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No. 7

# STUDY REPORT
# ON
# KUANTAN - KOTA KINABALU
# SUBMARINE CABLE PROJECT
# IN
# MALAYSIA

## (VOLUME 2)

## TRAFFIC FORECAST
## AND
## ESTIMATION OF TRUNK CIRCUITS

JANUARY 1987

JAPAN INTERNATIONAL COOPERATION AGENCY

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# 1. SUMMARY

# III. TRAFFIC FORECAST AND ESTIMATION OF TRUNK CIRCUITS

## 1. Summary

This Part III describes the results of the traffic forecast and estimation of trunk circuits up to the year 2015 A.D. to design a new submarine cable system with an economical service life (25 years).

As a result of our study, we have roughly estimated the number of the circuits as shown below, depending on the GDP growth rates per annum, 2%, 4% and 6%.

| Between Peninsular Malaysia and the following states | No. of Trunk Circuits in 2015 A.D. GDP Growth Rate | | |
|---|---|---|---|
| | 2% | 4% | 6% |
| - Sabah | 901 | 1,914 | 4,057 |
| - Sarawak | 1,719 | 3,727 | 8,007 |
| Total (case) | 2,620 (pessimistic) | 5,641 (normal) | 12,064 (optimistic) |

Our study has been mainly concentrated on telephone demand forecast. However, the above trunk circuits obtained by three sensitivity cases show the equivalent circuits in terms of telephony circuits including other non-telephone services, e.g. telex, telegram and data communication, since we take the following conditions into consideration.

(1) As far as the present status is concerned, such non-telephone services may not require thousands of circuits between Peninsular Malaysia and Sabah/Sarawak, as compared with the telephone circuits.

(2) The future trend will show the remarkable decrease of the revenue from telex and telegram as indicated in the Annual Report 1984 of JTM.

(3) At this stage, it is difficult to estimate the additional circuits for the new telecommunications services; but additional 30% margin is added to the estimated telephone traffic.

In Malaysia, the future 4% GDP growth rate per annum is considered to be reasonable, as compared with the past trend of Malaysia as well as the other countries. In our study, therefore, this constant 4% GDP growth rate is defined as a normal case.

To design economically the new submarine cable system, the total number of the intermediate period, i.e., 3,200 circuits in 2003 A.D, is allocated.

In our forecasting the following steps have been taken:

Step 1: Collection of the data and information on the telecommunications and economics, etc.;

Step 2: Time-series and regression analyses of the above data and information;

Step 3: Determination of the fitting models for the long-term forecasting of telephone subscriber lines and traffic, together with sensitivity by GDP and estimation of total demand;

Step 4: Distribution of the telephone demand and teletraffic by Zone Centre;

Step 5: Estimation of the Trunk Circuits between Peninsular Malaysia and Sabah/Sarawak every five years starting in 1990 A.D. and ending in 2015 A.D.

The overall work flow of demand and traffic forecasts is shown in Figure III-1. These procedures will be described hereafter in more detail.

Since this forecasting is not made for a short-term provisioning purpose, the results of our study should be reviewed according to the economic outlook, etc. for the nation as continuously as possible.

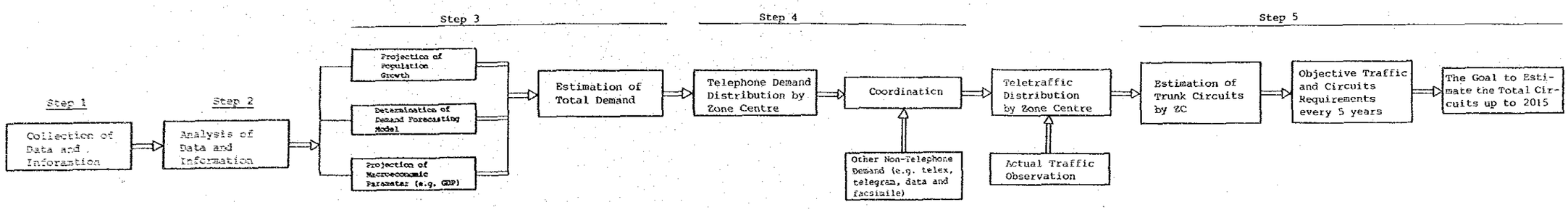



Figure III-1 Work Flow of Demand and Traffic Forecasts

# 2. FORECASTING METHODS

## 2. Forecasting Methods

### 2.1 Basic Concepts of Forecasting

In the telecommunications network, the majority of the services are focused on the telephone service. We, therefore, study mainly telephone demand forecasting to obtain the final number of trunk circuits between Peninsular Malaysia and Sabah/Sarawak via the new submarine cable system.

In this study, the three forecasts are required as follows:

(1) Estimate the number of telephone subscribers in the expected exchanges;

(2) Estimate the volume and distribution of the interexchange traffic originated by the above subscribers;

(3) Calculate the trunk circuits for the above traffic.

### 2.2 Long-term Demand Forecast

In this study, the long-term demand forecast has to be made to estimate the number of telephone subscribers over a whole country for 25 years. Such forecast is divided into the following two approaches;

(1) Macroscopic approach (Top-down method) to estimate the number of main subscribers stations and lines. In this case telephone density (or penetration factor) can be derived.

(2) Microscopic approach (Bottom-up method) to estimate the numbers of households and the different kinds of business activities. In this case field survey in depth is required by area.

Results by these approaches are coordinated each other as the case may be. In our study, the macroscopic approach only is applied.

## 2.3 Forecasting Model

### 2.3.1 Demand Forecast

The demand model for telephones, generally, is expressed as follows:

$$Qt = F\ (X, N, Pi, Ps, Pc, d, e, t) \quad \ldots\ldots\ldots\ldots \quad (2.1)$$

where, Qt = Total demand

X = A measure of income appropriate to residential and business users, e.g., gross domestic product (GDP)

N = Total population

Pi = Installation charges

Ps = Subscription charges

Pc = Call charges

d = A trend development factor

e = Other measurable influences, e.g. influence from income distribution

t = Time

Therefore, the total demand, Qt is dependent on the other factors.

On the other hand, the total density of main telephone stations (Dt) is expressed as follows:

$$Dt = \frac{Qt}{N} \times 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2.2)$$

In our study, due to the lack of the detailed data and information on Pi, Ps, Pc, d, or e, the above (2.1) formula is simplified as follows:

$$Qt = F(X, N, t) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2.3)$$

The future demand forecasting is made as follows:

(1) Estimate the total population

(2) Estimate the telephone density (Dt) using a single independent variable, GDP

(3) Estimate the GDP

### 2.3.2 Traffic Forecast

In case the present traffic conditions and the future exchange growth are known, the following CCITT's model can be applied to estimate the interexchange traffic.

$$Akl = Akl^{O} \cdot \frac{Nk \cdot \frac{Nl}{Nl^{O}} + Nl \cdot \frac{Nk}{Nk^{O}}}{Nk + Nl} \quad \ldots\ldots\ldots \quad (2.4)$$

where,

Akl is the interexchange traffic at a future point of time

Nk, Nl are the future numbers of subscribers in the areas k and l, respectively.

$Akl^{o}$ is the present interexchange traffic

$Nk^{o}$, $Nl^{o}$ are the present numbers of subscribers in the areas k and l, respectively.

### 2.3.3 Estimation of the Trunk Circuits

After obtaining the interexchange traffic by the formula (2.4), the number of the trunk circuits can be estimated by the following Erlang's Loss (B) formula.

$$En(a) = B = \frac{\frac{a^n}{n!}}{1 + a + \frac{a^2}{2!} + \ldots + \frac{a^n}{n!}} \quad \ldots\ldots\ldots (2.5)$$

where,

n = The total number of circuits

a = The volume of traffic offered in Erlangs

En(a) = The grade of service to be expected under the conditions of "n" and "a" specified above

B = The call congestion

Figure III-2 shows the Telephone Network Configuration in Malaysia for reference.

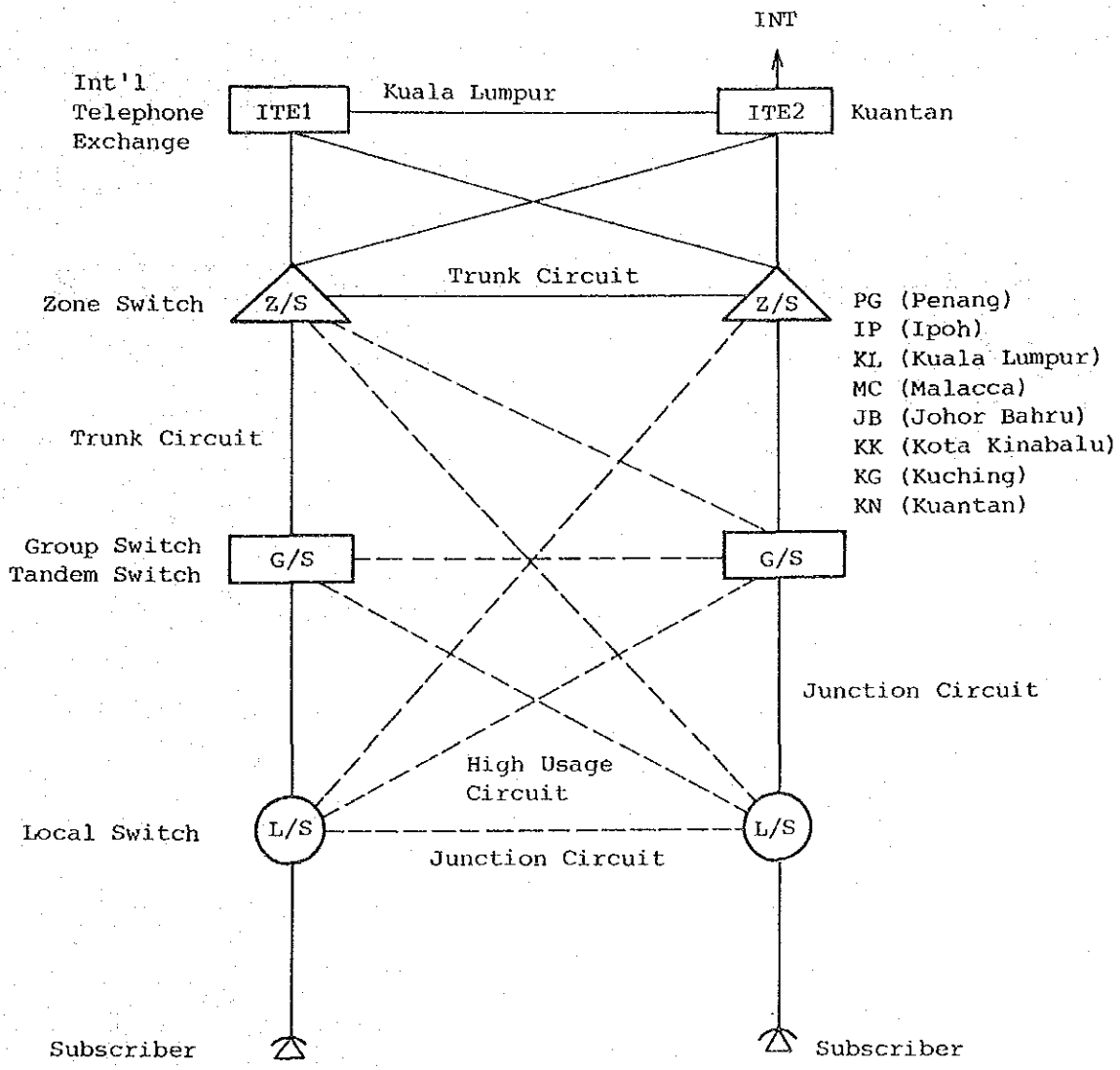



Figure III-2 Telephone Network Configuration in Malaysia

# 3. TELEPHONE DEMAND FORECAST

## 3. Telephone Demand Forecast

### 3.1 Basic Formula for Long-term Forecasting

As stated earlier, the basic forecasting model is given in the equation (2.3). In the demand forecast, the following analyses are carried out to determine an appropriate concrete formula.

- Time-series analysis; and
- Regression analysis.

The time-series analysis is effective to know the past trends and normally applied to estimate a short-term period (2 - 3 years ahead) by using extrapolation method as one of the standard methods for forecasting.

The regression analysis, on the other hand, is applied for the long-term forecasting (over 15 years ahead) by using an elastic model (e.g. GDP versus Telephone Demand Density) which is called "CCITT's Cross-Sectional Analysis".

#### 3.1.1 Time-series Analysis

First of all, we have studied the past data collected through our recent survey in Malaysia. The data are summarized in Table III-1, including the 1970, 1980-1985 economical and demographic backgrounds. This table represents US$2,113 for GDP per capita, 6.1 main telephone lines per 100 people and 2.67% population growth rate for 1985, for instance. The details of the past demand growth ('80 - '85) is referred to in ANNEX III-1 (Table 1). As a result of the time-series analysis, a good linear correlation has been obtained as shown in Figure III-3.

The equation obtained is as follows:

$$Y = 398,533 + 125,367 \cdot X \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3.1)$$

where,

Y = Number of total telephone demand in a certain of time

X = Time in year

r = Multiple correlation coefficient = 0.999207

N.B. Telephone demand = DEL plus waiting applicants
DEL = Direct Exchange Line = Main Telephone Line

As stated in paragraph 3.1, this equation (3.1) is applied for the short-term forecasting.

### 3.1.2 Regression Analysis

As an alternative approach, we have tried a cross-sectional analysis by selecting 22 major countries as shown in Table III-2. The results of this analysis are shown in Figure III-4 and indicated by the following equation:

$$Y = 1.83692 \times 10^{-4} \times X^{1.33139} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3.2)$$

where,

Y = DEL (Direct Exchange Line)

X = GDP per capita in US$

r = Multiple correlation coefficient = 0.914072

This equation covers various countries ranging from US$216 to US$9,812 for GDP per capita at 1981 prices and will be applicable to this Project.

This equation, however, has been slightly modified considering the past trend in Malaysia; it becomes:

$$Y = 1.83692 \times 10^{-4} \times X^{1.36} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3.3)$$

This formula was employed for the long-term forecasting up to the year 2015 A.D.

## 3.2 Projection of Population Growth

The future demand forecast is affected by the economic and demographic parameters. With regard to such economic and demographic outlooks, there is no information available up to the year 2015 A.D. in Malaysia.

The projection of population growth, therefore, is made by assuming that the population will be saturated to 28 million people in 2050 A.D. which is derived from the World Development Report 1984 published by the World Bank.

According to the past data shown in Table III-1, we have obtained the following logistic formula:

$$Y = k/(1 + m \cdot e^{-a \cdot x}) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.4)$$

where,

Y = Population at x time

m = Constant coefficient (1.1008)

a = Constant coefficient ($5.5833 \times 10^{-2}$)

k = Constant coefficient = 28 millions

The results of using this formula are illustrated on the both logarithms sections in Figure III-5.

## 3.3 Growth Projections of Telephone Lines

By using the previous formulas (3.3 and 3.4), we have estimated the growths of population and telephone lines from 1986 to 2015 A.D. inclusive. In Malaysia, macroeconomic forecast has been already carried out by the United Nations Industrial Development Organization (UNIDO). According to this forecast, the average annual GDP growth rate is 6.4% from 1985 to 1995.

The GDP growth rate of 6.4% is considered to be not reasonable to apply to the long term of over 25 years; then the average growth rate of less than 6.0% will be applied in comparison with the past rates derived from the 20 upper middle-income including Malaysia and 19 industrial market economies from 1965 to 1984 inclusive as shown in Table III-3.

Accordingly, we have assumed that the GDP in Malaysia may change between 2% (pessimistic) and 6% (optimistic).

The following sensitivity cases, therefore, are applied:

(1) For pessimistic case 2% GDP growth rate p.a.

(2) For normal case 4% GDP growth rate p.a.

(3) For optimistic case 6% GDP growth rate p.a.

The results based on the above cases are shown in Table III-4.

## 3.4 Distribution of the Projected DEL

The projected DEL (direct exchange line) was distributed to each Zone Centre, assuming that the present economic situation will continue up to the 2015 A.D. The results are shown in Table III-5, depending on sensitivity study of GDP growth rates.

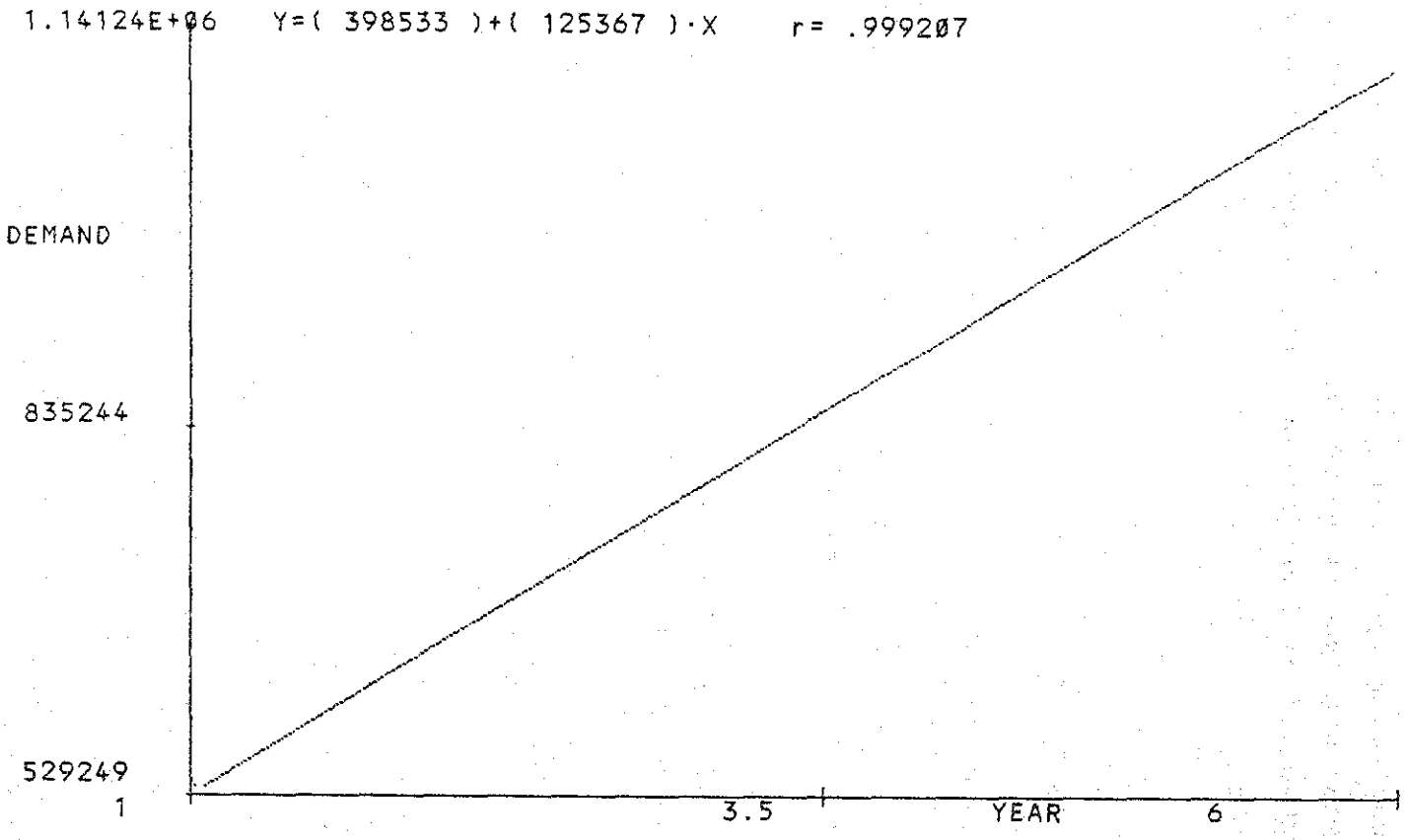



Figure III-3 Correlation Diagram (1980-1985) Between Time and Telephone Demand in Malaysia

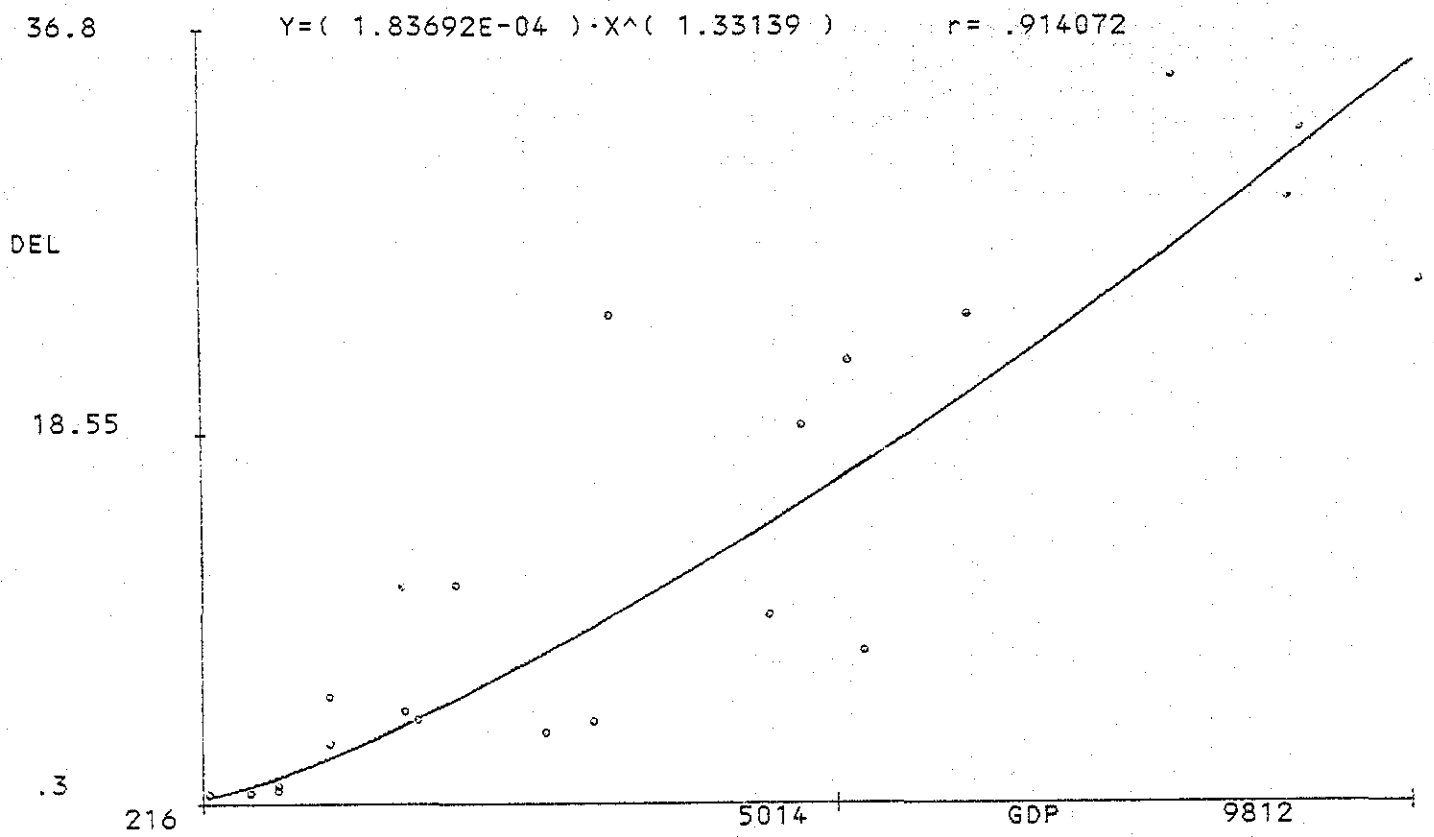



Figure III-4 Correlation Diagram Among 22 Countries as of 1981
(GDP vs. DEL)

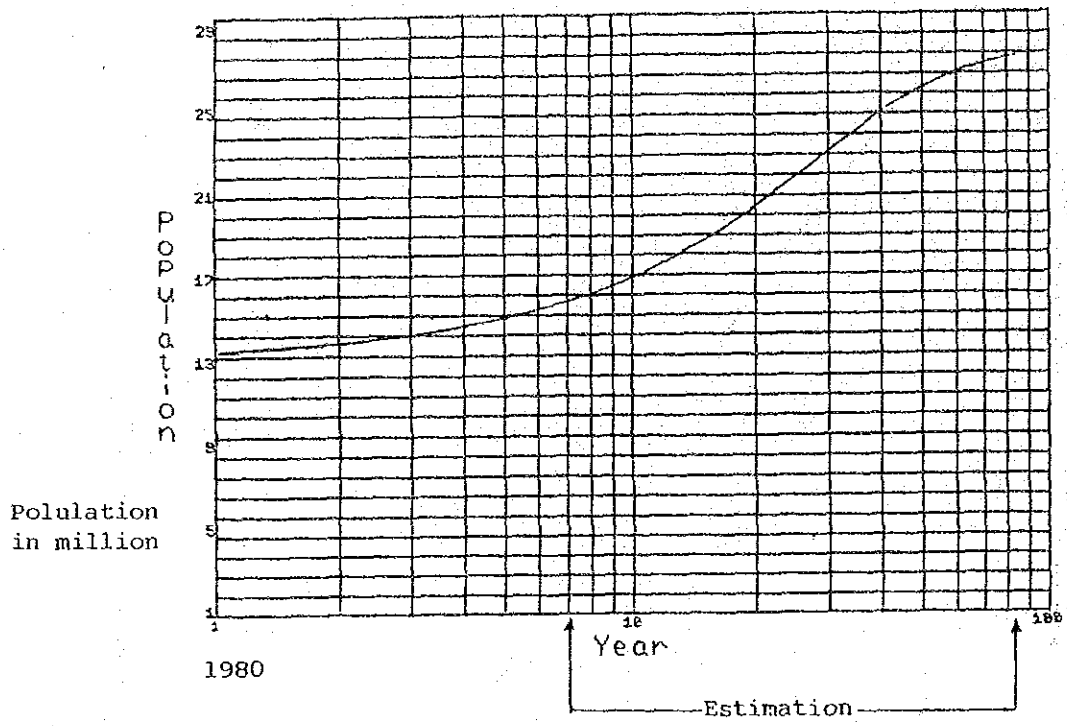



Figure III-5 Population Growth in Malaysia

Table III-1 Past Data of Population, GDP and Telephone Demand, etc.

| Item | 1970 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 |
|---|---|---|---|---|---|---|---|---|
| Total Population ('000) | 10,395 | 13,745 | 14,075 | 14,506 | 14,888 | 15,270 | 15,677* | |
| Ratio (%) | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | |
| Peninsular Malaysia | 8,775 | 11,427 | 11,678 | 12,039 | 12,345 | 12,651 | 12,978 | |
| Ratio (%) | 84.4 | 83.1 | 83.0 | 83.0 | 82.9 | 82.8 | 82.8 | |
| Sabah/Sarawak | 1,620 | 2,318 | 2,397 | 2,467 | 2,543 | 2,619 | 2,699 | |
| Ratio (%) | 15.6 | 16.9 | 17.0 | 17.0 | 17.1 | 17.2 | 17.2 | |
| Annual Growth Rate (%) | - | - | +2.40 | +3.06 | +2.63 | +2.57 | +2.67 | |
| Total GDP (M$ millions) | n.a. | 53,538 | 57,821 | 62,695 | 69,910 | 79,634 | 82,829 | 87,466 |
| GDP Growth Rate (%) | | +15.3 | +8.0 | +8.4 | +11.5 | +13.9 | +4.0 | +5.6* |
| Real GDP Growth Rate (%)** | 6.3 | n.a. | 6.9 | 5.6 | 6.3 | 7.6 | 5.2 | |
| Exchange Rate per US$ 1 | 3.08 | 2.22 | 2.24 | 2.32 | 2.33 | 2.42 | 2.50 | 2.59 |
| GDP per capita in US$ | n.a. | 1,755 | 1,834 | 1,863 | 2,015 | 2,155 | 2,113 | |
| Total Telephone | n.a. | 529,249 | 638,620 | 775,195 | 899,928 | 1,039,671 | 1,141,239 | |
| Demand Density (%) | n.a. | 3.9 | 4.5 | 5.3 | 6.0 | 6.8 | 7.3 | |
| No. of DEL | n.a. | 395,640 | 488,675 | 585,387 | 700,097 | 849,127 | 958,598 | |
| Ratio (%) | | 74.8 | 76.5 | 75.5 | 77.8 | 81.7 | 84.0 | |
| No. of Waiters | n.a. | 133,609 | 149,945 | 189,808 | 199,831 | 190,544 | 182,641 | |
| Ratio (%) | | 25.2 | 23.5 | 24.5 | 22.2 | 18.3 | 16.0 | |
| No. of DEL per 100 people | n.a. | 2.9 | 3.5 | 4.0 | 4.7 | 5.6 | 6.1 | |

Sources: 1. Annual Report 1984 of Jabatan Telekom Malaysia
2. Economic Report 1985/86 of Ministry of Finance, Malaysia

Notes: * Estimate by M.O.F., Malaysia
** Based on 1978 prices
n.a. Not available
DEL Direct Exchange Line

Table III-2 Distribution of the Selected Countries' Main Telephones, Population, and GDP as of 1981

| No. | Country | Total GDP (US$ millions) | Total Population ('000) | GDP per Capita (US$) | No. of DEL per 100 People |
|---|---|---|---|---|---|
| 1 | Belgium | 96,940 | 9,879.0 | 9,812 | 26.4 |
| 2 | U.K. | 496,580 | 55,992.0 | 8,869 | 34.1 |
| 3 | Austria | 66,240 | 7,555.3 | 8,767 | 30.7 |
| 4 | New Zealand | 25,010 | 3,190.1 | 7,840 | 36.8 |
| 5 | Italy | 350,220 | 56,244.0 | 6,227 | 24.6 |
| 6 | Argentina | 153,330 | 28,336.0 | 5,411 | 7.5 |
| 7 | Singapore | 12,910 | 2,443.3 | 5,284 | 22.4 |
| 8 | Spain | 185,080 | 37,693.0 | 4,910 | 19.1 |
| 9 | Venezuela | 67,800 | 14,602.0 | 4,643 | 9.4 |
| 10 | Greece | 33,390 | 9,780.0 | 3,414 | 24.6 |
| 11 | Mexico | 238,960 | 73,167.0 | 3,266 | 3.9 |
| 12 | Chile | 32,860 | 11,390.0 | 2,885 | 3.4 |
| 13 | Portugal | 21,290 | 9,804.0 | 2,172 | 10.8 |
| 14 | Malaysia | 24,770 | 13,000.0 | 1,905 | 4.3 |
| 15 | Brazil | 210,660 | 119,070.9 | 1,769 | 4.5 |
| 16 | S. Korea | 65,750 | 37,436.0 | 1,756 | 10.9 |
| 17 | Turkey | 53,910 | 45,217.6 | 1,192 | 2.9 |
| 18 | Colombia | 32,970 | 27,869.0 | 1,183 | 5.1 |
| 19 | Philippines | 38,900 | 49,960.4 | 779 | 0.7 |
| 20 | Thailand | 36,810 | 47,875.0 | 769 | 0.8 |
| 21 | Indonesia | 84,960 | 152,441.0 | 557 | 0.3 |
| 22 | India | 142,010 | 658,141.0 | 216 | 0.3 |

Sources: 1. The World's Telephones as of Jan. 1, 1982 by AT & T
2. World Development Report, 1983 (Statistical data for 1981)

Table III-3 Average Annual Growth Rates (%) of GDP by Country Group

| Upper Middle-income | 1965-73 | 1973-84 |
|---|---|---|
| Chile | 3.4 | 2.7 |
| Brazil | 9.8 | 4.4 |
| Portugal | 7.0 | - |
| Malaysia | 6.7 | 7.3 |
| Panama | 7.4 | 5.0 |
| Uruguay | 1.2 | 2.0 |
| Mexico | 7.9 | 5.1 |
| Korea, Rep. of | 10.0 | 7.2 |
| Yugoslavia | 6.1 | 4.2 |
| Argentina | 4.3 | 0.4 |
| South Africa | 5.1 | 2.7 |
| Algeria | 7.0 | 6.4 |
| Venezuela | 5.1 | 1.9 |
| Greece | 7.5 | 2.7 |
| Israel | 9.6 | 3.1 |
| Hong Kong | 7.9 | 9.1 |
| Trinidad and Tobago | 3.5 | 5.2 |
| Singapore | 13.0 | 8.2 |
| Iran, Islamic Rep. | 10.4 | - |
| Iraq | 4.4 | - |
| Average | 6.87 | 4.56 |

| Industrial Market Economies | 1965-73 | 1973-84 |
|---|---|---|
| Spain | 6.4 | 1.6 |
| Ireland | 5.0 | 3.9 |
| Italy | 5.2 | 2.1 |
| New Zealand | 3.7 | 1.4 |
| United Kingdom | 2.8 | 1.0 |
| Belgium | 5.2 | 1.7 |
| Austria | 5.5 | 2.5 |
| Netherlands | 5.5 | 1.6 |
| France | 5.5 | 2.3 |
| Japan | 9.8 | 4.3 |
| Finland | 5.3 | 2.9 |
| Germany, Fed. Rep. | 4.6 | 2.0 |
| Denmark | 3.9 | 1.7 |
| Australia | 5.6 | 2.4 |
| Sweden | 3.6 | 1.4 |
| Canada | 5.2 | 2.5 |
| Norway | 4.0 | 3.7 |
| United States | 3.2 | 2.3 |
| Switzerland | 4.2 | 0.8 |
| Average | 4.96 | 2.22 |

Source: World Development Report 1986 by the World Bank

Table III-4 Growth Projections of Population, GDP and Total Telephone Lines

| Year | Estimated Population (x1000) | Population Growth (%) | In Case of 2% GDP Growth p.a. | | | In Case of 4% GDP Growth p.a. | | | In Case of 6% GDP Growth p.a. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | GDP per capita | DEL Density per 100 People | Total DEL | GDP per capita | DEL Density per 100 People | Total DEL | GDP per capita | DEL Density per 100 People | Total DEL |
| 1986 | 16,049 | 2.37 | 2,105.3 | 6.1 | 978,989 | 2,146.6 | 6.2 | 995,038 | 2,187.9 | 6.4 | 1,027,136 |
| 1987 | 16,430 | 2.37 | 2,097.6 | 6.0 | 985,800 | 2,180.7 | 6.4 | 1,051,520 | 2,265.4 | 6.7 | 1,100,810 |
| 1988 | 16,807 | 2.29 | 2,091.6 | 6.0 | 1,008,420 | 2,217.0 | 6.5 | 1,092,455 | 2,347.4 | 7.0 | 1,176,490 |
| 1989 | 17,180 | 2.22 | 2,087.1 | 6.0 | 1,030,800 | 2,255.7 | 6.7 | 1,151,060 | 2,434.2 | 7.4 | 1,271,320 |
| 1990 | 17,548 | 2.14 | 2,084.2 | 6.0 | 1,052,880 | 2,296.7 | 6.8 | 1,193,264 | 2,526.2 | 7.8 | 1,368,744 |
| 1991 | 17,911 | 2.07 | 2,082.8 | 6.0 | 1,074,660 | 2,340.1 | 7.0 | 1,253,770 | 2,623.5 | 8.2 | 1,468,702 |
| 1992 | 18,268 | 1.99 | 2,082.9 | 6.0 | 1,096,080 | 2,386.2 | 7.2 | 1,315,296 | 2,726.5 | 8.6 | 1,571,048 |
| 1993 | 18,620 | 1.93 | 2,084.4 | 6.0 | 1,117,200 | 2,434.7 | 7.4 | 1,377,880 | 2,835.5 | 9.1 | 1,694,420 |
| 1994 | 18,965 | 1.85 | 2,087.4 | 6.0 | 1,137,900 | 2,486.0 | 7.6 | 1,441,340 | 2,951.0 | 9.6 | 1,820,640 |
| 1995 | 19,303 | 1.78 | 2,091.9 | 6.0 | 1,158,180 | 2,540.2 | 7.8 | 1,505,634 | 3,073.2 | 10.2 | 1,968,906 |
| 1996 | 19,634 | 1.71 | 2,097.8 | 6.0 | 1,178,040 | 2,597.3 | 8.1 | 1,590,354 | 3,202.7 | 10.8 | 2,120,472 |
| 1997 | 19,958 | 1.65 | 2,105.0 | 6.1 | 1,217,438 | 2,657.3 | 8.3 | 1,656,514 | 3,339.8 | 11.4 | 2,275,212 |
| 1998 | 20,274 | 1.58 | 2,113.6 | 6.1 | 1,236,714 | 2,720.5 | 8.6 | 1,743,564 | 3,485.0 | 12.1 | 2,453,154 |
| 1999 | 20,583 | 1.52 | 2,123.5 | 6.2 | 1,276,146 | 2,786.9 | 8.9 | 1,831,887 | 3,638.6 | 12.8 | 2,634,624 |
| 2000 | 20,883 | 1.46 | 2,134.9 | 6.2 | 1,294,746 | 2,856.7 | 9.2 | 1,921,236 | 3,801.5 | 13.6 | 2,840,088 |
| 2001 | 21,175 | 1.40 | 2,147.5 | 6.2 | 1,312,850 | 2,930.0 | 9.5 | 2,011,625 | 3,974.0 | 14.4 | 3,049,200 |
| 2002 | 21,459 | 1.34 | 2,161.5 | 6.3 | 1,351,917 | 3,006.9 | 9.9 | 2,124,441 | 4,156.7 | 15.3 | 3,283,227 |
| 2003 | 21,735 | 1.29 | 2,176.7 | 6.4 | 1,391,040 | 3,087.5 | 10.2 | 2,216,970 | 4,350.2 | 16.3 | 3,542,805 |
| 2004 | 22,002 | 1.23 | 2,193.3 | 6.4 | 1,408,128 | 3,172.0 | 10.6 | 2,332,212 | 4,555.2 | 17.4 | 3,828,348 |
| 2005 | 22,261 | 1.18 | 2,211.2 | 6.5 | 1,446,965 | 3,260.5 | 11.0 | 2,448,710 | 4,772.4 | 18.5 | 4,118,285 |
| 2006 | 22,512 | 1.13 | 2,230.2 | 6.6 | 1,485,792 | 3,353.1 | 11.4 | 2,566,368 | 5,002.3 | 19.7 | 4,434,864 |
| 2007 | 22,754 | 1.07 | 2,250.7 | 6.7 | 1,524,518 | 3,450.2 | 11.9 | 2,707,726 | 5,246.1 | 21.0 | 4,778,340 |
| 2008 | 22,988 | 1.03 | 2,272.3 | 6.7 | 1,540,196 | 3,551.6 | 12.4 | 2,850,512 | 5,504.2 | 22.5 | 5,172,300 |
| 2009 | 23,214 | 0.98 | 2,295.2 | 6.8 | 1,578,552 | 3,657.7 | 12.9 | 2,994,606 | 5,777.7 | 24.0 | 5,571,360 |
| 2010 | 23,431 | 0.93 | 2,319.4 | 6.9 | 1,616,739 | 3,768.8 | 13.4 | 3,139,754 | 6,067.6 | 25.6 | 5,998,336 |
| 2011 | 23,641 | 0.90 | 2,344.8 | 7.0 | 1,654,870 | 3,884.8 | 14.0 | 3,309,740 | 6,374.5 | 27.4 | 6,477,634 |
| 2012 | 23,842 | 0.85 | 2,371.5 | 7.1 | 1,692,782 | 4,006.1 | 14.6 | 3,480,932 | 6,700.1 | 29.3 | 6,985,706 |
| 2013 | 24,036 | 0.81 | 2,399.4 | 7.3 | 1,754,628 | 4,132.7 | 15.2 | 3,653,472 | 7,044.7 | 31.4 | 7,547,304 |
| 2014 | 24,222 | 0.77 | 2,428.6 | 7.4 | 1,792,428 | 4,265.0 | 15.9 | 3,851,298 | 7,410.1 | 33.7 | 8,162,814 |
| 2015 | 24,401 | 0.74 | 2,459.0 | 7.5 | 1,830,075 | 4,403.1 | 16.6 | 4,050,566 | 7,797.1 | 36.1 | 8,808,761 |

Note: DEL = Direct Exchange Line

## Table III-5 Distribution of the Projected DEL by Zone Centre Area

(1) In Case of 2% GDP Growth Per Annum

| Zone Centre | 1985 Ratio(%) | 1985 | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|---|---|---|---|
| Penang (PG) | 12.5 | 119,381 | 131,610 | 144,773 | 161,843 | 180,871 | 202,092 | 228,759 |
| Ipoh (IP) | 10.0 | 95,860 | 105,288 | 115,818 | 129,475 | 144,697 | 161,674 | 183,008 |
| Kuantan (KN) | 7.9 | 75,736 | 83,178 | 91,496 | 102,285 | 114,310 | 127,722 | 144,576 |
| Kuala Lumpur (KL) | 36.7 | 352,238 | 386,407 | 425,052 | 475,172 | 531,036 | 593,343 | 671,638 |
| Malacca (MC) | 6.8 | 64,864 | 71,596 | 78,756 | 88,043 | 98,394 | 109,938 | 124,445 |
| Johor Baru (JB) | 11.7 | 112,337 | 123,187 | 135,507 | 151,485 | 169,295 | 189,158 | 214,119 |
| Kuching (KG) | 7.2 | 68,790 | 75,807 | 83,389 | 93,222 | 104,181 | 116,405 | 131,765 |
| Kota Kinabalu (KK) | 7.2 | 69,392 | 75,807 | 83,389 | 93,222 | 104,181 | 116,405 | 131,765 |
| Total | 100.0 | 958,598 | 1,052,880 | 1,158,180 | 1,294,746 | 1,446,965 | 1,616,739 | 1,830,075 |

(2) In Case of 4% GDP Growth Per Annum

| Zone Centre | 1985 Ratio(%) | 1985 | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|---|---|---|---|
| Penang (PG) | 12.5 | 119,381 | 149,158 | 188,204 | 240,155 | 306,089 | 392,469 | 506,321 |
| Ipoh (IP) | 10.0 | 95,860 | 119,326 | 150,563 | 192,124 | 244,871 | 313,975 | 405,057 |
| Kuantan (KN) | 7.9 | 75,736 | 94,268 | 118,945 | 151,778 | 193,448 | 248,041 | 319,995 |
| Kuala Lumpur (KL) | 36.7 | 352,238 | 437,928 | 552,568 | 705,094 | 898,677 | 1,152,290 | 1,486,558 |
| Malacca (MC) | 6.8 | 64,864 | 81,142 | 102,383 | 130,644 | 166,512 | 213,503 | 275,438 |
| Johor Baru (JB) | 11.7 | 112,337 | 139,612 | 176,159 | 224,785 | 286,499 | 367,351 | 473,916 |
| Kuching (KG) | 7.2 | 68,790 | 85,915 | 108,406 | 138,329 | 176,307 | 226,062 | 291,641 |
| Kota Kinabalu (KK) | 7.2 | 69,392 | 85,915 | 108,406 | 138,329 | 176,307 | 226,062 | 291,641 |
| Total | 100.0 | 958,598 | 1,193,264 | 1,505,634 | 1,921,236 | 2,448,710 | 3,139,754 | 4,050,566 |

(3) In Case of 6% GDP Growth Per Annum

| Zone Centre | 1985 Ratio(%) | 1985 | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|---|---|---|---|
| Penang (PG) | 12.5 | 119,381 | 171,093 | 246,113 | 355,011 | 514,786 | 749,792 | 1,101,095 |
| Ipoh (IP) | 10.0 | 95,860 | 136,874 | 196,891 | 284,009 | 411,829 | 599,834 | 880,876 |
| Kuantan (KN) | 7.9 | 75,736 | 108,131 | 155,544 | 224,367 | 325,345 | 473,869 | 695,892 |
| Kuala Lumpur (KL) | 36.7 | 352,238 | 502,329 | 722,589 | 1,042,312 | 1,511,411 | 2,201,389 | 3,232,815 |
| Malacca (MC) | 6.8 | 64,864 | 93,075 | 133,886 | 193,126 | 280,043 | 407,887 | 598,996 |
| Johor Baru (JB) | 11.7 | 112,337 | 160,143 | 230,362 | 332,290 | 481,839 | 701,805 | 1,030,625 |
| Kuching (KG) | 7.2 | 68,790 | 98,550 | 141,761 | 204,486 | 296,517 | 431,880 | 634,231 |
| Kota Kinabalu (KK) | 7.2 | 69,392 | 98,550 | 141,761 | 204,486 | 296,517 | 431,880 | 634,231 |
| Total | 100.0 | 958,598 | 1,368,744 | 1,968,906 | 2,840,088 | 4,118,285 | 5,998,336 | 8,808,761 |

# 4. NON-TELEPHONE DEMAND FORECAST

## 4. Non-telephone Demand Forecast

### 4.1 Telex and Telegram

The present telex and telegram network is shown in Figure III-6. Two international/national telex exchanges (two units) are installed in Kuala Lumpur (KL) and five local exchanges in five Zone Centres. For example, a total of 360 telex circuits is provided between KL and Kota Kinabalu or Kuching Zone Centre.

JTM has carried out the telex demand forecast covering 1986-1990 as shown in ANNEX III-1 (Table 2). According to this forecast, about 7.2% growth rate is expected annually.

Moreover, JTM is now planning a new data switching network (i.e., Circuit Switched Public Data Network) which may start its services around the end-1986. This network is shown in Figure III-7 and will absorb the existing telex network.

### 4.2 MAYPAC

MAYPAC (Malaysian Packet Switched Public Data Network) is now providing its services with not lots of subscribers, of which network is shown in Figure III-8. The recent demand growth is shown below.

| Year/Month | 85/3 | /4 | /5 | /6 | /7 | /8 | /9 | /10 | /11 |
|---|---|---|---|---|---|---|---|---|---|
| No. of Subs. | 2 | 3 | 10 | 15 | 44 | 63 | 70 | 91 | 96 |

| Year/Month | 85/12 | 86/1 | /2 | /3 | /4 | /5 |
|---|---|---|---|---|---|---|
| No. of Subs. | 99 | 110 | 120 | 146 | 156 | 173 |

JTM is expecting an average annual 20-30% growth rate; but almost all subscribers exist in Kuala Lumpur.

## 4.3 DATEL

DATEL, i.e., the computer-computer communication via the public telephone network, uses modems and acoustic couplers approved by JTM. The past and recent authorized number of users is shown below.

| Year/Month | 83/3 | 84/3 | 84/6 | 84/9 | 84/12 | 85/1 | 85/2 | 85/3 |
|---|---|---|---|---|---|---|---|---|
| No. of Subs. | 2 | 15 | 28 | 53 | 116 | 126 | 128 | 136 |

| Year/Month | 85/4 | /5 | /6 | /7 | /8 | /9 | /10 | /11 |
|---|---|---|---|---|---|---|---|---|
| No. of Subs. | 143 | 159 | 170 | 178 | 191 | 203 | 211 | 224 |

| Year/Month | 85/12 | 86/1 | /2 | /3 | /4 | /5 |
|---|---|---|---|---|---|---|
| No. of Subs. | 238 | 248 | 267 | 274 | 285 | 292 |

## 4.4 Leased Circuits

The following numbers of circuits were leased:

| Year/Month | 75/12 | 77/12 | 78/12 | 79/12 | 80/12 | 81/12 |
|---|---|---|---|---|---|---|
| Circuits | 21 | 28 | 52 | 86 | 160 | 294 |

| Year/Month | 82/12 | 83/12 | 84/12 | 85/9 | 85/12 |
|---|---|---|---|---|---|
| Circuits | 432 | 619 | 908 | 1150 | 1500* |

N.B. * JTM's estimation

No details of users are available.

## 4.5 Telefax

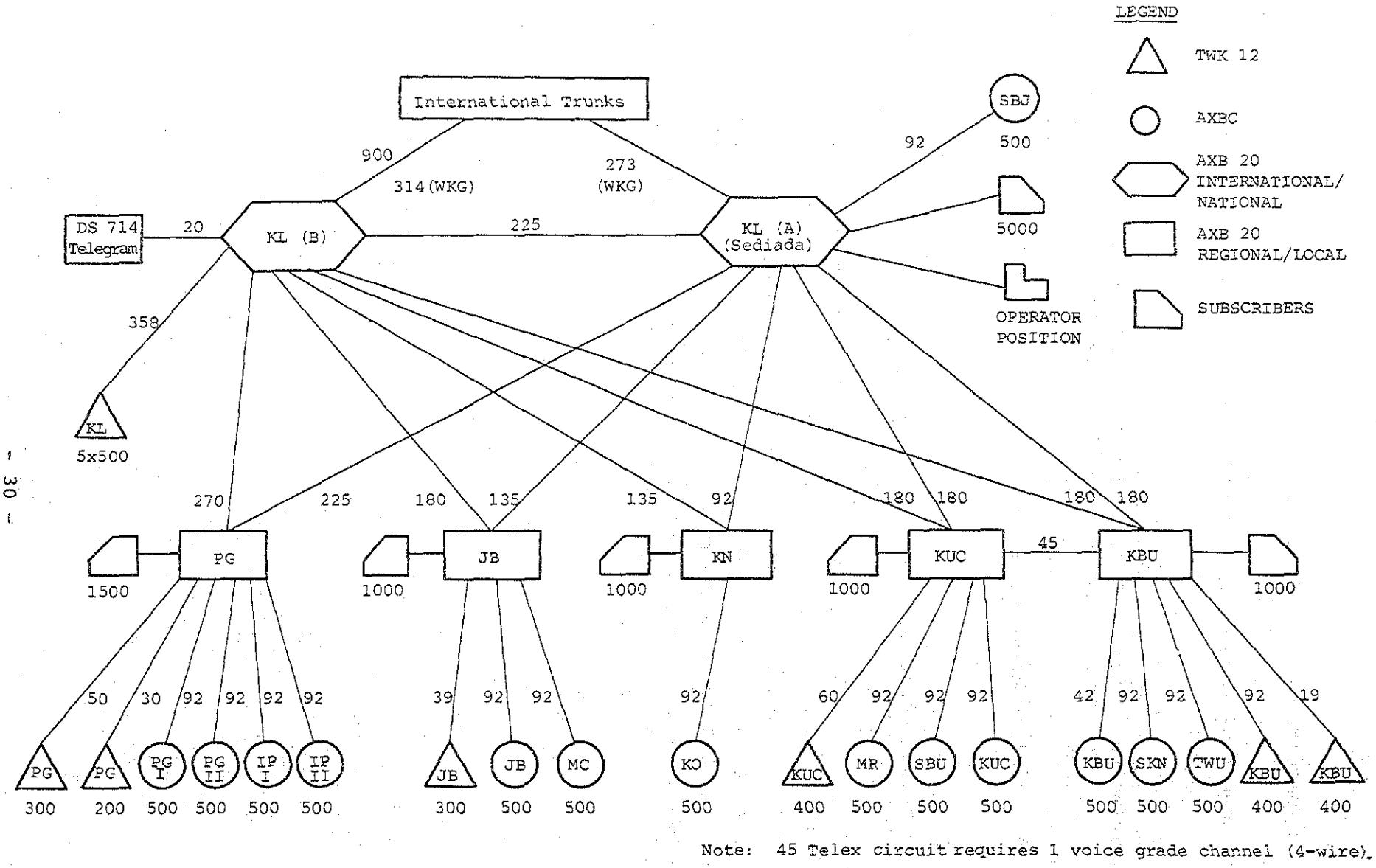
The number of telefax subscribers has been sharply increasing as shown below.

| Year/Month | 83/8 | 83/12 | 84/12 | 85/12 | 86/2 | 86/4 | 86/12 |
|---|---|---|---|---|---|---|---|
| No. of Subs. | 20 | 50 | 200 | 500 | 600 | 772 | 950--1000* |

N.B. * JTM's estimation

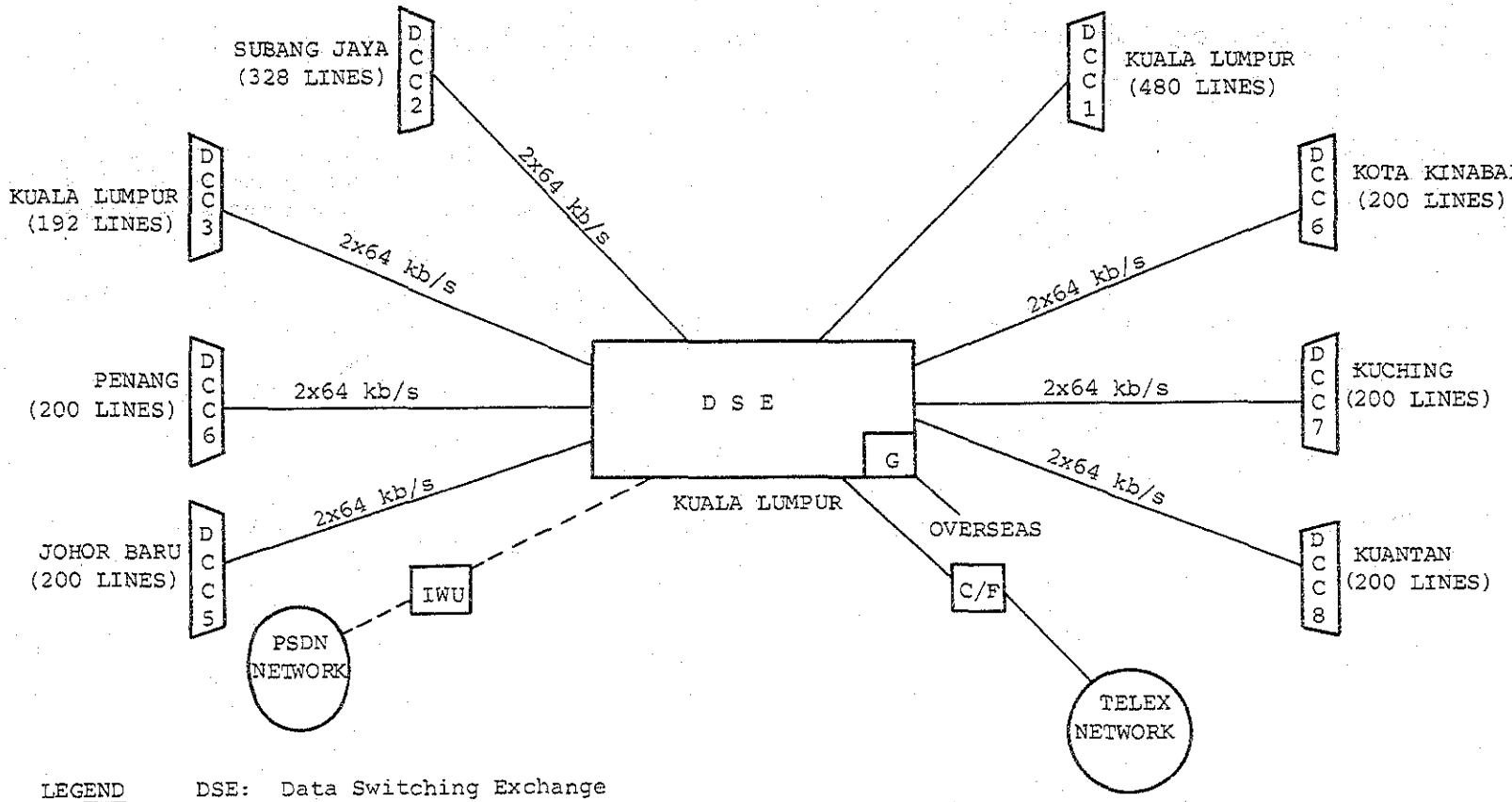
## 4.6 Demand Forecast of Non-telephone Services

At this stage it is quite difficult to estimate the demand for the new services. The number of toll circuits required for such services is very much smaller than that of the telephone services; it is considered to be negligible in the national network. However, we will give some margin with 30% in addition to the basic traffic values described after.




Note: 45 Telex circuit requires 1 voice grade channel (4-wire).

Figure III-6 Malaysian Telex Network Configuration




LEGEND

DSE: Data Switching Exchange
DCC: Data Circuit Concentrator
G: International Gateway
IWU: Interworking Unit
C/F: Conversion Facility
PSDN: Packet Switched Data Network

Figure III-7 Circuit Switch Public Data Network (AXB 30)

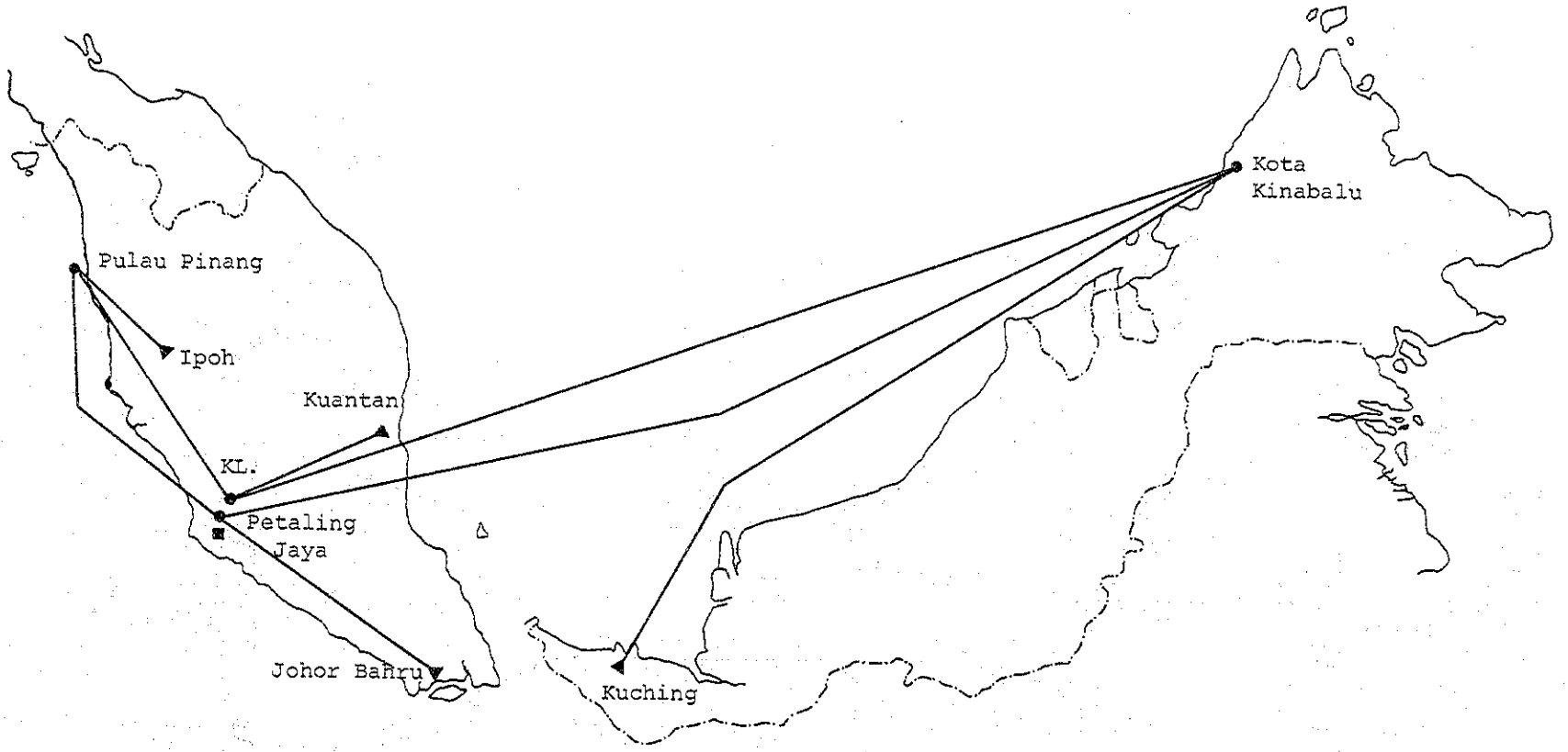



Figure III-8 MAYPAC Malaysian Packet Switched Public Data Network

# 5. TRAFFIC FORECAST

## 5. Traffic Forecast

### 5.1 Basic Formula

To estimate the future interexchange traffic, the formula (2.4) is applied, assuming that the present network conditions will remain unchanged. In the case of calculating the traffic value the Zone Centres are regarded as the telephone exchanges to contain all the equivalent telecoms traffic.

### 5.2 Traffic Survey

For the calculation based on the basic formula (2.4), the past and present traffic variations should be obtained. We have carried out the traffic measurements at all eight Zone Centres; the results are shown in ANNEX III-2 and ANNEX III-3. Location of the major telephone exchanges is shown in Figure III-9.

The traffic distribution ratios of the main routes from/to Kota Kinabalu area are as follows:

| Route | KL | MC | IP | KN | PG | JB | KG | KK | ITE2 | SE | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Outgoing* | 8.07 | 0.32 | 0.57 | 0.56 | 0.70 | 0.78 | 3.93 | 81.74 | 0.45 | 2.90 | 100% |
| Incoming | 6.98 | 0.13 | 0.48 | 0.25 | 0.37 | 0.65 | 2.36 | 83.48 | 3.30 | 2.00 | 100% |

N.B. ITE2: Kuantan International Exchange
SE: Singapore Exchange

Likewise, the following are the distribution ratios at Kuching area.

| Route | KL | MC | IP | KN | PG | JB | KG | KK | ITE2 | SE | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Outgoing | 10.40 | 0.50 | 0.30 | 0.50 | 0.50 | 0.90 | 79.90 | 2.20 | 0.70 | 4.10 | 100% |
| Incoming | 8.40 | 0.20 | 0.30 | 0.50 | 0.60 | 0.50 | 81.40 | 3.30 | 1.70 | 3.10 | 100% |

According to the traffic survey at a Kuching local exchange, the following distribution ratios have been obtained for reference:

| Intra-office | Toll Call | Own Zone Centre |
|---|---|---|
| 23% | 16% | 61% |

These obtained distribution ratios seem reasonable.

The following are the average holding times in seconds.

At Kuching Zone Centre

| Route | KL | MC | IP | KN | PG | JB | KG | KK | ITE1 | ITE2 | SE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Outgoing | 77 | 108 | 86 | 84 | 47 | 51 | 92 | 47 | - | 89 | 126 |
| Incoming | 35 | 77 | 135 | - | 85 | 48 | 78 | 90 | - | 111 | 65 |

At Kota Kinabalu Zone Centre

| Route | KL | MC | IP | KN | PG | JB | KG | KK | ITE1 | ITE2 | SE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Outgoing | 86 | - | 200 | - | - | - | 90 | - | - | - | - |
| Incoming | 135 | - | 46 | - | - | - | 47 | - | - | - | - |

As seen above, the average holding times vary with the routes. These data will be used for the economic study, if necessary.

The interexchange toll traffic values between Kota Kinabalu/ Kuching Zone Centres and other Zone Centres are shown in Figures III-10 and III-11, respectively.

It is found that the majority of the traffic volumes (approx. 80%) is its own area traffic, and its remaining traffic, about 18%, is distributed to Peninsular Malaysia area. But the above distribution may not always represent the constant value due to the traffic fluctuations from time to time. A certain route shows a very high traffic value at a night time thanks to discouted charging rate.

## 5.3 Traffic Estimation

Since there is no sufficient data on the present nation-wide traffic flows, we have estimated the peak traffic volumes between Peninsular Malaysia and Sabah/Sarawak by adding safety margin of 50% to the currently-surveyed traffic values.

Besides we have given additional margins in respect of the traffic increment in future as follows:

- For network improvement: 20%
- For additional new services: 30%
  (e.g. telefax and MAYPAC)

Considering these factors, the interexchange traffic flows between two Zone Centres are estimated by using the previously-mentioned formula (2.4) and summarized in Tables III-6 thru III-8 for Kota Kinabalu (Sabah) and in Tables III-9 thru III-11 for Kuching (Sarawak), respectively, depending on the constant GDP growth rates per annum.