STUDY ON TELECOMMUNICATIONS NETWORK DEVELOPMENT IN THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

SUMMARY

CHAPTER 1 INTRODUCTION

1.1 Background

In Ethiopia, with a population of 65 million and a land of approximately 1,100 square kilometers, switching capacity has reached to 511,000 lines with only 291,000 subscribers, mostly of major cities (as of July 2001).

New services such as mobile telephony, the Internet, and data transmission services, have been introduced, but the telecommunications penetration is still low at a rate of less than 0.5% and even lower than 0.07% in rural areas. The distribution of existing telecommunications systems is uneven throughout the country, with 60% of automatic switching capacity concentrated in the Capital and its suburban sphere and deformed network distribution accompanies the low penetration rate.

The Government of Ethiopia, in its first 5-Year National Economic Development plan of 1995, placed the importance on the development in the telecommunications. ETC, in its Seventh 5-Year Program, planned to improve the penetration rate to 1.28% by 2002 with aids from AfDB and EIB, in addition to its own capital.

Despite the effort by ETC with its Eighth 5-Year Program in accordance with the 2nd National Economic Development Plan, there are many waiting applicants and undeveloped rural areas.

Under these circumstances in 2000, the Government of Ethiopia has requested technical assistance to the Government of Japan, who has dispatched a JICA Study Team.

1.2 Objectives and Scope of Study

(1) Objectives

- To formulate a Master Plan for telecommunicatons development in Ethiopia upto year 2020
- To conduct a feaseibility study on Priority Project
- To pursue technology transfer to the counterpart personnel

(2) Scope of Study

(a) Phase I Master Plan

1) Collection, review and analysis of related data and information
2) Field survey
3) Identification of the existing facilities
4) Analysis of the current development plan
5) Formulation of the master plan

(b) Phase II Feasivility Study

1) Selection and decision of the objective project
2) Field survey and data collection
3) Planning/engineering and implementation design
4) Cost /revenue estimation and financial analysis
5) Project implementation plan and project evaluation

(c) Technology Transfer

1) On-the-job training
2) Work-shop for technical/financial/general matters
3) Seminor for Master Plan/Feasibility Study

1.3 Policy of the Study

The study has paid the keen attntion on;

1) The shift from mono-poly operation to the competitive operation by the new investers/operators
2) The shift of the demand from the fixed-phone services to the mobile-phone and internet/data services
3) Current trend of the technology development such as the circuit switching network to the packet-switching network
4) Promotion of the digital network expansion into rural/remote areas in order to minimize "Digital Divide" considering "Cross Subsides" between urban areas and rural/remote areas
5) Efficient investment on the well-balanced network expansion program
6) Technology transfer on the above points

1.4 Work Schedule

The study was carried out as follows:

Nov. 2001～Dec. 2001	Preliminaly study in Japan
	(Inception Report)
Dec. 2001～Mar. 2002	First Work in Ethiopia
	(Progress Report)
Apr. 2002～Jul. 2002	First Work in Japan
	(Interim Report)
Jul. 2002～Aug. 2002	Second work in Ethiopia
	(Working Paper for F/S projects)
Sep. 2002～Oct.2002	Secondary work in Ethiopia
	(Draft Final Report)
Oct. 2002～Nov. 2002	Third work in Ethiopia
	(Technology transfer seminar)
Nov. 2002～Dec.2002	Third work in Japan
	(Final Report)

CHAPTER 2 NATURAL AND SOCIO-ECONOMIC CONDITIONS

Ethiopia is situated between 4 deg. and 18 deg. north of the Equator in eastern Africa. It is a ruggedly mountainous country enjoying a generally temperate climate throughout the year, bordered by the Sudan, Kenya, Somalia, Eritrea and Djibouti, and is the tenth largest country in Africa. The land of Ethiopia is 1,098,000 square kilometres. At present only 10.4% of the country is under any form of cultivation, although 68.8% of the land area is deemed to be arable.

2.1 Population

Population by region in 2001 estimated by National Statistical Authority.

Table 2-1 Population (2001) and Land Area by Region

Province	Population	Urban Pop.	Rural Pop.	Land Area (Sq. km)
TIGRAY	3,803,000	638,904	3,164,096	50,078.64
AFFAR	1,246,000	100,926	1,145,074	n.a.
AMHARA	16,773,000	1,727,619	15,045,381	159,173.66
OROMIYA	23,058,000	2,720,844	20,337,156	353,006.81
SOMALI	3,708,000	561,391	3,146,609	n.a.
BENISHANGUL	552,000	48,576	503,424	49,289.46
SNNPR	12,916,000	994,532	11,921,468	112,343.19
GAMBELLA	217,000	36,890	180,110	25,802.01
HARARI	166,000	100,596	65,404	311.25
ADDIS ABABA	2,574,000	2,574,000	0	530.14
DIRE DAWA	331,000	238,320	92,680	1,213.20
Ethiopia	**65,344,000**	**9,742,598**	**55,601,402**	**1,098,000.00**

Source: Central Statistical Authority
Note: All localities with population less than 1,000 persons should be considered as rural.

2.2 Social Indicators

Demographic parameters of Ethiopia are summarised in followings.

Fiscal Year	:	July 1st – June 30th
Unemployment Rate (as a % of Labour Force): 1994	:	2.90 % (National)
	:	21.97 % (Urban)
Inflation (% change of Ethiopia Consumer's Price Index)	:	4.20 % (1999/2000)
Life Expectancy (by 1994 Census)	:	50.7 Yrs
Literacy Rate (Aged 5 years & above)	:	25.80% (1999)
Crude Birth Rate (per '000)	:	44.2
Crude Death Rate (per '000)	:	15.0
Infant mortality (per '000 live births)	:	107.0

Languages : Amharic, Oromiyan, Tigray, Afar, Somali and others
English and Amharic are mainly used in business.

Currency : Birr 8.56 : US$1.00 (August, 2002).

2.3 Gross Domestic Products and Gross Regional Domestic Product

GDP : Birr 64,342.51 million (2000/01)

GDP Growth Rate : 7.9% (2000/01)

5.24% during 1993/94 – 1999/2000

Per Capita GDP : Birr 1,013.15 (2000/01)

Population : 63,495,000 (2000)

Table 2-2 Productive System of Ethiopia

Unit: Birr million

Sector	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/2000
1. Agriculture, Fishing	6,078.0	6,284.0	7,206.2	7,453.9	6,648.9	6,904.2	7,052.8
2.Industry	1,307.0	1,412.5	1,488.9	1,593.8	1,630.9	1,815.7	1,870.9
3.Distributive Service	1,650.9	1,757.3	1,914.7	2,062.1	2,177.9	2,253.9	2,423.1
4.Other Service	2,963.3	3,190.5	3,377.3	3,603.8	4,084.9	4,487.1	4,955.0
5. GDP	11,999.2	12,644.4	13,987.1	14,713.6	14,542.6	15,460.9	16,301.8
6. Growth Rate	1.70%	5.37%	10.60%	5.19%	-1.16%	6.31%	5.43%

Note: 1980/1981 Factor cost
Source: MoFED (MEDaC)

Table 2-3 GRDP/cap. (FY2000/01) by Region

Unit: Birr

District name	GRDP (Est.)	District name	GRDP (Est.)
TIGRAY	975	SNNAPR	859
AFFAR	978	GAMBELLA	1,014
AMHARA	974	HARARI	2,013
OROMIYA	898	ADDIS ABEBE	3,153
SOMALI	871	DIRE DAWA	2,216
BGR	996	NATIONAL	1,013

Source: Study Team

2.4 National Develeopment Plan

(1) Development Strategy, Policy and Institutional Framework

Development program rests upon the following principles;

1) To sustain the progress made in restoring stable socio-economic and political environment in the country;
2) To strengthen the effort in creating conducive environment for economic agents to take initiatives;
3) To re-assert the government's commitment in addressing the structural problems of the economy;
4) To re-confirm the government's commitment to ensure food security and for the eradication of poverty

(2) National Development Vision and Target for 2010

Ethiopia's long term development objective is to enhance the welfare of the people. In this context, for Ethiopia, the present development challenge and agenda for the decade will continue to be broad based economic growth and poverty reduction.

For Ethiopia to reduce extreme poverty, high and sustained economic growth is the most important strategy. The pattern of growth has to be broad-based with an underlying structural transformation. For average income to improve as per the target, a sustainable economic growth of at least 7.6% p.a. is envisaged.

The estimated growth rate of agriculture, the mainstay of the economy, is expected to be at least 5.0% p.a. on the average.

The Ethiopian Government in 1993 adopted the Agricultural Development Led Industrialization Strategy (ADLI). These strategy aims at improving agricultural production and productivity as a basis for improved income and living standard for the small holder farming population. Improved farm income would also generate sufficient demand for the industrial sector instigating dynamism and inter-sector linkages.

2.5 Regional Development Plan

As can be seen in the proclamation and regulations related to telecommunications and in "National Communication Policy", telecommunication sector should serve to the development of economy and industries, in parallel with providing universal access to local communities.

Current development level of the regions can be summarized as the following three groups.

a) Urban Areas: Addis Ababa, Dire Dawa and Harari are urban regions, most of whose areas composed of urban areas. Economic infrastructure as well as social infrastructure is comparatively well developed in these areas. Concentration of telecommunication networks in Addis Ababa seems to be extremely higher than that of other economic infrastructure (electricity and roads). Other areas of this category need to be prioritized in telecommunication development.

b) Central Highland Areas: Most part of Tigrey and Amhara, central part of Oromiya, and northern part of SNNPR belong to this category. Other regions have very limited portion of this area. The areas of this category have moderate rainfall, and rain-fed agriculture has been historically prevailing. In these areas, social infrastructure has been developed at the average or slightly higher level. Major towns in these areas should have a priority in rollout targets of economic infrastructure, including telecommunication services.

c) Marginal Areas: These areas surround the central highlands. Most parts of Afar, Benishangul/Gumuz, Gambella and Somali, and southern parts of SNNPR and Oromiya fall to this category. In these areas, rainfall is normally not enough for agriculture, modern agriculture has not developed, and people have sparsely populated, although there is some potential for agricultural development with irrigation projects in southern and western areas. Social infrastructure, as well as economic infrastructure, has been less developed than the average. For these areas, development of social infrastructure for basic human needs should have higher priority than the development of economic infrastructure. Among economic infrastructure, road construction, and probably electrification as well, may have higher priority than telecommunication development.

Universal access to telecommunication services should be pursued over the country. However, with limited resources available, realization of the universal access should be cost efficient. Selection of target local community should be made taking into account of costs for network expansion, size of population and social and economic importance of the communities.

CHAPTER 3 PRESENT STATUS OF TELECOMMUNICATIONS SECTOR

3.1 Present Telecommunications Services

ETC (Ethiopian Telecommunications Corporation) is the monopoly for all of the communications services such as fixed, public, and mobile telephone, telex, the Internet, data transmission, and international telecommunications and TV program transmission services.

The number of subscribers of the fixed-phone was 291,000 nationwide (July 2001), with the penetration rate as low as 0.5 per 100 inhabitants. The lack of outside plant facilities, in comparison with switching capacities, is one of the major causes for the large number of waiting applicants, currently at 155,000.

Based on the governmental policies, telecommunications network expansion is planned as for 197 rural are as a part of the Eighth Program. The 85% of the nation's population is living in the rural areas, mostly without an access to the telephone. Facility expansion to such areas requires a tremendous amount of investment, however.

Mobile telephone services are limited to the Capital area and its peripheral areas. Current number of subscribers are 36,000 due to the shortage of system capacity, and the system has been expanded to the capacity of 60,000.

The Internet services are administered solely by ETC, with POPs in Addis Ababa and 9 other major regional cities. However, its subscribers are concentrated in Addis Ababa and scarce in other areas. The slow growth of internet service may be caused be the low PC diffusion (0.07 units per 100 inhabitants as of 1999), high tariff, and low interest in the Internet.

The Government plans to invite a partner with a minority stock share (30%) from private sector for joint administration of ETC to improve its financial, administrative, and technological capacities. Divisions for fixed telephone, mobile telephone, the Internet, and data transmission are to be restructured to semi-autonomy Departments under the same ETC for separate administration and operation.

3.2 Problems

(1) Conditions of the Facilities

1) Subscriber access network (539,000 by copper and 6,000 by WLL) is not evenly developed in comparison with its corresponding switching capacity of 554,000 LU, resulting in the long lists of waiting applicants.

2) Many Obsolete Facilities
   - The outdated use of paper-insulated cables in the outside plant causes faults during rainy seasons and shall be rehabilitated.
   - Manual boards and PBX are in use as the semi-automatic local exchanges and shall be replaced by 2010.
   - Analog switching systems shall be replaced with digital switching within the Short-Term Plan.

3) Analog transmission (2GHz-band UHF and P-P VHF) may be replaced with digital systems in the Middle-Term period. Trunk transmission routes have been under the installation of the digital streams.

4) Traffic routing within a tandem area is to be simplified by re-routing the traffic in conformity with the administrative tandem area.

5) Rural Network

Almost no telephone services is available in rural/remote areas. Considering the high cost required for the expansion of the rural service network, the gradual /reasonable extent of the rural network expansion shall be plannned.

(2) Operation and Maintenance

1) Control of facility inventory records is insufficient.

2) Daily operations records are insufficient.

- Failure/reparation records, inventry record
- Target control for failure rate
- Target control for faulty recovery time
- Plant record updating

3) Lack of spare parts and tools/measurement tools

Maintenance procedure and management responsibility for spares/tools/ measurement equipment shall be standardized.

Inventory control for spare parts shall be strengthened based on the statistical site data of the mean time between failure (MTBF).

4) Additional vehicles for maintenance purpose will be required to shorten the fault recovery period.

5) Traffic management for Service Improvement

- Standard operation schedule for traffic measurement
- Target control for call completion rate
- Analyses of call loss points (route busy, no response or busy, switch, network congestion, etc.) for preparation of measures and early expansion plan
- Application of TQC

3.3 Project Management

(1) Project Execution by Technical Division

1) Idle facility should be minimized through turn-key projects with switching, transmission, and OSP in single packages.

2) Expansion of the subscriber access network shall be implemented by a high priority for the utilization of the idle capacity of the switching system.

(2) Insufficient Inter-system Coordination for Project Planning

1) Preparation and management of the integrated implementation schedule up to the new

subscriber connection

2) Completion of OSP basic design prior to the determination of switching capacity

(3) Enforcement of Responsibility/Authority for Project Implementation Management

1) Establishment of an Implementation Body independent from technical divisions for project administration
2) Enforcement of supervision and progress management for new subscriber connection target.
3) Stronger authority on project management including the implementation of ad-hoc action plan.
4) Smooth transfer of the facility to O&M division upon construction

3.4 Customer Service

(1) Improvement in Management of Key Customers

- Comprehension of service status and improvement by periodical monitoring
- Service improvement by O/F ring introduction for key customers

(2) Application Management

- Improvement of procedure, updating of applicant list and other related data with the help of computerization (particulary done in Addis Ababa)

(3) Target Management of New Subscribers (annual, monthly, quarterly)

- Integration of information on existing facilities and on-going project and simplification of the service order procedure through the computer aided system
- Trouble shooting and planning action orders through monthly monitoring meeting for progress confirmation (including an additional budget, if required)

(4) Applicants for Mobile Telephone

- System expansion for increasing applicants
- Establishment of new independent department for faster decision making in accordance with the corporate strategy
- Earlist introduction of pre-paid (SIM) cards

(5) The Internet

- Aggressive sales operation against slow subscriber growth in accordance with national ICT strengthening strategy
- Increased opportunities for the Internet access through cyber cafés and other establishment
- More instructors for new customer connection
- Network capacity expansion and advertisement through mass media

3.5 Organization and Human Resource Development

(1) Current Legislation on Telecommunications

Proclamation No. 49/1996 gives legal framework for the telecommunication sector. The proclamation stipulates basic provisions on 1) Licensing of telecommunication operator, 2) Tariff, 3) Technical standards, 4) Approval of equipment, and 5) Radio Communication and assignment of frequency. The proclamation established a separate regulatory organ, namely Ethiopian Telecommunications Agency (ETA).

Council of Ministers Regulation No. 47/1999 stipulated principles and procedures on 1) Telecommunication Service License, 2) Telecommunication Service Price and Tariff, 3) Technical Standards for Public Switched Telecommunication Network and Cellular Mobile Network, 4) Management of Frequencies and Radio Regulations, etc.

According to the Proclamation No. 116/1998, "investors shall be allowed in the area of telecommunication services only in partnership with the Government."

Important amendments to the Proclamation No.49/1996 were made at the beginning of the Phase-II of the Study which made possible for other persons or companies than ETC to participate in telecommunication businesses although they are limited to non-core part such as re-sale of telecommunication services, outside cable installation /maintenance or PABX installation/maintenance. The amendments also established a base for control to import of telecommunication equipment.

(2) Organizations Related to Telecommunication Sector

(a) Ministry of Infrastructure (MOI)

MOI is the supervising entity of telecommunication sector at ministerial level. The duties of the ministry include, formulation of policy of the sector, supervise ETA, as well as coordination with other sectors.

(b) Ethiopia Telecommunications Agency (ETA)

ETA was established in November 1996 as an autonomous federal regulatory agency of telecommunication sector. ETA currently employs only 43 persons and has a plan to increase its staff to 88 persons to discharge its important duties. Human resource development and enhancement of information collection capability is necessary to carry out its duties.

(c) Ethiopian Telecommunications Corporation (ETC)

Ethiopian Telecommunications Corporation (ETC) is established by Council of Ministers Regulations No. 10/1996 in November 1996, as a *public enterprise*, with authorized capital of Birr 1.47 billion and paid capital of Birr 480 million. ETC has 7,348 employees as of January 2002, with Managing Director's Office and Departments of, 1)

Telecom Infrastructure Development (571 employees), 2) Corporate Planning and Business Development (89 employees), 3) Telecom Services (5,739 employees), 4) Finance and Material Resources (580 employees), 5) Information Technology and New Services (171 employees), 6) Human Resources Management and Manpower Development (122 employees), as well as with six Addis Ababa Zones (1,894 employees), eight Regions (3,388 employees) under Telecom Services Department.

ETC has made substantial efforts in training. The training institutes currently place emphasis on training, mainly computer courses, inviting external persons with charging fees. In 2001, the institute invited five persons for the training of cable jointing from a private company outside ETC.

Following major problems/issues were found.

- Efforts to offer services that customers think worth to pay appear insufficient.
- Performance evaluation is not linked to rewarding.
- Coordination among departments and divisions looks weak. Resource allocation might not be consistent and flexible.
- Junior managers seem not to have enough knowledge on jobs and situations of other divisions or teams. Since major tasks for managers are coordination with related divisions/teams, lack of capability for the coordination may cause fatal results for good management.
- Staff in the head office seems taking attitudes of guiding rather than trying to improve performance together with profit centers or than to serve to persons in regions and zones.
- Monitoring and evaluation seems weak to improve the project management

3.6 Current Financial Status of ETC

The P/L, Cash Flow Statement, Balance Sheet, and Financial Indicators presented by ETC indicate that ETC is being managed soundly. However, a number of problems were brought to light as a result of hearings conducted with ETC employees. These include problems relating to the collection rate and problems relating to changes in the revenue structure. The term of accounts receivable stood at well beyond 140 days in 2001/02, presenting a far from comfortable operating environment. However, the collection rate (collected amount/billed amount) for the entire year remained at over 90%.

The assessment to problem from the viewpoint of ETC employees, which is the nucleus of the problem with the collection rate, is how to improve the existing subscriber collection system. Under the present system, the collectors (ETC employees) contact the subscribers individually and advise them of the amount to be paid. Subscribers then pay at a nearby telephone office. Since it would be difficult to imagine a more efficient system, yet in Ethiopia, where it is still relatively uncommon to have a bank account, it seems the most effective way of maintaining a high collection rate. However, it should not be forgotten that it has only been possible to achieve this

feat because until now there have only been some 330,000 subscribers. For the future environment, the easiest and least expensive way of improving this situation would be to encourage the use of automatic payments from back accounts. The increase of subscription collection offices would offer temporary relief, but would not provide a permanent solution to this problem.

Changes in the revenue structure refer to the fact that the bulk of revenue will come from the mobile-phone sector instead of the international sector. As long as the existing business model is still followed, there will be no escaping a gradual deterioration of the business environment. ETC staff has already noticed a fall off in revenue from the international sector as a result of such factors as a drop in the international settlement rate and a decline in voice traffic. As well as calling for the promotion of rural development, the Master Plan also incorporates a business plan involving the strategic growing of the mobile-phone sector.

Table 3-1 Current Status of Telecommunications Services

Index	Sub-Indexes	Status as of 2001
Socio-Economy	Population (‘000) - Urban - Rural GDP/Capita in Birr (National)	65,344 9,742 55,344 1,013
Demand	Telephone (‘000) Fixed-phone - Urban - Rural Mobile-phone	750 736 (717) (19) 142
	Public Data Service (‘000)	4.073
Facility and Subscribers	Switching Capacity (Line Units) Fixed-phone (‘000) - Digital SW - VoIP Mobile-phone (‘000)	 512 (411) (--) 36
	Subscribers (‘000) and Penetration/100 inhabitants (%) Fixed Telephone Mobile Telephone	 291/0.46 28/0.04
	Payphone (Urban/Rural)	935/ -
	PCO (Tele-access) (%)	-
	No of POPs	10
	No of Public Data Subs. (‘000) / Penetration (%)	4/0.01
(Mobile Telephone)	Service area	A.A. and surrounding towns
Operation and Maintenance	Call completion rate (%)	37**
	Faults per 100 main line/Year	145
	Fault Clear Rate within 24 hrs	NA
	O & M Staff / All ETC Staff	5,739 / 7,345
Network Facilities	Switching System (Fixed)	Manual/Analog/Digital
	(Mobile)	TDMA
	Terrestrial Transmission Sys. - Back-born Route - Spur Route	 Radio: Analog+Digital Radio: Analog+Digital
	Satellite System	TDMA, SCPC
	Subscriber Network	Metal + WLL

**: Information from Mekele Regional Office

CHAPTER 4 REVIEW OF THE TELECOMMUNICATIONS DEVELOPMENT PLAN

4.1 Overview of the Network Situation in January 2002

As the result of the imbalanded investment weighted on the switching equipment, the idle capacity of the swittching system is as follows;

Switching capacity	581,174
Number of subscribers	319,503
Idle capacity	**261,671**
Waiting applicant	160,000

While the capacity of the local access network ready for the implementation (design completed) is only 185,000 MDF pairs.

Addis Ababa	70,000 pr
Regions	115,000 pr

The implemetation of the above 185,000 MDF pairs will take further 2 years.

Dependeing on the current information, ETC has already established the implementation plan for 269,000 lines of subscriber access network within the fiscal years of 2002/03 (2 years).

4.2 Review of the Priority Projects (45 Projects for Regions and Addis Ababa)

		Original	After evaluation
Regions	Switch	70,000	53,000 (Replace 28,500)
	WLL	8,000	(8,000)
	Copper loop	142,800	102,600
Addis Ababa	Switch	50,000	50,000 (Replace)
	WLL	30,000	19,000
	Copper loop	200,000	187,100

The evaluation was made considering;

1) Balance with the existing facilities
2) Waiting applicant and demand of year 2005
3) Maximum replacement of Analog switches
4) Minimum expansion of subscriber access network by WLL
5) Rehabilitation of obsolete Cables in Addis Ababa.

4.3 Revision of Eighth 5-year Development Plan Including Priority Projects

(1) Switch Expansion Plan (Phase I and Phase II)

	Ph I	Ph II	Total	Priority (after evaluation)
Expansion	94,000	22,000	116,000	24,500
Replace	0	24,250	24,250	78,500
New	43,750	46,500	90,250	-
WLL	-	-	-	27,000
Copper loop	-	-	-	289,700
Increase of switch	140,500 l.u. + 90,250 l.u.			
Increase of Local access	289,700 MDF pr + 27,000 WLL			

The evaluation of the above figures was made giving the priority on

1) Effective use of the idle switching capacity of 260,000 l.u.
2) Replacement of analog switch by digital switch
   (78,500 l.u. out of 80,000 l.u.)
3) Replacement of RAX switch due to the lack of CCS No.7 and unstable charging function.

As the result, the following points are recommended.

- To cancell or decrease the expansion of swiches

Filwoha	10,000 l.u. to be cancelled
Mekele	15,000 l.u. to be decreased
Combolcha	5,000 l.u. to be cancelled
Dire Dawa	4,000 l.u. to be cancelled
Harar	8,000 l.u. to be decreased
Jijiga	4,000 l.u. to be decreased
Moyale	2,000 l.u. to be cancelled

- To postpone the installation of 163 new switches (90,250 l.u.) until the plan will be supported by basic plan of the subscriber access network.

(2) Over-all Target of Eighth 5-year Development Plan

(a) Target of Switching Capacity (1,000,000 l.u.)

Additional 470,000 l.u. of the swithcing capacity will be too much ambitious, and will cause the further idle capacity considering the current preparation and the longer installation period required for the subscriber acess network.

Out of the 206,000 l.u. packaged for Ph(I + II), 110,000 l.u. only will be so far justifiable.

(b) Targe of the Subscriber Connection (800,000 DELs)

DEL in Jan. 2002 is 319,500.

Considering the long installation period of the subscriber access network (except high cost WLL), the target will be too much ambitious.

(c) Expansion of Mobile Telephone

Improvement targets of the Eighth 5-Year Development Program of ETC included the expected number of mobile telephone customers to reach 61,727 in 2005 including additional major 12 cities. This target, after a drastic revision of the plan by ETC realized in April 2002, was raised 6.5-fold to 400,000 customers by 2005. Accordingly, based on a SIM card introduction plan, its procurement procedure is already under execution with 60,000 cards. Such moves are very desirable and encouraged for optimal realization of the plan.

In order to meet such drastic increase, ETC's quality of services should be well-organized in areas of customer attention and satisfaction, terminals procurement and provision, etc.

(d) Expansion Plan of Internet Services

In the eighth 5-Year Development Plan it forecasted the number of Internet subscribers as follows:

Year	2000	2001	2002	2003	2004
Subs.	6,961	12,961	20,961	26,961	31,961
Increase		6,000	8,000	6,000	5,000

Compared with the present subscribers of 6,000 as of April 2002 and forecasted number of 20,961 for 2002, there are still big deviation. Growth of private Internet subscriber depends on diffusion of personal computers and the Internet tariffs. It is expected that the Internet subscriber will be increased after the mobile telephone enables the Internet access. It is also necessary for ETC to promote subscription roll-up. For example, ETC makes it free of connection fee for initial 2 months, or extension of allowed hour per month for new subscribers.

(e) Expansion of VSAT and DRCS

The planned 123 new sites of DRCS and 24 new sites of VSAT are recommended to be implemented as scheduled.

(f) Expansion of Transmission Network

The planned expansion has been put into the implementation stage.

The planned capacity as well as the system have been confirmed to be adequiate.

CHAPTER 5 DEMAND FORECAST

5.1 Population Growth Rate

Ethiopia entered the 20th century with about 11 million people and left it with about 65.344 million people at the beginning of 21st century. National population Agency has estimated the population growth as follows.

Table 5-1 Future Population

Unit: 1000

Year	Population	Year	Population
2002	67,221	**2008**	79,220
2003	69,126	**2009**	81,343
2004	71,065	**2010**	83,483
2005	73,044	**2015**	94,526
2006	75,068	**2020**	106,003
2007	77,128	Ave. G. Rate : 2.56%	

Source: Central Statistical Bureau

5.2 Economic Growth Rate

FY1991 – FY1999 showed average economic growth of 3.98% p.a.

Economic growth rate of FY2002/03-FY2020/21 was projected by IMF, World Bank and Central National Bank.

Table 5-2 Future Economic Growth for GDP

Unit: US$ million

Year	Growth Rate	GDP	Year	Growth Rate	GDP
2000/01	7.90%	8,568	2005/06	6.50%	11,784
2001/02	7.00%	9,167	2010/11	6.50%	16,135
2002/03	6.50%	9,760	2015/16	6.00%	21,972
2003/04	6.50%	10,394	2020/21	6.00%	29,382
2004/05	6.50%	11,067	Average G.rate : 6.36%		

Source: IMF, National Bank of Ethiopia

Table 5-3 Future Economic Growth for GDP/cap.

Unit: US$

Year	GDP/cap.	Year	GDP/cap.
2000/01	135	2005/06	161
2001/02	140	2010/11	193
2002/03	145	2015/16	232
2003/04	150	2020/21	277
2004/05	156		

Source: IMF, National Bank of Ethiopia

5.3 Fixed-phone Demand

The model formula for macro demand forecast is arrived using the ITU data of the similar 46 countries to Ethiopia in size of population, size of the land area and the GDP/capita.

Model formula which has the high correlation factor ($R^{2=}0.8308$), is adjusted applying the current telephone penetration and the waiting list.

$Y = 0.18 + 0.004x^{0.9889}$ (Y: demand density)

where x is GDP per capita and 0.18 is a parameter based on the particular conditions of Ethiopia as of 2000.

Year 2000/01

Subscribers:	283,683
Waiting applicants:	155,208
Total:	438,891
Demand density:	0.691
Population:	63,495,000
GDP per capita (US$):	135

Year 2020/21

Main line demand:	1,295,300
Demand density:	1.222
Population:	106,000,000
GDP per capita (US$):	277

The macro demand is further adjusted to the micro demand by application of potential demands and the service area expandability.

Table 5-4 Micro Demand

Item	2001	2003	2005	2010	2015	2020
Urban	719,800	827,800	917,500	1,197,900	1,553,000	2,003,300
Rural	18,800	23,000	27,100	38,300	53,400	72,600
Total	738,600	850,800	944,600	1,214,800	1,606,400	2,075,900
Shift to Mobile			-229,400	-299,500	-388,200	-500,800
Micro demand			688,100	898,400	1,164,800	1,502,500

5.4 Mobile-phone Demand

The demand for the fixed-phone is originated from the places such as offices and houses. While, the mobile-phone demand is originated from personnel.

The long term demand of mobile-phone will be much bigger than the fixed-phone (1.2～2 times).

The forecasted mobile-phone demands are as follows.

Table 5-5 Mobile-phone Demand

Item	2001	2005	2010	2015	2020
Demand	142,800	213,500	311,400	431,400	614,800
Shift from Fixed		82,000	179,700	233,000	300,500
Temporary		21,400	21,800	25,900	30,800
Total (Target capacity)	-	316,800	509,800	688,100	946,000

5.5 Demand Forecast for Internet/Data Services

The subscriber of the internet service was 4,000 in year 2001, and will increase gradually for a few years. While, the internet service will be spread into the urban areas shortly owing to the tide of the globalizatoin.

In addition the mobile-phone (GPRS) will become the key tool of the internet service.

Table 5-6 Internet Demand

Item	2005	2010	2015	2020
Computer	36,000	58,100	93,600	150,700
Mobile	64,000	93,400	129,500	184,500
Education	2,000	10,000	20,000	30,000
Medical	2,000	10,000	15,000	20,000
Government	5,000	10,000	15,000	20,000
Total	109,000	181,500	273,100	405,200

CHAPTER 6 TRAFFIC FORECAST AND CIRCUIT CALCULATION

6.1 Assumption for Originating Calling Rate

The calling rate will be decreased depending on the decrease of business/official subscriber's raio to the total subscribers.

The calls from the fixed-phone will be shifted gradually to other medias such as mobile-phone and internet services.

Item	2001	2005	2010	2015	2020
Fixed-phone:					
Call mixture					
Business (85m Erl) (%)	33.4	30.0	28.0	26.0	25.0
Residence (25m Erl) (%)	66.6	70.0	72.0	74.0	75.0
Calling Rate (m Erl)	45.0	43.0	41.8	40.6	40.0
Shift to other media					
Mobile (%)	3.0	5.0	10.0	15.0	20.0
Internet (%)	0.5	2.0	5.0	8.0	10.0
Assumed calling rate (m Erl)	43.5	40.0	35.5	31.3	28.0
Calling Rate for Eng. Purpose (m Erl)	57.0	50.0	48.0	44.0	40.0
Mobile-phone:					
Basic calling rate (m Erl)	63.2	36.0	34.4	33.4	32.0
Call mix (ratio of business) (%)	90.0	33.4	30.0	28.0	26.0
Shift from fixed-phone (m Erl)	0.9	1.7	2.9	4.1	6.0
Assumed calling rate (m Erl)	64.1	37.7	37.3	37.5	38.0
Calling rate for Eng. purpose (m Erl)	-	40.0	40.0	40.0	40.0
Internet:					
Call mix (business) (%)	100	65.0	50.0	40.0	30.0
Calling rate (m Erl)	100	68.5	55.0	46.0	37.0

6.2 Assumption for Call Distribution

(1) Fixed-phone

a) Addis Ababa area
- 80% calls are assumed to be terminated within Addis Ababa area
- 20% calls are to be terminated to other areas.

b) Primary center (PC) area
- 70% calls are assumed to be terminated within the same PC area
- 30% calls are to be terminated to other areas

(2) Mobile-phone

a) Addis Ababa area
- 40% within AA mobile
- 40% to Addis Ababa fixed-phone
- 20% to secondary center

b) Other PC area
- 40% to fixed-phone within the same PC area
- 30% to mobile-phone within the same area
- 30% to other areas

6.3 Circuit Calculation

1) Circuit switching network

Grade of service is given as follows

Inter region backbone circuit	0.005
Other than above	0.010

The digital stream is calculated;

Fixed-phone	64kbps/CCT
Mobile-phone	32kbps/CCT

2) IP network

G729 is mainly applied for the packeting way specific requirement (Facsimile, etc.)

		Packeting cycle	Pay load	Header	Required Band/ch
G711	64kbps	20ms	160 B	40 B	80 kbps
G729	8kbps	40ms	40 B	40 B	16 kbps

CHAPTER 7 FRAMEWORK OF THE MASTER PLAN

7.1 Objectives and Policies for Telecommunications in Ethiopia

Ethiopian Ministry of Infrastructure has formulated in April 2002 telecommunications sector objectives and policies in line with the governmental vision to improve quality of life of citizens, to transform the next-generation Ethiopians to a knowledge-based society, and to foster the economic and social development of the nation.

The policies are:

1) To accelerate the development in telecommunications with a substantial increase in telephone penetration/density
2) To ensure the balanced and equitable distributions of telecommunications infrastructure to enhance integrated regional development and attainment of universal access to modern telecommunications services at affordable and cost-based tariffs.
3) To continuously strive to improve reliability, efficiency and quality of services to ensure consumer responsiveness through commercial principles and regulations
4) To maintain ETC as a single entity under one single partnership responsible for the four key service lines, namely, fixed, mobile, data and the Internet

7.2 Planning Period and Target Years of the Master Plan

This Master Plan covers a long-term telecommunications development up to 2020/21 in the whole of Ethiopia.

The planning period up to 2020/21 is divided into three phases:

1) Short Term: (2003/04 - 2005/06)
2) Middle Term: (2006/07 - 2010/11)
3) Long Term: (2011/12 - 2020/21)

7.3 Framework of the Master Plan

The framework of the Master Plan is formulated in conformity with the social needs of Ethiopia considering the prospects of improvement in the social and economic condition of the country, technical innovation, and involvement of new players expected in the telecom sector.

(1) Mobile-phone Service

Mobile-phone network shall be expanded actively placing a top priority to regional towns including medium and small town as early as possible.

In order to enhance the services and stimulate further demand growth, an enhanced GPRS system shall be introduced.

(2) Fixed-phone Service

Considering the idle capacity of the existing switching system, immediate implementation plan has to be firstly prepared as a solution to minimize the idle capacity, and secondly focusing on the high priority area of network expansion paying attention to the well-balanced facility development.

Construction of fixed-phone network should be limited to approx. 75% of the fixed-phone demand taking into account the rapidly increasing trend of worldwide mobile-phone subscribers in order to develop an economic and balanced network and hence avoiding double investment on both fixed- and mobile-phone infrastructures.

An optical fiber transmission system will be constructed for NSC (Addis Ababa) - Nazareth section to meet the increasing circuit requirements as well as to secure the network reliability.

Analog exchanges will be replaced with digital exchanges in short term, and also RAX exchanges will be replaced (40,500 l.u).

(3) Introduction of IP Based Network

VoIP technology will be introduced from the beginning of Middle Term period, and no more conventional digital switch is to be deployed from then, in principle.

IP based trunk network and junction link, connecting 6 primary centers, MSC and 6 tandem exchanges in Addis Ababa, will be introduced within Short Term (by 2005) to alleviate overload on NSC transit switch, and also to provide foundation for furture IP based network.

(4) Improvement of Tele-access in Rural Areas

Master plan targets are set paying keen attention to the government's telecommunications sector policy with strong emphasis on increasing Tele-access (percentages of population who can access to telephone with a walking distance) in the rural areas where more than 85 % of the national population lives without the access to telecommunications.

Master plan target is to be set at the reasonable level considering the financial capability of ETC since the fund for implementing the rural telecommunication network is to be secured from other profitable telecom business.

(5) Expansion of Public Data Network and Internet Services

The present number of subscribers is at low level, however, it is expected to increase the internet users gradually by introduction of an enhanced GPRS mobile system. And. reduction of Internet subscription fee by 80 % made in August 2002 would also stimulate new subscriptions.

Considering the above factors, public data network as well as Internet services are to be actively expanded nationwide.

(6) Rollout Target of License

ETC has been granted the service operator licenses conditioned to satisfy the rollout targets based on the target of the eighth development plan.

The number of DELs has been drastically increased since 1999 by out-sourcing local access network construction from foreign contractors.

Given the same procurement method is applied, it would be very hard to achieve the rollout target of 800,000 DELs by year 2005 due to substantial delay in the construction of local access network.

Moreover, waiting applicants are limited (approx. 155,000) and the current trend of the growth rate

of the fixed-phone application is low compared with the mobile-phone application.

The number of mobile subscribers has increased steadily and rapidly after system capacity expansion up to 60,000 in Addis Ababa and Nazareth. In addition, further expansion up to 400,000 line units is planned to implement by 2005 for providing services to 13 major regional towns. Considering the above situation, the number of subscribers will exceed the rollout target (61,727) and is expected to reach around 320,000 by 2005.

(7) Implementation of CIMIS

In order to monitor and manage various projects to be implemented systematically and effectively, computer aided systems are to be introduced as a tool in customer service division, planning division, operation and maintenance divisions, and other corresponding divisions. These sub-systems are to be integrated to CIMIS (Corporate Integrated Information Management System) to share the information among the offices concerned in regions as well as the head office.

(8) Procurement Method and Packaging

It is recommendable that a single turnkey project covers OSP, transmission, and switching facilities, with construction works to be taken place in the same period in order to save the management efforts and to avoid resource inefficiency.

(9) Out-sourcing

In this Master Plan, the facility volume of year 2001 is to be increased more than double by the fiscal year of 2005/06 for fixed-phone and mobile-phone networks.

Under these circumstances, in order to minimize sector risks and minimize the increase in fixed costs, a policy of out-sourcing certain activities to external entities (companies) should be followed. Such out-sourcing may be executed in the fields, such as OSP civil work, building construction and other related works, Operation of PCO services in rural area.

(10) Provision of Telecommunications Services in Effective and Efficient Manners

The government of Ethiopia has a policy to engage a strategic partner in ETC from 2003, with 30 % of share, to enhance the capability of ETC's capital, management and technology, and also to establish 3 separate business entities responsible for fixed, mobile and Data/internet services under the Head Quarter of ETC.

However, it is expected that the profitable businesses, such as mobile-phone, Internet/data will be opened to private investors/operators to enhance the services in the future within Middle Term.

To cope with the changes in telecom sector, the following aspects are to be considered in organization and human resource development plan.

1) To enhance the capacity of the regulator
2) To introduce customer-oriented management
3) To allocate proper personnel and enhance out-sourcing
4) To introduce objective oriented performance evaluation and reward

5) To enhance human resources development in order to meet present and prospective needs

(11) Target of the Master Plan

Development of targets for various service provisions, service quality, operational efficiency, and network facility provisions for respective Phases are summarized in Table 7-1.

Table 7.1 Target of the Master Plan (1/2)

Index	Sub-Indexes	Status as of 2001	Development Targets		
			Short-Term By 2005	Middle-Term By 2010	Long-Term By 2020
Socio-Economy	Population (‘000) - Urban - Rural GDP/Capita in US$ (National)	65,344 9,742 55,344 135	73,044 11,509 61,535 161	83,483 14,141 69,342 193	106,003 20,744 85,259 277
Demand	Telephone (‘000) Fixed-phone - Urban - Rural Mobile-phone	881 739 (720) (19) 142	1,023 706 679(=918-229*1) (27) 317(=214+103*2)	1,445 936 898(=1,198-300)*1 (38) 509(=311+198)*2	2,522 1,576 1,503(=2,003-501)*1 (73) 946(=615+331)*2
	Public Data Service (‘000)	4.073	109*3	192*3	405*3
Supply Plan and Subscribers (Fixed Telephone)	Switching Capacity (Line Units) Fixed-phone (‘000) - Digital SW - VoIP Mobile-phone (‘000) PCO / Lines in Rural Area	 512 (411) (-) 36	 679 (679) (27) 400 700 / 5,600	 898 (645) (253) 550 2,225 / 17,800	 1,502 (582) (920) 960 5,116 / 40,928
	Subscribers (‘000) and Penetration/100 inhabitants (%) Fixed Telephone Mobile Telephone	 291 / 0.46 28 / 0.04	 616 / 0.84 317 / 0.43	 841 / 1.01 510 / 0.61	 1,341 / 1.27 946 / 0.89
	Payphone (Urban/Rural)	935 / -	5,516 / 1,400	6,816 / 4,250	7,316 / 10,232
	PCO (Tele-access) (%)	-	13	41	87
	No of POPs	15	15	25	31
	No of Public Data Subs. (‘000) / Penetration (%)	4 / 0.01	76 / 0.10	172 / 0.21	365 / 0.34
(Mobile Telephone)	Service area	A.A. and surrounding towns	13 towns	13 towns	21 towns

Table 7-1 Target of the Master Plan (2/2)

Index	Sub-Indexes	Status as of 2001	Development Targets		
			Short-Term By 2005	**Middle-Term By 2010**	**Long-Term By 2020**
Operation and Maintenance	Call completion rate	37*4	50	65	70
	Faults per 100 main line/Year	145	30	18	12
	Fault Clear Rate within 24 hrs	-	60	75	90
	O & M Staff / All ETC Staff	5,739 / 7,345	6,453 / 7,736	7,128 / 8,472	8,518 / 10,022
	O & M System	O & M Staff / ETC	CIMIS OPMC (OSP)	CIMIS OPMC+Out-sourcing	Same as left
Network Facilities	Switching System (Fixed)	Manual/Analog/Digital	Manual/Analog/Digital/IP	Digital + IP	Digital + IP
	(Mobile)	GSM	GSM + GPRS	GPRS	GPRS + UMTS
	Terrestrial Transmission Sys. - Backborn Route - Spur Route	 Radio: Analog+Digital Radio: Analog+Digital	 Radio (SDH+PDH)/FOT Radio(PDH)	 Radio/FOT Radio/FOT	Same as left
	Satellite System	TDMA, SCPC	TDMA	TDMA	Same as left
	Subscriber Network	Metal + WLL+ Radio	Metal + WLL + FOT + Radio	Metal + WLL + FOT + Radio	Same as left

Legend: **IP**: IP based Network, **FOT**: Fiber Optical Transmission System, **SDH**: Synchronous Digital Hierarchy, **PDH**: Plesiochronous Digital Hierarchy, **Metal**: Metallic Cable, **WLL**: Wireless Local Loop, **GPRS**: General Packet Radio System, **UMTS**: Universal Mobile Telecommunications System, **TDMA**: Time Division Multiple Access, **SW**: Switching System, **TR**: Transmission System, **OPMC**: Outside Plant Maintenance Center, **SCPC**: Single Channel Per Carrier.

Note: Other services, such as Telex, Telegraph services are not indicated in the list since those services will be replaced with other means in the future.
*1: Demand sifting to mobile-phone is taken into account (25% of Fixed-phone demand), *2: Demand shifting from fixed and Tempraly users (Prepaid Card) are taken into account. *3: Internet users from Moble phone, e-Gov., Tele-medicine, distant learning, etc. are taken into account.
*4: Information from Makale reginonal Office.

CHAPTER 8 SECTOR BUSINESS STRATEGY

Potential problems that the Ethiopian telecommunications sector may face in the future, should the status quo be maintained without modification were examined using the examples of Bangladesh and neighboring Uganda, which have similar sector environments.

The main problems were found to be as follows:

(1) Strategic Equity Partner
(2) Monopolistic environment created by ETC
(3) Heavy Rollout Target
(4) Lack of a clear division of responsibilities between the public and private sectors
(5) Low efficient operational management
(6) Inadequate investment in telecommunications infrastructure
(7) Low rate of call completion
(8) Insufficientbackbone network capacity
(9) Existence of a digital divides in Ethiopia
(10) Rapid technology revolution, ICT revolution
(11) Interconnectivity between new and existing telecom. operator
(12) Problem of HRD
(13) Insufficient capacity of outsoursings
(14) Legalization of VoIP
(15) Presence of private ISPs
(16) Segregation of telecommunications and ICT sectors

The possibility of these problems arising in the future has been taken into account in formulating the master plan. The primary issues here are whether ETC is strong enough to tackle these problems, and how long the monopoly should be maintained in order for ETC to build up the strength required to do so.

At this stage the Ethiopian government has indicated it would like to see the telecommunications sector remain a monopoly. Realistically, however, if the country is to make the successful transition to an ICT society and not fall behind the rest of the international community, it will need to privatize the telecommunications sector wherever possible. Scenarios for doing so have been examined in the Master Plan.

The following two business plans will be examined, based on the business model described below.

Scenario 1

This scenario involves private sector investors participating by purchasing a 30% stake in ETC in 2002/03, with ETC remaining a monopoly until 2007/08. From 2008/09 onward, a number of

private mobile-phone and ISP operators would join in the telecommunications sector. Under this scenario, it is assumed that ETC will have been offered an incentive in the form of a continuation of its monopoly for a period of five years following the participation of the equity partner, and that during these five years ETC will have done enough to ensure it is soundly managed.

Scenario 2

As with Scenario 1, this scenario involves private sector investors participating by purchasing a 30% stake in ETC in 2002/03, with ETC remaining a monopoly until 2007/08. From 2008/09 onward, the telecommunications sector would be opened up to private operators. However, as private operators fail to enter the market because they find it unappealing, in this scenario the ETC Group would continue operating with its three-company structure until 2020/21. As with Scenario 1, under this scenario it is assumed that ETC will have been offered an incentive in the form of a continuation of its monopoly for a period of five years following the participation of the equity partner.

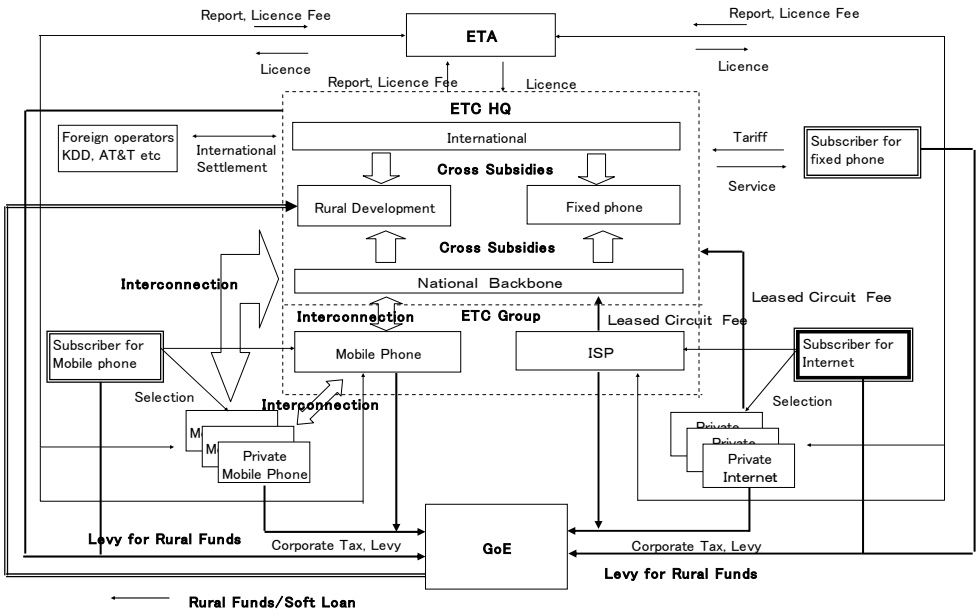

Figure 8-1 Business Model（Scenario1:2008/09）

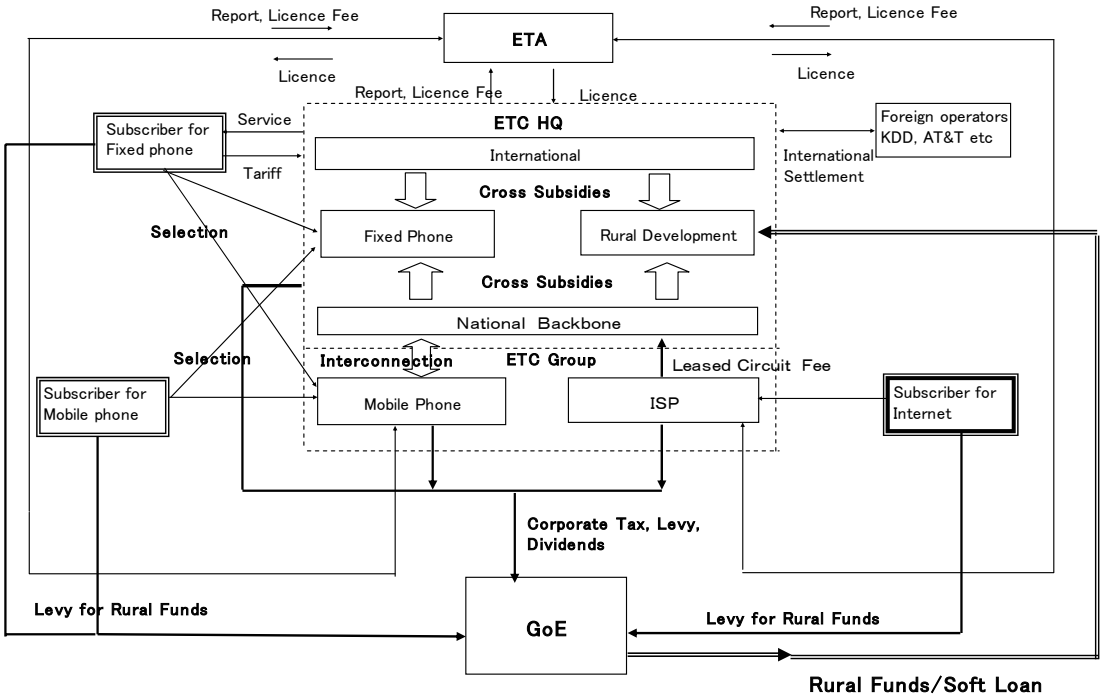

Figure 8-2 Business Model（Scenario2:2008/09）