3. Present Status of Telecommunications Networks Operated by SLT

3.1 General

Since the taking over of the operations of telecommunications services from SLTD in 1991, SLT has been targeting to meet the long-standing demand for the basic telecommunications services throughout the country. In consequence, rapid expansion and modernisation of the telecommunications network for both domestic and international services have been the key activity for SLT.

As a result of the achievement, 87% of 180,724 in the total DEL are connected to digital switching systems and 87% of the total transmission channels as of October 1994 have been digitalised. Both switching and transmission systems will be fully digitalised by the year 2000. At the same time, improvement and expansion of subscriber network are also accelerated by the recent big projects. From a view of demand fulfilment, however, approximately 186,000 applicants which is larger than the existing DEL are waiting for 3 years in average.

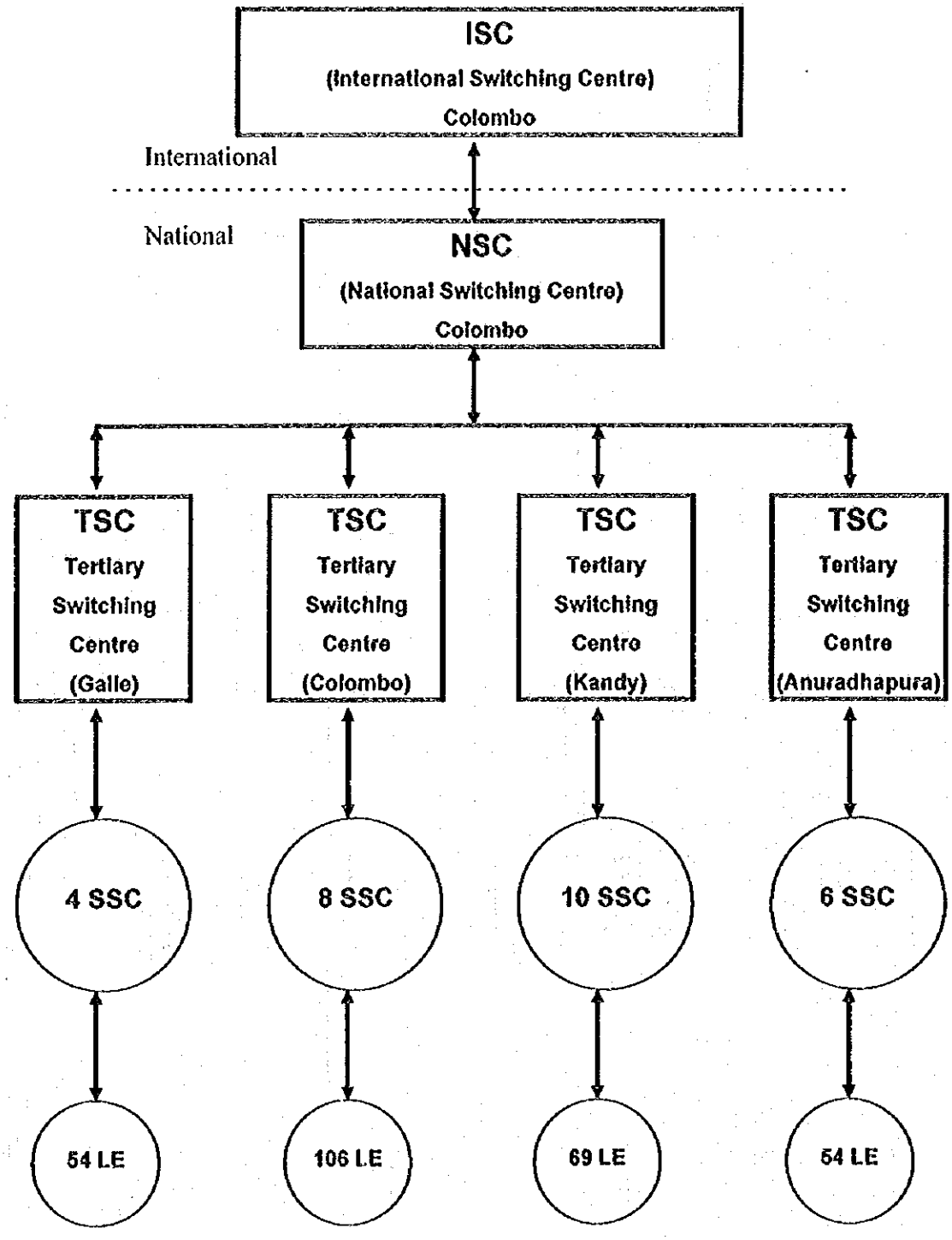
An overview of the present status of the telecommunications systems operated by SLT is described in the following sub-sections. Further details of the networks and systems are referred to in Chapters 8 and 10.

3.2 Switching Network

The switching network in Sri Lanka mainly consists of national telephone switching network, international switching network and telex switching network.

3.2.1 National Telephone Switching Network

The national telephone switching network is structured by one (1) National Switching Centre (NSC) as a gateway to/from International Switching Centre (ISC), four (4) Tertiary Switching Centres in Colombo, Galle, Kandy and Anuradhapura, twenty eight (28) Secondary Switching Centres and 283 Local Exchanges. More than 20 exchanges in certain areas of North and East Regions are not functioned at present. Figure 4-3-1 shows the hierarchical structure of national telephone Network. In Sri Lanka, various type of switching systems are introduced as shown in the Table 4-3-1.



Note: the above figures mean the numbers of SSCs and LEs.

Figure 4-3-1 Hierarchical Structure of National Telephone Network

Table 4-3-1 Types of Local Exchanges Introduced in Sri Lanka

Exchange Type		Model	Exchange Capacity	No. of DEL	No. of Exchanges
Automatic	Digital	5-ESS	24,500	19,285	2
		AXE-10	5,000	4,973	1
		DX-200	2,372	1,866	5
		DX-210	640	605	1
		E10-B	92,838	73,155	8
		HDX-10	300	261	1
		NEAX-61	8,876	6,068	6
		NEAX-61E	3,471	766	4
		NEAX-61K	10,037	7,322	8
		NEAX-61VSE	1,726	1,476	3
		RSU	54,443	40,373	119
	Analogue	C23	10,776	8,004	18
		ERS	800	406	4
		NC400	12,000	8,744	1
		NC460	6,900	5,597	7
		PABX	96	61	1
		SXS	2,062	1,239	33
Manual		20S	20	19	1
		CBS	134	103	23
		MAG	125	88	23
		MILT64	120	59	2
Subscriber line extension system			230	254	12
Total			237,466	180,724	283

Source: Sri Lanka Telecom

Note: RSU: Remote switch of digital exchange

As of December 1994, 7 switch expansion and improvement projects by the finance of SLT, World Bank, OECF, Finland, France and suppliers are on-going. After the completion of the projects, the total switch capacity will reach to approximately 620,000 at the year 1997.

3.2.2 International Telephone Switching Network

For International Switching Centre (ISC), two (2) international switches i.e. ARE-13 and 5ESS are operated in Colombo. In addition to the existing switches, NEAX-61 is under installation. The international connections to/from foreign destinations are made through INTELSAT and/or submarine cable systems i.e. SEA-ME-WE-I and II. The following Figure 4-3-2 shows the international telephone network configuration as of May 1995.

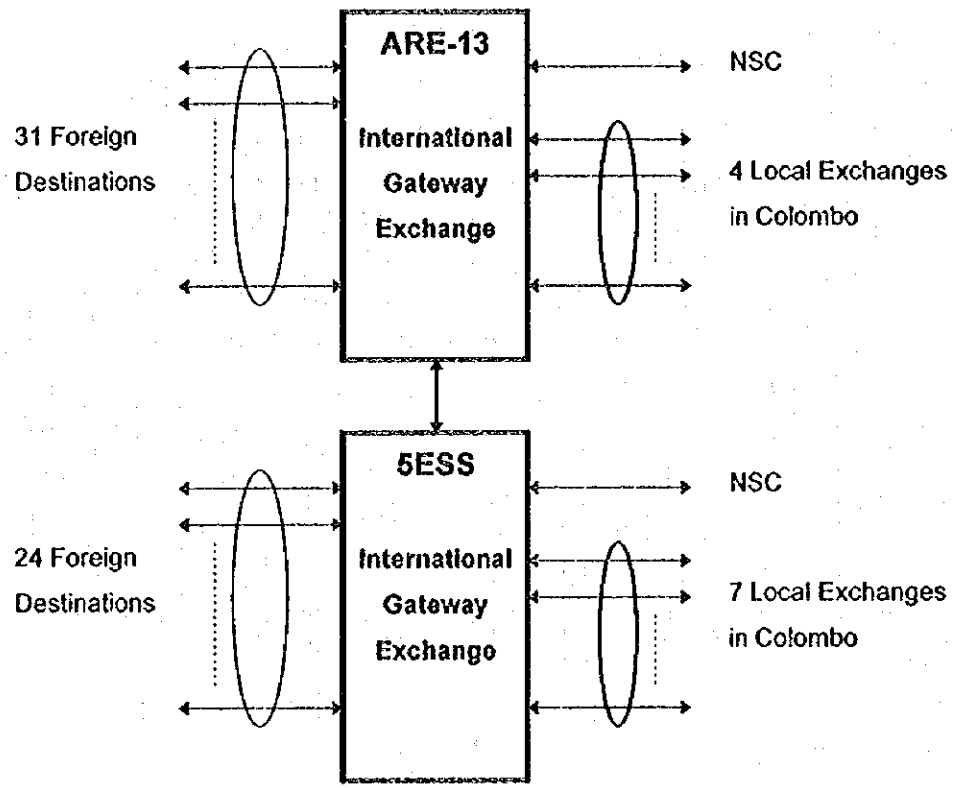


Figure 4-3-2 International Telephone Network Configuration

3.2.3 Telex Switching Network

For telex service, only one (1) telex exchange is operated in Colombo for both domestic and international services. As of March 1995, the total number of telex subscribers is 1,560. The telex network is also used for gentex service covering 44 post offices with 88 telex terminals on nation-wide basis. International service is also provided with 213 international circuits. The Figure 4-3-3 shows telex network configuration.

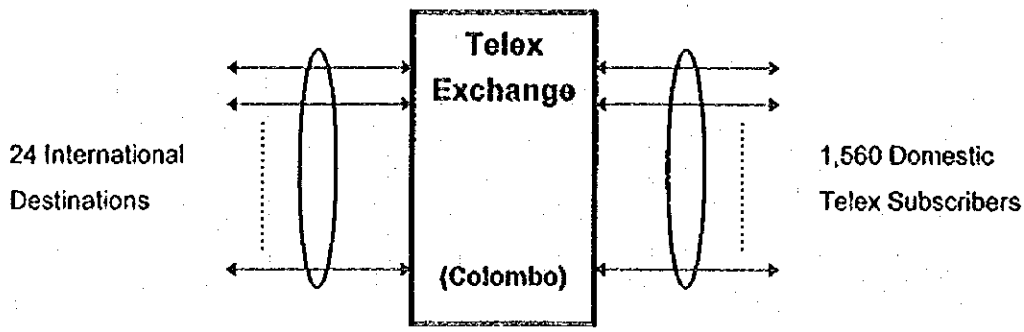


Figure 4-3-3 Telex Network Configuration

3.3 Transmission Network

Transmission network mainly consists of national network and junction network in Greater Colombo Area by both analogue and digital systems. As of December 1994, digitalisation ratio is approximately 87%. After the completion of on-going projects financed by SLT, ADB, Finland and Suppliers, digitalisation ratio on channel basis will become approximately 97% at the year 1997.

3.3.1 National Transmission Network

National transmission network mainly consists of digital microwave transmission system except several spur links which are still of analogue system, as of May 1995. In some short sections, traditional cable PCM system is still being operated. Fibre optic transmission system was introduced for only one section between Kandy and Primrose at this moment. The national transmission network as of May 1995 and future national network at the year

1997 when the on-going projects will be completed are referred to in the respective Figures 4-3-4 and 4-3-5.

3.3.2 Junction Transmission Network in Greater Colombo Area

Junction transmission network in Greater Colombo area mainly consists of fibre optic transmission system covering the whole Greater Colombo area. For several sections, cable PCM system and microwave transmission system are still operated. The Figure 4-3-6 shows the existing junction transmission network in Greater Colombo area as of May 1995.

3.3.3 International Transmission Network

International transmission network in Sri Lanka mainly consists of satellite transmission and submarine cable transmission networks for the connections with 37 international destinations. Regarding the satellite transmission network, there are three kind of earth stations consisting of PDK-1A (INTELSAT-A type) with FDM/FM, SCPC and IDR transmission which was commissioned in 1975, COL-1B (INTELSAT-B type) which was commissioned in 1990 and PDK-2A which has recently established. As for the submarine cable transmission network, there are two submarine cables consisting of SEA-ME-WE No.1 by a coaxial submarine cable system and SEA-ME-WE No.2 by a fibre optic cable system which were commissioned in 1985 and 1994 respectively.

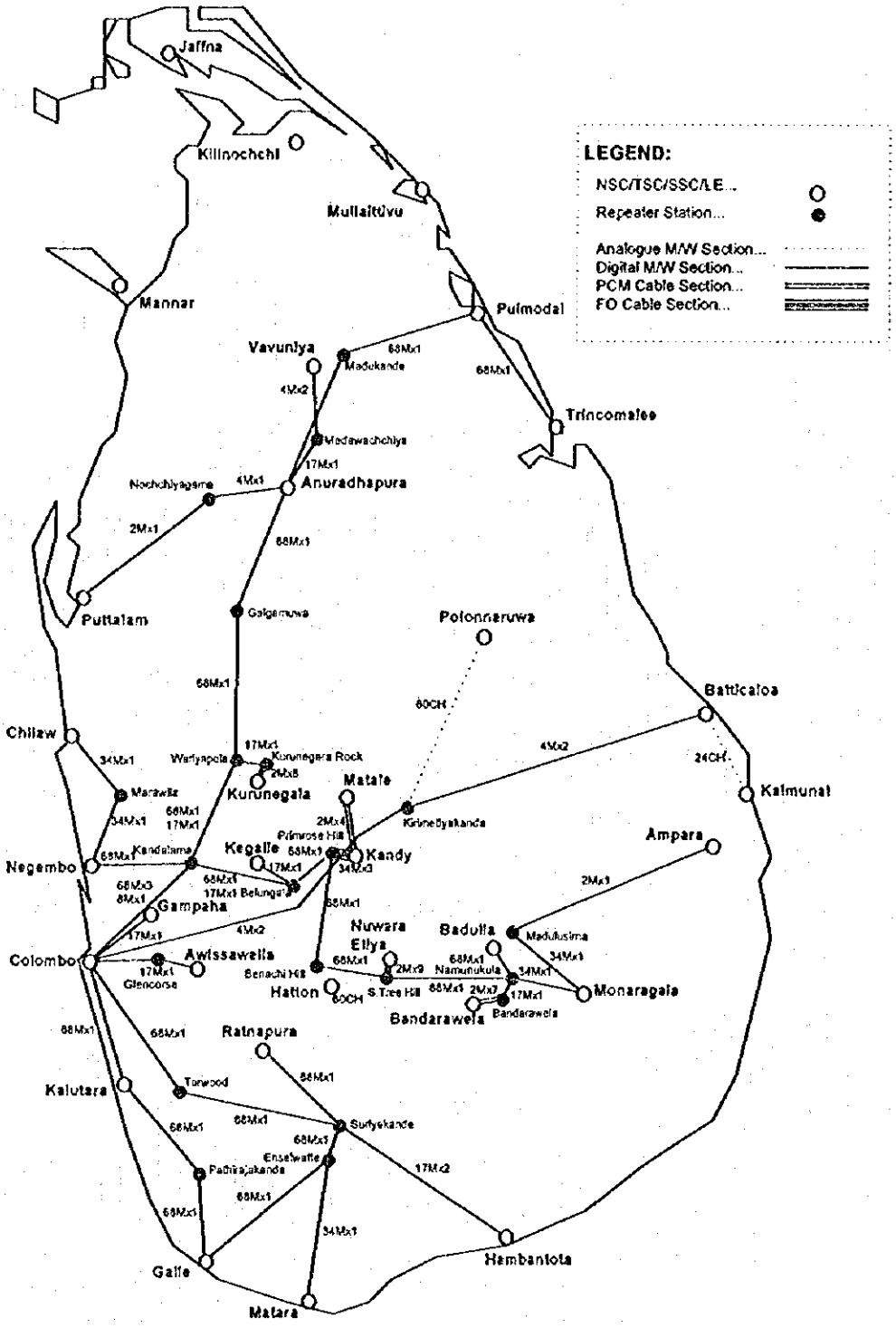


Figure 4-3-4 National Transmission Network as of May 1995

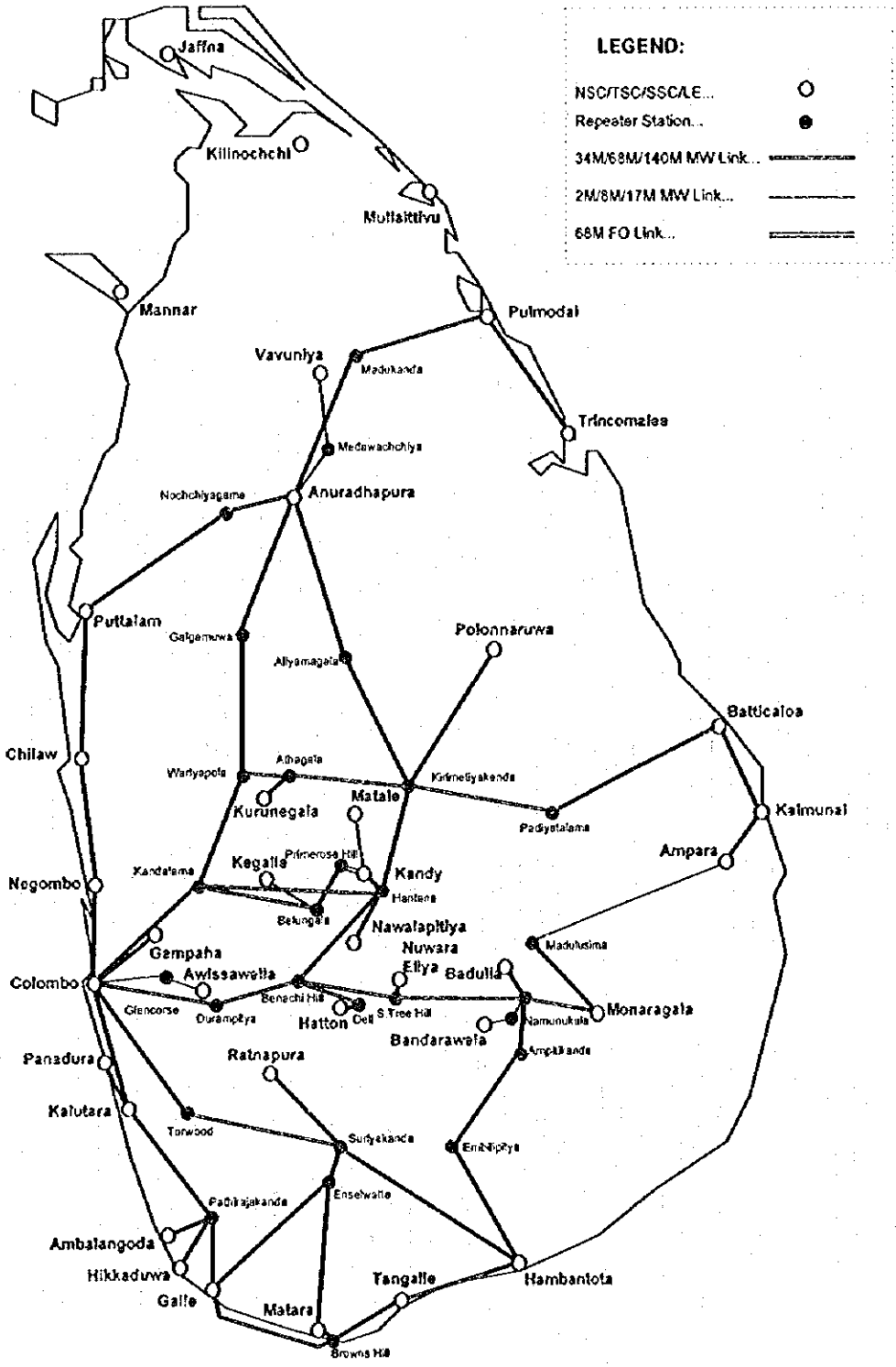


Figure 4-3-5 National Transmission Network in 1997

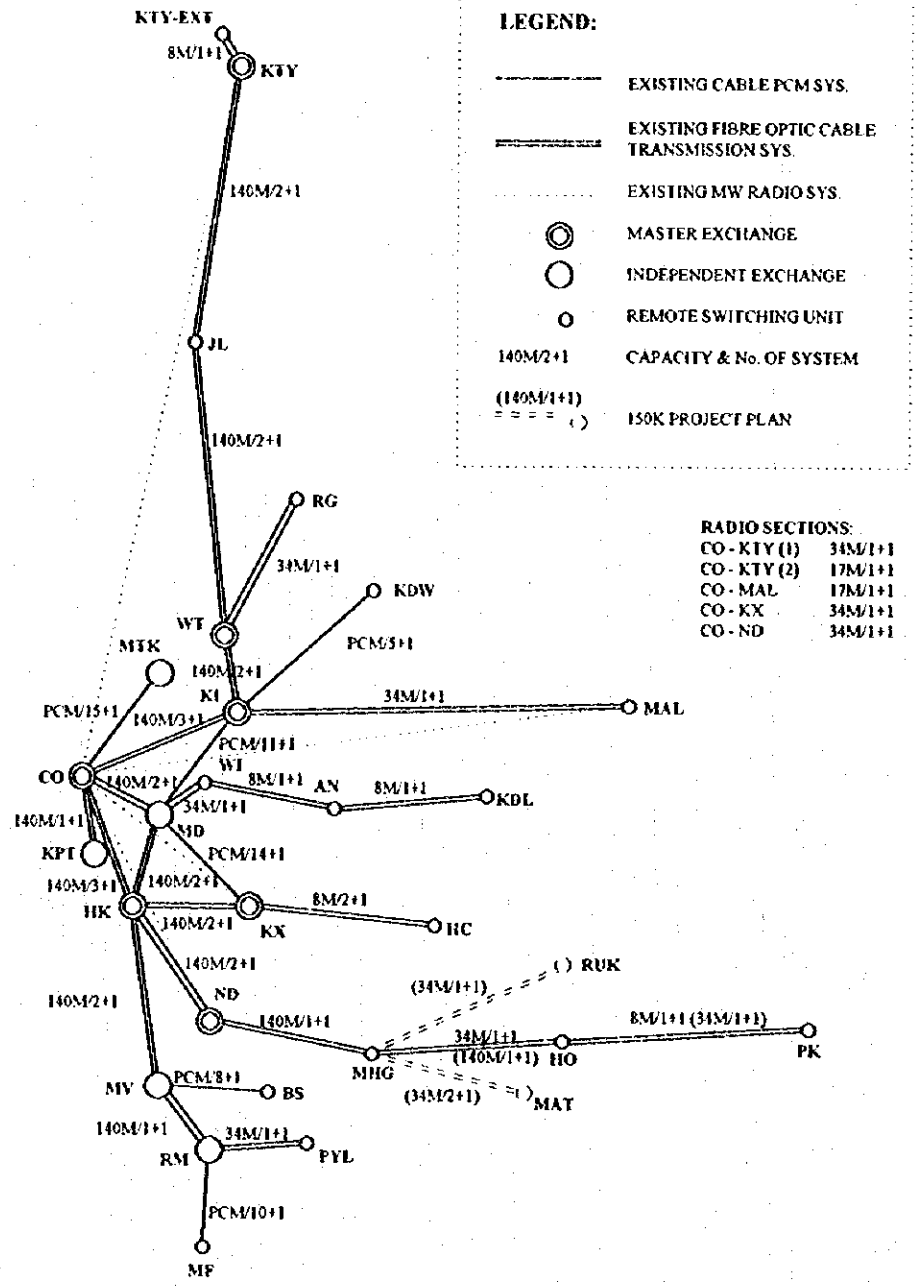


Figure 4-3-6 Junction Transmission Network in Colombo Area at the end of 1995

3.4 Subscriber Access Network

3.4.1 General

The subscriber access network in Sri Lanka mostly consists of the metallic cables, however, DRMASS (Digital Radio Multiple Access Subscriber System) is applied in the remote and isolated areas where the installation of cables is very difficult due to the economical or geographical reasons.

The subscriber cable network has been rapidly improved by replacing deteriorated lead sheathed cables with polyethylene sheathed cables. As of December 1994, only 4.6% of lead sheathed cables are still used. However, it will be replaced with new cables by the recent projects by the year 1997. The following Table 4-3-2 shows the present conditions of subscriber cable facility as of December 1994 and as of 1997 when the on-going projects will be completed. In addition to the replacement of deteriorated cables, improvement of defective facilities between distribution points and subscriber premises which are most of causes of the faults is essential.

Table 4-3-2 Subscriber Cable Facilities as of 1994 and 1997

Categories	Condition as of the end of 1994	Condition at the year 1997
Switch Capacity	237,466	619,987
Primary Cable Pairs	295,715	738,962
Cable Pairs / Switch Capacity	1.25	1.19

Source: SLT

3.4.2 Distribution System, Transmission Requirements and Conductor Diameters

Fixed distributing system has been employed and cross-connection cabinet system is generally adopted. However, direct distribution system is also applied in the areas where comparatively suitable and stable demand exists in the immediately vicinity of the exchange. The attenuation loss and the loop resistance of subscriber line are limited to 8dB at 1,500Hz and 1,500 Ohms respectively. The finest uni-gauge is generally applied to subscriber loop, however, the economical combination of two gauges is also allowed. Within one cabinet area, uni-gauge is applied in principle.

3.4.3 Primary Cable

All primary cables are conduit cables, and the type of cable is of polyethylene single sheathed with moisture barrier and jelly filled cellular-solid polyethylene insulated pair / quad type. The following Table 4-3-3 shows the type of primary cables:

Table 4-3-3 Type of Primary Cables

Conductor Diameter	Number of Pairs
0.4mm	300, 400, 600, 800, 1000, 1200, 1500, 1800, 2400
0.5mm	300, 400, 600, 800, 1000, 1200, 1800
0.65mm	300, 400, 600, 800, 1000, 1200
0.9mm	200, 300, 400, 600

3.4.4 Secondary Cable

The secondary cable consists of conduit cable, buried cable and aerial cable. The type of conduit cable is the same as primary cable. The buried cable is polyethylene single sheathed with moisture barrier and jelly filled cellular-solid polyethylene insulated pair /quad type cable with steel tape armoured. The aerial cable is of polyethylene single sheathed with moisture barrier and solid polyethylene insulated pair / quad cable of self-supporting type. The following Table 4-3-4 shows the type of secondary cables:

Table 4-3-4 Type of Secondary Cables

Conduit Cable and Buried Cable	
Conductor Diameter	Number of Pairs
0.4mm	10, 20, 30, 50, 100, 150, 200
0.5mm	10, 20, 30, 50, 100, 150, 200, 300, 400
0.65mm	10, 20, 30, 50, 100, 150, 200, 300, 400
0.9mm	10, 20, 30, 50, 100, 150, 200, 300, (400) ( ):conduit cable
Aerial Cable	
0.4mm	10, 20, 30, 50, 100, 150, 200
0.5mm	10, 20, 30, 50, 100, 150, 200
0.65mm	10, 20, 30, 50, 100, 150
0.9mm	10, 20, 30, 50

4. Present Status of Telecommunications Networks Operated by Other Operators

This sub-section describes the present status of telecommunications networks operated by private operators other than SLT. The description covers mainly data communication networks and mobile telephone networks.

4.1 Data Communication Network

Two private operators i.e. Lanka Communication Services and Electrotek are provided data communication service. The DataNET operated by Lanka Communication Services is providing their services in Colombo area. The network which was commissioned in 1993 is connected to TelePACK in Singapore. The number of subscribers is 700 as of June 1995. The Electrotek has just started to provide the service in Colombo area. The number of subscribers is counted 800 as of June 1995. In addition, Lanka Internet as a Internet Provider in Sri Lanka is providing the Internet connection service. The number of subscribers is 200 as of June 1995.

4.2 Mobile Telephone Network

In Sri Lanka, there are four mobile telephone networks operated by respective four private operators. The name of networks is Celltel, Call Link, Mobitel and MTN Networks. Mobitel which is one of those operators is joint venture among SLT and private company. The respective four networks have the following features as shown in the Table 4-3-5:

Table 4-3-5 Features of Mobile Telephone Networks

Items	Celltel	Call Link	Mobitel	MTN Networks
Foreign Partner	MIC(USA)	Singapore Telecom	Telestra (Australia)	Telecom Malaysia
System	TACS	TACS	AMPS	GSM
Frequency Band	800-900MHz	800-900MHz	800-900MHz	1.8-1.9GHz
Access Code	072	078	071	077
Year of Operation	1989	1993	1993	1995
No. of Subs	18,000	7,800	12,462	1,500
Roaming	None	N.A.	in Asia	International

4.2.1 Celltel Network

The Celltel Network is operated by the Celltel Lanka Limited mainly invested by the Miliam International Cellular (MIC) company of USA. The service coverage areas are Colombo, Kandy, Galle and other several cities. The network consists of four digital switches in Colombo, Kandy and Galle, and 22 base stations which are connected with own trunk links.

The share of registered subscribers is 80%, 15% and 5% in respective Colombo, Kandy and Other areas. The subscribers of Celltel Network are able to use not only ordinary telephone but also facsimile and voice mail services. Celltel intend to expand the network by GSM system and to cover Puttalam, Dambulla, Ratnapura, Badulla and Bandarawela.

4.2.2 Mobitel Network

The Mobitel Network is operated by OTC Australia Ltd. which is the subsidiary of the Telestra Corporation of Australia. The operation has started in 1993 as BOT scheme to SLT. However, the agreement was changed to joint venture scheme in order to expand the network and introduce new technology from May 1995.

The service coverage areas are Colombo, Galle, Kandy, Anuradhapura and other several cities. The network consists of one digital switch and 20 base stations which are connected with leased circuits from SLT except Mobitel's own link between Galle and Matara. The network is connected with SLT's telephone network in Colombo.

The Mobitel provides international roaming to other AMPS networks. At present, the international roaming is available in five Asian countries, i.e. Australia, New Zealand, Hong Kong, Singapore, Thailand and Malaysia.

CHAPTER 5

PROBLEMS BEING ENCOUNTERED IN SECTOR

CHAPTER 5

PROBLEMS BEING ENCOUNTERED IN TELECOM SECTOR

1. General

1.1 Service Provision

On the review of activities in telecom sector, the most important item is the available services and their volume capacity. In Sri Lanka, the basic telecom services, such as fixed telephone, telex, telegram and leased circuit services are operated by SLT as monopoly at present. On the other hand, the value added services, such as cellular mobile telephone, public payphone, electric mail, data communication and paging services are operated by several private companies. However, the enhanced value added services, like video conference, ISDN and IN services are not provided yet.

In this chapter, problems on the fixed telephone service by SLT are introduced as the largest telecom service in Sri Lanka. Major problems are found from the following view points:

1) Demand fulfilment and network development
2) Increase of main lines and waiting applicants
3) Expansion of exchange capacity and its usage

Details of these items are discussed in the Section 2 of this chapter. The problems in other services are to be reviewed separately under the other studies.

1.2 Service Quality

The service quality is also one of the important items for telecom services. In general, the following indexes are used:

1) Call completion rate
2) Fault occurrence rate
3) Fault clearance rate

The detailed data for these items are available on the telephone service by SLT, not in other services by private operators. These items are discussed in the Section 3 of this chapter.

1.3 Operational Management

The public telecommunication services must be provided with low service charge and high quality as well as possible. For this objectives, the management of telecom operators must be performed in good balance on manpower, facilities and finance. For this matter, the following items are discussed on the SLT management:

1) Staff productivity (number of staff per main lines)
2) Composition of staff for each field
3) Training of staff
4) Revenue and expenditure
5) Billing system
6) Accounting system

Detailed discussions are stated in Section 4 in this chapter.

1.4 Telecom Sector Management

In Sri Lanka, the telecom sector is managed by the Sri Lanka Telecommunications Authority (SLTA) under the Ministry of Posts and Telecommunications. SLTA mainly controls tariff system, licensing of operators, radio frequency allocation, national numbering, consumer protection, enforcement of relevant laws and licensing conditions, in accordance with the Telecommunications Act No.25 of 1991.

Based on the information by SLTA, some problems exist on the frequency management. Details are stated in the Section 5 in this chapter.

2. Demand Fulfilment and Network Development

2.1 Demand Fulfilment and Network Development Targets

In line with the National Policy on Telecommunications which follows the Economic Policy Statement of the Government of Sri Lanka announced on 13th September 1994, SLT has driven forward its plans to meet the requirements pointed out in the new telecommunications policy.

The Government of Sri Lanka intends to achieve the following targets:

a) Telephone to be made available on demand by 1998. All waiters' lists to be cleared by this time. Those who are far away from cable networks will be provided the service by wireless means.

b) To provide telephones, telegraph and facsimile access to all villages and villagers by 1998.

It was estimated, in keeping with the aspirations of the people and the demand arising from rapid economic growth, that the requirement for telephone (Direct Exchange Lines, DEL) will be in the following order of magnitude:

December 1995 - 460,000 lines;
December 1998 - 565,600 lines;
December 2000 - 636,000 lines.

In response to the requirements, SLT is expanding its network adding around 385,600 new lines to the existing approximately 180,000 lines by the year 1998. The on-going programmes by means of financing by World Bank, OECF, Finnish Export Credit, ADB, French Protocol, EDCF Korea, SLT fund and the supplier's credit for "150,000 Lines" are expected to meet the requirement. Those programmes are being carried out by introducing new digital exchanges, providing subscriber network by cables or radio systems, and expanding transmission network linking exchanges, whole the country except areas where there is security problem.

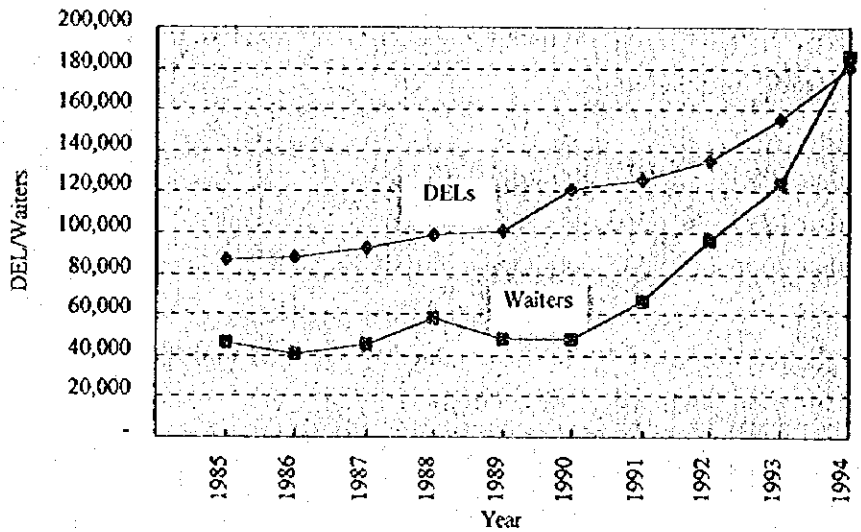
2.2 Increase of main lines or direct exchange lines and the waiters

SLT has increased the main lines or direct exchange lines (DEL) at an annual increase rate of 8.5 % for the past 10 years. The number of DELs at the end of the year 1994 recorded 180,724. However, the numbers of waiters recorded 45,924 in the year 1985 came up to 186,245 as of the end of 1994, i.e., it increased at an average increase rate of 16.8 % per year, which is almost double of DEL increase rate. Table 5-2-1 and Figure 5-2-1 shows the number of DELs and waiters and the increase trend, respectively. As read out of the Table and Figure, the expansion programs implemented by SLT for the past years have not been sufficient to meet the demand increase.

Table 5-2-1 Number of DELs and Waiters for the Past 10 Years

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
DELs	86,599	87,974	92,779	98,920	101,162	121,388	125,834	135,504	155,475	180,724
Increase		1,375	4,805	6,141	2,242	20,226	4,446	9,670	19,971	25,249
Waiters	45,924	40,797	45,054	58,741	48,400	47,945	66,574	96,207	123,839	186,245

Source: SLT.



Source: SLT.

Figure 5-2-1 Increase trend of the number of DELs and waiters

2.3 Expansion of Exchange Capacity and Its Usage

SLT has exerted itself to eliminate the waiting applicants by expanding telephone exchange capacity. SLT has increased the installed exchange capacity to around 238,000 subscriber lines at national base, including around 159,000 lines in Colombo Metro, by the end of 1994. Exchange capacity increased by 19,000 lines during the period 1992 to 1993 and 32,000 lines 1993 to 1994. Table 5-2-2 shows the growth of exchange capacity.

Table 5-2-2 Growth of Exchange Capacity

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Capacity	129,440	128,397	129,781	134,087	152,726	158,518	159,667	186,047	218,356	237,464

Source: SLT.

SLT had 237,464 lines of exchange capacity and 180,724 connected lines at the end of 1994. It indicates that SLT made use of around 76 % of the installed exchange capacity on the average at the end of 1994. It is understood that the exchange resources could not be used at the most, in spite of a large number of waiters, because outside plant installation could not follow duly the rapid increase of exchange capacity. A due management on the outside plant completion time and line connection work force is desired so that the exchange resources can be used effectively as much as possible. It was learned also through interviews with officials at site that there were many waiting applicants out of the normal service area of exchange, who had waited for several years, for the SLT network could not cover all the populated areas always. This may be another factor hampering a high use rate of the resources. Table 5-2-3 shows the installed exchange capacity and connected lines of each SSC area. In Jaffna area the telecommunications facilities are supposed destroyed completely.

Table 5-2-3 Installed Exchange Capacity and Connected Lines (December 1994)

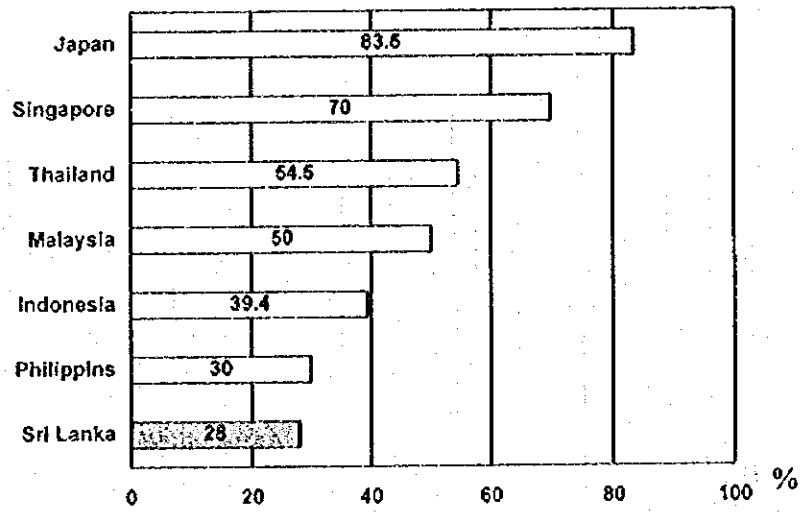
SSC area	Exchange installed capacity	Connected lines	SSC area	Exchange installed capacity	Connected lines
Ampara	500	475	Kandy	11,771	8,421
Anuradhapura	3,856	2,751	Kegalle	3,084	1,947
Awissawella	2,640	1,821	Kurunegala	4,742	3,793
Badulla	3,586	3,208	Mannar	600	124
Bandarawela	2,340	1,815	Matale	2,731	2,104
Batticaloa	1,700	1,629	Matara	2,115	1,830
Chilaw	2,865	1,771	Nawalapitiya	420	329
Colombo	159,141	124,032	Negombo	5,896	3,461
Galle	5,095	3,393	Nuwera Eliya	2,848	1,860
Gampaha	2,774	2,114	Polonnaruwa	1,070	747
Hambantota	4,326	2,793	Ratnapura	3,856	2,634
Hatton	962	803	Trincomalee	922	824
Jaffna	0	0	Vavuniya	600	583
Kalmune	900	900	**Total**	**237,464**	**180,724**
Kalutara	6,124	4,562			

Source: SLT.

3. Telecommunication Service Quality

3.1 Low Call Completion Rate

The call completion rate is one of the most important indicators to explain the telephone service quality. The call completion rate means percentage of call attempts that receive an answer. Busy, no-answer and incomplete dialling are not considered successful calls. In good networks, a call completion rate of above 60% can be achieved.



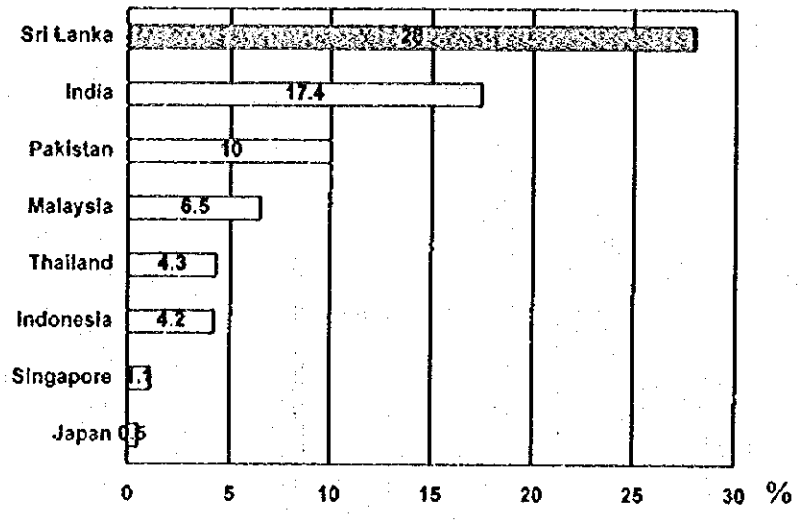
Source: ITU.

Figure 5-3-1 Telephone Call Completion Rate in Asia (1990-1994)

The call completion rate in Sri Lanka is very low compared with other countries in Asia. This situation invites low customer satisfaction and decrease of revenue. This matter must be improved referring to the analysis of causes.

3.2 Many and Frequent Faults in Operation

The fault rate is also an important indicator to the service quality. This rate generally indicates as the number of faults per month per 100 main lines. As shown in Figure 5-3-2, there are various results by country. In general, customers will not satisfy the higher rate over 8 which means one fault per year.



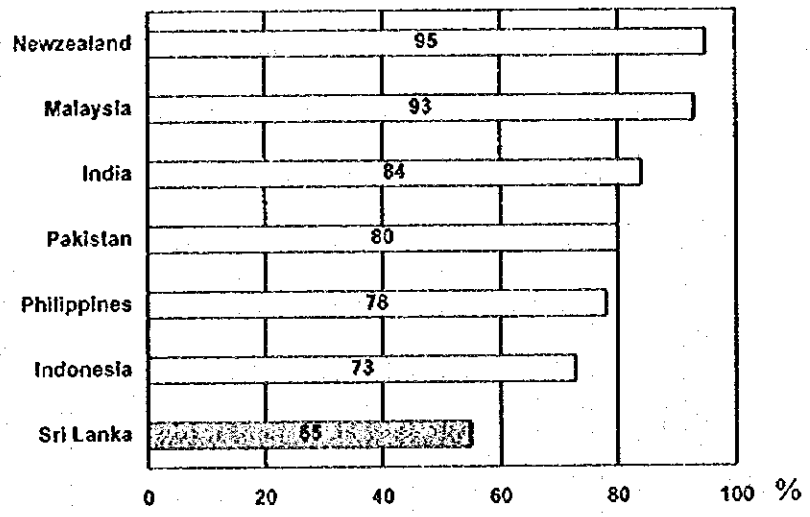
Source: ITU.

Figure 5-3-2 Telephone Line Fault Rate in Asia (1991, 1994)

The fault rate of Sri Lanka is very high (bad) compared with other countries in Asia. The value, 26 means that every telephone lines have faults 3 time per year. This problem occurs mainly on overhead lines to subscribers. About 10% of faults are repeating within a month. To solve such problems, the skill of maintenance staff must be up-graded in addition to the rehabilitation of subscriber lines.

3.3 Delay of Fault Clearance Work

The clearance time is one of major quality indicators concerning the maintenance efficiency. In general, customers cannot wait more than one day to clear a telephone line fault. Therefore, this item indicates the percentage of cleared faults within 24 hours (actually, within next one day). Figure 5-3-3 shows the result of clearance in various country in Asia.



Source: ITU.

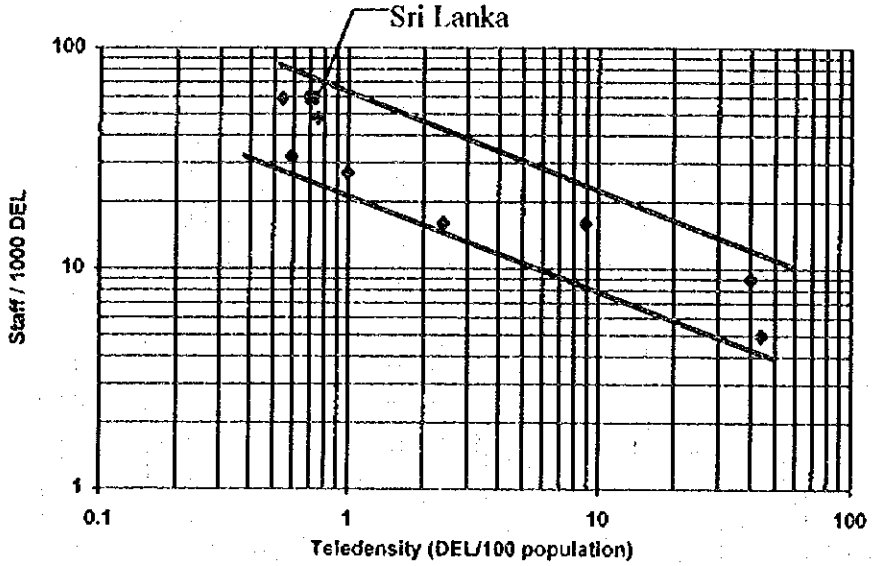
Figure 5-3-3 Fault Clear Rate within 24 hours (1991, 1994)

The clear rate of Sri Lanka is very low compared with other countries in Asia. Major reason of this problem is due to many number of faults. It seems that the clear rate can be improved easily when the number of faults will be reduced by the rehabilitation of the existing cable network..

4. Operational Management

4.1 Low Staff Productivity

The staff productivity vary relating to various factors, such as number of main lines, teledensity, average staff cost, geographical conditions and technology used for network. Among these factors, in general, the teledensity has the largest relation with staff productivity as shown in Figure 5-4-1.



Source: ITU.

Figure 5-4-1 Staff Productivity in Asia (1991)

The staff productivity of Sri Lanka is 59 staff / 1000DEL in 1991. This level is slightly lower worse compared with Asian trend. It was improved to 42 in 1994. The productivity must be improved more relating to the increase of teledensity.

4.2 Shortage of Technicians

In 1994, SLT has 55% of technical staff. However, it consists of technicians (12%) and skilled workmen (43%). The technical level of skilled workmen is not so sufficient for the maintenance of digitalised and computerised facilities.

The number of managers including engineer is only 263. This is 3.5% of total SLT staff (7,516) in 1994. It also too short to manage telecommunication network in whole Sri Lanka.

4.3 Insufficient Progress of Training

There are two main training centres and three regional training centres in SLT. During the year 1994, SLT planned to complete 4,326 trainees. However, training has achieved for only 2,855 staff. It means 66% progress to plan. The training system and management must be improved considering further expansion of network.

4.4 Insufficient Income to New Investment

The revenue structure of 1994 reveals that 70% of it is international calls. Furthermore, 60% of all subscribers pay only 500 SRs / month or less for their bills. Viewed in the light of the special circumstances of Sri Lanka, the current tariff system clearly indicates that the lower price set for domestic calls creates greater opportunities for the widespread use of telecommunications. On the other hand, international calls are basically collected from profitable business users, as a cost bearing by beneficiaries. It seems that the current tariff system can be viewed as quite adequate for the social condition, under the current development stage of telecommunications.

Proposed projects in the Master Plan, however, call for an increase primarily in the number of residential subscribers. Because the majority of subscribers will spend only about USD 100 annually, appropriate measures must be taken to deal with this situation. Increase of residential subscriber, namely, decrease of revenue per subscriber will be come steadily. Number of subscriber for consumption is shown in Table 5-1-1.

Without any guarantee in sight for securing sufficient revenues in the future, however, SLT will certainly find it extremely difficult to universally satisfy demand in telephone services throughout the country given the limited financial resources. Revision of basic tariff policy should be examined urgently by SLT.

In additions, when private inward investment abroad is introduced into the telecommunications sector in the current situation where projects for residential subscribers are expected to increase, investments in low return projects are likely to be neglected under the current tariff levels. Balancing and restricting measures should therefore be explored.

Table 5-4-1 The Number of Subscribers for Consumption in December 1992

Interval in Rupee	International		National		Total	
0 - 200	121,495	92.39%	55,678	42.34%	52,947	40.26%
200 - 500	1,159	0.88%	25,781	19.60%	23,911	18.18%
500 - 1,000	1,438	1.09%	20,421	15.53%	19,216	14.61%
1,000 - 2,000	1,559	1.19%	15,640	11.89%	15,671	11.92%
2,000 - 5,000	2,273	1.73%	10,906	8.29%	12,822	9.75%
5,000 - 10,000	1,427	1.09%	2,325	1.77%	3,867	2.94%
10,000 - 20,000	973	0.74%	529	0.40%	1,582	1.20%
20,000 - 50,000	801	0.61%	103	0.08%	957	0.73%
50,000 -	380	0.29%	122	0.09%	532	0.40%
Total	131,505	100.0%	131,505	100.0%	131,505	100.0%

Source: SLT.

4.5 Delay of Billing

Problems have arisen in the collection of telephone bills because of chronic delays in current billing operations. The existing computerised bill processing system has been in operation since 1983 and has already served its designed life span. Hence, this old system gives frequent hardware malfunctions and as a result, the efficiency of the bill processing has been delayed extensively and a number of billing cycles remain pending.

In order to rectify this problem, SLT has appropriated replacement expenses for the current computer facilities. When replacement is completed, it will take only two weeks to issue telephone bills, and most of the present problems will be solved.

4.6 No Detailed Accounting

Under the current accounting system, it is impossible to conduct cost-benefit analyses for each type of services. This is due to the fact that while revenues are calculated for each type of service, expenditures are not.

Such data is a minimum requirement for future formulation of investment programmes which can be achieved by attempting to maximise investment effects. This is why the current accounting system must be improved. According to SLT staff members, such improvement is part of SLT's future plan. To reach the target of the investment programmes, some kind of improvement in this area is urgently required.

5. Telecom Sector Management

For further development of the telecommunications sector, the movement that basic telecommunications service provider be extended to the private operators will be realised in near future. Profitability will be keenly required under this status, so the fear for unbalanced telecommunications network development is expected. Especially the rural telecommunications may remain behind.

Coping with these status, the management for the overall telecommunications sector will be more important than ever. SLTA should conduct the sector management in collaboration with the Ministry of Posts and Telecommunications.

CHAPTER 6

DEMAND FORECAST

CHAPTER 6

DEMAND FORECAST

1. Introduction

This chapter describes estimation of demand for telephone, telex, telegram and value-added services, which provides a basis for the economic and technical study of the master plan for development of the telecommunications network in Sri Lanka up to the year 2015. The forecasting base year is set at 1995, and successive forecasts are made at 2000, 2005 and 2015.

In order to make realistic forecasts, emphasis was placed on collection of the latest data. For some areas in Northern and Eastern provinces, however, not sufficient data were available, and demands in such areas were estimated by the study team.

Demand for national telephone service was estimated by the macroscopic forecast method, based on two models: ITU model (national level forecasting) and Sri Lanka model (district level forecasting).

Also Demand for telex and telegram services were estimated by adoption of the decreasing ratio based on latest trend in Sri Lanka. Demands for value-added services, i.e., cellular mobile telephone service, radio paging service, leased circuit services and ISDN were estimated in this study based on mainly other countries data. The estimation of demand for new services at an initial stage usually needs detailed market surveys including direct interviews for collection of fairly reliable data. Unfortunately, in this master plan, sufficient data for new services was not collected due to time limitation.

2. Expressed Demand at the end of 1994

The Expressed Demand (DEL's and waiters) in the whole country was **366,969** at the end of 1994, and that in the Colombo district was 185,002, which accounts for approximately 50% of the total demand.

The above figure, however, does not include the demand in 3 (three) non-telephone districts in Northern and Eastern provinces, namely, Jaffna, Kilinochchi and Mullativu. The study team estimated the "probable" expressed demand in these districts, based on the

expressed demand densities of similar districts. For other 3 (three) districts in the same provinces, namely, Mannar, Batticaloa and Trincomalee, where telephone services are now provided only in limited areas, the study team also estimated the "probable" expressed demand in the same way.

To identify "similar districts" to the above six districts, all the districts in Sri Lanka were classified into 6 (six) categories by their respective characteristics, such as urban population ratio, the number of public facilities and the telephone service level.

The districts thus categorised are illustrated in Figure 6-2-1. The characteristics of each district are shown in Table 6-2-1.

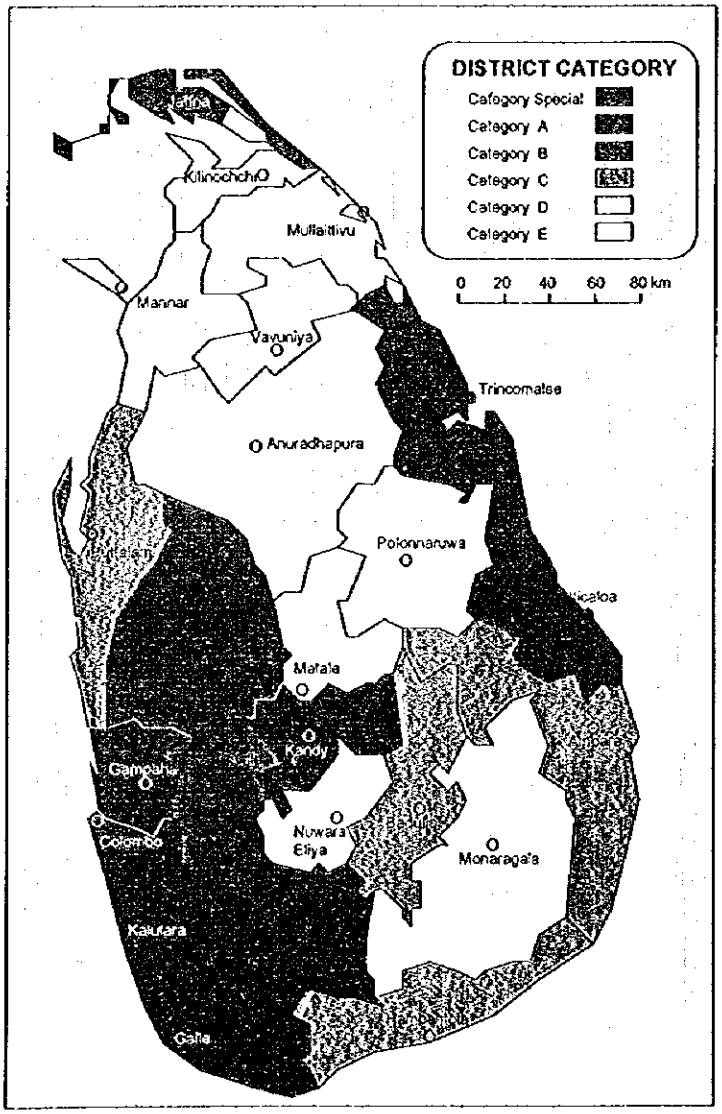


Figure 6-2-1 Categorization of District

Table 6-2-1 Categorization of Each District and Sample Areas for Socio-Economic Survey

Administration				Population & Land						Public Facilities					Telecommunication (1994)			Remarks	
Name of Province	No.	Name of District	No. of Divisional Secretariat	Population at 1994 ('000)	Land Area (sq. Km.)	Pop.den. at 1994 (p./sq.Km)	Urban Ratio (%) at 1994	Geography Condition	Sub Category	Co-operative Devp. Dept. at 1992	No. of Bank Branch at 1992	No. of School at 1990	No. of Total Facilities	Sub Category	Telephone Density	Expressed Demand Density	Sub Category	Final Category	Sample Area of Survey
Western	1	Colombo	10	2,008	674.6	2,977	61	Urban	Special	501	178	449	1,128	A	5.86	9.21	Special	Special	
	2	Gampaha	13	1,696	1,352.5	1,254	14	Urban	A	721	61	585	1,367	Special	0.73	3.22	Special	Special	
	3	Kalutara	11	937	1,575.5	595	12		A	460	49	465	974	C	0.42	1.24	A	A	
Central	4	Kandy	17	1,219	1,867.8	653	15	Hilly/inland	A	598	58	677	1,333	Special	0.72	1.82	A	Special	Selected
	5	Matale	11	422	1,953.9	216	9	Hilly/inland	C	223	24	311	558	D	0.49	1.01	B	D	
	6	Nuwara Eliya	5	670	1,668.4	402	8	Mountain	C	240	33	483	756	C	0.48	0.82	C	D	Selected
Southern	7	Galle	16	954	1,616.1	590	11		B	517	48	505	1,070	B	0.42	1.23	A	A	Selected
	8	Matara	14	754	1,289.4	594	9		C	366	44	394	804	C	0.24	1.16	A	B	
	9	Hambantota	11	518	2,512.8	206	4		C	255	28	314	597	C	0.44	0.79	C	C	Selected
Northern	10	Jaffna	14	978	929.2	1,053	——	Urban	(A)	646	22	481	1,149	Special	0.00	0.00	(A)	A	
	11	Killinochchi	2	146	1,205.4	121	——		(E)	102	3	76	181	E	0.00	0.00	(E)	E	
	12	Mannar	4	112	1,880.5	60	——		(C)	66	3	104	173	E	0.11	0.20	(E)	E	
	13	Vavuniya	4	129	1,860.7	69	——	inland	(C)	62	3	127	192	E	0.45	1.05	B	D	
	14	Mulativu	1	103	2,415.4	43	——		(D)	44	3	91	138	E	0.00	0.00	(E)	E	
Eastern	15	Batticaloa	7	461	2,389.1	193	——		(B)	183	12	257	452	D	0.35	0.83	(A)	B	
	16	Ampara	12	537	4,239.3	127	——		(C)	300	24	320	644	C	0.26	1.06	B	C	
	17	Trincomalee	10	353	2,529.4	140	——	Urban	(A)	138	11	217	366	D	0.23	0.44	(B)	B	
North Western	18	Kurunegala	27	1,376	4,584.3	300	2	inland	D	717	62	953	1,732	Special	0.29	0.82	C	B	Selected
	19	Puttalam	16	599	2,846.5	210	9		C	308	33	336	677	C	0.37	1.08	B	C	
North Central	20	Anuraghapura	21	675	6,663.8	101	7	inland	C	386	51	547	984	C	0.41	0.87	C	D	Selected
	21	Polonnaruwa	6	330	3,117.2	106	0	inland	E	210	25	202	437	D	0.24	0.68	D	E	Selected
UVA	22	Badulla	14	748	2,788.0	268	7	Hilly/inland	C	498	46	556	1,100	B	0.50	0.77	C	C	Selected
	23	Moneragala	10	365	5,527.9	66	0	inland	E	145	21	209	375	D	0.21	0.37	D	D	
Sabaragamuwa	24	Ratnapura	16	919	3,235.9	284	6	inland	C	497	40	589	1,126	A	0.38	0.80	C	B	
	25	Kegalle	10	756	1,632.9	463	2	inland	D	498	40	608	1,146	Special	0.32	0.82	C	B	
			282	17,765	62,336.5	285				218,725	922	9,856	229,503		1.02	2.03			

( ) : estimated by Study Team

tab6-2-1.xls

Note : Final categorization of each district was decided after a discussion between the study team and SLT staff.

The expressed demand density of each category is shown in Table 6-2-2.

Table 6-2-2 Expressed Demand Density of Each Category

Category	Population	Expressed Demand	Expressed Demand Density
Special	4,922,296	261,760	5.32
A	1,890,998	23,345	1.23
B	3,804,756	33,593	0.88
C	1,865,325	16,334	0.88
D	2,131,481	16,999	0.80
E	330,228	2,253	0.68

Note : Not including demand in Northern and Eastern Provinces

The demands in the 6 (six) districts in Northern and Eastern Provinces were estimated, by applying the expressed demand density of the same category. Table 6-2-3 presents the "probable" demands estimated for the 6 (six) districts.

Table 6-2-3 Estimated Expressed Demand of Six Districts

District Name	Category	Expressed Demand
Jaffna	A	12,032
Kilinochchi	E	994
Mannar	E	763
Mullaitivu	E	701
Batticaloa	B	4,060
Trincomalee	B	3,102

As a result, the expressed demand in the whole Sri Lanka at the end of 1994 was estimated to be 383,011.

The revised expressed demand in each district in the whole country is summarised in Table 6-2-4.

Table 6-2-4 Expressed Demand (DEL's + Waiters at Dec. 1994)

Province	District	No. of D. S.	Categ.	Population Total	SSC	SW Cap.	PRM Loops	DEL's	Reg. Wait	Expressed Demand	(%)	District Demand	(%)	Demand Density	Estimated Demand	Estimated Density	Final Demand
Western	Colombo				Awissawella	1,356	1,700	985	1,341	2,326	0.63%						
		10	Special	2,007,703	Colombo	150,403	179,854	116,571	66,105	182,676	49.78%	185,002	50.41%	9.21			185,002
	Gampaha				Colombo	8,738	8,821	7,461	23,471	30,932	8.43%						
					Gampaha	2,774	3,099	2,114	12,800	14,914	4.06%						
		13	Special	1,695,728	Negombo	5,204	4,300	2,840	5,944	8,784	2.39%	54,630	14.89%	3.22			54,630
	Kalutara	11	A	937,183	Kalutara	5,260	7,000	3,905	7,751	11,656	3.18%	11,656	3.18%	1.24			11,656
Central	Kandy				Kandy	11,771	13,650	8,421	12,940	21,361	5.82%						
					Matale	9	9	9	51	60	0.02%						
		17	Special	1,218,865	Nawalaptiya	420	750	329	378	707	0.19%	22,128	6.03%	1.82			22,128
	Matale	11	D	421,629	Matale	2,670	3,585	2,046	2,225	4,271	1.16%	4,271	1.16%	1.01			4,271
	Nuwera Eliya				Bandarawela	708	1,200	563	521	1,084	0.30%						
					Hatton	962	1,279	803	665	1,468	0.40%						
		5	D	670,128	Nuwera Eliya	2,848	4,705	1,860	1,116	2,976	0.81%	5,528	1.51%	0.82			5,528
Southern	Galle				Galle	5,095	6,420	3,393	6,307	9,700	2.64%						
		16	A	953,815	Kalutara	864	633	657	1,332	1,989	0.54%	11,689	3.19%	1.23			11,689
	Matara	14	B	754,044	Matara	2,115	2,942	1,830	6,908	8,738	2.38%	8,738	2.38%	1.16			8,738
	Hambantota	11	C	518,366	Hambantota	3,622	5,450	2,283	1,825	4,108	1.12%	4,108	1.12%	0.79			4,108
Northern	Jaffna	14	A	978,251	Jaffna	0	0	0	0	0	0.00%	0	0.00%		12,032	1.23	12,032
	Kilinochchi	2	E	146,228	Jaffna	0	0	0	0	0	0.00%	0	0.00%		994	0.68	994
	Mannar				Mannar	600	400	124	95	219	0.06%						
		4	E	112,221	Vavuniya	0	0	0	0	0	0.00%	219	0.06%		763	0.68	763
	Vavuniya	4	D	129,224	Vavuniya	600	600	583	777	1,360	0.37%	1,360	0.37%				1,360
	Mullaitivu	1	E	103,153	Mullaitivu	0	0	0	0	0	0.00%	0	0.00%		701	0.68	701
Eastern	Batticaloa	7	B	461,353	Batticaloa	1,700	2,800	1,629	2,201	3,830	1.04%	3,830	1.04%		4,060	0.88	4,060
	Amparai				Ampara	500	900	475	380	855	0.23%						
		12	C	537,301	Kalmune	900	1,600	900	3,960	4,860	1.32%	5,715	1.56%				5,715
	Trincomalee	10	B	352,533	Trincomalee	922	1,560	824	737	1,561	0.43%	1,561	0.43%		3,102	0.88	3,102
North-Western	Kurunegala				Kurunegala	4,742	9,700	3,793	7,043	10,836	2.95%						
					Negombo	192	400	124	250	374	0.10%						
		27	B	1,375,591	Chilaw	100	50	25	86	111	0.03%	11,321	3.09%	0.82			11,321
	Puttalam				Chilaw	2,765	3,116	1,746	2,999	4,745	1.29%						
		16	C	598,932	Negombo	500	600	497	1,205	1,702	0.46%	6,447	1.76%	1.08			6,447
North-Central	Anuradhapura				Anuradhapura	3,858	6,130	2,751	3,116	5,867	1.60%						
		21	D	675,125	Vavuniya	0	0	0	0	0	0.00%	5,867	1.60%	0.87			5,867
	Polonnaruwa				Matale	72	317	66	43	109	0.03%						
		6	E	330,228	Polonnaruwa	1,050	995	730	1,414	2,144	0.58%	2,253	0.61%	0.68			2,253
Uva	Badulla				Badulla	2,950	4,150	2,507	1,096	3,603	0.98%						
		14	C	748,027	Bandarawela	1,580	2,050	1,217	959	2,176	0.59%	5,779	1.57%	0.77			5,779
	Moneragala				Badulla	756	1,700	701	520	1,221	0.33%						
					Bandarawela	52	100	35	34	69	0.02%						
		10	D	364,599	Hambantota	64	100	26	17	43	0.01%	1,333	0.36%	0.37			1,333
Saberagamuwa	Ratnapura				Hambantota	640	1,150	484	469	953	0.26%						
					Awissawella	424	800	349	322	671	0.18%						
		16	B	918,684	Ratnapura	3,856	4,800	2,634	3,091	5,725	1.56%	7,349	2.00%	0.80			7,349
	Kegalle				Awissawella	860	1,600	487	457	944	0.26%						
		10	B	756,437	Kegalle	3,084	4,500	1,947	3,294	5,241	1.43%	6,185	1.69%	0.82			6,185
Grand - Total		282		17,765,348		237,586	295,515	180,724	186,245	366,969	100.00%	361,359	100.00%	2.03	21,652		383,011

3. Socio-Economic Growth Forecast

In order to forecast telephone demand, the socio-economic growth in Sri Lanka was estimated in terms of population, GDP, GDP/capita and GRDP for each forecast year. The average growth ratio of GDP from 1994 to 2015 was estimated to be 6.5 % per annum.

3.1 Population and GDP Projection (for ITU Regression Model)

For the macroscopic demand forecast by the ITU regression model, GDP in each forecast year was estimated at 1992 constant price. For population projection, the data published by the Department of Census and Statistics ("Standard projection" in Population and Labour Force published in March 1994) were used. The population, GDP and GDP/capita projected for each forecast year are shown in Table 6-3-1.

Table 6-3-1 Population and GDP Projection (for ITU regression model)

Year	1994	2000	2005	2015
Population (thousands)	17,765.3	18,830.9	19,780.6	21,524.0
GDP (Million US$)	9,494	14,339	20,882	36,014
GDP/Capita (US$)	534	761	1,056	1,673

3.2 Population and GRDP Projection by District (for Sri Lanka Model & Distribution of Demand)

For the macroscopic demand forecast by the Sri Lanka Model, GRDPs of all districts in each forecast year were estimated at 1992 constant price. Annual migration ratio of each district was calculated based on the difference between the population in 1994 and the last census made in 1981. Population of each district in each forecast year up to 2015 was estimated by using these migration ratios. The difference between the known national population as a whole and the sum of the district populations thus estimated individually was adjusted, based on the ratio of each district population to the national population.

GRDPs and populations projected for each forecast year are shown in the following Table 6-3-2.

Table 6-3-2 Population and GRDP Projection by District

(UNIT: Population in thousand ; GRDP in US$ millions)

Year	1994		2000		2005		2015	
District Name	Population	GRDP	Population	GRDP	Population	GRDP	Population	GRDP
Colombo	2,007.8	1,959	2,112.8	3,073	2,204.3	4,613	2,361.3	8,141
Gampaha	1,695.7	1,572	1,810.3	2,502	1,911.6	3,817	2,097.6	6,920
Kalutara	937.2	828	965.9	1,290	990.4	1,929	1,024.8	3,415
Kandy	1,218.9	546	1,273.2	827	1,320.1	1,204	1,396.7	2,064
Matale	421.6	180	443.3	242	462.2	312	494.5	464
Nuwera Eliya	670.1	233	685.1	309	697.9	394	712.6	580
Galle	953.8	357	999.5	532	1,039.2	767	1,105.5	1,311
Matara	754.0	286	790.2	423	821.6	606	874.1	1,036
Hambantota	518.4	161	554.0	232	585.5	323	643.5	532
Jaffna	978.3	231	1,069.2	347	1,205.1	507	1,433.4	881
Kilinochchi	146.2	26	163.8	41	180.1	61	214.2	107
Mannar	112.2	34	112.1	50	112.1	69	110.1	112
Vavuniya	129.2	33	144.8	48	159.2	66	189.4	107
Mullaitivu	103.2	25	115.0	34	125.8	46	148.1	72
Batticaloa	461.4	210	524.5	316	583.6	459	711.1	794
Ampara	537.3	238	607.7	355	673.3	513	813.5	883
Trincomalee	352.5	178	398.2	268	440.6	388	531.1	664
Kurunegala	1,375.6	652	1,421.0	954	1,459.8	1,350	1,516.3	2,265
Puttalam	598.9	265	638.6	391	673.7	557	737.8	941
Anuradhapura	675.1	279	701.1	372	723.5	473	758.1	689
Polonnaruwa	330.2	112	358.2	152	383.3	201	432.0	309
Badulla	748.0	295	782.6	397	812.6	514	862.1	763
Moneragala	364.6	122	405.6	168	443.2	225	520.7	353
Ratnapura	918.7	356	955.7	535	987.6	779	1,037.9	1,360
Kegalle	756.4	316	771.5	481	784.3	709	797.6	1,251
TOTAL	17,765.3	9,494	18,830.9	14,339	19,780.6	20,882	21,524.0	36,014

Note : At 1992 Constant Price

4. Suppressed Demand Forecast at the end of 1994 (Socio-economic field survey)

To collect necessary statistical data from local offices, objective districts were selected in such a manner that the selected districts can cover all the categories mentioned in the preceding section. The survey routes are illustrated in Figure 6-4-1.

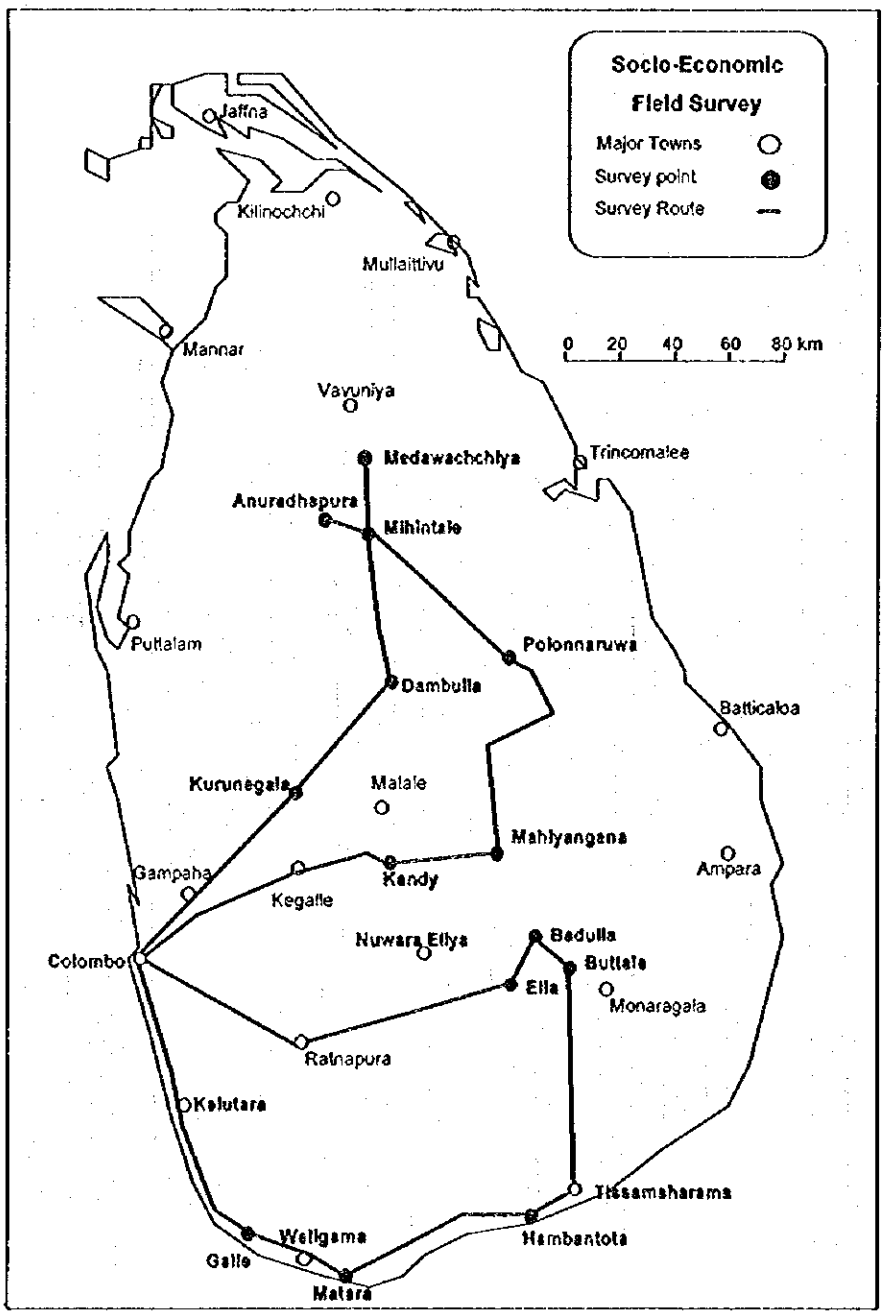


Figure 6-4-1 Socio-Economic Survey Route

Questionnaires and answers collected during the field survey for the socio-economic study are attached in DATA BOOK. Based on the data obtained through the interviews with RTEs (Regional Technical Engineers) during the field survey by the technical study team, suppressed demands in SSC (Secondary Switching Centre) areas at present were assumed to be almost equal to the number of registered waiters with some exceptions.

For Colombo, Gampaha and Kalutara, the study team assumed that the suppressed demand would be 10% of the registered waiters, while for Galle, Kandy and Negombo, 50%, since these areas have already achieved higher telephone density than other areas.

Table 6-4-1 shows the estimated suppressed demand ratio in each SSC area. As can be seen from the table, the estimated suppressed demand in total corresponds to **20%** of the existing expressed demand in Sri Lanka.

Table 6-4-1 Estimated Suppressed Demand by SSC

NO.	SSC	DEL's	Waiters	DEL's + Wait	Suppressed/ Waiter	Suppressed Demand	Suppressed / Demand
1	Ampara	475	380	855	100%	380	44%
2	Anuradhapura	2,751	3,116	5,867	100%	3,116	53%
3	Awissawella	1,821	2,120	3,941	100%	2,120	54%
4	Badulla	3,208	1,616	4,824	100%	1,616	33%
5	Bandarawela	1,815	1,514	3,329	100%	1,514	45%
6	Batticaloa	1,629	2,201	3,830	100%	2,201	57%
7	Chilaw	1,771	3,085	4,856	100%	3,085	64%
8	Colombo	124,032	89,576	213,608	10%	8,958	4%
9	Galle	3,393	6,307	9,700	50%	3,154	33%
10	Gampaha	2,114	12,800	14,914	10%	1,280	9%
11	Hambantota	2,793	2,311	5,104	100%	2,311	45%
12	Hatton	803	665	1,468	100%	665	45%
13	Jaffna	0	0	0	100%	0	0%
14	Kalmune	900	3,960	4,860	100%	3,960	81%
15	Kalutara	4,562	9,083	13,645	10%	908	7%
16	Kandy	8,421	12,940	21,361	50%	6,470	30%
17	Kegalle	1,947	3,294	5,241	100%	3,294	63%
18	Kurunegala	3,793	7,043	10,836	100%	7,043	65%
19	Mannar	124	95	219	100%	95	43%
20	Matale	2,104	2,304	4,408	100%	2,304	52%
21	Matara	1,830	6,908	8,738	100%	6,908	79%
22	Nawalapitiya	329	378	707	100%	378	53%
23	Negombo	3,461	7,399	10,860	50%	3,700	34%
24	Nuwera Eliya	1,860	1,116	2,976	100%	1,116	38%
25	Polonnaruwa	747	1,429	2,176	100%	1,429	66%
26	Ratnapura	2,634	3,091	5,725	100%	3,091	54%
27	Trincomalee	824	737	1,561	100%	737	47%
28	Vavuniya	583	777	1,360	100%	777	57%
		180,724	**186,245**	**366,969**		**72,609**	**20%**

5. Telephone Demand Forecast

5.1 Demand Forecast Procedures

Two models were used for the macroscopic demand forecast, i.e., ITU model and Sri Lanka Model. Figure 6-5-1 presents a flow chart of macroscopic demand forecast procedures of respective models.

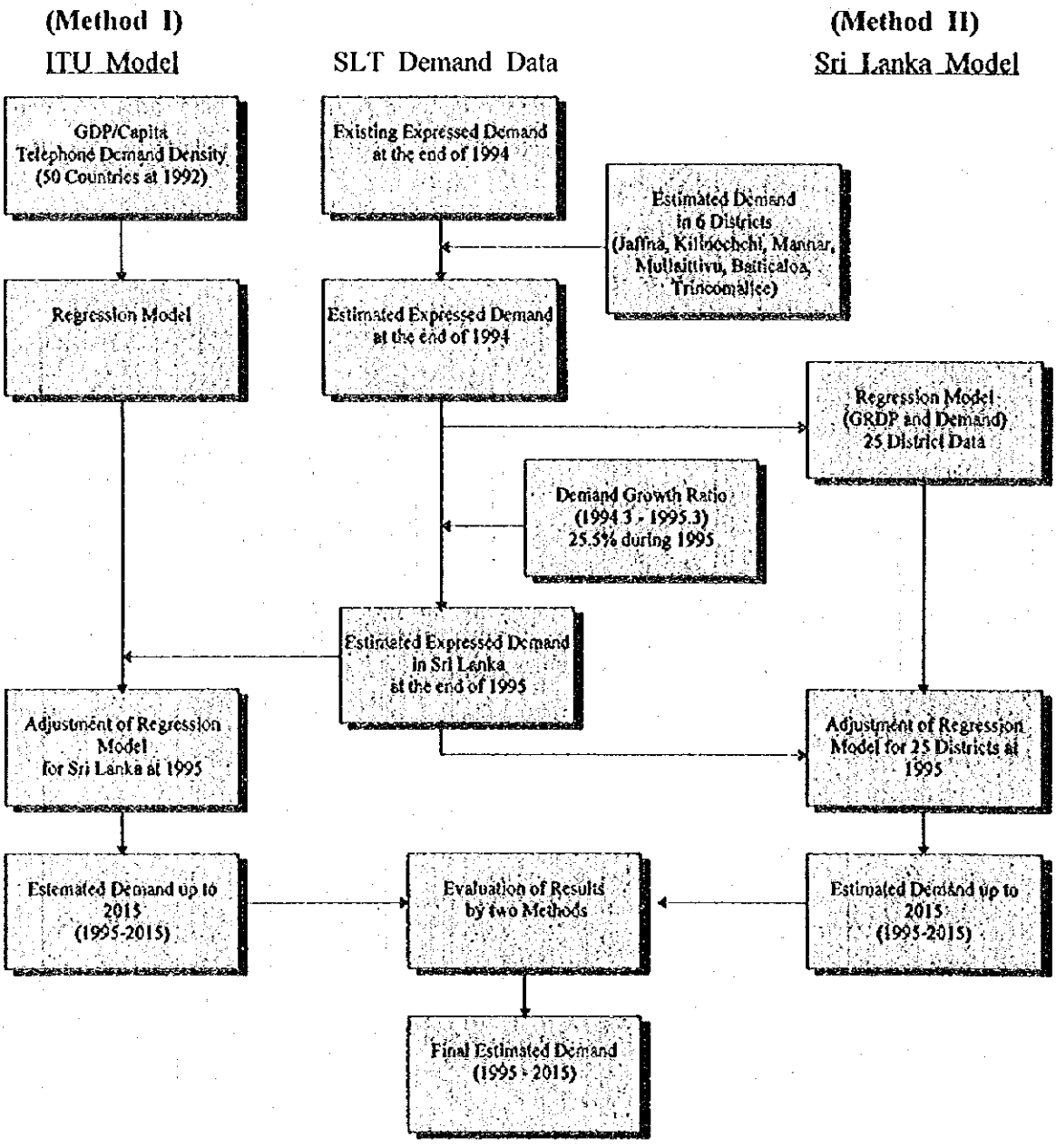


Figure 6-5-1 Macroscopic Demand Forecasting Procedures

5.2 Macroscopic Demand Forecast by ITU Model (Method I)

For the macroscopic demand forecast by the ITU regression model, a forecast model was developed by the regression analysis. The analysis was made by studying a correlation between the expressed demand density and GDP per capita using the statistical data as of 1992 of 50 (Fifty) countries over the world.

For selection of the above mentioned 50 countries, the following conditions were taken into account, in consideration of the situation in Sri Lanka:

(1) Population : More than 10.0 millions
(2) GDP per Capita : More than US$200
(3) Telephone Data at 1992 : Available

The data used to develop the model for the macroscopic demand forecast consist of the numbers of the existing main lines and registered waiting applicants. Accordingly, the calculation results do not include potential demand.

As a result of the analysis, the following regression model was obtained:

$$Ln((ML + WE)/POP \times 100) = -5.502 + 0.9692 \times Ln(GDP/POP) \quad \cdots\cdots (1)$$

$$(R^2 = 0.82)$$

where,

Ln : natural logarithmic operator
ML : the number of main lines at 1992
WE : the number of registered waiters at 1992
POP : population at 1992
GDP : GDP at 1992 price

The data used for obtaining the regression model are shown in Table 6-5-1.

Table 6-5-1 World Telephone Service

NO.	Country	Population (Millions)	GDP (Millions)	GDP/Cap (US$)	Main Line (1000 lines)	Waiting list (1000 lines)	Teledensity (per 100)	Demand Density
1	Algeria	26.3	35,674	1,356	962.3	756.9	3.66	6.54
2	Argentina	33.1	228,779	6,912	3,759.2	373.7	11.36	12.49
3	Australia	17.5	294,760	16,843	8,257.0	4.3	47.18	47.21
4	Bangladesh	114.1	23,783	208	256.3	121.5	0.22	0.33
5	Belgium	10.0	218,836	21,884	4,264.3	6.7	42.64	42.71
6	Brazil	153.9	360,405	2,342	10,670.1	510.3	6.93	7.26
7	Cameroon	12.2	10,397	852	52.0	9.0	0.43	0.50
8	Canada	27.4	493,602	18,015	16,246.6	0.0	59.29	59.29
9	Chile	13.6	41,203	3,030	1,213.2	313.7	8.92	11.23
10	China	1,162.2	506,075	435	11,469.1	1,620.4	0.99	1.13
11	Colombia	33.4	48,583	1,455	2,821.7	650.0	8.45	10.39
12	Cote D'Ivore	12.9	8,726	676	86.1	36.2	0.67	0.95
13	Czech Rep.	10.3	26,187	2,542	1,818.6	490.3	17.66	22.42
14	Ecuador	11.0	12,681	1,153	531.3	95.6	4.83	5.70
15	Egypt	54.7	33,553	613	2,173.6	1,267.5	3.97	6.29
16	France	57.4	1,319,883	22,994	29,905.3	1,267.5	52.10	54.31
17	Germany	80.6	1,789,261	22,199	35,420.8	1,200.0	43.95	45.44
18	Ghana	15.8	6,884	436	47.8	9.7	0.30	0.36
19	Greece	10.3	67,278	6,532	4,496.5	658.6	43.66	50.05
20	Hungary	10.3	35,218	3,419	1,291.1	753.0	12.53	19.85
21	India	883.6	214,598	243	6,796.7	2,845.9	0.77	1.09
22	Indonesia	184.3	126,364	686	1,485.3	225.7	0.81	0.93
23	Iran	59.6	110,258	1,850	2,997.9	508.0	5.03	5.88
24	Italy	57.8	1,222,962	21,159	23,709.0	45.0	41.02	41.10
25	Japan	124.5	3,670,979	29,486	57,652.3	0.0	46.31	46.31
26	Kenya	25.7	6,884	268	207.4	88.0	0.81	1.15
27	Korea Rep.	43.7	296,136	6,777	15,865.1	0.0	36.30	36.30
28	Madagascar	12.4	2,767	223	36.6	3.4	0.30	0.32
29	Malaysia	18.6	57,568	3,095	2091.6	168.7	11.25	12.15
30	Mexico	85.0	329,011	3,871	6753.7	662.5	7.95	8.72
31	Morocco	26.2	28,401	1,084	653.9	134.6	2.50	3.01
32	Netherlands	15.2	320,290	21,072	7,395.0	20.0	48.65	48.78
33	Nigeria	101.9	29,667	291	320.9	243.1	0.31	0.55
34	Pakistan	119.3	41,904	351	1,243.6	743.4	1.04	1.67
35	Peru	22.4	22,100	987	613.7	346.2	2.74	4.29
36	Philippines	64.3	52,462	816	660.6	789.3	1.03	2.25
37	Poland	38.4	83,823	2,183	3,945.0	2,422.0	10.27	16.58
38	Romania	22.7	24,438	1,077	2,574.1	1,026.9	11.34	15.86
39	Saudi Arabia	16.8	111,343	6,628	1,568.4	399.9	9.34	11.72
40	South Africa	39.8	103,651	2,604	3,524.1	120.4	8.85	9.16
41	Spain	39.1	574,844	14,702	13,792.2	74.0	35.27	35.46
42	Sri Lanka	17.4	8,769	504	135.5	96.2	0.78	1.33
43	Syria	13.0	17,236	1,326	513.4	1,720.0	3.95	17.18
44	Thailand	58.0	110,337	1,902	1,790.0	1,591.8	3.09	5.83
45	Turkey	58.5	99,696	1,704	9,471.9	1,202.9	16.19	18.25
46	U. K.	57.8	903,126	15,625	26,084.0	0.0	45.13	45.13
47	U.S.A.	255.4	5,920,199	23,180	144,056.7	0.0	56.40	56.40
48	Venezuela	20.2	61,137	3,027	1,804.3	562.3	8.93	11.72
49	Yemen Rep.	13.0	9,615	740	143.4	98.0	1.10	1.86
50	Zimbabwe	10.4	5,035	484	127.1	88.8	1.22	2.08

Source : World Development Report 1994, published by the World Bank (Population & GDP at 1992)

: ITU Statistical Yearbook 1994 "Chronological Series 1985-1992", published by ITU

(Main Lines and Waiting Lines at 1992)

Figure 6-5-2 shows the demand regression curve expressing a correlation between telephone demand density and GDP per capita and the supply regression curve expressing a correlation between telephone supply density and GDP per capita. It can be said that the demand density was in line with the economic level of the country respectively.

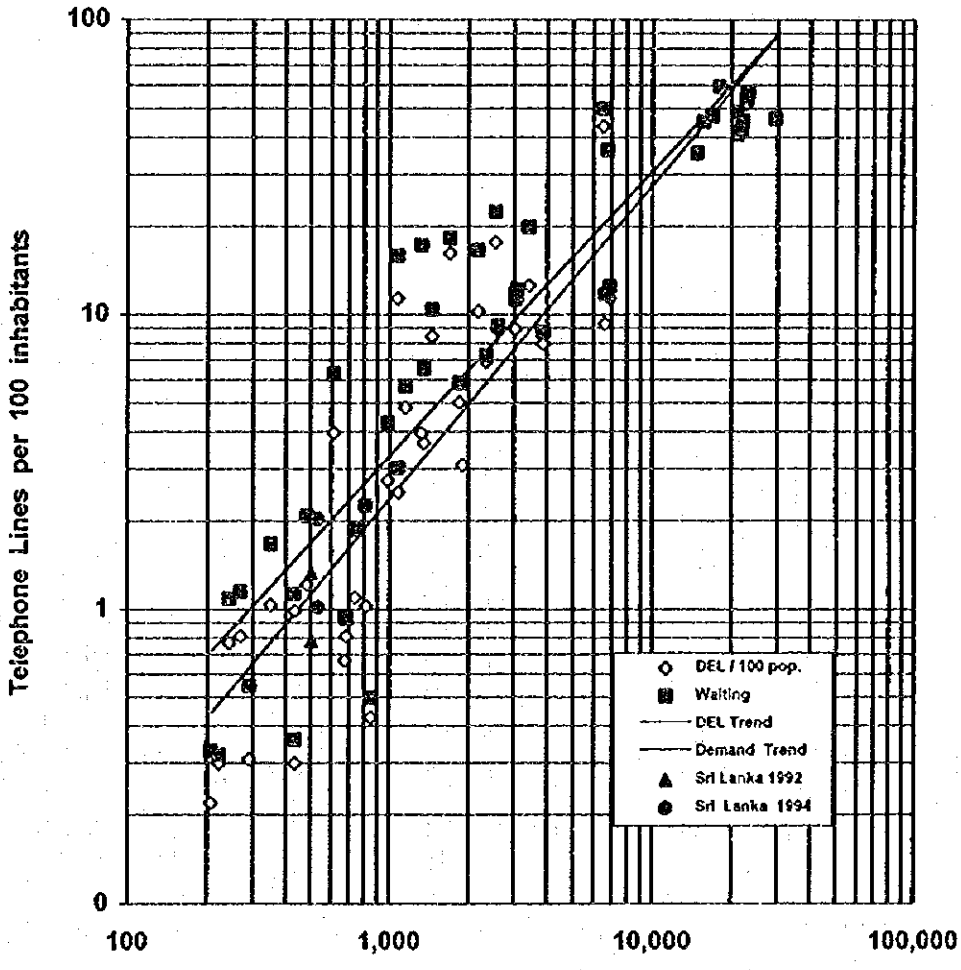


Figure 6-5-2 World Telephone Service in 1992

However, an attention must be paid here to a conspicuous trend observed just recently. The expressed demand growth ratio in the past one year was in Sri Lanka as high as 25.5%. That is, the expressed demand of 309,863 in March 1994 was increased to 388,971 in March 1995. According to SLT staff, this is mainly because a lot of new registrations were made in 1994 in response to the advertisement on newspapers which encouraged new

telephone subscriptions, saying that new connections would be made promptly with the completion of on-going projects. The study team assumed that this trend would continue up to the end of 1995. Then the expressed demand at the end of 1995 was estimated to be 480,679 (an increase of 25.5% over the level of 1994). Table 6-5-2 shows the trend of the expressed demand during the past one year.

Table 6-5-2 Expressed Demand Trend

Date	DEL's	Waiters	Expressed Demand	Growth Rate / month
1994, Mar.	161,488	148,375	309,863	2.52%
Apr.	163,102	151,411	314,513	1.50%
May	165,234	155,347	320,581	1.93%
June	167,546	160,424	327,970	2.30%
July	170,081	164,167	334,248	1.91%
Aug.	172,577	166,913	339,490	1.57%
Sep.	174,736	170,975	345,711	1.83%
Oct.	176,666	176,057	352,723	2.03%
Nov.	178,770	180,494	359,264	1.85%
Dec.	180,724	186,245	366,969	2.14%
1995, Jan.	182,566	190,972	373,538	1.79%
Feb.	184,500	195,642	380,142	1.77%
Mar.	186,329	202,642	388,971	2.32%

Note : Not including the data of 6 districts in Northern and Eastern provinces.

To reflect the above in forecasting the expressed demand in and after 1996 up to 2015, the formula (1) was modified, based on the estimated expressed demand at the end of 1995, i.e., 480,679, as follows:

$$\text{Ln}((\text{ML} + \text{WE})/\text{POP} \times 100) = -5.149 + 0.9692 \times \text{Ln}(\text{GDP}/\text{POP}) \quad \cdots\cdots (2)$$

Then, to estimate the demand including the suppressed demand amounting to 20% of the expressed demand, the formula was revised as follows:

$$\text{Ln}((\text{ML} + \text{WE})/\text{POP} \times 100) = -4.967 + 0.9692 \times \text{Ln}(\text{GDP}/\text{POP}) \quad \cdots\cdots (3)$$

Table 6-5-3 shows the results of the macroscopic demand forecast by Method (I) for two cases: one including, and the other not including, the suppressed demand.

Table 6-5-3 Results of Demand forecast by ITU Model

Item	1995	2000	2005	2015
Population (Thousands)	17,937.3	18,830.9	19,780.6	21,524.0
Suppressed : 0%	480,679	678,127	978,536	1,663,173
Demand Density	2.68	3.60	4.95	7.73
Suppressed : 20%	576,815	813,753	1,174,244	1,995,808
Demand Density	3.22	4.32	5.94	9.27

5.3 Macroscopic Demand Forecast by Sri Lanka Model (Method II)

Sri Lanka model was made based on the correlation between the GRDP and the total demand of 25 (twenty five) districts in 1994. The demand of each district was described in previous Section 2 "Expressed Demand at the End of 1994" in this Chapter.

As a result of the analysis, the following regression model was obtained:

$$(\text{Total Demand in the District}) = 19.456 \times (\text{GRDP})^{1.051}$$

$$(R^2 = 0.88)$$

The regression curve obtained is shown in Figure 6-5-3.

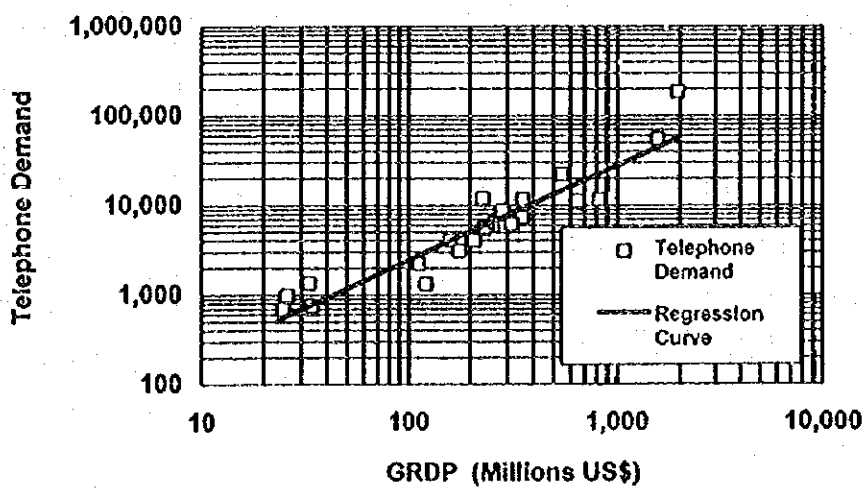


Figure 6-5-3 Regression Curve of Sri Lanka Model

As mentioned previously, the express demand over the country at the end of 1995 was estimated to be 480,679 (a 25.5% increase over the 1994 level). This sharp increase was taken into account in demand forecast by the Sri Lanka model also. The estimated demand, 480,679, was allocated to individual districts, based on their respective demand shares as of the end of 1994 and, on the base of the allocated demand, the regression curve mentioned above was adjusted for each district. Then, the demands in individual districts in and after 1996 up to 2015 were estimated, by applying their respective regression models. Table 6-5-4 shows the results of demand forecast obtained by the Sri Lanka model (Method II).

Table 6-5-4 The Results of Demand Forecast (Sri Lanka Model)

Item	1995	2000	2005	2015
Population (Thousands)	17,937.3	18,830.9	19,780.6	21,524.0
Demand	480,679	707,752	1,066,176	1,914,006
Demand Density	2.68	3.76	5.39	8.89

5.4 Evaluation of Results of Demand Forecast

The results of the macroscopic telephone demand forecast for three cases, two by the ITU model and one by the Sri Lanka model, are summarised in Table 6-5-5.

Table 6-5-5 Summary of Estimated Telephone Demands

Item	1995	2000	2005	2015
Population (Thousands)	17,937.3	18,830.9	19,780.6	21,524.0
ITU model (1)	480,679	678,127	978,536	1,663,173
(Suppressed : 0%)	2.68	3.60	4.95	7.73
ITU model (2)	576,815	813,753	1,174,244	1,995,808
(Suppressed : 20%)	3.22	4.32	5.94	9.27
Sri Lanka model	480,679	707,752	1,066,176	1,914,006
	2.68	3.76	5.39	8.89

Generally speaking, potential demand will turn out to be visible demand according as the telephone density improves, since potential users are encouraged to subscriber telephones,

with the expectation of immediate connection. In this sense, the suppressed demand corresponding to 20% of the expressed demand as of the end of 1994 is likely to decrease in coming years. Therefore the ITU model (2) in which the suppressed demand is estimated to be 20% of the expressed demand for each forecast year up to 2015 is presented here just for reference.

The demand estimated by the ITU model (1) and that by the Sri Lanka model are based on the expressed demand, without taking into account the suppressed demand. The demand at 2015 thus estimated by the ITU model (1) is 1,663,173, while that by the Sri Lank model, 1,914,006, the former being higher than the latter by approx. 250,000.

In the ITU model, forecast was made through the study of the correlation between the expressed demand density and GDP per capita using the data in 50 countries, and it was assumed that the demand in Sri Lanka would follow the trend observed in the 50 countries, while in the Sri Lanka model, the trend observed in each district with respect to the correlation between GRDP and telephone demand was assumed to continue up to 2015.

To evaluate the demand forecast by the two models mentioned above, discussions were made with SLT counterpart staff. As a result, the conclusion was reached that the demand obtained by the ITU model (1) be adopted for this study as the reasonable demand, regarding the demand by the Sri Lank model as the optimistic one. Reasons are:

(1) The value obtained by the Sri Lanka model is too high.

(2) The Sri Lanka model reflects current trend in Sri Lanka but, in a long run, it will follow the international trend.

In consequence, the results of the demand forecast by the ITU model (1) are to be used as the basic data in estimation of traffic for network expansion planning. Figure 6-5-4 illustrates the results of macroscopic demand forecast.

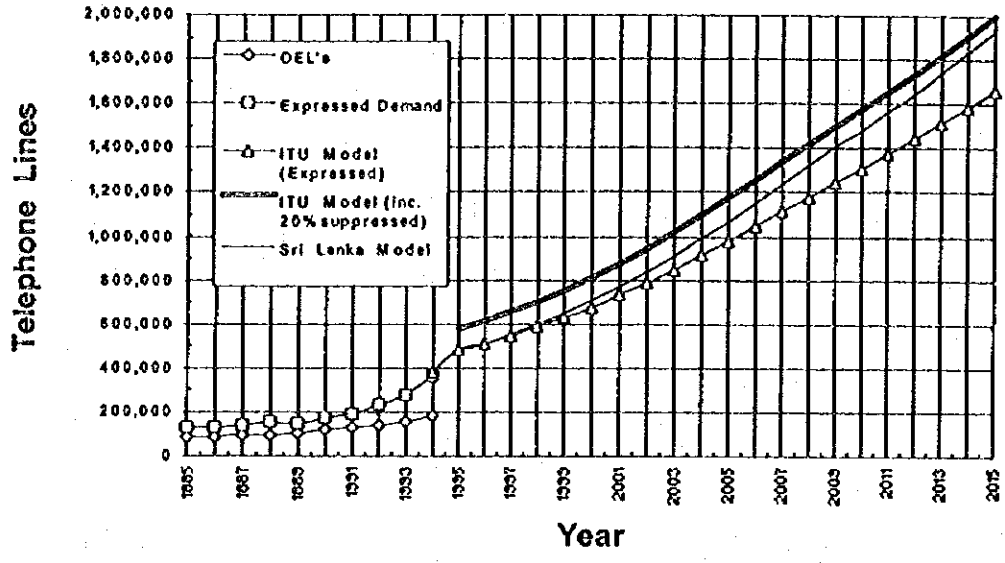


Figure 6-5-4 The Results of Demand Forecast

Table 6-5-6 shows the final demand in this study and the demand estimated by Ewbank Preece consultants in the previous master plan published in 1990 under ADB fund.

The demand in 2005 projected by the previous master plan is 860,900, while the demand estimated by this study is 978,536, the latter being higher than the former by approx. 120,000, through the former includes the suppressed demand corresponding to 50% of the expressed demand. It can be said that such difference has resulted mainly from the difference in estimated GDP.

Table 6-5-6 Demand Comparison

Study Team	1995	2000	2005
Ewbank Preece Ltd.	376,000	575,700	860,900
(GDP per Cap.)	428	570	766
JICA (this study)	480,679	678,127	978,536
(GDP per Cap.)	561	761	1,056

(Unit : US$)

5.5 Demand Distribution

The demand obtained by the ITU model (1) was distributed over the districts for each forecast year using a proportional distribution equivalent to the share of district demand estimated by Sri Lanka model. The following table shows the demand and the share of demand of Colombo and other districts in the forecast base years.

Table 6-5-7 Demand in Colombo district and others

Area	Items	1995	2000	2005	2015
Sri Lanka	Pop. ('000)	17,937.3	18,830.9	19,780.6	21,524.0
	Demand	480,679	678,127	978,536	1,663,173
Colombo	Pop. ('000)	2,024.9	2,112.8	2,204.3	2,361.3
	Demand	232,180	333,652	489,919	842,887
	(Share)	48.30%	49.20%	50.10%	50.70%
Other district	Pop. ('000)	15,912.4	16,718.1	17,576.3	19,162.7
	Demand	248,499	344,475	488,617	820,286
	(Share)	51.70%	50.80%	49.90%	49.30%

As can be seen from the above table, The demand share of the Colombo district in the national total will gradually increase during the forecast years. In 2015, it will account for 50.70% of the total demand. For, the Central province including the Colombo district will maintain higher GRDP growth and economic activities during the forecast years, as compared with other provinces.

Then, the demand in each district was distributed to local exchanges in the district for respective forecast years, based on the distribution share of the expressed demand of each exchange as of 1994, with some exceptions. For some districts, i.e., Jaffna, Kilinochchi, Mannar, Vavuniya, Mullaitivu and Trincomalee in Northern and Eastern provinces, the expressed demands of local exchanges in 1994 were not available and the data as of 1992, the latest available one, was used.

In addition, the capacity of local switches to be installed and new local exchanges to be established by on-going project were taken into account. The results of demand distribution to each exchange are referred to in PART 2 of VOLUME-IV.

6. Telex and Telegram Demand Forecast

The historical growth of telex and telegram services is shown in Table 6-6-1. The study team collected these data from several data sources, i.e., "ITU Statistical Yearbook issued in 1994" for 1985-1992 data, DGT for 1993 data and SLT for 1994 data.

Table 6-6-1 Historical Data of Telex and Telegram Services

(UNIT : 1,000)

Items		1985	1990	1991	1992	1993	1994
TELEX	Subscriber Lines	1,190	1,664	1,739	1,789	1,966	1,966
	National Traffic (Min.)	N.A.	5,329.8	5,576.0	5,825.0	N.A.	N.A.
	INT. O/G Traffic (Min.)	4,487.71	4,472.12	4,298.00	4,231.00	3,276.66	N.A.
TELEGRAM	National (Messages)	N.A.	N.A.	1,078.00	2,483.00	N.A.	N.A.
	INT.O/G (Messages)	141.65	91.10	N.A.	94.90	84.80	N.A.
	Telegram Offices	N.A.	4,062	2,230	2,205	N.A.	N.A.

The average annual growth rate of telex subscriber lines including teleprinters connected to GENTEX system is 5.7% in 1985 through 1994. The number of telex subscribers had been increasing slowly. However, there was no telex subscriber increase between 1993 and 1994 and it decreased to 1,560 as of May 1995. The international traffic in terms of paid minutes per annum was sharply decreased between 1992 and 1993 due to the introduction of the facsimile service in the international business field. On the other hand, the national traffic in terms of paid minutes per annum is still increasing though in slow pace. The main reason for this is that the telephone density in Sri Lanka still remains low (1.02 DELs per 100 population at the end of 1994) and the cost of domestic telex is very low making it an effective substitute for telephone.

Demand for telex service will decrease rapidly in coming years following the trend in a lot of countries where telex service demand is being transferred to other service media, i.e., facsimile, data communication, etc. On the other hand, telegram service is used as a substitutive media of the telephone service in rural area where telephone lines are not sufficient yet at present. It means that demand of telegram messages will maintain in coming years.

It was observed that the decreasing ratio of telex subscribers is approx. 20% from the end of 1994 to May 1995. The ratio will continue to increase until the end of 1995. The study team assumed that the ratio will reach approx. 30% at the end of 1995. Then, for the

demand forecasting of telex subscriber lines, this decreasing ratio, i.e., **30% per annum.**, is used in this study.

However, to keep telegram service level served by GENTEX system in rural area, **88 telex subscribers** in operation at present, telex subscriber lines providing telegram service will be still remained until 2005. Finally, telex and telegram services will be integrated into ISDN services by 2015 in Sri Lanka. Table 6-6-2 summarises the results of the telex demand.

Table 6-6-2 Telex Demand

Item	1995	2000	2005	2015
No. of Telex Subscribers	1,380	230	90	0

7. Value-added Services Demand Forecast

7.1 General

In recent years, a growing awareness of the critical role played by telecommunications for the promotion of economic and social development could be seen. Many countries allocate considerable resources to the building of a modern country-wide telecommunications network.

The use of computers for data processing and storage is growing dramatically in developing countries also. Data communication is essential for the easy access to, and exchange of data. Data communication to make the best use of information is required as a new kind of resource to enhance the development of its social welfare, education, culture, etc.

Sri Lanka faces two formidable challenges. Firstly, Sri Lanka must continue efforts to extend basic telephone services to the large majority of the population. Secondly, at the same time, Sri Lanka must provide advanced services to its scientific, administrative, industrial and commercial sectors, in order to enable them to take full advantage of the latest developments in information technology.

For the above reason, it is important to assess the demand for value-added services in Sri Lanka. Some of them are already in operation by private entities in major cities under competition, i.e., cellular mobile service, radio paging service, payphone and packet communication services. Generally, it is necessary to conduct "Market Segmentation" analysis by questionnaires and/or interviews for respective services. The detail field survey, however, was not conducted in this study due to limitation of time. Then, demand forecasting is carried out roughly by macroscopic method for value-added services, i.e., cellular mobile telephone service, radio paging service, leased circuit service and ISDN.

7.2 Cellular Mobile Telephone Service

7.2.1 The Status of Cellular Mobile Telephone Service in Sri Lanka

Sri Lanka's two TACS (Total Access Communications System) networks are steadily expanding their services. The first to launch its service in 1989, Celltel Lanka, is a joint venture with Millicom and Comvik as foreign shareholders. The number of Celltel's subscribers reached 15,000 in September 1994. The TACS-A network, Lanka Cellular

Services (Call Link) who launched in January 1993 is a joint venture between Singapore Telecom International, Capital Development and Investment of Sri Lanka and the World Bank's International Finance Corporation (IFC).

The third analogue network, Mobitel, started operating in the AMPS-A (Advanced Mobile Phone Services) band in April 1993. The AMPS network covered Colombo, Kandy and Negombo initially, before expanding to Chilaw, Kuliyapitiya, Anuradhapura, Kurunegala, Kalutara, Galle, Ratnapura, Matara and Dikwella. Mobitel is 100 per cent owned by Telstra Corporation of Australia and operates under a seven-year (up to 2000) BOT (Build-Operate-Transfer). Under this BOT agreement, Mobitel would get to use SLT's extensive telecommunication infrastructure, mainly its transmission towers. However, just in two years after the signing, Mobitel dropped its original BOT agreement and entered into a new joint venture equity partnership with SLT. SLT has agreed to scrap the BOT agreement for a 40% share of Mobitel's ownership. The balance 60% of the company remained with OTC Australia from May 1995. The network has an Ericsson AXE switch and 20 base stations and has over 10,500 subscribers in Feb. 1995.

The DGT issued a fourth cellular operator's licence in September 1993 to MTN Network Pte Ltd, a joint venture between Telecom Malaysia (80 per cent) and Sunpower Systems; the Maharaja Group. The group received approval for a GSM(Grobal System for Mobile communication) network and ordered a 10,000 capacity system from Alcatel in May 1994. The network is expected to be in commercial operation in Colombo in 1995. The following table shows the past trend of cellular mobile telephone services in Sri Lanka.

Table 6-7-1 Cellular Mobile Telephone Service in Sri Lanka

Year	1989	1990	1991	1992	1993	1994
No. of Sub.	500	1,010	1,973	4,000	13,000	32,500
Annual Growth	-	102%	95%	103%	225%	150%

7.2.2 Demand Forecast for Cellular Mobile Telephone

As shown in Table 6-7-1, the annual growth ratio of cellular mobile telephone in Sri Lanka was not steady during past years. Therefore, demand forecast by using past trend in Sri Lanka was difficult. Then, the demand of cellular mobile telephone was made in this study, by the following approach.

In analysing the level of development of cellular mobile telephone services in different countries and different regions of the world, two of the most useful indicators are: (1) a correlation between the cellular mobile subscribers per 1,000 inhabitants and fixed-link subscribers per 100 inhabitants, and (2) a correlation between the cellular mobile subscribers per fixed-link subscribers (DELs) and fixed-link subscribers per 100 inhabitants. The first indicator highlights those countries which have the most mature systems (e.g., the Nordic countries) and which have the more developed economies (e.g., North America, Switzerland). The second indicator gives a rather different picture because it indicates those countries which have a high demand *mobility* (e.g., oil rich nations such as Brunei, Bahrain, the United Arab Emirates) or which have poorly developed fixed-link networks or so many waiters in long term (e.g., Thailand). A number of countries in Asia and Latin America are witnessing explosive growth of cellular mobile communications at the moment because it provides an alternative to the fixed-link, namely main telephone line, infrastructure.

As shown in Table 6-7-1, the number of cellular mobile subscribers was rapidly increased in Sri Lanka during a past few years, in spite of the growth of fixed-line being still as low as 1.02 line per 100 inhabitants, with GDP per capita as low as 534 US$ at the end of 1994. It means that the first indicator could not applied to demand estimation for cellular mobile telephone service in Sri Lanka, because the regression trend curve made by a correlation between cellular mobile telephone densities and main telephone densities or GDP per capita is lower than the past growth trend in Sri Lanka and it was found that the second indicator mentioned above represents the characteristics of situation in Sri Lanka as described below.

Figure 6-7-1 shows the world trend of cellular mobile telephone on the relation between cellular mobile subscribers ratio to main telephone lines and main telephone density per 100 inhabitants in the world. Countries providing cellular mobile telephone services can be classified into three (3) groups, i.e., low telephone density group, medium telephone density group and high telephone density group in main telephone lines.

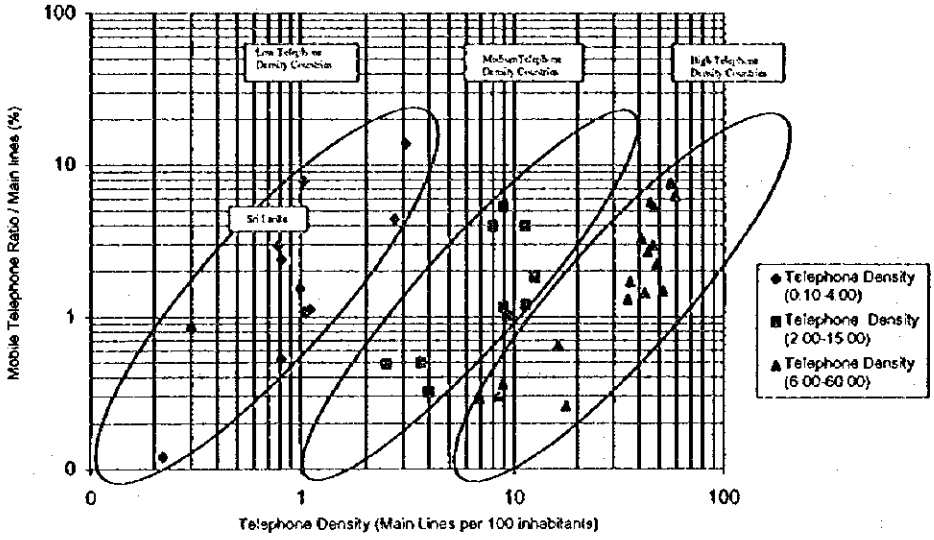


Figure 6-7-1 Mobile Telephone Ratio to Main Lines in the World (1992)

The price of cellular mobile terminal is decreasing in the world and time to be required for service connection is rather short as compared to that for cable network. Then, the cellular mobile telephone penetration ratio to main telephone lines in some developing countries, such as Thailand, Malaysia and Philippines, is relatively high in spite of low telephone density (low telephone density group). Sri Lanka is also involved in low telephone density group. Figure 6-7-2 illustrates the regression model based on the relation the ratio of cellular mobile subscribers to main telephone subscribers and main telephone density at the end of 1992 in the low density countries, and illustrates the ratio of Sri Lanka in 1992, 1993 and 1994.

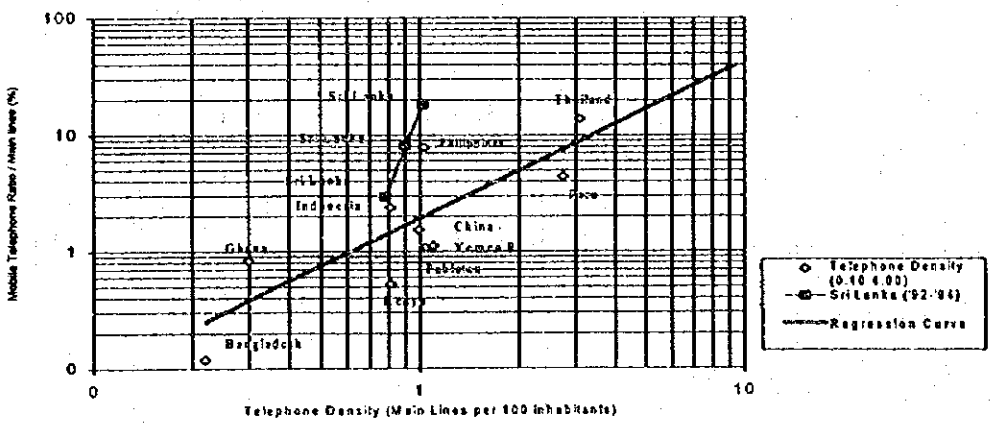


Figure 6-7-2 Mobile Telephone Ratio to Main Lines in Low Teledensity Countries in 1992

The regression model obtained in low telephone density countries is as follows:

$$(MTt / MLt) = 1.9452 \times (MLt / POPt \times 100)^{1.3514} \qquad (R^2 = 0.64)$$

where,

MTt : the number of mobile telephones in period t
MLt : the number of main lines in period t
POPt : population in period t

The data used for the regression analysis mentioned above are shown in Table 6-7-2.

Table 6-7-2 Cellular Mobile Telephone Service in Low Density Countries

No.	Country	Mobile Telephone / Main Lines (%)	Teledensity (Main Lines/100 pop)
1	Bangladesh	0.12	0.22
2	China	1.54	0.99
3	Ghana	0.84	0.30
4	Indonesia	2.39	0.81
5	Kenya	0.53	0.81
6	Pakistan	1.09	1.04
7	Peru	4.42	2.74
8	Philippines	7.87	1.03
9	Sri Lanka	2.95	0.78
10	Thailand	13.89	3.09
11	Yemen Rep.	1.12	1.10

Source: ITU Statistical Yearbook 1994 "Chronological Series 1985-1992" (1992 Data)

As can be seen in Figure 6-7-2, the ratio of Sri Lanka in 1993 and 1994 are shifting away from the regression curve obtained based on 1992 data in low telephone density countries. It means that the growth of cellular mobile telephone in Sri Lanka in higher than the average in low telephone density.

On the other hand, in case of Thailand who belongs to the same low telephone density group, the ratio of cellular mobile subscribers to the total main telephone subscribers was the highest in the world in 1992 (14%, compared to the world average of 3.7%) as shown Figure 6-7-3. However, its growth ratio is rapidly decreasing before reaching 15% in 1991 and 1992.

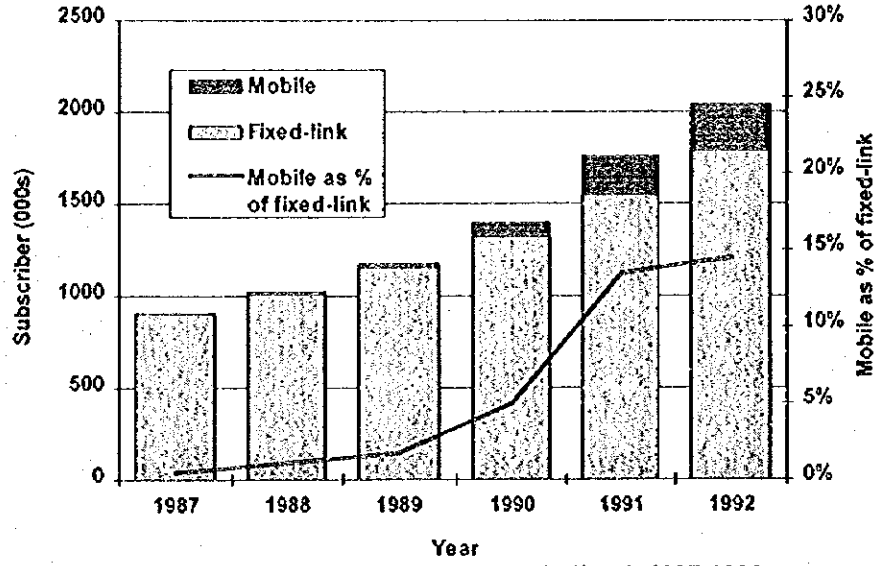


Figure 6-7-3 Network Growth in Thailand, 1987-1992

Source : ITU/BDT Telecommunication Indicator Database.

In Sri Lanka, Its ratio at the end of 1994 is approx. **18%** even higher than the Thailand level (14%), as well as the world average(3.7%). Because, the cellular mobile service is mainly used as the remedy for main telephone due to the following reasons:

1) The density of main telephone is still very low level such as 1.02 line per 100 inhabitants;
2) The number of waiting applicants is more than the number of existing telephone subscriber at the end of 1994.

However, the growth ratio was slowed down last year in Sri Lanka, and it is predicted that Sri Lanka will follow the case of Thailand in the near future, i.e., down slow in cellular telephone growth will be seen in line with the increasing of the diffusion of main telephone service in the future.

Finally, in the consideration of recent growth in the number of cellular telephone subscribers, it is assumed that the ratio of cellular mobile subscribers to the total main telephone subscribers in Sri Lanka will be **20%**. This ratio is used for the demand forecast of cellular telephone subscriber in this study up to 2015. The results of the demand forecast are shown Table 6-7-3. And it is noted that Cellular mobile telephone demand will depend on future tariff system and socio-economic activities in Sri Lanka. In that case, the detail market survey is to be conducted for further expansion.

Table 6-7-3 The Results of Mobile Telephone Demand Forecast

Year	1995	2000	2005	2015
Mobile Telephones	47,400	133,400	195,800	332,600

7.3 Radio Paging services

7.3.1 Present Status of Radio Paging Service

The radio paging service is provided by private companies under licence of SLTA. The current operators and various indicators are listed below.

Table 6-7-4 Radio Paging Service in Sri Lanka

As of Feb. 1995

Company Name	No. of Sub.	Licence Given	Year of operation
Fentons	900	1989	1990
Bell Comm.	525	1989	1990
Equipt. Trades	890	1981	1982
Infocom Lanka	3,500	1992	1993
Intercity Paging	1,600	1989	1990

The number of radio paging terminals in operation is **7,415** as of Feb. 1995. Radio paging service is working on a nation-wide level, but not covering the whole island at present. The number of radio paging terminals is shown in Table 6-7-5.

Table 6-7-5 Trend of Radio Paging Service

Year	1991	1992	1993	1994
No. of DEL's	125,830	135,500	157,770	180,724
No. of Paging Terminal	1,973	2,650	(*) 4,846	(*) 7,042

(*) : Estimated by Study Team

7.3.2 Demand Forecast of Radio Paging Terminals

Generally, the demand for radio paging service is closely linked to the diffusion of public payphone and main telephone lines. In consequence, radio paging service demand is estimated by the regression model based on the relation between main telephone density and radio paging terminal density. The data in 30 countries were used for analysis and the data used for obtaining the regression model in these 30 countries are attached in Annex 3-2 "Demand Forecast". As a result of analysis, the following regression model was obtained:

$$PGTt / POPt \times 1000 = 0.1263 \times (MLt / POPt \times 100)^{1.1643} \quad \text{..... (1)}$$
$$(R^2 = 0.75)$$

where,

PGTt : the number of radio paging terminals in period t
POPt : population in period t
MLt : the number of main lines in period t

To reflect the existing paging service level in Sri Lanka, the formula (1) was modified as follows, based on the number of radio paging terminals at the end of 1994 which were estimated by the study team, at 7,042.

$$PGTt / POPt \times 1000 = 0.3874 \times (MLt / POPt \times 100)^{1.1643} \quad \text{..... (2)}$$

For the forecast of demand for radio paging service in the future, the formula (2) regression model was applied. The result of the demand forecast for radio paging service up to 2015 is shown in Table 6-7-6.

Table 6-7-6 The Result of Radio Paging Service Demand Forecast

Item	1995	2000	2005	2015
Paging Terminals	9,600	31,782	49,326	90,186
Paging Density (per 1,000 pop.)	0.54	1.69	2.49	4.19

7.4 Leased Circuit Services

7.4.1 Leased Circuit Services at Present

Leased circuit services provided by SLT consist of the following:

1) Data Circuits,
2) Voice Circuits,
3) Packet Ports,
4) Telex Circuits,
5) Others (not categorised circuits due to insufficient data).

At present, the number of leased circuits registered to SLT is 1,465 circuits. According to SLT staff in the customer service section, approximately 1,100 leased circuits out of the total registered circuits are actually in operation as of June 1995. The leased circuits provided by SLT in the past is shown in the following table by category. The share of telex circuits to the total was decreased from 46.4% in 1985 to 27.7% in June 1995 due to the transfer from telex to other media, i.e., facsimile service and data communications, etc.

Table 6-7-7 Leased Circuits by usage of service

Service Categories	1985	1990	1994 (June, 1995)
Data Circuits	3	56	230
[Share (%)]	0.4%	6.0%	15.7%
Voice Circuits	363	505	756
[Share (%)]	50.8%	54.3%	51.6%
Packet Circuits (Port)	0	0	4
Terminals (SLT)	-	-	(25)
Terminals (PVT)	-	-	(250)
[Share (%)]	0.0%	0.0%	0.3%
Telex Circuits	331	344	401
[Share (%)]	46.4%	37.0%	27.4%
Others	17	25	74
[Share (%)]	2.4%	2.7%	5.0%
Total	**714**	**930**	**1,465**
[Share (%)]	**100.0%**	**100.0%**	**100.0%**

The number of leased circuits at the end of 1994 by category was not available, then, the number of its in June 1995 was regarded as the data at the end of 1994 in this study.

Demand for leased circuits is the sum of demands for leased circuit service, such as data circuits, voice circuits, packet circuits and telex circuits. After forecasting the demand for these circuits, the total required number of leased circuits will be finally estimated.

7.4.2 Demand Forecast for Data Circuits (except for packet circuits)

According to the recent trend, the higher demand growth is expected in the future. In other countries, needs of data communication are steadily expanding, and the demand for data communication between computers as an essential infrastructure in business is growing also in developing countries, also.

Generally, the development of data communication will be promoted by the increment of main telephone lines. Then, for an estimation of demand for data circuits, the following regression model was obtained. It presents a correlation between main telephone line densities and leased circuit densities in 38 countries. The data used for regression analysis for demand estimation are refer to in Annex 3-3 "Demand Forecast".

$$DCt / POPt \times 1000 = 0.0052 \times (MLt / POPt \times 100)^{1.8361} \quad \text{..... (1)}$$
$$(R^2 = 0.84)$$

where,

DCt : the number of data circuits in period t
POPt : population in period t
MLt : the number of main lines in period t

To reflect the existing registered leased circuits in estimation of demand for data transfer service provided by SLT, the formula (1) was modified, based on its number at the end of 1994, i.e., 230 circuits. Modified regression model is shown below and this model was used to forecast data circuits in Sri Lanka.

$$DCt / POPt \times 1000 = 0.0125 \times (MLt / POPt \times 100)^{1.8361} \quad \text{..... (2)}$$

Table 6-7-8 presents the result of estimated demand for leased circuits for data transfer service up to 2015.

Table 6-7-8 Demand of Leased Circuit for Data Transfer Service

Year	1995	2000	2005	2015
Data Circuits	373	2,398	4,661	11,498

7.4.3 Demand Forecast for Voice Circuits

According to the past data, the average growth rate per annum is 28 circuits between 1985 and 1990 and 63 circuits between 1990 and 1994. These figure prove that the increment of leased circuits for voice service is quite steady. Then, the study team assumed that this trend will continue up to 2015. In order to estimate the demand for voice circuits, the following regression model was obtained based on past data, i.e., those in 1985, 1990 and 1994 in Sri Lanka.

$$VCt = 832.57 \times (MLt / POPt) - 91.423$$
$$(R^2 = 0.99)$$

where,

VCt : the number of voice circuits in period t
POPt : population in period t
MLt : the number of main lines in period t

The result of estimated demand for leased circuits for voice service is shown in Table 6-7-9.

Table 6-7-9 Demand for leased circuit for Voice Service

Item	1995	2000	2005	2010	2015
Voice Circuits	1,008	2,856	4,030	5,187	6,344

7.4.4 Demand Forecast of Packet Terminals and Packet Circuits

As shown in Table 6-7-7, the total number of packet terminals in operation is 275 consisting of 25 terminals provided by SLT and 50 terminals provided by private companies. The average number of data terminals per one leased circuit (port) for transferring packet data is 8 packet terminals in SLT.

Generally, the development of data communication will be promoted by the increment of main lines. Then, for the demand forecast of packet terminals in the future, the following regression model was applied in this study. This regression model presents a correlation between main telephone line densities and packet data terminals densities in 61 countries. The data used for regression analysis for demand estimation are referred to in PART 2 of VOLUME-IV.

$$PTt / POPt \times 1000 = 0.0006 \times (MLt / POPt \times 100)^{1.2613} \quad \text{..... (1)}$$
$$(R^2 = 0.81)$$

where,

PTt : the number of packet data terminals in period t
POPt : population in period t
MLt : the number of main lines in period t

The formula (1) was modified, based on the number of the existing packet data terminals served by both SLT and private companies at the end of 1994, i.e., 275 terminals. Modified regression model is shown below and this model is used to forecast the demand in Sri Lanka in future.

$$PTt / POPt \times 1000 = 0.0151 \times (MLt / POPt \times 100)^{1.2613} \quad \text{..... (2)}$$

Table 6-7-10 presents the estimated demand for packet data terminals and leased circuits for packet data service in SLT up to 2015. In this demand estimate, it is assumed that one eleventh of the packet data terminals estimated by formula (2) will be served by SLT and the average number of data terminals per one leased circuit for packet data service is eight (8) packet terminals up to 2015.

Table 6-7-10 Demand for Packet Terminals and Leased Circuits for Packet Data Service

Item	1995	2000	2005	2015
Packet Terminals	384	1,401	2,246	4,287
(SLT : 1/11)	(35)	(127)	(204)	(390)
(PVT : 12/11)	(349)	(1,274)	(2,042)	(3,897)
Leased Circuits (Packet Ports)	5	16	26	49

7.4.5 Demand Forecast for Telex Circuits

Historical data of both telex subscriber lines and the number of leased circuits for telex service is shown in Table 6-7-11.

Table 6-7-11 Historical Data of Telex subscriber lines and Leased Circuits for Telex Service

Year	1895	1990	1994
No. of subscriber Lines	1,190	1,664	1,966
Leased Circuits (Telex)	331	344	401
LC / Telex Sub. (%)	27.8	20.7	20.4

At the end of 1994, the number of telex subscribers connected to Telex Network provided by SLT is 1,966 and the number of leased circuits connecting between teleprinters is 401, which are not connecting to the above Telex Network.

The ratio of the number of leased circuits for connection between teleprinters to the number of telex subscribers on Telex Network is approx. **20%** in 1994 in Sri Lanka. This ratio was applied in demand estimation of leased circuits for telex circuits in this study up to 2015. In consideration of the world trend of telex services and the situation in Sri Lanka, where main customers of telex leased circuits are in the business field, it was assumed that telex service demand would be transferred to that for other media, i.e., facsimile, data communication, etc., demand for telex leased circuits would also be rapidly decreased in line with the decrease of the number of telex subscribers. The estimated demand for leased circuits for telex service is shown in Table 6-7-12.

Table 6-7-12 Demand of Leased Circuit for Telex Service

Year	1995	2000	2005	2015
No. of subscriber Lines	1,380	230	90	0
Leased Circuits (Telex)	280	50	20	0

7.4.6 Demand Forecast for Leased Circuits

As a result of the above forecast for leased circuits by category, future demand of leased circuits was estimated as Table 6-7-13 and Figure 6-7-4.

Table 6-7-13 Leased Circuit Demand by Service Category

Service Categories	1995	2000	2005	2015
Data Circuit	373	2,398	4,661	11,498
[Share (%)]	22.4%	45.1%	53.3%	64.3%
Voice Circuit	1,008	2,856	4,030	6,344
[Share (%)]	60.5%	53.7%	46.1%	35.4%
Packet Circuit (Port,SLT)	5	16	26	49
Terminals (SLT)	(35)	(127)	(204)	(390)
Terminals (PVT)	(349)	(1,274)	(2,042)	(3,897)
[Share (%)]	0.3%	0.3%	0.4%	0.3%
Telex Circuit	280	50	20	0
[Share (%)]	16.8%	0.9%	0.2%	0.0%
Total	**1,666**	**5,320**	**8,737**	**17,891**
[Share (%)]	**100.0%**	**100.0%**	**100.0%**	**100.0%**

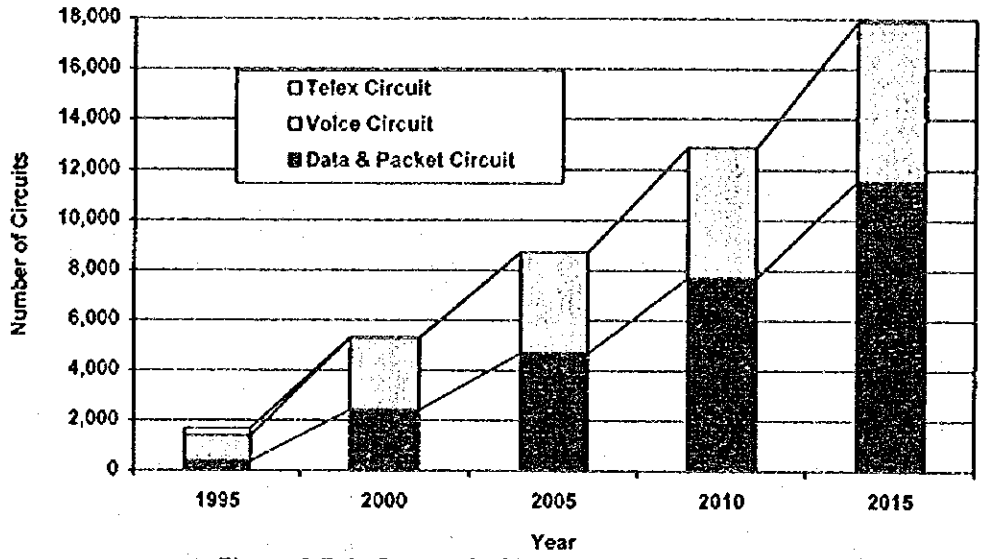


Figure 6-7-4 Demand of Loased Circuits

7.5 ISDN Services

The evolution towards an ISDN is the declared aim by most world's telephone administrations. The intention is to progress from telecommunication infrastructures which utilise digital technology for switching and transmission to a first-generation "Narrowband ISDN", with an integrated digital network (IDN).

Essentially, enhanced and advanced telephone network, such as ISDN, will support a wide range of both telephone and data communication services and offer standard access through the network terminal equipment and the terminal adopter. The principal services provided by ISDN are divided into the following two categories:

- bearer services that provide complete capability of transmitting any signals between users/network interfaces.
- tele-services that provide complete capability for communication users, including terminal equipment functions.

At present, several countries in the world have already carried out their respective ISDN field trials, and some of them have launched offering commercial ISDN services mostly to business customers.

A portion of the demand in data communication's circuits/terminals, such as data circuits and packet terminals, described in the previous respective paragraphs will become a portion of the demand for ISDN services. Some of Internet users also will become the demand of ISDN services. This service is provided by Lanka Internet Company at present and spreading in the world for past a few years. However, demand of Internet was not estimated in this study due to limitation of data.

To estimate demand for ISDN services, i.e., to get the percentage of ISDN circuits to total of data circuits, the average ratio of ISDN circuits to the total data circuits/terminals in other countries is shown in Table 6-7-14.

Table 6-7-14 ISDN Services

(at 1992)

No.	Country	Data Circuits ('000)	ISDN Circuits ('000)	ISDN Circuits / Data Circuits (%)
1	Australia	735.58	0.80	0.11%
2	Austria	22.01	0.18	0.81%
3	France	(560.01)	(350.00)	(62.50%)
4	France Polynesia	0.44	0.02	4.55%
5	Germany	(231.00)	(138.80)	(60.09%)
6	Hong Kong	54.13	0.06	0.11%
7	Japan	1,032.01	156.81	15.19%
8	Korea (Rep.)	442.90	1.30	0.29%
9	New Caledonia	0.79	0.02	2.53%
10	Portugal	14.55	0.04	0.27%
11	Sweden	515.00	1.50	0.29%
12	Switzerland	35.32	2.20	6.23%
13	United Arab E.	0.63	0.17	26.98%
TOTAL		**2,853.39**	**163.10**	**5.72%**

Source : World Telecommunication Development Report by ITU (at 1994)

( ) : Not including in total Figure

The data in only above 13 countries were available. The ratio is very high in France and Germany; however, the ratio in 6 countries is less than 1%. The average ratio of ISDN circuits to the total data circuits in 11 countries except for France and Germany as highly developed countries in the data communication field is **approx. 6%.** In this study, It is assumed by the study team that at least 6% of data circuits estimated in Section 7.4.2 will be potential demand of ISDN circuits, i.e. ISDN terminals, and all packet terminals estimated in Section 7.4.4 is assumed to be potential demand of ISDN circuits, i.e. ISDN terminals. Table 6-7-15 and Figure 6-7-5 shows the estimated ISDN demand.

Table 6-7-15 ISDN Demand

Item	1995	2000	2005	2010	2015
No. of Data Circuits	373	2,398	4,661	7,681	11,498
Potential ISDN Circuits (6%)	22	144	280	461	690
No. of Packet Terminals	384	1,401	2,246	3,209	4,287
No. of ISDN Terminals	**406**	**1,545**	**2,526**	**3,670**	**4,977**

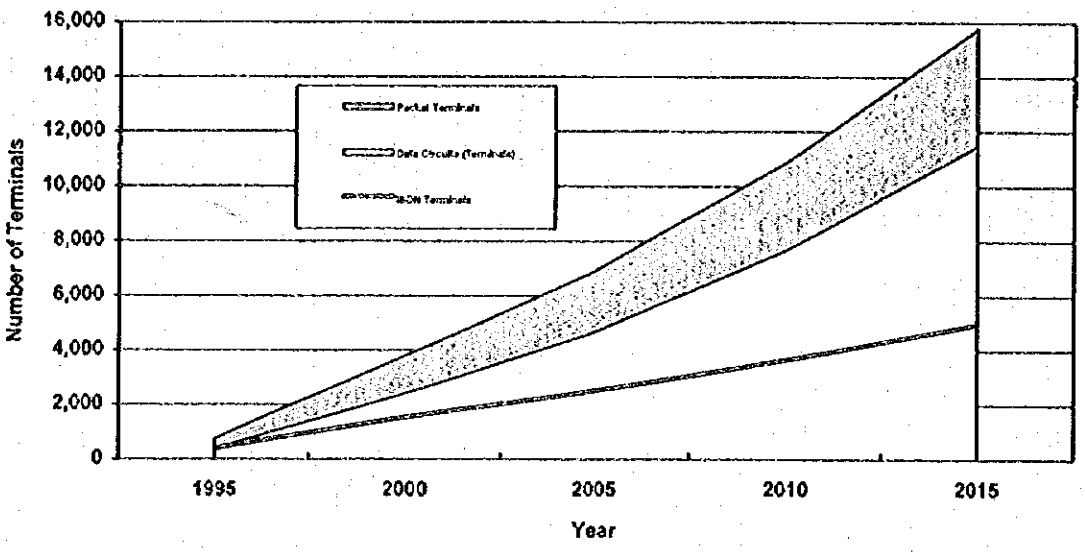


Figure 6-7-5 Demand of ISDN Terminals

7.6 Comparison among types of data transmission services

Data transmission services include leased circuit services, and circuit switched and packet switched services. Leased circuit service is provided with dedicated transmission elements, or possibly integrated with the PSTN (Public Switched Telephone Network). Circuit switched service is provided over a PSTN, a CSPDN (Circuit Switched Public Data Network), or an ISDN while packet switched service is realised over PSPDN (Packet Switched Public Data Network) or an ISDN is able to provide all these services simultaneously in one network. Table 6-7-16 shows the technical comparison of the data transmission services. These services are compared from the following three points:

1) service elements (maximum transmission speed, optional user facilities);
2) quality of service (call set-up time, network transit delay);
3) characteristics of the service (transparency of transmitted data, availability of interworking, possible type of transmission systems, importance of connection distance, availability between DTEs of different speeds, multiplexing of logical paths).

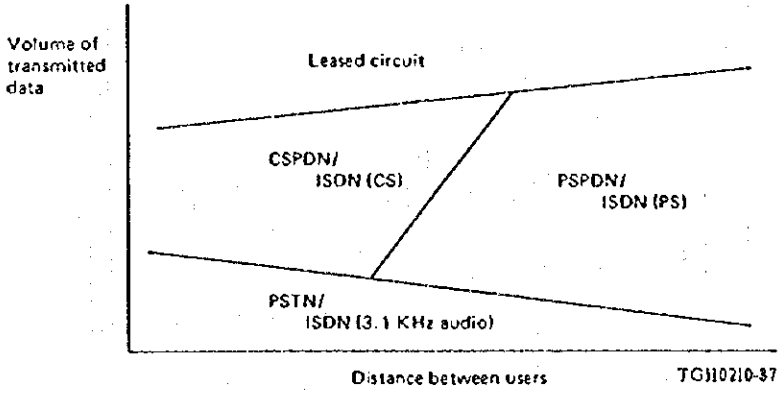
Since the user/network interface for data transmission services is defined in a general mannar (e.g., transmission speed or general purpose protocol), a user make use of data transmission services for various applications. Four data transmission services are compared in Table 6-7-16 from technical viewpoints as described the above. Each item should be carefully examined from the viewpoints of user's application.

In addition to the technical considerations, economic aspects must be taken into account. Since the leased circuit cost is high but fixed, it is suitable for very large amounts of data. Figures 6-7-6 and 6-7-7 show, in general terms, the various domains where each data transmission service is relatively more economical.

Table 6-7-16 Technical Comparison among Data Transmission Services

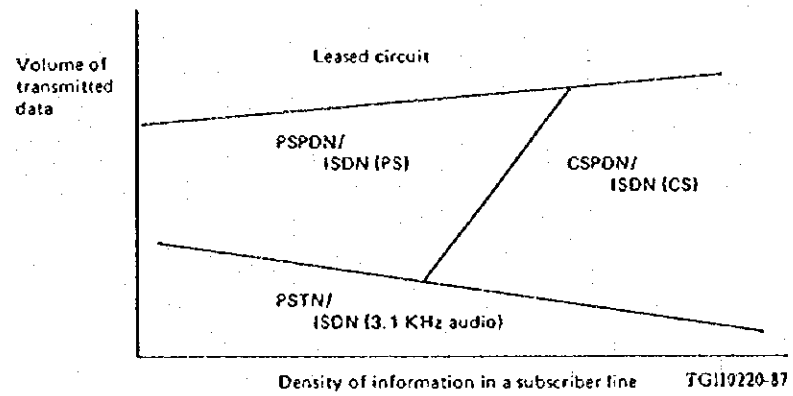
Items	Leased Circuit	PSTN	CSPDN	PSPDN	ISDN
Maximum transmission speed	48 kbit/s	Several kbit/s	48 kbit/s	48 kbit/s	64 kbit/s
Optional user facilities	Facilities defined in X.2 are available	Limited by telephone network	Facilities defined in X.2 are available	Facilities defined in X.2 are available	(Not yet specified)
Call set-up time	–	Several second	Around 1 second	Around 1 second	Around 1 second
Delay time of data	Small and fixed	Small and fixed	Small and fixed	Medium and varies (X.135)	CS: see CSPDN PS: see PSPDN
Transparency of transmitted data	Transparent	Transparent except call control phase	Transparent except call control phase	Protocol for data transfer is defined	CS: see CSPDN PS: see PSPDN
Possible type of transmission systems	Analog/digital	Analog/digital	Digital	Analog digital	Digital
Importance of distance in determining cost	Important	Important	Important	Less important	CS: Important PS: Less important
Occupation of inter-exchange circuit in a call	–	Fully occupied	Fully occupied	Occupied during data transmission	CS: see CSPDN PS: see PSPDN
Connection between DTEs of different speeds	No	No	No	Yes	CS: no PS: yes
Multiplexing of logical paths into a physical line	No	No	No	Yes	CS: no PS: yes

Note – ISDN can also provide a service equivalent to PSTN data transmission service.



Note – The network name in a domain indicates the most economical network type

Figure 6-7-6 Economical Comparison of Data Network Types (in Distance between Users)



Note – The network name in a domain indicates the most economical network type

Figure 6-7-7 Economical Comparison of Data Network Types (in Density of Information in a Subscriber Line)

CHAPTER 7

DEVELOPMENT FRAMEWORK AND STRATEGIES

CHAPTER 7

DEVELOPMENT FRAMEWORK AND STRATEGIES

1. Basic Concept of Master Plan

1.1 World Trend on Telecommunications Needs

Recent technological development in telecommunications, transportation, data processing and various production process allows us the world-wide socio-economic activities. In consequence, international economic relationships have been increasingly become complex and tightly connected.

In these circumstances, volume of information transactions in economic entities, especially in industrial and service sectors, has significantly increased. To support these transaction requirements, not only enhancement of conventional telecommunications means by increasing voice telephony but also introduction of new type telecommunications means including data communication, facsimile and utilisation of data / information processing equipment are essential. Accordingly, telecommunications network has been indispensable infrastructure for those activities.

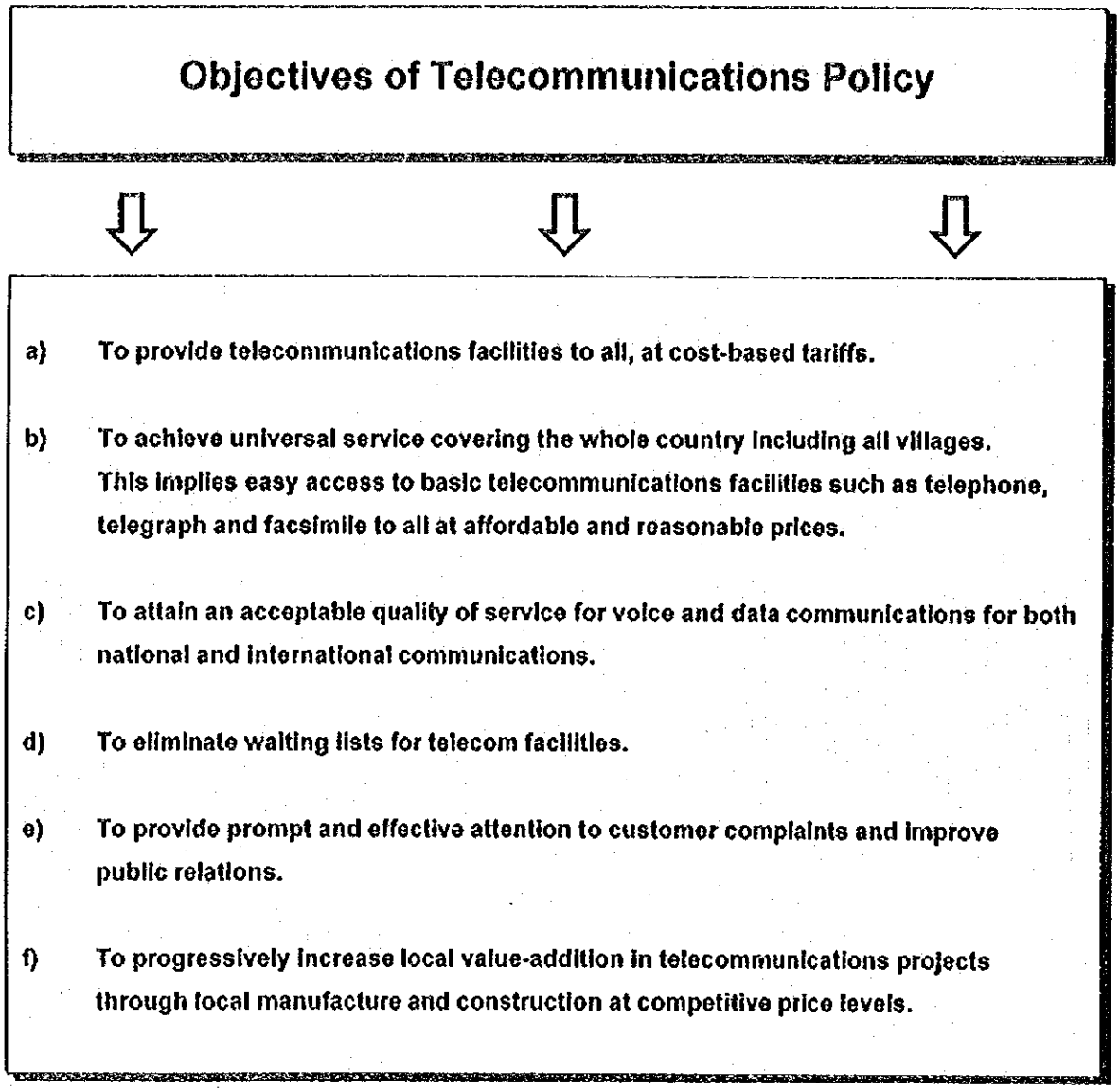
1.2 Telecommunications Needs in Sri Lanka

To realise higher economic growth and equitable distribution of social benefits, the Government of Sri Lanka has been strongly emphasising the needs for adequate, efficient and reliable infrastructures in the national development policy. In the policy, telecommunications development is placed as a highest priority for the industrial development, higher productivity of agriculture and enhancing efficiency in the service sector.

1.3 Telecommunications Policy and Objectives in Sri Lanka

Telecommunications policy has been established by the department of national planning keeping with the Economic Policy Statement of the Government of Sri Lanka which was announced on September 1994. The Economic Policy states that public investment would be needed to build the infrastructure which is required as a necessary complement to rapid private sector growth and socio-economic activities.

In line with the above policy, the Telecommunications Policy has the objectives mentioned in the following Figure 7-1-1. However, the defence, security and environmental interests of the country will be protected while meeting the above objectives.



Source: Department of National Planning

Figure 7-1-1 Objectives of Telecommunications Policy

1.4 Planning Period and Target Years of the Master Plan

This master plan covers long-term development for the telecommunications networks up to 2015 in whole Sri Lanka. The planning period up to 2015 is divided into several milestones as target years i.e. a short-term plan on exchange basis up to 2000, a medium-term plan on exchange basis up to 2005 and a long-term plan on SSC area basis up to 2015. The figure 7-1-2 shows a concept of planning period and target years in this master plan.

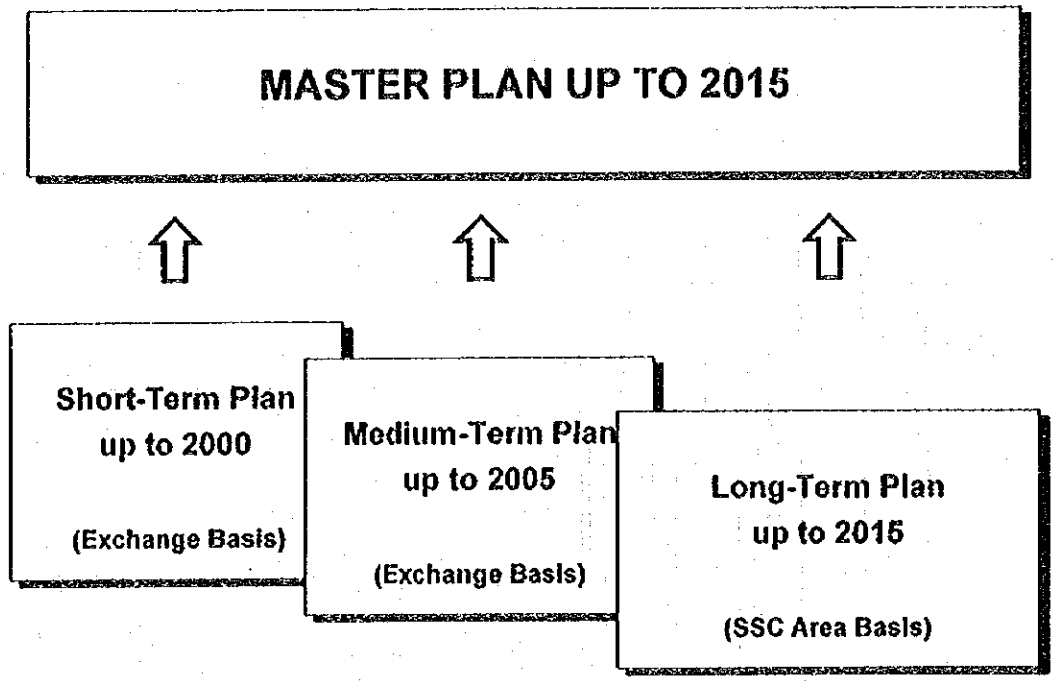


Figure 7-1-2 Planning Period and Target Years in the Master Plan

2. Key Development Targets up to 2015

Key development targets consisting of those for various service provisions, service quality, operational efficiency and network facility provisions for the respective short-term, medium term and long-term plans up to 2015 are summarised in the Table 7-2-1.

Table 7-2-1 Key Development Targets up to 2015 (1/2)

Indexes	Sub-Indexes	Present Status as of 1994	Development Targets		
			Short-Term Targets By FY 2000	Medium-Term Targets by FY 2005	Long-Term Targets by FY 2015
Socio-Economy	Population	17,765,000	18,831,000	19,781,000	21,524,000
	GDP/Capita (US$ Price in 1992)	534	761	1,056	1,673
Plain Ordinary Telephone Service (POTS)	Expressed Demand +20% Hidden Demand (DELs)	-	820,000	1,180,000	2,000,000
	Expressed Demand (DELs)	367,000	680,000	980,000	1,670,000
	Supply Volume (DELs)	181,000	667,000	980,000	1,670,000
	Switching Capacity (Line Units)	237,000	800,000	1,200,000	2,000,000
	DELs / 100 inhabitants	1.0	3.5	5.0	7.8
	Network Coverage	to Major Villages	to All Villagers by 1998	-	-
Telex Service	Telex Subscriber Demand	Decreasing	Decreasing	Decreasing	-
	Supply Volume (DELs)	1,560	No Expansion	No Expansion	to Other Services
Telegram Service	Gentex Service	88 Terminals for 44 Post Office	Same as the present	Same as the present	to Other Services
Leased Circuit	Voice Circuits, Data Circuits	Between Major Cities	Between Major Cities	Between All Districts	Nation-wide Service
Maritime Communication Services	Ordinary Services by MF, HF, VHF / INMARSAT services	Ordinary Services / INMARSAT services	Ordinary Services / Enhancing INMARSAT services	Ordinary Services / Enhancing INMARSAT services	Ordinary Services / Enhancing INMARSAT services
Value Added Services	Cellular Mobile Telephone	Operated (32,500DEL)	Major Cities	All District Capitals	All Districts
	Public Payphones	Operated	All Villages	Increase the Number	Increase the Number
	Electronic Mail	Operate in 1995	Major Cities	Major Districts	All District Capitals
	Data Communications	Operated	Major Cities	Major Districts	All District Capitals
	Voice Mail	Not Operated	Colombo	Major Cities	Major Districts
	Video Text	Not Operated	Colombo	Major Cities	Major Districts
	Audio Conference	Not Operated	Colombo	Major Cities	Major Districts
	Video Conference	Not Operated	Colombo	Major Cities	Major Districts
	Radio Paging	Operated	Major Cities	All District Capitals	Nation-wide Service
	Trunked Mobile Radio Services	Operated	Major Cities	Major Districts	All Districts
	Narrowband ISDN Services	Not Operated	Colombo	Major Cities	All District Capitals
	Broadband ISDN Services	Not Operated	-	-	Major Cities
	IN Services	Not Operated	Colombo	Major Cities	All Districts

Table 7-2-1 Key Development Targets up to 2015 (2/2)

Indexes	Sub-Indexes	Present Status as of 1994	Development Targets		
			Short-Term Targets By FY 2000	Medium-Term Targets by FY 2005	Long-Term Targets by FY 2015
Service Quality (for basic services)	Call Completion Rate	28%	45%	55%	70%
	No. of Faults (/ month / 100 DEL)	26	15	10	5
	Fault Clear Rate within 24hours	55%	85%	90%	95%
Operational Efficiency (for basic services)	Number of Staff	7,500	9,200	10,000	10,900
	Staff / 1,000 DEL	42	14	10	7
Network Facilities	Switching System	Manual / Analog / Digital	100% Digital	100% Digital	100% Digital / Introduction of ATM
	Transmission System	Microwave & FOTS / Analogue & PDH	FOTS & Microwave / 100% Digital / Backbone by FOTS/ Introduction of SDH	FOTS & Microwave / 100% Digital / Expansion of Backbone by FOTS / Expansion of SDH	FOTS & Microwave / 100% Digital / Expansion of Backbone by FOTS / Expansion of SDH
	Subscriber Network	Metallic Cable & Radio	Metallic Cable & Radio / Introduction of Optical Fibre Cable	Metallic, Optical Fibre and Radio system / Expansion of Optical Fibre	Metallic, Optical Fibre and Radio system / Expansion of Optical Fibre
	Maritime Communication	Conventional System	Introduction of GMDSS	-	-

dev-indx.xls

Abbreviations:
DEL: Direct Exchange Line
PDH: Presiochronous Digital Hierarchy
SDH: Synchronous Digital Hierarchy
ATM: Asynchronous Transfer Mode
FOTS: Fibre Optic Transmission System
GMDSS: Global Maritime Distress and Safety System

3. Service Provision and Supply Volume

The service provision and supply volume up to the year 2015 are established based on the new telecommunications policy which is outlined in keeping with Economic Policy Statement of the Government of Sri Lanka announced on September 1994. In the policy, major objectives for the service provision and supply volume are as follows:

- **To achieve universal service covering the whole country including all villages.**
- **To attain an acceptable quality of service for voice and data communications for both national and international communications.**
- **To eliminate waiting lists for telecom facilities.**

3.1 Service Provision

The telecommunications operators in Sri Lanka are providing various telecommunications services mainly consisting of basic telecommunications services and value added services. At present, Sri Lanka Telecom provides basic services covering plain ordinary telephone service (POTS), telex service and telegram service as a monopoly. In addition, Sri Lanka Telecom provides leased circuit service and maritime communications services.

Regarding the value added services, it is opened to private operators and Sri Lanka Telecom to provide the services based on the Telecommunications Act 1991. An introduction of the value added services to be expected to popularise from short-term and long-term views are proposed considering a service development strategy of Sri Lanka and a world-wide trend on the telecommunications service development. In the basic services in Sri Lanka, it is expected from a view in a world trend that telex and telegram services will be substituted and transferred to other value added services.

The following Table 7-3-1 shows a summary of the telecommunications services operated as of 1995 and proposed to be operated by the year 2015. The value added services both operated already and proposed are provided initially in Colombo and gradually expanded to outside Colombo in the country. The details of service introduction and enhancement are referred to in the Table 7-2-1 in Sub-Section 2. "Key Development Targets up to 2015".

Table 7-3-1 Service Provision up to the Year 2015

Service Categories	Sub-Service Categories	Present Status as of 1994	Objectives up to 2015
Basic Services	POTS	1.0 DEL/100P	Improvement up to 7.8
	Telex	1,560 Sub	to other services
	Telegram	44 post office	to other services
Leased Circuit Service		Major cities	Nation-wide service
Maritime Communication Services		Ordinary service	INMARSAT services
Value Added Services	Cellular Mobile Telephone	Operated	Service area enhancement to all districts
	Public Payphones	Operated	Increase the number
	Electronic Mail	Operate in 1995	All district capitals
	Data Communication	Operated	All district capitals
	Voice Mail	Not operated	Major districts
	Video Text	Not operated	Major districts
	Audio Conference	Not operated	Major districts
	Video Conference	Not operated	Major districts
	Radio Paging	Operated	Nation-wide service
	Trunk Mobile Radio	Operated	All districts
	Narrowband ISDN	Not Operated	All district capitals
	Broadband ISDN	Not Operated	Major cities
	IN	Not Operated	All districts

Note: POTS: Plain ordinary telephone service
DEL: Direct exchange line
ISDN: Integrated services digital network
IN: Intelligent network

3.2 Supply Volume

The supply volume up to the year 2015 is established based on the new telecommunications policy statement 1994. According to the policy, "To element waiting lists for telecommunications facilities" is the most crucial objective. Establishment of the supply volume described in this Chapter is mainly that for the plain ordinary telephone service.

3.2.1 Plain Ordinary Telephone Service (POTS)

As of the end of 1994, approximately 181,000 DEL (Direct Exchange Line) are provided as a result of development up to the present. It means 1.0 DEL per 100 inhabitants. However, approximately 186,000 people are registered and waiting for telephone lines. Most of them is waiting for over 5 years.

According to the telecommunications policy 1994, the Government of Sri Lanka intends to achieve that telephone service is to be made available on demand by the year 1998. It means that all waiters will be cleared by 1998. However, as a result of analyses of the progress of the on-going projects and demand estimate, it is realistic that the target as a 100% demand fulfilment will be attained by the year 2001 with further investment in addition to the on-going investment. This master plan is prepared considering the above concept. The following figure 7-3-1 shows a basic condition of master plan.

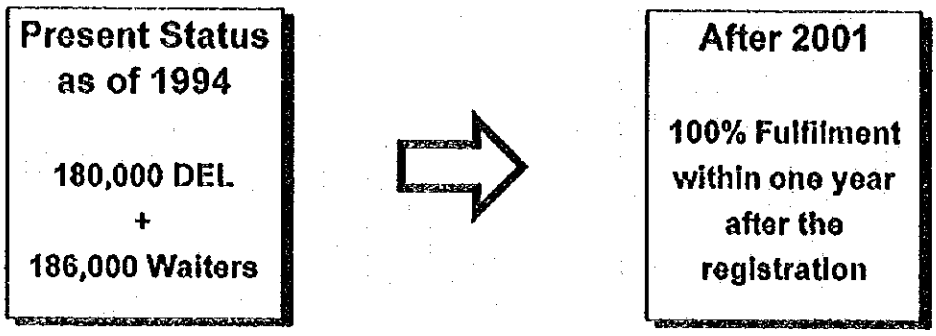


Figure 7-3-1 Basic Condition of this Master Plan

In consequence, all the planning components consisting of supply plan, network plan, facility plan, manpower plan, etc. are prepared based on the above condition.

The following Table 7-3-2 shows a summary of the expressed demand estimated and DEL supply volume established based on the demand and the basic condition. The number of DEL by SSC area is referred to in Table 7-3-3.

Table 7-3-2 Expressed Demand and DEL Supply Volume

Year	1994	2000	2005	2015
Expressed Demand	367,000	680,000	980,000	1,670,000
DEL Supply Volume	181,000	667,000	980,000	1,670,000
DEL / 100 inhabitants	1.0	3.5	5.0	7.8

Note: the demand and the number of DELs are the same after 2001 due to 100% fulfilment.

In addition to the Table 7-3-2, the number of DEL by SSC area up to the year 2015 is referred to in PART 3 of Volume-IV. The number of DEL on exchange basis up to the year 2015 is also referred to in PART 2 of Volume-IV, because that the number of DEL is equal to the demand after the year 2001.

Table 7-3-3 The Number of Direct Exchange Lines (DEL) up the year 2015

SSC \ Year	1994	2000	2005	2015
Ampara	475	2,376	3,399	5,699
Anuradhapura	2,751	7,031	10,989	15,449
Awissawella	1,821	6,799	10,024	17,211
Badulla	3,208	7,238	9,318	13,587
Bandarawela	1,815	4,965	6,301	9,027
Batticaloa	1,629	6,949	9,991	16,831
Chilaw	1,771	7,605	10,714	17,603
Colombo	124,032	379,988	567,180	979,929
Galle	3,393	16,523	23,583	39,226
Gampaha	2,114	27,911	42,271	74,812
Hambantota	2,793	8,437	11,704	18,946
Hatton	803	2,282	2,862	4,071
Jaffna	0	22,517	32,635	55,267
Kalmune	900	7,127	10,190	17,089
Kalutara	4,562	24,005	35,404	60,813
Kandy	8,421	36,873	53,160	88,714
Kegalle	1,947	9,159	13,377	23,007
Kurunegala	3,793	18,141	25,381	41,417
Mannar	124	1,255	1,712	2,697
Matale	2,104	6,842	8,700	12,541
Matara	1,830	14,766	20,931	34,826
Nawalapitiya	329	1,209	1,744	2,909
Negombo	3,461	19,638	29,309	51,139
Nuwara Eliya	1,860	4,538	5,692	8,098
Polonnaruwa	747	4,069	5,312	7,935
Ratnapura	2,634	9,856	14,215	24,173
Trincomalee	824	5,310	7,613	12,690
Vavuniya	583	3,591	4,825	7,467
Total	180,724	667,000	978,536	1,663,173

3-2-2 Telex and Telegram Services

According to the telecommunications policy statement, the Government of Sri Lanka intends to provide not only telephones but also telegram and facsimile access to all villages and villagers by the year 1998. The telegram service is realised by gentex service by using telex network and the facsimile service is realised by telephone network. As for the facsimile service expansion, it will be expanded depending on the development of the telephone network.

However, from a view of international trend on telex and telegram services, the number of telex subscribers and telegram messages have been gradually declining. In fact, the same trend is seen also in Sri Lanka. Considering the above situation, it is not proposed to expand the existing system. In the future, those services will be substituted with other services and transferred to the value added services.

3-2-3 Leased Circuit Service

In Sri Lanka, leased circuits mainly consists of data, voice, packet, telex circuits. In the business activities, leased circuit services become important means of business communication in all industrial and service sectors. In addition, the leased circuit service is also indispensable not only for ordinary commercial sectors but also for telecommunications business sector, especially for value added service operators. Based on a result of leased circuit demand estimate and considering the above circumstances, necessary leased circuit capacity is included in the transmission network plan and facility plan. From a view of area expansion, the leased circuit service is to be expanded to nation-wide service. With a progress of popularisation of the value added services and computer communication toward the information society, careful market survey is to be carried out.

3-2-4 Maritime Communication Services

Maritime communication services are provided for ships off the coast of Sri Lanka to contact subscribers over conventional system i.e. HF, MF, VHF radio systems. At present, there are two coastal stations i.e. Colombo and Galle. In addition, INMARSAT services are also available through foreign coastal stations.

With globalisation over the border, sea traffic to be brought by an increase of sea transportation will rapidly increase and maritime safety and navigation are an important issue.

Especially Sri Lanka is located at very important position for the sea transportation in Indian Ocean. Considering the above, it is proposed that a new coastal station is to be placed at Trincomalee in addition to the existing Colombo and Galle stations. By this, whole sea area surrounding Sri Lanka will be covered.

For the maritime safety, the existing conventional system is to be replaced by the year 1999 to GMDSS (Global Maritime Distress and Safety System) recommended based on the international treaty.

3-2-5 Value Added Services

Recognition of the crucial role played by telecommunications for the promotion of socio-economic development and business development is very significant not in the developed countries but also in the developing countries. With a progress of innovation toward information society, value added services will be essential for administrative, business and social activities. In addition, the operation itself of the value added services will be much attractive as a business in the new era.

In accordance with the telecommunications policy statement 1994, the Government of Sri Lanka encourages investment and parallel operation by the private sector in healthy competition with the Government sector for the operation of the value added services to be expected to popularise. The status of operation of the value added services at the end of 1994 is referred to in the Table 7-3-1.

(1) Cellular Mobile Telephone Service

The cellular mobile telephone service has been operated by four companies including Mobitel which is the joint venture with Sri Lanka Telecom. The total number of cellular mobile telephone subscribers amounts to 32,500 as the end of 1994. It is 15% of the total telephone subscribers. The coverage areas of the service are Colombo and other major cities. Most of the subscribers is registered in Colombo and are using the service mainly for the purpose of their business. In addition, in case persons who are living in the area where the plain ordinary telephone service is not available want to use the telephone, the cellular mobile telephone service is quite essential.

Since the first cellular mobile telephone operator, Lanka Celltel has started the operation of the service in 1989, the number of mobile subscribers has been quite rapidly

increasing. Especially, for past a few years, the growth of the number is 100% - 225% per year. However, it seems that the increase of the number is slightly slowing down at present. According to the demand forecast of the cellular mobile telephone service described in Chapter 6, the number of the subscribers will reach to approximately 330,000 in 2015. It will be 20% of the plain ordinary telephone subscribers.

The cellular mobile telephone service meets the need to personal communication that people wants to communicate anytime, anywhere and with anybody. In consequence, this service has been rapidly popularised in many countries which are not only developed countries but also developing countries.

The Government of Sri Lanka is encouraging investment and parallel operation by private sector in healthy competition among operators including Sri Lanka Telecom. Considering the above condition, it is proposed that the service coverage is to be expanded to all districts by 2015 by parallel operation among operators playing the role of fulfilment of the demand which is one of the objectives of the national policy. Based on the above scenario, detailed market survey and area by area basis demand forecast are to be carried out.

(2) Other Value Added Services

As already described at the beginning of this sub-section, the Government of Sri Lanka encourages the private sector participation to the operation of the value added services in healthy competition. The value added services have many potential needs toward information society and are keeping unforeseeable needs for users and immeasurable large business market for telecommunications service providers in not only the developed countries but also the developing countries including Sri Lanka.

In Sri Lanka, Most of the value added services excluding several services are not provided yet. Considering the situation, it is proposed that the value added services which are not provided yet is to be started as a pilot project in Colombo. With an increase of the number of the users, the service areas will be gradually expanded to other major cities and major districts. For the value added services, careful market survey, user survey and example survey in not only Sri Lanka but also other countries which have experience to such services.

4. Network Expansion and Improvement

Considering the telecommunication policy 1994, most important development objective is to eliminate waiting lists more than the number of the existing telephone subscribers. In this master plan, it is proposed that the above objective will be achieved by the year 2001 considering the progress of on-going projects. In consequence, 100% fulfilment to the expressed demand within one year after the registration of the application will be attained.

Based on the above, the proposed telecommunications network of this master plan is designed in consideration of the following:

a) The network is economical in not only the installation but also the operation.
b) The network is made up applying latest technologies at present.
c) The network is capable to fulfil every new application of basic telephone service within one year after its registration in the year 2001 and afterwards.
d) The network is equipped with integrated services digital network (ISDN) and intelligent network (IN) function, and covering whole the country of the Democratic Socialist Republic of Sri Lanka.

The development targets for respective network components are shown in Table 7-4-1. For more details, Chapter 8 "Telecommunications Network Plan" is to be referred.

Table 7-4-1 Development Targets for Network Component up to 2015

System	Present Status as of 1994	Development Targets		
		Short-Term by 2000	Medium-Term by 2005	Long-Term by 2015
Switching	Manual, analogue & digital	100% digital	100% digital	100% digital / Introduction of ATM
Transmission	Microwave & FOTS/ Analogue & PDH	FOTS & microwave/ 100% digital / Backbone by FOTS / Introduction of SDH	FOTS & microwave / 100% digital / Expansion of backbone by FOTS / Expansion of SDH	FOTS & microwave / 100% digital / Expansion of backbone by FOTS / Expansion of SDH
Subscriber Network	Metallic cable & radio system	Metallic cable & radio system / Introduction of optical fibre cable	Metallic, optical fibre cable & radio system/ Expansion of optical fibre cable	Metallic, optical fibre cable & radio system/ Expansion of optical fibre cable
Maritime	Conventional system	Conventional system/ Introduction of GMDSS	Conventional system & GMDSS	Conventional system & GMDSS

Abbreviations: ATM: Asynchronous Transfer Mode
FOTS: Fibre Optic Transmission System
PDH: Presiochronous Digital Hierarchy
SDH: Synchronous Digital Hierarchy
GMDSS: Global Maritime Distress and Safety System

5. Service Quality Improvement

The service quality is able to be indicated by major three factors i.e. call completion rate, faults rate and fault clear rate. They are still low level compared with those in developed countries. Low call completion rate will result loss of revenue from call charge and high faults rate will bring an increase of operation and maintenance cost. Low clear rate will affect to various customers' activities. The present service quality as of the end of 1994 is as follows:

- **Call Completion Rate: 28%**
  Mainly caused by called number busy, customer error and forward system.

- **Faults Rate: 26 / month / 100DEL**
  Mainly occurs at subscriber cables and overhead lines.

- **Fault Clear Rate within 24 hours: 55%**
  The figure is low but is acceptable level considering the large number of faults.

The above service quality will be able to be improved by taking appropriate actions with an introduction of adequate quality control system. Improvement targets of the service quality are shown in the following Table 7-5-1. For more details, Chapter 11 is to be referred.

Table 7-5-1 Improvement Targets of the Service Quality

Item	Target Year				Actions to be taken
	1994	2000	2005	2015	
Call Completion Rate	28%	45%	55%	70%	■ Increase DEL for high traffic subscribers ■ Promote pilot number and call waiting service ■ Campaign to reduce incorrect dialling ■ Expand trunk lines
Faults Rate	26	15	10	5	■ Replace unreliable overhead lines ■ Improve lightning protectors ■ Up-grade skill of maintenance staff
Clearance Rate within 24 hours	55%	85%	90%	95%	■ Modernise customer service management ■ Reinforce maintenance teams

6. Operational Efficiency Improvement

The operational efficiency is able to be indicated by the number of staff per 1,000DEL. The number of staff per 1,000DEL as of the end of 1994 was 42. It means low efficiency compared with 16 of both Thai and Malaysia in 1991. This low efficiency will result large operation and maintenance cost.

The present low efficiency will be able to be improved mainly by modernising network facilities, introducing computerised operation and maintenance system and restructuring operation and management. Improvement targets of the operational efficiency and the required number of staff are shown in the following Table 7-6-1. For more details, Chapter 12 is to be referred.

Table 7-6-1 Improvement Targets of the Operational Efficiency

Item	Target Year			
	1994	2000	2005	2015
No. of DEL	181,000	667,000	979,000	1,663,000
No. of Total Staff	7,516	9,200	10,000	11,900
No. of Staff / 1000DEL	42	14	10	7

CHAPTER 8

TELECOMMUNICATIONS NETWORK PLAN

CHAPTER 8

TELECOMMUNICATIONS NETWORK PLAN

1. Basic Concept of Network Plan

1.1 Fundamentals of Network Plan

The proposed network of this Master Plan is designed in consideration of;

a) The network is economical in not only installation but also the operation;
b) The network is made up applying latest technologies at present;
c) The network is capable to fulfil every new application of basic telephone service within one year after its registration in the year 2001 and afterwards.
d) The network is equipped with integrated services digital network (ISDN) and intelligent network (IN) function; and

covering whole the country of the Democratic Socialist Republic of Sri Lanka.

The discussion on the design of the network is done on the assumption that the nation wide general service is provided by one network provider. However, the network plan is not affected by regional division. Attention is paid to the fact that several telecommunications service entities coexist already in Sri Lanka.

1.2 Compatibility of Different Networks

Sri Lanka has taken the policy of deregulation for introducing new telecommunications service entities and some private telecommunications service entities are found besides SLT as at 1995.

The private telecommunications service entities have their own network, respectively. Some of them are inter-connected by some means with SLT network. There are four cellular telephone service networks, three data communications service networks, three pay telephone service networks, etc. Sri Lanka Telecommunication Authority (SLTA) plans to introduce some more networks in future. Only SLT provides a general network which is consisted of subscriber line networks, transmission links, and telephone switching centres, covering whole the country.

Those different networks will continue to coexist in Sri Lanka. Inter-network connection of those networks are taken into consideration in making up the proposed network. The SLT network has a gateway switching centre in Colombo for inter-network connection with such different networks. JICA Study Team recommends SLT to introduce a new switching unit of NSC equipped with Common Channel Signalling System No. 7, which is becoming the standard signalling system all over the world, for a smooth compatibility with private entities' networks which come in future.

1.3 Evolution of Existing Network to ISDN

Many developed countries have introduced ISDN to integrate the telephone network, telex network, data communication network, though it is still on the way of development in the world. Introduction of an ISDN is proposed in this Master Plan to offer, by means of high quality network, services popular in other countries covering major cities in the Country.

The existing SLT network should be changed gradually into an ISDN in consideration of economic aspects and technical issues. The assets accumulated for the past should be maintained and used with the utmost. Accordingly, it is recommended to extend the ISDN from a point to line, and a line to area, in proportion to the growth of demand after it is introduced in the national capital, Colombo, at the first stage of ISDN era. The ISDN should be compatible with Intelligent Network (IN). The ISDN is planned to equip with ISDN User Part (ISUP) of CCS No. 7. The transport layer by the ISDN will be connected to the IN layer by means of the ISUP of CCS No. 7.

During the transfer phase from conventional networks to an ISDN, such various networks as normal telephone network, data communication networks, cellular telephone networks, telex network, and leased circuits networks will coexist. The telex network now provided by SLT will be demolished when its subscriber number is considerably reduced. Then the telex service may be substituted by facsimile or data communication service through digital telephone network or ISDN.

1.4 Measures for Higher Reliability of Networks

As the leading entity providing general telecommunications services, SLT has adopted measures for getting higher reliability of its network, for instance, providing key telephone switching nodes with separate units of hardware. Study Team recommends decentralisation of

capital function in telecommunications network and enforcement in telecommunications facilities to support such efforts.

New marine cables should be landed at a new point to support the existing landing point of Colombo City. JICA Study Team recommends introduction of an earth station for satellite communications into a new location to guarantee higher reliability of international links. A new international switching centre (ISC) should also be introduced there for a higher reliability of international telephone facilities, in addition to the international switching centre situated in Headquarters in Colombo. Such decentralisation of telecommunications facilities is expected to contribute for higher reliability of Sri Lankan telecommunications network.

The national switching centre (NSC) consists of two units of switching system situated in Colombo. However, one unit of the NSC, or the 5-ESS switch, is a multi-function switch having the function of NSC, TSC, SSC, and Local exchange at a time. The other or NEAX-61 has NSC and TSC function at a time. Introduction of new separate switching system units is planned to enforce the network in the Capital and the existing NSC switching systems will be removed when their life ends.

The SLT network has four tertiary switching centres (TSCs), that is, Colombo TSC, Kandy TSC, Galle TSC, and Anuradhapura TSC at present. The inter-TSC traffic is converged basically to NSC situated in Colombo. A new separate TSC switching unit will be introduced to support Colombo TSC into a new point near Colombo City. The TSCs will be linked by direct circuits to form a substantial mesh network of TSC level and reduce somewhat the role of NSC in Colombo for a higher network reliability. In line with this, TSCs will have direct links to ISC.

Powerful loop transmission paths should be established to realise the direct circuits linking the TSCs and SSCs. The loop path should be large in capacity enough to support the normal operation of network even in case a section of the loop is disconnected by failure. The loop should also be ready for leased circuits to SLT users and other private telecommunications network providers as a leading telecommunications operating entity of the Country.

The Colombo area network should be established with a highest reliability taking account of its role as the national Capital. Loop links of optical fibre transmission system, by means of SDH, linking importnat exchanges in the Capital will be introduced to make up a reliable network.

1.5 Introduction of New Services and Technologies

An integrated services digital network (ISDN) will be introduced into SLT network in Colombo to meet the requirements on the services planned in the National Policy on Telecommunications by the year 2000. The ISDN will be expanded to Kandy, Negombo and Galle areas in proportion to the demand by the year 2005. The ISDN will be expanded to all district capitals by the year 2015.

The ISDN will enable SLT to offer the transparent bearer service and such supplementary services as a) User-to-user signalling, b) Close user group, c) Calling line identification (presentation and restriction), d) Direct dialling in, e) Call forwarding, etc. The existing telex network will be substituted by a message switch and ISDN by the year 2015.

An intelligent network (IN) will be established adding a data base management technology to the SLT network consisting of Public Switched Telephone Network (PSTN) and ISDN in 2000. Toll free call service, premium charge call service, universal personal number service will be offered to the public by the year 2000. Advanced services depending on IN will be expanded gradually to whole the country in proportion to demand.

Asynchronous transfer mode (ATM) technology is essential to realise a broad band integrated services digital network (B-ISDN). The ATM technology will be introduced by the year 2015. Making use of the ATM technology, a high speed and broad band leased circuit network will be introduced as well as a B-ISDN.