.

As explained, MT has taken steps from an early stage to confront the Y2K problem within the company; adopted measures following discussion with manufacturers; and confirmed that all systems installed under this project are Y2K-compliant and contribute to the resolution of the problem on a national level. These

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4 Training locally takes place at the MT training school, and overseas under the guidance of telecommunications providers and manufacturers chiefly in the US, UK, France, Sweden, Australia, and Singapore.

5 In January 1997 the British Standard Institution DISC released policy recommendations for Y2K readiness measures. The possibility of drawing these recommendations up as British Standards was also examined at the time, however because formulation as national standards would take time, they were released as a Published Document instead.

6 The most work required was reported to have involved changing the date displayed on printouts for the charge collection system from two to four digits (system recognition was four digits from the start).

7 Set up by the Ministry of Telecommunication and Technology under NCB Act 43 of 1988.

activities are highly evaluated. However, trials on other MT systems (those falling outside the scope of the loan) are scheduled to be completed in February 1999, at this point in time it cannot be said that preparations are complete over the entire network. Furthermore, work is by no means complete on systems receiving external data such as payment collection details forwarded by banks and post offices and international toll call charges transferred from telecommunications carriers in other countries. Efforts to solve the Y2K problem must therefore continue in conjunction with the relevant organizations.

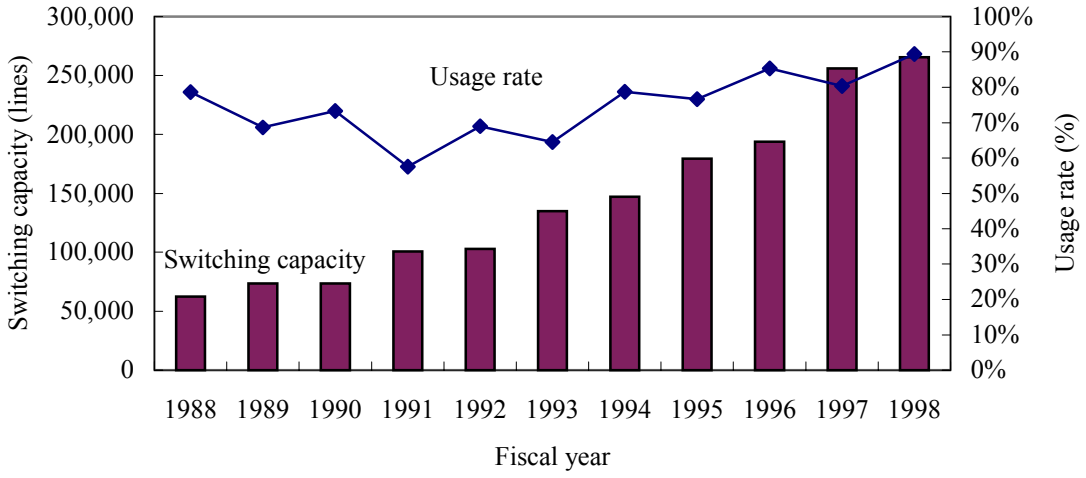
2.2.2 Operations and maintenance

1) Expansion of switching systems and usage rates

The functioning of telecommunications facilities as a network makes it difficult to assess separately the facilities provided under this project; and in any case owing to the nature of networks the operational status of the entire system is of importance. The following therefore will provide an overall view of the operations and maintenance of the telecommunications network as a whole.

Via this project, and the continuing efforts of MT to expand telecommunications facilities, switching capacity increased from 73,500 lines in FY1990 to 265,294 in FY1998. With an increase in switching capacity of this magnitude, and usage rates of switching systems averaging approximately 74.7% (1988 – 1998), all switching systems including those installed under this project can confidently be said to be receiving ample use.

Figure 2.6 Switching Capacity and Usage Rates



(Source): Produced from materials of Mauritius Telecom

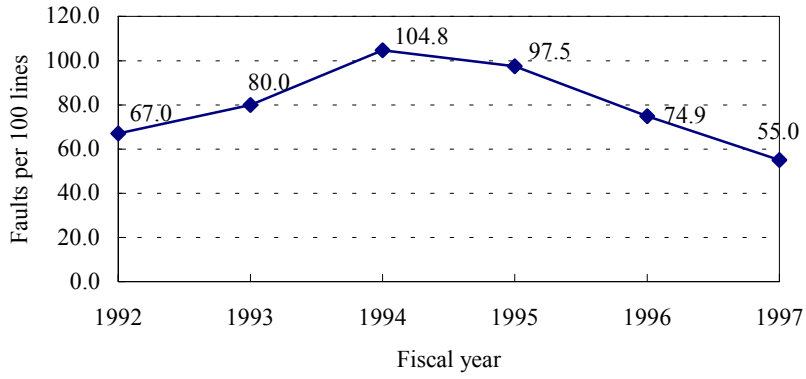
This efficient operation of equipment is backed up by daily contact with manufacturers. MT carries out basic repairs to switching systems itself, however when faults occur in control system software and electronic equipment etc., which it is difficult for MT itself to deal with, MT consults directly with

manufacturers and if necessary asks them to carry out repairs. In terms of the equipment installed in this project, MT has praised the meticulous service provided by Japanese companies in response to such consultation even now, almost ten years after project completion.

2) Quality of telecommunications services

One indication of the quality of a telecommunications network is the number of faults (per 100 lines). The number here represents faults that actually required some type of repair work, as opposed to the number of complaints. As the graph indicates, incidences of faults increased between 1992 and 1994, but have since then been on the decline. This improvement in quality, as explained earlier, can be attributed to efforts by MT to improve service during the continuing expansion of the network.[8]

Figure 2.7 Faults per 100 lines



(Source): "Year Book of Statistics" ITU.

3) Customer service

MT has established Customer Service Centers in sixteen locations around the country with the aim of providing assistance to customers.[9] These conduct the following services:

① Processing of applications for all services
② Processing of complaints and enquiries related to all services
③ Domestic and international telephone calls, faxes
④ Payment of telephone bills
⑤ Telecommunications equipment sales
⑥ Telephone card (pre-paid card) sales

[8] The number of actual faults rose to 138,501 in 1995, falling however in 1996 and 1997 to 130,127 and 128,448 respectively.
[9] The majority of service centers are located at exchanges.

According to MT, the time taken from completion of an application for connection to actual connection is generally one day (provided there is an existing subscriber line connected with the exchange). Demand in urban areas has almost been met, and the next important step is a rapid response to demand in rural areas.

In the interests of improving service, MT also conducts regular surveys of subscriber needs. According to a survey carried out in 1997[10], over 80% of subscribers are satisfied with the service provided by MT.

2.2.3 Policies for privatization in the telecommunications sector

1) Privatization of the telecommunications sector in Mauritius

(1) Steps in privatization up to the present day

As explained earlier, the telecommunications sector in Mauritius is currently undergoing a gradual privatization. The following is a summary of this process.

Table 2.1 Transition in the Telecommunications Sector in Mauritius

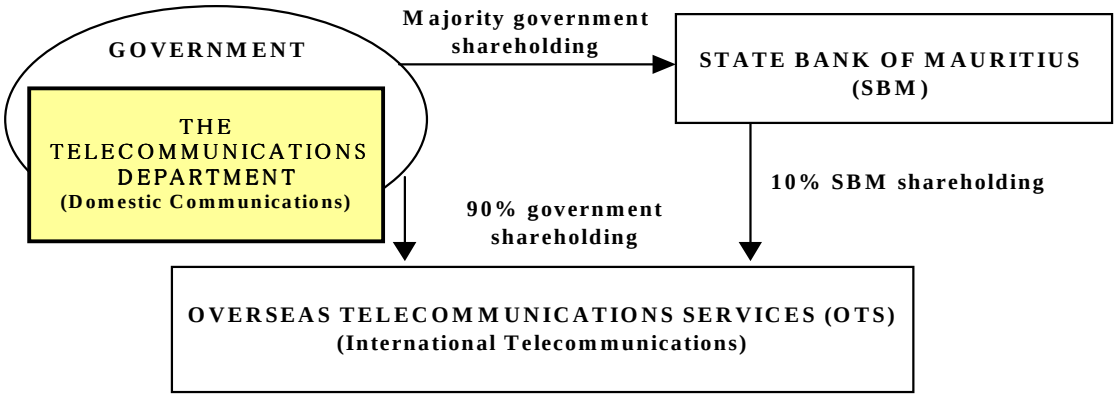
	Steps in Privatization
Before 1985 [Government organization]	International telecommunication services are implemented by Cable & Wireless (British company)
	Domestic telecommunication services are implemented by the Telecommunications Department
1985	Responsibility for international telecommunications transferred from Cable & Wireless to the government-financed company, Overseas Telecommunications Services Co. Ltd. (OTS)
July 1988 [Corporatization] (Possessed by government)	Domestic telecommunications services and related assets and liabilities transferred from the Telecommunications Department to MTS (founded April 1988) Setting up of the Telecommunication Authority (TA) as regulating body and the Telecommunication Advisory Council to advise on telecommunication policy.
July 1992	International telecommunication services transferred from OTS to MTS, which becomes Mauritius Telecom (MT)
February 1997	Mauritius government promised WTO complete liberalization of the telecommunications sector by 2004

(Source): Produced from Telecommunication Authority (Mauritius), Mauritius Telecom materials etc.

[10] Survey conducted by SOFRES

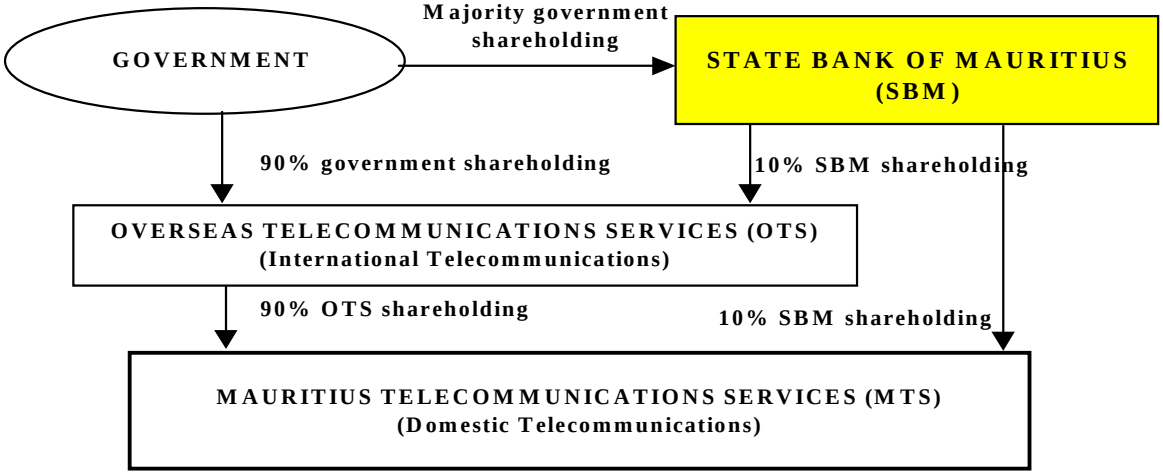
The following diagrams (Figures 2.8 – 2.10) provide an overview of the changes in shareholding relationships of the telecommunications sector in Mauritius during the stages outlined above.

Figure 2.8 Shareholding Relationship of the Telecommunications Sector in Mauritius



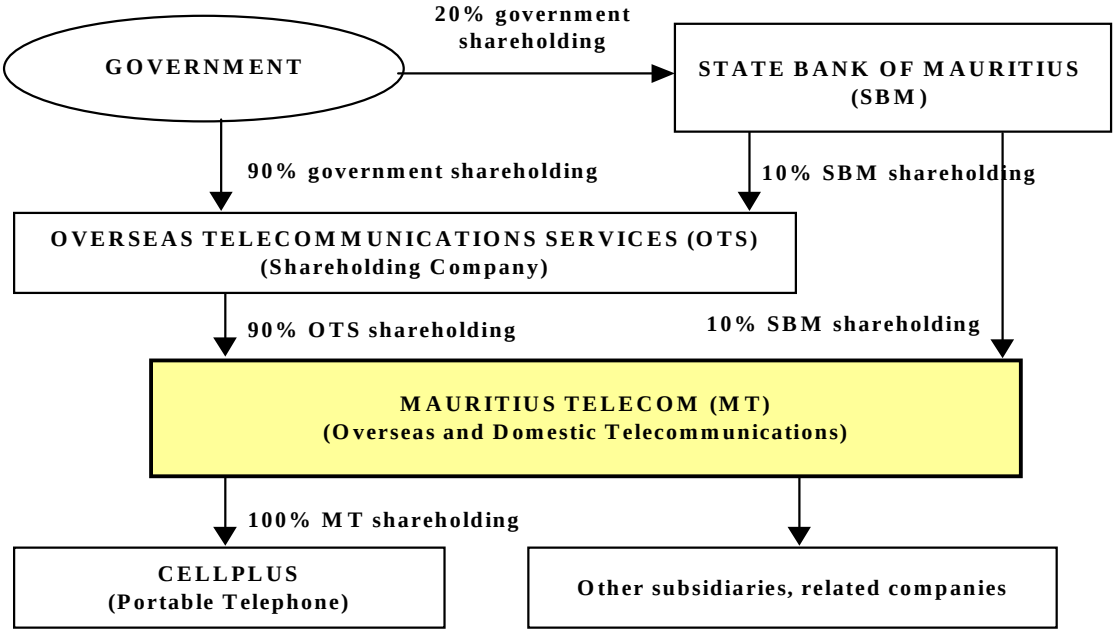
(Source): Produced from the material data of Telecommunication Authority (Mauritius), Mauritius Telecom etc.

Figure 2.9 Shareholding Relationships of the Telecommunication Sector in Mauritius (July 1988-June 1992)



(Source): Produced from the material data of Telecommunication Authority (Mauritius), Mauritius Telecom etc.

Figure 2.10 Shareholding Relationships of the Telecommunication Sector in Mauritius (July 1992 – as of December 1998)



(Source): Produced from the material data of Telecommunication Authority (Mauritius), Mauritius Telecom etc.

As the diagrams show, in July 1988 MTS was set up as a subsidiary of OTS, then in July 1992 the international telecommunications services operated by OTS transferred to MTS (MT). The reason for this gradual transfer of responsibilities, as may be surmised from the fact that domestic telephone charges, which had until that time been subject to frequent increases, settled down around the period of the transfer (integration of services), may be thought to lie in an intention to channel the high profits of the OTS international telecommunications operation into the considerable investment required in the MTS domestic telecommunications operation, by integrating international and domestic telecommunications; at the same time minimizing price increases in domestic telecommunications. On the other hand, a look at the ownership structure of the corporatized MT reveals as indicated in Figure 2.10 that the majority of shares are held by the government.

(2) Future plans

① Revision of the Telecommunication Act

The next aim for Mauritius is the complete liberalization of the telecommunications sector (abolition of monopoly, unrestricted entry to the industry including that by foreign carriers) in accordance with the principle of competition. The present TA is very much a government organ by nature, with assistance from the government in terms of personnel and funding indispensable to its existence. It is predicted furthermore that the complete opening up of the sector in the future will generate competition over connection charges between new entrants and the existing businesses, which are in a favorable position owing to their existing ownership of the domestic telecommunications network. Under these circumstances, ensuring fairness in the process of complete liberalization will probably require an increase in the powers of the Telecommunication Authority (established July 1988 as a regulating body for the telecommunication sector; hereunder known as the TA) and changes to its role. By revising the Telecommunication Act (1988), the government of Mauritius plans to reinforce the independence of the TA as a regulating body, and strengthen its role and authority in the following ways.

- Increase TA degree of financial and personnel independence from government
- Provide the TA with the power to resolve conflicts between carriers
- Employ around fifteen specialist staff under the office of the Chief Executive Officer

② Sale of shares

Vis-a-vis the privatization of MT (sale of shares), there are plans to contract a specialist financial advisor to advise on practical concerns such as the timing and method of share offers. The following points will be important in the sale of shares.

- Government shareholding following privatization and the adoption of golden shares[11]
- Possible release of OTS or MT shares (ref. Figure 2.10)
- Possible priority share allocation to employees and the methods

2) Policies for balancing the interests involved in privatization

The following is a comparative summary of the measures planned by Mauritius to achieve balance between various interests in its privatization of the telecommunication sector, and the example of privatization of the telecommunications sector in Malaysia.

[11] Special shares granting veto rights in relation to specified important matters (joint ventures etc.). By holding these a government can ensure its policies are reflected in the management of a privatized company. Shares of this type were issued for the privatization of British Telecom, and in the same manner for Telecom Malaysia, in the case of which they were known as special shares. In the case of Malaysia, prior approval of the special shareholders is required for matters such as changes to the articles of association, liquidation of the company, important acquisitions, the transfer of important assets and joint ventures. Company law in Mauritius does not include any provisions for the issue of this type of share, therefore hypothetically revision of company law is required before the government can exert any influence on MT by the holding of shares.

Table 2.2 Privatization in the Telecommunication Sectors of Malaysia and Mauritius

	Policies implemented in Malaysia	Policies planned in Mauritius
Elimination of regional differences (government, beneficiaries) and the pursuit of profits (company/shareholder)	Privatized operator obliged to promote development in outlying areas	Payment of subsidies from a universal fund
Equitable pricing of services (government, beneficiaries) and the pursuit of profits (company/shareholder)	Pricing approval system	Establishing of principles for price setting, e.g. the abolition of internal subsidies; supervision by the regulating authorities on the basis of these principles
Increased efficiency in management and the security of employment and preservation of working conditions	Company obliged to guarantee employment for a specified length of time following privatization	Tax breaks as incentive for employees to take early retirement

In contrast to Malaysia therefore, where the policies toward operators following privatization that were designed to achieve balance between conflicting interests included a number of conditions (promotion of development in the regions, prohibiting layoffs etc.) on the granting of monopoly rights, the intention of Mauritius appears to be to introduce a policy with greater emphasis on competition, and to adopt ways of achieving balance between various interests that is superior in terms of transparency.

3) An evaluation of privatization in the telecommunications sector to date and pending issues for the future

Here we shall examine how MT, currently at an intermediary stage on the road to complete privatization, has managed to reduce its financial burdens and improve the efficiency of operations, and how staff concerns have been overcome.

(1) Reduction of the financial burden

Since the privatization of the telecommunications sector in June 1988 there has been no financial outlay on the telecommunications sector, therefore in this sense the financial burden can be viewed as having been reduced. On the other hand, from a revenue perspective, the contribution to finances of both tax revenue and revenue from dividends has been minor. Any genuine contribution to finances will probably have to wait until the sale of shares.

(2) Progress in efficiency

Turnover per MT employee, ratio of labor costs to turnover, business costs per line and number of lines per employee were calculated and analyzed to provide an indication of the progress of efficiency.

Table 2.3 Efficiency Index of MT

Fiscal Year	1993	1994	1995	1996	1997	1998	94-98 average
Number of employees	1,422	1,438	1,480	1,705	1,817	1,839	—
Number of lines	87,672	117,044	138,838	166,311	204,908	234,104	—
Turnover per employee	564	817	902	907	1,023	1,127	—
Growth rate of turnover per employee	—	45%	10%	1%	13%	10%	16%
Ratio of labor costs to turnover	23%	19%	20%	25%	19%	19%	—
Business costs per line	6.648	5.443	5.079	5.788	5.055	5.098	—
Growth rate of business cost per line	—	-18%	-7%	14%	-13%	1%	-5%
Number of lines per employee	61.7	81.4	93.8	97.5	112.8	127.3	—
Growth rate of number of lines per employee	—	32%	15%	4%	16%	13%	16%

(Source): Calculated on the basis of material data by MT
(Note): Data on line numbers was collected at a different period in Table 2.5, resulting in a slight difference in the figures

The number of MT employees has consistently continued to increase, however owing to even greater increases in turnover, average annual turnover per employee rose by an impressive 16% between FY1994 and 1998. Furthermore owing to this increase in turnover per employee, the ratio of labor costs to turnover showed a slight decline from 23% in the June 1993 to 19% in the June 1998 period. Business costs per line also fell an average of 5% annually (FY94 – FY98) despite inflation during the same period, and there was a high average annual increase of 16% (FY94 – FY98) in the number of lines per employee. These last figures, however, may be largely attributed to a marked increase in the number of lines.

(3) Pending issues for the future

① Elimination of internal subsidies: rectifying differences in international and domestic charges

Preventing the employment of internal subsidies by carriers is important for the equitable setting of prices for services. The danger exists that carrier in an advantageous position (e.g. a monopoly) in terms of providing a particular service may use those profits to cover losses in another service (e.g. a new business) and block the entry of new operators into that business.

At present MT may be assumed to be using profits from its international telecommunications operation to make up for losses in its domestic calling services.[12] In the case also of the MT mobile telephone subsidiary Cell Plus, MT can be considered to be engaging in real terms in internal subsidies, failing as it is to properly recover the costs involved in collecting charges or administration by agencies.

The planned abolition of monopoly rights will to some extent stop companies from engaging in internal subsidization. If for example a new carrier entered the international telecommunications sector in which MT is currently enjoying high profitability, competition would force MT to reduce its international calling charges, losing the inflated profits it owes to its monopoly, and the funding source for internal subsidies of domestic calling services.

There is no doubt therefore that with the adoption of a policy of competition, MT will be under pressure to lower its international calling charges. To compensate for this on the other hand, it is expected that MT will raise its domestic telecommunications charges, thus reducing the discrepancy between international and domestic charges. However because political resistance is expected to any rise in domestic charges, it will be vital for MT to prepare the environment for rises by such means as reducing costs to contain the level of the rises and bringing transparency to the accounting in each of its business units.

② Carrier accounting by business unit

For the purposes of eliminating internal subsidies between services and ensuring equitable price setting in the future; determining appropriate connection charges between operators, and making decisions on subsidies from the universal fund, it is essential that telecommunications carriers, in particular large carriers such as MT providing a multitude of services, account separately for the costs involved in their different types of operation.

[12] At present MT does not separate and work out the business costs of its domestic and international services, and thus it is impossible to judge the extent of internal subsidies. However the high profits shown by OTS when it was dealing exclusively with international telecommunications coupled with the significant gap between international and domestic call charges leaves little room for doubt that internal subsidies do exist. Despite the fact that personnel and facilities in the international division are extremely limited (the number of employees responsible for the international network being less than half those involved in the domestic network for example), while the ratio of international calls may be declining in terms of volume, the division still provides almost half of MT's revenue, and it can be assumed that MT is reaping significant profits from international call services.

③ Progress in efficiency

Since privatization, MT has remained in a favorable financial position and seen major improvements in efficiency across all indicators. This situation can however be mainly attributed to an increase in sales volumes (and line numbers) against the backdrop of MT's monopoly of both the domestic and international sectors. The introduction of a policy of competition in the telecommunications sector will not only make it difficult for MT to expand in terms of volume as before, but will also bring with it the distinct possibility that MT will be forced to slash its international telecommunications charges, which until now have served as a major source of funds. Therefore as a private sector company, MT needs to further improve its efficiency.

④ Management of the universal fund

A universal fund is envisaged as part of the TA as a means of ensuring equitable network coverage in sparsely populated areas. This fund would pay subsidies to (telecommunications) carriers. The universal fund would be collected separately from the usual license fees collected from (telecommunications) carriers, however considerable technical difficulties are envisaged in the operation of a universal fund, e.g. the setting of appropriate fees, decisions on payment of subsidies and calculation of subsidy amounts. In particular with domestic charges being comparatively low, if miscalculations were made in the management of a universal fund, it could become difficult to provide equitable service to non-profitable regions.

2.2.4 Financial analysis of the Mauritius Telecom Group

1) A comparison with other companies in the industry

The following table uses the consolidated balance sheet of OTS to compare the finances of the MT group with four Japanese companies in the same industry.

Table 2.4 A comparison of Financial Data of OTS and Japanese Telecommunications Carriers

	OTS consolidated	Nippon Telecom	Daini Denden	NTT	KDD
Ratio of current profits to net worth	33%	13%	23%	7%	7%
Ratio of current profits to total liabilities and net worth	12%	7%	10%	3%	4%
Ratio of current profits to turnover	29%	9%	9%	4%	9%
Ratio of net worth	33%	49%	44%	40%	60%
Turnover ratio of total liabilities and net worth	42%	74%	102%	57%	50%

(Source): OTS material

The data of Japanese telecommunications carries are based on financial statement (average between FY1995 – FY1998)

OTS figures on ratio of current profits to net worth and ratio of current profits to total liabilities and net

worth are high in comparison with the Japanese telecommunications carriers. The source of these however is a remarkably high ratio of current profits to turnover. In contrast, turnover ratio of total liabilities and net worth is low compared to the four Japanese companies. This indicates that while the monopoly status of OTS allows the company to enjoy high profit ratios, it lacks efficient management of its assets.

2) Time-series analysis

Generally speaking, OTS ratio of profits to total liabilities and net worth on a consolidated basis declined between the June 1989 period when domestic telecommunications services were transferred from the Telecommunications Department to MT, and the June period of 1993 when returns began to recover. This may be considered to be the result of expansion in profits lagging behind enormous capital investment between the June period of 1989 and the June period of 1993. If ratio of profits to total liabilities and net worth is divided into turnover ratio of total liabilities and net worth, and ratio of profits to turnover for consideration, it may be observed that both have displayed slow but steady growth since June 1993. This may be viewed as the slightly delayed result in terms of sales growth (improvement in turnover ratio of total liabilities and net worth) and return on sales of the previous significant capital investment.

Growth in sales moreover has been brought about entirely by an increase in the volume of calls, as there have been no increases in domestic or international calling charges in recent years. Call volume can be divided into number of lines and volume of calls per line. While sales per line (= call volume) are showing a gradual decline, the number of lines has increased by an average 20% each year since June 1993, and this may be viewed as the reason for growth in sales.

On the other hand the improvement in ratio of current profits to turnover may be assumed to have been achieved easily even without particular steps such as cost reduction via sales growth, due to the nature of the industry with its emphasis on equipment and consequent high ratio of fixed costs.

Table 2.5 OTS Consolidated Financial Data

(Unit: Thousand Rs.)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	94-98 Average
Current ratio	231%	170%	134%	167%	180%	170%	192%	158%	87%	101%	174%	142%
Ratio of net worth	54%	29%	22%	24%	22%	22%	28%	30%	35%	40%	44%	35%
Turnover ratio of total asset		41%	26%	22%	40%	37%	42%	40%	40%	44%	46%	42%
Ratio of profits to turnover												
Exchange loss and profit before adding up	61%	48%	34%	47%	42%	14%	29%	31%	24%	26%	34%	**29%**
Ratio of profits to total liabilities and net worth												
Exchange loss and profit before adding up		20%	9%	10%	17%	5%	12%	13%	10%	11%	15%	**12%**
Ratio of profits to net worth												
Exchange loss and profit before subtraction		47%	34%	40%	69%	22%	41%	38%	27%	27%	33%	**33%**

(Source): OTS consolidated financial statement (individual financial statement only for FY1988)
(Note): Data as of 30th June for each of the years

2.2.5 Environmental impact

Because the installation of equipment in the project did not involve drainage, emissions, waste disposal,

noise etc. there have been no adverse effects on the environment. Nor has there been any requirement to relocate residents for the purposes of project implementation. There is on the other hand the possibility of some flow of mud and gravel during the construction of exchange buildings, and changes to the landscape arising from the building of telecommunications towers, however, these cannot be considered to have had any serious effects on the environment. The project is therefore judged to have had almost no impact on the environment.

2.3 Project Effects and Impacts

The effects and impacts expected in the project appraisal were as follows.

Quantitative effects and impacts	FIRR: 11.6%
Qualitative effects and impacts	① Response to increasing demand for telephones in conjunction with growth in the economy of the Republic of Mauritius ② Improvement in the quality of telephone services via the renewal of deteriorating facilities ③ Removal of step-by-step switchboards and introduction of digital switching systems, and international direct dialing from most areas of the Republic via the provision of a satellite earth station completed in July 1987 and international switching system (not covered by ODA loan) ④ The provision of the telecommunication infrastructure essential for the nurturing of exporting industries and tourism, aimed at by the government of the Republic of Mauritius, via the improvements ① – ③ above of the quality and quantity of telephone services in ① – ③ above, and furthermore, a contribution to the economic development of the country

(Source): Appraisal materials

This post-evaluation will quantify as far as is feasible the extent to which these project effects and impacts have occurred, dividing them broadly into ① Economic effects and impacts; ② Quantitative improvements in telecommunications and ③Qualitative improvements in telecommunications

2.3.1 Economic effects and impacts

1) Internal rate of return

The original plan assumed an FIRR of 11.6%, however, recalculations made on the basis of actual data resulted in a figure of 9.3%.

(1) Calculations in the original plan

① Profit determination
Additional revenue for MTD (Telecommunications Department, current MT) from the implementation of the project:
[Calling charges + rental charges + installation charges]

・Calling charges:
(Revenue per line as of FY1985 [calling charge revenue/no. of lines])×(No. of lines to be installed in the project [30,000])

This, however, assumes the inclusion of international charges in the calling charges (at the time international calling services were provided by OTS (Overseas Telecommunications Services) and international calling charge amounts of the executing agency, MTS, are thought to be the amount paid by OTS for the use of domestic lines for international calls).

② Cost determination
Additional costs required for MTS (current MT) implementation of project
[Investment cost + administration/operational/maintenance costs]

③ Determination of project life, residual value, tax etc.
- Project life envisaged of 20 years
- Residual value, tax etc. not taken into account

④ Real values
- In calculations carried out at the time of appraisal, income and expenditure based on results in FY1985 were expected to be maintained in real terms.

(2) Preconditions of recalculations

Recalculations were carried out using where feasible the same methods as at the time of appraisal, to ensure that comparisons could be made. There were, however, limits to the data MT was able to provide, and the domestic line usage charges for international calls calculated at the time of appraisal were not obtained, therefore calculations differed from those at the time of appraisal since this charge was omitted from profits.

① Profit determination
As at the time of appraisal, additional revenue for MT from implementation of the project
[Calling charges + rental charges + installation charges]

- With regard to calling charges, there is the problem of whether to consider only domestic calling services as increased revenue from the project, or whether to also take into account increased revenue from international calls (domestic line usage charges + international line usage charges). As explained, there was a limit to the data available; therefore revenue calculations were confined to domestic calling charges (the project was concerned with the provision of domestic lines and switching systems, and while the installation of domestic lines would undeniably increase income from international calling charges, this is not so much a direct effect to be included in profit calculations as an indirect effect).

② Cost determination
Additional costs required for MT to implement project
[Investment cost + administration/operational/maintenance costs]

③ Determination of project life, residual value, tax etc.
- Project life envisaged of 20 years (same as at time of appraisal)
- Residual value, tax etc. not taken into account (same as at time of appraisal)

(3) Variance analysis

Real internal rate of return was calculated at 9.3%, slightly less than the 11.6% calculated at the time of appraisal. However, as explained earlier it is necessary to remember that part of the revenue from international calling charges was included in the calculations at the time of appraisal.

① Profits

In the original projections, it was assumed that 1985 income levels per line would be maintained in real terms in the following years, however the government of Mauritius blocked rises in domestic calling charges, resulting in a fall in turnover per line in real terms.

② Costs

At the time of appraisal, total expenditure was estimated at 395.8 million rupees, however the actual result was less than this with a nominal figure of 349.5 million rupees and the real figure 285.1 million rupees.

③ Administration/operational/maintenance costs

At the time of appraisal, it was assumed that costs per line would retain their 1985 level in real terms, however because cost increases were kept down in comparison with the increase in the number of lines, even nominal costs of administration, operation and maintenance of lines were reduced.

The above results show that in comparison with the time of the appraisal, because calling charges were not increased for a considerable period, real revenue fell, however this was covered by a decrease in actual expenditure and a real reduction in costs of administration, operations and maintenance per line owing to a significant increase in line numbers. The recalculated internal rate of return, therefore, did not differ greatly from that calculated at the time of appraisal.

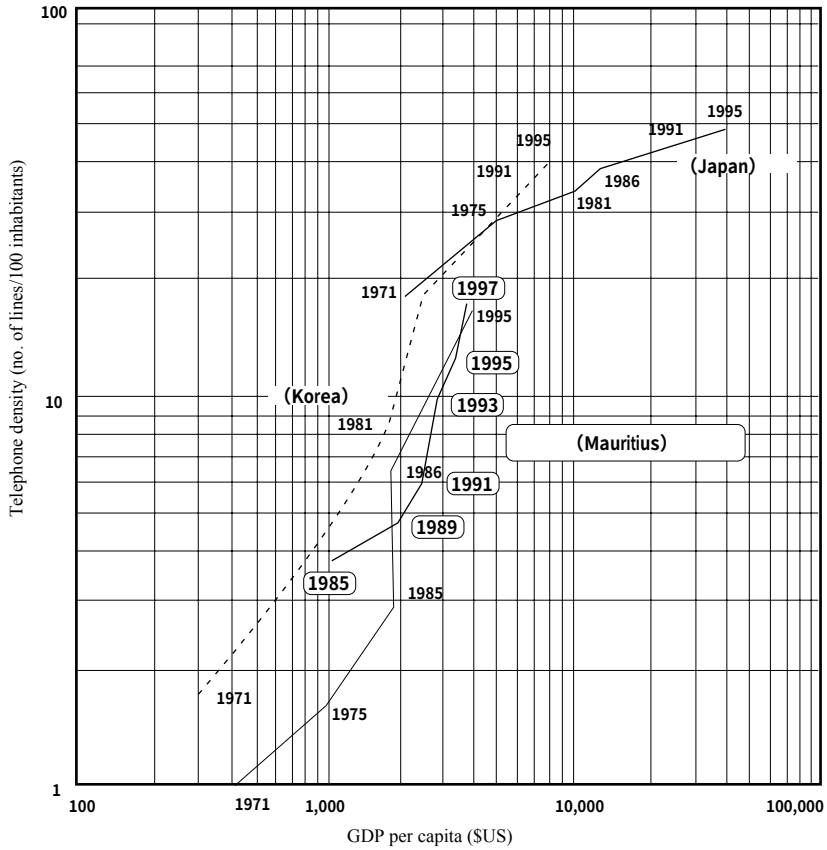
2) Development of the economy and telephone density

(1) GDP per capita and telephone density

Economic development and the development of telecommunications are believed to be closely entwined. When a locus for the Republic of Mauritius (1985 – 1997) is compared to loci showing the relationship (1971 – 1995) in Japan, Korea and Malaysia between GDP per capita and telephone density[13], the Republic of Mauritius is found to have achieved the same steady economic development and telephone penetration as in the case of Malaysia.

[13] Loci showing relationships in Japan, Korea and Malaysia between per capita GDP and telephone density (1971-1995) are similar to those for the same distributions in 190 countries in 1995. “World Telecom Visual Data” 1998 New Japan ITU Association

Figure 2.8 Telephone Density and GDP Per Capita

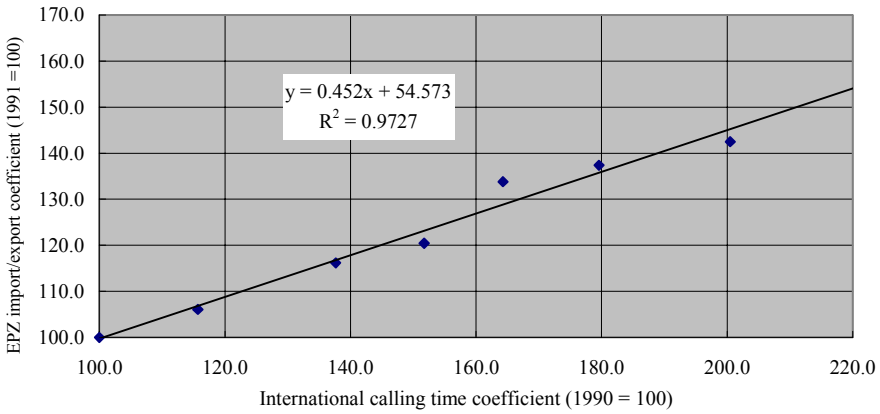


(2) Industrial development and international calling charge volumes

In the 1970s the Republic of Mauritius was a monoculture economy dependent mainly on sugar refining, however as a result of serious efforts by the government from the 1980s to promote diversification in the economic structure, growth in the Export Processing Zone (EPZ) and tourism was remarkable. These structural reforms resulted in an average annual increase in real GDP of 7.1% in the five years between 1986 and 1990, and there is no doubt about the importance of their contribution to the economic development of Mauritius. The Export Processing Zone (EPZ)[14] and tourist industry together accounted for approximately 20% of the GDP in the years between 1990 and 1997. Because the use of international telecommunications may be considered essential for efficient development in both these sectors, an analysis will be conducted here of the dissemination of telephones in these two sectors which have been the mainstay of economic development in the Republic of Mauritius.

This project did away with step-by-step switchboards, which were already outdated before the project commenced, and introduced digital switching systems. The introduction of digital switching systems, combined with the satellite earth station completed in 1987 and international switching, made International Direct Dialing (IDD) possible in the Republic of Mauritius, and calling conditions can also be considered to have improved. In the graph below, the figure of 100 represents the volume of international calls (hours of call transmission and receiving) in 1990. Actual values for EPZ imports and exports and tourism revenues for 1991 have also been given a value of 100, for ease of understanding, this becoming the figure for 1990, and the figures for years from 1992 onward calculated in the same manner, as that for the previous year. These calculations assume a period of one year between the setting up of telecommunication facilities and the manifestation of actual economic effects. It may be observed from the graph for both international calling time and EPZ import/export figures (Figure 2.9) and that for international calling time and tourism revenue (Figure 2.10), that international calling time and EPZ import/export figures and tourism revenue increase respectively close to a fixed rate.

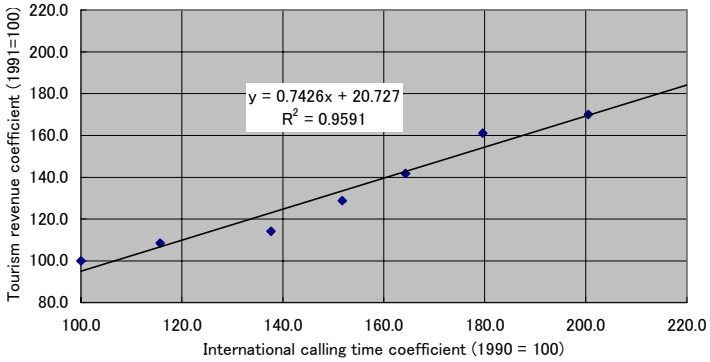
Figure 2.9 International Calling Time and EPZ Import/Export Figures



(Source): MT materials, Ministry of Economic Development and Regional Cooperation

[14] Companies investing in the Export Processing Zone must export all of their products, and receive exemptions from tax for a fixed period (10-20 years) as well as the right to obtain imported raw materials duty-free.

Figure 2.10　International Calling Time and Tourism Revenue



(Source): MT materials, Ministry of Economic Development and Regional Cooperation

Furthermore, because a study of international calling time and EPZ import/export figures for different countries in 1997 reveals that the countries with the highest figures for both are France, Britain and the United States in that order, it is said that there is the relationship between telecommunications and economic activity. For reasons of geography, however, the US is only ranked twelfth in terms of visitor overnights.

Table 2.4　International Calling Time and Tourism Revenue

		1st	2nd	3rd		Total of 20
		France	**UK**	**US***	**Other**	major nations
International calling time	(x 1000 minutes)	11,372	9,542	6,319	26,805	54,038
Share	**(%)**	**21.0**	**17.7**	**11.7**	**49.6**	**100**
EPZ import/export figures	(x million Rs)	13,293	7,918	5,720	42,675	69,606
Share	**(%)**	**19.1**	**11.4**	**8.2**	**61.3**	**100**
Visitor nights	(people/nights)	1,509,687	625,419	26,205	3,290,003	5,451,314
Share	**(%)**	**27.7**	**11.5**	**0.5**	**60.3**	**100**

(Source): MT materials, Ministry of Economic Development and Regional Cooperation
(Note) *: US is ranked 12th in total visitor nights

2.3.2 Improvements in Terms of Volume in Response to Demand Pressure for Telecommunications Facilities

1) Switching capacity

Telecommunications demand in FY1987 immediately prior to implementation of the project was 76,055 lines, 1.7 times the available switching capacity of 45,050 lines, with a switchboard usage rate recorded of approximately 98.1%. The completion of this project, the aim of which was to alleviate this switching overload situation, resulted in a net increase of 22,950 lines and the modernization (digitalization) of telecommunication facilities[15], and with usage of switching systems falling as low as 58% for a time, a foundation can be said to have been laid for fulfilling future demand. Usage rates in FY1992 and FY1994 rose incidentally to approximately 69% and 79% respectively.

Table 2.5 Economic Development and Development of Telecommunications Facilities

Item/Fiscal Year		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998 1)
Population	(1,000 persons)	1,028	1,036	1,043	1,051	1,059	1,070	1,084	1,097	1,113	1,122	1,134	1,148	1,160
Nominal GDP	(US$ mil)	1,459	1,892	2,141	2,175	2,636	2,823	3,182	3,192	3,496	3,970	4,312	4,295	4,560
GDP per capita	(US$ mil)	1,420	1,827	2,052	2,069	2,489	2,638	2,935	2,909	3,141	3,539	3,803	3,741	3,931
Switching capacity	(line)	45,050	45,050	62,500	73,500	73,500	100,533	102,916	134,963	147,169	179,288	193,614	256,016	265,294
Usage rate	(%)	92.8	98.1	78.6	68.7	73.3	57.5	69.0	64.5	78.7	76.6	85.3	80.3	89.4
No. of subscriber lines	(line)	41,828	44,205	49,154	50,469	53,903	57,821	71,000	87,022	115,797	137,424	165,083	205,672	237,046
Rate of increase	(%)	…	5.7	11.2	2.7	6.8	7.3	22.8	22.6	33.1	18.7	20.1	24.6	15.3
Telephone density 2)	(line/100 persons)	4.08	4.59	4.79	5.02	5.26	5.99	7.35	9.80	11.72	13.11	14.67	17.94	20.34
Unmet demand	(1,000 persons)	26.562	31.850	38.090	35.279	45.659	54.084	62.870	71.572	65.186	72.790	41.142	26.708	23.579
Unmet ratio	(%)	63.5	72.1	77.5	69.9	84.7	93.5	88.5	82.2	56.3	53.0	24.9	13.0	9.9

(Source): Produced from Ministry of Economic Development Productivity and Regional Development, Mauritius Telecom, ITU materials.
(Note): 1) Estimate
2) Figures for December. Not adjusted to other figures for June (ITU materials)
3) Slight variation in data on no. of lines to [Table 2.3] owing to different data collection periods

2) Number of subscriber lines

The expansion of switching facilities allowed an increase in the number of subscriber lines: in the five years between 1992 and 1996, an average increase of 23% was recorded, in contrast to an average increase of 6.7% in the five years from 1987 to 1991.

3) Telephone density

Figures for the dissemination of telephones show that by FY1993 telephone density (no. of lines/100 inhabitants) had reached 9.80, approximately twice the rate of 4.59 for FY1987, and outpacing population increase.

ITU statistics incidentally show that in 1996, Reunion (French-controlled) had the highest telephone density in Africa at 34.0, followed by the Republic of the Seychelles at 19.6 and the Republic of

[15] The original plan aimed not to fulfil all demand by completion of the project, but to provide a net increase in lines of 22,950 and modernization (digitalization) of telecommunication facilities, and a shortfall of approximately 8,800 lines was expected on project completion. In actual fact 100,533 lines were provided to meet a demand of 111,905 in FY1991, a shortfall of approximately 11,000, however this was deemed not to reflect any problem with demand forecasts so much as an increase in demand greater than that predicted, for reasons which could not have been foreseen.

Mauritius at 16.2. In the same year the over all average of the African nations was 1.85 (Northern Africa average 4.94, South Africa 10.12, Sub-Saharan Africa 0.52), a confirmation of the high telephone density of Mauritius.

4) Unmet ratio

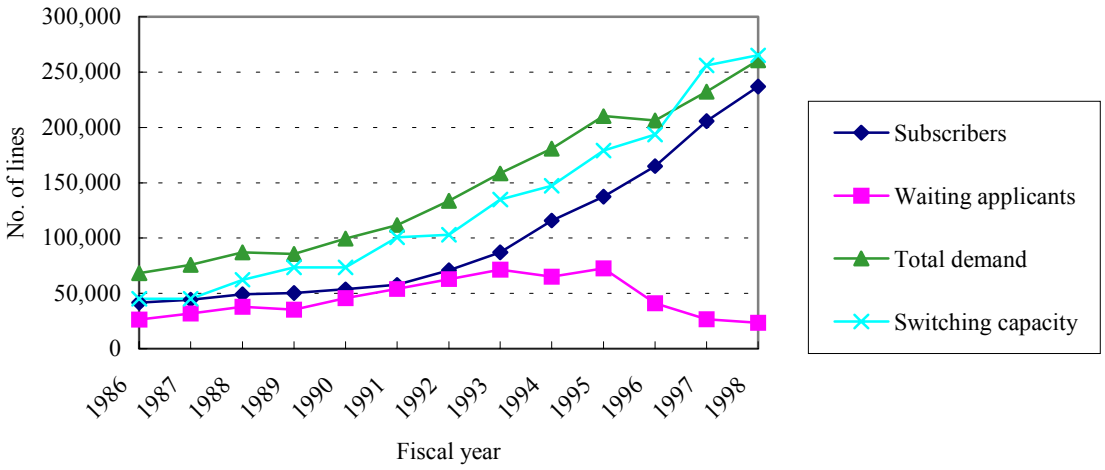
The figures for those waiting for telephone connections also point to an improvement in the provision of services. The unmet ratio (=waiting applicants/subscribers) recorded its highest level of 93.5 in FY1991 before entering a steady annual decline.

Even in 1998, however, demand remains unfulfilled. This is due to increased demand as a result of economic development, and the provision of new telecommunications services via projects including this project to expand facilities, resulting in the appearance of latent demand. MT has said it aims to eliminate waiting applicants by the end of 1999 via continuing expansion of facilities.

5) Timing of project implementation

The above results confirm that since completion of the project in 1991, telecommunications in the Republic of Mauritius have moved in the direction of improvement. As an early initiative alleviating a desperate supply and demand situation caused by rapid economic development, the project laid the foundations for future expansion work, and thus is deemed to have been appropriate in terms of timing.

Figure 2.13 Transition in Supply and Demand



(Source): MT materials

2.3.3 Improvements in Telecommunications Quality

1) Digitalization of telecommunications

The digitalization of telecommunications facilities carried out in this project enabled data communications between computers via a digital signal, in conjunction with developments in computer technology. With regard to the digitalization of data communications, it has the following features compared to previous analog communications.

① Because all information is digitalized there is no need to differentiate between types of information on the communications network.

② Digital communications are able to handle digital information in data communications or facsimiles.

③ Cost of components such as ICs and LSI falling as a result of a revolution in technology

④ Analog transmission is prone to static, a gradual deterioration in quality and fluctuations in signal size, whereas in digital transmissions the accumulation of static is extremely minimal and the signal is able to be maintained at a specified size via the encoding process.

It is worth mentioning that in 1996, of the fifty-five countries in Africa, only ten including Mauritius (Botswana, Chad, Djibouti, Gambia, Mayotte, Reunion, Rwanda the Seychelles and Togo) had completed digitalized their main switching systems. In 1994, MT also commenced ISDN (Integrated Services Digital Network) services in a limited area, with 88 subscribers registered by 1997.

2.4 Plans for New Development

2.4.1 Wireless Local Loop

MT is investigating the possibility of implementing a WLL (wireless local loop) system in the outlying regions of the country. WLL involves connecting subscribers to the exchange by a wireless system instead of by the current mainstream method via copper wires. Benefits of this system include low construction costs in areas of low demand concentration and reduction of the time required for the implementation schedule. MT sources indicate that the company is in the process of carefully selecting a WLL system suitable for the requirements of future telecommunications demand.

2.4.2 Submarine Cables

Submarine cable communications and satellite communications are the two most common means of international telecommunications. Submarine cables have the advantage of low setup costs in comparison with satellite communications. Furthermore, owing to a revolution in fiber optic technology, far greater volumes of communication of far superior quality are possible than with the use of previous coaxial submarine cables.

As one of its new development projects, MT is implementing the SAFE (submarine fiber optic cable) project connecting the Republic of South Africa[16] and Malaysia via the Republic of Mauritius. Construction is underway, in the south of Mauritius Island, of a submarine cable relay station with satellite switching systems as a domestic project related to this submarine cable, and is due to be completed by the end of 1999.

3. Lessons Learned

3.1 Lessons Learned

1) While the telecommunications sector is in its early stage of expansion, it is important that work proceeds under government direction

In countries with low levels of telecommunication facilities (telephone density of less than 10%, as one standard), until all citizens have access to at least the most basic services it is important that work on telecommunications facilities be government- directed. The same advice was included in the JBIC Discussion Papers No. 1 "Government Responsibilities in the Telecommunications Sector" (March 1994).

Furthermore, when economic transaction with other countries (in this project industrialization centered around the Economic Processing Zone and promotion of tourism targeting overseas visitors) forms the basis of the nation's economic development plan, telecommunications facilities provided without delay in the early stages government direction of the telecommunications sector is vital, taking into account plans for other development projects.

2) It is important for the success of the project that it is recognized as a priority project by the government of the recipient nation in its development plans.

The government of Mauritius indicated clearly its objectives of providing telecommunications facilities and attaining economic development via the expansion of telecommunications facilities, and included the project in its National Development Plan as a priority project.

In this project, while there were several modifications to project scope, the objectives (of the original plan), such as installation of 30,000 lines worth of switching capacity and the setting up of a digital telecommunications network were designated priority projects in the National Development Plan, thus no unnecessary interference, nor casual changes to project scope had occurred. This enabled the project to be completed successfully.

[16] Currently of the SADC nations, only the Republic of South Africa has direct telecommunications networks established with other member nation. South Africa is also the only one of the SADC nations to have fiber optic cable links with the US and Europe.

Appendix

1. List of Exchanges for Mauritius Telecom

MAIN EXCHANGES	
NAME	LOCATION
PL4	PORT LOUIS
● **PV3**	**PLAINE VERTE**
RH4	ROSE HILL
● **CD3**	**CANDOS**
FL4	FLOREAL
FQ4	FLACQ
GB4	GRAND BAY
● **FS3**	**FOREST SIDE**
TL4	TRIOLET

●:JBIC LOAN PROJECT SCOPE

REMOTE LINE UNITS	
NAME	LOCATION
● GL3	**GOODLANDS**
● **MP3**	**MAPOU**
PT3	PITON
● **PM3**	**PAMPLEMOUSSES**
● TR3	**TERRE ROUGE**
● LM3	**LONG MOUNTAIN**
CR3	COROMANDEL
● **PS3**	**PITE AUX SABLES**
● **NF3**	**NOUVELLE FRANCE**
RB3	**ROSEBELLE**
● **ES3**	**ESCALIER**
MG3	**MEHEBOURG**
PA3	**PLAISANCE**
● **SC3**	**SOUILLAC**
GS3	**GRANBOIS**
VG3	**VIEUX GRANDPORT**
SZ3	**SEIZEME MILLE**
RE3	**RICHE EN EAU**

●:JBIC LOAN PROJECT SCOPE

REMOTE LINE UNITS	
NAME	LOCATION
AL4	ALBION CSND
BA4	BEL AIR CSND
BB4	BAMBOUS CSND
BC4	BAIE DU CAP
BM4	BELLE MARE
BV4	BRISEE VERDIERE
CD4	CANDOS
CG4	CHEMIN GRENIER
CM4	CAMPS DE MASQUE
CR4	COROMANDEL
CX4	CAP MALHEUREUX
DB4	DUBREUIL
FF4	FLIC EN FLAC
FS4	FOREST SIDE
GL4	GOODLANDS
GS4	GRAND BOIS
IP4	INFORMATICS PARK
LM4	LONG MOUNTAIN
LG4	LA GAULETTE
MP4	MAPOU
MK4	MOKA
M04	LE MORNE
MG4	MAHEBOURG
MB4	MONTAGNE BLANCHE
NF4	NOUVELLE FRANCE
PA4	PLAISANCE
PF4	P LA FAYETTE
PM4	PAMPLEMOUSSES
PS4	PTE AUX SABLE
PT4	PITON
PV4	PLAINE VERTE
QM4	QUARTIER MILITAIRE
QS4	QUATRES SOEUR
RA4	R. DES ANGUILLES
RB4	ROSE BELLE
RN4	ROCHE NOIRE
RP4	RIPAILLES
RR4	R.DU REMPART
SC4	SOUILLAC
TA4	T. AUX BICHES
TB4	TOMBEAU BAY
TM4	TAMARIN
TR4	TERRE ROUGE

① Mauritius Telecom Headquarter

② Digital switching system that switches and connects 6,000 subscriber lines

③ A parabolic antenna for transmitting microwave