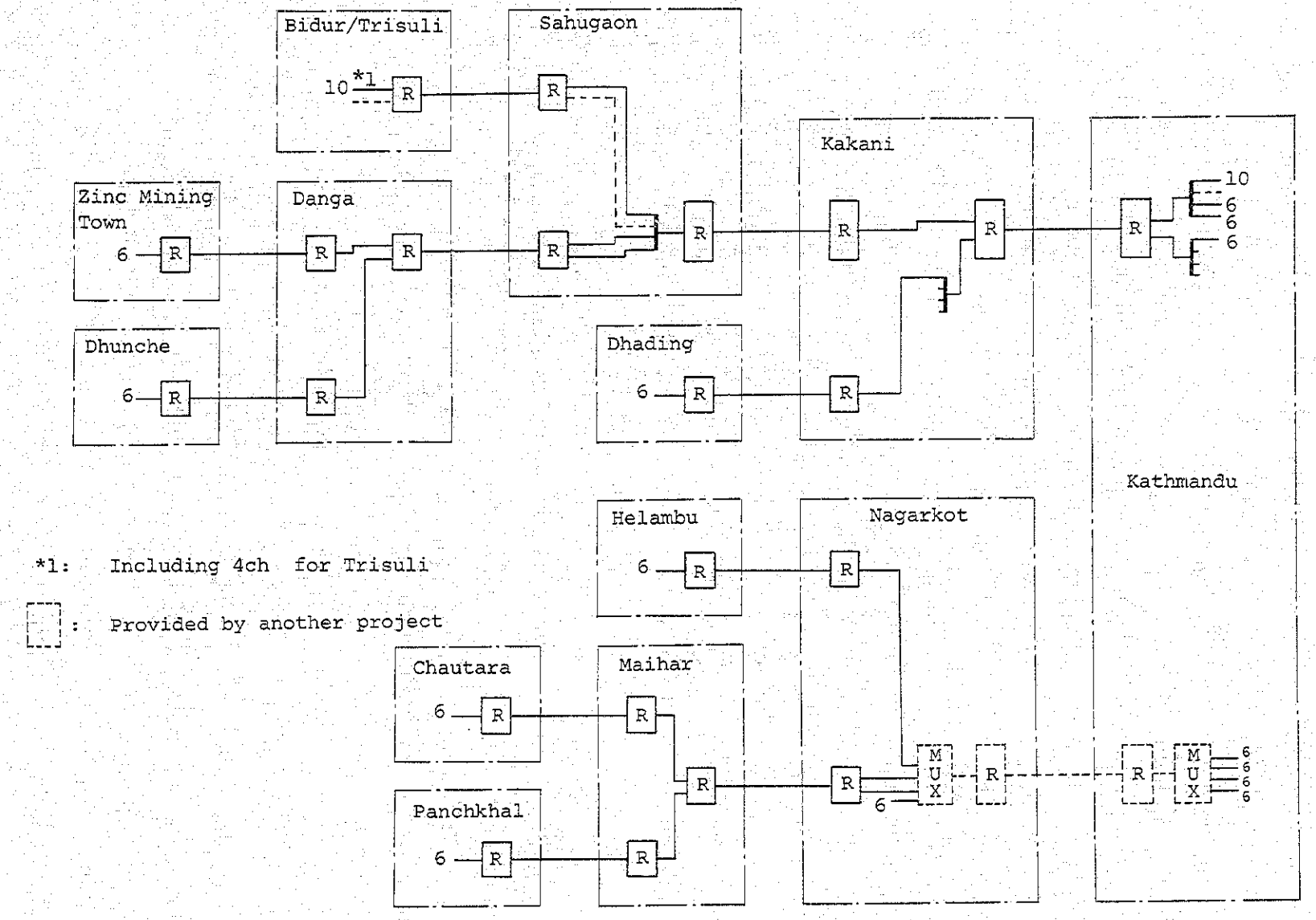


*1: Including 4ch for Trisuli

: Provided by another project

Figure 5-1-4 (2/11) Channel Accommodation Plan at Initial Stage (01 Area)

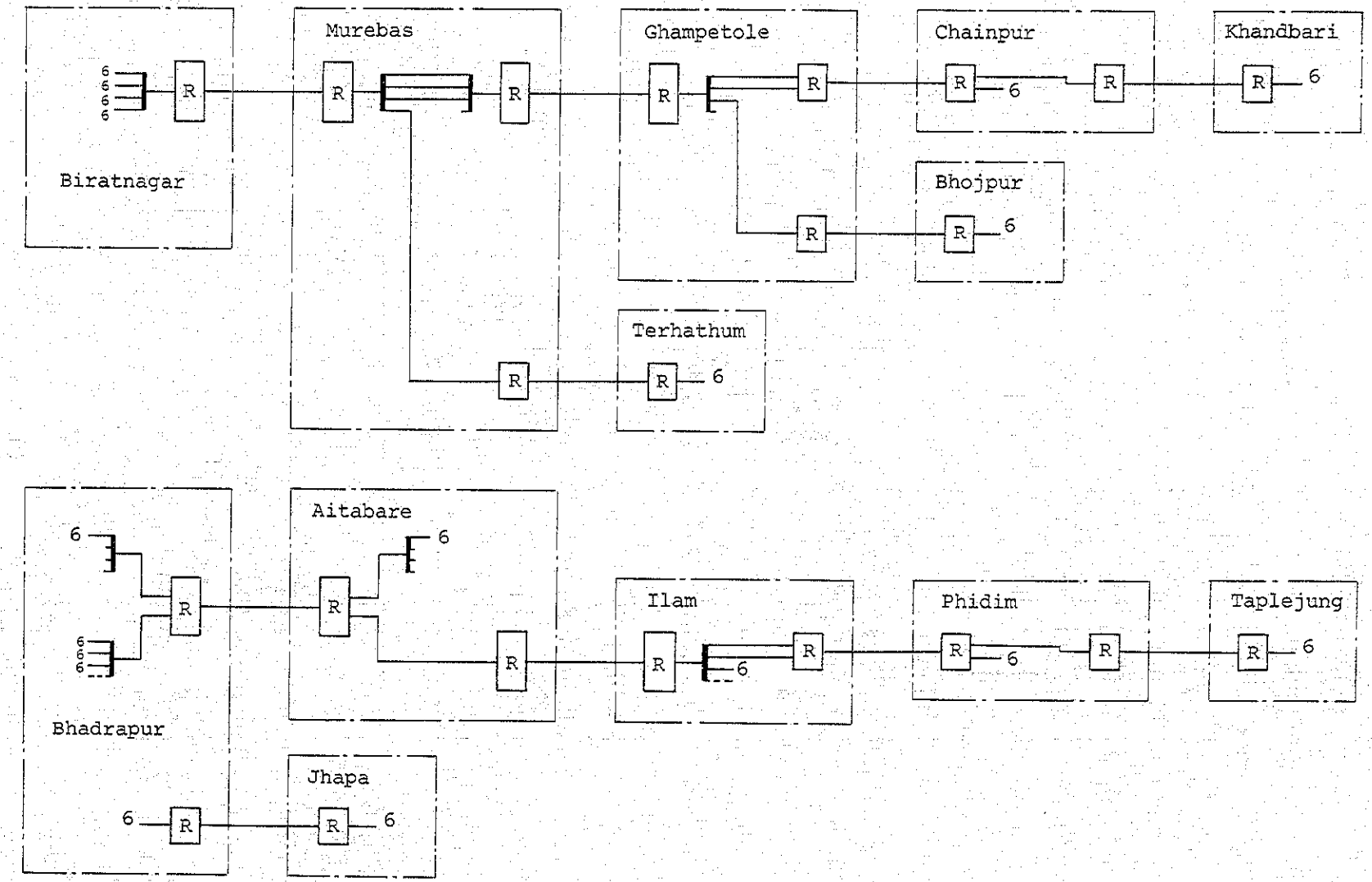


Figure 5-1-4 (3/11) Channel Accommodation Plan at Initial Stage (02 Area)

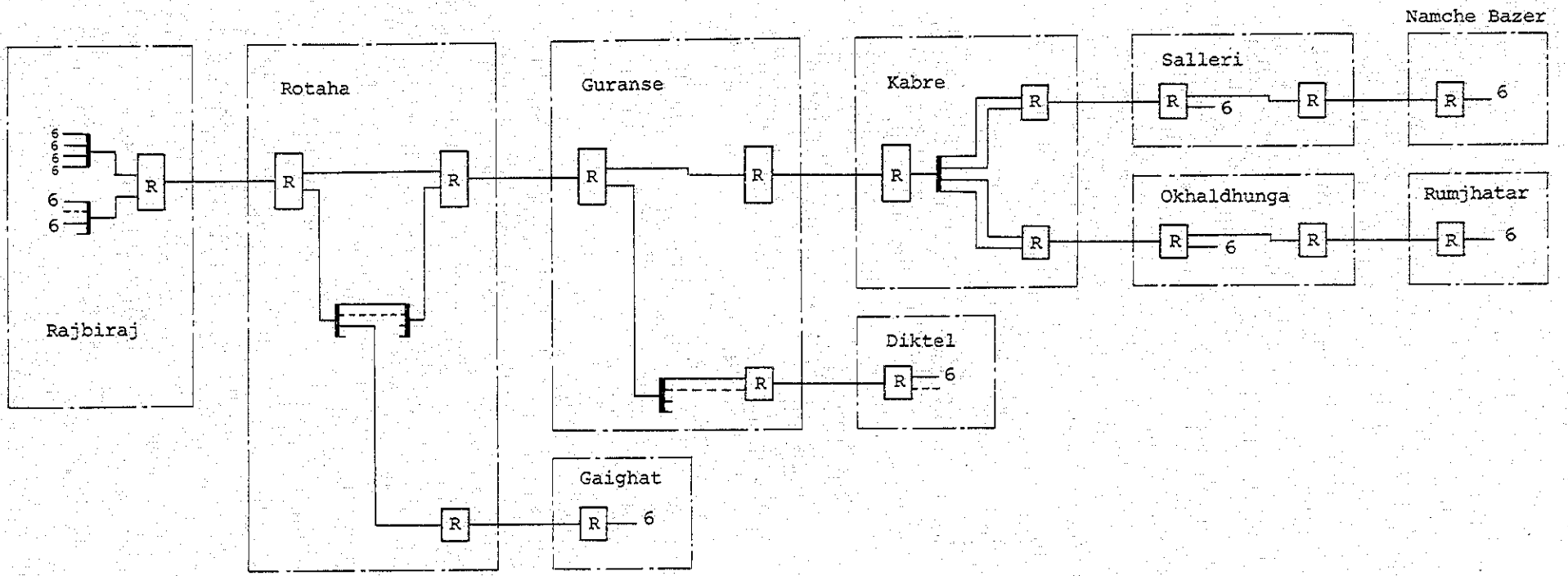


Figure 5-1-4 (4/11) Channel Accommodation Plan at Initial Stage (03 Area)

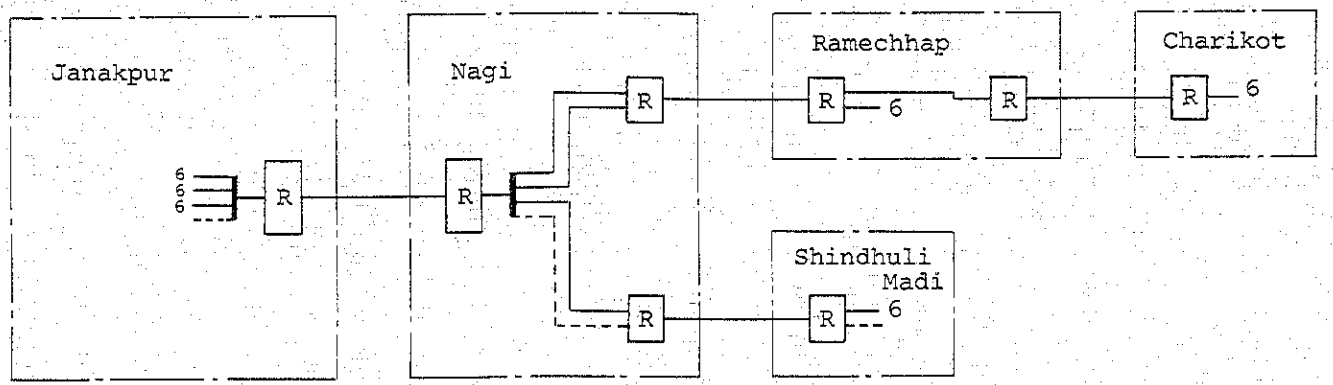
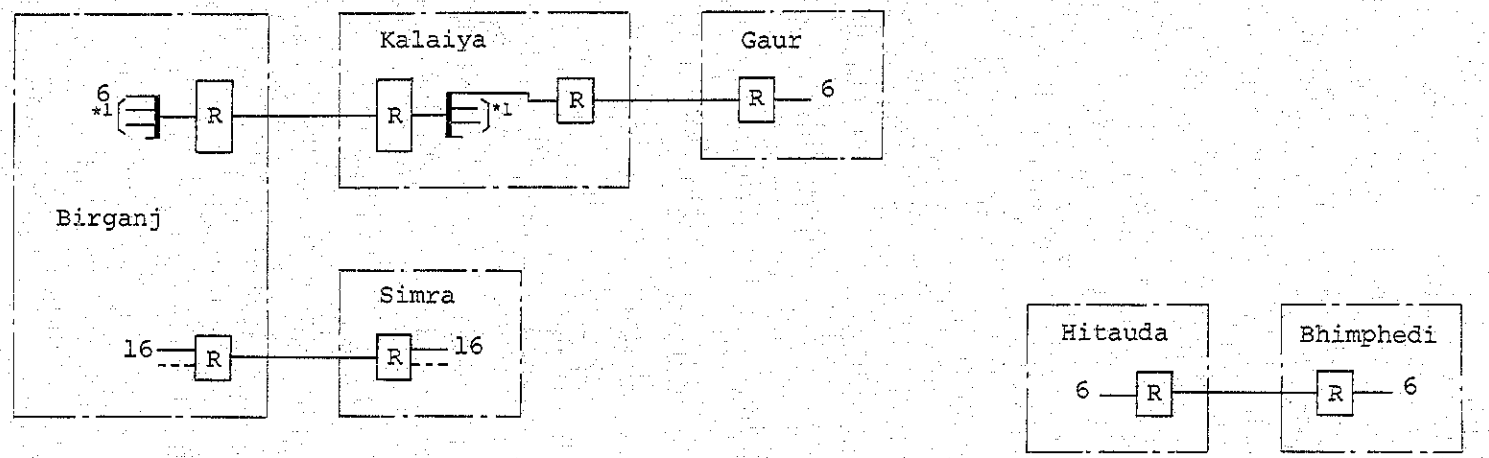


Figure 5-1-4 (5/11) Channel Accommodation Plan at Initial Stage (04 Area)



*1: Digital interface on 2 Mbit/s basis

Figure 5-1-4 (6/11) Channel Accommodation Plan at Initial Stage (05 Area)

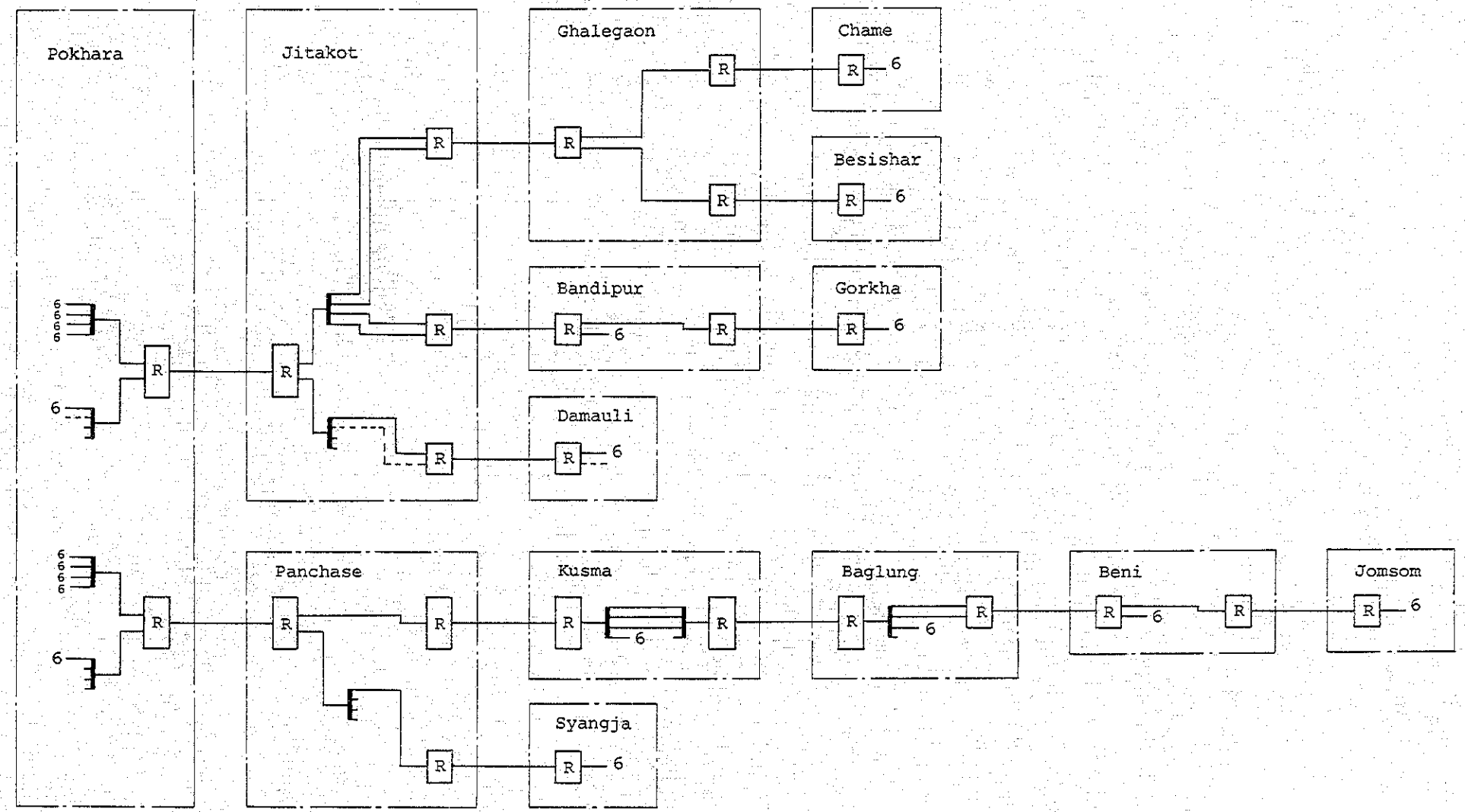


Figure 5-1-4 (7/11) Channel Accommodation Plan at Initial Stage (06 Area)

: Provided by another project

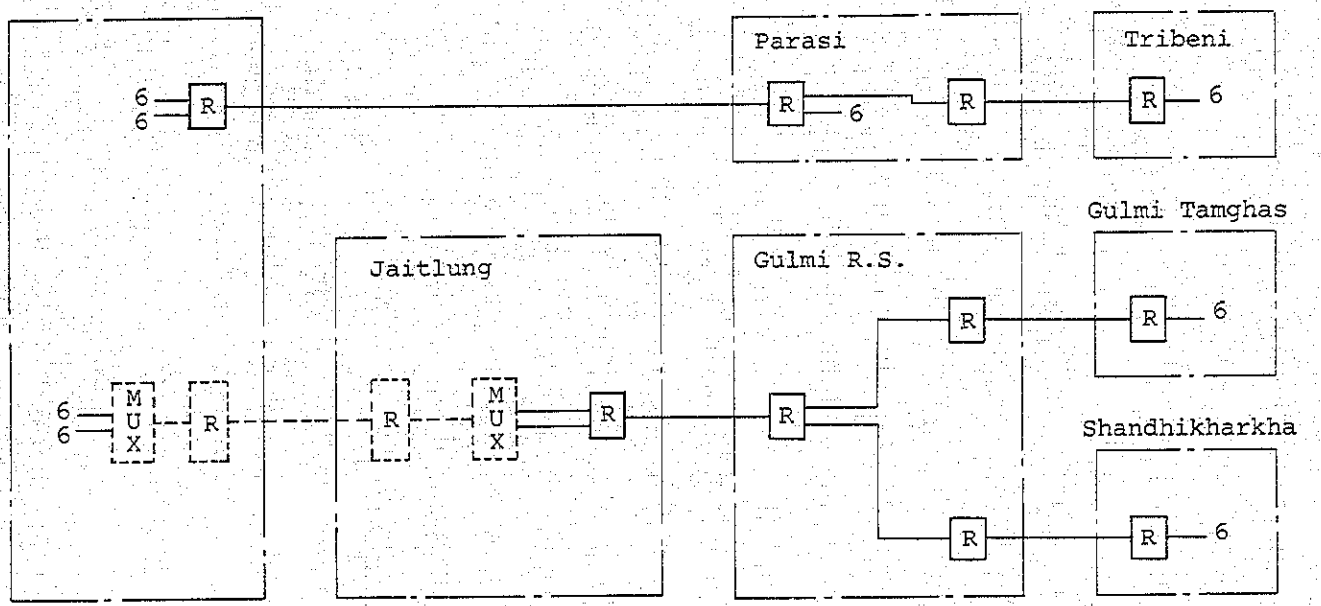


Figure 5-1-4 (8/11) Channel Accommodation Plan at Initial Stage (07 Area)

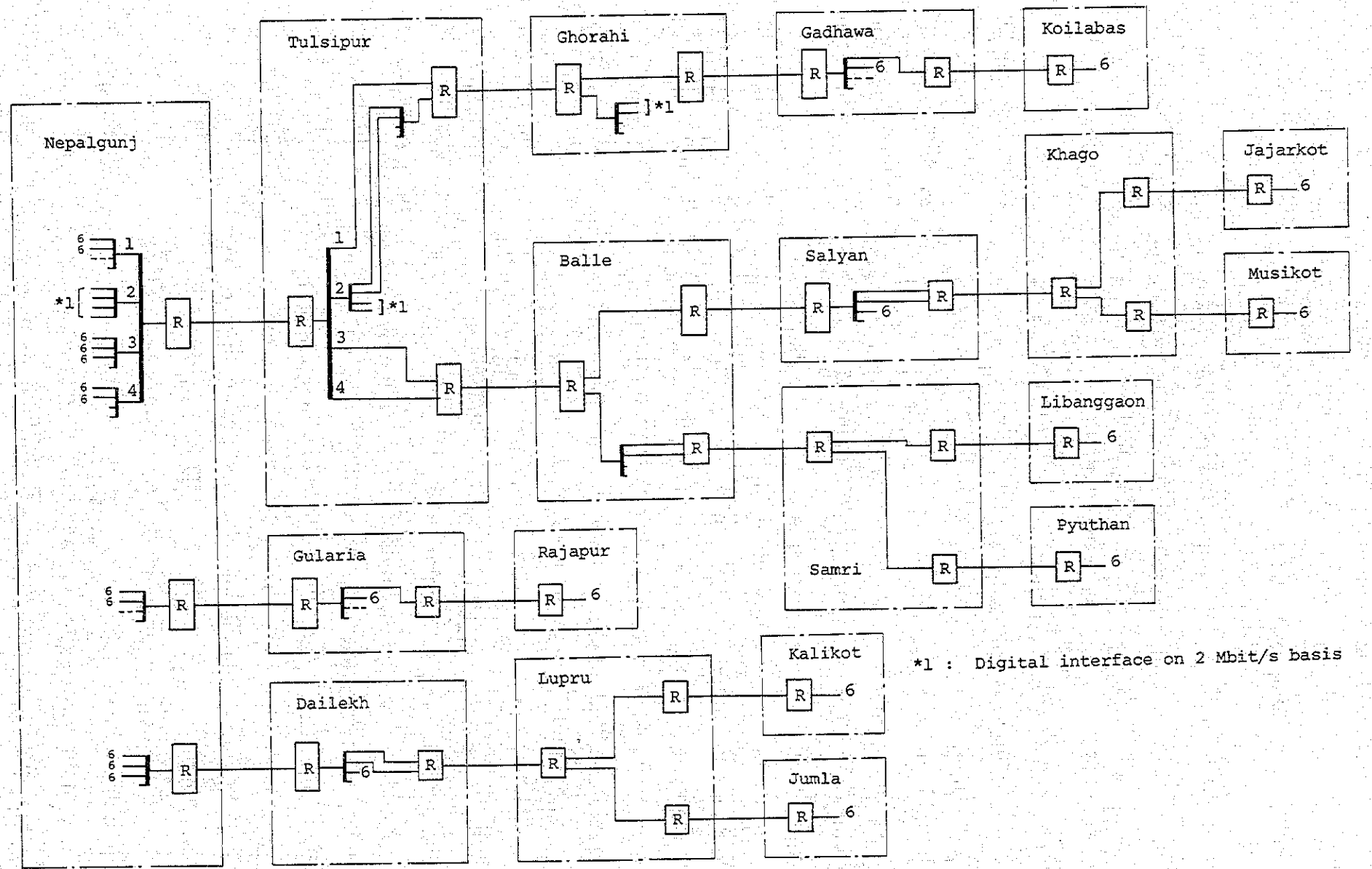
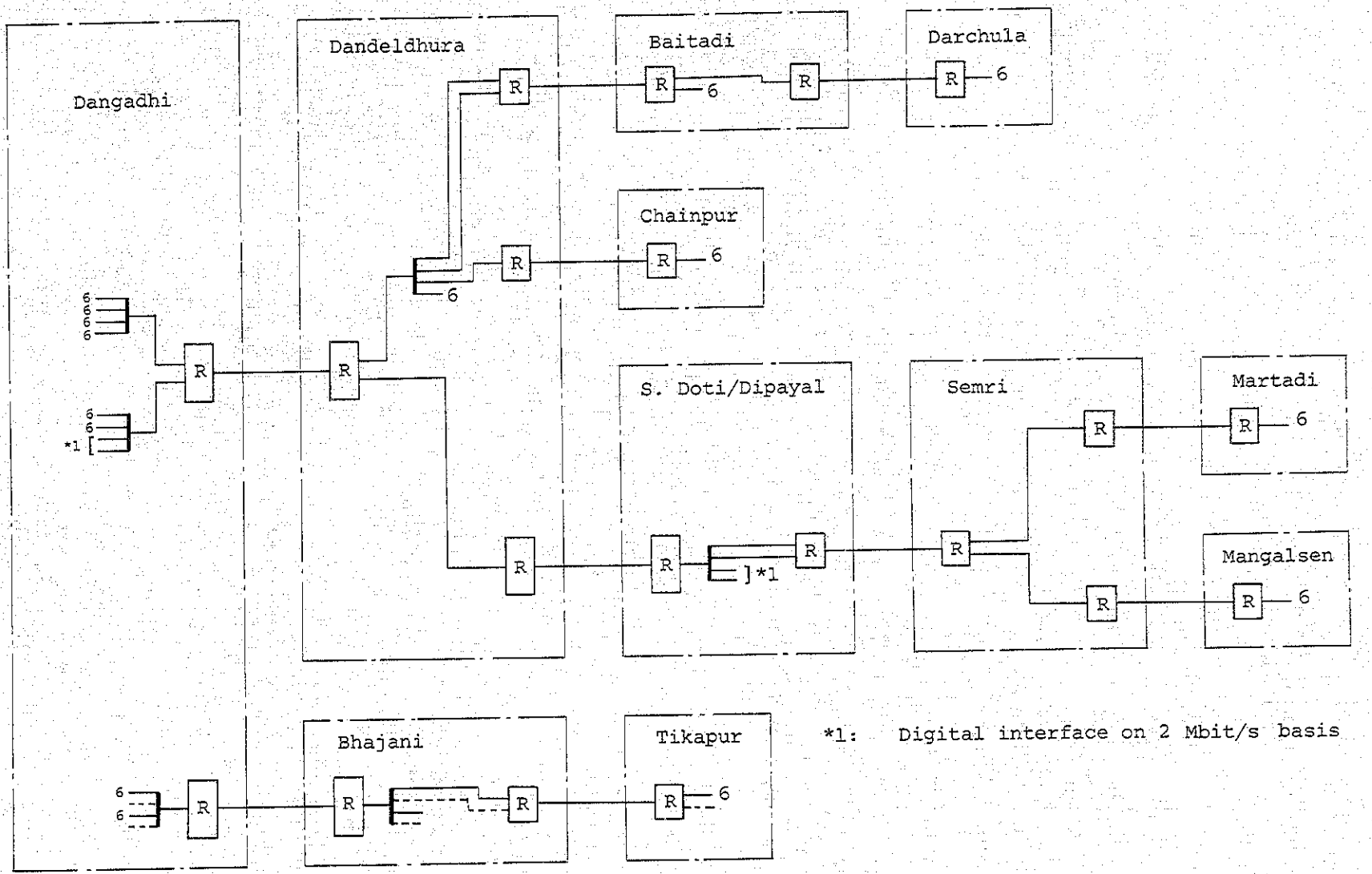


Figure 5-1-4 (9/11) Channel Accommodation Plan at Initial Stage (08 Area)



*1: Digital interface on 2 Mbit/s basis

Figure 5-1-4 (10/11) Channel Accommodation Plan at Initial Stage (09 Area)

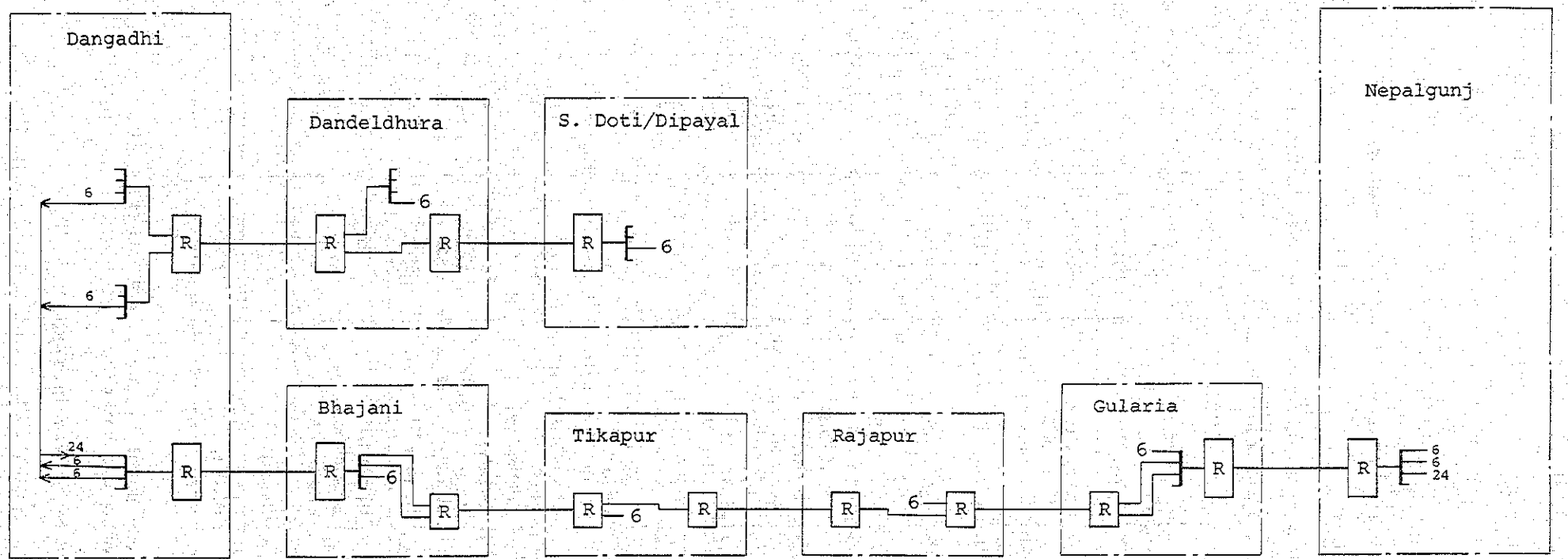


Figure 5-1-4 (11/11) Temporary Channel Accommodation Plan at Initial Stage

Table 5-1-1 (1/11) Antenna Height, Tower Height and Type of Tower by Site

(01 Area)

Item St. Name	Direction to:	Antenna		Tower	
		Diameter (m)	Height (m)	Type	Height (m)
Kathmandu	Nagarkot Kakani	* 1.2	* 20	* Roof top	* 5
Kakani	Kathmandu Sahugaon Thamubhanjyang	1.2 1.2 1.2	10 10 10	Self	17
Sahugaon	Kakani Danga Bidur	1.2 1.2 1.2	10 25 10	Self	27
Bidur	Sahugaon	1.2	15	Pole	17
Danga	Sahugaon Dhunche Zinc Minig Town	1.2 1.2 1.2	10 10 35	Guyed	37
Dhunche	Danga	1.2	15	Pole	17
Zinc Mining Town	Danga	1.2	15	Pole	17
Thamubhanjyang	Kakani Dhading	1.2 1.2	10 10	Self	12
Dhading	Thamubhanjyang	1.2	15	Pole	17
Nagarkot	Kathmandu Helambu Maihar	* 1.2 1.2	* 15 15	To be provided by the other project	
Helambu	Magarkot	1.2	15	Pole	17
Maihar	Nagarkot Panchkhal Chautara	1.2 1.2 1.2	10 10 10	Self	17
Panchkhal	Maihar	1.2	15	Pole	17
Chautara	Maihar	1.2	15	Pole	17

Note: The antenna tower height is determined taking into account the antenna mounting position.

* Covered by another project

Table 5-1-1 (2/11) Antenna Height, Tower Height and Type of Tower by Site

(02 Area)

Item / St. Name	Direction to:	Antenna		Tower	
		Diameter (m)	Height (m)	Type	Height (m)
Biratnagar	Murebas	2.4	30	(Existing)	
Murebas	Biratnagar Terhathum Ghampetole	2.4 1.2 1.2	15 10 10	Self	17
Terhathum	Murebas	1.2	15	Pole	17
Ghampetole	Murebas Ramche Bhojpur	1.2 1.2 1.2	10 10 10	Self	17
Bhojpur	Ghampetole	1.2	15	Pole	17
Ramche	Ghampetole Chainpur	1.2 1.2	10 10	Self	12
Chainpur	Ramche Khandbari	1.2 1.2	15 15	Self	17
Khandbari	Chainpur	1.2	15	Pole	17
Jhapa	Bhadrapur	1.8	40	Guyed	42
Bhadrapur	Jhapa Aitabare	1.8 2.4	40 30	(Existing)	
Aitabare	Bhadrapur Ilam	2.4 1.2	10 10	Self	17
Ilam	Aitabare Chhintapu	1.2 1.2	10 15	Self	17
Chhintapu	Ilam Phidim	1.2 1.2	10 10	Self	12
Phidim	Chhintapu Taplejung	1.2 1.2	20 15	Self	22
Taplejung	Phidim	1.2	15	Pole	17

Table 5-1-1 (3/11) Antenna Height, Tower Height and Type of Tower by Site

(03 Area)

Item / St. Name	Direction to:	Antenna		Tower	
		Diameter (m)	Height (m)	Type	Height (m)
Rajbiraj	Rotaha	2.4	30	(Existing)	
Rotaha	Rajbiraj Guranse Gaighat	2.4 1.8 1.2	10 10 10	Self	17
Gaighat	Rotaha	1.2	15	Pole	17
Guaranse	Rotaha Diktel Kabre	1.8 1.2 1.2	10 10 10	Self	17
Diktel	Guranse	1.2	15	Pole	17
Kabre	Guranse Jantra Khani Okhaldhunga	1.2 1.2 1.2	10 10 10	Self	17
Okhaldhunga	Kabre Rumjhatar	1.2 1.2	15 15	Self	17
Rumjhatar	Okhaldhunga	1.2	15	Pole	17
Jantra Khani	Kabre Salleri	1.2 1.2	10 10	Self	12
Salleri	Jantra Khani Satung	1.2 1.2	15 20	Self	22
Satung	Salleri Jubing	1.2 1.2	10 10	Self	12
Jubing	Satung Namche Bazar	1.2 1.2	10 25	Self	27
Namche Bazar	Jubing	1.2	20	Pole	22

Table 5-1-1 (4/11) Antenna Height, Tower Height and Type of Tower by Site

(04 Area)

Item / St. Name	Direction to:	Antenna		Tower	
		Diameter (m)	Height (m)	Type	Height (m)
Janakpur	Nagi	3.3	30	(Existing)	
Nagi	Janakpur Sindhuli Madi Ramechhap	3.3 1.2 1.2	10 10 10	Self	17
Sindhuli Madi	Nagi	1.2	15	Pole	17
Ramechhap	Nagi Charikot	1.2 4.0	15 15	Self	17
Charikot	Ramechhap	4.0	15	Pole	17

(05 Area)

Birganj	Simra Kalaiya	1.8 1.2	30 35	(Existing)	
Simra	Birganj	1.2	30	Guyed	32
Kalaiya	Birganj Gaur	1.2 4.0	35 75	Guyed	77
Gaur	Kalaiya	4.0	75	Guyed	77
Hitauda	Shimbhanjyang	1.2	10	(on roof)	
Shimbhanjyang	Hitauda Basanti	1.2 1.2	10 35	Guyed	37
Basanti	Shimbhanjyang Bhimphedi	1.2 1.2	10 10	Self	12
Bhimphedi	Basanti	1.2	15	Pole	17

Table 5-1-1 (5/11) Antenna Height, Tower Height and Type of Tower by Site

(06 Area 1/2)

Item / St. Name	Direction to:	Antenna		Tower	
		Diameter (m)	Height (m)	Type	Height (m)
Pokhara	Panchase Marjyankot	1.2 1.2	15 15	Self	17
Panchase	Pokhara Syangja Kusma	1.2 1.2 1.2	10 10 10	Self	17
Syangja	Panchase	1.2	15	Pole	17
Kusma	Panchase Baglung	1.2 1.2	15 25	Self	27
Baglung	Kusma Salyan	1.2 1.2	25 15	Self	27
Salyan	Baglung Beni	1.2 1.2	15 10	Self	17
Beni	Salyan Rakhu	1.2 1.2	20 15	Self	22
Rakhu	Beni Topang	1.2 1.2	10 10	Self	12
Topang	Rakhu Dhampugaon	1.2 1.2	10 10	Self	12
Dhampugaon	Topang Dhumpha	1.2 1.2	10 10	Self	12
Dhumpha	Dhampugaon Jomsom	1.2 1.2	10 10	Self	12
Jomsom	Dhumpha	1.2	15	Pole	17
Marjyangkot	Pokhara Jitakot	1.2 1.2	10 10	Self	12
Jitakot	Marjyangkot Ghalegaon Bandipur Sankhar	1.2 1.2 1.2 1.2	10 10 10 10	Self	17

Table 5-1-1 (6/11) Antenna Height, Tower Height and Type of Tower by Site

(06 Area 2/2)

Item / St. Name	Direction to:	Antenna		Tower	
		Diameter (m)	Height (m)	Type	Height (m)
Sankhar	Jitakot Damauli	1.2 1.2	10 10	Self	12
Damauli	Sankhar	1.2	15	Pole	17
Bandipur	Jitakot Gorkha	1.2 1.2	15 15	Self	17
Gorkha	Bandipur	1.2	15	Pole	17
Ghalegaon	Jitakot Besishar Chhiju	1.2 1.2 1.2	10 10 10	Self	17
Besishar	Ghalegaon	1.2	15	Pole	17
Chhiju	Ghalegaon Thonje	1.2 1.2	10 10	Self	12
Thonje	Chhiju Bagarchhap	1.2 1.2	10 10	Self	12
Bagarchhap	Thonje Chame	1.2 1.2	10 10	Self	12
Chame	Bagarchhap	1.2	15	Pole	17

Table 5-1-1 (7/11) Antenna Height, Tower Height and Type of Tower by Site

(07 Area)

Item / St. Name	Direction to:	Antenna		Tower	
		Diameter (m)	Height (m)	Type	Height (m)
Bhairawa	Parasi Jaitlung	1.8 *	20 *	(Existing)	
Jaitlung	Bhairawa Gulmi R.S.	* 1.8	* 10	* Self	* 12
Gulmi R.S.	Jaitlung Gulmi Tamghas Shandhikharkha	1.8 1.2 1.2	10 10 10	Self	17
Gulmi Tamghas	Gulmi R.S.	1.2	15	Pole	17
Shandhikharkha	Gulmi R.S.	1.2	15	Pole	17
Parasi	Bhairawa Tribeni	1.8 1.8	95 55	Guyed	97
Tribeni	Parasi	1.8	50	Guyed	52

Note: * Covered by another project

Table 5-1-1 (8/11) Antenna Height, Tower Height and Type of Tower by Site

(08 Area 1/2)

Item / St. Name	Direction to:	Antenna		Tower	
		Diameter (m)	Height (m)	Type	Height (m)
Nepalgunj	Gularia Chamere Rajhakot	2.4 1.8 4.0	35 30 30	Self	37
Gularia	Nepalgunj Rajapur	2.4 3.0	45 70	Guyed	72
Rajapur	Gularia (Tikapur)	3.0 1.2	65 40	Guyed	67
Chamere	Nepalgunj Ramimatta	2.4 1.8	10 10	Self	17
Ramimatta	Chamere Dailekh	1.8 1.2	10 10	Self	12
Dailekh	Ramimatta Mabu Peak	1.2 1.2	15 15	Self	17
Mabu Peak	Dailekh Lupru	1.2 1.2	30 20	Guyed	32
Lupru	Mabu Peak Kalikot Ghonhore	1.2 1.2 1.2	10 10 10	Self	17
Kalikot	Lupru	1.2	15	Pole	17
Ghonhore	Lupru Malabhir	1.2 1.8	10 30	Guyed	32
Malabhir	Ghonhore Jumla	1.2 1.2	10 20	Self	22
Jumla	Malabhir	1.2	15	Pole	17
Rajhakot	Nepalgunj Tulsipur	4.0 1.2	10 10	Self	17
Tulsipur	Rajhakot Ghorahi Balle	1.2 1.8 1.2	20 30 20	Guyed	32

Table 5-1-1 (9/11) Antenna Height, Tower Height and Type of Tower by Site

(08 Area 2/2)

Item / St. Name	Direction to:	Antenna		Tower	
		Diameter (m)	Height (m)	Type	Height (m)
Ghorahi	Tulsipur Chaupatta	1.8 1.2	50 30	Guyed	52
Chaupatta	Ghorahi Gadhawa	1.2 1.2	10 10	Self	12
Gadhawa	Chaupatta R.S. (2400F)	1.2 1.2	20 20	Self	22
R.S. (2400F)	Gadhawa Koilabas	1.2 1.2	10 20	Self	22
Koilabas	R.S. (2400F)	1.2	20	Pole	22
Balle	Tulsipur Salyan Samri	1.2 1.2 1.2	10 10 10	Self	17
Salyan	Balle Kumar	1.2 1.2	15 15	Self	17
Kumar	Salyan Khago	1.2 1.2	10 10	Self	12
Khago	Kumar Jajarkot Musikot	1.2 1.2 1.2	10 10 10	Self	17
Jajarkot	Khago	1.2	15	Pole	17
Musikot	Khago	1.2	15	Pole	17
Samri	Balle Pyuthan Dharban	1.2 1.8 1.2	10 10 10	Self	17
Pyuthan	Samri	1.8	15	Pole	17
Dharban	Samri Libanggaon	1.2 1.2	10 30	Guyed	32
Libanggaon	Dharban	1.2	15	Pole	17

Table 5-1-1 (10/11) Antenna Height, Tower Height and Type of Tower by Site

(09 Area 1/2)

Item / St. Name	Direction to:	Antenna		Tower	
		Diameter (m)	Height (m)	Type	Height (m)
Dangadhi	Bhajani Buretola	4.0 1.8	70 30	Guyed	72
Buretola	Dangadhi Kaphali	1.8 1.8	10 10	Self	17
Kaphali	Buretola Dandeldhura	1.8 1.2	10 10	Self	12
Dandeldhura	Kaphali Dhanga Kado S.Doti	1.2 1.8 1.8 1.8	15 65 15 15	Self	67
Dhanga	Dandeldhura Baitadi	1.8 1.2	10 10	Self	12
Baitadi	Dhanga Balchkharka	1.2 1.8	15 15	Self	17
Balchkharka	Baitadi Darchula	1.8 1.2	25 30	Guyed	32
Darchula	Balchkharka	1.2	15	Pole	17
Kado	Dandeldhura Panikha	1.8 1.2	10 10	Self	12
Panikha	Kado Chainpur	1.2 1.2	10 10	Self	12
Chainpur	Panikha	1.2	15	Pole	17
S. Doti	Dandeldhura Semri	1.8 1.2	15 15	Self	17
Semri	S. Doti Mangalsen Martadi	1.2 1.2 2.4	10 10 10	Self	17
Mangalsen	Semri	1.2	15	Pole	17
Martadi	Semri	2.4	15	Pole	17

Table 5-1-1 (11/11) Antenna Height, Tower Height and Type of Tower by Site

(09 Area 2/2)

Item / St. Name	Direction to:	Antenna		Tower	
		Diameter (m)	Height (m)	Type	Height (m)
Bhajani	Dangadhi Tikapur	3.0 1.8	70 50	Guyed	72
Tikapur	Bhajani (Rajapur)	1.8 1.2	40 40	Guyed	42

5-2 Telephone Switching Facilities

5-2-1 Sites Where to Introduce Facilities and Installation Capacity

As stated in Chapter IV, sites where to introduce telephone switching facilities and installation capacities at initial and final stages are as under:

Site	Initial Stage Capacity	Final Stage Capacity
Tulsipur	250 line units	500 line units
Ghorahi	250 "	500 "
S. Doti	350 "	500 "

5-2-2 Type of Facilities and Control System

Switching facilities to be introduced are of digital type (Refer to Chapter III.) For control system, the small stand-alone system is to be adopted.

Both Tulsipur and Ghorahi are located in Dang basin and the distance between them is short so that the control system for them may well be the remote control system wherein either of them controls the switching function of the other.

Generally, however, the remote control system cannot prove its economic merit unless the combined total of line units of both the controlling and controlled exchanges is approximately 3,000 or more. Therefore, it is not to be introduced, this time.

5-2-3 Basic Requirements for Facilities

With regard to the basic requirements of the switching facilities, the top priority is to be compatible with the operational philosophy of digital telephone network now being planned by NTC. Furthermore, the switching facilities are to be simple in construction and not to cost much.

Basic requirements determined are as under:

(1) Subscriber Circuit Accommodation

To accommodate not only ordinary subscriber circuits but PBX and public telephone circuits also.

(2) Trunk Circuit Accommodation

To accommodate trunk circuits through digital interface with transmission bit rate of 2 M-bit/s.

(3) Routing

To route to the parent exchange all the calls except intra-office calls and part of special number calls (police, fire, emergency and maintenance calls).

(4) Maintenance and Operation

To provide the undermentioned necessary minimum capabilities:

- Subscriber circuit and trunk circuit test
- Switching operation monitoring and test
- Switching facilities fault alarm and fault information indication
- Traffic overload control

- Automatic measurement of traffic volume
- Switching service and charging observation
- Subscriber circuit and trunk circuit status modification
- Offering, circuit holding and re-ringing.

5-2-4 Air-Conditioning Facilities

Ambient temperature and relative humidity required for long term, stable operation of digital switching facilities are generally as under:

Ambient temperature: 18°C - 30°C

Relative humidity : 30% - 65%

Temperature and humidity in Tulsipur, Ghorahi and S. Doti areas where digital switching facilities are to be introduced by the current plan cannot be known precisely because of the lack of detailed statistical data about meteorology. However, when presumed from data available at Kathmandu, they are:

Temperature : (average) 10°C - 30°C

Relative humidity: (average) 30% - 90%

During 2.5 to three months from June to September, i.e., the summer monsoon season, there will frequently continue the days in which the daytime maximum temperature is 45°C in an extreme case and maximum humidity even reaches 100%. Under such high temperature and high humidity environment, the stable operation of facilities cannot be expected. Especially the high humidity is deleterious to insulation, causing the insulating material to inflate and giving rise to rust and mildew. These will degrade the performance of facilities, leading to their malfunctions.

Therefore, in the current plan, air-conditioning facilities are to be introduced at three independent exchanges of Tulsipur, Ghorahi and S. Doti.

5-3 Cable and Outside Plant Facilities

5-3-1 Introduction Plan and Installation Capacity

Cable and outside plant facilities are to be introduced at public call offices, independent exchanges and parent exchanges. Introduction plans and installation capacities are as under.

(1) Public Call Office

In the public call office area, outside plant facilities are to be introduced to connect special subscribers in the area to the public call office. In the initial stage of the plan, such subscribers number four barring exceptions, so that, for outside plant, subscriber distribution (SD) wire is to be used instead of cable. At Bidur and Simra where the number of initial stage subscribers is large, cable and SD wire are to be used exceptionally.

Installation capacities by public call offices, based on the number of initial stage subscribers, are as under:

Public Call Office	Installation Capacity
Bidur (including Trisuli)	For 8 subscribers
Simra	For 15 subscribers
Others (61)	For 4 subscribers/ call office

(2) Independent Exchange

In the independent exchange area, outside plant facilities are to be introduced to connect ordinary subscribers in the area to the independent exchange.

Installation capacity is to be commensurate with switching facilities capacity at the initial stage of the plan. That is to say, at Tulsipur and Ghorahi, installation capacity is for 250 line units each and, at S. Doti, for 350 line units.

(3) Parent Exchange

Some of parent exchanges hold the radio transmission facilities building and the telephone switching facilities building separately constructed. For those parent exchanges, outside plant facilities to connect the two separate buildings (hereafter referred to as inter-office tie cable) are to be introduced.

The inter-office tie cable capacity is to consist of cable pairs commensurate with the capacity of transmission facilities to be introduced at the radio transmission facilities building by the current plan.

Parent exchanges where inter-office tie cable is to be introduced and such tie cable capacity are as under:

Parent Exchange Where to Introduce Tie Cable	Installation Capacity (cable pairs/distance)
Biratnagar	150/350 m
Rajbiraj	200/700 m
Janakpur	150/1,500 m
Birganj	150/400 m
Pokhara	300/50 m

5-3-2 Basic Design

(1) Subscriber Line Loss Distribution and DC Loop Resistance

Subscriber line loss distribution is to be determined, in conformity with the distribution values specified by NTC. That is to say, NTC, in its Basic Plan for the telephone network, specifies the maximum line loss distributed to subscriber line to be 8 dB at a standard and 10 dB in an exceptional case.

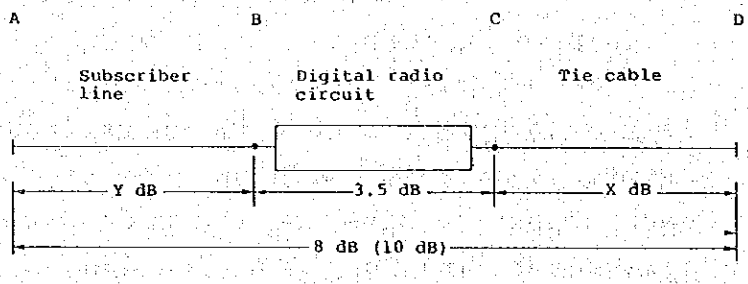
To be noted here is that the public call office subscriber circuit consists of subscriber line, digital radio circuit and (inter-office or intra-office) tie cable. (Refer to the illustration that appears later.) Therefore, the line loss of 8 dB (10 dB) allowable for the whole system (from parent exchange to subscriber terminal of public call office) is to be distributed to the component segments as under.

a) To the digital radio circuit, the minimum line loss of 3.5 dB required for stable circuit performance is to be distributed.

b) To the subscriber line and tie cable, the remaining 4.5 dB (6.5 dB) is to be allocated and distributed between the two.

In the current plant, the tie cable loss ranges between 0.5 dB in the case of the shortest intra-office tie cable and 2.0 dB in the case of longest inter-office tie cable provided that the conductor diameter of inter-office tie cable is 0.65 mm. Therefore, the line loss that can be distributed to subscriber line is 4 dB (6 dB) at a maximum and 2.5 dB (4.5 dB) at a minimum.

Subscriber Circuit Configuration of Public Call Office



A: Subscriber terminal of public call office

B: Distribution frame at public call office

C: Distribution frame for transmission facilities at parent exchange

D: Distribution frame for switching facilities at parent exchange

DC loop resistance of subscriber's line must be kept within a certain limit in order to avoid the malfunction of telephone set and switching facility. However, this limit value varies according to the types of telephone set and switching facility to be installed so that it cannot be determined universally. In the current plan, DC loop resistance is determined as under in consideration of the corresponding values in effect in Japan and many other countries.

a) Subscriber line of public call office: 1,500 ohms

b) Subscriber line of independent exchange: 1,500 ohms

c) Tie cable: 1,200 ohms

(2) Cable Installation and Cable Conductor Diameter

The most part of objective areas of the current plan is still without the improvement of infrastructures. As this improvement makes progress from now forward, land rezoning and housing area rearrangement will follow suit. Thus, for cable installation, the aerial system is to be adopted because this system can respond to those environmental variations with relative ease.

With regard to cable conductor diameters, decision is made as under according to the types of cables adopted. In this decision, the service area of each objective site and the aforementioned subscriber line loss distribution are duly considered.

a) SD wire of public call office:

0.65 mm or 0.9 mm, whichever better suited.

b) Subscriber line of independent exchange:

0.4 mm, 0.5 mm and 0.65 mm, provided that the selection is made by single-gauge arrangement as occasion requires.

c) Inter-office tie cable:

0.65 mm, in order that as much loss value as possible can be distributed to subscriber line of public call office.

For aerial cable, self-supporting type cable is to be adopted, in principle, because the installation work is relatively easy and the maintenance material can also be procured with relative ease. In the section where multi-pair cable, not self-supporting in type, is required, plain cable is to be used as an exception.

(3) Cable Conductor Distribution

For cable conductor distribution, NTC presently uses the fixed distribution method. Therefore, in the current plan also, the fixed distribution method is to be used.

Switching facilities capacity of the three independent exchanges (Tulsipur, Ghorahi and S. Doti) in the current plan is not more than 500 line units even in the final stage, so that the cross-connecting cabinets are not to be introduced.

(4) Environmental Conditions and Counterplans

Main environmental conditions and counterplans considered in the basic design for outside plant facilities are as under.

a) Wind Load

According to meteorological data of 1975, the average maximum wind velocity observed at surface level in Kathmandu in that year was 8.7 m/sec. When the risk of 1% is considered, the maximum wind velocity becomes 16.9 m/sec. In the current plan, this maximum wind velocity plus the difference by area and the required margin, i.e., 20 m/sec., is used as maximum wind velocity whereby to determine the wind load.

b) Protective Measures against Thunder Harm

In Nepal, the days of thunderstorm average 60 days per year.

Measures to be taken to protect inside and outside plant facilities from thunder harm are as under:

- To establish protectors in subscriber premises, public call office and independent exchange buildings.
- To establish on-pole protectors at the points where cable and SD wire are spliced.
- To establish forward protectors in case where the length of SD wire to be connected to cable exceeds 400 m.
- To have cables aluminum tape sheathed and to have aluminum tape grounded at intervals of 500 m.

5-4 Power Supply Facilities

5-4-1 Installation Criteria

Installation criteria for power supply facilities are as under.

(1) For power supply facilities of parent exchanges, except rectifiers and batteries at Janakpur and Birganj, the existing facilities or the facilities to be prepared by NTC separately from the current plan are to be utilized.

(2) Dangadhi and Kalaiya, before they begin to perform as exchanges with switching facilities introduced, are to be temporarily equipped with radio repeater facilities. Power supply facilities to these radio repeaters are to be installed by the current plan.

(3) Power supply facilities of public call offices (except Nagarkot), independent exchanges, and radio repeater stations are to be installed by the current plan.

5-4-2 System Selection

Sites are divided into sites where commercial power supply is available and sites where commercial power supply is not available so that stand-alone power supply system must necessarily be established. Power supply system to be adopted for each category of sites is as under.

(1) Commercial Power Using Site

Power supply systems commonly used at commercial power using sites are threefold. They are alternate charge-discharge system, partial floating system and full floating system, one differing from another in the way of using storage batteries.

Out of these three, full floating system is most commonly adopted as the standard power supply system at commercial power using sites. This is because of the undermentioned advantages of the system.

a) Storage battery capacity can be reduced broadly.

b) Storage battery life can be extended.

c) Maintenance is easy.

d) Power conversion efficiency is high so that system operation cost can be saved.

Therefore, in the current plan also, full floating system is to be adopted for power supply at commercial power using sites. For stand-by system at the time of commercial power failure, diesel engine generator is to be installed.

Sites where full floating system is to be adopted are as under.

- Public Call Offices:

  Bidur, Panchkhal, Phidim, Salleri, Gaur, Bhimphedi, Simra, Baglung, Jomsom, Jumla

- Independent Exchange:

  S. Doti

- Radio Repeater Station:

  Dangadhi, Kalaiya

(2) Stand-alone System Using Site

Stand-alone power supply systems comprise the following:

- Internal combustion engine generator system (mainly using diesel engine generator)
- Solar photovoltaic cell system
- Wind energy conversion system
- Thermoelectric generator (TEG) system

- Fuel cell system
- Hydro power system

In the current plan, internal combustion engine generator system and solar photovoltaic cell system are to be adopted as stand-alone power supply systems. The former is to be used at independent exchanges and the latter at public call offices and radio repeater stations.

The reasons for selection of those two systems are as under.

a) Independent exchange power consumption is around 27 kVA. The technically established and least expensive stand-alone power supply system for a site where power consumption exceeds several kW is the diesel engine generator system.

b) Power consumption at public call offices and radio repeater stations differs from site to site. However, power consumption is less than 350 W. For stand-alone power supply system in such cases of small power consumption, the aforementioned systems can be taken up for study. In the current plan, decision is made to adopt the solar cell system in consideration of the undermentioned facts.

   - In Nepal, areas where stable wind energy fit for the wind energy conversion system is available are extremely few. Likewise, the water resource availability essential for the

hydro power generating system is scarce. Therefore, neither of these systems is desirable because the system standardization, as well as the maintenance and operation standardization, is difficult.

- Engine generator system, TEG system and fuel cell system require fuel supply. In the current plan wherein the objective sites are scattered in remote areas where roads are far from being well developed, such fuel supply is difficult. The three power generating systems mentioned require large capacity fuel tanks also.

- Solar cell system does not require fuel. Although the initial installation cost is high, maintenance cost is relatively low. (According to the present worth of annual cost comparison, the economic utility zone for solar cell system is up to load power of 300 - 500 W.)

- NTC already adopts solar cell system at HF radio stations and radio repeater stations, and is fully confident of solar cell system maintenance and operation efficiency.

5-4-3 Initial Stage Installation Plan

(1) Basic Principles

The basic principles for initial stage installation of power supply facilities are as under.

a) Facilities to be introduced are to be limited to the necessary minimum in order to save the initial installation cost.

b) Solar cell system allows no small cost reduction at the future stage. Furthermore, it can be combined with another stand-alone power generating system to make an economically operating plus stable and reliable system. Therefore, to begin with small capacity facilities and install additional facilities when so required at a later stage will be advisable.

c) In view of the above, power consumption estimates at all objective sites are to be made in the necessary minimum for system operation in the immediate future so as to save power consumption.

(2) Installation Parameters

Installation parameters for initial stage facilities are as under.

a) Commercial Power Using Site

- D.C. supply system: Full floating system
- Stand-by system: By diesel engine generator
- Battery holding time: Three hours

b) Stand-alone Power Using Site

1) Independent Exchange

- Power generating system: Dual prime mover system by diesel engine
- D.C. supply system: Full floating system
- Battery holding time: Three hours
- One mobile engine generator commonly used at Tulsipur and Ghorahi.

2) Public Call Office and Radio Repeater Station

- Power generating system: Solar cell system (to be designed by solar radiation energy: 320 langlay/day and sunshine hours: 5 hours/day)
- D.C. supply system: Floating system
- Battery holding time: 15 days

5-5 Terminal Facilities

Terminal facilities (telephone and facsimile terminals) to be introduced by the current plan are as under.

5-5-1 Telephone Set

(1) Selection of Type

NTC, in its third telecommunication development programme, decided to adopt the push button dialling telephone sets as the standard type to replace the conventional rotary dialling telephone sets.

In accordance with such decision of NTC, telephone sets to be newly introduced by the current plan are to be the push button dialling telephone sets.

(2) Installation Plan

a) Telephone Sets at Public Call Office

At public call offices, three kinds of telephone sets, i.e., telephone set for public call operator, telephone set for caller and telephone set for telegram service are to be installed. The first one is with the call meter

and can indicate the number of tariff unit(s) or the call duration by the signal transmitted from the parent exchange. The second one is a telephone set for speech, without the push button dialling function. The third one is the standard type with push button dial.

b) Telephone Sets for Ordinary Subscribers

At the ordinary subscriber premises in public call office and independent exchange service areas, the standard type push button dialling telephone sets are to be installed.

c) Public Call Telephone Sets at Independent Exchange

At independent exchanges, the same kinds of public call telephone sets as at public call offices, i.e., telephone with call meter and telephone for speech, are to be installed.

(3) Initial Stage Installation

Initial stage installation by sites and by types of telephones are as under.

Site	Telephone with Call Meter	Telephone for Speech	Ordinary Subscriber Telephone	Telephone for Telegram Service
Public call office	63	63	*267	63
Independent exchange	3	3	**850	-
Total	66	66	1,117	63

* Bidur, 8; Simra, 15; 61 others, 244 (4 each)

** Tulsipur, 250; Ghorahi, 250; S.Doti, 350.

5-5-2 Facsimile Terminal

(1) Type

As stated in Chapter IV, the type of facsimile terminal to be introduced is CCITT recommended G-II.

Facsimile terminal is divided into two categories. One is the combined type provided with both sending and receiving functions. The other is the separate type provided with sending and receiving functions, separately. In the current plan, the former, i.e., the combined type is to be introduced. The reasons are as under.

a) The separate type is of higher cost than the combined type. Power consumption is also greater.

b) The most part of facsimile terminal manufactured and utilized in many countries is the combined type.
Demand for the separate type is small so that cost reduction is a slim possibility.

c) Service life of facsimile terminal is 5-6 years. For the immediate future, the combined type can serve the purpose. When its service life terminates, it can be replaced with the separate type at the sites where traffic congests. This arrangement is more advisable than installing and operating the separate type from the outset.

(2) Basic Functions

Facsimile service is restricted to telegraphic message service and document transmission service so that the terminal is to be provided with basic functions in the necessary minimum for the said two service categories. This arrangement is intended to save installation cost also.

The basic functions required are as under.

- Automatic receiving function
- Function to send a plural number of texts continuously
- Function to indicate equipment trouble

For the receiver scanning method, the thermal printing method that outperforms other methods is to be adopted.

(3) Initial Stage Installation

Initial stage installations by sites are as under. (Refer to Chapter IV.)

Independent exchanges	3 sets (1 set/exchange)
Parent exchanges (excluding Kathmandu)	20 sets (2 set/exchange)
Kathmandu	4 sets
Total	27 sets

Facsimile terminal is to have telephone sets attached. The telephone set is to be the standard type with push button dial.

5-6 Building Facilities

Building facilities criteria in the current plan are as under.

(1) Public call office (except Nagarkot), independent exchange and repeater buildings (including Dangadhi and Kalaiya) are to be newly established.

(2) For parent exchange buildings, either the existing available buildings or those to be constructed separately by NTC are to be utilized.

(3) All buildings to be newly constructed under this current plan are to be the prefabricated type that can be constructed easily and in a short period.

(4) Prefabricated type buildings are to be as small sized as possible and be the kind that can be assembled at the field. This is because of the road situation in the objective areas, or, more precisely, because the sites accessible by car are the independent exchange sites and part of public call office sites, and access to all other sites must be by cattle or by manpower.

(5) Besides the fact that buildings are to be small sized, cost of construction must also be economized. For this reason, auxiliary equipments, such as batteries and engines, are to be accommodated in an ad hoc structure of simple build, separately from the main equipment.

The typical site layout plan for public call offices, independent exchanges and repeaters, as well as the floor layout plan of main equipment building, based on the foregoing building facilities criteria appear in Figure 5-6-1 and Figure 5-6-2, respectively.

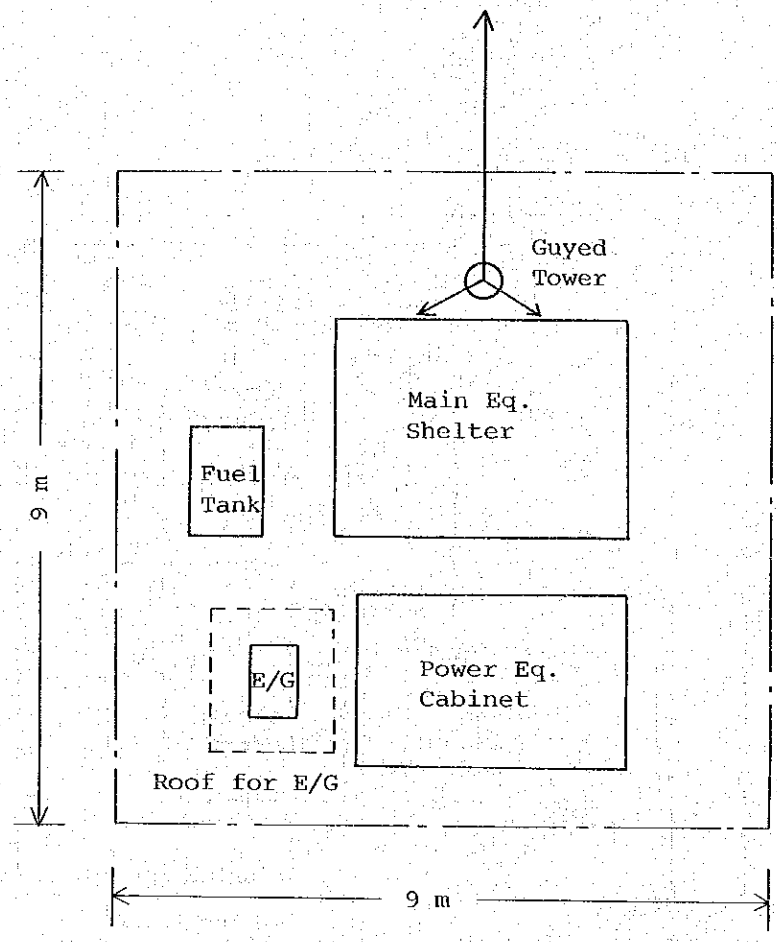


Figure 5-6-1 (1/5) Typical Site Layout Plan for PCO with Commercial Power Supply System and Guyed Antenna Tower

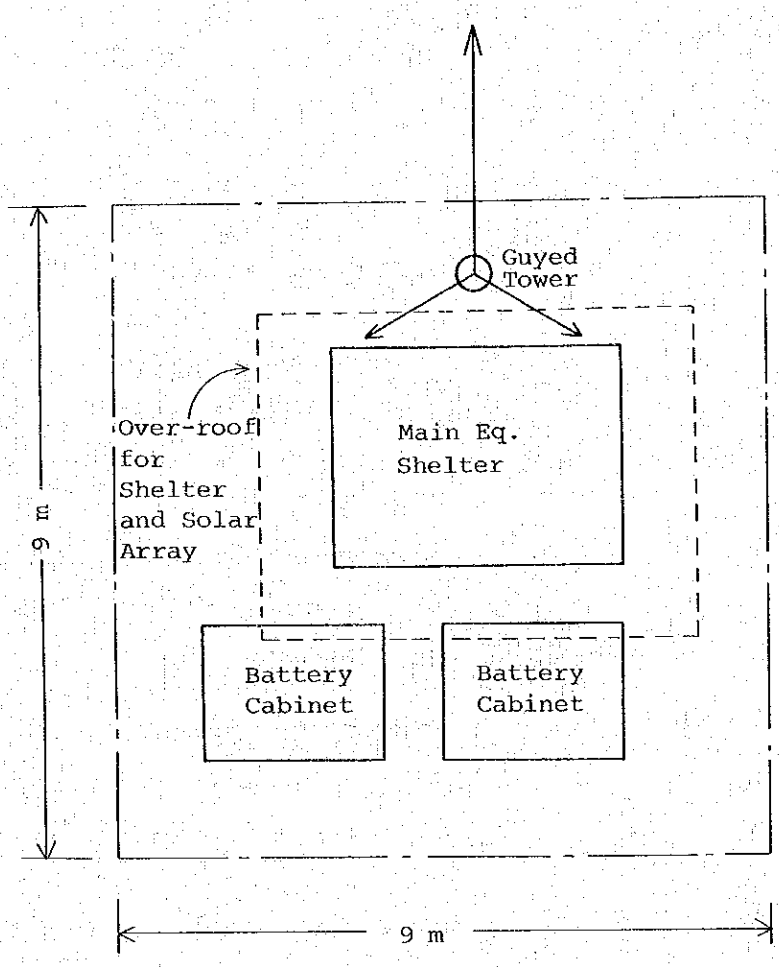


Figure 5-6-1 (2/5) Typical Site Layout Plan for PCO with Solar Power System and Guyed Antenna Tower

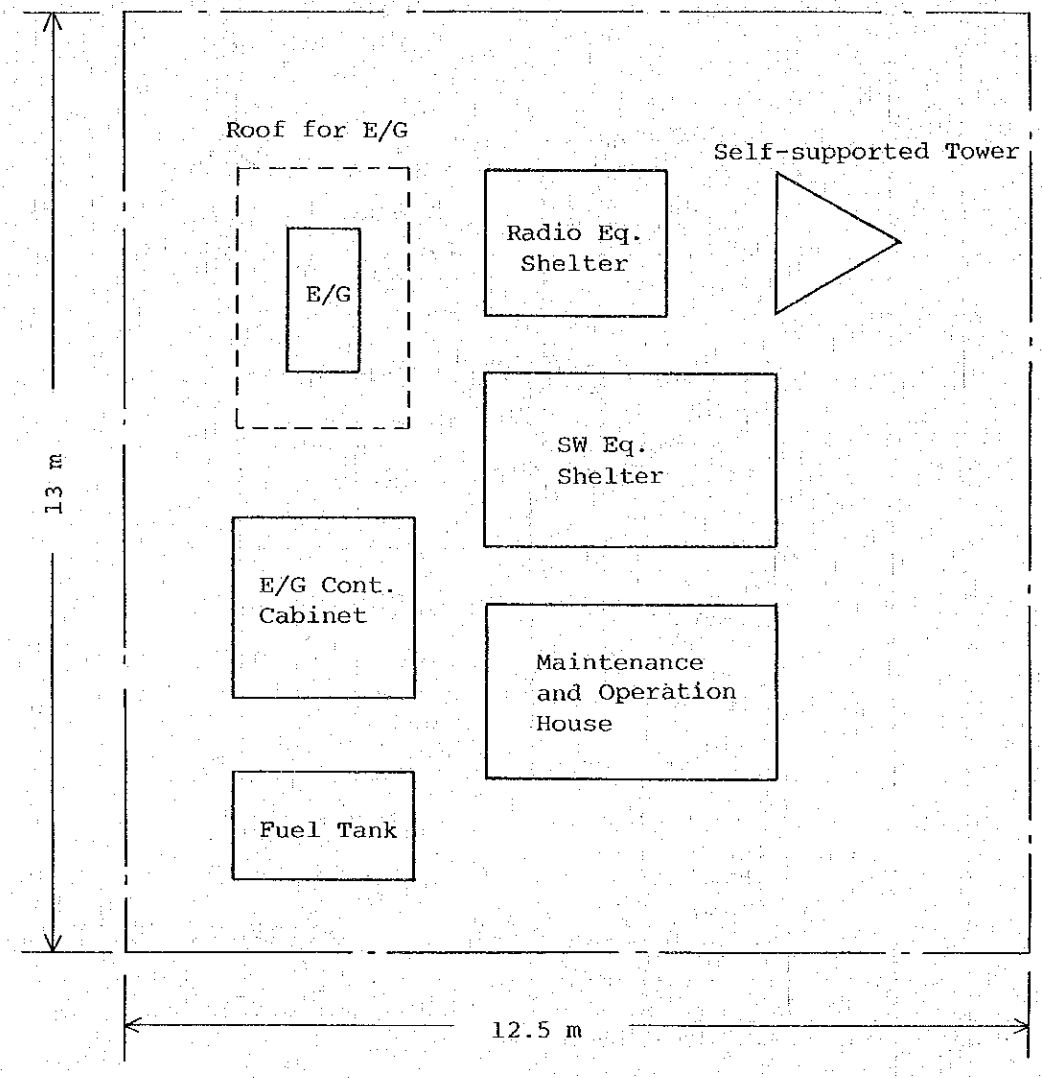


Figure 5-6-1 (3/5) Typical Site Layout Plan for Exchange with Commercial Power Supply System and Self-supported Antenna Tower

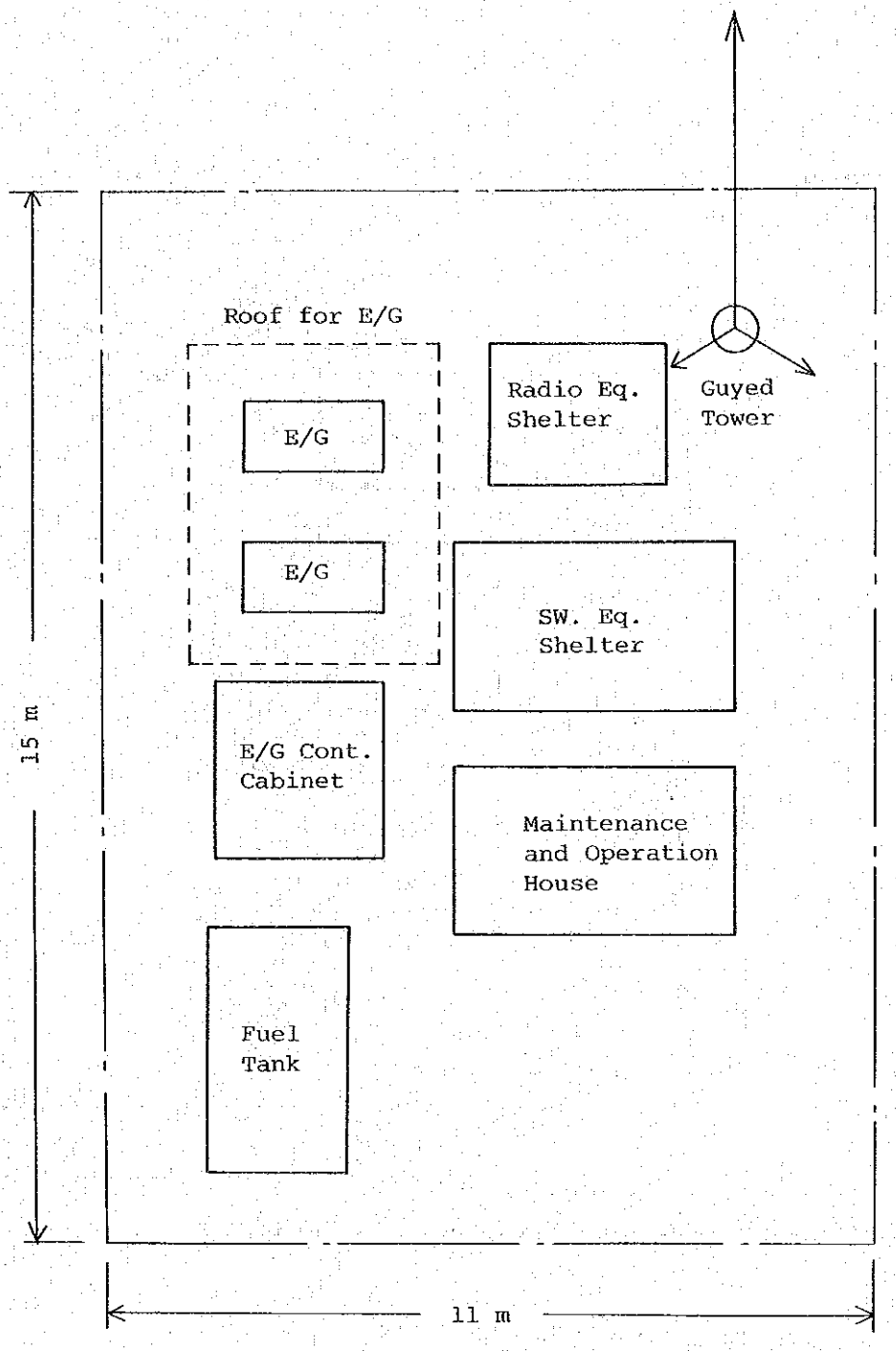


Figure 5-6-1 (4/5) Typical Site Layout Plan for Self-Powered Exchange with Guyde Antenna Tower

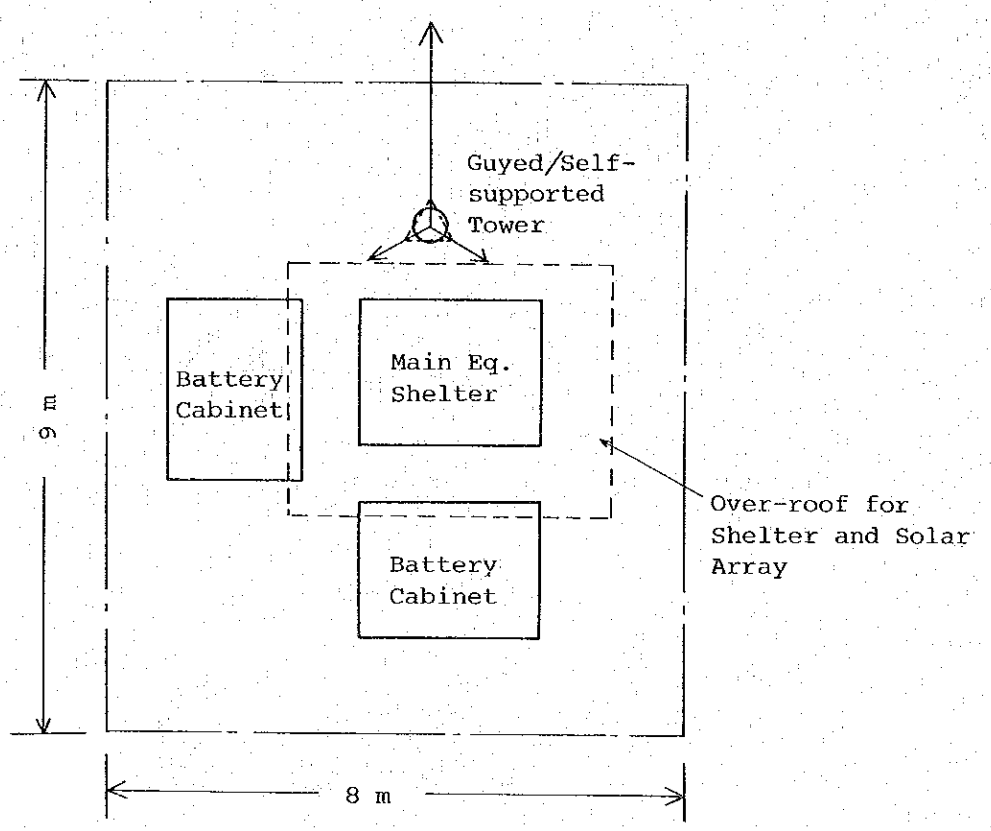
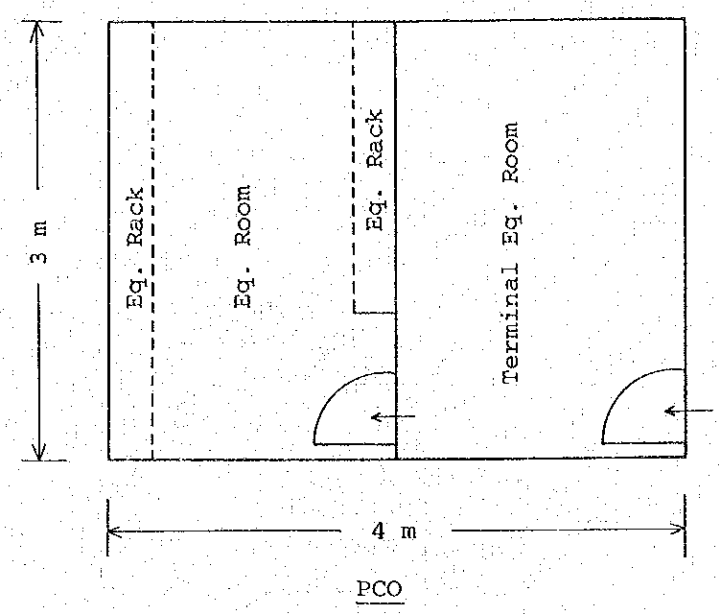
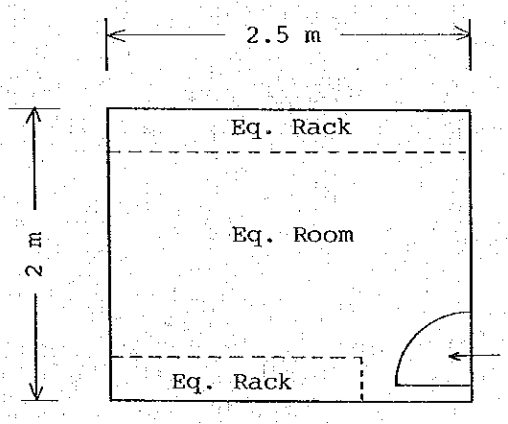


Figure 5-6-1 (5/5) Typical Site Layout Plan for Repeater Station with Solar Power System and Guyed/self-supported Antenna Tower



PCO



Repeater Station

Figure 5-6-2 Floor Layout Plan for Main Equipment Shelter

VI. MAINTENANCE AND OPERATION

VI. MAINTENANCE AND OPERATION

6-1 Scope of Work

The scope of maintenance and operation work is generally as under.

(1) Maintenance Work

a) Preventive Maintenance

Preventive maintenance includes tests, inspections, maintenance itinerary and adjustment.

b) Corrective Maintenance

Corrective maintenance includes trouble-shooting, repairs and normalization.

c) Facilities Management

Facilities management includes inventory management and plant record keeping.

(2) Operation Work

a) Facilities Operation

Facilities operation includes operation, supervision and control of facilities.

b) System Management

System management includes system operation control in case of abnormal conditions in network.

(3) Collateral Work

a) Personnel Management

Personnel management includes manpower planning and duty performance management.

b) Workmanship Management

Workmanship management includes technical training of personnel concerned.

c) Machines/Equipment Management

Machines/equipment management includes keeping machines and equipment, including measuring equipment, and vehicles in good order.

For maintenance and operation of rural telecommunications network to be introduced by the current plan, the rational and effective organization and the necessary personnel must be secured for fulfillment of the foregoing work items. Study and decision for this purpose must be made comprehensively in careful consideration of mutual relationships of all systems including the existing systems and those to be planned and constructed otherwise than by the current plan.

In regard to the maintenance and operation organization and personnel considered to be essential for realization of the current plan, as well as the training program for those personnel, proposals are made as under.

6-2 Proposal for Maintenance and Operation Organization

The proposal concerning the maintenance and operation organization for the rural telecommunications network to be introduced follows:

(1) To establish the maintenance center in each parent exchange, excluding Hitauda.

Each maintenance center is to take care of maintenance of its dependent unattended station facilities (transmission and its associated facilities in public call offices and independent exchanges, and all the facilities in radio repeater stations). Main maintenance items are:

- To supervise and control the whole system in the maintenance area by means of remote supervisory and control system.
- To itinerate unattended stations for inspection.
- To report troubles and extraordinary damage to the central maintenance center (described in the next paragraph) and, in accordance with instructions from the central maintenance center, locate the trouble ridden point and probe into the cause of trouble and, at the same time, take necessary remedial actions.

(2) To establish the central maintenance center in Kathmandu in addition to the maitenance center.

Main duty items of the central maintenance center are:

- To carry out integral periodical tests of the system.
- To keep measuring equipment and maintenance parts in safe custody.
- To keep standard practices and plant records in good order and in safe custody.
- To administer training and education of maintenance and operation personnel.

6-3 Proposal Concerning Personnel and Training

(1) Maintenance and Operation Personnel

a) Public Call Office

Proposal is made to the effect that public call offices are to handle mainly the operation of public telephones and telegram services, and that three personnel are to be assigned to duty at each public call office.

Main duty items are:

- To accept call applications and establish circuits for call connections.
- To collect call tariffs.
- To deliver telegraphic messages to the addressees.
- To perform simple maintenance work, such as cleaning of solar cell panel, in accordance with instructions from the maintenance center concerned.

b) Independent Exchange

Proposal is made to the effect that independent exchanges are to perform the undermentioned maintenance and operation work, and that nine maintenance personnel (five for switching division and four for outside plant division) and three operation personnel are to be assigned to duty at each independent exchange.

- To maintain switching, power supply and outside plant facilities, to perform trouble-shooting and restore the system to normal operation. (Transmission facilities maintenance is by remote supervisory and control from the maintenance center concerned.)

- To itinerate subscriber premises and outside plants for inspection.

- To carry out periodical facilities tests.

- To install new/additional subscriber terminals where necessary.

- To accept trouble complaints and take remedial measures.

- To perform traffic control.

c) Parent Exchange

Proposal is made to the effect that parent exchanges are to be staffed with an average of nine personnel per exchange in order that they can perform functions as maintenance centers successfully.

The breakdown of nine personnel follows:

- Transmission division:	2	persons
- Power supply division:	2	"
- Outside plant and facsimile terminal division:	5	"

The above number of personnel is on the assumption that the itinerant inspection of unattended stations is to be made once every three months, in principle. Since the number of dependent unattended stations differs from one parent exchange to another, the number of personnel given above indicates just the average requirement.

d) Kathmandu

The central maintenance center to be established in Kathmandu is to take care of maintenance of all systems including the existing systems and those to be planned and constructed separately from the current plan. This fact must be duly considered when the required number of personnel is determined. Here, the personnel needed by the current plan only are proposed for the purpose of reference.

Out of the central maintenance center functions previously described, the function having directly to do with the current plan is that to make integral periodical tests of the system. And the tests of this kind must be carried out at least once every year at the parent exchange level. Therefore, the central maintenance center is to be staffed with six personnel, and these six are to be divided into three groups, each composed of two members, so that each such group can undertake the tests.

The foregoing maintenance and operation personnel arrangement can be summarized as under.

Site	Number of Sites	Number of Maintenance Personnel	Number of Operation Personnel
Public Call Offices	63	-	189
Independent Exchanges	3	27	9
Maintenance Centers	10	90	-
Central Maintenance Center	1	6	-
Total		123	198

The breakdown of maintenance personnel by specialty divisions is as under.

Transmission:	*26	persons
Switching:	15	"
Outside plant (including terminal equipment)	62	"
Power suppy:	20	"

Note: Marked with * include six at central maintenance center in Kathmandu.

(2) Training

Training is divided into two categories: maintenance personnel training and operation personnel training. In the current plan, operation personnel are mainly to operate public telephones and facsimile terminals so that they may not need specific technical training. Here, proposal is made concerning the training of maintenance personnel only.

Maintenance personnel training is to be administered before the construction work by the current plan is completed and the maintenance and operation work becomes necessary. The proposed training program is as under.

a) Training at Facilities Manufacturer's Factory

This training is intended to acquaint maintenance personnel about the outlines of facilities that constitute the rural telecommunications network and to give them the general knowledge of the system as a whole.

Maintenance personnel who have finished this training are preferably to work as instructors in the subsequent training series or as responsible persons for management of the whole maintenance work. Therefore, the trainees should rather be chosen from among senior engineers with a certain degree of field experience, e.g., the personnel scheduled to be assigned to duty in the central maintenance center described in Paragraph 6-2.

The number of trainees and their training period depend upon the budget available. However, at least three persons will have to be dispatched to receive a minimum of two months training.

b) Training at Training Center in Kathmandu

This training is to give all the maintenance personnel the basic knowledge about the system as a whole and to enable them to learn the standard maintenance practices in their respective specialty fields.

This training should be administered with instructors dispatched from, curricula prepared by and training equipment supplied by the facilities manufacturer. Since the current plan is to be carried out phase after phase in a total of four phases as stated in Chapter VII, the training also should follow suit.

c) On-the-Job Training

All the maintenance personnel who have finished their training at the training center are to take part in the construction work and, through the experience therein, acquire the necessary knowledge for the subsequent maintenance work, such as the methods of testing and of handling the measuring equipment.