# Ⅳ. DEMAND FORECAST AND SCALE OF INSTALLATION

# IV. DEMAND FORECAST AND SCALE OF INSTALLATION

## 4-1 Demand Forecast

In the objective areas of the feasibility study, development of telephone service is still in the initiatory stage. Therefore, the main concern of the feasibility study is, after all, to formulate an effective plan for introducing the communication network in the necessary minimum to serve major government organizations and public establishments. In the case like this not intended to fulfill telephone demand among the general public, demand forecast by model formula and so forth is essentially not worthwhile to make. However, since the system to be constructed, as well as the scale of installation required, should rather be determined in consideration of the demand potential, the study of prospective demand is to be made as much as necessary.

### 4-1-1 Telephone Subscriber Demand Forecast

#### (1) Macroscopic Forecast Model

For macroscopic demand forecast, several methods are available. In the objective areas of study, this time, telephone service still remains in the initiatory stage so that basic data for demand forecast cannot be obtained as much as required. The method of forecast commonly used in the case like this is to estimate the demand from the correlation between GDP per capita and main telephone density. This method is used this time.

Table 4-1 presents GDP per capita and the number of main telephones in 54 countries as of 1979. The correlation between the two elements can be obtained by the regression line that follows:

$$Y = 0.0003854\ X^{1.2395}$$

where

Y : Number of main telephones per 100 of population

X : GDP per capita (in US dollars)

(2) Population Forecast

According to statistical data for 1964 through 1979, the average annual population growth rate of Nepal is 2.25%. His Majesty's Government of Nepal is presently promoting the population growth control plans including family planning, for the purpose of balanced economic development. However, in the feasibility study, this time, the assumption is made that the trend of population growth at a relatively high rate as above will still continue for the current feasibility study period.

Based on that assumption and from the population of 15,020,451 as of 1981 Census, the populations in the base years of 1985, 1990, 1995 and 2000 in the current feasibility study period (1985-2000) can be forecasted as under:

| | |
|---|---|
| 1985 | 16,420,000 |
| 1990 | 18,350,000 |
| 1995 | 20,510,000 |
| 2000 | 22,920,000 |

(3) GDP Growth Prospect

With regard to the long term economic plan of Nepal, there is no official announcement at present. Therefore, the GDP growth prospect cannot but be estimated from the past records.

Statistics show that the GDP records of Nepal are subject to no small variations from year to year. (Refer to Table 4-2.) On the whole, however, the uptrend can be noticed, the average annual growth rate being 9.3% at the current market price and 2.48% at the constant market price as of 1974. The GDP growth rate per capita in real terms, when calculated by the previously mentioned average annual population growth rate of 2.25%, becomes 0.225% in the annual average. Given in Table 4-2 are the GDP forecasts as of 1985, 1990, 1995 and 2000 calculated by the above growth rate.

Meanwhile, those GDP forecasts are given as referred to 1979 as the base year. However, since the GDP at constant 1974 market price of 1979 is smaller than that of the year before, the calculated value obtained by the regression formula from the past data, i.e., the value obtained by upward revision of the real value, is used as the reference value.

(4) Number of Subscribers (Number of Main Telephones) Estimation

The result of estimation by base years in regard to the number of main telephones in the whole territories of Nepal, based on the foregoing criteria, appears below.

| Year | Population (x $10^6$) | GDP per Capita at Constant Market Price of 1979 (in US$) | Main Telephone Density | Number of Main Telephone |
|---|---|---|---|---|
| 1985 | 16.42 | 148.1 | 0.189 | 31,034 |
| 1990 | 18.35 | 149.8 | 0.192 | 35,232 |
| 1995 | 20.51 | 151.4 | 0.194 | 39,789 |
| 2000 | 22.92 | 153.2 | 0.197 | 45,152 |

(5) Number of Main Telephones at Objective Sites

For the estimation of the number of main telephones at each objective site, the area by area difference in GDP, as well as the telephone demand difference between the area where telephone service is already available and the area where telephone service is not yet available, should of course be taken into consideration. This time, however, such data are scarce so that the assumption is made that the differences mentioned do not exist. On this assumption plus by the area by area population distribution ratios, the number of main telephones in the whole territories of Nepal as estimated in the preceding paragraph is to be distributed to the objective sites in proportion to the population of each objective site.

The number of main telephones, thus estimated for each objective site according to the base years of forecast, appears in Table 4-3.

In this case, the population used as the basis of distribution calculation is not the total population in the whole territories of Nepal as forecasted in Paragraph (2), but is 14% of that total population. The reason is that, out of the total population in the districts where the communication network normally operates, the resident population in subscriber telephone service areas occupies approximately 14%. (Refer to Table 4-4.)

At present, the subscriber telephone service areas in those districts are practically restricted to the administrative centers. Furthermore, the objective sites of the feasibility study, this time, where the communication network is to be newly introduced, are also limited to the administrative centers for the most part.

Therefore, when estimating the number of main telephones at the objective sites, it will be reasonable to use not the total population in the whole territories of Nepal but 14% of it as the basis of distribution calculation.

The population forecasts by objective sites, used in the distribution calculation, appear in Table 4-5.

4-1-2 Demand Forecast for Non-Voice Communication Services

(1) Service Policy

With regard to non-voice communication services in the objective areas, NTC intends to provide such services as telegraph service and document transmission service by facsimile terminals. No other new service is under contemplation.

(2) Existing Service Status and Demand Forecast

a) Telegraph Service

Telegraph service in the objective areas is now provided by HF radio system.

The number of telegraphic messages served by HF radio system from 1972 up to the present is as under:

| | |
|---|---|
| 1972 | 290,000 |
| 1973 | 270,000 |
| 1974 | 322,000 |
| 1975 | 280,000 |
| 1976 | 215,000 |
| 1977 | 271,000 |
| (1978-1981: missing) | |
| 1982 | 294,000 |

As far as the above time series data indicates, the number of telegraphic messages served varies broadly from year to year, and no constant uptrend is found. This fact may be attributable to the depression of demand due to unstable HF radio system operation and insufficient service by time sharing. Considering, however, that the number in 1982 is smaller than that in 1974, the recent peak, the limited number of telegraphic messages served cannot necessarily be attributed to the depression of demand only. Whatever the situation, the estimation of future trends from the time series data quoted above is difficult. Nor is it easy to make a successful estimate by international correlation models.

b) Document Transmission Service

Document transmission service is an entirely new service so that the estimation of future demand behaviors at the present stage is difficult. In the objective areas, the degree of dependence upon agriculture is so great that the users of document transmission service are restricted to administrative organizations and public establishments. Therefore, the demand for this new service is considered not to be especially great, compared with the demand for telegraph service.

As in the foregoing, the estimation of future demand behaviors for the two service categories is extremely difficult. However, as long as both service categories are provided by facsimile terminals, rapid demand growth can be catered for by additional facsimile terminal installation only, without exerting a serious influence on switching system and transmission system capacities.

Thus, in the feasibility study, this time, the assumption is made that the number of messages handled in both service categories will increase at annual average growth rate of 10%. This assumption serves as a guideline to determine the capacity of facilities to be newly installed.

For the purpose of information, the annual changes in the number of telegraphic messages handled in both developed and developing countries are presented in Figure 4-1. This data indicates that in the developed countries, i.e., the countries where the spread of telephone service is in the diffusion or penetration stage, the demand for telegraph service is on the downgrade; however, in the countries where the spread of telephone service has not yet reached the diffusion stage, the demand for telegraph service still continues to increase, barring a few exceptions, and the annual growth rate is upwards of 10% in all cases.

(3) Number of Messages Handled per Objective Site

According to the field survey findings, this time, the average number of telegraphic messages handled per day at the objective sites where the public call offices are to be introduced is 38. These objective sites are in the areas where telegraph service is presently provided by HF radio system. The daily average of 38 telegraphic messages handled consists of outgoing and incoming messages in almost equal numbers. The average rates of traffic flow by destinations are as under:

| | |
|---|---|
| To Kathmandu | 40% |
| To own parent exchange | 40% |
| To other parent exchanges | 20% |

The future trend of demand for non-voice communication service per public call office, when shown in the average number of messages handled per day, with the above data and the previously assumed growth rate taken into consideration, is as under:

| Forecast Base Year | Total Number of Messages Handled | Breakdown by Destinations | | |
|---|---|---|---|---|
| | | To Kathmandu | To Own Parent Exchange | To Other Parent Exchanges |
| 1985 | 42 | 17 | 17 | 9 |
| 1990 | 68 | 28 | 28 | 14 |
| 1995 | 110 | 44 | 44 | 22 |
| 2000 | 178 | 72 | 72 | 36 |

Table 4-1 (1/2) GDP per Capita and Telephone Density (1979) in 54 Countries

| Country | GDP/Capita (US$) | Telephone Density | Country | GDP/Capita (US$) | Telephone Density |
|---|---|---|---|---|---|
| Canada | 9,578 | 40.0 | Yugoslavia | 2,783 | 6.1 |
| Dominica | 987 | 3.8 | Argentine | 3,484 | 7.2 |
| Jamaica | 1,086 | 2.2 | Brazil | 1,755 | 3.4 |
| U.S.A. | 10,510 | 41.2 | Chile | 1,919 | 3.1 |
| Algeria | 1,638 | 1.4 | Colombia | 967 | 4.7 |
| Ethiopia | 114 | 0.2 | Costa Rica | 1,814 | 5.7 |
| Egypt | 416 | 1.1 | Ecuador | 1,174 | 2.7 |
| Kenya | 345 | 0.5 | Haiti | 241 | 0.4 |
| Liberia | 522 | 0.4 | Honduras | 528 | 1.0 |
| Malawi | 210 | 0.2 | Mexico | 1,852 | 3.3 |
| South Africa | 1,857 | 5.7 | Nicaragua | 600 | 1.5 |
| Tunisia | 979 | 1.6 | Panama | 1,539 | 6.7 |
| Zambia | 579 | 0.5 | Peru | 864 | 0.6 |
| Austria | 9,119 | 26.5 | Venezuela | 3,377 | 5.0 |
| Belgium | 11,318 | 23.5 | Australia | 8,938 | 33.4 |
| Denmark | 12,986 | 42.5 | New Zealand | 5,725 | 35.0 |
| Finland | 8,627 | 31.8 | Papua New Guinia | 707 | 0.7 |
| France | 10,699 | 25.9 | Philippines | 629 | 0.7 |
| Germany | 12,483 | 31.3 | Singapore | 3,754 | 18.8 |
| Greece | 3,588 | 22.7 | Thailand | 607 | 0.7 |
| Italy | 5,697 | 21.3 | Hong Kong | 3,478 | 23.4 |
| Netherlands | 10,647 | 33.7 | Japan | 8,419 | 34.4 |
| Norway | 13,163 | 24.7 | Korea | 1,605 | 6.3 |

Table 4-1 (2/2) GDP per Capita and Telephone Density (1979) in 54 Countries

| Country | GDP/Capita (US$) | Telephone Density | Country | GDP/Capita (US$) | Telephone Density |
|---|---|---|---|---|---|
| Portugal | 1,894 | 9.5 | India | 170 | 0.3 |
| Spain | 4,886 | 16.8 | Pakistan | 225 | 0.3 |
| Sweden | 12,228 | 52.2 | Turkey | 1,277 | 2.5 |
| Switzerland | 14,617 | 43.6 | | | |
| U.K. | 7,617 | 31.7 | | | |

Table 4-2 Gross Domestic Product in Nepal

| Year | GDP at Current Market Price (x $10^6$ Rs) | | 1974 Market Price * (x $10^6$ Rs) | GDP per Capita at Constant 1979 Market Price | |
|---|---|---|---|---|---|
| | Statistic* | Calculated | | Rs | US$ |
| 1964 | 6,274 | 6,220 | 13,323 | | |
| 1965 | 7,738 | 6,803 | 14,268 | | |
| 1966 | 7,180 | 7,440 | 14,036 | | |
| 1967 | 8,034 | 8,138 | 14,135 | | |
| 1968 | 8,943 | 8,900 | 14,765 | | |
| 1969 | 9,820 | 9,734 | 15,146 | | |
| 1970 | 10,010 | 10,646 | 14,964 | | |
| 1971 | 11,613 | 11,644 | 15,428 | | |
| 1972 | 11,165 | 12,735 | 15,361 | | |
| 1973 | 14,345 | 13,928 | 16,339 | | |
| 1974 | 16,571 | 15,233 | 16,571 | | |
| 1975 | 17,394 | 16,660 | 17,300 | | |
| 1976 | 17,280 | 18,221 | 17,822 | | |
| 1977 | 19,732 | 19,928 | 18,211 | | |
| 1978 | 22,215 | 21,796 | 19,708 | | |
| 1979 | 23,351 | 23,838 | 18,110 | 1,739 | 146.1 |
| 1980 | | | | | |
| 1982 | | | | 1,751 | 147.1 |
| 1985 | | | | 1,763 | 148.1 |
| 1990 | | | | 1,783 | 149.8 |
| 1995 | | | | 1,803 | 151.4 |
| 2000 | | | | 1,823 | 153.2 |

* : Source Central Bureau of Statistics HMG/Nepal

Table 4-3 (1/3) Telephone Demand Forecast by Objective Sites

| Area No. | District Name | Site Name | Main Telephone Demand | | | | Remarks |
|---|---|---|---|---|---|---|---|
| | | | 1985 | 1990 | 1995 | 2000 | |
| 01 | Bhaktapur | Nagarkot | 49 | 55 | 63 | 71 | |
| | Kabhre-planchok | Panchkhal | 74 | 84 | 95 | 107 | |
| | Sindhu-palchok | Chautara | 100 | 114 | 129 | 147 | |
| | | Helambu | 49 | 55 | 63 | 71 | |
| | Nuwakot | Bidur-Trisuli | 176 | 199 | 225 | 257 | |
| | Rasuwa | Dhunche | 18 | 21 | 23 | 25 | |
| | | Zinc Mining Town | 18 | 21 | 23 | 25 | |
| | Dhading | Dhading | 73 | 189 | 100 | 114 | |
| 02 | Jhapa | Jhapa | 89 | 100 | 114 | 128 | |
| | Ilam | Ilam | 139 | 158 | 178 | 202 | |
| | | Aitabare | 69 | 78 | 89 | 102 | |
| | Panchthar | Phidim | 50 | 58 | 64 | 73 | |
| | Taplejung | Taplejung | 61 | 69 | 78 | 89 | |
| | Terhathum | Terhathum | 54 | 62 | 71 | 79 | |
| | Bhojpur | Bhojpur | 77 | 88 | 99 | 111 | |
| | Sankhu-wasabha | Khandbari | 76 | 85 | 97 | 110 | |
| | | Chainpur | 69 | 78 | 89 | 102 | |
| 03 | Udayapur | Ghaighat | 96 | 108 | 124 | 140 | |
| | Khotang | Diktel | 93 | 105 | 120 | 135 | |
| | Okhaldhunga | Okhaldhunga | 54 | 62 | 71 | 79 | |
| | | Rumjhatar | 77 | 88 | 99 | 111 | |

Table 4-3 (2/3) Telephone Demand Forecast by Objective Sites

| Area No. | District Name | Site Name | Main Telephone Demand | | | | Remarks |
|---|---|---|---|---|---|---|---|
| | | | 1985 | 1990 | 1995 | 2000 | |
| 03 | Solukhumbu | Salleri | 68 | 77 | 88 | 99 | |
| | | Namche Bazar | 23 | 27 | 31 | 34 | |
| 04 | Sindhuli | Sindhuli Madi | 186 | 211 | 239 | 271 | |
| | Ramechhap | Ramechhap | 68 | 77 | 88 | 99 | |
| | Dolakha | Charikot | 70 | 81 | 92 | 103 | |
| 05 | Rautahat | Gaur | 122 | 137 | 156 | 176 | |
| | Bara | Simra | 186 | 211 | 239 | 271 | |
| | | Kalaiya | 101 | 115 | 131 | 148 | |
| | Makawanpur | Bhimphedi | 80 | 90 | 103 | 116 | |
| 06 | Gorkha | Gorkha | 95 | 107 | 121 | 138 | |
| | Tanahun | Damauli | 194 | 221 | 250 | 283 | |
| | | Bandipur | 122 | 137 | 156 | 176 | |
| | Syangja | Syangja | 57 | 63 | 72 | 82 | |
| | Lamjung | Besishar | 77 | 88 | 99 | 111 | |
| | Manang | Chame | 11 | 12 | 14 | 16 | |
| | Baglung | Baglung | 65 | 74 | 83 | 94 | |
| | Myagdi | Beni | 78 | 89 | 100 | 114 | |
| | Mustang | Jomsom | 22 | 25 | 28 | 32 | |
| | Parbat | Kusma | 76 | 85 | 97 | 110 | |
| 07 | Arghakhanchi | Shandhikharkha | 58 | 66 | 74 | 85 | |
| | Gulmi | Gulmi Tamghas | 65 | 74 | 83 | 94 | |
| | Nawalparasi | Parasi | 77 | 88 | 99 | 111 | |
| | | Tribeni | 46 | 52 | 53 | 66 | |

Table 4-3 (3/3) Telephone Demand Forecast by Objective Sites

| Area No. | District Name | Site name | Main Telephone Demand | | | | Remarks |
|---|---|---|---|---|---|---|---|
| | | | 1985 | 1990 | 1995 | 2000 | |
| 08 | Dang | Tulsipur | 115 | 130 | 149 | 168 | |
| | | Ghorahi | 147 | 167 | 190 | 216 | |
| | | Gadhawa | 116 | 133 | 150 | 171 | |
| | | Koilabas | 38 | 44 | 50 | 56 | |
| | | Rajapur | 76 | 85 | 97 | 110 | |
| | Pyuthan | Pyuthan | 113 | 129 | 146 | 166 | |
| | Salyan | Salyan | 109 | 123 | 140 | 159 | |
| | Rolpa | Libanggaon | 82 | 93 | 106 | 120 | |
| | Rukum | Musikot | 86 | 99 | 113 | 127 | |
| | Jajarkot | Jajarkot | 89 | 100 | 114 | 128 | |
| | Bardia | Gularia | 136 | 153 | 175 | 197 | |
| | Dailekh | Dailekh | 74 | 84 | 95 | 107 | |
| | Jumla | Jumla | 47 | 53 | 61 | 69 | |
| | Kalikot | Kalikot | 50 | 58 | 64 | 73 | |
| 09 | Kailali | Bhajani | 155 | 175 | 199 | 226 | |
| | | Tikapur | 200 | 226 | 256 | 290 | |
| | Achham | Mangalsen | 89 | 100 | 114 | 128 | |
| | Doti | S. Doti | 258 | 293 | 332 | 376 | |
| | Bajura | Martadi | 50 | 58 | 64 | 73 | |
| | Bajhang | Chainpur | 45 | 51 | 57 | 65 | |
| | Dandeldhura | Dandeldhura | 38 | 44 | 50 | 56 | |
| | Baitadi | Baitadi | 66 | 75 | 85 | 97 | |
| | Darchula | Darchula | 66 | 75 | 86 | 97 | |

Table 4-4 Total Population in District and Population in Subscriber Telephone Service Area

| | Population in District (1981) | Population in Service Area (1981) |
|---|---|---|
| Kathmandu | 422,670 | 235,211 |
| Bhaktapur | 160,686 | 50,468 |
| Patan | 183,464 | 73,764 |
| Banepa | 307,602 | 10,680 |
| Bhadrapur | 480,056 | 14,890 |
| Biratnagar | 534,490 | 93,889 |
| Dharan | 343,007 | 42,696 |
| Dhankuta | 128,568 | 13,230 |
| Rajbiraj | 381,277 | 16,319 |
| Siraha | 376,390 | 11,223 |
| Janakpur | 432,511 | 35,248 |
| Malangwa | 398,397 | 11,228 |
| Birgunj | 283,809 | 45,880 |
| Simra | 318,010 | 12,633 |
| Kalaiya | | 6,869 |
| Hitauda | 241,984 | 16,194 |
| Bharatpur | 257,332 | 35,073 |
| Pokhara | 223,486 | 48,456 |
| Bhairahwa | 379,031 | 30,084 |
| Butwal | | 19,900 |
| Tansen | 215,924 | 12,119 |
| Nepalgunj | 205,824 | 33,935 |
| Surket | 165,666 | 13,885 |
| Mahendranagar | 166,006 | 35,073 |
| | 6,606,190 | 918,952 (14%) |

Table 4-5 (1/3) Population Forecast by Objective Sites

| Area No. | District Name | Site Name | Population (x $10^3$) | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | 1981 | 1985 | 1990 | 1995 | 2000 | |
| 01 | Bhaktapur | Nagarkot | 3.3 | 3.6 | 4.0 | 4.5 | 5.0 | |
| | Kabhre-planchok | Panchkhal | 5.0 | 5.5 | 6.1 | 6.8 | 7.6 | |
| | Sindhu-palchok | Chautara | 6.8 | 7.4 | 8.3 | 9.3 | 10.4 | |
| | | Helambu | (3.3) | (3.6) | (4.0) | (4.5) | (5.0) | * |
| | Nuwakot | Bidur-Trisuli | 11.9 | 13.0 | 14.5 | 16.2 | 18.2 | |
| | Rasuwa | Dhunche | 1.2 | 1.3 | 1.5 | 1.6 | 1.8 | |
| | | Zinc Mining Town | (1.2) | (1.3) | (1.5) | (1.6) | (1.8) | * |
| | Dhading | Dhading | 5.3 | 5.8 | 6.5 | 7.2 | 8.1 | |
| 02 | Jhapa | Jhapa | 6.0 | 6.6 | 7.3 | 8.2 | 9.1 | |
| | Ilam | Ilam | 9.4 | 10.3 | 11.5 | 12.8 | 14.3 | |
| | | Aitabare | (4.7) | (5.1) | (5.7) | (6.4) | (7.2) | * |
| | Panchthar | Phidim | 3.4 | 3.7 | 4.2 | 4.6 | 5.2 | |
| | Taplejung | Taplejung | 4.1 | 4.5 | 5.0 | 5.6 | 6.3 | |
| | Terhathum | Terhathum | 3.7 | 4.0 | 4.5 | 5.1 | 5.6 | |
| | Bhojpur | Bhojpur | 5.2 | 5.7 | 6.4 | 7.1 | 7.9 | |
| | Sankhu-wasabha | Khandbari | 5.1 | 5.6 | 6.2 | 7.0 | 7.8 | |
| | | Chainpur | 4.7 | 5.1 | 5.7 | 6.4 | 7.2 | |
| 03 | Udayapur | Ghaighat | 6.5 | 7.1 | 7.9 | 8.9 | 9.9 | |
| | Khotang | Diktel | 6.3 | 6.9 | 7.7 | 8.6 | 9.6 | |
| | Okhaldhunga | Okhaldhunga | 3.7 | 4.0 | 4.5 | 5.1 | 5.6 | |
| | | Rumjhatar | 5.2 | 5.7 | 6.4 | 7.1 | 7.9 | |

Table 4-5 (2/3) Population Forecast by Objective Sites

| Area No. | District Name | Site Name | Population ($\times 10^3$) | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | 1981 | 1985 | 1990 | 1995 | 2000 | |
| 03 | Solukhumbu | Salleri | 4.6 | 5.0 | 5.6 | 6.3 | 7.0 | |
| | | Namche Bazar | 1.6 | 1.7 | 2.0 | 2.2 | 2.4 | |
| 04 | Sindhuli | Sindhuli Madi | 12.6 | 13.8 | 15.4 | 17.2 | 19.2 | |
| | Ramechhap | Ramechhap | 4.6 | 5.0 | 5.6 | 6.3 | 7.0 | |
| | Dolakha | Charikot | 4.8 | 5.2 | 5.9 | 6.6 | 7.3 | |
| 05 | Rautahat | Gaur | 8.2 | 9.0 | 10.0 | 11.2 | 12.5 | |
| | Bara | Simra | 12.6 | 13.8 | 15.4 | 17.2 | 19.2 | |
| | | Kalaiya | 6.9 | 7.5 | 8.4 | 9.4 | 10.5 | |
| | Makawanpur | Bhimphedi | 5.4 | 5.9 | 6.6 | 7.4 | 8.2 | |
| 06 | Gorkha | Gorkha | 6.4 | 7.0 | 7.8 | 8.7 | 9.8 | |
| | Tanahun | Damauli | 13.2 | 14.4 | 16.1 | 18.0 | 20.1 | |
| | | Bandipur | 8.2 | 9.0 | 10.0 | 11.2 | 12.5 | |
| | Syangja | Syangja | 3.8 | 4.2 | 4.6 | 5.2 | 5.8 | |
| | Lamjung | Besishar | 5.2 | 5.7 | 6.4 | 7.1 | 7.9 | |
| | Manang | Chame | 0.7 | 0.8 | 0.9 | 1.0 | 1.1 | |
| | Baglung | Baglung | 4.4 | 4.8 | 5.4 | 6.0 | 6.7 | |
| | Myagdi | Beni | 5.3 | 5.8 | 6.5 | 7.2 | 8.1 | |
| | Mustang | Jomsom | 1.5 | 1.6 | 1.8 | 2.0 | 2.3 | |
| | Parbat | Kusma | 5.1 | 5.6 | 6.2 | 7.0 | 7.8 | |
| 07 | Arghakhanchi | Shandhikharkha | 3.9 | 4.3 | 4.8 | 5.3 | 6.0 | |
| | Gulmi | Gulmi Tamghas | 4.4 | 4.8 | 5.4 | 6.0 | 6.7 | |
| | Nawalparasi | Parasi | 5.2 | 5.7 | 6.4 | 7.1 | 7.9 | |
| | | Tribeni | 3.1 | 3.4 | 3.8 | 4.2 | 4.7 | |

Table 4-5 (3/3) Population Forecast by Objective Sites

| Area No. | District Name | Site name | Population (x $10^3$) | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | 1981 | 1985 | 1990 | 1995 | 2000 | |
| 08 | Dang | Tulsipur | 7.8 | 8.5 | 9.5 | 10.7 | 11.9 | |
| | | Ghorahi | 10.0 | 10.9 | 12.2 | 13.7 | 15.3 | |
| | | Gadhawa | 7.9 | 8.6 | 9.7 | 10.8 | 12.1 | |
| | | Koilabas | 2.6 | 2.8 | 3.2 | 3.6 | 4.0 | |
| | | Rajapur | 5.1 | 5.6 | 6.2 | 7.0 | 7.8 | |
| | Pyuthan | Pyuthan | 7.7 | 8.4 | 9.4 | 10.5 | 11.8 | |
| | Salyan | Salyan | 7.4 | 8.1 | 9.0 | 10.1 | 11.3 | |
| | Rolpa | Libanggaon | 5.6 | 6.1 | 6.8 | 7.6 | 8.5 | |
| | Rukum | Musikot | 5.9 | 6.4 | 7.2 | 8.1 | 9.0 | |
| | Jajarkot | Jajarkot | 6.0 | 6.6 | 7.3 | 8.2 | 9.1 | |
| | Bardia | Gularia | 9.2 | 10.1 | 11.2 | 12.6 | 14.0 | |
| | Dailekh | Dailekh | 5.0 | 5.5 | 6.1 | 6.8 | 7.6 | |
| | Jumla | Jumla | 3.2 | 3.5 | 3.9 | 4.4 | 4.9 | |
| | Kalikot | Kalikot | 3.4 | 3.7 | 4.2 | 4.6 | 5.2 | |
| 09 | Kailali | Bhajani | 10.5 | 11.5 | 12.8 | 14.3 | 16.0 | |
| | | Tikapur | 13.5 | 14.8 | 16.5 | 18.4 | 20.6 | |
| | Achham | Mangalsen | 6.0 | 6.6 | 7.3 | 8.2 | 9.1 | |
| | Doti | S. Doti | 17.5 | 19.1 | 21.4 | 23.9 | 26.7 | |
| | Bajura | Martadi | 3.4 | 3.7 | 4.2 | 4.6 | 5.2 | |
| | Bajhang | Chainpur | 3.0 | 3.3 | 3.7 | 4.1 | 4.6 | |
| | Dandeldhura | Dandeldhura | 2.6 | 2.8 | 3.2 | 3.6 | 4.0 | |
| | Baitadi | Baitadi | 4.5 | 4.9 | 5.5 | 6.1 | 6.9 | |
| | Darchula | Darchula | 4.5 | 4.9 | 5.5 | 6.2 | 6.9 | |
| | | | | 434.3 | 485.7 | 542.8 | 607.2 | |

* : Estimated due to the lack of statistics

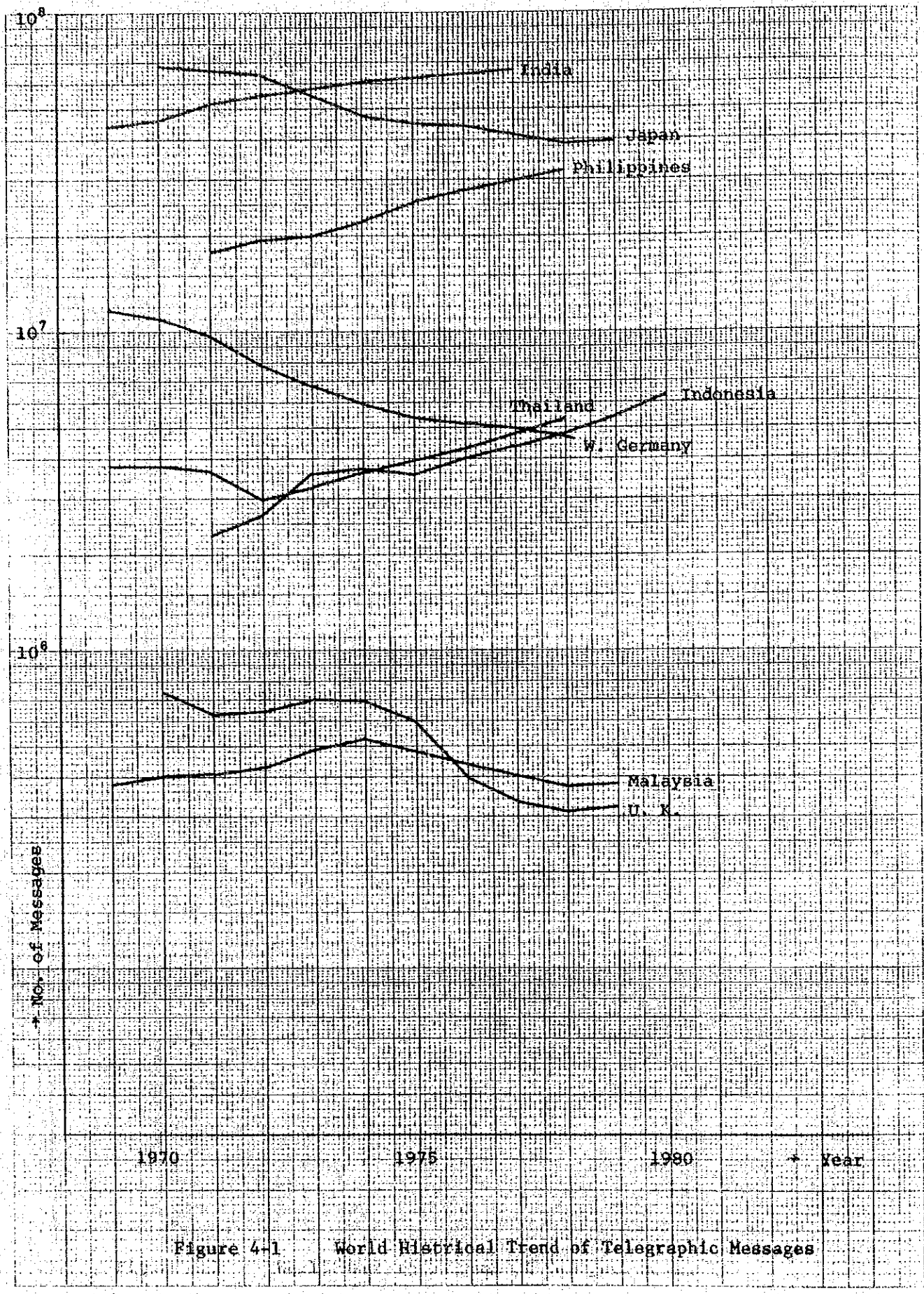



Figure 4-1 World Historical Trend of Telegraphic Messages

## 4-2 Scale of Installation

### 4-2-1 NTC's Basic Concept

In the basic concept formulated by NTC with regard to the rural telecommunication network improvement plan, this time, items having directly to do with the capacity of facilities to be installed are as under.

(1) Public Call Office

NTC considers that the equipment mentioned below will have to be introduced in the public call office.

a) One telephone set with call meter, to be used for public telephone calls, and one telephone set to be exclusively used for telegram service.

b) A minimum of four telephone sets for toll calls to administrative offices, as well as public establishments, such as police, banks and medical institutes.

c) Transmission route is to have capacity of at least 30 channels to cater for future demand growth.

(2) Telephone Exchange Site

(Hereafter referred to as Independent Exchange)

At the initial stage, independent exchange is to be introduced at Tulsipur and Ghorahi (08 area), S. Doti (09 area) and Kalaiya (05 area). Capacities are as under:

a) Tulsipur and Ghorahi: 250 line units, each

b) S. Doti: 350 line units

c) Kalaiya: To be determined separately. Switching facilities are to be prepared by NTC in a separate plan. Hence, this time, transmission system only is taken up for study.

d) Exchange building is to be transportable. Container length is to be 4 m at a maximum.

(3) Parent Exchange

a) A total of 11 parent exchanges, one in each area, in principle, are to be established. They are:

| Area | Parent Exchange Name |
|---|---|
| 01 | Kathmandu |
| 02 | Biratnagar |
| 02 | *Bhadrapur |
| 03 | Rajbiraj |
| 04 | Janakpur |
| 05 | Birganj |
| 05 | *Hitauda |
| 06 | Pokhara |
| 07 | Bhairahwa |
| 08 | Nepalgunj |
| 09 | Dangadhi |

Note: Exchange marked with * is not the highest ranking exchange in the area as far as the telephone office hierarchy goes, but is exceptionally classified as parent exchange as the transmission network formation requires.

b) Switching facilities of parent exchanges are to be prepared by NTC separately from the current plan.

(4) Service Policy for Non-Voice Services by Facsimile Terminal

Telegraph service and document transmission service by facsimile terminals may be introduced in the parent exchanges and independent exchanges (except Kalaiya) only at the initial stage.

With the experience thus gained at the initial stage and the development of other infrastructures, this service may be introduced to all the public call offices in the future.

4-2-2 Scale of Installation

Capacity of facilities to be installed is basically to be determined in accordance with NTC's basic concept described in the preceding paragraph and in consideration of the demand forecast result in Paragraph 4-1-1. However, in order that the capacity of facilities determined will be optimum, considering the status quo of Nepal, further study is to be made in both technical and economic aspects, based on the field survey findings and the result of consultation with NTC.

The scale of facilities installation for each objective site, determined from the above viewpoint, is as under.

(1) Public Call Office

a) Number of Telephone Sets

NTC's basic concept in favor of providing one telephone set for public toll calls, one telephone set for telegram message service and

four telephone sets for toll calls to four out of key government organizations and public establishments corresponds with the basic principle of the feasibility study, this time, intended for introducing facilities in the necessary minimum and is considered to be justifiable.

b) Transmission Capacity

Subscriber demand at 63 public call offices, estimated in Paragraph 4-1-1, averages 81 per call office in the initial forecast year of 1985 and 118 in the final forecast year of 2000, (refer to Table 4-3). Since the feasibility study, this time, is not aimed at thorough fulfillment of such subscriber demand, NTC's proposal of 30 channels (corresponding to the basic primary group of 2.048 M-bit/s, the lowest unit of multiplexing in the digital multiplex system) as public call office capacity can be considered to be reasonable. When the small capacity line concentrator of low cost is introduced in the future, it becomes possible to satisfy the 200 subscribers or thereabouts demand by 30 channels. This fact also allows the judgment that the public call office capacity of 30 channels is appropriate.

However, according to the forecast, the final stage subscriber demand at the undermentioned public call office sites exceeds 200, so that, at these sites, the introduction of independent exchanges during the effective period of the plan is worth consideration. Therefore, at these public call office sites, the transmission capacity is exceptionally set at 60 channels.

| Public Call Office | Final Stage Subscriber Demand |
|---|---|
| Bidur-Trisuli | 257 |
| Ilam | 202 |
| Sindhuli Madi | 271 |
| Simra | 271 |
| Damauli | 283 |
| Gularia | 197 (≒ 200) |
| Bhajani | 226 |
| Tikapur | 290 |

(2) Independent Exchange

a) Sites and Number of Line Units

NTC's plan to introduce independent exchanges at three sites, i.e., Tulsipur, Ghorahi and S. Doti, by the current project is considered to be justifiable. The reasons are:

- Tulsipur and Ghorahi are the administrative centers of Rapti Zone and Dang District, respectively. Both are designated by His Majesty's Government of Nepal as the agricultural development bases of top importance and are located in the Dang basin where the improvement and expansion of infrastructures, as well as the associated undertakings of various kinds, are being promoted with financial assistance mainly from the World Bank. Thus, at Tulsipur and Ghorahi, economic activities are sure to be stepped up with the rapid growth of telephone demand to follow.

- S. Doti, along with the adjoining Dipayal, constitutes the administrative center of the Far Western Development Region. This development region is of utmost importance to His Majesty's Government of Nepal, and improvement/expansion works of many kinds are now being carried out. In this connection, an early introduction of communication facilities at S. Doti (Dipayal), the center of the development region, is keenly desired.

At the three telephone exchanges, the final stage capacity of switching facilities is to be 500 line units each, whereas the initial year capacity is to be 250 line units each at Tulsipur and Ghorahi and 350 line units at S. Doti. The initial year capacities are as proposed by NTC. The reasons for such capacity decision are:

- According to the forecast, the final stage subscriber demand is 168 at Tulsipur, 216 at Ghorahi and 376 at S. Doti. This conservative forecast is on the assumption that no difference exists from area to area in the structures of economy and industry, nor are there fluctuations in the area by area population distribution.

  As stated previously, all three telephone exchanges occupy the strategic position in regional development, so that the actual subscriber demand is considered to exceed the forecast.

- NTC specifies the length of transportable exchange building to be not more than 4 m so as not to inconvenience transportation. Accommodation capacity of such exchange building is about 500 to 700 line units.

- The initial year subscriber demand is forecasted to be 115 at Tulsipur, 147 at Ghorahi and 258 at S. Doti. All these are smaller than the numbers proposed by NTC. However, the difference to this extent exerts no much influence on installation cost. Furthermore, to cope with demand upswing successfully, surplus exchange capacity to a certain degree is desirable.

b) Transmission Capacity

All three exchanges - Tulsipur, Ghorahi and S. Doti - are to be newly established. Hence no traffic data of the past. Therefore, using as reference the data available at the time of planning of the World Bank financed project now being implemented, decision is made to set transmission capacity of the three exchanges at 60 channels (4 M-bit/s) each. More precisely:

- By means of originating and terminating toll calling rate in rural areas at the time of planning of the World Bank financed project plus 20% as coefficient to cater for traffic fluctuations, the originating and terminating toll calling rate is estimated as under:

Originating toll calling rate:

0.0331 Erl/Sub.

Terminating toll calling rate:

0.0255 Erl/Sub.

- When calculated from the above calling rate, the toll transmission capacity required of the telephone exchange equipped with 250 to 600 line units becomes 33 to 60 channels.

As for Kalaiya telephone exchange where NTC is scheduled to introduce switching facilities separately from the current plan, the transmission capacity is to be 60 channels. This is because the final stage subscriber demand at Kalaiya, forecasted in Paragraph 4-1-1, is conservative at 148; however, according to NTC's independent exchange installation standard, the minimum capacity at initial stage is 250.

(3) Parent Exchange

a) All switching facilities are to be prepared by NTC so that they are not taken up for consideration in the feasibility study, this time.

b) As regards the transmission capacity, decision is to be made according to the transmission route to be selected by the degree of toll circuit concentration from public call offices and independent exchanges. A detailed study is made in the next Capter.

(4) Facsimile Terminal Equipment

NEC's basic concept for non-voice services by facsimile terminal equipment described in the preceeding paragraph corresponds with the basic principle of the feasibility study intending to introduce facilities in the necessary minimum and is considered to be justifiable.

In view of the above and the results of consultation with NTC, number of facsimile terminals of CCITT G-II type to be provided at the initial stage are determined as under:

Independent Exchanges (except Kalaiya)
: 3 sets (one per exchange)

Parent Exchanges (except Kathmandu)
: 20 sets (two per exchange)

Kathmandu
: 4 sets

For the purpose of reference at the time of introducing the facsimile terminals to all public call offices in the future, the findings in studies regarding the selection of equipment and number of equipments required at each objective site in the future are summarized in APPENDIX B.

# V. BASIC INSTALLATION PLAN AND BASIC DESIGN

# V. BASIC INSTALLATION PLAN AND BASIC DESIGN

The rural telecommunications network to be introduced by the current project is to be composed of the following main categories of facilities:

(1) Transmission facilities

(2) Telephone switching facilities

(3) Cable and outside plant facilities

(4) Power supply facilities

(5) Terminal (telephone and facsimile) facilities

(6) Building facilities

This Chapter presents the basic plan for each category of facilities mentioned above and studies the basic designs of those facilities.

## 5-1 Transmission Facilities

For the planning of transmission facilities, the transmission route selection and the transmission system selection are the two prerequisites. Following are the studies of these two prerequisites, and the transmission facilities planning, as well as the basic designing, based on such study findings.

### 5-1-1 Transmission Route Selection and Circuit Grouping

(1) Transmission Route Selection

For the transmission route selection, the following basic items are to be considered:

a) As stated in Chapter III, circuits between each two objective sites are to be established between the parent exchange and the public call office or independent exchange that belongs to the parent exchange. Therefore, the transmission network is to be constructed as an independent network centering upon each parent exchange.

b) The selected transmission system (the system selection is described in the next Paragraph 5-1-2) is to be compatible with the technical requirements, including the radio propagation requirement, on the transmission route.

c) The transmission route length is to be as short as technically possible. The number of radio repeaters is also to be reduced to the necessary minimum.

d) The repeater site is to be in the village environs as much as possible and such site is to be easy of access.

e) The public call office and independent exchange sites are to be selected at the centers of their respective service areas, in principle.

f) The parent exchange is to be established in the existing exchange building. For the parent exchanges yet to be established, the buildings to be constructed by NTC in the separate plan are to be utilized.

The transmission route plan selected in due consideration of the foregoing basic items appears in Figure 5-1-1. The profile map of each hop of the transmission route is given in APPENDIX A.

This transmission route plan is based on the desk design using maps of a scale of 1:50,000. Therefore, at the time of project implementation, the route plan must of course be modified where necessary, based on findings in more detailed investigation and studies including field survey. Especially for newly selected sites, in-depth survey and study are required in regard to land availability, land formation facility or difficulty, and site accessibility.

For Dangadhi, Bhajani, Chame and Bhadrapur sites and their surroundings, maps of 1:50,000 scale were not available so that the transmission routes covering these areas are schematic routes selected by study with rougher scale maps and associated data obtained in the field survey. Thus, for decision of final transmission route, especially minute survey and study are required.

(2) Circuit Grouping

Circuits between one public call office/independent exchange and the parent exchange in the final stage of the plan number 30 or 60 as stated in Chapter IV. When the total number of circuits is distributed on the transmission route selected in the preceding paragraph, the hop by hop ciruit groupings consist of 30 circuits at a minimum and 330 circuits at a maximum.

5-1-2 Transmission System Selection

As stated in Chapter III, the transmission system to be used in the current plan is the digital, line-of-sight UHF or SHF system (hereafter to be referred to as the digital radio system).

For the digital radio system, several types, one differing from another in frequency band and transmission capacity, have already been developed and are being operated on utility basis. After the comparative study of these different system types, selection is made, this time, for the one whose frequency band is from 1.5 GHz to 2.5 GHz (hereafter to be collectively called the 2 GHz band) and whose transmission capacity is for 480 channels (34 M-bit/s) or less.

The reasons for this selection are as under:

(1) As previsouly stated, the hop by hop circuit groupings on the transmission route at the final stage of the plan consist of 330 circuits even at a maximum whereas the minimum is 30 circuits. The frequency band of the transmission system developed and operated as an optimum system for such small/medium capacity hop is from 800 MHz to 2 GHz.

(2) The frequency band ranging from 610 to 960 MHz is allocated to India and Pakistan for broadcasting service (Refer to Radio Reguration, Article 5, No. 339). Therefore, the allocation of this frequency band to Nepal should be avoided.

Presently, NTC holds the main transmission route west of Kathmandu composed of the 2 GHz band (center frequency: 1,903 MHz) analog radio system. The digital radio system scheduled to be constructed in the near future is also the 2 GHz band type. Hence, the 2 GHz band frequency allocation to the current plan requires utmost circumspection because of possible frequency interference with the said two radio systems.

## 5-1-3 Basic Design

The basic design parameters of the selected transmission system are as under.

(1) System Performance Objective

Transmission performance of digital radio system is expressed in terms of bit error ratio (BER). With regard to allowable BER of the hypothetical reference digital path (HRDP) for radio-relay systems for telephony, CCIR recommends the following provisional objective (Rec. 594):

a) Low BER Objective

BER should not exceed $1 \times 10^{-6}$ for more than 1% of any month.

(As for the BER measuring time duration, no recommendation has yet been made. However, there is a proposal that supports one minute as being appropriate for BER measuring duration.)

b) High BER objective

BER should not exceed $1 \times 10^{-3}$ for more than 0.05% of any month (BER measuring time duration: 1 second).

For the path of different composition and length from the HRDP, CCIR proposes that the real path objective as under can apply (Rep. 930):

a) For high BER objective, the allowable percent of time given in a) above for the HRDP is to be proportionally divided by circuit length.

b) For low BER objective, statistical analysis of bit error probability should also be made besides the proportional division of the available percent of time given in b) above (hereafter called the time factor) by route length.

The digital radio transmission route planned, this time, differs in both length and configuration from HRDP defined by CCIR. Thus, for the system performance objective, decision is made to apply the above real path objective correspondingly. Decision is also made to carry out the time factor division by distance only in case where the transmission route length exceeds 280 km, and this is in accordance with CCIR Rep. 930. When the transmission route length is less than 280 km, the time factor allowable for the distance of 280 km is to be applied instead of the time factor division by distance.

(2) Transmission Bit Rate and System Configuration

Transmission bit rate of transmission system is to be determined at a level commensurate with the circuit demand at the final stage of the plan in each hop of the transmission route. Thus, for the transmission bit rate, either of 2, 4, 8, 17 and 34 M-bit/s is to be chosen.

Transmission bit rate of transmission system applied for the transmission route is shown in Figure 5-1-2.

For transmission system configuration, the spare equipment system is to be adopted in all cases. This is for the effective use of frequency spectrum, free from restrictions in the way of RF channel allocation. Also, to reduce power consumption by equipment and to economize operating cost of power supply facilities, the power supply to spare equipment is to be made only when the operation is changed over to spare equipment. This is the so-called "cold stand-by" system.

Figure 5-1-3 illustrates the typical system configurations of terminal station and repeater station.

(3) Remote Supervisory and Control System

In order to do with the minimum number of maintenance personnel after the introduction of transmission facilities, the remote supervisory and control function is to be provided to transmission facilities.

By this remote supervisory and control system, all the radio terminals and radio repeaters other than parent exchanges are made unattended. They are to be supervised and controlled from the radio terminal of parent exchange concerned.

Items to be supervised/controlled are as under:

- Supervision of transmitting and receiving equipment alarm system
- Discrimination of transmitting and receiving equipment in operation (working or stand-by equipment)

- Supervision of system operation and detection of trouble when it takes place
- Supervision of power supply system and detection of abnormality, if any
- Supervision of building alarms (door open, fire, etc.)
- Control of working to/from stand-by transmitting and receiving equipment changeover
- Engine generator start/stop control

(4) Antenna and Tower

1) Antenna

For antenna, the grid type parabolic antenna is to be adopted.

To determine the required antenna height, the prerequisite is to know the atmosphere refraction index inclination that exerts a great influence on radio propagation characteristic. However, in the field survey, this time, detailed data could not be obtained. Therefore, the following requirements are to be considered for determining the antenna height:

a) With K = 4/3, U is to be 0.6 or more, and with K = 2/3, U is to be 0.3 or more. Out of antenna heights that can be obtained under such conditions, whichever higher is to be adopted.

K: Effective earth radius factor

U: Path clearance factor

b) In consideration of arboreal growth on the propagation path and buildings in the neighborhood of the proposed site, the antenna height is to be at least higher than given below.

- In the case of site located in city area: 30 m
- In the case of site located in town/village and on flat land: 15 m
- In the case of site located on hill or mountain top: 10 m

2) Tower

For tower, the top requirement is to endure the maximum wind load of 160 km/hour. Furthermore, to facilitate the erection work and to reduce the erection work cost, the tower of lightest possible weight and lowest possible price is to be introduced. The principles of tower planning are as under:

a) In case the number of antenna to be mounted is one and the tower height is 22 m or less, the steal tubular pole is to be adopted.

b) In case the number of antenna to be mounted is two or more and the tower height is 32 m or less, the self-supporting type triangle tower is to be adopted.

c) In case the tower height is more than 32 m, the guyed tower is to be adopted.

The antenna height and tower height, as well as the type of tower, at each site, determined according to the foregoing basic design, appear in Table 5-1-1.

5-1-4 Initial Stage Facilities Planning

Transmission facilities planning at the initial stage is shown in Figure 5-1-4. This initial stage facilities planning complies with the undermentioned requirements.

(1) The number of circuits at public call offices and independent exchanges in the initial stage is as under:

a) Public Call Offices

- Bidur : 9 telephone circuits; 1 telegram message circuit
- Simra: 16 telephone circuits; 1 telegram message circuit
- Others: (Each) 5 telephone circuits; 1 telegram message circuit

b) Independent Exchanges

Tulsipur, Ghorahi and S. Doti are respectively to be equipped with 60 circuits including one facsimile circuit.

(2) Interface between transmission facilities and switching facilities at independent exchanges is to be made on 2 M-bit/s digital primary group base.

(3) Switching facilities of parent exchanges are to be prepared separately by NTC. Interface of those switching facilities with transmission facilities is to be made on circuit by circuit base.

(4) At the radio terminal and/or branching station to be established in the middle of transmission route, interface between carrier multiplex equipment and radio equipment is to be made on digital base of as high order group as possible, so as to minimize the transmission performance deterioration and to reduce the installation cost.

The initial stage facilities planning is to be implemented in four phases. (For details, see Chapter VII). Scheduled in Phase I is the establishment of circuits at S. Doti, Dandeldhura, Bhajani and Tikapur sites (all in area 09), and these circuits temporarily concentrate at Nepalgunj, the parent exchange of area 08. And, at the time the switching facilities are introduced by NTC at Dangadhi, the parent exchange of area 09, those circuits are to be re-accommodated at Dangadhi. (This period is expected to be in Phase III.) Thus, at S. Doti, the independent exchange is to be constructed in Phase III while in Phase I the public call office is to be established temporarily at S. Doti as at other sites.

Figure 5-1-4 shows the channel accommodation plan by such temporary plan also.

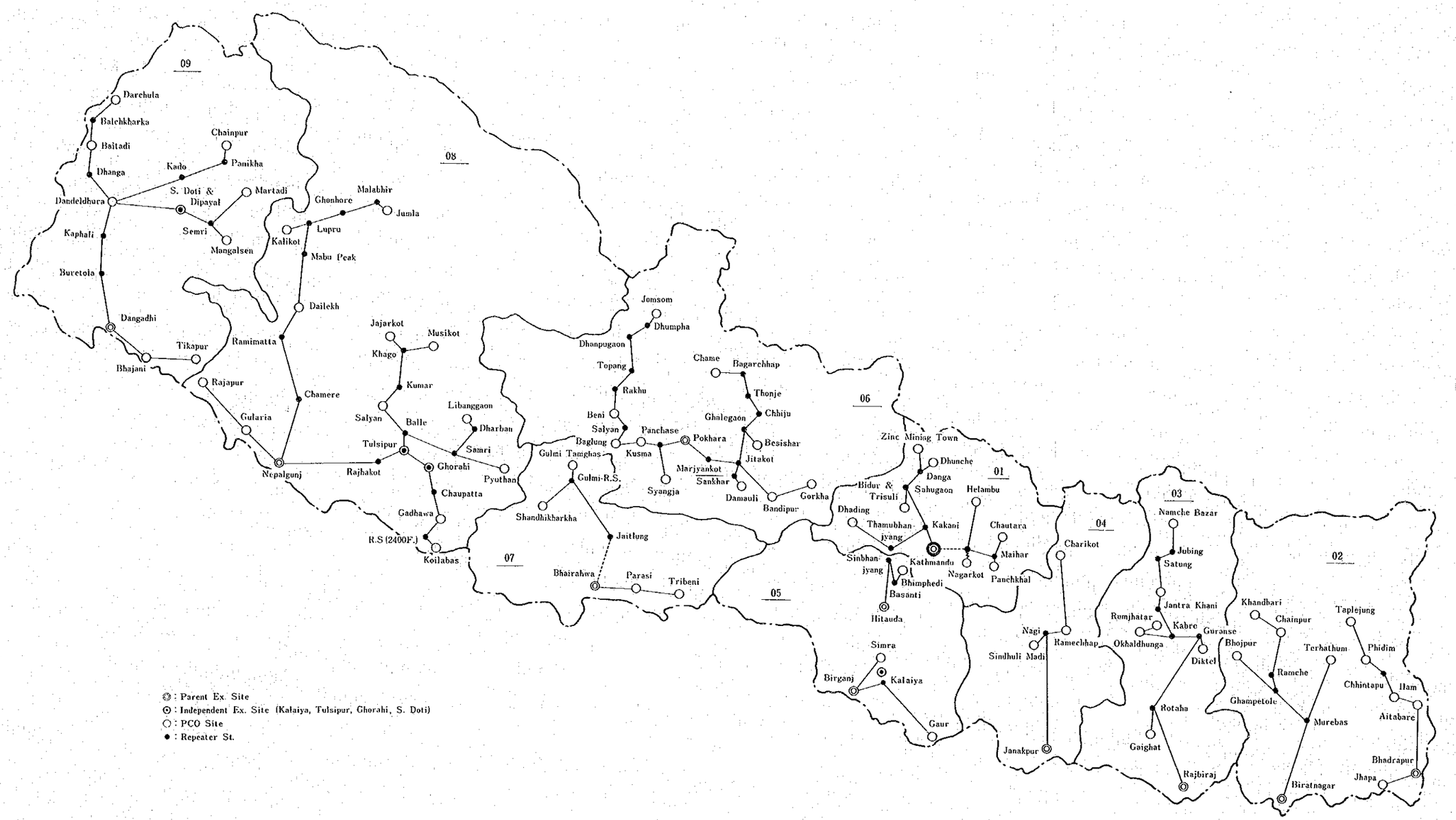
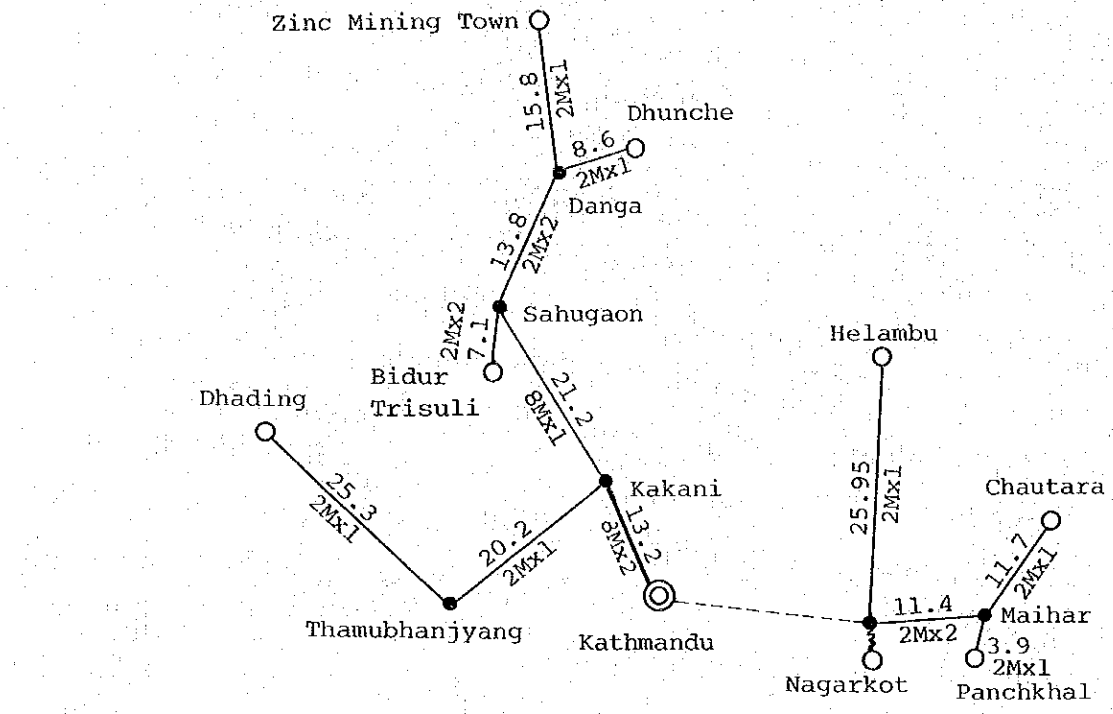



Figure 5-1-1 Transmission Route Plan




Legend

xx.x ← Path distance (km)

ooM x Δ ← No. of digital streams

Bit rate in Mbit/s of digital stream

Figure 5-1-2 (1/9) Bit Rate on Transmission Route (01 Area)

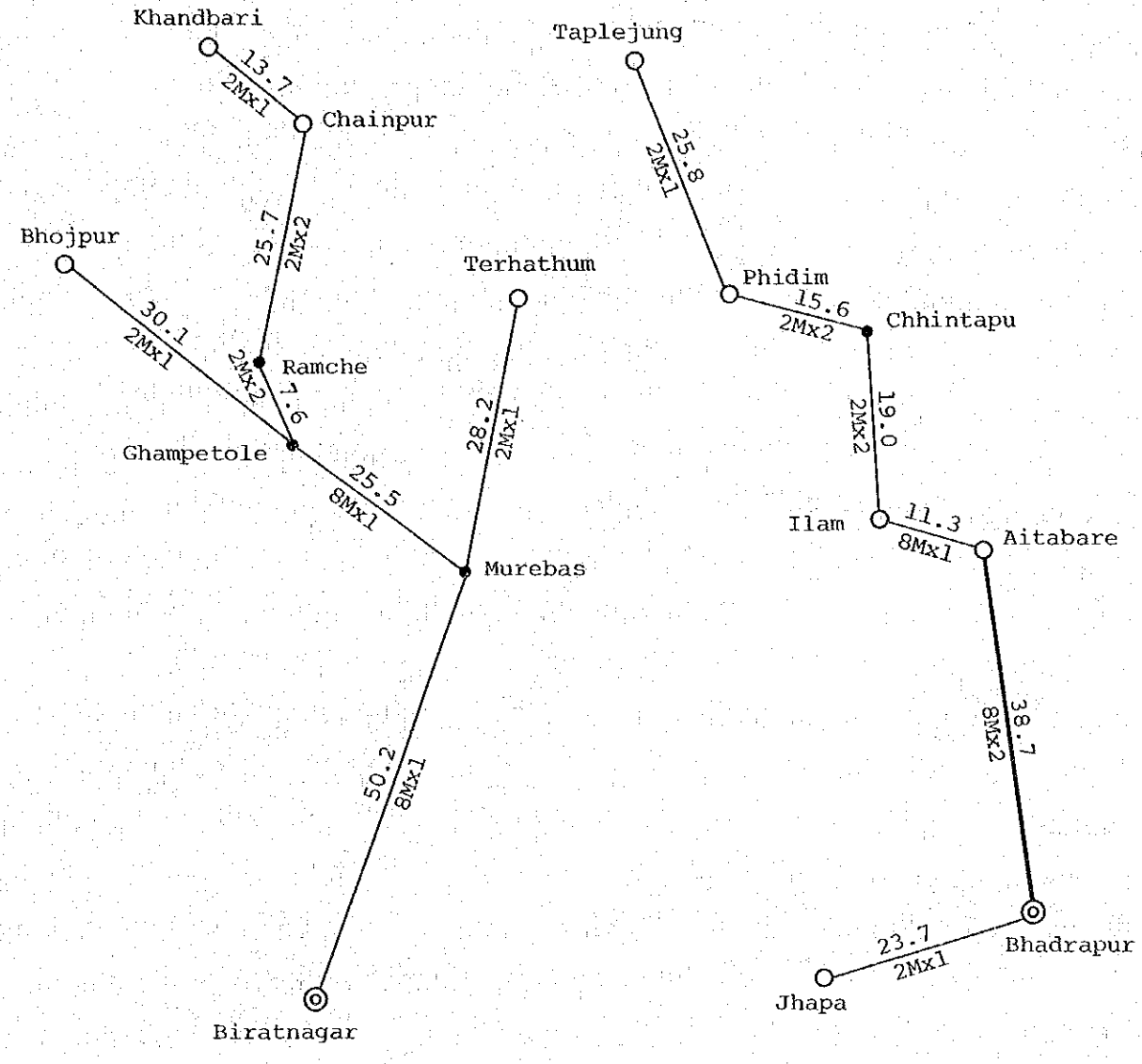



Figure 5-1-2 (2/9) Bit Rate on Transmission Route (02 Area)

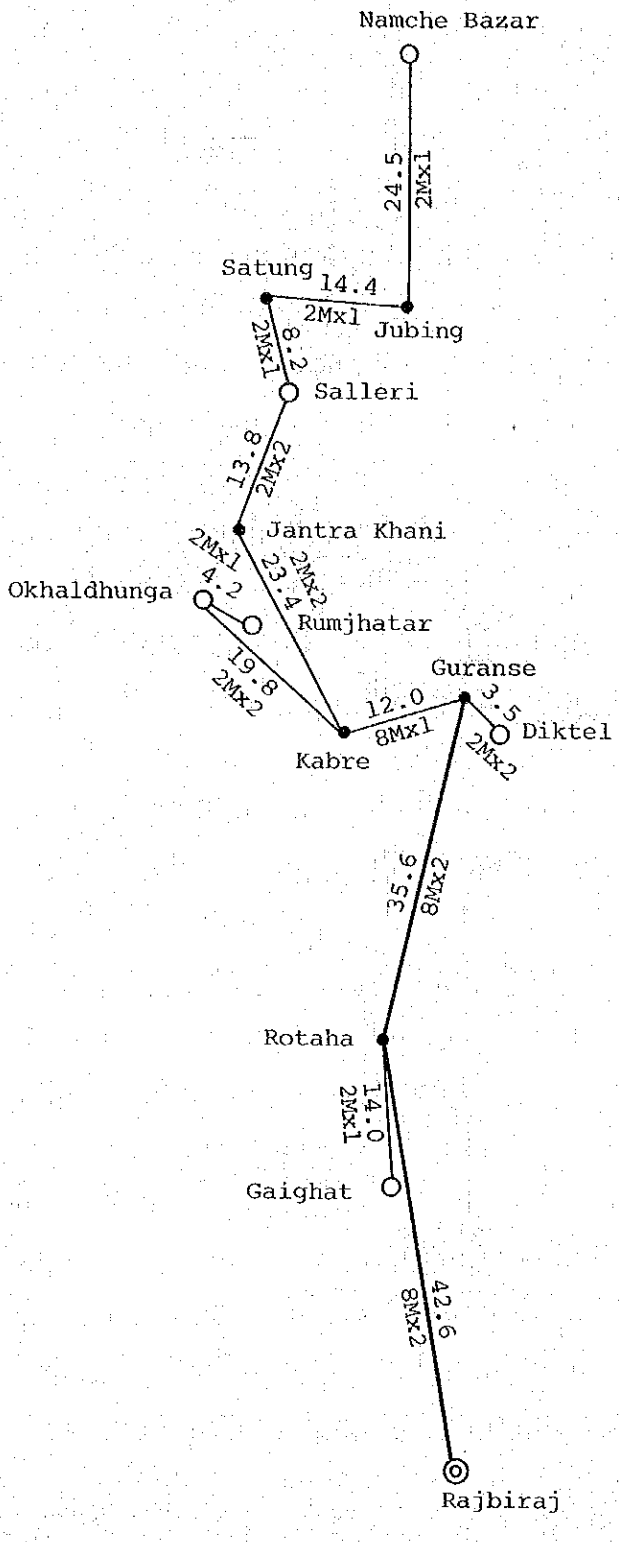



Figure 5-1-2 (3/9) Bit Rate on Transmission Route (03 Area)

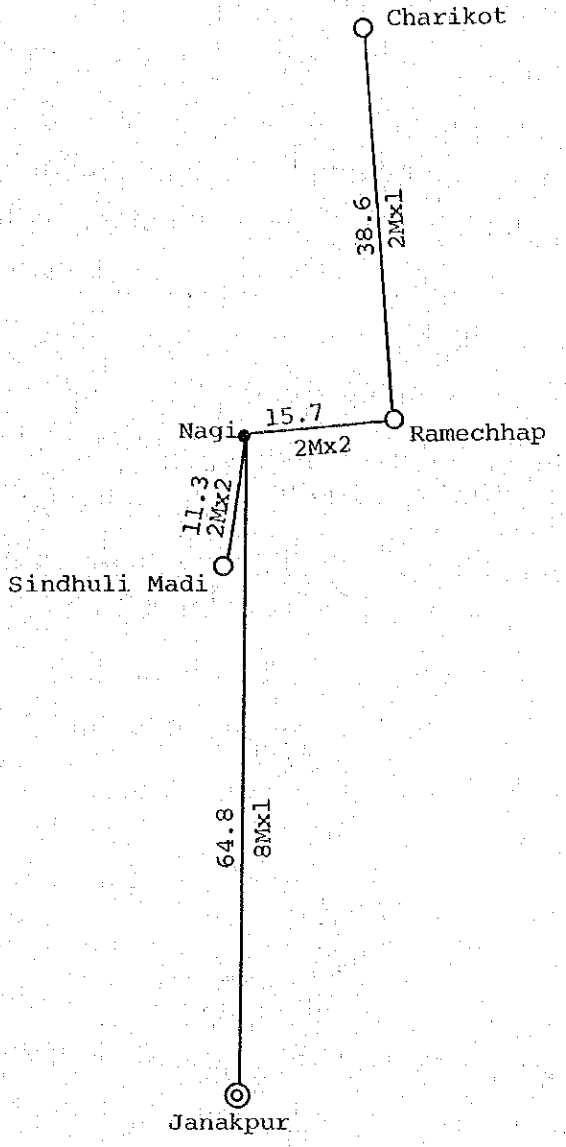



Figure 5-1-2 (4/9) Bit Rate on Transmission Route (04 Area)

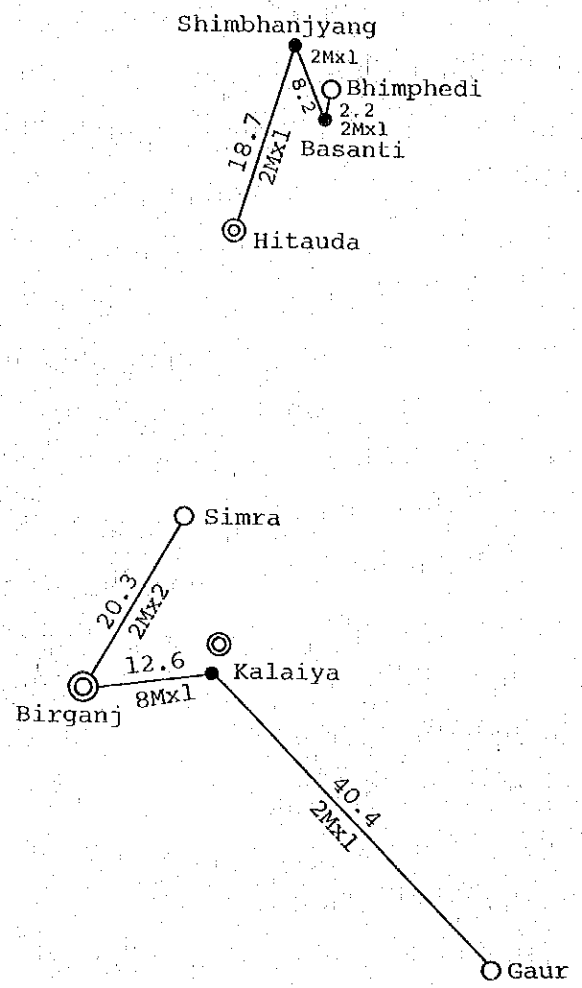



Figure 5-1-2 (5/9) Bit Rate on Transmission Route (05 Area)

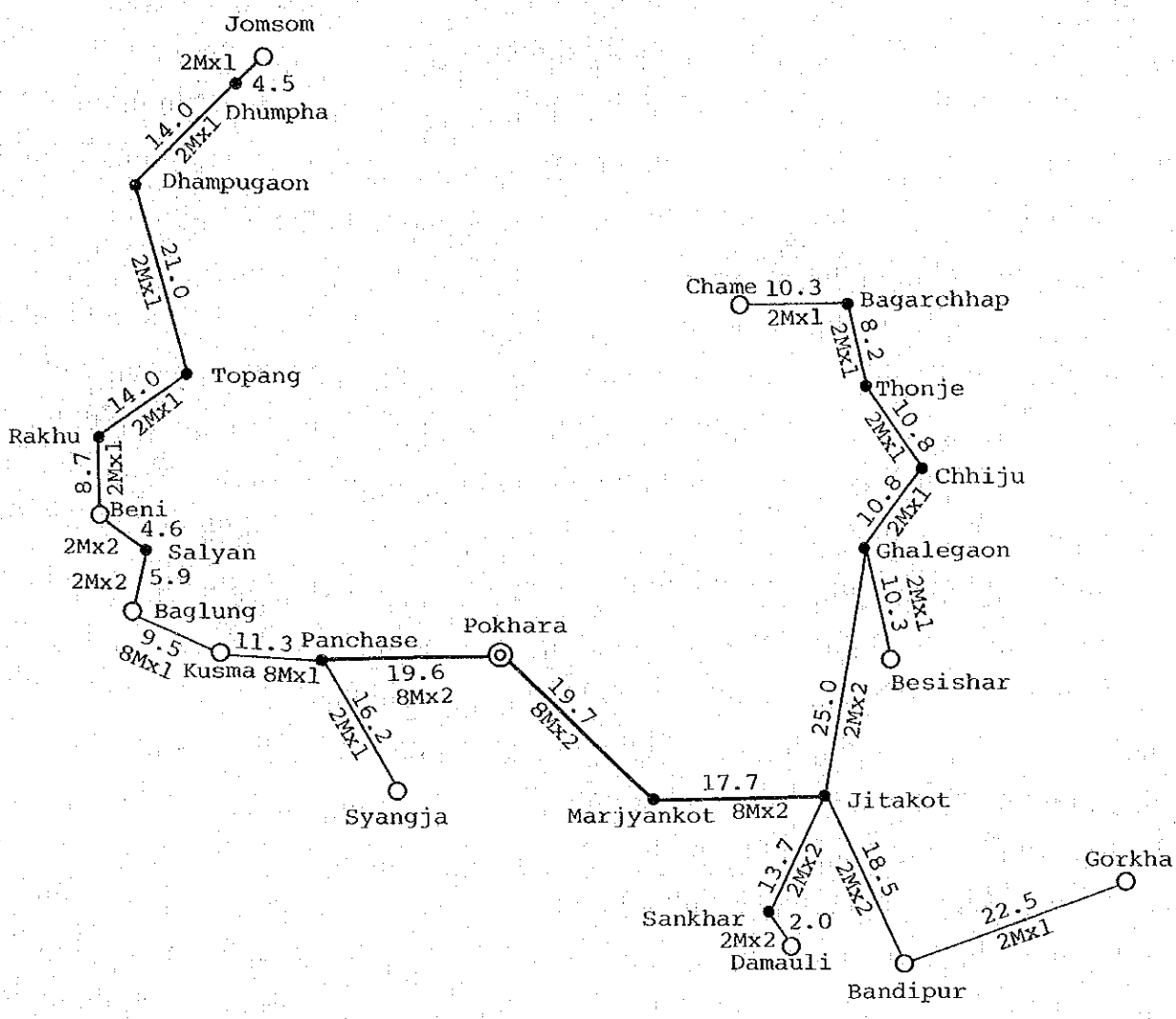



Figure 5-1-2 (6/9) Bit Rate on Transmission Route (06 Area)

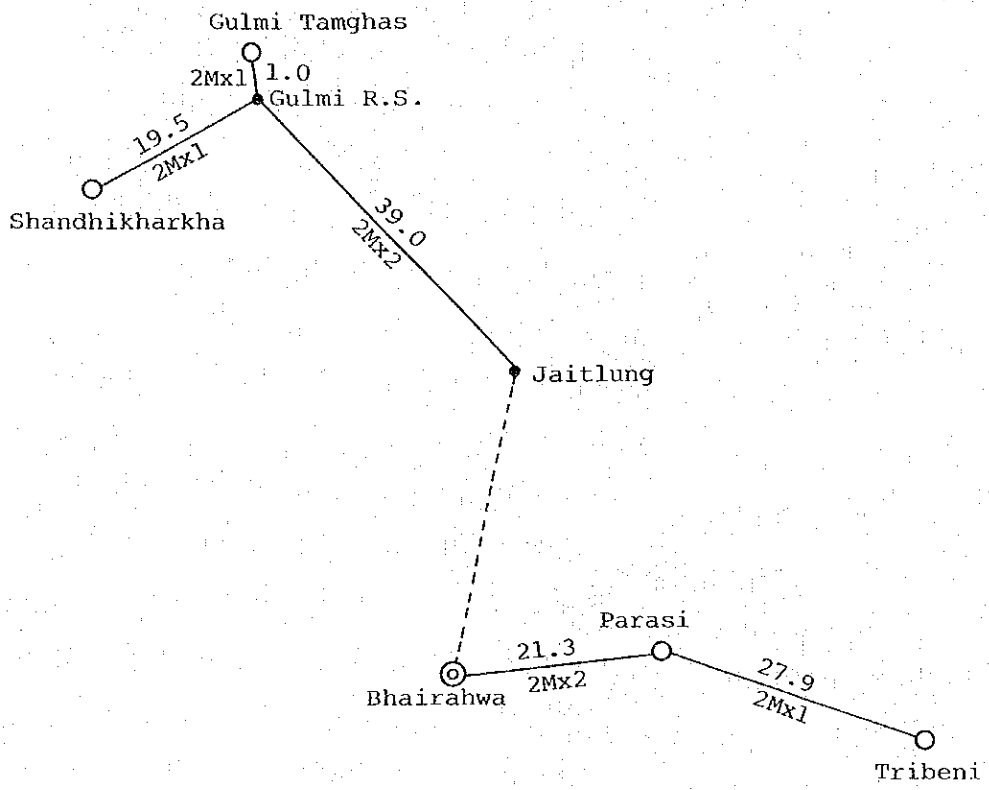



Figure 5-1-2 (7/9) Bit Rate on Transmission Route (07 Area)

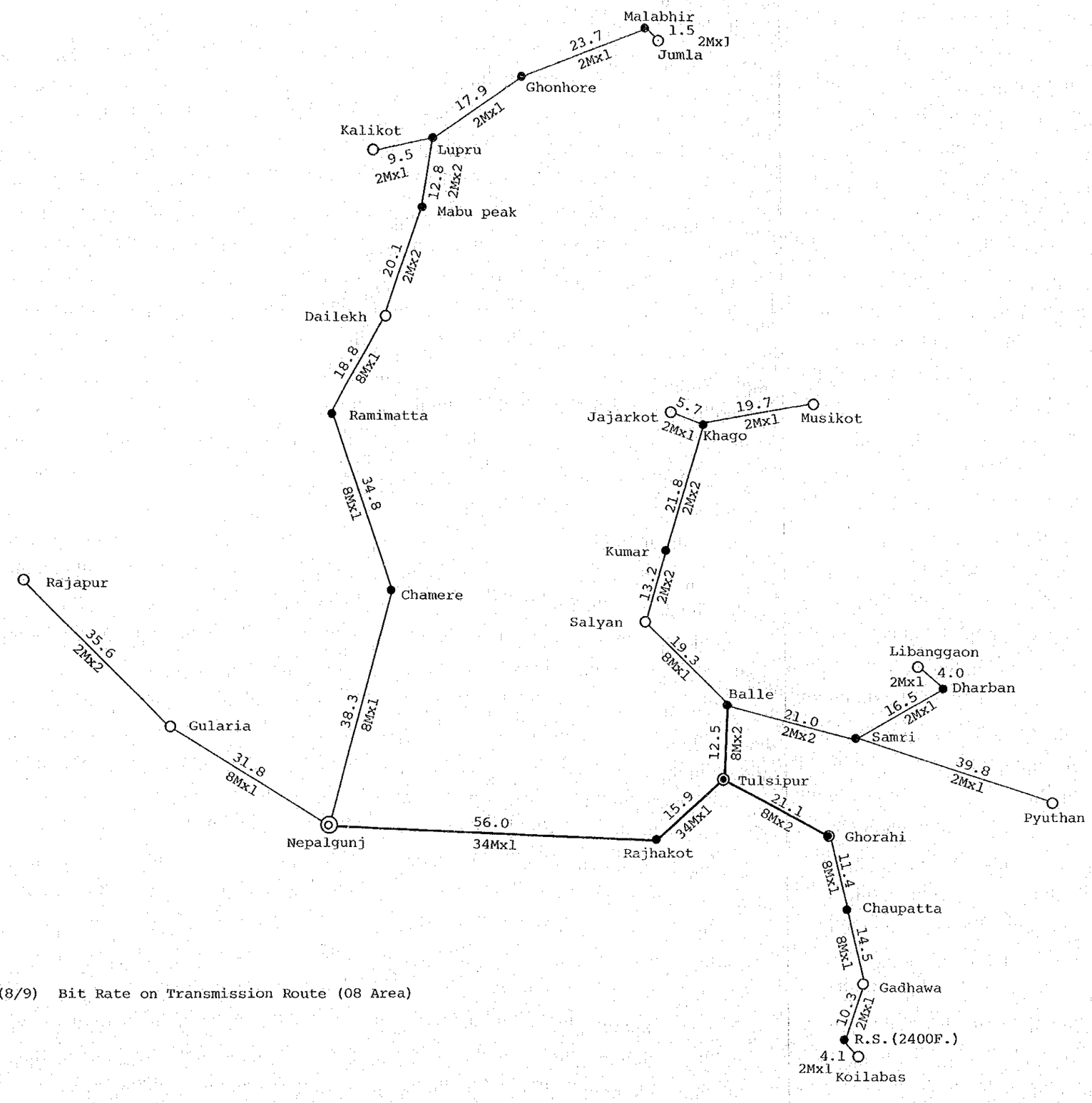



Figure 5-1-2 (8/9) Bit Rate on Transmission Route (08 Area)

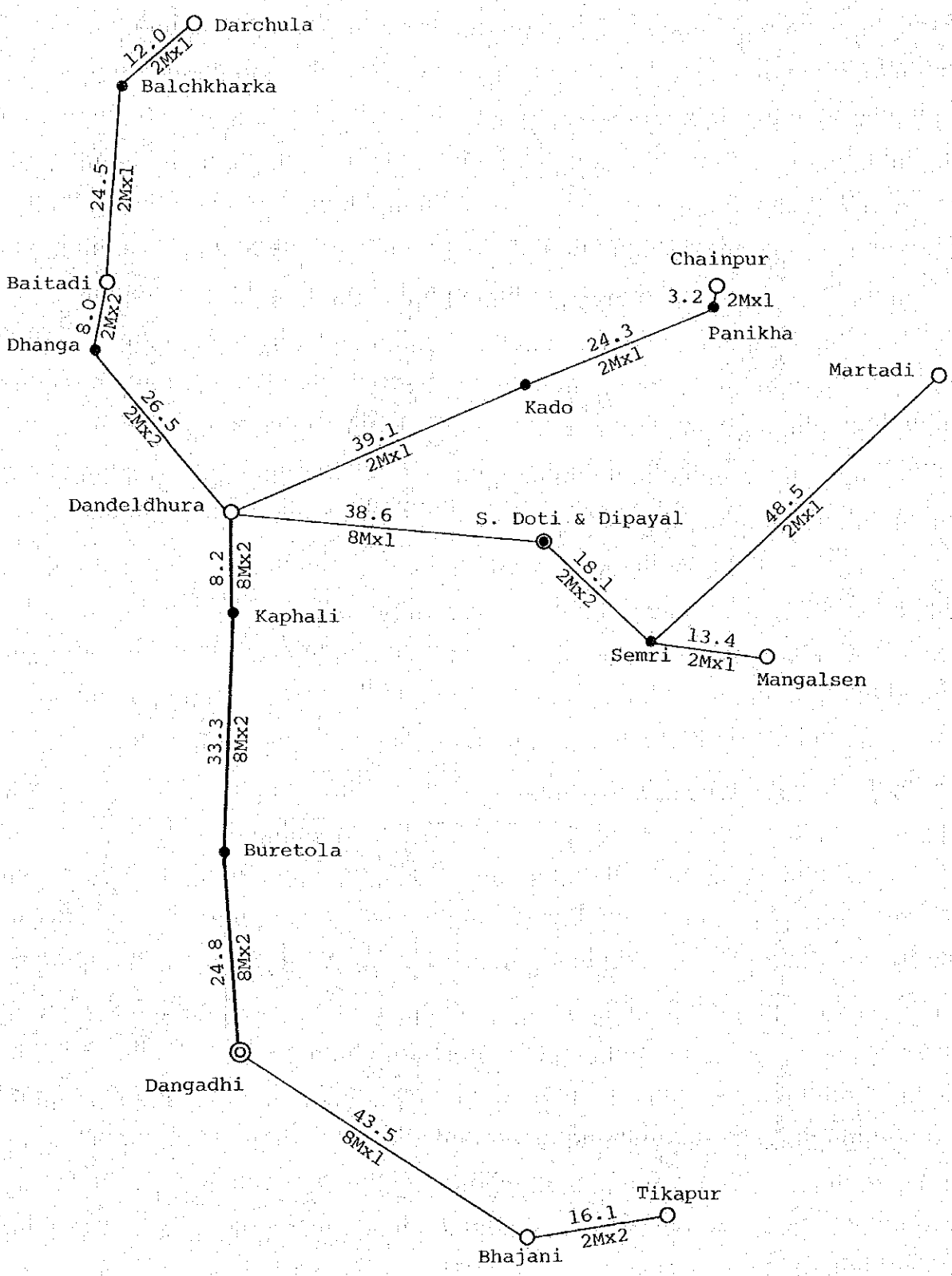



Figure 5-1-2 (9/9) Bit Rate on Transmission Route (09 Area)

Figure 5-1-3 Typical System Configurations of Terminal Station and Repeater Station

Figure 5-1-4 (1/11) Channel Accommodation Plan at Initial Stage