ROYAL MINISTRY
OF FOREIGN AFFAIRS
Norway

Evaluation Report 3B.90

TELE-COMMUNICATIONS IN THE SADCC REGION

ANNEXES

by
The Centre for
Development and Technology
University of Trondheim

SECTOR EVALUATION TELECOMMUNICATIONS

GENERAL ANALYSIS OF SECTOR POLICY

EVALUATION OF FOUR PROJECTS IN THE SADCC REGION

ANNEXES

MARCH 1991

H. HELLENES
J. MUCHELEMBA
G. STETTE

CENTRE FOR DEVELOPMENT AND TECHNOLOGY
UNIVERSITY OF TRONDHEIM

ANNEXES - FINAL REPORT

TABLE OF CONTENTS

Annex F. THE NORTH-WESTERN PROVINCE OF ZAMBIA

Annex G. TELECOMMUNICATIONS SYSTEMS

Annex A

SADCC AND PANAFTEL

A.1. BACKGROUND.

The background for SADCC, the Southern African Development Co-ordination Conference, was the situation for a number of countries in the southern part of Africa which in the sixties gained independence, but at the same time were in a situation without properly developed infrastructure, and with a strong dependence on South Africa.

The intiative of forming a coordinating body for these countries, based on a decentralized non-buraucratic structure, was taken by Zambia. Following an exploratory conference attended by the frontline states Angola, Botswana, Mozambique, Tanzania and Zambia, together with cooperating partners, the final launch of SADCC took place in Lusaka in 1980.

The inaugural document of SADCC, "Southern Africa: toward economic liberation", set four development objectives:

- the reduction of economic dependence, particularly, but not only, on the Republic of South Africa;
- the forging of links to create a genuine and equitable regional integration;
- the mobilization of resources to promote the implementation of national, interstate and regional policies; and
- concerted action to secure international cooperation within the framework of SADCC's strategy for economic liberation.

SADCC comprises now nine countries, and an economic and demographic summary is given in Table A.1[1].

A.2. TELECOMMUNICATIONS SYSTEMS.

Transport and communications was a sector where the infrastructure was insufficient and the dependence on South Africa large. Because special priority was given to this sector a Southern African Transport and Communications Commission (SATCC) was set up in Maputo for coordination purposes. This is the only part of SADCC posessing a legal and administrative status.

Table A.1. Economic and demographic summary.

Country	Population (millions)	Area '000 km	Urban population (%)	GDP per capita (USD)
Angola	7.9	1247	24	470
Botswana	1.1	600	20	930
Lesotho	1.5	30	13	570
Malawi	7.1	94	12	210
Mozambique	13.9	802	16	240
Swaziland	0.7	17	26	890
Tanzania	21.7	945	14	210
Zambia	6.8	753	48	580
Zimbabwe	8.4	391	27	770
Region	69.1	4879	21	380

The SATCC Technical unit is organized as shown in Fig. A.1 (Page 3).

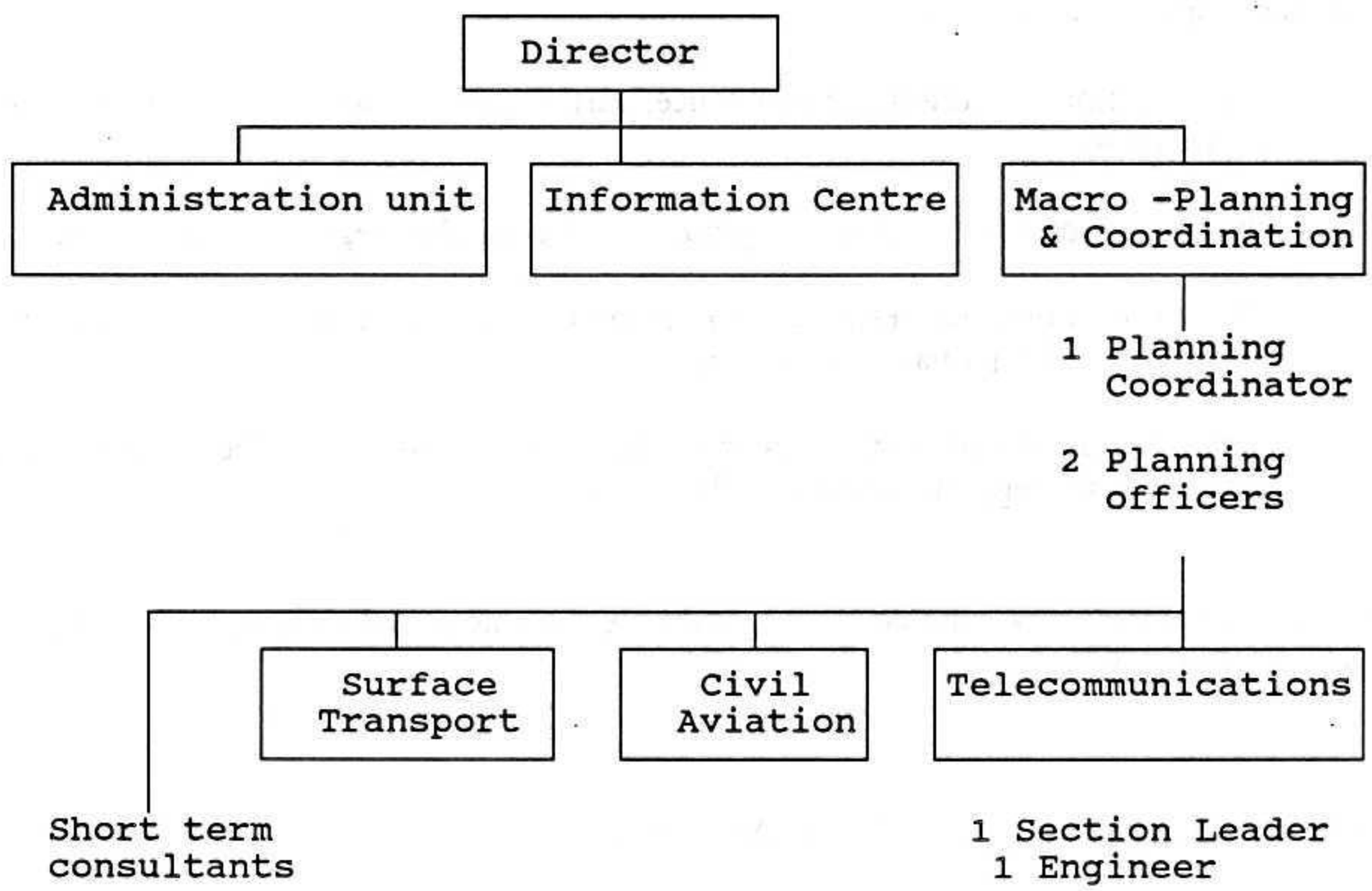

Fig. A.1. Organigram for the SATCC Technical Unit.

The general situation in the telecommunications sector in the SADCC countries in 1986 is shown in Table A.2[2].

Table A.2. Telecommunications statistics for 1986.

Country	DELs in 1986 (000)	Teleph. in 1986 (000)	Reg. waiters (000)	DELs per 100
Angola	46.0	47.0	NA	0.6
Botswana	10.7	21.0	4.3	1.0
Lesotho	8.9	17.7	5.0	0.6
Malawi	20.8	44.9	3.8	0.3
Mozambique	39.1	60.2	15.0(est.)	0.3
Swaziland	8.2	20.0	NA	1.2
Tanzania	54.1	116.8	65.5	0.2
Zambia	47.4	73.4	24.1	0.7
Zimbabwe	108.2	251.3	35.1	1.3
Region	343.4	652.3	152.8	0.5

In the telecommunications field SATCC have been coordinating the following:

- regional components of PANAFTEL, the Pan African Telecommunications Network;
- satellite earth station connectivity within the area;
- international telephone and telex switching centres in the member countries;
- special-application telecommunications in support of regional transportation and meteorological projects;
- training and personnel development, including setting up of joint or cooperative programmes and ensuring that each major capital project contains a training element.

The SATCC prepares long term development plans. The Telecommunications 10 Year Development Plan sets out the investment requirements to 1995.

Fig. A.2, taken from the SATCC report[3], which was dated March 1987, gives the elements of the region's transmission infrastructures which constitute the PANAFTEL network.

It is noted that one of the links, the Harare - Tete - Blantyre link, indicated in the figure as proposed SADCC project, is now installed and about to be commisioned as REG 024, constructed by EB Nera and financed by NORAD and SIDA.

It is also shown in Fig. A.2. that the microwave link in the North- Western province of Zambia, REG 020, forms a part of the international link to Angola.

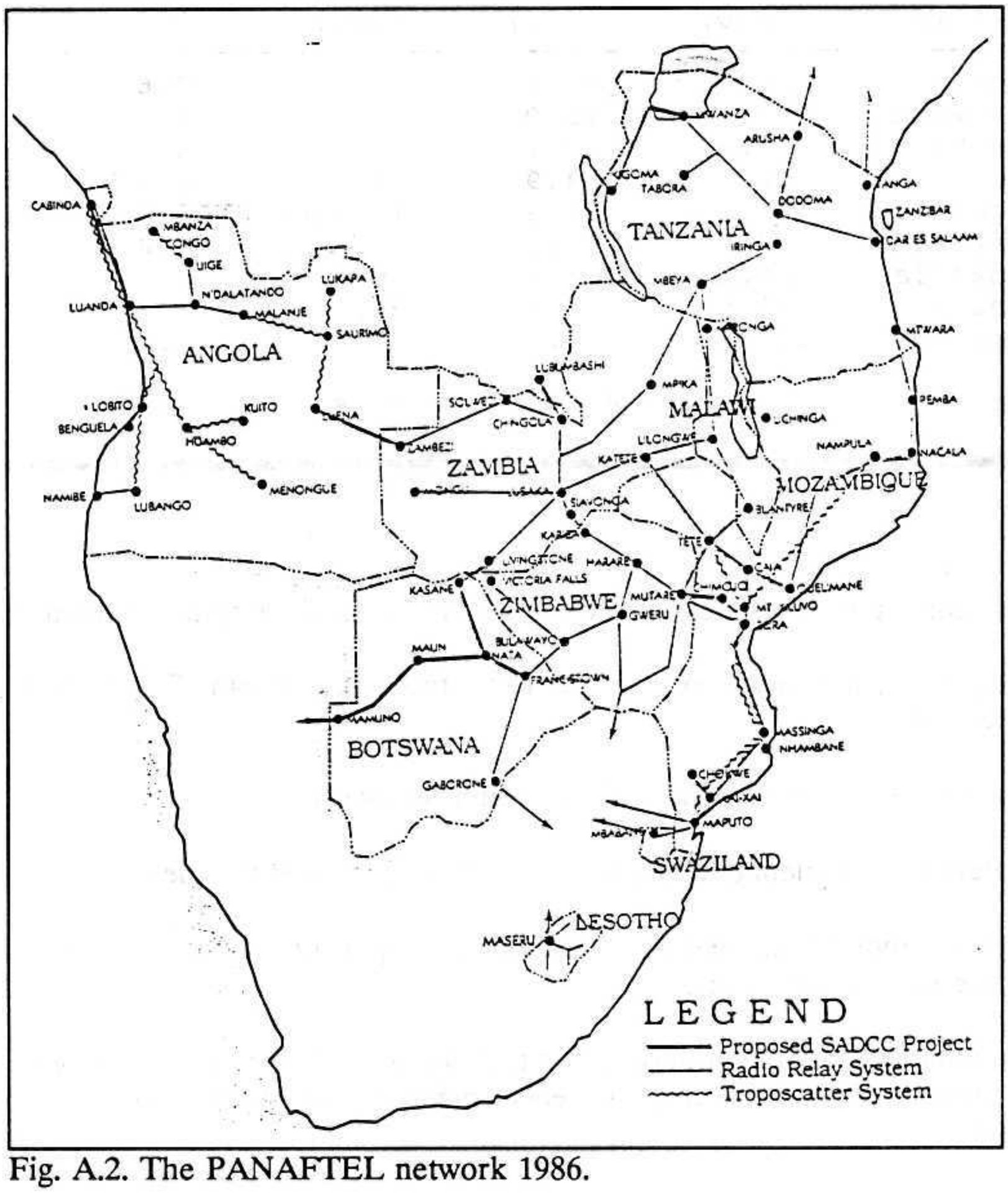

Fig. A.2. The PANAFTEL network 1986.

Another planned PANAFTEL system, the link Francistown - Nata - Kasane, and Francistown - Nata - Maun - Mamuno with further extension to Namibia, is connected to the microwave system REG 004.

A.3 TELECOMMUNICATIONS TRAFFIC.

The telecommunications traffic within the SADCC countries is still very low. This is shown in Table A.3 [4], which gives outgoing traffic from Botswana, Malawi, Tanzania, Zambia and Zimbabwe to the same SADCC countries plus Lesotho and Swaziland. The volume is expressed in in paid minutes for the year 1986/87.

Table A.3. Telephone traffic within SADCC countries.

OUTGOING TRAFFIC
(Paid Minutes)

	BOT	LES	MAL	MOZ	SWA	TAN	ZAM	ZIM
BOT	***	31557	17238	3951	33955	11212	118576	832362
MAL	24479	10115	***	16742	16400	35530	211033	507695
TAN	16010	4020	41010	18290	11650	***	140790	98860
ZAM	129170	12810	263080	5730	49100	126760	***	1018740
ZIM	502 693	13537	467510	87614	26454	154914	856118	***

Another interesting aspect of the traffic pattern is the traffic distribution to different countries, and how this has developed.

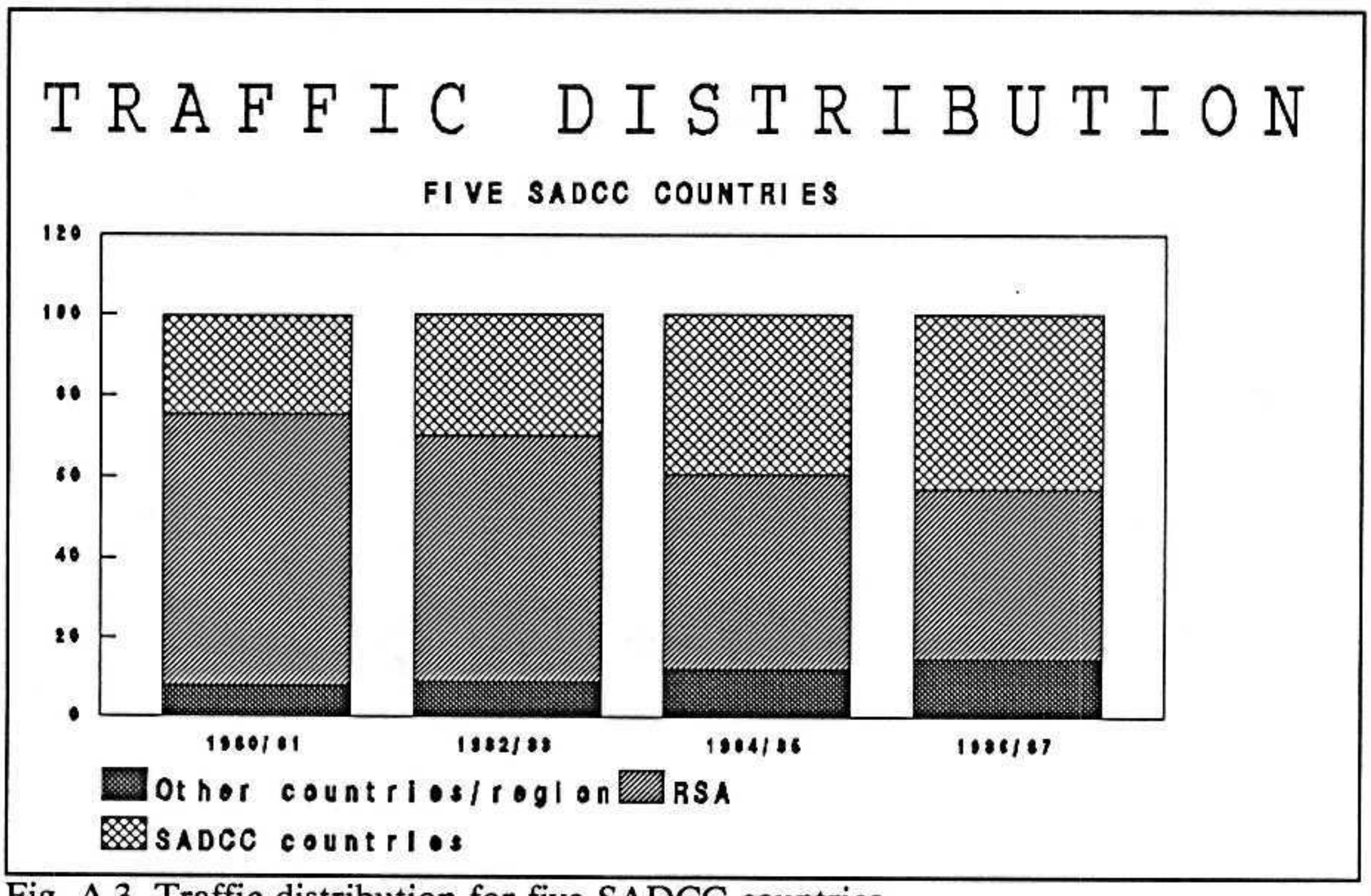

Fig. A.3. Traffic distribution for five SADCC countries.

Fig. A.3 shows percentage of total traffic from the five SADCC countries listed in Table A.4 to (a) SADCC countries, (b) RSA and (c) other destinations for the years 1980/81, 1982/83, 1984/85 and 1986/87.

Over the same period of time the traffic on direct routes has increased from 88.7 % to 92.7 %, and the transit via RSA has been reduced from 9 % to 4.1 %. This shows that the effort to reduce the dependance on South Africa has had an effect.

Looking at individual countries, Zimbabwe has reduced the percentage of traffic to South Africa from 88.1 % to 54.8 %, which corresponds to even a slight reduction of traffic volume in a period with increasing total volume.

Table A.4 Percentage of traffic to South Africa.

	1980/81	1982/83	1984/85	1986/87
Botswana	83.7	81.1	74.6	72.5
Malawi	33.3	29.3	28.2	29.3
Tanzania	0.2	0.2	0.1	0.1
Zambia	19.2	16.5	15.4	12.4
Zimbabwe	88.1	85.7	75.1	54.8
Five countries	67.2	60.9	48.2	42.0

REFERENCES

1. World Development Report 1986, World Bank.

2. Telecommunications ten-year Development Plan. Dated March 1987. Submitted to the SATCC by Canadian International Development Agency.

3. Ibid.

4. SATCC, Private Communications.

Annex B.

BOTSWANA

B.1 THE COUNTRY.

Botswana is a landlocked country straddling the Tropic of Capricorn, and bordering Zimbabwe, Namibia, Zambia and the Republic of South Africa.

The area is 582 000 km^2, with a mean altitude of about 1000 m above sea level. The climate is arid and semi arid.

The population is small, 1.1 mill. in 1986, which gives a population density of 1.9/km^2, the lowest among the SADCC countries. The population is consentrated in the southern and eastern part of the country (the Gaborone - Francistown axis), which accounts for 83% of the population. The rest of the country is extremely sparsely populated, with an average density of 0.14/km^2.

The low population, and the settlement pattern, has important implications for the development of infrastructure, including telecommunications.

Botswana gained its independence from Great Britain in 1966, and is a multi-party democracy.

Botswana's traditional economy was dominated by livestock. From the late 1960's mining, in particular diamond mining, has developed rapidly into the main sector of the economy, and giving the country a comparatively healthy export economy.

Because of its location, and its economy, the country is very dependent on the Republic of South Africa (RSA). Practically all export and import is via RSA.

B.2 DEVELOPMENT OF THE TELECOMMUNICATIONS SYSTEM.

Until the 1970s the telecommunications system of Botswana was mainly a basic one along the line of rail stretching from south to north.

In the 1970s the existing exchanges were of the electro-mechanical step-by-step Strowger type, and these were experienced as often unreliable, requiring continous maintenance, and offering few facilities.

During the 1970s the Government of Botswana realized that the various generation of telephone exchanges marketed at that time were purely transitional and decided to await the final development of digital switching before updating Botswana's telephone exchanges.

In November 1986 a number of fully electronic digital exchanges, made by Ericsson, came into operation. At the same time, in August 1986, the Botswana Telecommunications Corporation (BTC) established a digital mocrowave link from Lobatse via Gaborone to Francistown, with spur links to Selebi-Phikwe, Jwaneng and Serowe.

B.3 BOTSWANA TELECOMMUNICATIONS CORPORATION (BTC).

B.3.1 Status and operating conditions.

BTC became an independent parastatal organization in 1980. The corporation is fully owned by the Government of Botswana. As a parastatal BTC is supposed to operate on a fully commercial basis.

BTC is responsible for the provision, development, operation and management of Botswana's national and international telecommunications services. Postal services is the responsibility of the Department of Postal Services under the Ministry of Works and Communications.

The Ministry of Works and Communications is responsible for the over all development of the transport and communicatons sector, general policy issues for the telecommunications development, and also for the overseas activities of BTC. The Permanent Secretary, Ministry of Works and Communications, is the chairman of the BTC's board.

BTC operates according to a rotating 5 year corporate plan, approved by its board.

BTC is independent in its financial operations, but tariffs have to be approved by the parent ministry, and foreign loans by the Ministry of Finance.

BTC is managed under a management contract with the British company Cable and Wireless, who supplies senior staff and back-up services. The present contract with Cable and Wireless will expire in 1992. The objective is that by that time Botswana should be able to take over the management of BTC. This may be too optimistic.

B.3.2 Organization.

The organizational structure of BTC is shown in Fig.B.1. The positions of Chief Executive, Chief Engineer and Financial Controller are presently filled by expatriates under the management contract with Cable and Wireless.

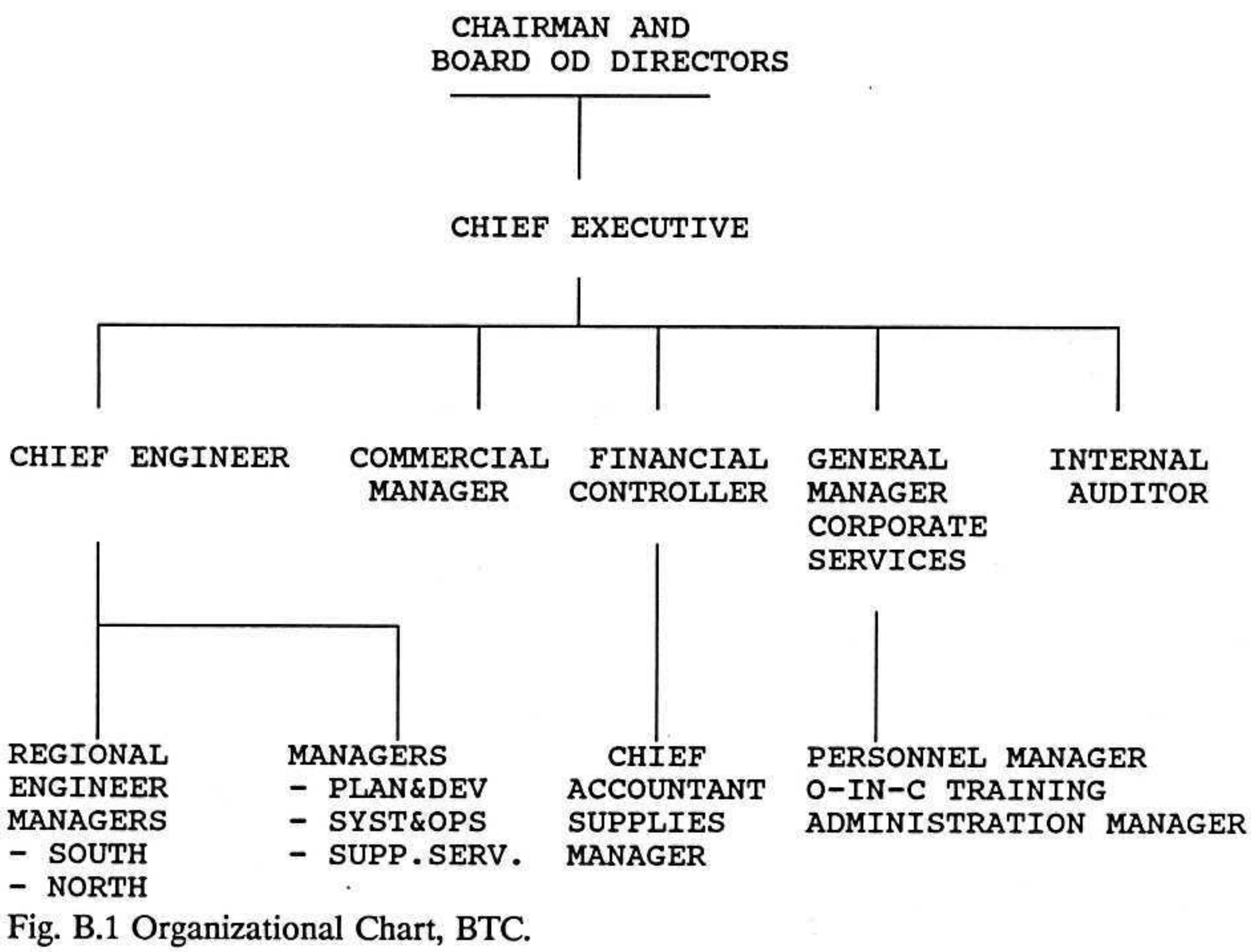

Fig. B.1 Organizational Chart, BTC.

Below the national level the country is divided into two regions, North and South.

The establishment of a third region is being considered. The regions are headed by a regional telephone manager. Their main responsibility is the interface with the public.

B.3.3 Operations and maintenance.

The national telecommunications system has expanded and is expanding rapidly. The Minister of Works and Communications expressed that in particular manpower development has lagged behind, and that BTC therefore did not have the manpower to operate and maintain the system.

Contrary to the situastion in the other SADCC countries, availability of foreign exchange for the import of necessary spare parts etc is not a major problem, due to the healthy foreign exchange situation of the country.

Manpower is therefor the most critical factor in operation and maintenance. There is in particular a shortage in skilled technicians.

Maintenance of the trunk routes is the responsibility of the Systems and Operations Department, which also has some regionally placed staff for this purpose. Maintenance of the total network is the responsibility of the regional telephone managers.

B.3.4 Staffing/Training.

BTC staff requirement is about 2000 employees but only 900 people are currently employed. The expatriate staff in BTC has declined from more than 80 in 1985 to 44 in 1989. Although staffing at technician level has not been localised, BTC has senior manpower constraints for installation and maintenance of the telecommunications network.

BTC has a training centre which offers both academic training and in-house training programmes. The academic type of training for technicians is based on the City Guilds of London. The trainees are recruited from Cambridge school leavers with at least level three pass. The training takes a period of two years of which three months is spent in the field doing practicals. The academic training goes up to part two. City Guilds and advanced training is offered in the U.K for Higher National Diploma Certificates.

The College normally recruits 15 technician trainees, but in 1989 the number has been increased to 30 in view of the need for more personnel at this level. On the other hand, in-house training deals with issues such as installation practice, wiring overhead, underground cables and fibre optics. But this kind of training is adversely affected by lack of adequate equipment for training purposes, although a reasonable amount of equipment is available at the training centre. It was learned that NORAD would not finance training equipment due to experiences from other developing countries where NERA equipment provided to the college disappeared in the field.

Since there is a general shortage of technicians, it is usually not possible to release them for training, especially outside the country. However, BTC staff who specialize in transmission and switching are sent to Sweden for training, while those specializing in telex equipment are sent to the USA. BTC Training Centre also conducts evening classes from 1700 - 1900 hrs, and this type of training can take up to four years. The Centre also provides short term specialized training to technicians whenever new equipment is installed in the field. Training for planners, accountants and secretaries is also organised through the training centre. As a matter of fact, all training for BTC staff is processed through the training centre.

A number of BTC staff are currently undergoing training abroad. These include two in USA (telex), two in the U.K (degree courses), another two in the USA, two in Sweden and two at the SADCC Centre in Malawi. BTC also sends its staff for advanced training at the Nairobi Centre which is based on the ITU advanced training programme.

Generally, BTC staff are trained locally at the Training Centre and it also makes use of the training facilities in the region as a means of promoting regional cooperation.

B.4. PRESENT NATIONAL NETWORK.

B.4.1 The switching system.

Botswana has a total of 42 operational public exchanges, of type as shown in Table B.1.

Table B.1 Public exchanges

AXE10 MSU	5
AXE10 RSU	12
E.T.100	4
T + N	4
Magneto Switchboard	17
	42

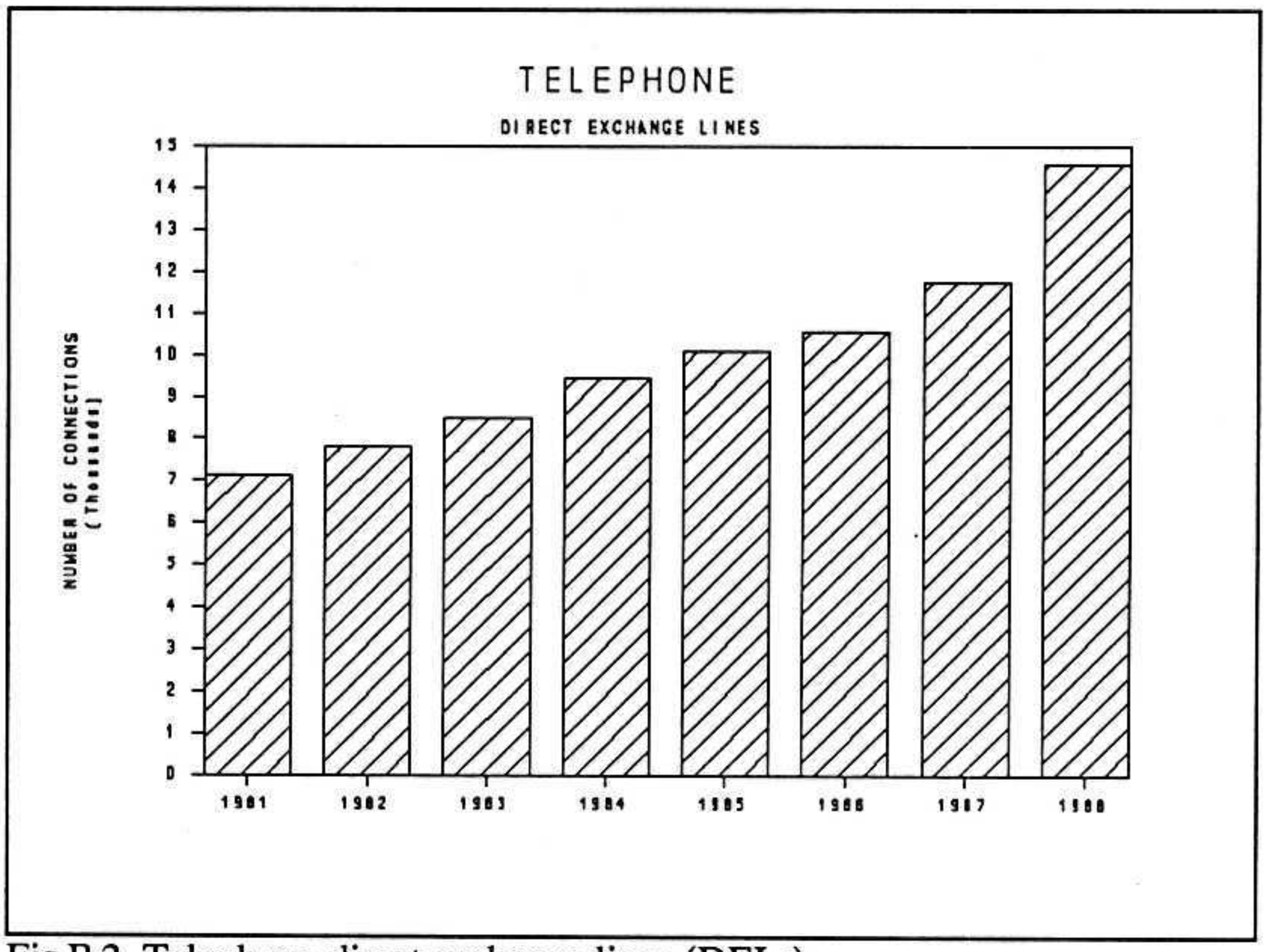

Fig.B.2. Telephone direct exchange lines (DELs).

The total exchange capacity in Botswana is 20836 lines in the Southern Region and 6156 in the Northern Region. The number of direct exchange lines for the period 1981 to 1988 is shown in Fig.B.2.

There are two international gateways, the AXE10 exchanges in Gaborone and Francistown, both combined national and international exchanges.

B.4.2 The transmission system.

Tha main transmission system of Botswana is a digital microwave system as shown on Fig.B.3. The radio part and the civil works, about 2/3 of the project, was supplied by EB-Nera and the multiplex equipment together with a number of exchanges, was supplied by Ericsson.

The project was mainly financed by the African Development bank. NORAD financed the training component of the project.

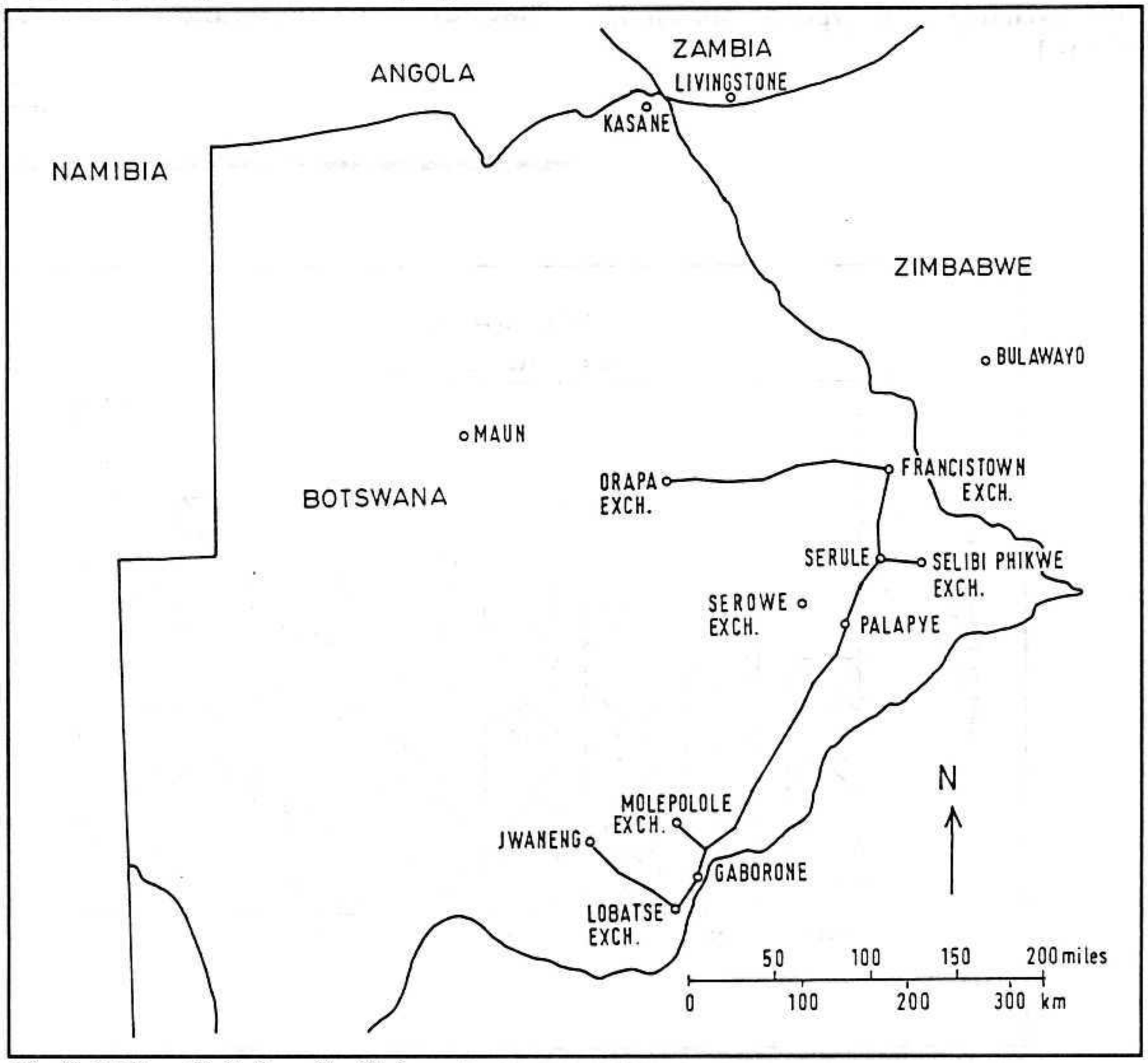

Fig.B.3 The digital radio link system.

The capacity is 34 Mbit/s per radio channel in a (1+1) configuration between Lobatse and Gaborone, a (2+1) configuration between Gaborone and Serowe, and a (1+1) configuration between Serowe and Francistown. The capacity on the spur links and on the Francistown - Orapa link is 8 Mbit/s.

The capacity demand increases as the system is developed and there is a shift from 8 Mbit/s to 34 Mbit/s links, and from (1+1) to (2+1) configurations.

There are also some additional UHF radio links with very limited capacity and open wire systems which are difficult to maintain:

- Maun is connected to the national system via an open wire system to Nata and further via a UHF system to Francistown.

- Tutume is connected to Francistown via a UHF link.

Kasane is now connected to the national network via an analog microwave system to Livingstone in Zambia and further to Bulawayo in Zimbabwe and Francistown (REG 004), and 24 channels are allocated for this.

In the Northern, Western and South-Western parts of the country very little exists apart from HF radio.

B.4.3 Rural communications.

The rural telecommunications development is an integral part of rural development. A village with at least 500 people will be provided with a telephone facility. Two hundred communities have already been identified and at least one third have been provided with the service using pay phone. The system is fully utilized and tends to be viable. The main problem is to take the investment to rural areas in view of the high cost due to long distance and sparse population. A rural survey commission has been working into the aspects of providing the telephone service to the rural communities. On the technical side, the structure is already in place with at least 5.5 percent of the population living within a 5 kilometre radius of a telephone.

As part of the telecommunications development stratagy, the existing party line system will be phased out and replaced by multi-access and open wire systems since the party lines have been providing poor service. The multi-access radio equipment will be used in the Southern and North-East district areas. These new systems are expected to be installed during 1989, and will bring communications to over 20 new villages. The multi-access radio system allows one 15 channel radio system to be shared by up to 90 telephone users within a 40 kilometre radius of the base station. All the remote sites are solar powered.

B.4.4 International connections.

Botswana was connected to the PANAFTEL network in 1984 when the analog microwave radio link system from Francistown to Bulawayo in Zimbabwe was commissioned (REG 004). This system has a capacity of 960 channels in a (1+1) configuration. It is being used for the traffic to Zimbabwe and Zambia.

It is a general policy not to use terrestrial links when the number of transit countries is two or more. The traffic to Tanzania and Malawi is therefor routed via London on satellite.

There is also an analog microwave system with a capacity of 1260 channels to South Africa and this is also used for traffic to Mozambique, Lesotho, Swaziland and Namibia.

A 12 channel open-wire system is recently installed for trans border traffic between Kasane and Kazungula to Zambia.

Fig. B.4 shows the volume of national and international telephone traffic, expressed in thousands of metered call units and in hundreds of traffic minutes respectively.

The distribution and volume of the international traffic is as given in Table B.2 and Fig. B.5. The traffic to Zimbabwe via the REG 004 microwave system Francistown - Bulawayo is dominating as far as traffic to the SADCC countries is concerned.

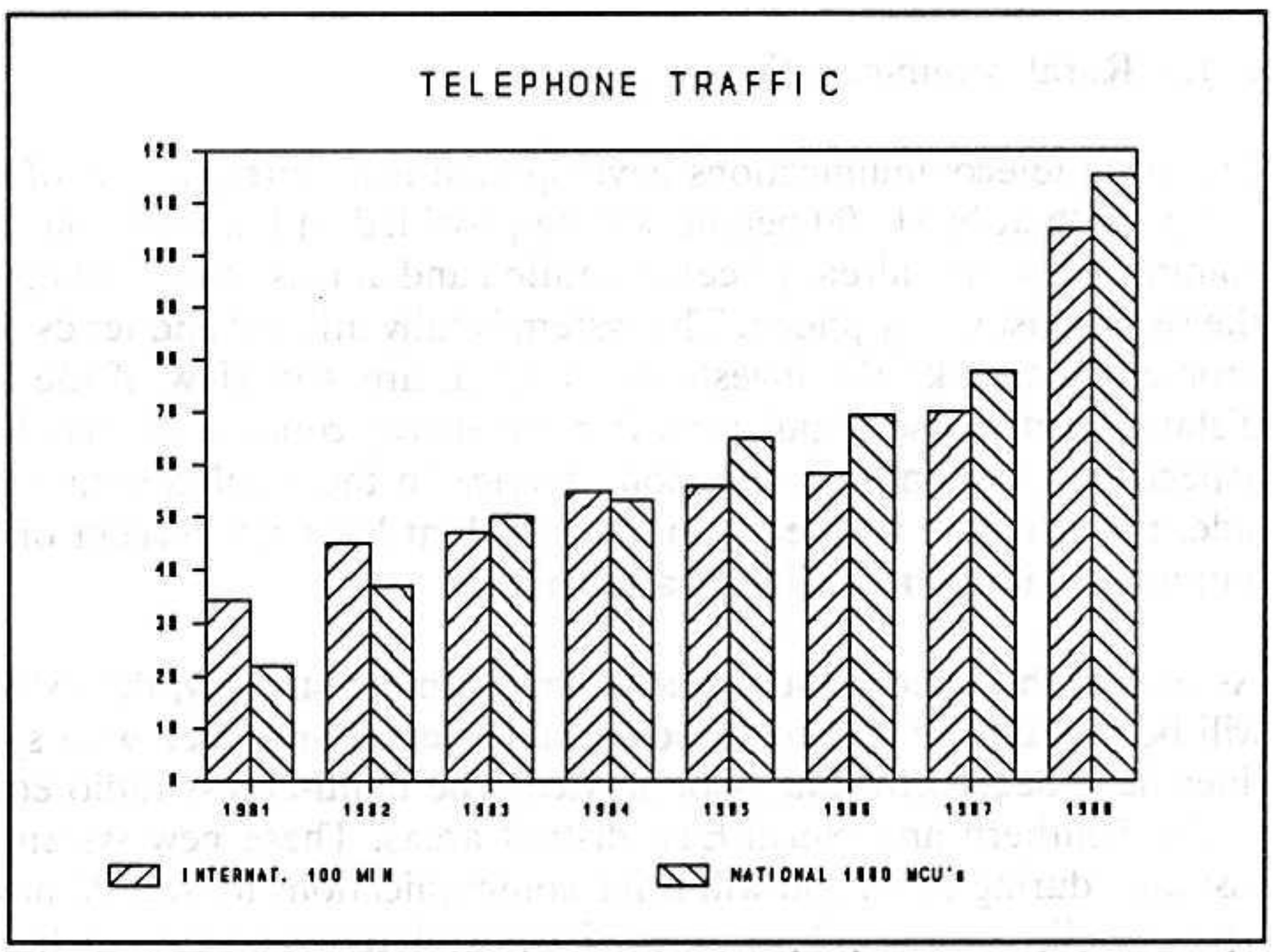

Fig. B.4 Telephone traffic in hundreds of minutes and thousands of metered call units.

B.5. THE MAIN DEVELOPMENT PROGRAMME.

In 1980 a 20 year development plan for the telecommunications sector was prepared. The core of this plan, referred to as the Main Development Programme (MDP), consisted of a modernization of the national rtelecommunications network, previously largely consisting of open-wire transmission and electromechanical switching, to a system based on digital microwave transmission and digital switching.

Table B.2 International Traffic in Erlang.

INTERNATIONAL TRAFFIC
Fiscal year 1987/88 (Apr-Mar)

	Outgoing	Incoming	Country of transit
Angola	0.00	0.00	UK
Botswana	***	***	***
Lesotho	1.11	1.13	RSA
Malawi	0.48	0.42	UK
Mozambique	0.04	0.05	RSA
Swaziland	0.93	0.46	RSA
Tanzania	0.22	0.22	UK
Zambia	2.30	3.50	Dir
Zimbabwe	12.30	12.28	Dir
RSA	62.02	38.42	Dir
UK	4.10	5.33	Dir-SAT
USA	3.00	1.38	Dir-SAT
Others	0.01	0.00	UK
Total	86.51	63.19	

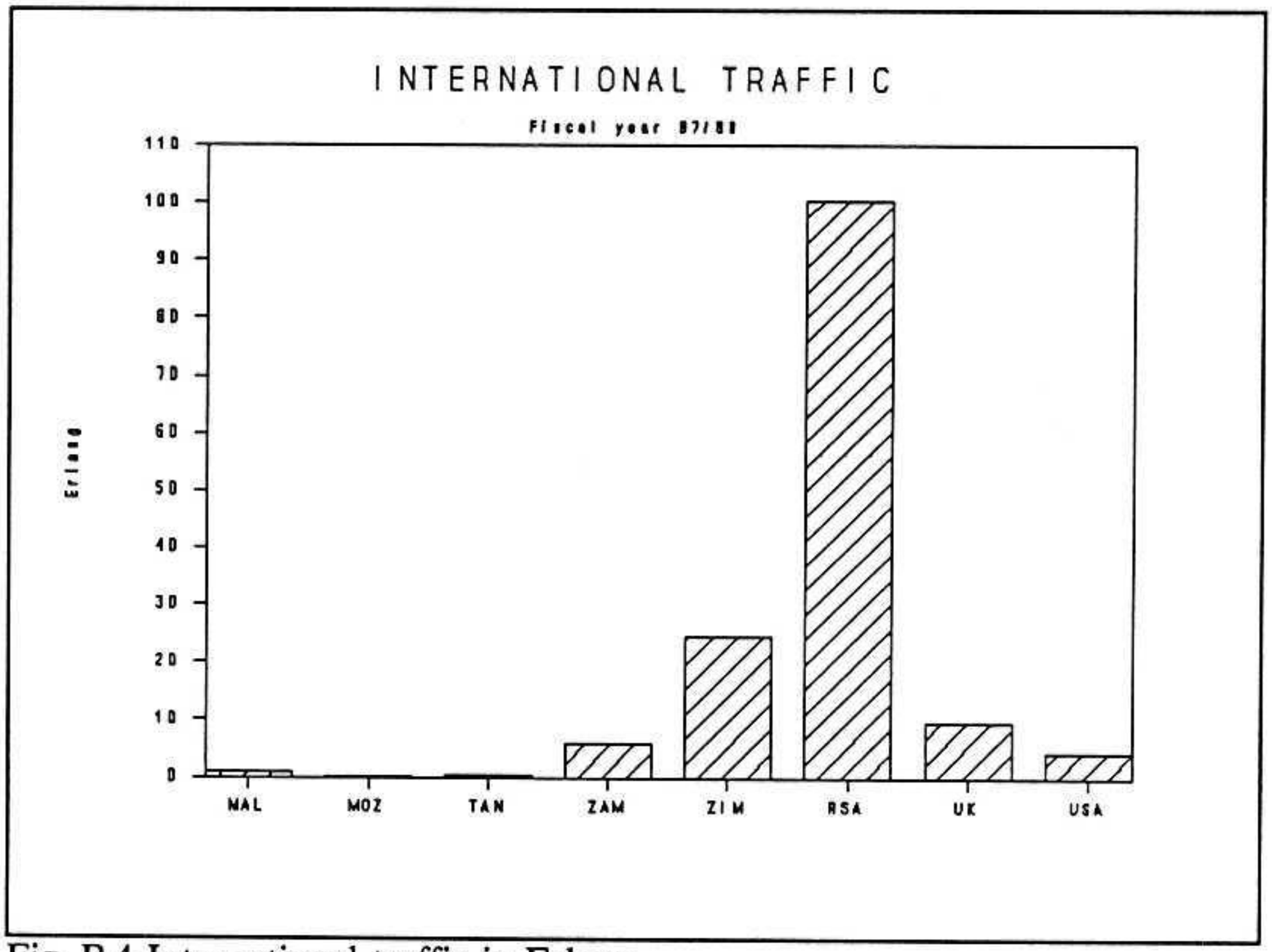

Fig. B.4 International traffic in Erlang.

Supplementary to this was the establishment of microwave links to the neighbouring countries, and the installation of a new earth satellite station for international connections.

The Telecommunications Master Development Plan (MDP) consists of three phases as follows:

MDP Phase 1: development of the main network.
MDP Phase 2: extension of the network.
MDP Phase 3: extension of the network from Ghanzi to Namibia.(PANAFTEL)

The MDP phase 1 was funded with loans from the African Development Bank (ADB) and the NORDIC Bank, for the installation of the transmission route system from the South to the Eastern part of the country. The digital microwave system from Lobatse to Francistown with links to Selebi-Phikwe, Jwaneng and Serowe was established in 1986. This forms the communication backbone stretching 1020 kilometres at a total cost of about 100 million pula. All these centres have been equipped fully with electronic digital telephone exchangers. As a result, the telephone lines increased from 10,000 in late 1986 to 17,000 in 1989, with a total of 34,000 telephone stations. This digital micro-wave system was designed by Cable and Wireless (U.K), while the implementation was done by NERA with Ericsson being the main contractor.

BTC is in the process of implementing MDP Phase 2. which is aimed at spreading the telecommunications system to the far north and west and connect them to the main system. The extension will be connected from Francistown to Natu and Kasane. From Nata the system will spread westwards to Maun and then Ghanzi and then to Jwaneng. This will complete the ring so that the micro-wave system will replace the badly congested, poor quality openline circuits currently servicing northern and western Botswana.

The MDP phase 2 is being funded by the Norwegian Government. The contract with EB NERA is valued at 45.4 million pula, of which 9.6 million pula is a grant by NORAD. MDP phase 2 is expected to be completed by mid-1991.

Annex C.

MOZAMBIQUE[1]

C.1. THE COUNTRY.

The People's Republic of Mozambique is situated on the east coast of Africa, between parallels 10 deg 17 min and 26 deg 52 min lattitude South and between meridiens 30 deg 12 min and 40 deg 51 min longitude East, bordering RSA, Tanzania, Swaziland, Zimbabwe, and Malawi.

The area is 799 380 square km, of which 13 000 square km are inland waters.

The total population is estimated at 14.36 mill (1. January 1987) with a population density of 18 inhabitants per square kilometer.

The independence of Mozambique was proclaimed on 25 June 1975. Mozambique is according to the constitution guided by the political line of theFrelimo Party. The People's assembly is the supreme organ of State power, and the Council of Ministers is the governing body.

After independence, Mozambique lost much of its (Portugese) trained manpower. The development of the educational system lagged behind that of the other countries in the region. At independence Mozambique therefore had a critical shortage of all types of trained manpower.

During the last years, the security situation in the country has been difficult. RENAMO, with backing from RSA, is launching attacks on communications installations, as well as on other targets. Transport and communication between the different parts of the country has therefore become difficult. This has also had implications for telecommunications.

The security situation has also contributed to a worsening economic situation.

Due to its geopgraphical position in Southern Africa, Mozambique, with its main ports of Nacala, Beira and Maputo, plays a strategic role for transport to and from the hinterland countries.

The security situation is, however, making it difficult to realize this potential.

C.2. DEVELOPMENT OF THE TELECOMMUNICATIONS SYSTEM.

At the time of independence Mozambique had a telecommunications system consisting of

- automatic step-by-step Strowger switches in all major cities and manual switchboards in some district capitals and other villages.
- transmission systems using troposcatter, HF radio and open wire lines for national links, and satellite for the entire overseas communication through Portugal.

Data for number of telephone and telex subscribers together with traffic data for the period up to 1987 is shown in Table C.1.

Table C.1 Mozambique telecommunications.

	Telephone DELs	Telex	Revenue (1000Mt)	Telephone Nat.(pls. *1000)	Int.(min *1000)
1975	31100	379			
1976					
1977					
1978					
1979					
1080	33500	479	465500		
1981	35400	519	397400	56394	1936
1982	36500	558	529900	57346	2055
1983	36900	602	644100	77571	2768
1984	37600	618	860900	101316	3473
1985	38300	644	1101100	111448	3823
1986	39000	686	1165200	115000	4491
1987	40174	783	5065300	90000	2893

The development of telephone Direct Exchange Lines (DELs) is shown in Fig. C.1. The national traffic expressed in terms of pulses is shown in Fig. C.2. The unit "pulses" is a measure of revenue, given that the charge per pulse is fixed, and it should therefore indicate the development of revenues in fixed prices.

The international traffic in Table C.1 is given in minutes.

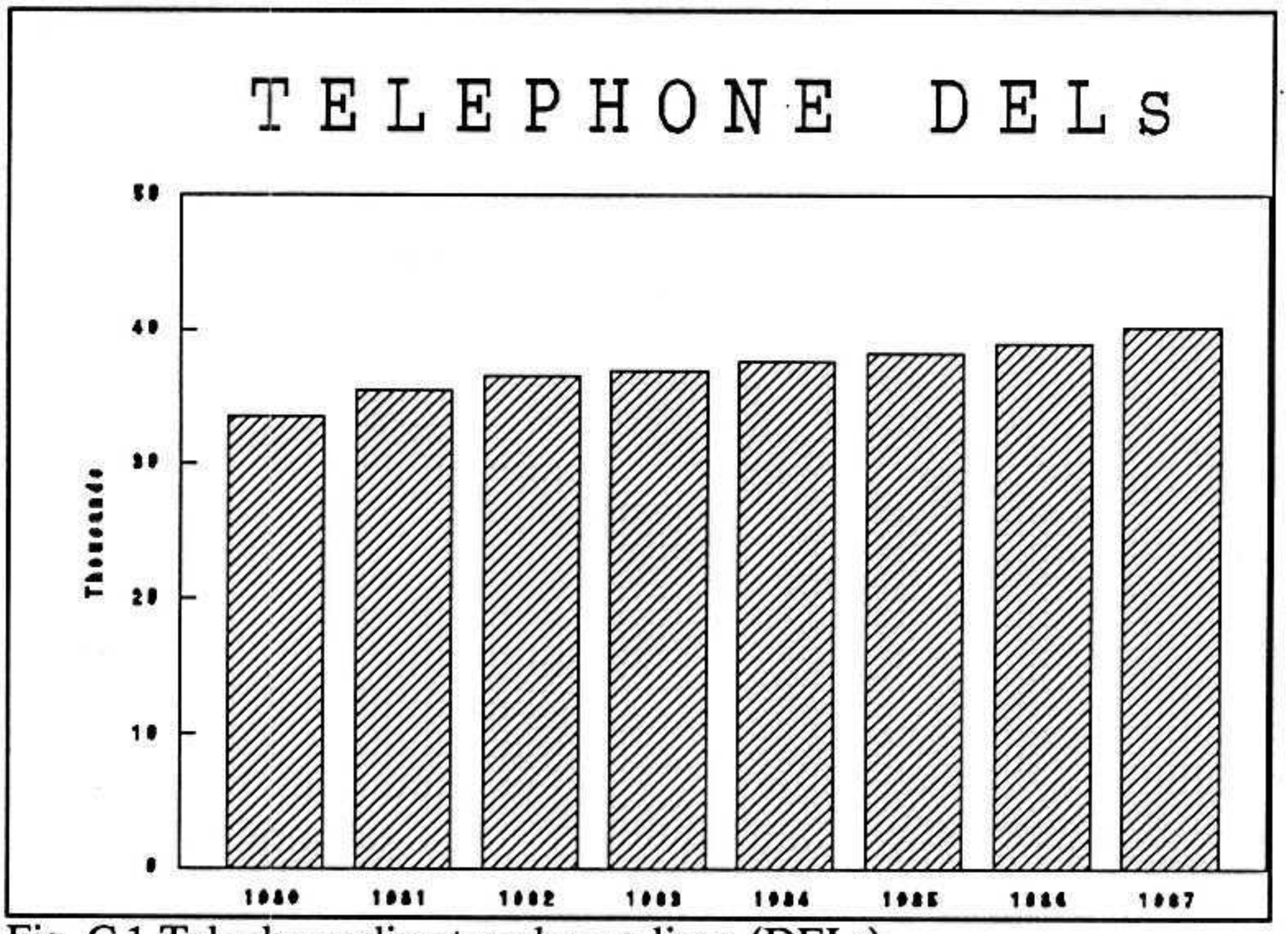

Fig. C.1 Telephone direct exchange lines (DELs).

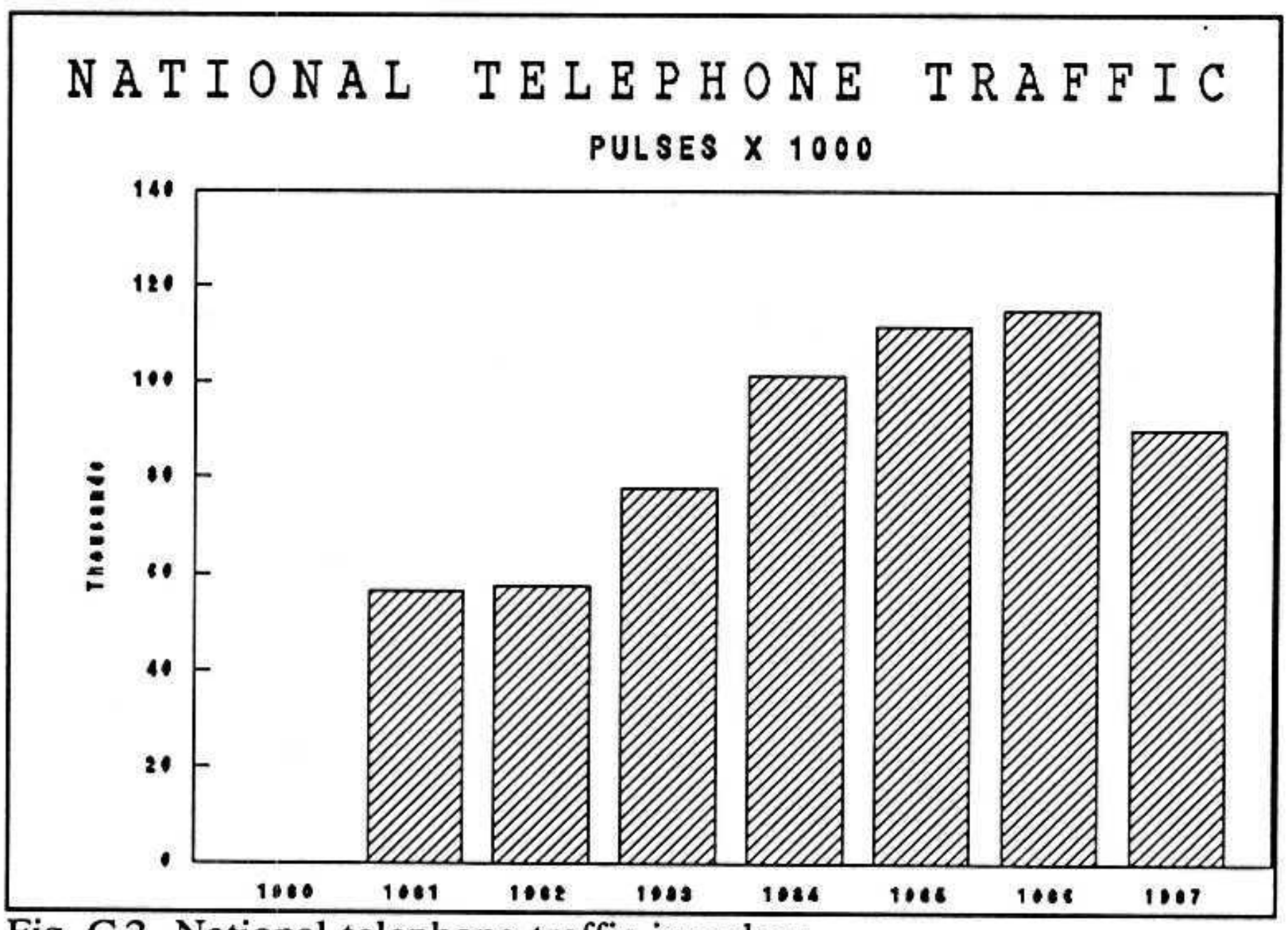

Fig. C.2 National telephone traffic in pulses.

C.3. THE POST AND TELECOMMUNICATIONS CORPORATION.

C.3.1 Status and operating conditions.

Telecomunicacoes de Mocambique (TDM) is a parastatal organization which is entrusted the operational responsibilities of telecommunications services in Mozambique. It holds the full monopoly of the telecommunications system.

TDM also combines the responsibility of operating its network and services with some regulatory functions which are performed on behalf of the Ministry of Transport and Communications.

TDM is a state enterprise endowed with juridical personality and administrative and financial authonomy.

C.3.2 Organization.

TDM is headed by a Director General, (Mr. Rui Fernandes), who is responsible to the Vice-Minister for Telecommunication within the Ministry of Transport and Communications, (Mr. Rui Lousa). The structural organization of TDM is shown in Fig.C.3.

C.3.3 Financial conditions.

The policy of TDM on financing telecommunications projects is based on the rate of return of the project. All costs should be covered in total, but telecommunications in rural areas should be subsidized.

External financing is passed on to TDM at 30 per cent commercial interest rate at a project by project evaluation.Investment financing is done on a government basis through soft loans and grants.

Mocambique receives grants from, among others, Norway and Sweden.TDM claimed that the financial status is solid, but, in order to maintain this status, special attention should be devoted in terms of optimization of new investment.

The revenues of Mozambique Telecommunications are shown in Fig.C.4.

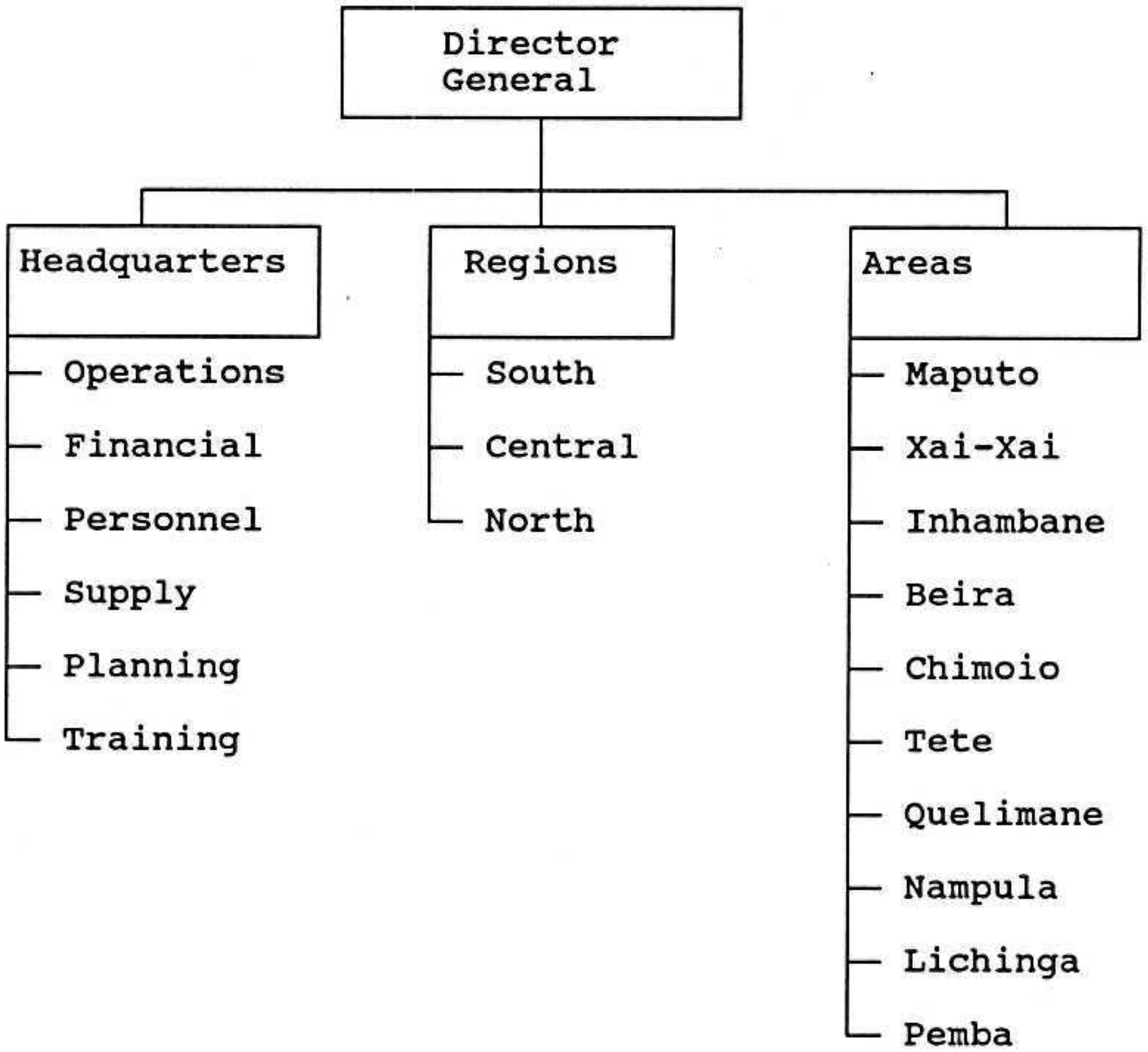

Fig. C.3. TDM Organizational Chart.

C.3.4 Operations and maintenance.

Mozambique is planning an ambitous expansion of its network, together with the introduction of new, digital equipment. This provides a great challenge in terms of operation and maintenance of the system.

Mozambique's economic problems make availability of foreign exchange for import of spare parts a problem.

Personell for maintenance is also a major constraint, even more so than in the neighbouring countries (cf C.3.5 below).

In addition to these more general problems, the security situation both creates increased need for maintenance and at the same time makes maintenance of a terrestrial network very difficult. On the basis of a study by ITU, a maintenance project has been prepared.

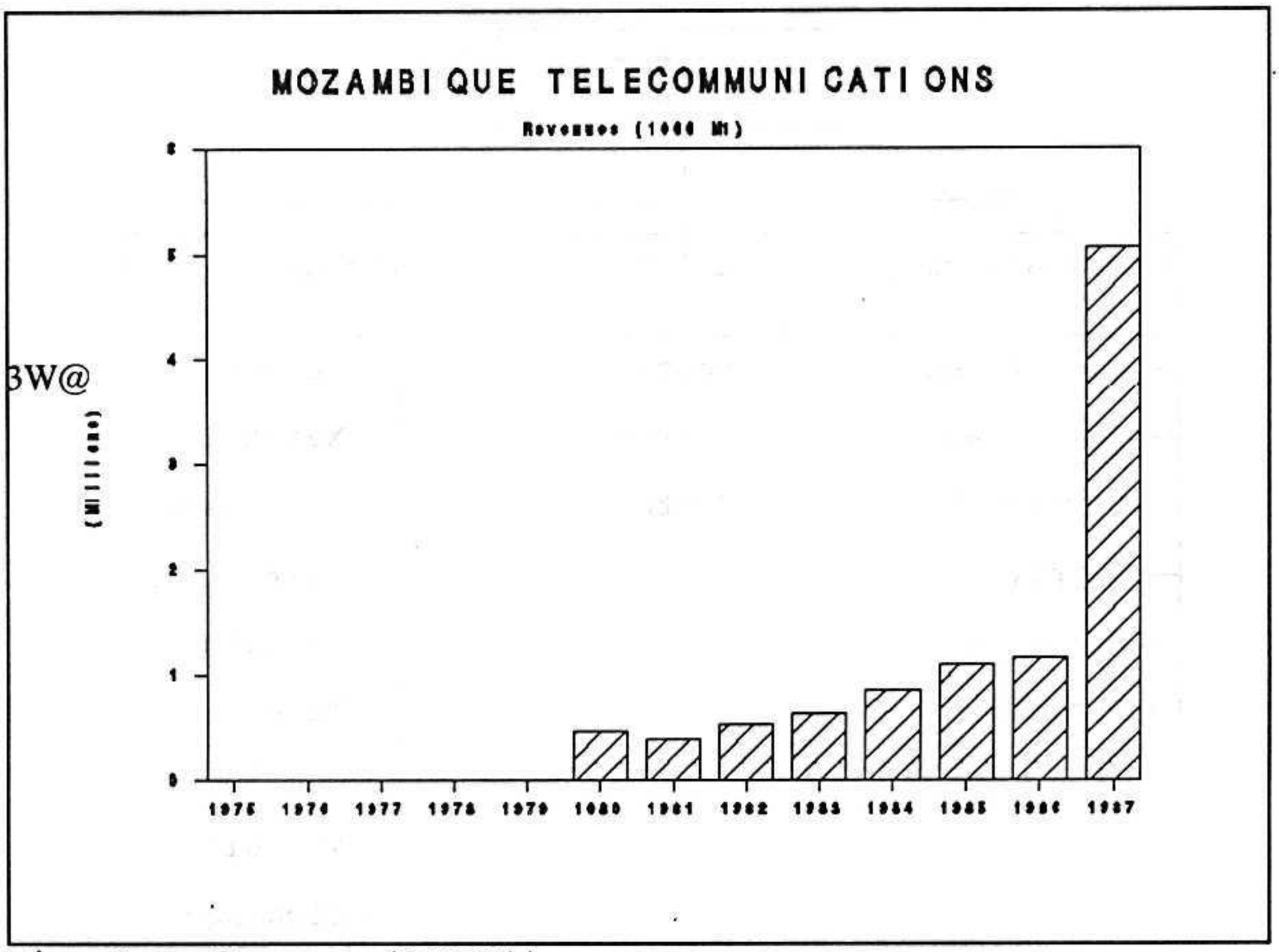

Fig. C.4. Revenue (1000Mt)

C.3.5 Staffing/Training.

The present manpower situation, compared to the projected requirements after the completion of TDM is shown in table C.2.

Table C.2. Manpower situation and requirement.

Category:	Staff 1987	Staff requirement 1997
Level 5 (professional)	8	51
Level 4 (sub-profess.)	114	675
Level 3 (middle level)	463	1474
Level 2 (lower level)	926	1150
Level 1 (support labour)	862	1000

As indicated in the table, there is an acute shortage of skilled staff (level 3, 4 and 5). Recruitment of skilled manpower, and retraining of some of its existing lower level manpower presents a great challange to TDM.

TDM today depends heavily on technical assistance and management support, mainly provided by consultants, mainly from Sweden and Italy. This dependence on technical assitance will continue for some time.

Training of technicians and operators is undertaken at the TDM training centre, supported by Sweden. A new training centre is under construction, with Italian assistance.

Under an agreement with the university, TDM is given 10 students/year in the engeneering faculty.

The language problem makes it more difficult for Mozambique to benefit from regional level training for the higher levels of manpower.

A new post as Director of Training is being established, to stengthen the position of training in the organization.

C.4. PRESENT NATIONAL NETWORK.

C.4.1 Network structure.

The main problem for Mozambique in developing the national telecommunications network is the present security situation which makes operation of terrestrial wideband systems difficult, if not impossible.

Fig. C.5 shows the present network. Tropospcatter, HF, overhead lines and satellite are used for the national trunk system. Also microwave radio relay systems are being used, but to a very limited extent. There is one analog wideband microwave link installed in 1982 from Maputo to South Africa, and there is one installed in 1981 from Beira to Xhiluvo and in 1985 extended to Chimoio.

This means that vital back-bone links forming part of the PANAFTEL system are still missing.

The situation is somewhat ameliorated by the operation of three satellte earth stations using a 1/4 transponder leased from INTELSAT.

C.4.2 International connections.

The international links from the International Telephone Switching Centre in Maputo go via microwave links to South Africa and via satellite to Angola, Italy and Portugal. In addition there are direct links from Beira to Zimbabwe.

The situation in 1988 is shown in Table C.4. Since then a new exchange is being commissioned in Maputo (July 1989).

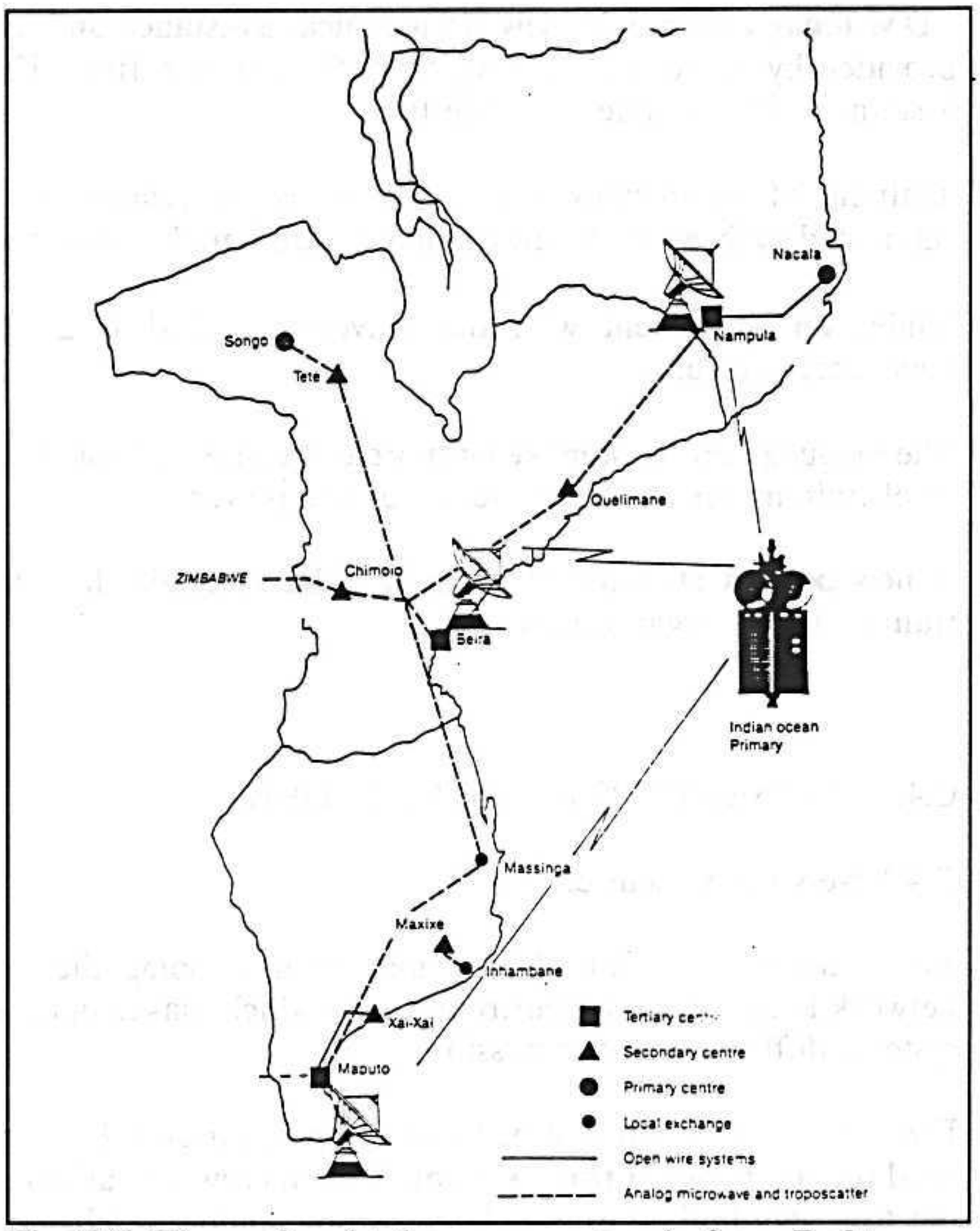

Fig. C.5. The national telecomms network, from Ref.1.

The international traffic for the fiscal year 1987/88 to the SADCC countries is as given in Table C.3. Clearly, the traffic to Swaziland is dominating as far as traffic to the SADCC countries is concerned.

The distribution of the international traffic is shown in Fig. C.6.

C.4.3 The switching system.

The automatic switching system consisted, early 1989, of 24 step-by-step exchanges of type Strowger 2000, RURAX 400 and ATU types produced by EAP of Portugal. The exchanges were installed during the period 1950 to 1974. The total capacity is 44 076 Direct Exchange Lines (DELs), with 36261 connected to subscribers.

Table C.3. International traffic to SADCC countries in Erlang.

	Outgoing	Incoming	Country of transit
Angola	0.11	0.07	SAT + Portugal
Botswana	0.05	0.04	RSA
Lesotho	0.16	0.04	RSA + UK
Malawi	0.19	0.28	RSA + UK +Zim
Mozambique	***	***	
Swaziland	6.17	6.75	Dir
Tanzania	0.10	0.18	UK + Italy
Zambia	0.01	0.06	RSA
Zimbabwe	1.38	1.03	Dir

Table C.4. International circuits.

		CIRCUITS			
	Destination	Outgoing	Bothways	Incoming	Via
MAPUTO	Angola	1		1	SAT
	Swaziland	12		11	MW
	Zambia	2	2		MW
	Zimbabwe	4		4	NW
	South Africa	16		15	MW
	Italy	2		2	SAT
	Portugal	16		16	SAT
BEIRA	Zimbabwe	10		10	MW
	TOTAL	61	2	52	
	SAT = SATELLITE		MW=	MICRO-WAVE	

The manual switching system consists of 121 switchboards from Ericsson and from Standard Electric of Portugal. The total capacity is 5755 DELs of which 3813 are connected to subscribers.

A number of digital exchanges of type AXE 10, manufactured by FATME of Italy, will be commissioned later in 1989. The effect of this, in terms of automatic digital DELs, is shown in the plans for the switching system development.

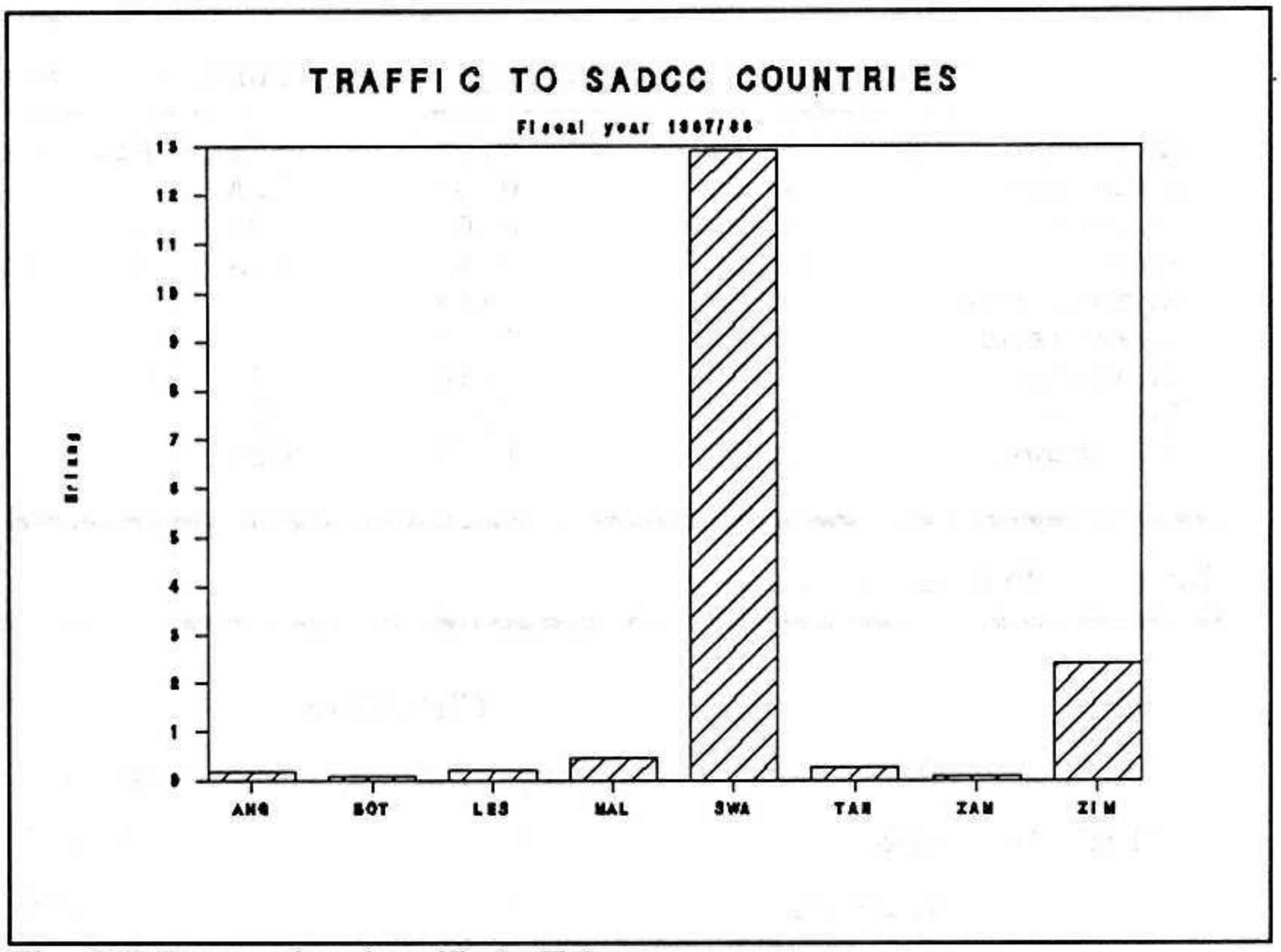

Fig. C.6. International traffic in Erlang.

The number of automatic and manual DELs in the major cities, together with the number of lines installed, is shown in Table C.5.

There are trunk exchanges, 2 wire with E&M signalling, in the locations shown in Table C.6.

Some of these exchanges are, or are about to be, replaced, and new ones are being installed, as described later.

The international exchanges and the number of circuits, incoming (I/C), both ways (BW) and outgoing (O/G), was shown in Section C.4.2 above.

Table C.5. Telephone exchanges.

	Automatic	Manual
Maputo	27392	1400
Xai-Xai	700	525
Chokwe		330
Inhambane	400	900
Beira	8400	280
Chimoio	600	390
Quelimane	1200	800
Tete	1400	220
Nampula	2984	420
Lichinga	400	130
Pemba	600	370
Total	44076	5755

There are five telex exchanges in Mozambique, in Maputo, Beira, Nampula, Tete and Queliman. The telex service is of good quality in Maputo, but difficulties are experienced with other centres due to the quality of the transmission systems.

Table C.6. Trunk exchanges.

			CIRCUITS		
			IC	BW	O/G
Maputo	Nat/Intnat	1950	213	53	211
Xai-Xai	Nat	1967	8	12	7
Inhambane	Nat	1971	4	25	4
Beira	Nat/Intnat	1950	93	50	100
Chimoio	Nat	1967	5	6	6
Tete	Nat	1973	13	7	10
Quelimane	Nat	1966	7	23	7
Nampula	Nat	1966	58	32	60
Lichinga	Nat	1971	6		
Pemba	Nat	1969	4		

C.4.4 The transmission system.

Microwave radio links, which form the backbone of the telecommunication system of the other SADCC countries, and which will form an essential part of the terrestrial PANAFTEL network, are only operated to a very limited extent due to the security situation.

Maputo is connected to Swaziland and South Africa via an analog microwave system with a capacity of 960 channels installed in 1982 and operating at 7GHz.

A second system goes from Beira via Dondo to Xiluvo. This system was installed in 1981, has a capacity of 960 channels and operates in the 7 GHz band.

In 1985 the system was extended to Chimoio with a 120 channel system operating at 450 MHz.

The third system is in the Tete region, and connects Tete to Mt. Caroeira with a 120 channel system operating at 2 GHz. This was replaced by a digital 34 Mbit/s system as a spur link to the Harare - Tete - Blantyre link as a part of the REG 024 project in August 1989.

Satellite communications is used for both international and national communications.

An INTELSAT Standard A station operating via the Atlantic Ocean region Primary Path satellite is used for connections to UK and Portugal.

Since 1986 Mocambique has been operating a domestic satellite system with three earth stations in Maputo, Beira and Nampula. The system operates via 1/4 of a transponder leased from INTELSAT on a preemptible basis.

The present capacity is

Maputo - Beira	65 circuits
Maputo - Nampula	31 "
Beira - Nampula	17 "

Troposcatter communications is used for national trunk circuits, but reliability and circuit quality are not satisfactory. This is both due to equipment problems (the systems were installed in 1973 and 1975), and wave propagation conditions.

For example, the connection Massinga - Beira (Xiluvo) was initially designed for 120 channels, but must be operated at 60 channels

A number of overhead wire systems are operated. These were installed in 1974, except the connection Maputo - Xai-Xai, which was installed in 1968. The capacities of this systems are 3 to 12 circuits.

High Frequency radio is also used extensively, both for national and international connections. The longest connection, between Maputo and Pemba, covers a distance of 1625 km. The capacity of the HF equipment is 1 channel, except Maputo - Licinga which has a capacity of two channels, and Maputo - Quelimane with four circuits.

C.5. TDP, THE TELECOMMUNICATIONS DEVELOPMENT PLAN.

The Telecommunications Development Plan (TDP) has been defined on the basis of the financial availibility, and the technical and economical viability.

The implementation schedule is shown in Fig.C.7.

TDP Phase 1 consists of two steps

- Step 1, which is under implementation and due for completion by mid-1989.

- Step 2, which is currently being engineered and expected to be implemented after Step 1.

The development of the switching system is shown in Table. C.7.

Two new domestic satellite links are being engineered, with Licinga and Pemba, each with a capacity of 30 circuits.

There are plans to rehabilitate and upgrade the troposcatter systems, including to establish a network control centre and a preventive maintenance programme.

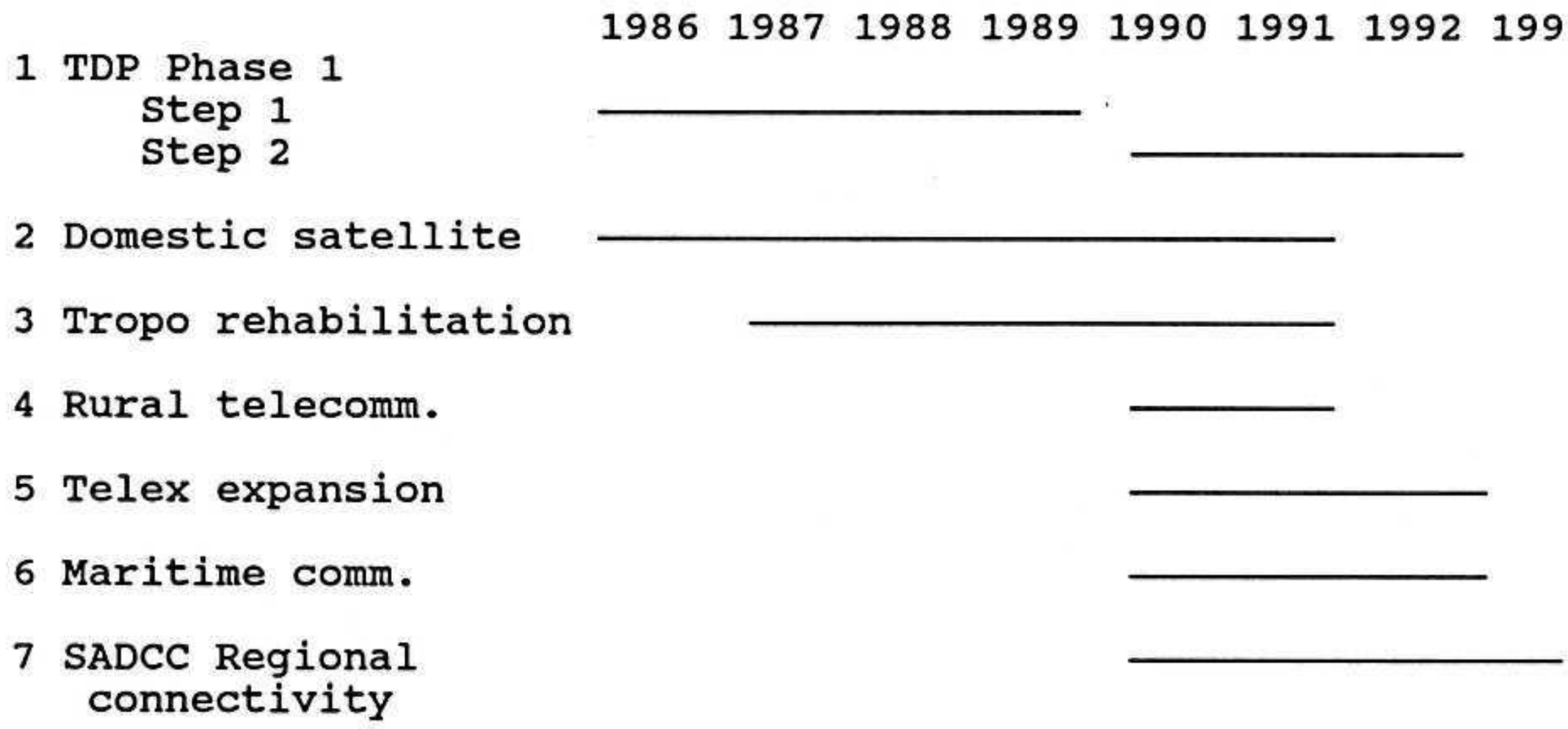

Fig. C.7. Time schedule.

Table C.7 Switching system development.

		1988	1989	1992
Automatic DEL's	Analogue	44 076	3 084	17 684
	Digital		54 104	72 664
	Total	44 076	77 188	90 348
Manual DEL's		5 755	5 315	5 075
Total DEL's		49 831	82 503	95 423
Degree of automation		88 %	94 %	95 %
Degree of digitilization		0 %	66 %	76 %

The rural communications network consists of HF and VHF radio links, linking each district with its provincial capital. There are also plans for narrow band satellite links to some of the major rural centres, and cooperation with the railway company to develop a joint system for the transport system and for the public.

REFERENCES

1. Mozambique Telecommunications Operational Management Plan, TDM Maputo, 1989.

Annex D

ZAMBIA

D.1 THE COUNTRY

The Republic of Zambia is located in the southern part of Africa, bordering Zaire, Tanzania, Malawi, Mozambique, Zimbabwe, Botswana, Namibia and Angola.

The area is 752 620 km^2, and the population is 6.24 mill, corresponding to a density of 9 per km^2. The annual population growth is 3.2 %.

The capital, Lusaka, has a population of 540 000. Other important cities are Kitwe, population 315 000, and Ndola, 285 000, where also the headquarters of the Post and Telecommunications Corporation is located.

Development of the economy, and of the transport and communication network, has been concentrated along "the old line of rail", i.e. the Livingstone - Lusaka - Copperbelt axis.

Mining still plays a central, though declining, role in the economy. As a consequence of declining income from the copper industry, Zambia has been hit by a severe economic crisis during the last decade, in particular affecting the country's ability to import goods.

As a landlocked country, Zambia is extremely dependent on the regional transport and communication system. Most of the overseas trade goes via the port of Dar es Salaam.

D.2 DEVELOPMENT OF THE TELECOMMUNICATIONS SYSTEM.

The first telecommunications system i Zambia, which existed at the time of independence in 1964, was an open wire line along the railway line to the copper belt, Bulawayo-Livingstone-Lusaka-Ndola.

Outside the railway link there was virtually nothing, three 12 channel open wire systems, to the Eastern province, the Northern province and to the Western province. In addition to this there were only some HF-links to various provincial and district centres mainly for transmission of telegrams.

The first modern, high capacity system was a microwave radio link for 960 voice channels between Lusaka and Ndola which was delivered by GEC in 1968. This link was expanded to 1800 channels in 1987, delivered and financed by Japan.

The Livingstone - Lusaka microwave link with a capacity of 960 channels was commissioned in 1974.

A microwave link to Tanzania, as a part of the PANAFTEL system, was constructed in 1978, financed by the African Development Bank. The eastern link to Chipata, financed by the World Bank, was built in 1979 and the Lusaka - Monga link, also financed by the World Bank, in 1982. The capacity was 960 channels for all these links, and the configuratin (1+1), i.e. one operating and one spare.

The Chipata link was in 1984 extended to the border of Malawi and connected to an NEC link to provide a connection to Lilongwe.

The change in the North-Western province came in 1985 when the microwave link from Chingola to the province capital of Solwezi and further to Mwinilunga and Zambezi was commissioned. The system was delivered by EB Nera and financed by NORAD. The capacity to Solwezi was 960 channels in a (2+1) configuration **to** Solwezi and 300 channels in a (1+1) configuration **from** Solwezi to Zambesi and Mwinilunga. The additional channel to Solwezi is used for TV transmission.

The international communication in the period from the UDI of Rhodesia in 1965, when Zambia was isolated, to 1974 was accomplished via an international HF transmitter installed in 1968 and operated by Cable and Wireless Ltd. This provided 4 circuits to London, and the waiting time for a telephone call was up to 72 hours. There were also HF-circuits to Nairobi and Dar es Salaam.

A great improvement was achieved when the Satellite Earth station at Mwembeshi was commissioned in 1974. The station is located 42 km. north west of Lusaka and is equippped with a 30 meter antenna, INTELSAT Standard A. The supplier was NEC, Japan. It is now operating the INTELSAT satellite over the Indian Ocean Region at 60 degree East.

This station was in 1988 equipped with a second antenna with diameter 18.3 m (Revised Standard A), now operating the INTELSAT satellite in the Atlantic Ocean Region at 342 degrees East (18 degrees West).

D.3 THE POST AND TELECOMMUNICATIONS CORPORATION.

D.3.1 Status and operating conditions.

The Telecommunications organization was formerly a government agency, the General Post Office. It was transformed into a parastatal organization by an Act of Parliament on 1 May 1975. On 1 April 1988 the Corporation was turned into a limited company under the Companies Act and became a direct subsidiary of ZIMCO (Zambia Industrial and Mining Corporation).

The Post and Telecommunications Organization (PTC) is responsible for internal and external telecommunications services, and enjoys a monopoly status in providing these services.

D.3.2 Organization.

The Post and Telecommunications Corporation Limited has undergone major organizational restructuring since independence in October 1964. Up until 1975, PTC operated as a government department under the General Post Office (GPO), and had very limited powers. It became a corporation in 1975.

In mid 1988, PTC became a limited company and 100 percent subsidiary of the Zambia Industrial Mining Corporation (ZIMCO), in April 1989. These restructuring efforts have been aimed at improving PTC's resource mobilization capacity and autonomy which are necessary for meeting the challenges of providing efficient communication services within and outside the country.

At government level, PTC falls under the Communications Wing of the Ministry of Power, Transport and Communications (MPTC). The MPTC is responsible for formulation of policy while PTC is technically responsible for the implementation, management and operation of the telecommunications programmes/projects.

PTC has a monopoly of the telecommunications sector in the country. In addition to policy formulation, the MPTC is also responsible for negotiations with regard to external loans and grants, and thereby, enters into agreements with the donor agencies on the behalf of the PTC.

PTC is controlled by a Board of Directors under the chairmanship of one of the ZIMCO executive directors. At the organizational level, PTC is headed by a Managing Director, and below him there are two directors, each in charge of the Postal Division and Telecommunications Division repectively.

The two Divisions operate as seperate entities although they are both under the same Board of Directors and one Corporate Services Section which makes financial decisions on behalf of the entire Corporation.

At PTC headquarter in Ndola, the Telecommunications Division is divided into four departments, namely, Finance, Technical Services, Operations Systems and Manpower and Training which also includes PTC Staff Training College. The Departments are headed by assistant directors. On the other hand, the country is divided into two regions i.e. Northern Region with its headquarters in Kitwe and Southern Region with its headquarters in Lusaka.

The Northern Region is sub-divided into seven areas covering Kabwe, Solwezi, Ndola, Kasama, Mansa, Kitwe and Chingola. The Southern Region is also sub-divided into five areas comprising Mongu, Livingstone, Choma, Lusaka and Chipata. The regions are

headed by Assistant Directors who are responsible to the Deputy Director Telecommunications Division, Ndola.

The Area Managers who are responsible to the Assistant Directors in their respective regions are in charge of all aspects of telecommunications in their areas, such as, operations and maintenance including collection of revenue. The Area Managers are always engineers by profession and their post is answerable to the Senior engineer at headquarters.

D.3.3 Financial conditions.

The financial policy of PTC is to cover the cost from its operations and then put aside some money for further development. The totality of the operations is profitable and turnover on investment is about 15 percent as compared to 11 percent recommended by the World Bank.

PTC contributes large sums of money to the government revenues in form of various taxes. For instance, PTC pays about K60 million per year in form of sales tax based on billings and not on the actual revenues collected. The Corporation also pays duty on imported equipment and declares dividends to the government. The Corporation further pays income tax at 45 percent of taxable income.

According to PTC, in 1974 there were 20,000 connected lines with a turnover of K12 million. By 1988 there were 60,000 lines with a turnover of K600 million, and the turnover in 1989 is expected to be just below a billion Kwacha. PTC is profitable in Kwacha terms and covers all its local costs. However, the operations of PTC are adversely affected by the general foreign exchange constraints of the country, and also given that PTC is a net payer of foreign exchange on its external operations.

PTC has been operating one price structure at all times but plans are underway to introduce a two tariff rate system for low hours, i.e. during holidays, weekends and evenings, and peak hours i.e. during working hours.

The price structure for PTC has been as follows:

	National charges per unit, Kwacha	International charges averages per minute country wise, US$
Before July 1, 1989	K 0.45	US$ 3.50
After July 1, 1989	K 0.65	US$ 5.50

With effect from August 1,1989, PTC has increased the basic unit charge for telephone and telex services by over 100 percent. The increase has been necessitated by escalating costs of telecommunications equipment and servicing given the pace at which

telecommunications technology has been advancing thus requiring substantial investment in new equipment. In addition to the cost of servicing, the loans have added more strain to PTC's financial position.

80 percent of the Telecommunications Division income comes from telephone services, while the remaining 20 percent come from telex, leased services and telegraph.

D.3.4 Operations and maintenance.

The national telecommunications network has expanded rapidly during the last decade. The capability of PTC to operate and maintain the network has not increased at the same speed.

The main problems are:

- manpower development, both at technician level to take care of the day to day work, and at managerial level, to replace the rapidly decreasing number of expatriates.

- access to foreign exchange to import spares and necessary equipment, including cars needed for extensive network.

- the status of maintenance in PTC. Traditionally, network expansion seems to have been given higher priority.

- the comparatively weak position of the regional managers.

The establishment, with Danish support, of the electrical repair centre in Lusaka, has improved the situation as far as repair of cards conserns. This can now generally be done in the country.

D.3.5 Staffing/Training.

Personnel development has been one of the priority areas of PTC. Whereas in 1975 there were only three (3) Zambian graduate engineers, by 1987 this number had been increased to 32. During the 1970's, there were more than 200 expatriates working in PTC provided under various multilateral and bilateral agreements. However, by 1989, there are only 15 expatriates in PTC. This situation is partly due to the Zambianization programme and partly due to foreign exchange problems which makes it difficult for PTC to recruit expatriate personnel.

There is still great need for expatriates to work in various departments of the Telecommunications Division. For instance, the Technical Services department is currently understaffed. NORAD last year planned to send two Norwegian experts to work in the sections of traffic and power supply at the PTC headquarters in Ndola. However, due to

the security situation in the Copperbelt, their departure was postponed. NORAD has for the time being frozen the recruitment of personnel going to work in Zambia until the security situation improves.

With regard to manpower development, the PTC Staff Training College which was established in 1972 with the assistance of ITU provides in-service training to the staff of both the Postal Services and Telecommunications Division.

The College is divided into two branches - postal and telecommunications. The postal branch trains staff from postman to postal manager while the telecommunications branch is responsible for training technicians and operations staff. The College also trains telephone and telex operators, sales staff, basic management and personnel assistants, secretarial and refresher courses including library studies.

The telecommunications training programme has four training programmes namely, Transmission, Switching, External Telecommunications Operations and Management. The trainee technicians are recruited from amoung GCE O Level School Leavers. The course lasts for 2 1/2 years.

The first year includes basic mandatory courses divided into modules covering general induction courses in telecommunications and basic electricity. The specialized courses in transmitting, switching, external telecommunications and operations are given upon completion of the basic courses. The expansion of the telecommunications network has to be complemented by increased level of training both qualitatively and quantitatively.

The College has a Course Development Unit (CDU) assisted by NORAD. The CDU is responsible for updating the training material. The textbooks are generally in short supply and students depend to a large extent on lectures and handouts.

The teaching staff at the College is drawn from the field taking the best candidates. The College staff are trained in Luanshya Vocational and Technical Training College where they attend a one year teachers' training course. Other members of staff have also been trained in Kenya. The College teaching staff is between 40 -45 inclusive 3 expatriate staff. There are normally 120 - 140 students per year and 8 students per module although this number can be increased to between 12 and 15.

The College operates a fixed budget of about K10 million of which personnel costs account for K2-3 million or 20-30 percent. External assistance to the College include electronic kits, a photocopier and duplicating machines from NORAD.

The long term requirements of the College is to upgrade it from training technicians only to offering diplomas underwritten by the University of Zambia. This matter is still under consideration by the University of Zambia Senate, and a decision is expected to be made soon. The local costs of running the College will continue to be met from PTC's own resources while external assistance in form of equipment and personnel will be necessary from donor agencies.

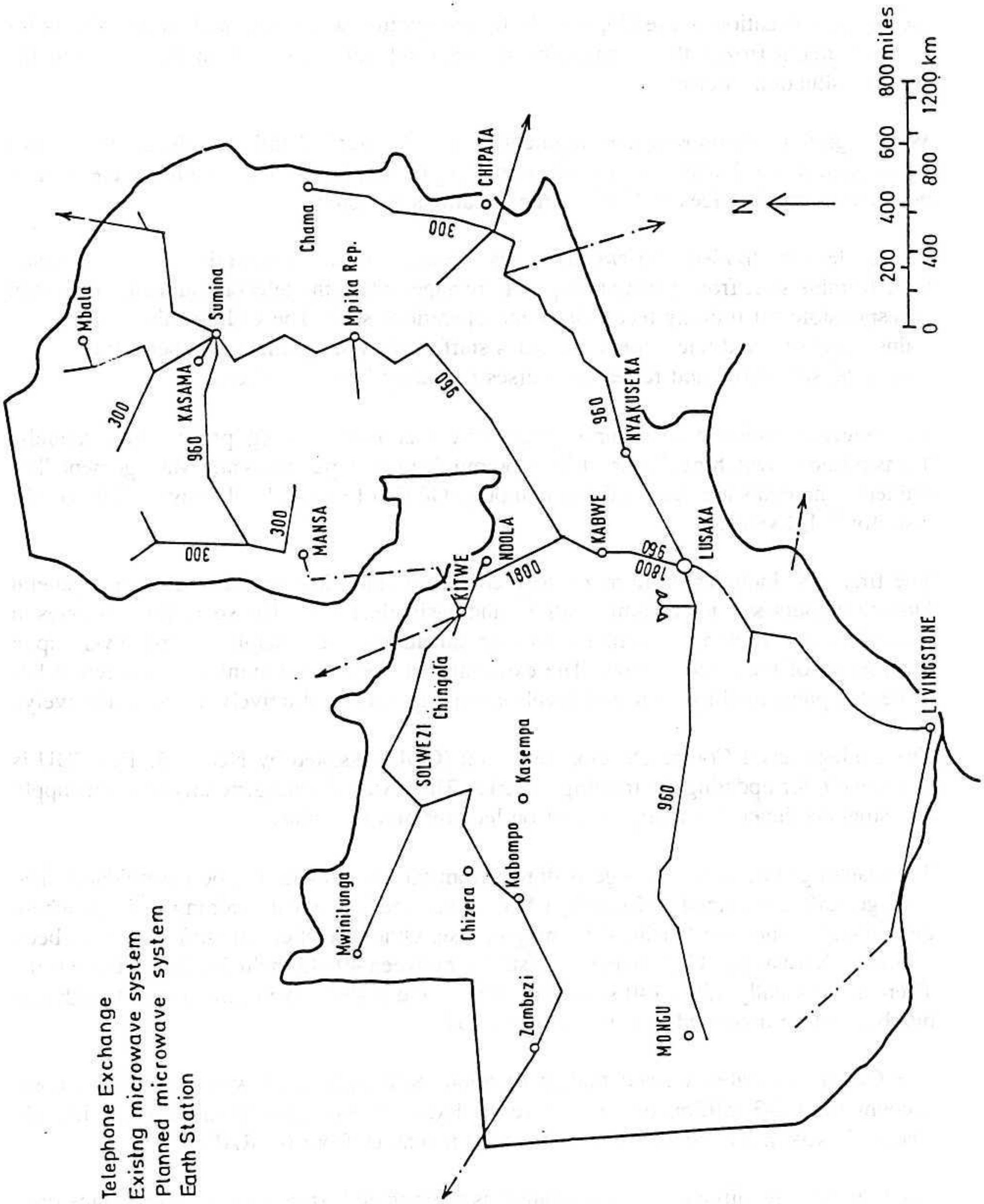

Fig. D.1 The Zambian telecommunications network 1988 - 1993.

At the moment, degree courses are offered at the University of Zambia and outside the country. The technicians are also sent to Kenya for specialized training.

D.4. PRESENT NATIONAL NETWORK.

D.4.1 Network structure.

Fig. D.1 shows the telephone network of Zambia, the facilities existing per 1 April 1988 and the planned facilities for the period up to 1993.

The present network is fairly spread out over the country's nine provinces. It provides services to 73 major town, rural centres and cities. Total direct exchange subsribers is about 50 000, and the telephone penetration is estimated at 1.13 per 100 inhabitants.

D.4.2 International connections.

The telecommunications network of Zambia forms an integrated part of the PANAFTEL network, as shown on Fig D.2[1]. Solid lines show existing radio relay systems, January 1987, and dashed lines show planned ones.

Terrestrial links to Zimbabwe and Botswana are established via the 960 channel analog microwave link Lusaka - Livingstone - Bulawayo with further connections to Gaborone via Francistown. There is also a trans-border link from Livingstone to Victoria Falls, and a trans border-link to Zimbabwe near Siavonga with a capacity of 120 channels. A new link to Botswana via Kasane is also planned.

Zimbabwe has since two years had a microwave link up to the Zambian border near Siavonga. If a proposed Italian project is realized there could be an international connection to Zimbabwe completed in medio 1991. This system would represent capacity increase and redundancy for the Livingstone - Bulawayo link.

To Tanzania there is the microwave link Lusaka - Kasaama - Dar es Salaam, which was completed on the Zambian side in 1978.

In the direction of Mozambique there is a microwave link up to the border at Katete, awaiting a calmer situation in the northern region of Mocambique.

To Malawi there is a microwave link to Lilongwe via Kanjara Hill, near Chipata. This link was completed in 1984.

The traffic to Angola is at the moment carried by satellite and routed via Italy. There are plans for a terrestrial microwaver system to Angola as an extension of the microwave link from Solwezi to Zambezi, the REG 020 project.

Fig. D.2 The PANAFTEL network in Zambia.

There is at the moment a 14 channel system between Zaire and Chingola. Of these are 4 public, the rest private. There is much trade between Zaire and SADCC, and there are requirements for better communications. NORAD has been approached to finance a 120 channel microwave link, possibly with an addition of a channel for exchange of TV-programmes.

The satellite earth station operating in the INTELSAT system at Mwembeshi near Lusaka is connected to the International Telephone Switching Centre (ITSC) via a 960 channel analog microwave link operating in a (2+1) configuration at 7 GHz.

The international traffic in Erlang for the fiscal year 1987/88 is as shown in Table D.1.

The distribution of the international traffic to neighbouring countries is shown in Fig.D.3

D.4.3 The switching system.

The ITSC in Lusaka consists of an Ericsson AXE-10 exchange and an exchange of type ARM.

Table D.1 International traffic in Erlang.[39]

INTERNATIONAL TRAFFIC
Fiscal year 1987/88 (jul-Jun)

	Outgoing	Incoming	Country of transit
Angola	0.16	0.03	Italy
Botswana	1.29	0.61	Dir.
Lesotho	0.13	0.06	RSA + USA
Malawi	2.63	1.51	Dir
Mozambique	0.06	0.01	Dir
Swaziland	0.49	0.32	RSA + UK
Tanzania	1.27	1.42	Dir
Zambia	***	***	
Zimbabwe	8.93	8.83	Dir
Australia	0.23	0.30	UK
Canada	0.61	0.49	Dir-SAT
France	0.77	0.27	Dir-SAT
Germany	1.08	1.03	Dir-SAT
Italy	1.26	0.71	Dir-SAT
Kenya	2.02	1.13	Dir-SAT
Japan	0.42	0.21	UK
RSA	9.10	8.01	Dir
UK	18.86	12.12	Dir-SAT
USA	3.72	5.23	Dir-SAT
Others	6.15	3.49	
Total	59.18	45.78	

The Lusaka main exchange is up to now an exchange of type NX-1E made by Northern Telecom in Canada and installed in 1980. The nominal capacity is 15000 lines, and 8000 to 9000 are being used.

The NX-1E exchange will assisted by an exchange of type NEAX-61, financed by the African Development Bank, and made by NEC, Japan. The NEAX-61 exchange, which has a capacity of 10000 lines, will take over the transit function and 5000 subscribers. Cut-over is planned for 1 July 1989. In addition to the main exchange there will be installed 4 satellite exchanges of the same type to increase the total capacity.

New digital exchanges of type E 10 B, manufactured by CIT ALCATEL, were commissioned in Ndola (13000 lines), Livingstone (5000 lines) and Woodlands in Lusaka (4000 lines).

The next level in the switching system comprises the transit exchanges shown in Table D.2[2].

The next level in the hierarcy can be illustrated by the situation in the North-Western Province: Each of the district centres in this province is equipped with an STK MCR (Metaconta Rural Exchange), partly financed by the world bank, and partly by NORAD under project REG 100. The capacity of the exchanges is 128 subsriber lines and 12 external lines, except for the Cinzela exchange which has a capacity of 96 lines.

D.4.4 The transmission system.

The transmission system is mainly radio analog relay with 23 microwave and 28 VHF/UHF systems, and the main links are shown in Fig. D.1.

An 1800 channel system links Lusaka with Kitwe, and there are 960 channel systems to Solwezi, Mongu, Livingstone, Chipata, and Mansa. There are furter 300 and 120 channel systems linking District Centres to the main network.

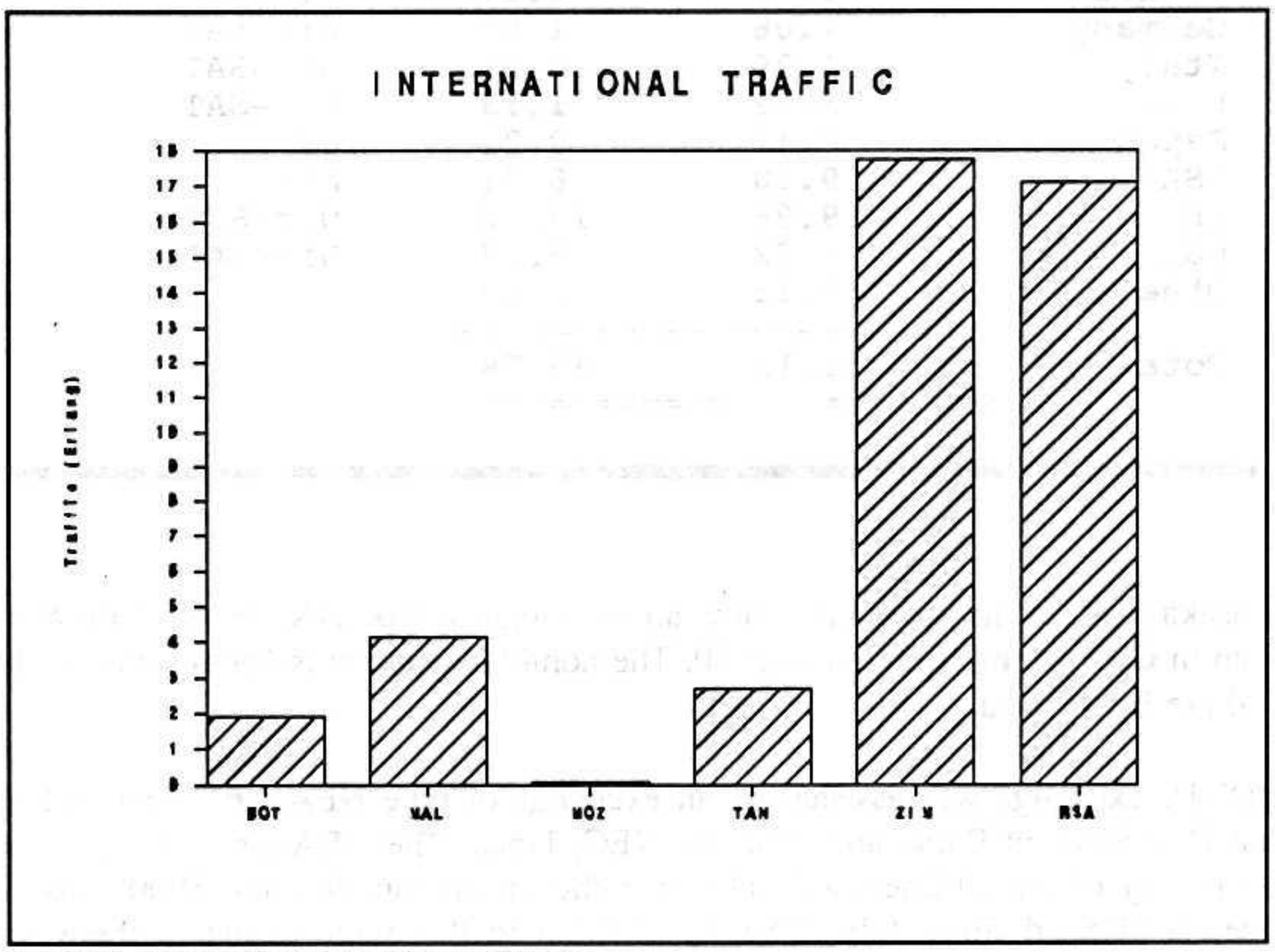

Fig.D.3 International traffic in Erlang.

D.4.5 Rural communications.

It was the policy of the 4. National Plan to connect all District Centres to the telecommunications network. This is achieved today, except for three locations.

Table D.2. Transit exchanges.

Location	Type	Incoming/outgoing circuits
Lusaka Main	NX-1E	1210
Lusaka Transit	ARM 201	1200
Lusaka International	ARM 800	800
Lusaka International	AXE 10	1024
Kitwe	ARM 201	1200
Ndola	E10B	605
Mansa	NX - 1E	191
Choma	ARM 201	400
Kasama	NX - 1E	280
Kabwe	NX - 1 E	306
Chipata	ARM 201	1000
Mongu	NX - 1E	1150
Solwezi	NX - 1E	152

The District centres would be equipped with exchanges. The World Bank financed 26 rural exchanges of type MCR (Metaconta Rural Exchanges), made by Alcatel STK of Norway, and NORAD financed later 16 more such exchanges.

There are at the moment 3 manual exchanges left in the country, and the total number of automatic ones is 99.

The subscriber lines in the rural areas can be normal twisted pair cables, usable for distances up to some kilometres, or overhead lines, which can be used for distances up to 25 kilometer. The overhead lines are costly to build and difficult to maintain.

Party line systems with up to 12 subscribers have been used with the automatic exchanges.

A novel type of systems, multi access rural telephone, has been gaining wide acceptance since it was introduced for the first time in 1984. At the moment there are 11 such systems operating, delivered by NEC and financed by World Bank loans.

The rural telephone systems are of two types, one with a capacity of up to 75 subscribers, and one with 31 subscribers and 4 circuits. The total capacity is 693 lines, and 580 subscribers are connected.

The systems are analog and operate in the 900 MHz band. The range is limited by line of sight, typically 50 km. New digital systems are now becoming available. An Italian project of 20 M US$ will also comprise the financing of 32 systems, manufactured by ITALTEL.

D.5 DEVELOPMENT PLANS.

Zambia has followed a strategy of planned development since independence in 1964. Three national development plans have already been implemented and the fourth is currently under implementation. Like all other sectors in the economy, telecommunications development have been planned and implemented within the context of these national development plans.

The sector policy and strategy was to provide telecommunications services to the urban areas as a priority, and the second stage was to extend the existing telephone network to the rural areas using Radio Telephone Systems (RTS). The current policy of the Zambian Government is to provide telecommunications services to support productive sectors of the economy such as agriculture, mining, manufacturing, tourism etc. throughout the country. The following sections highlight the telecommunications development during the past two decades.

(a) FIRST NATIONAL DEVELOPMENT PLAN (FNDP) 1966-1970

The main objective of telecommunications development during the FNDP was to improve and expand the existing postal and telecommunications networks in both urban and rural areas. The programme included the construction of trunk telephone lines to three provincial capitals ie. Chipata (Eastern Province), Kasama (Northern Province) and Solwezi (North Western Province).

The Luaska - Mongu telephone services were to be improved while telecommunications network between Copperbelt and Lusaka was also to be improved through the introduction of a micro-wave link and heavy investment in new lines, automatic exchanges and telephone apparatus. The planned total investment outlay was £5.0 million (K10.0 million), while estimated total growth income from telecommunications operations was K10.3 million over the plan period.

According to the available data and information, the plan objectives and targets were realised. Notable among these was the establishment of high capacity micro-wave links between Lusaka and the main cities on the copperbelt and the commissioning in Lusaka of the International Radio Station for providing tele-links with the outside world. The developments also included the construction of a new Satellite Earth Station which became operational in 1974.

(b) SECOND NATIONAL DEVELOPMENT PLAN (SNDP) 1972-1976

The main aim of the telecommunications development duing the SNDP was to expand further various aspects of telecommunications. The planned investment outlay was K45.0 million and the planned targets were as follows:

	1969	1976	% increase
Telephone connections	51 000	85 000	66.7
No. of Telex Subscribers	215	700	22.6
No. of Telegraph Offices	95	155	63.2

The percentage increase in the various telecommunications services were also planned as follows:

Name of servics	Percentage increase
Internal Telegraphs	33
International Cables	36
National and local telephone calls	156
International Telex Cables	314
International telephone calls	633
National trunk and local telex calls	

The implementation of the telecommunications projects during the SNDP period was adversely affected by a number of constraints which included inadequate funding, lack of engineering capacity, late completion of buildings and delay in arrival of equipment. As a result only K17.2 million was actually spent as compared to the planned investment of K45.0 million over the plan period. However, despite these problems, the following achivements were recorded during the SNDP period:

a) Commissioning of the Earth Satellite Station at Mwembeshi in October, 1974;

b) Commissioning of the telex exchange in 1976 and the commencement of the installation work relating to the international telephone exchange;

c) Completion of local exchange at Chingola, Luanshya, Choma, Mufulira, Mazabuka and Monze; and

d) Completion of installation work for Kitwe exchange and the commencement of work on Ndola and Livingstone exchanges.

(c) THIRD NATIONAL DEVELOPMENT PLAN (TNDP) 1980-1984

During the TNDP period, planned investments fell into three categories, i.e. on-going government programmes, World Bank Programmes and bilateral aid programmes. The government programmes were to be financed mainly from surpluses on the PTC current account, and the unused surpluses from the SNDP were to be used for investment into the expansion programme which had already been outlined, such as, the installation of new telephone exchanges on the Copperbelt, Southern and Eastern Provinces, the improvement of Lusaka and Copperbelt cable network, and a combined national and international telex in Lusaka.

The World Bank projects were to be implemented over a period of 5 years. These involved installation of equipment at local exchanges,expansion of cable network and subsribers equipment and a long distance network. The total World Bank assistance to these projects was estimated to be K26.6 million.

Under the Bilateral Agreement, SIDA was to provide trunk switching centres for Lusaka and Kitwe with an International switching centre in Lusaka. Under this GRZ/SIDA agreement, SIDA was to provide telecommunications equipment valued at K1.6 million. The local costs were to be funded from the corporation's own resources supplemented by the loan agreement with the Government of Zambia.

The planned total investment outlay for the telecommunications programmes/projects during the TNDP was K79.8 million of which 64.7 percent was domestic and 35.3 percent external resources. The actual investment during the TNDP period amounted to K96.7 million.

During the period 1979-1988, 67 new automatic exchanges were installed and commissioned throughout the country, thus increasing the equipped exchange capacity from 42,472 to 74,876 in 1984 and 91,124 in 1988. Practically all the districts (except three) have been provided with automatic rural telephone exchanges and have access to subscriber trunk dialling.

All the provincial centres have been provided with transit switching centres to handle the traffic from various areas interfacing district exchanges with the national network. The subscribers cable distribution network was developed in all the rural exchanges as well as in various major towns.

Between 1979 and 1987, the telephone capacity increased from 42,472 lines to 84,822 lines and working lines also increased from 30,020 to 48,492, and the number of automatic exchanges increased from 41 to 71. Another notable achievement was the commissioning of the AXE-10 International Telephone Exchange in Lusaka which marked the beginning of International Direct Dialling (IDD) in March 1985.

In addition, the IDD was introduced in Ndola and Livingstone. New rural automatic exchanges were commissioned in Namwala, Itezhi-tezhi, Siavonga, Namalundu Gorge,

Chibombo, Maamba, Chisamba, Lundazi, Choma, Chirundu and Mfuwe Airport. About 325 public call officies (PCO) were installed at strategic locations in various towns. The telex capacity increased from 1,280 lines to 2,048 lines, and the number of telex subscribers also increased from 877 to 1,479 between 1979 and 1987. Zambia has micro-wave links with most neighbouring countries except Angola and Zaire where the terminals have reached the borders.

The North-Western micro-wave link with financial assistance from NORAD, was commissioned in 1985 together with exchanges at Kasempa, Mwinilunga, Chizela and Zambezi with IDD in these areas thus, extending the capacity of these lines to 608 lines. Micro-wave links to other provinces namely Luapula, Northern, Eastern and Copperbelt were completed during the same period. This project aimed at extending telecommunications services to the rural areas in order to give impetus to social and economic development.

A 120 channel radio link between Choma and Maamba was commissioned in order to improve the service at Maamba. The link in conjunction with the automatic telephone

exchange has provided efficient and reliable telephone services to Maamba where Zambia's only coal mine is situated.

Construction of the second antenna at Mwembeshi Earth Station facing the Atlantic Ocean Satellite was completed during the period under review. This has improved direct links with the USA, Canada, South America, West African and Carribean states. Under SADCC, Zambia has been designated the satellite connectivity centre for the region.

RURAL RADIO TELEPHONE SYSTEM[3]

	Installed Capacity	Connected Suscribers	Spare Capacity
Lusaka	375	228	147
Mkushi	150	55	95
Kabwe	106	56	50
Mongu	31	6	25
Ndola	31	28	3
Total	693	373	320

Telecommunications needs for the rural areas were accomodated with the introduction of Rural Radio Telephone Systems (RRTS), which replaced party-line services in order to improve the service to the rural farming communities. The number of subscribers

connected to the multi-access Rural Radio System increased, and the utilization of the system was distributed to Lusaka, Mkushi, Kabwe, Mongu and Ndola for further redistribution to the rural communities in these areas.

(d) FORTH NATIONAL DEVELOPMENT PLAN (4th NDP) 1989-1993

During the 4th NDP, one of the main objectives is to improve the grade of service of crossbar exchange by installing additional common control equipment of 50,212 lines which would include replacement of 38,514 lines. This would bring the exchange equipped capacity to 129,638 lines at the end of the plan period.

Other objectives will include reticulation of external plant network including new radio links between Livingstone-Sesheke-Mongu and the remaining district centres; extension of Mwembeshi Earth Station for regional connectivity and International Telephone Switching Centres expansion by 500 lines, provision of multi-access radio telephone systems and extension of rural exchanges for providing services to rural community, establishment of radio monitoring stations, and introduction of mobile radio telephone system in Lusaka; expansion of training facilities, provision of staff welfare facilities and construction of staff houses.

The planned investment for programmes and projects in telecommunications during the 4th NDP is K243.9 million of which K120.54 million is in foreign currency, and K123.36 million is in local currency.

REFERENCES

1. The PANAFRICAN Telecommunications Network, ITU, January, 1987.

2. Hans Bondergaard: Work Report I, Dated 15 April, 1989.

3. Republic of Zambia, New Economic Recovery Programme, Fourth National Development Plan, 1989-1993.

Annex E

ZIMBABWE

E.1 THE COUNTRY.

Zimbabwe is a landlocked country bordering Zambia, Mozambique, Botswana and the Republic of South Africa.

The area is 390 245 km^2, and the population 8.6 mill, which gives a population density of 22/km^2, above the average for the SADCC region.

Zimbabwe became independent in 1980, after a long civil war, and a period of international boycott after the UDI in 1965.

Zimbabwe has the most developed economy among the SADCC countries, with an extensive industrial base. There are, however, great internal differences within the country.

In terms of transport and communications, Zimbabwe is dependent upon RSA and Mozambique for access to ports. Zimbabwe is therefore heavily involved in improving the functioning of the Beira corridor, to reduce its dependence on RSA.

E.2 DEVELOPMENT OF THE TELECOMMUNICATIONS SYSTEM.

The telecommunications services began in the 1890s with a single wire telegraph cable capable of sending cable messages to Europe.

By 1901 there were 269 telephone subscribers in Harare, Bulawayo, Mutare and Shurugwi.

In 1906 local telecommunications engineers made a cable linking the telegraph and telephone systems in Zimbabwe and Zambia over the Victoria Falls Bridge. Up to the implementation of the microwave link Francistown - Bulawayo - Livingstone (REG 004), the links between these two countries was an overhead wire system with a capacity of 24 channels.

In 1953 Harare, Bulawayo and Mutare were linked by a subscriber-trunk-dialling (STD) system designed and built locally.

The first microwave link was commissioned in 1969 when Harare and Bulawayo were linked by an analog system. Before this time the connection was an overhead wire system with a capacity of 24 channels. The capacity on the microwave link is now 2700 channels.

E.3 THE POST AND TELECOMMUNICATIONS CORPORATION.

E.3.1 Status and operating conditions.

Postal, telephone, telegraph, telex and radio transmission services within, to and from Zimbabwe are the responsibility of the Ministry of Information, Posts and Telecommunications. Their operations and development are delegated to the Posts and Telecommunications Corporation (PTC).

The PTC is controlled by a board, appointed by the Minister in terms of the Posts and Telecommunications Corporation Act, and is run by a Management Committee chaired by the Postmaster General.

E.3.2 Organization.

The Zimbabwe Posts and Telecommunications Corporation is a parastatal under the Ministry of Information, Post and Telecommunications.

The ministry sets the general policy guidelines for development within the sector, and supervices the activities of PTC.

PTC is in charge of the development and operation of both the postal and telecommunications services.

Under the Postmaster General, there are two Deputy Postmasters General, one for Telecommunications Development and one for Telecommunications Operations.
The country is devided into five regions, each with a regional telecommunications manager.

F.3.3 Financial conditions.

The Post an Telecommunications Corporation has traditionally experienced a sound financial situation. However, a marked detoriation has taken place and operating deficits have been incurred in recent years.

The financial detoriation resulted from a combination of factors.

Firstly, sizeable investment in long distance transmission lines, which resulted in high interest and debt payments. This investment was carried out in many instances, at the expense of needed rehabilitation and maintenance programmes.

Secondly, very low tariffs which have led, for example, to imbalance between outgoing and incoming telephone calls, and therefore negatively affecting the balance of payment position of the country.

Thirdly, PTC seems to have poor financial management which is manifested in a lack of proper procedures and financial policy formulation.

E.4 PRESENT NATIONAL NETWORK.

E.4.1 The transmission system.

The main structure of the present transmission system of Zimbabwe is shown on Fig. E.1.

The backbone of the national system is a wideband microwave link from Harare via Gweru to Bulawayo. The first part of this system was installed in 1969. The total capacity to Gweru is now 2700 analog voice channels, and the capacity from Gweru to Bulawayo is 1800 channels.

There is further an analog link with a capacity of 960 voice circuit Harare - Mutare for a future connection to Mozambique, and an link Harare - Chinhoyi - Kariba with a capacity of 1800 circuits. The latter will be extended to Siawonga and Lusaka in Zambia.

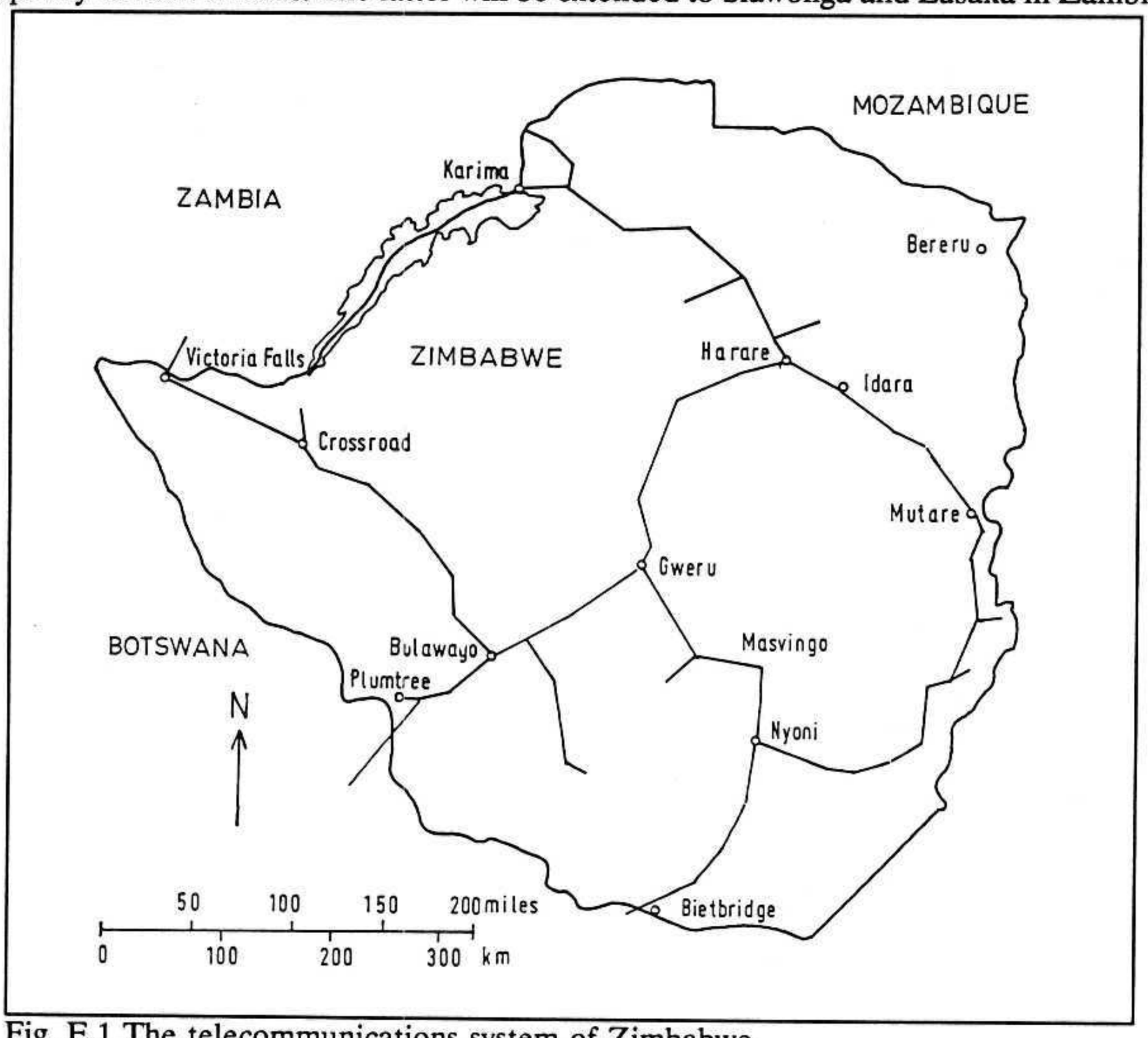

Fig. E.1 The telecommunications system of Zimbabwe.

The Harare - Gweru - Bulawayo link is connected to the 960 channel analog link Livingstone - Bulawayo - Francistown which was implemented in 1984 as REG 004 and financed by NORAD and SIDA.

Finally there is a wideband analog link from Harare via Gweru, Maswingo and Beitbridge to South Africa. The international microwave bearer has a capacity of 1800 channels.

Digital microwave links with capacity 140 Mbit/ are installed on the route Bulawayo - Gweru - Harare, and on the route Harare - Mutare.

A digital microwave link Harare - Blantyre via Tete is about to be commissioned, REG 024 delivered by NERA and financed by NORAD and SIDA. The capacity to Bereru, the last repeater station on the Zimbabwian side, is 140 Mbit/s, and the capacity to Blantyre in Malawi is 34 Mbit/s.

There is also a wideband network for TV only.

The rest of the inter-zone network is covered by 300 channel radio relay systems. There are also extensive use of low-capacity radio relay as well as single channel radio links to subscriber terminals.

Zimbabwe has also a large number of open-wire systems with capacities from 3 to 24, exceptionally up to 36, voice circuits. In Matabeleland, for example, there are 17 such systems with a total capacity of about 300 circuits.

Zimbabwe has an INTELSAT earth station at Mazove equipped with two antennas, one for communication via the Atlantic Ocean Region (AOR) satellite, and one via the Indian Ocean Region (IOR) satellite.

E.4.3 The switching system.

The international telephone exchange is of type AXE 10D located in Gweru. A second international exchange is planned to be built in Harare.

The next level is designated **zone centre,** and all zone centres are planned to be interconnected. Up to 1986 calls might have to pass via an intermediate zone centre before reaching the final zone.

Further down the hierarchi are the **group centres,** which serve as routing and charging centres.

There was a substantial increase in automatic telephone traffic from 1985/86 to 1986/87 as shown in Table E.1.[1]

Table E.1 Development of national traffic, expressed in traffic units.

	1985/86	1986/87	% increase
Total volume of telephone traffic	750 000	1 002 000	34
Local telephone traffic	179 000	264 000	47
International subscriber dial.	142 000	302 000	112
Subscriber trunk dial.	350 000	368 000	5
Operator controlled traffic	79 000	68 000	-14

E.4.3 Rural communications.

The subscriber plant in rural areas is mainly of the overhead type employing copper conductor open-wires and drop wires. A very large number of party-lines exist, both electronic and manual ones.

There are both manual and small Strowger exchanges in the rural town areas. The manual exchanges are being replaced by renovated Strowger exchanges purchased from the UK.

Rural telecommunications services are usually provided in the form of attended public call offices at a post and telegraph service. The government has introduced a scheme for establishment of rural growth centres and these will require to be provided with telephone exchanges in the future.

The government has defined a policy for telephone facilities to be provided within a radial distance of 5 km as far as posssible. In an effort to achieve this a rural radio scheme, a digital multi-access radio system with a nominal capacity of 94 subscribers operating over 15 UHF radio circuits, has been selected for a pilot project.

E.4.4 International connections.

There are two main means of communications for the international connections, via satellite and via terrestrial links.

In the terrestrial system Zimbabwe is connected to Malawi via the Bulawayo - Livingstone link, and further via Lusaka and Kanjara Hill in Zambia to Lilongwe. One supergroup is allocated for this on the Bulawayo to Livingstone link. This situation will be greatly improved with the Harare - Tete - Blantyre link (REG 024).

The links to Zambia follow the same route, and two supergroups are allocated for this.

Tanzania is reached via Zambia, terrestrial or via satellite.

To Botswana there are connections via the microwave link Bulawayo - Francistown where the Supergroups 6 to 16 are allocated for the international part from Plumtree to Tshesebe.

Mozambique is reached via satellite and via the 24 channel analogue radio link system Mutare - Chimoio. For this link funds have been secured and a 34 Mbit/s digital system is planned to be in operation by 1991.

Satellite is further ised to reach all the other countries.

The international traffic, outgoing and incoming traffic expressed in Erlangs (E), from Zimbabwe is shown in Table E.2 for the most important countries. Table E.2 also shows country of transit where applicable.

The dominating partner is South Africa, but the percentage of traffic to the other SADCC countries is increasing, as shown in Fig. E.2.

Most of the interegional traffic, to Botswana, Malawi and Zambia goes via the terrestrial microwave link REG 004 Bulawayo - Francistown and Bulawayo - Livingstone. Transit via RSA is only required for the traffic to Swaziland and Lesotho.

Direct satellite links are only available to countries served by the same AOR satellite. Spain and Portugal is served via USA. On the eastern hemisphere, wich is served by the IOR satellite, the traffic goes via UK. This applies to the countries Cyprus, Hong Kong, India, Japan, New Zealand and Yugoslavia. Plans exist for equipping the Malowe satellite earth station with a second antenna.

The traffic to Uganda goes via Zambia.

E.5. TELECOMMUNICATION DEVELOPMENT PLAN 1986 - 2002.

To achieve an orderly expansion of the national telecommunication network, and to meet the demand for services which will be generated by the expected socio-economic growth, the Government of Zimbabwe, in association with the United Nations Development Programme, formulated a project for Telecommunications Development Planning in April 1985. The ITU was designated as executive agency.

Table E.2 International traffic in Erlang.

	INTERNATIONAL TRAFFIC Fiscal year 1987/88		
	Outgoing	Incoming	Country of transit
Angola	0.00	0.05	Italy
Botswana	12.28	14.09	Dir.
Lesotho	0.14	0.51	RSA
Malawi	5.82	5.52	Dir
Mozambique	1.03	1.38	Dir
Swaziland	0.52	0.60	RSA
Tanzania	1.46	0.81	UK + Dir
Zambia	9.56	10.46	Dir
Zimbabwe	***	***	
Australia	2.94	2.92	Dir-SAT
Canada	1.80	1.57	Dir-SAT
France	1.57	1.23	Dir-SAT
Germany	3.03	2.99	Dir-SAT
Italy	1.82	1.14	Dir-SAT
Kenya	1.72	1.57	Dir-SAT
Japan	0.40	0.24	UK
RSA	123.49	72.59	Dir
UK	35.20	20.97	Dir-SAT
USA	9.70	13.25	Dir-SAT
Others	19.31	9.15	
Total	231.79	161.04	

"The objectives of these plans have been defined as follows:

- to plan for the entire telecommunication network and for its growth over the period 1986 - 2005, taking into consideration effective service penetration into rural areas of the country and close correlation and integration with national industrial and economic plans, in order to enhance rapid national progress;

- to analyze the existing situation, establish forecasts of telecommunication service demand, including domestic telephone and telex/data traffic, international telephone and telex/data traffic per destination, particular needs of special users such as civil aviation, broadcasting (sound and television) and other service agencies; facsimile services, leased services and new services resulting from technological innovations;

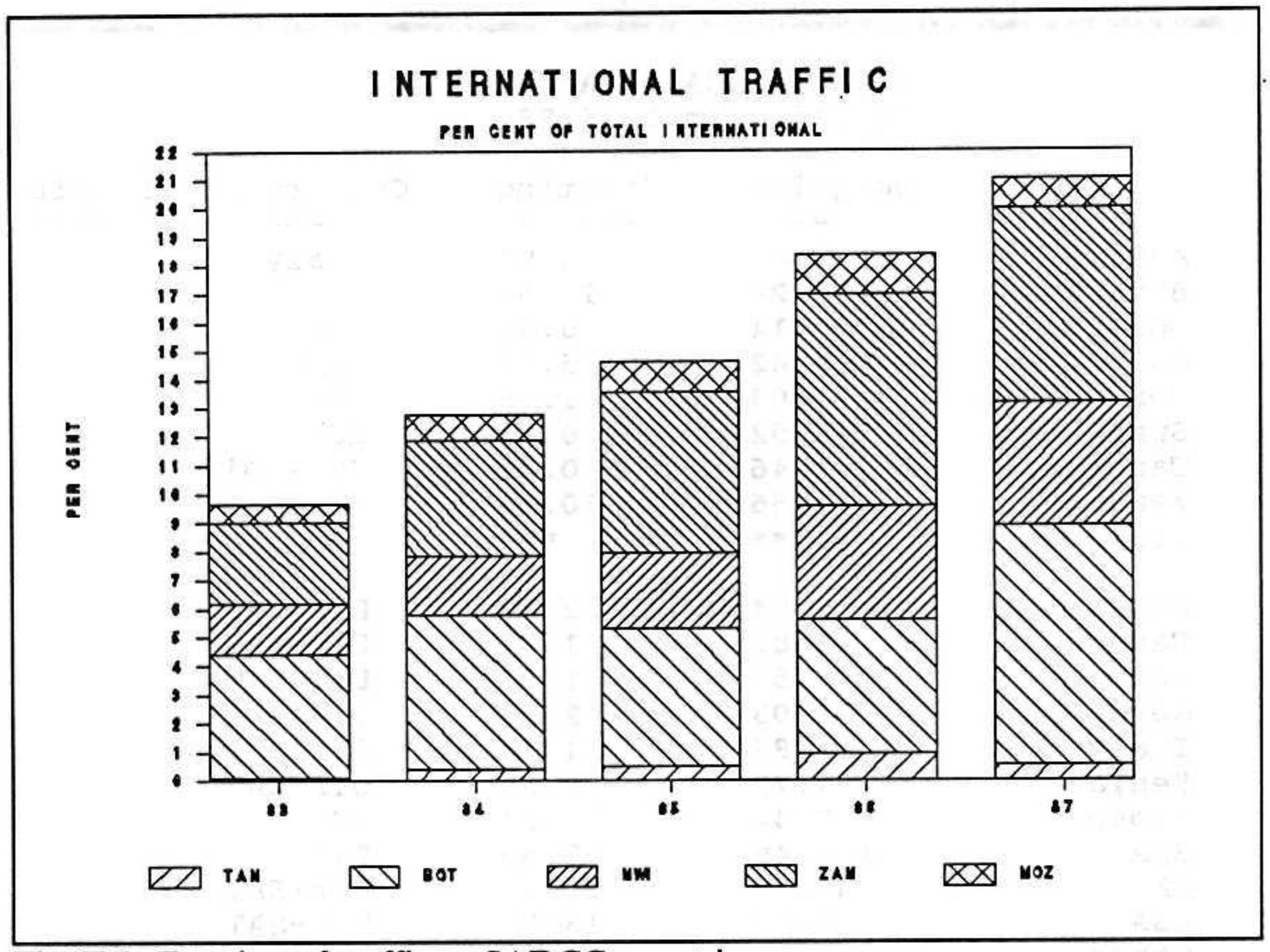

Fig. E.2 Fraction of traffic to SADCC countries.

- to provide detailed costings for the short-term investment plans over the period 1986

- 1992 and give an indication of further investment proposals up to the year 2005;

- to assess the economical viability of the proposed development projects, calculate the rate of return on the investments which can be expected under various conditions and review the existing tariff policy;

- to propose staffing levels and adjustments to the management structure, appropriate to the implementation of the recommendations made and in the light of relevant proposals of previous studies;

- to study the general existing situation regarding the quality of the telecommunication services provided by the PTC, with the view to evolving an integrated plan of action in the area of maintenance and to bring about an improvement in this field."

REFERENCES

1. Zimbabwe Post and Telecommunications Corporation Annual Report 1986/87.

Annex F.

THE NORTH-WESTERN PROVINCE OF ZAMBIA.

F.1 INTRODUCTION.

On the following pages we shall give a short description of the North-Western province as to size, population, manpower and present and potential economic opportunities.

The scope of the exercise is to show how backward this province is as a background for understanding the problems of utilizing a telecommunications system in an economically feasible way.

F.2 LOCATION, AREA AND DISTRICTS.

The province is located in the North-Western part of Zambia boardering to the west the People's Republic of Angola and to the north the Republic of Zaire.

The province covers an area of 124,800 km2, 16.7 % of Zambia.

The province is divided into the following six districts:

Solwezi
Mwinilunga
Kasempa
Chizela
Kabompo
Zambezi

Solwezi is the Provincial Capital.

F.3 NATURAL RESOURCES.

Most of the area in the NW-province is covered by forest, game management areas and National Parks. About 10 % is grassland, and it is estimated that about 10 % may be used as farm land for crop production applying shifting cultivation. Less than 1 % of the total area of the NW-province is under cultivation.

There are basically two types of soil in the province: a very sandy and acidic soil in the south-western parts and loamy sands in the eastern and northern parts.

The soils are not generally very good for crop production. There exist areas in every districts, however, with quite good soil to the effect that the province as a whole should be capable of creating a surplus production.

The climate is not a limiting factor to farming.

There are several big rivers including Zambezi, Kafue, Kabompo and Lunga. In addition, there is an extensive net of smaller rivers and streams. It is generally easy to find ground water and there is a good potential for local hydro-power stations.

F.4 POPULATION, HUMAN RESOURCES.

Total population in the province is estimated to 384,400 in the year 1988. The expected annual growth rate is 3.1 % for the period 1989-1993 compared to 3.6 % for the whole country. NW- province is still an out-migration area.

It is estimated that approximately 14.3 % of the total NW- province population are living in the six districts centres.

The average size of household is 4.4 persons.

North-Western province is very sparsely populated, the population density is 3.0 persons per km2 compared to 9.8 persons per km2 for Zambia as a whole.

The biggest town is the provincial headquarters, Solwezi, with about 22,000 people.

Table 3.5 shows urban/rural population by district and year, and Table 3.6 population density by district.

	Urban		Rural	
District	Population	% of total	Population	% of total
Solwezi	15 032	16.2	77 741	83.8
Mwinilunga	3 169	4.6	65 676	95.4
Kasempa	3 063	10.6	25 727	89.4
Chizela	577	5.2	10 525	94.8
Kabompo	5 357	13.3	34 990	86.7
Zambezi	8 166	13.4	52 645	86.6
Total	35 364	11.4	267 304	88.3

Table F.1. Urban/rural population by district, North-Western province, 1980.

North Western province is less urbanized than other provinces in Zambia.
Most of the people are living in small settlement clusters along the roads and rivers.
The total manpower of the NW-province is estimated to be about 183,000 in 1988. Most

of this workforce is engaged in subsistence agriculture in addition to some cash earning like cash crop farming, fishing, hunting, crafts production, petty trading, beer brewing, honey and beeswax production etc.

District	Acreage (sq.km)	Density
Solwezi	29 690	4.0
Mwinilunga	20 920	3.8
Kasempa	21 100	1.6
Chizela	20 500	0.6
Kabompo	14 530	3.1
Zambezi	19 070	3.2
Tot. NW-Province	125 800	2.8
Tot. Zambia	752.660	8.9

Table. F.2. Population density by district, North-Western Province, 1985.

Approximately 10,000 people are under regular employment, most of them - 90 % - with government and parastatal institutions.

In the last few years employment opportunities have nearly stagnated, at the same time more than 8000 school leavers look each year for jobs.

F.5 THE ECONOMIC SITUATION IN THE NORTH-WESTERN PROVINCE.

F.5.1 General.

The economic situation in the North-Western province is hampered by the problematic situation in the country as a whole to the effect that funds for capital projects have been reduced over the past years. In addition, funds for recurrent expenditure have not been sufficient to run the established services effectively. Supply shortages are also a serious problem.

F.5.2 Agriculture.

The agricultural sector in NW-province is predominantly characterised by subsistence agriculture of casava and sorghum based on shifting cultivation using the hoe-technology. In the last years emphasise has been put on small scale farming by the introduction of the "Lime Credit Scheme" through The Integrated Rural Development Programme. This programme has been quite successful showing that a lot of peasants farmers are capable and willing to produce more surplus if they get access to reliable and improved services.

There has been a rather fast spread of the utilization of work-oxen, a major factor contributing to the increase in crop production.

NW-province is not yet self-sufficient in the supply of staple food. The main reason for this is the fact that the consumption pattern of the urban population (maize, bread from wheat) does not correspond with the consumption and production pattern of the rural population.

The structure of agricultural production has changed in recent years. In the 60's and 70's, some few farmers using tractors were responsible for a big part of cash crop production. Now small scale farmers using hoe and work oxens is the dynamic element in agricultural development.

Reliable and sufficient transport is a big problem, and the rural areas lack easy access to telecommunications.

The development in marketable surplus in the North- Western province for maize is shown in Fig F.1, and the growth has been sustantial.

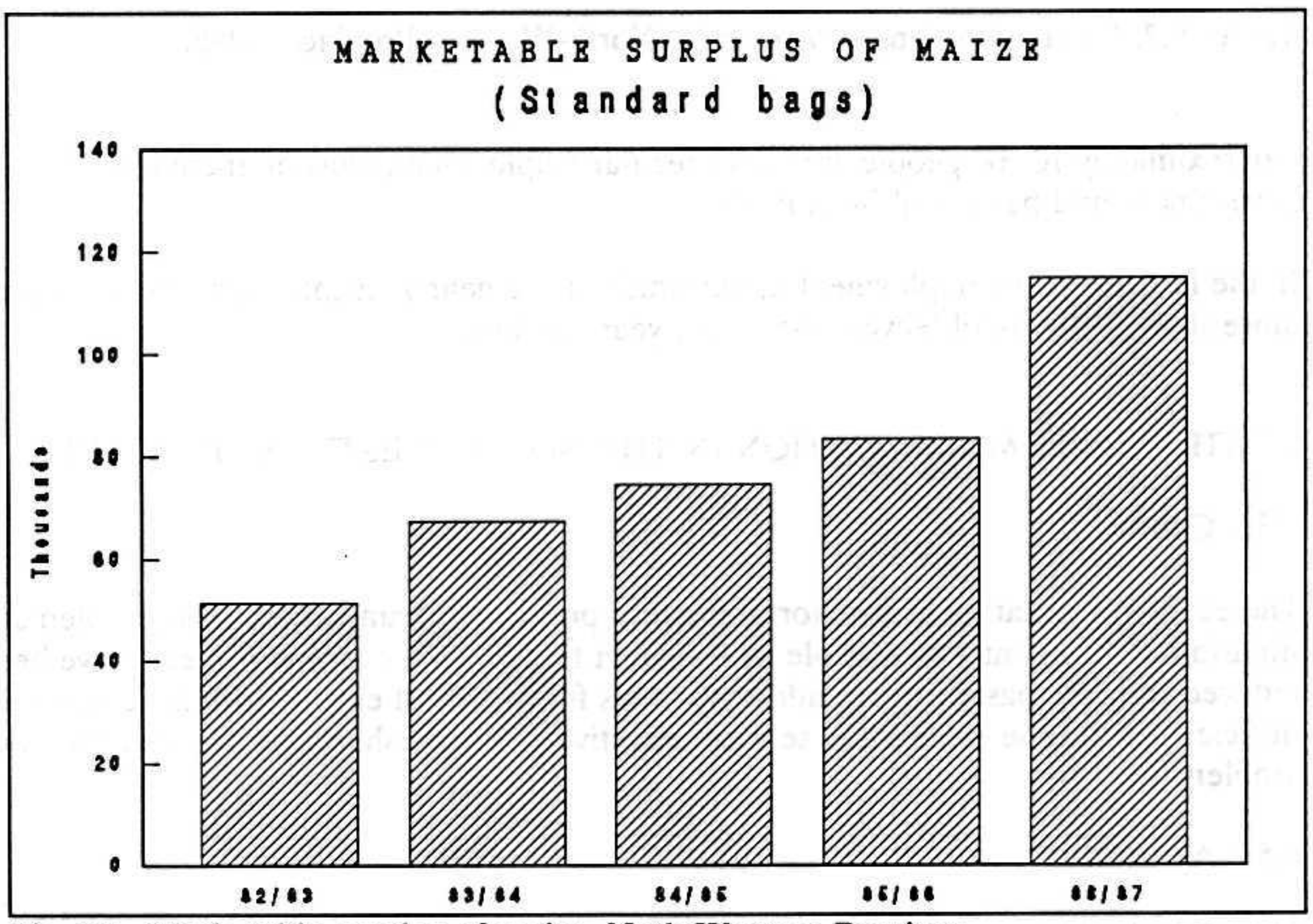

Fig. F.1. Marketable surplus of maize, Noth-Western Province.

F.5.3 Cattle.

Cattle - kept in the traditional way - play a major role in Zambezi District and in Mwinilunga. There are a few commercial farmers and a State Ranch. However, beef and milk production are far from satisfying local demand.

F.5.4 Fishing.

The NW-province is not regarded as an important area for fishing. Fishing plays a major role in the local economy only on the Westbank of the Zambezi river. There has been little progress in the production volume from lake and river fishing. Efforts have been done to promote fish farming in some protein deficit areas like Solwezi, Mwinilunga and Kasempa. Mulungushi Investments has started a large-scale fish farm near Solwezi.

F.5.5 Forestry.

The huge forest resources in the province are highly under-utilized. A few commercial enterprises from outside exploit some timber resources without bringing much benefits to the local economy.

There is some production of exotic timber species from state forest plantations, but the production is declining and cannot even satisfy the local demand for poles and construction timber.

F.5.6 Honey and beeswax.

The province has got a large potential for this kind of production. A Provincial Beekeeping Programme aims at extending the activities to different districts.
There is a honey factory in Kabompo which is not yet fully utilized.

Table F.3 shows the development in honey and beeswax production. There has been a substantial increase in these kinds of production from 1984 to 1986, and the province has still an unutilized potential.

	Year		
	1984	1985	1986
Honey	34 325	68 276	134 169
Beeswax	4 696	5 704	16 285

Table F.3. Development of production of honey and beeswax in NW-province.

F.5.7 Manufacturing industries.

Production in manufacturing industries is insignificant. There is a grinding mill in Solwezi, INDECO, and one in Kabompo, and some few very small grinding mills. In addition there is a pineapple cannery in Mwinilunga, a honey factory in Kabompo, a state saw mill and four bakeries.

The capacity of the industries is in many cases very much underutilized, due to insufficient supply of raw materials, problems with fuel and spareparts and lack of proper planning and management.

There is a newly built rice mill in Solwezi.

Finally there are some small village industries like carpentry, blacksmithing and some rural crafts.

A wide range of industrial products which could have been produced locally using local raw materials and manpower is being bought from outside. In many cases these products are in short supply.

F.5.8 Mines.

There are two mines at Kansanshi and Kalengwa which are both closed for economic reasons.

F.5.9 The construction sector.

There are some few medium-size/small building contractors mainly relying on government contracts. However, their capacity is not sufficient to satisfy the demand. Thus a substantial part of construction work has been given to contractors from the Copperbelt.

F.5.10 Tourism.

The NW-province has got two National Parks, the northern part of Kafue and Lunga West. However, there is hardly any tourism at all in these areas. They are remote and the transport situation is difficult. The potential is probably for small-scale tourism.

F.5.11 Trade and services.

The supply of several basic commodities like mealie, meal, sugar, cooking oil, paraffin, soap, washing powder etc. is very poor in the countryside and even in the district capitals. Essential services like banking facilities, fuel stations and the like are not available in the districts.

This situation is very difficult taking into account that the distance from Solwezi to the nearest district centre is nearly 200 kilometres and to the furthest 400 kilometres.

Annex G.

TELECOMMUNICATION SYSTEMS

G.1. THE TELEPHONE SYSTEM.

G.1.1 System Structure.

The general structure of a communication system for telephony is shown i Fig.B.1.

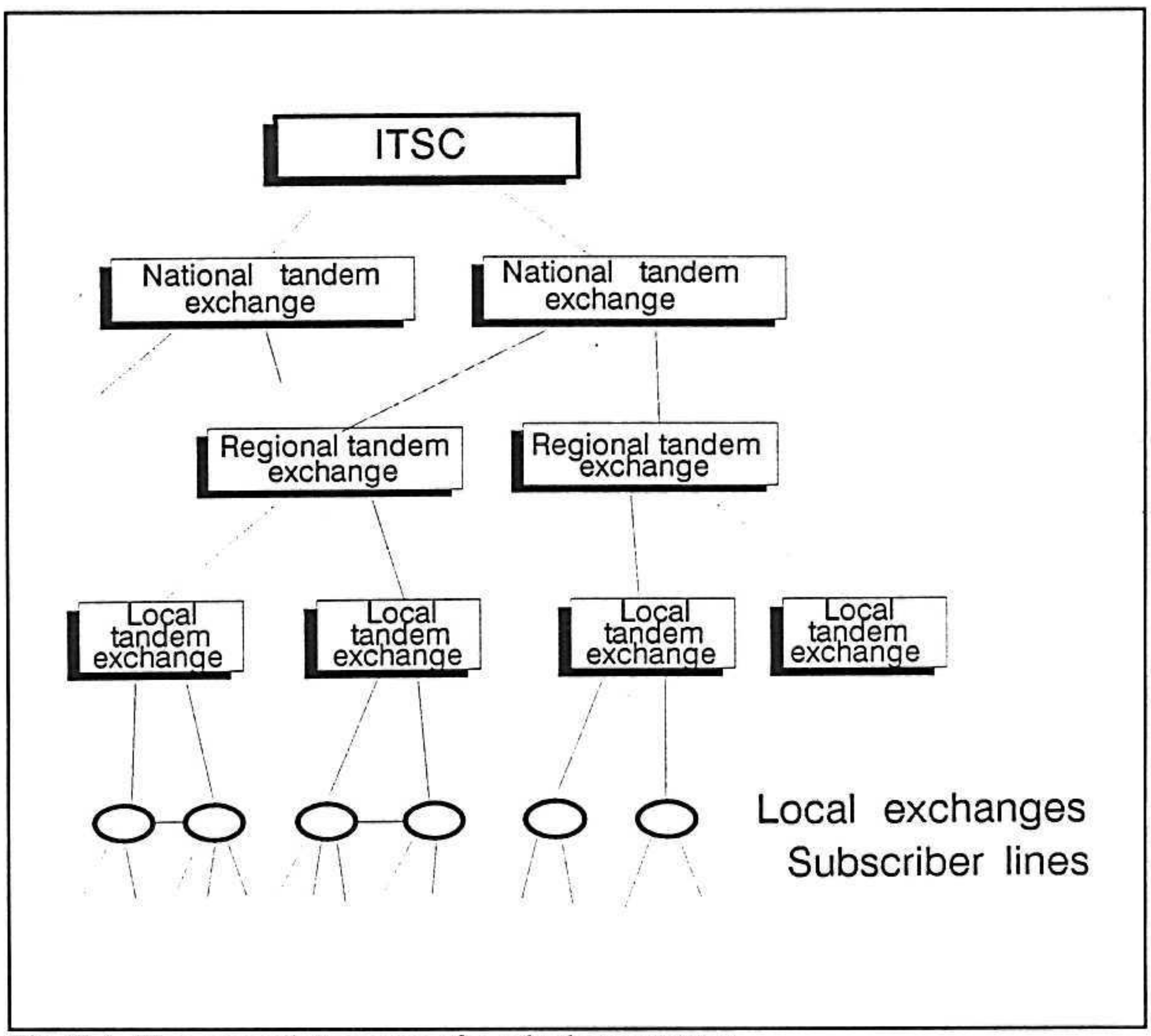

Fig. G.1. The general structure of a telephone system.

The subscribers are connected to the local exchanges. These exchanges are connected via a system of tandem exchanges or switches of different types, (local tandem exchange, regional tandem exchanges, national tandem exchanges), to a network.

The subscribers are connected to the **local exchange** via a direct exchange line (DEL), or via a party line. The exchanges are interlinked with multi-channel links called **trunks**, via a system of **trunk exchanges**, also referred to as **tandem exchanges** or **trunk switching centres.**

A telecommunication system must therefore perform the following two main functions:

- select a path between the subscribers through the system of exchanges, setup and monitor the calls, (switching), and

- provide the necessary channels between the different exchanges or nodes of the system (transmission).

G.1.2 **Switching.**

The function of establishing connections between arbitrary subscribers in a communications network is performed by the switching system. The nodes of the network are formed by exchanges of different level, usually organized in a hierarchical structure as shown on Fig.B.1. The system structures will differ from country to country.

Important elements of a switching system are

- the numbering plan which organizes the subscribers of a network in a systematical manner relative to their geographical location and the structure of the network.

- the signalling system, which transfers all information related to subscriber identity and location, which is required by the switching function, and which is used to establish, monitor and disconnect calls.

The local exchange can establish calls between subscribers belonging to the same exchange. Calls between subscribers belonging to different lokal exchanges will in general be established via the trunk exchanges or the tanden exchanges which have higher position in the switching hierarchi as shown on Fig. G.1.

G.1.3 Transmission.

The basic voice channel has a bandwidth from 300 to 3400 Hz, and this is the building block of the traditional telephone system. There are standardized requirements on signal-to-noise ratios, depending on how the channel is used in the over all transmission plan. A channel that will form a part of a trunk circuit must in general have a higher quality, expressed in terms of channel noise, than a channel that is terminated directly at a user.

Each subscriber must have a dedicated line to the local exchange, or be connected via a party line.

The connections between the trunk exchanges will usually have the capacity of several basic channels which are combined, **multiplexed**, to a single high capacity composite signal. There are standardized parameters for multiplexing of the voice channels, and it is therefore possible to interconnect transmission systems of different type, provided that the capacity is the same.

The choice of transmission medium between the nodes (exchanges) of a communications system does in principle not affect the quality and characteristics of a system as seen from a user. It will be based on economical and technical considerations.

Different transmission systems will be described in Section G.4. Cables are efficient in densely populated areas because of their high capacity and ease of adding and subtracting circuits from the combined signal. Radio systems of different type are more suitable for long distance communication, and to cover wide areas.

G.2. OTHER FIXED TELECOMMUNICATIONS SERVICES.

G.2.1 Telex.

In addition to telephony there is only one other globally established telecommunications service, an that is telex. This is defined as a two-way teleprinter service with given technical characteristics.

The transmission speed of a teleprinter is usually expressed i Baud. The telex system is based on 50 Baud speed, which corresponds to a maximum of 11 characters per second.

The telex network is organized in a system similar to that of the telephone network.

It is important to note that telex is method of communication that is very efficient with respect to requirements for transmission capacity. In analog systems a voice channel can be divided into several telex channels, typically 12 to 48. In the future

digital systems the number of telex channels per voice channel is even higher, typically 1000.

A telex system will use voice channels for transmission. One or two telex channels can be added to a voice channel without perceivable degradation of speech quality. For toll circuits between telex exchanges several telex channels can be established via a single dedicated voice channel, as explained above. The telex network requires seperate exchanges.
The disadvantage of telex is that it only conveys written messages, which in many occations will represent operational disadvantages.

G.2.2 Telefax.

Telefax can be regarded as remote copying of written documents, and this method of communication has recently increased enormously.

In the telefax terminal, the pages are scanned, line by line, and the ligt-dark pattern along a line is converted to signals suitable for transmission over telephone channels.Transmission of an A4 page takes typically 20 seconds.

Telefax uses standard voice channels for transmission of the information and does not require a seperate communication system. It can therefore be introduced as an additional service using the already established telephone network and thus make use of investments already made for other purposes.

On the other hand, it requires a high channel capacity compared to the telex channel.

G.2.3 Data communication.

The telephone channels can also be used as carriers of data. The data signals are then converted into electrical waveforms suited for transmission over standard voice channels.

The data rate depends on the quality of the voice channel and to some extend on the complexity of the modem. Typical values for a dialled voice channel are in the range 1200 to 4800 bit/s, or 9600 bit/s with more complex equipment.

G.2.4 Radio broadcasting.

The telecommunication network will also be used to distribute sound programs to geographically distributed radio broadcasting stations. To obtain the necessary sound quality, and to transmit the necessary additional control and monitoring signals, a number of voice channels is required for one program channel, typically six to twelve.

G.2.5 Television broadcasting.

A television program requires a bandwith which is much higher than that of the telephone channel. It is in the range 3 MHz to 10 MHz depending on the system. In the standardized multiplexing hierarchi the lowest number of voice channel that can be replaced by a TV signal is 960, and this is therefore an attractive minimum capacity for the transmission systems.

G.3 MOBILE SERVICES.

B.3.1 Terrestrial mobile services.

One of the most expanding field of communication in the industrialized countries is mobile communications. The main purpose of this service is to extend the normal service like voice and data communication to itinerant users.

The basis for this expansion is technology development. A terrestrial mobile system that shall cover a large area must be **cellular**. This means that a subscriber is automaticaly handed over from one cell to another during conversation without any interruption of the conversation.

This requires very complicated call handling both at the fixed base stations and at the mobile terminal, and this could not be implemented without extensive use of modern micro electronics.

Up to now the mobile systems have only covered small ares in densely populated areas, with very limited capacity, expensive equipment, and a complete lack of standardization among different countries. The highly successful Nordic system, the NMT, is here an exception.

A new standard for all European countries has now been reached, the GSM system, and this will give another boost to the development and deployment of such systems. As the production volumes of mobile and fixed stations increase, systems of this type will become very interesting to developing countries as an immediate help in areas with very little communication infrastructure.

G.3.2 Satellite mobile systems.

A system for communications via satellite for maritime mobile users is being operated by the international organization INMARSAT, which is jointly owned by about 50 countries.

Satellites have the advantage of covering a large geographical area. One satellite can cover about 40% of the earth's surface.The INMARSAT system could therefore be of importance for special applications in developing countries.

The INMARSAT system has at the moment about 7000 users equipped with Standard A terminals for voice. The majority of the users are shipborne, but a considerable number of Standard A stations are also being usen on land where the communication cannot be provided by traditional means.

INMARSAT is also developing a new type, Standard C, for two-way data communications (messages). This is terminal compact and portable, it can be fitted on any vehicle, and is expected to find wide application for land mobile use in the rural areas.

G.4 COMMUNICATIONS TECHNOLOGY.

G.4.1 **Background.**

This chapter will give a brief survey of some of the technological elements that could be referred to in connection with a broad evaluation of communication systems in developing countries.

G.4.2 **Analog contra digital systems.**

Up to recently voice signals were transmitted in analog form, i.e. that the sound pressure waweforms were represented by electrical waveforms of the same shape. The electrical waveforms were therefore determined by the type of signal to be transmitted. A channel for voice transmission must therefore be constructed to fit the statistical properties of speech signals. TV signals are entirely different from voice signals and require channels that are different.

This lead to separate communications systems for different telecommunications services. There was one network for telephony network, one network for high quality sound transmission, one for data, and one system for transmission of live pictures, etc. The different systems could to some extent make use of the same technical facilities and installations, operation of separate nets was not efficient.

A consequence of the information theory, which only dates back to the year 1949, was that the information contents of all types of signals could be expressed quantitatively as a number of binary digits or bits.

This, together with technology developement which made processing of data faster, cheaper and more reliable, lead to a development of systems where signals of different type and

origin are converted to the same form, a stream of binary digits. These could then be transmitted via a common network.

It was early decided to standardize the transmission of speech signals at 64 000 bit/s, the standard Pulse Code Modulation (PCM) format.

High quality sound broadcasting signals need a higher data rate, typically 384 000 bit/s, and high quality TV-signals require 100 to 200 000 000 bit/s, or 100 to 200 Mbit/s. On the other hand, teleprinter signals can be transmitted at 50 Bit/s.

A digital channel can be used for any composition of digital signals, provided that the total data rate is within the capacity of the channel. A 64 000 bit/s voice channel can be divided to give more than 1000 teleprinter channels.

At the same time it takes the equivalent capacity of more than 1000 speech channels to transmit one high quality TV signal.

The conversion of all types of signals into the same format, a data stream, leads to the possibilty of establishing a single communication system for all types of services. This is what is now being pursued in the industralized countries. The Integrated Services Digital Network (ISDN) is being developed and tested, and the first parts of this system are in the process of being implemented.

The ISDN is based on standard interface between users and the network. The lowest capacity is the (2 B + D) access, which gives

$$2x64\ 000 + 16\ 000 = 144\ 000 \text{ bit/s}$$

to each subscriber.

The reasons for going to digital communications systems are basically cost savings, but digital systems are also more suitable for obtaining better and more uniform transmission quality. It is also possible to incorporate additional services.

G.4.3 Conversion from analog to digital systems.

Up to about 20 years ago the communication systems were analog, although there could be some digital components for special purposes. Now the process of changing from analog to digital systems is under way, and this process must be an evolutionary one to ensure proper operation during the transfer period. It will last well beyond the year 2000.

The signal formats of analog and digital signals are entirely different, and a mixed system must therefore have repeated analog/digital and digital/analog converters.

The telecommunications administrations have developed their strategies for this conversion process, but the implementation requires a full control over the selection of type and the time of installation of the equipment.

Elements of such a strategy could be to:

- coordinate replacement of digital exchanges in order to obtain areas whish are all digital, "digital islands", and then gradually expand these areas.
- use digital transmission systems between digital exchanges.
- install digital transmission systems for any capacity increase of the transmission system.

G.4.4 Suscriber lines.

Subscribers are connected to the local exchange by overhead wires, or, to an increasing degree, by cable. The cable for a subscriber connection is usually a pair of twisted copper wires with a diameter in the range 0.4 to 0.8 mm. Such cables could also be used for ISDN subscriber lines at 144 kbit/s if the distance to the exchange is in the range up to a few kilometres.

Overhead lines or twisted copper wires can in principle be used for more than one telephone channel, but where such requirements exist there are usually other, more efficient solutions.

G.4.5 Coaxial cables

A coaxial cable consists of an inner conductor and an outer tube. These form a closed environment which can be used to transmit a large number of voice channels, up to typically 10800 per tube. Such coaxial cables require amplifiers at intervals in the range kilometres, depending on the type of cable and the number of telephone circuits. The power required to operate the amplifiers can be supplied via the cable itself.

G.4.6 Optical fibre cables.

A relatively novel type of cable, based on the transmission of light through optical fibres, is now gaining an ever increasing market, in particular on trunks with heavy traffic, i.e. on routes with a large number of channels.

The capacity for each fibre is in the region of several thousands of voice channels, depending on the distance between repeater stations. Fibres with lower and lower

losses are being developed and these permit increased distance between the repeater amplifiers.

G.4.7 Microwave radio relay systems.

Radio communication is an economically attractive method for many applications, in particular for communication over long distances and to cover large areas.

Microwaves, i.e. radiowaves with frequencies at 1 GHz (1000 MHz) or above, corresponding to a wavelength of 3 cm or less, can only be transmitted at line of sight.

It is therefore possible to establish a chain of repeater stations on mountain tops within line of sight (LOS) of each others, as shown on Fig G.2.

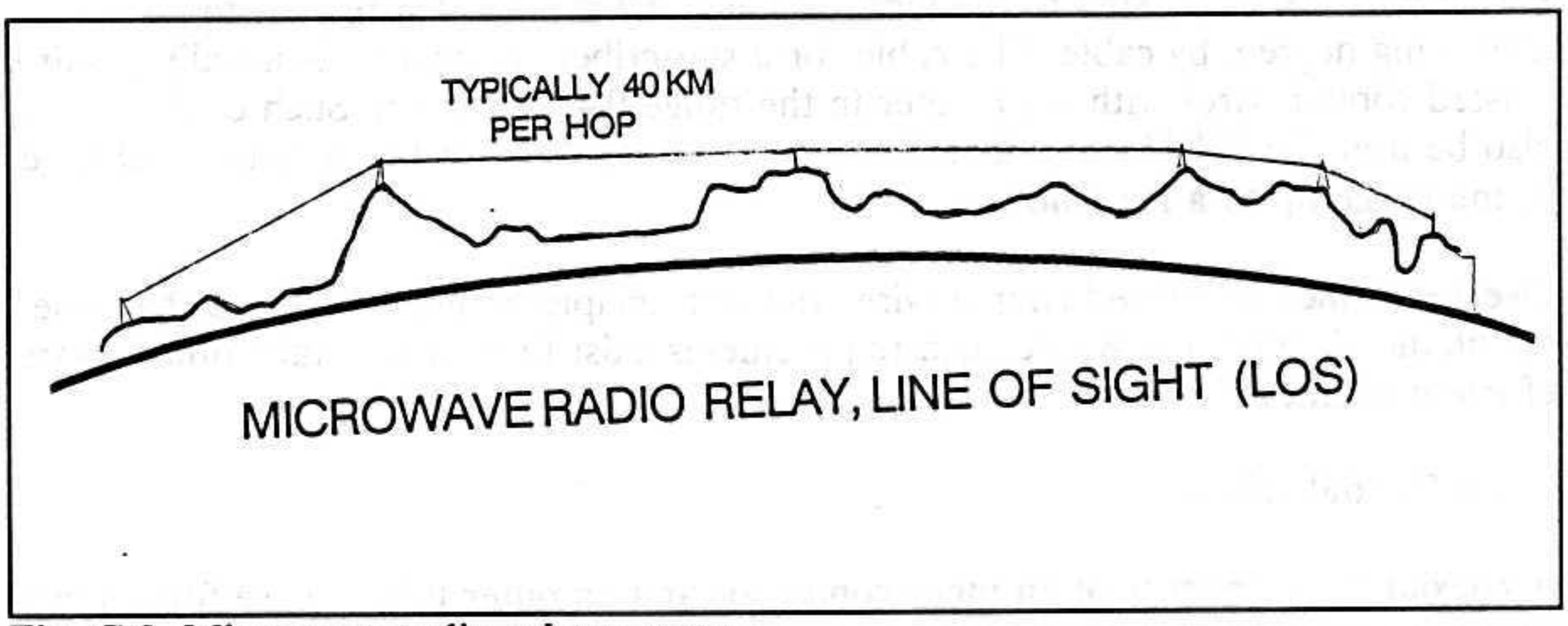

Fig. G.2. Microwave radio relay system.

Typical separation between repeaters is 40 to 50 km, but this is very much depending upon the topological and climatical conditions. Radio wavews at these high frequencies are susceptible to attenuation and dispersion (scattering) during heavy rain. In regions with high temperature, and with abnormal temperature variation with the altitude, radio relay systems are also vulnerable to excessive attenuation.

The capacity of a microwave LOS is typically in the region 300 to 1800 voice channels with analog modulation. A system with capacity 960 channels can also be used for a TV-channel, and this is therefore usually the minimum capacity chosen wherever possible.

A relay station requires continous power supply, connections to the public power system, solar or wind generators combined with batteries or continously running diesel-generators. Construction of elctronics with lower power consumption, together with technology advancement in the field of solar power generation, makes it more and more feasible to use renewable energy sources, sun and wind.

Multichannel signals are standardised in order to allow direct interconnectin between cable and microwave systems.

G.4.8 Tropospheric scatter (troposcatter) systems.

Tropospheric scatter propagation can be used to establish links over distances of several hundreds of kilometresbeyond the optical horizon. Radio waves are scattered in the troposphere about 10 to 15 km above the ground as shown in Fig.G.3 by mechanisms not yet fully understood.

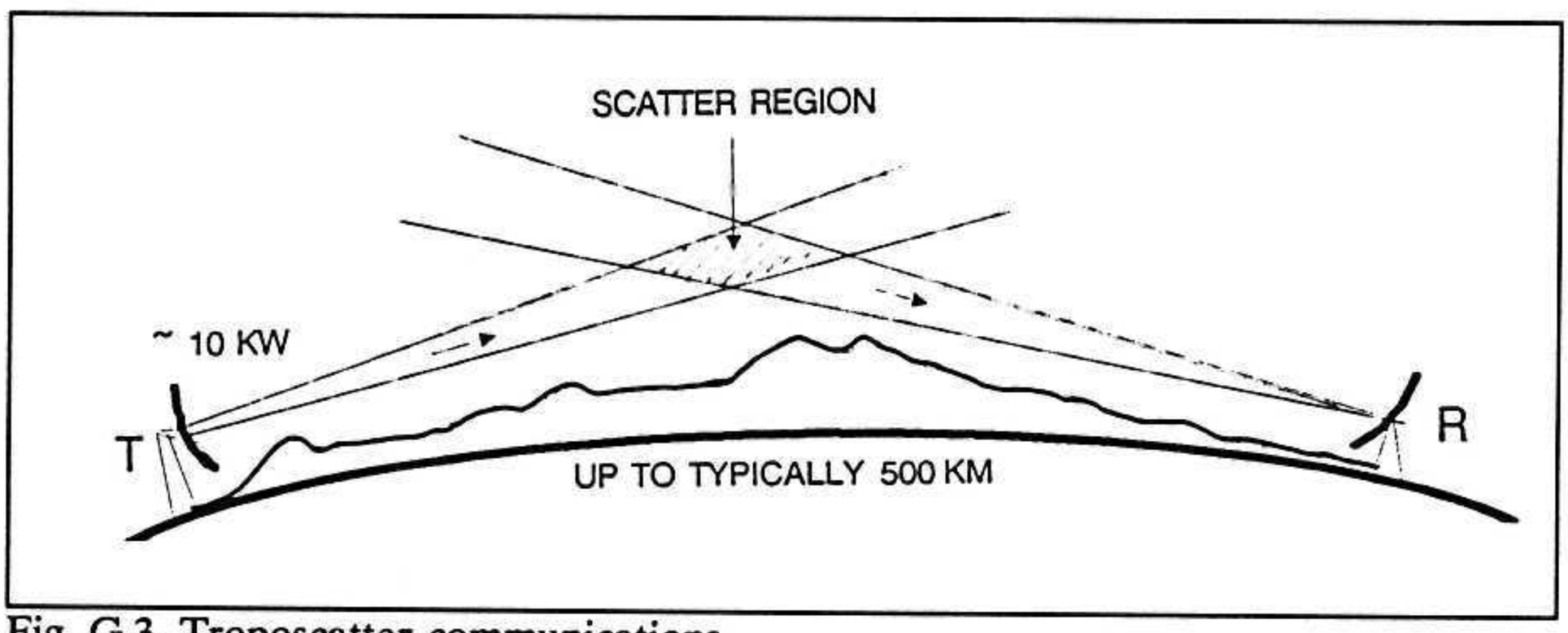

Fig. G.3. Troposcatter communications.

The transmit and receive stations must be quuipped with very large antennas generating narrow beams directed towards a common volume in the trposphere, where the scattering takes place.

Only a very small fraction reaches the receiving antenna, and high transmit powers are therefore needed, tens of kilowatts.

The capacity of a troposcatter system is limited, typically 60 to 90 voice channels, and they are not suitable for digital communication. Also, transmission of large amounts of radio frequency signals at low elevation angles "polutes" large areas.

G.4.9 Communication satellites.

Satellites are basically microwave LOS connections using a repeater placed on a satellite platform in the geostationary orbit, 36 000 km over the surface of the earth at equator. The cost of a satellite connection is nearly independant on the distance, and satellites are therefore most attractive for long distance, including intercontinental, communication.

Advancements in satellite technology, with increased satellite power and more directive antennas, allow smaller and less expensive ground stations to be used. Satellite systems are flexible and easy to implement. This is particularly useful to cover a large area with communication links.

Annex H.

NORWEGIAN ASSISTANCE TO THE TELECOMMUNICATIONS SECTOR.

The total Norwegian assistance to telecommunications projects that the Team has been able to identify is about 811 mill. NOK. In addition to this comes about 114mill. NOK of Swedish assistance to some of the same projects, which has also been administered by MDC. This does not include minor expenditure on consultancies, studies etc. related to the projects funded from MDC's global grant for consultancies.

Norwegian assistance to telecommunications development in developing countries have consisted of four main components:

1) Radio link projects in the SADCC region, as part of the expansion of the international PANAFTEL network, and related technical assistance to national telecommunication administrations in SADCC countries. The projects have been supported from the regional SADCC grant, and the total support to date amount to about 252 mill. NOK. In addition MDC has also been responsible for the administration of Swedish support to some of the same project, amounting to about 114 mill. NOK. These projects are delt with more in detail in section 6.4. The projects have been based on equipment supplied by EB Nera, and the projects implemented by EB Nera as turn-key projects.

These projects are:

REG 004: Radio link Botswana-Zimbabwe-Zambia, Original agreement 1982 Main line completed, additional spur link under construction. Norwegian support ca 65 mill. NOK, Swedish support 44 mill. NOK.

REG 008: HF radio connection Mozambique-Malawi-Zimbabwe Agreement 1983. Project completed and in operation. The equipment was delivered and installed by Dansk radio. Norwegian support 5 mill. NOK.

REG 009: Radio link Malawi-Tanzania Agreement 1985, construction completed. Norwegian support about 43 mill. NOK, Swedish support 30 mill. NOK. Maintenance assistance provided for 2 years by the project ended in April 1989.

REG 020: Radio link North-West province, Zambia (originally ZAM 018). Original agreement 1982. Construction work completed. Additional agreement on technical assistance, which was provided by Intech A.S. Norwegian support 78 mill. NOK.

REG 024: Radio link Zimbabwe-Mozambique-Malawi. Under implementation. Norwegian assistance 55 mill. NOK, Swedish support 40 mill. NOK.

REG 043: Technical assistance, Zimbabwe Under implementation. Norwegian support to date 3 mill. NOK (total grant 5 mill. NOK).

Related to this, Norway has also given general support to SADCC's transport secretariat in Maputo, SATCC. SATCC is responsible for the telecommunication projects from SADCC's end, but the support is not specifically for telecommunications.

The relevant projects are:

REG 003: Technical support to the establishment of the Transport Commission under SADCC (SATCC). The Norwegian funding is channeled through SIDA.

REG 028: Consultance fund, SATCC.

Norway has also funded studies on regional telecommunications projects that have not (yet) been funded, including REG 300 (Maritime telecommunications) and REG 041 (Blantyre-Mzuzu, Malawi).

Radio link equipment has also been supplied to Pakistan as commodity assistance (55 mill. NOK).

2) Supply of telephone exchanges to rural areas in Zambia and India, funded from the bilateral country programme, as commodity assistance or bilateral project aid. The exchanges have been supplied by STK, who was also responsible for the installation work. Civil works was the responsibility of the PTC. Total allocations amount to about 113 mill. NOK.

The projects are:

IND 030: Rural telecommunications Norwegian grant 83 mill. NOK.

ZAM 100: Commodity assistance: Delivery and installation of telephone exchanges to rural areas. Agreement 1983, last exchange installed ultimo 1988. Norwegian expenditure 30 mill. NOK.

3) Grants to closed telecommunications networks, for the railway in Bangladesh, and for electricity supply in Zambia and Pakistan.

Since a discussion of the wider impacts of these projects can only be undertaken within the context of the relevant "user sector", no attempt will be made to undertake an evaluation of this assistance here. From the recipients' side, these projects are not the responsibility of the national telecommunications administrations, but the railway and electricity administrations. Though they are from a technical point of view telecommunications projects, sectorially they belong to the respective user sectors. The total support amount to about 303 mill. NOK, of which less than 10 mill. to Africa.

The projects are:

BGD 024: Railway communication, Bangladesh. Agreement 1985, under implementation. Norwegian grant 150 mill. NOK.

+40

REG 054: Power communication, Zambia, Agreement 1987. Norwegian assistance 8 mill. NOK.

PAK 100: Commodity assistance to power communication in Pakistan. Norwegian assistance 145 mill. NOK.

4) Commercial assistance to support the delivery of Norwegian equipment to developing countries ("mixed credits"). The grant element in these projects are minimum 25%. This includes support to radio link projects in Botswana and China, an earth satellite station in China, and power communication in China and Malaysia. The Norwegian firm involved in all these projects has been EB. Apart from the recently approved project in Botswana, the support has been to Asian countries, mainly China. This is partly because credit garantees are needed, and this precondition is difficult to satisfy for the SADCC countries. Telecommunication has been the largest individual sector for this type of support. The total support amount to about 88 mill. NOK.

The projects are:

Earth satellite station, China: 15.6 mill. NOK in 1988

Radio link project, China: 8.6 mill. NOK in 1988

Radio link project, Botswana: 43 mill. NOK

Power communication, China: 14.1 mill. NOK in 1987-88

Power communication, Malaysis: 7.1 mill. NOK in 1987

A number of new projects are being considered, including support to China, Pakistan, Indonesia and Malawi.

Since MDC's capacity in this field is limited (one fulltime position), and agreement with the Norwegian telecommunications administration about technical advice has been established (GLO 398). The annual expenditure is about 0.7 mill. NOK.

Several types of development assistance, bilateral project aid (IND 030), bilateral commodity assistance (ZAM 100, PAK 100), regional SADCC grant (all REG projects) and commercial assistance (Botswana, China, Malaysia) have been used to support telecommunications development.

The aid channels differ in terms of procedures and criteria, and different parts of MDC's organization are involved. There does not seem to have been any attempt to consider the assistance as a totality, and use the different aid channels in a complementary way. The Energy and Telecommunication Division seems to a variable degree to have been involved as advisors to other divisions/departments in telecommunication projects. This lack of coordination is perhaps unavoidable in a situation where there is no overall strategy behind the assistance to the sector.

LIST OF ABBREVIATIONS

ADB	African Development Bank
AOR	The Atlantic Ocean Region
BTC	Botswana Telecommunications Corporation
DEL	Direct exchange line
E	Erlang
Erlang	a unit for traffic, the average number of concurrent calls
GDP	gross domestic product
HF	High frequency, the frequency band 3 to 30 MHz
IDD	international direct dialling
INTELSAT	International Telecommunications Satellite Organization
IOR	The Indian Ocean Region
ITSC	International telephone switching centre
ITU	The International Telecommunications Union
MCR	Metaconta Rural Exchange
MHz	million cycles per second
PANAFTEL	The Pan African Telecommunications Network
PCO	public call office
RRTS	rural radio telephone system
RSA	The Republic of South Africa
PTC	The Posts and Telecommunications of Zaire, The Posts and Telecommunications of Zambia and The Posts and Telecommunications of Zimbabwe
RTS	radio telephone system
SADCC	The Southern African Development Co-ordination Conference
SATCC	The Southern African Transport and Communications Commission
SIDA	Swedish foreign aid
STD	subscriber trunk dialling
TDM	Telecomunicacoes de Mocambique
UDI	the unilateral declaration of independence
UHF	Ultra high frequency, the frequency band 300 to 3000 MHz.
VHF	Very high frequency, the frequency band 30 to 300 MHz

GCS A/S, Oslo