

4. FORECAST OF TELEPHONE DEMANDS AND TRAFFIC

4.1 Telephone Demand Forecasting

(1) Macroscopic Demand Forecasting

The figures from the nationwide macroscopic demand forecasting created by JICA for the master plan in June 2002 are used as reference.

Macroscopic forecast values for the entire nation of Ethiopia, as well as F/S project areas are shown in Table 4.1.1 and Table 4.1.2.

**Table 4.1.1 Nationwide Macroscopic Demand Forecast for Ethiopia
(Fixed telephones)**

Region name	Year				
	2000/01	2005/06	2010/11	2015/16	2020/21
Tigray	28,834	37,440	48,69	63,338	81,524
Affar	1,690	3,338	5,579	8,658	12,595
Amhara	51,875	77,248	111,442	157,447	216,399
Oromiya	93,211	129,452	177,529	241,416	322,026
Somali	3,915	8,317	14,490	23,087	34,332
Benishangul	874	1,608	2,604	3,982	5,757
S.N.N.P.	28,608	45,850	70,490	105,014	150,032
Gambela	657	1,137	1,692	2,485	3,454
Addis Ababa	275,134	340,707	415,660	506,904	611,825
Dire Dawa	9,824	12,835	16,835	21,993	28,393
Harar	6,422	8,083	10,162	12,828	16,020
Nationwide total	501,044	666,015	826,600	1,147,152	1,482,357

Table 4.1.2 F/S Applicable Project Area Macroscopic Demand Forecast

Area name	Year				
	2000/01	2005/06	2010/11	2015/16	2020/21
Bahir Dar	3,970	5,914	8,534	12,061	16,579
Woreta	625	931	1,343	1,898	2,608
Merawi	381	567	818	1,155	1,588
Subtotal	4,976	7,412	10,695	15,114	20,775

(2) Microscopic Demand Forecasting

The figures from the nationwide microscopic demand forecasting by JICA for the master plan in June 2002 were used as reference.

Microscopic forecast values for the entire nation of Ethiopia, as well as F/S applicable project regions are shown in Table 4.1.3 and Table 4.1.4.

**Table 4.1.3 Nationwide Microscopic Demand Forecast for Ethiopia
(Fixed telephones)**

Region name	Year				
	2000/01	2005/06	2010/11	2015/16	2020/21
1	453,300	544,900	638,300	749,500	953,400
2	32,100	46,700	68,800	100,700	145,300
3	20,800	30,900	45,500	66,100	95,000
4	46,200	64,900	92,700	132,300	186,700
5	32,200	41,900	69,500	94,800	128,400
6	47,100	64,900	87,500	117,600	155,300
7	34,700	47,900	65,400	88,700	118,300
8	50,800	73,700	108,800	158,800	228,900
No.1-No8	717,200	915,800	1,176,500	1,508,500	2,011,300
Rural	18,800	27,100	38,300	53,400	72,600
Nationwide total	736,000	942,900	1,214,800	1,561,900	2,083,900

Table 4.1.4 F/S Applicable Project Areas Microscopic Demand Forecast

Area name	Year				
	2000/01	2005/06	2010/11	2015/16	2020/21
Bahir Dar	15,783	22,894	33,810	49,380	71,168
Woreta	569	826	1,220	1,781	2,567
Merawi	539	782	1,155	1,687	2,431
Sub total	16,891	24,502	36,185	52,848	76,166

(3) Microscopic Forecasting Values for the Semi-industrial Area to the East of Bahir Dar Exchange, New Residential Development, and Airport Area

The forecasted values of the microscopic demand for the semi-industrial area in the east of Bahir Dar Exchange, new residential development area, and airport area are determined by the results obtained from site surveys, answer to questionnaire, verifications and reviews of city planning documents, as well as opinions provided by ETC's local counterparts (CP).

Further, the 10% of the forecasted values are added as the demands for public telephones and non-telephone services.

The microscopic demand forecasted values for the semi-industrial region in the east of Bahir Dar Exchange, new residential development area, and airport areas are shown in Table 4.1.5.

**Table 4.1.5 Microscopic Demand Forecasting Values for the Bahir Dar Region
(New residential development and airport areas)**

Region name	Year				
	2002/03	2005/06	2010/11	2015/16	2020/21
FTZ No.1	130	240	354	518	746
FTZ No.2	126	240	354	518	746
FTZ No.3	70	110	162	237	342
Total	326	590	870	1,273	1,834

(Remarks) FTZ: Fiber to the Zone

4.2 Traffic Forecasting

Conventional communications networks are of circuit switching systems types, where a single call occupies the entire line from the beginning of the call to the end, whether any information, voice, or data are transmitted. This means that if there are more call initiations than the number of available circuit lines, the lines become busy and calling subscribers receives busy tone and can not establish a call connection.

In the past, transmission equipment was quite expensive, and it was not economically viable or easy to provide transmission lines with adequate capacity. For this reason, careful calculations were made to determine traffic and circuits in order to provide an optimum number of lines for services. In the calculation process, the call loss rate is usually set at 0.5% or 1%. This means that for 100 calls initiated, the probability of line busy state is 0.5 or 1%.

For the case of VoIP, which is proposed in this F/S, a particular call does not occupy the entire line as is the case with circuit switching. A single circuit line is shared and utilized by multiple data packets, including VoIP packets, in an efficient manner. Thus the call loss rate described above is not an applicable concept with packet exchanges due to difference in call traffic characteristics.

Offered traffic to the trunk links is varied according to the subscribers. This means that the trunk traffic rate is relatively large with small number of subscribers, while the trunk traffic becomes relatively small as the number of subscribers' increases.

The VoIP traffic and circuit line calculation results are shown in Table 4.2.1.

Table 4.2-1 Traffic Volume and The Number of 2M Circuits

No.	Location		2005/2006			2010/2011			2015/2016			2020/2021		
	Area	Host	Demand	Org Traffic (erl)	No. of 2M	Demand	Org Traffic (erl)	No. of 2M	Demand	Org Traffic (erl)	No. of 2M	Demand	Org Traffic (erl)	No. of 2M
Bahir Dar														
1	Kebele 11	Bahir Dar	240	12	1	354	18	1	518	26	1	746	37	1
2	Airport Road	Bahir Dar	240	12	1	354	18	1	518	26	1	746	37	1
3	Airport	Bahir Dar	110	6	1	162	8	1	237	12	1	342	17	1
4	Merawi	Bahir Dar	1,160	58	1	1,714	86	1	2,503	125	2	3,607	180	2
5	Woreta	Bahir Dar	3,026	151	2	4,469	223	2	6,527	326	3	9,406	470	4

Assumed Calling Rate/sub: 0.05erl
 Packet Size: 0.016Mbps

Assumed OG Traffic Rate

No. of Subs	Rate
Less than 500	80%
500 – 1,000	70%
1,001 – 2,000	60%
More than 2,001	50%

5. TELECOMMUNICATIONS NETWORKS DEVELOPMENT PROGRAM FOR THE F/S APPLICABLE PROJECT REGIONS

5.1 Frame Work for Establishing Telecommunications Network Development Programs for F/S Applicable Project Regions

The following policies are formulated in accordance with the national development plans of Ethiopia, and in order to provide contributions toward the socio-economic developments of the F/S applicable project regions, and to narrow the gap of telecommunications services offered in larger cities and rural areas:

(1) Bahir Dar exchange region

Seek provision of telecommunication services to regions (such as airport area and new development area in the east of Blue Nile River) that are currently not receiving or inadequately receiving telecommunications services or not receiving quality services.

(2) Woreta exchange and Merawi exchange regions (central area)

Eliminate waiting applicant by introducing VoIP systems in the Woreta Exchange and Merawi Exchange.

(3) Woreta region and Merawi region (rural areas)

In Ethiopia, 85% of its population, and the majority of the people engaged in agriculture do not benefited from telecommunications services. The following policy was established so that the plan proposed in this feasibility study can contribute to the minimization of areas having no telephones and to the development of social and economical activities in the relevant areas.

Taking into account the population condition, activity state, expansibility, development bases, etc., seek to eliminate such telephoneless areas through the provision of telecommunications services by the PCO.

5.2 Extent of the Service Provision

The following telecommunications network development program is established according to the policy set forth in Section 5.1 above.

5.2.1 Provision Policy

(1) Bahir Dar Exchange Area

For the semi-industrial area and new residential development area and airport area in the east of Blue Nile River within the Bahir Dar Exchange region, Study Team decided to introduce VoIP technology, based on the results obtained from survey questionnaires, field surveys and opinions from ETC's local counterparts. Introduction of an FTZ system is planned to lay optical

fiber cables to areas far from Exchange in order to provide quality lines to important customers such as airports and technical institutes. Thus, it is planned that these facilities can accommodate all the demand up to year 2005. The demand forecast in 2020 will be utmost 1,830. FTZ (Fiber to Zone) application is more economical and best solution rather than WLL system from the viewpoint of geographical feature and the feasibility of system expansion in future. That is, the WLL is a preferred system to be able to cope with quick and effective operation to the subscribers scattered in wide area but the above mentioned topography and demand conditions will let the merit of WLL definitely loose and WLL is not suitable system to be adopted in this area.

(2) Woreta Exchange and Merawi Exchange Areas (central area)

Study Team planned to introduce VoIP system in the Woreta Exchange and Merawi Exchange areas to eliminate the waiting applicant and to provide new services. ETC has already started designing the subscriber access system.

(3) Woreta Area and Merawi Area (rural area)

According to the policy set forth in Section 5.1, the F/S site survey group, including ETC's counterpart and the staff members of regional government offices in the Woreta ever have selected PCO positions that are considered to be optimum and effective, and then established a model plan.

Woreta (Fogera) Rural Areas (14 sites) Population (* within 5km in radius)

1. Gala Minder PCO Area	Approx. 1,000 households (8,000 people)
2. Wore Meda PCO Area	Approx. 1,000 households (8,000 people)
3. Arbaba WEJI PCO Area	Approx. 1,000 households (8,000 people)
4. Sheleko Medhane PCO Area	Approx. 1,000 households (8,000 people)
5. Anguko PCO Area	Approx. 1,000 households (8,000 people)
6. Mobil Gas Exchange PCO Area	Approx. 2,000 households (16,000 people)
7. Woreta ATVET PCO Area	Approx. 1,000 households (8,000 people)
8. Bawabat (Road Side) PCO Area	Approx. 1,000 households (8,000 people)
9. Shiga Maryam PCO Area	Approx. 1,000 households (8,000 people)
10. Shena Tekele Haymanot PCO Area	Approx. 1,000 households (8,000 people)
11. Hod GEBEYA PCO Area	Approx. 1,000 households (8,000 people)
12. Kidiste Hana PCO Area	Approx. 1,000 households (8,000 people)
13. Rice Farm Research PCO Area	Approx. 1,000 households (8,000 people)
14. SEFATRA PCO Area	Approx. 1,000 households (8,000 people)
Total	120,000 people
Woreta City	19,852 people

(*) : Area populations form Woreda Administration in Woreta

(**): Average number of family members per household in the Woreta area: 8 (2 adults and 6 children)

Please refer to Table 5.2.1-1 and Table 5.2.1.1-1 ~ Table 5.2.1.1-14 of the attachments for detailed results of the F/S. The beneficial effects (benefiting population) gained by the new installation of PCOs can be calculated as follows:

$$120,000 / (220,496-19,852) \times 100 \cong 59 (\%)$$

As a requirement based on the master plan, each PCO provides a transmission rate of 256kbps to make access to the Internet possible. Each PCO reserves a capacity of 8 telephone lines, and install VoIP telephones at their sites. All telephone units are terminated at individual PCOs, and are used as public telephones.

Merawi Rural Areas (13 sites) Population (* within 5km in radius)

1. Meshenti No.1 PCO Area	Approx. 1,000 households (8,000 people)
2. Meshenti No.2 PCO Area	Approx. 1,000 households (8,000 people)
3. Bachuma PCO Area	Approx. 1,000 households (8,000 people)
4. INAMRT Farmer Office PCO Area	Approx. 1,000 households (8,000 people)
5. Anbo Mask School PCO Area	Approx. 1,000 households (8,000 people)
6. Anbo Mask Farmer Office PCO Area	Approx. 1,000 households (8,000 people)
7. Kudimi School PCO Area	Approx. 1,000 households (8,000 people)
8. Inguti school PCO Area	Approx. 1,000 households (8,000 people)
9. Inguti (Road side)PCO Area	Approx. 1,000 households (8,000 people)
10. Wetet ABAY PCO Area	Approx. 1,000 households (8,000 people)
11. KURT BAHIR PCO Area	Approx. 1,000 households (8,000 people)
12. RIM PCO Area	Approx. 1,000 households (8,000 people)
13. Kurkurit PCO Area	Approx. 1,000 households (8,000 people)
Total	104,000 people
Merawi City	12,838 people

(*) : Area populations from Woreda Administration in Merawi

(**): Average number of family members per household in the Merawi area: 8 (2 adults and 6 children)

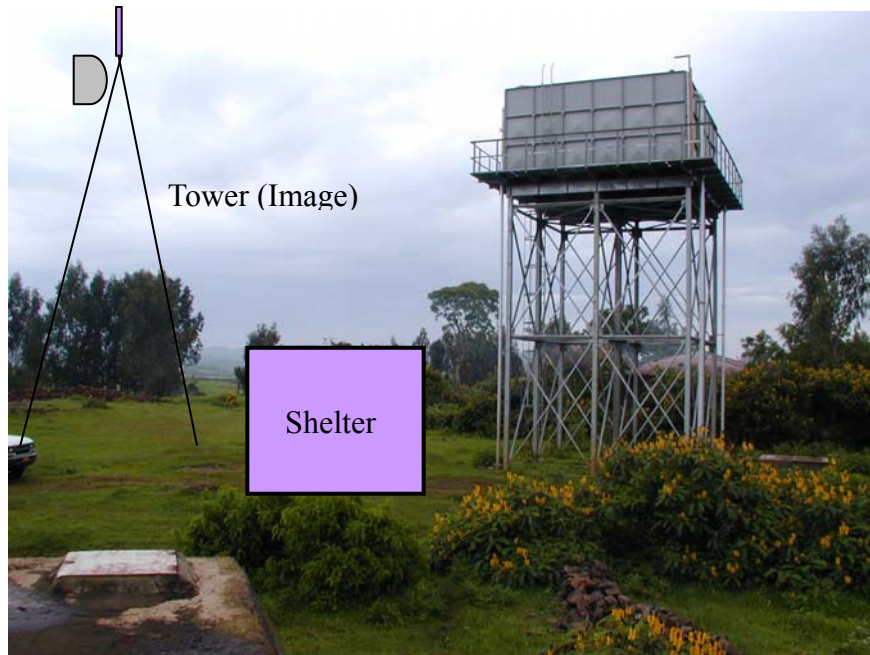
Ethiopia Rural PCO System F/S Result
Table 5.2.1.1 Woreta PCO Base Station

(1) Site Information

<i>Category</i>	<i>Survey Item</i>	<i>Survey Result</i>	<i>Remarks</i>	
1. Location	Site Name	Woreta PCO Base Station	To be newly installed (Possible site)	
	Latitude	11° 55' 20" N		
	Longitude	37° 42' 10" E		
	Above Sea Level	1,880m		
	Site condition	See Attachment -7.		
2. Building	Building Structure	None	Required	
	Air conditioning	None	Required	
	Installation place	None	Required	
3. Tower	Tower condition	None	Required	
4. Power	Commercial Power	Not available	Required power line installation work	
	DC power supply	None		Required
	Power for outdoor	None		Required
5. Grounding	Indoor Grounding	None	Required	
	Outdoor Grounding	None	Required	
6. Equipment Installation	Vehicle Access Road	OK	Exposed to the weather	
	Material Temporary Storage	Approx. 100m ² available		
	Vehicle Carrying in/Parking	OK		
7. Others	Population of Site	220,496 (19,852: Central city)		

(2) Transmission Facilities

<i>Category</i>	<i>Survey Item</i>	<i>Survey Result</i>	<i>Remarks</i>
1. System	BCO Base Station System	1) No. of PCO Stations: 14 2) No. of PCO Repeater Stations :2	
Circuit (Subject for F/S)	Required digital circuit (2xE1) between Woreta city and Woreta PCO BASE.	(Cable Link : Woreta city – PCO BASE)	To be newly procured
2. Antenna (Subject for F/S)	Antenna For direction to PCO st.	42m (Omni-directional antenna)	To be newly procured
3. Tower (Subject for F/S)	Tower/Height required	Self-supporting type: 40m	To be newly procured
	For direction to PCO stations	Mounting position: H = 40m	



**Attachment – 7 Woreta PCO Base Station (Planned Construction site)
(Required Tower (H=40m) and Equipment shelter)**

Please refer to Table 5.2.1-2 and Table 5.2.1.2-1~Table 5.2.1.2-13 of the attachments for detailed results of the F/S. The beneficial effects (benefiting population) gained by the new installation of PCOs can be calculated as follows:

$$104,000 / (184,642 - 12,838) \times 100 \cong 60 (\%)$$

As a requirement based on the master plan, each PCO provides a transmission rate of 256kbps to make access to the Internet possible. Each PCO reserves a capacity of 8 telephone lines, and install VoIP telephones at their sites. All telephone units are terminated at individual PCOs, and are used as public telephones. If further demands for telephone services arise in the future, the ETC's counterparts and the staff members of regional government offices may agree on the additional PCOs and telephone line extension.

Ethiopia Rural PCO System F/S Result
Table 5.2.1.2 Merawi North PCO Base Station

(1) Site Information

<i>Category</i>	<i>Survey Item</i>	<i>Survey Result</i>	<i>Remarks</i>
1. Location	Site Name	Merawi North PCO Base Station	Existing Rep. Station to be expanded Possible site)
	Latitude	11° 26' 57" N	
	Longitude	37° 11' 25" E	
	Altitude	2,146 m	
	Site condition	See Attachment –8.	
2. Building	Building Structure	Existing one-story building (rain leaking)	ETC: Repair required (See Fig 3.1.2-5) (Photo) 40 m (See Fig 3.1.2-6) Equipment layout
	Air conditioning	None	
	Installation	Antenna: Existing tower available M/W equipment: Equipment room	
3. Tower	Antenna tower	Existing (H=62m)	Available
4. Power	Commercial Power	(Not available)	Surplus capacity to be verified. Available
	Power for indoor equipment	Existing solar power system	
	DC power	DC – 24V power supply	
	Engine generation	None	
5. Grounding	Indoor Grounding	Within 20m from earth terminal	
	Outdoor Grounding	For microwave tower (existing)	
6. Equipment Installation	Vehicle Access Road	OK (1km mountain road)	Exposed to the weather
	Material Temporary Storage	Approx. 100m ² available	
	Vehicle Carrying in/Parking	OK (up to 5 vehicles)	
	Minimum Entrance space	1.7m(H)/1.0m(W)	
7. Others	Population of Site	184,642 (12,838: Central city)	

(2) Transmission Facilities

Category	Survey Item	Survey Result	Remarks
1. System	BCO Base Station system	1) Adjacent M/W station: Bahir Dar 2) No. of PCO Stations: 13 3) No. of PCO Rep. Stations :1	
1.1 M/W Link	1) Bahir Dar (PC) Station	M/W transmission link (Under construction)	
1.2 Circuit (Subject for F/S)	Required digital circuit (2xE1) To Bahir Dar Station	Link: Bahir Dar – Merawi North PCO BASE (PDH 8x2M is currently under construction)	
2. Antenna (Subject for F/S)	1) For direction to Bahir Dar MW station 2) For direction to PCO stations	40m (Constructed under the on-going project) 40m (Omni-directional antenna) (New installation)	Omni-ANT to be newly installed
3. Antenna tower (Subject for F/S)	Ant. height required 1) For PCO Rep. 2) For direction to PCO stations	(Self-supporting type: 40m (Existing)) Mounting position: H= 20m Mounting position: H= 40m	



Attachment – 8 Merawi PCO Base Station (Planned Construction site)

5.2.2 Facility Plan

(1) Bahir Dar Exchange Area

The capacity of facilities installed in this area has been decided, in principle, based on the forecast of demands at the start of service (2005). This is to avoid vast facility investment, which will result the long idle period of the facilities. However, to avoid increase in investment amounts due to repetitive installation work, the investment for outside plant will be made for the demands of year 2010.

(2) Woreta Exchange and Merawi Exchange Regions (central area)

Installation of VoIP (See Figure 5.2.2-1)

(3) Woreta Area and Merawi Area (rural areas)

1) Woreta (Fogera) rural area

The Woreta rural area, having a comparative low population density, is scattered in small communities. The Fogera Plain, facing Lake Tana, is a low land and a fertile agricultural ground. Since access roads become muddy in rain seasons, the area is isolated even from neighbouring communities as a result. The mountain area where roads are still in bad conditions is also scattered with many isolated communities. The feasibility study was conducted focusing on such isolated areas. Figure 5.2.2-2 shows PCO candidates, and Table 5.2.2-1 provides station data.

As described above, implementation of point-to-multipoint radio systems is recommended as communication method intended for areas with scattered hamlets and villages. Further, as indicated in the feasibility study reports by FG7 of ITU, “the Internet is a platform that is most widely used for providing multimedia services in the rural areas of developing countries.” Therefore, wide-band and high-speed communications lines will be provided for PCOs to offer easy access to the Internet. In the report from FG7 of ITU-D, it is further mentioned, “the Internet is important for developing countries, as the Internet can provide potentials for improvements of economic and educational resources exchange within a nation, between isolated rural societies and cities.” Survey Team also expects that the gap described above will be eliminated by the construction of PCOs.

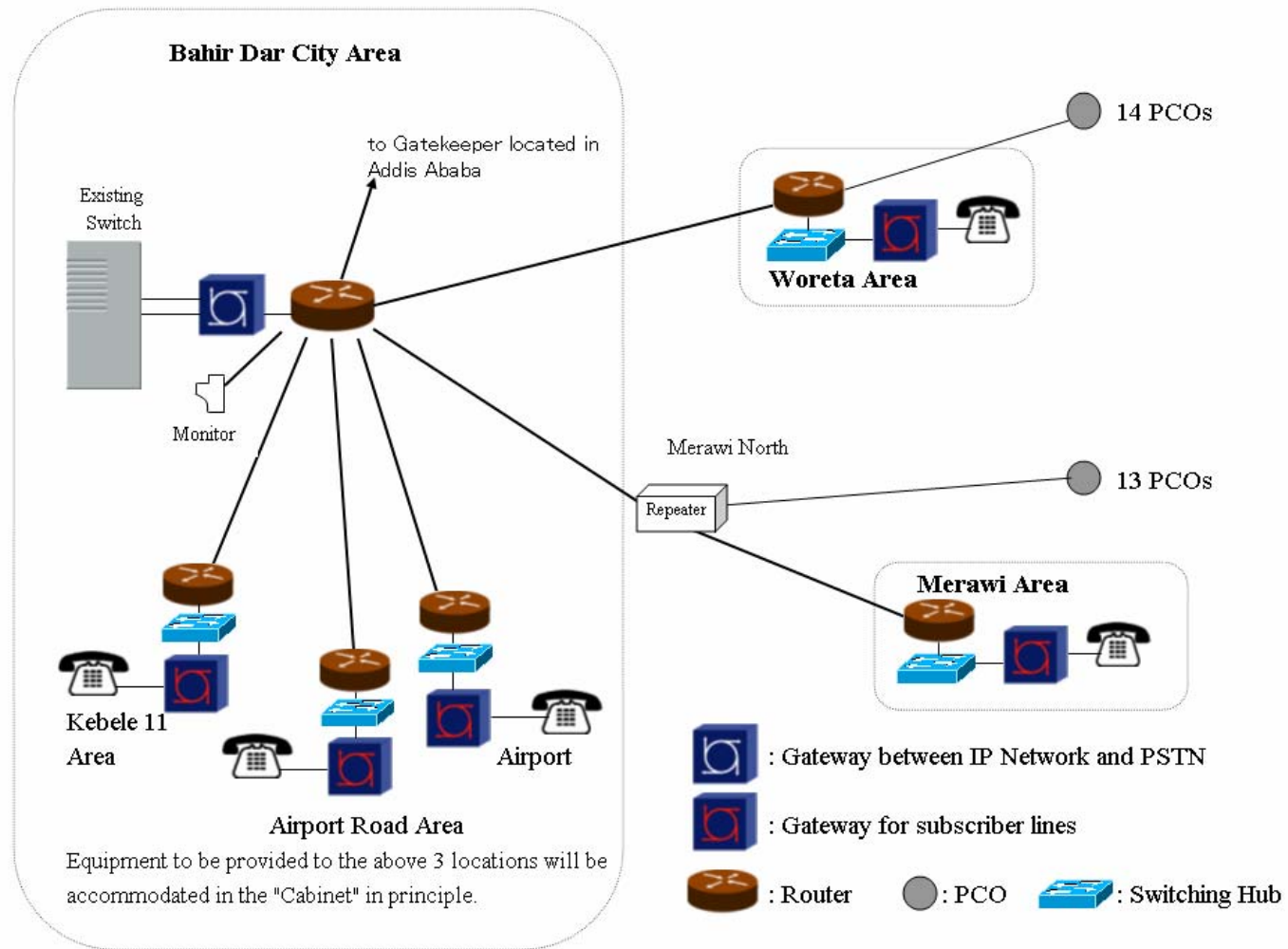


Figure 5.2.2-1 VoIP Network Configuration in Bahir Dar Area

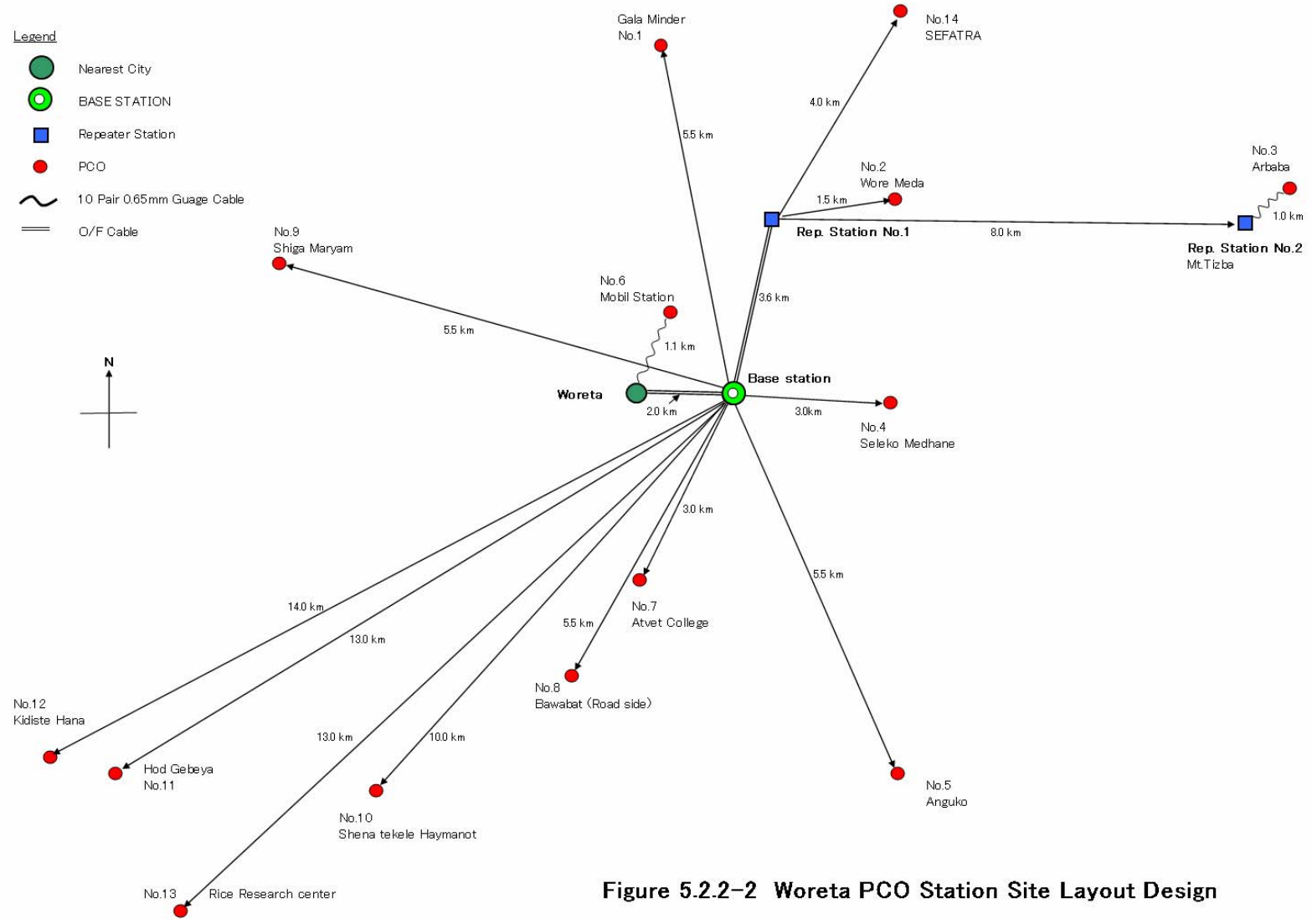


Figure 5.2.2-2 Woreta PCO Station Site Layout Design

Table 5.2.2-1 Woreta PCO Station Data List (Planned)

No.	PCO	Station Name	Latitude (N)	Longitude(E)	Height (m)	Distance (Km)	Required Tower Height (m)	Remarks
	A	Washa Indorios	12° 08' 50"	37° 43' 28"	2420		62m (existing)	SDH Repeater
	B	Woreta City (Tel House)	11° 55' 30"	37° 41' 30"	1820		30	ETC Tel House
1	C	Woreta PCO(BASE)	11° 55' 20"	37° 42' 10"	1880	0	40	PCO BASE
2	D	PCO Repeater (Rep No.1)	11° 56' 48"	37° 43' 10"	1878	3.6	30	From PCO base
3	E	PCO Repeater (Rep No.2) Mt. Tizba	11° 55' 34"	37° 47' 32"	2015	11.6 (3.6+8)	20	From Rep. No.1
4	*1	Gala Minder (PCO No.1)	11° 58' 00"	37° 42' 10"	1793	5.5	10	
5	2	Wore Meda (PCO No.2)	11° 56' 50"	37° 43' 50"	1820	5.1 (3.6+1.5)	10	
6	*3	Arbaba (PCO No.3) WEJI	11° 55' 50"	37° 47' 32"	2015	12.6 (3.6+8+1)		Connected by Cable
7	4	Sheleko Medhane (PCO No.4)	11° 55' 00"	37° 48' 04"	1860	3	10	
8	*5	Anguko (PCO No.5)	11° 52' 38"	37° 43' 15"	1920	5.5	20	
9	6	Mobil Gas Station (PCO No.6)	11° 55' 58"	37° 41' 23"	1800	1.1		Connected by Cable from City
10	7	Woreta ATVET College (PCO No.7)	11° 54' 07"	37° 41' 36"	1880	3	10	
11	*8	Bawabat (Road Side) (PCO No.8)	11° 53' 28"	37° 39' 50"	1800	5.5	20	
12	*9	Shiga Maryam (PCO No.9)	11° 58' 56"	37° 39' 26"	1792	5.5	20	
13	10	Shena Tekele Haymanot (PCO No.10)	11° 53' 20"	37° 37' 13"	1790	10	20	
14	*11	Hod GEBEYA (PCO No.11)	11° 53' 20"	37° 35' 10"	1789	13	10	
15	12	Kidiste Hana (PCO No.12)	11° 54' 27"	37° 34' 27"	1789	14	10	
16	13	Rice Farm Research (PCO No.13)	11° 52' 14"	37° 35' 34"	1790	13	10	
17	*14	SEFATRA (PCO No.14)	11° 58' 50"	37° 44' 17"	1798	7.6 (3.6+4)	10	From Rep. No.1

Note:

7 sites with * marks are PCO candidates to be established under the "Optional Plan".

(i) Microwave Radio Transmission Link

PCOs in the Woreta Woreda rural area are connected to the network, as a subscriber of Bahir Dar PC. Connection is through the digital transmission lines between Bahir Dar PC, Washa Indorias Rep. and Woreta City (under construction), and through the optical fiber cable transmission system between Woreta City and PCO Base. The capacity of the transmission link is as shown below. Figure 5.2.2-3 shows a system connection diagram “Transmission System Configuration for Woreta”.

A part of the following transmission links, which are currently under construction or being planned to construct in the near future, will be used for establishing the network.

(Transmission Link):

Bahir Dar - Washa Indorias: (STM-1 x 3 sys) - under construction

Washa Indorias - Woreta City: (8Mbps) – planned under the sepalete project

Woreta City - Woreta Base: (4Mbps) for PCO network – to be newly constructed

(ii) PCO Network

This network is comprised of the Woreta PCO Base Station that will be constructed on a hill with a city water supply tank, commanding a panoramic view of the city, two PCO repeater stations, and above-mentioned 14 PCO subscriber stations. Please see Figure 5.2.2-4 “PCO Network Diagram”. Further, one personal computers (PC) will be connected at each PCO.

The PCO network established by this plan would be capable of connecting a maximum 15 PCO subscriber stations for each base station. A wide-band PCO circuits with a capacity of 256kb/s per PCO will be constructed, making easier to access to the IP based services.

In addition to the plan (main plan), an optional plan was studied to set put 7 PCOs out of above mentioned 14 candidates for establishing the network economically. Distance to PCO becomes longer compared with 14 PCOs for some of the communities located in a distant PCO coverage area, however, it is still within a walking distance range described in the M/P (5-10km). Therefore, estimated tele-access and beneficiaries will remain unchanged. The 7 PCOs considered in the optional plan is listed in Table 5.2.2-1.

(iii) Power Facilities

This plan requires the following power facilities:

a) Woreta Local Exchange (existing)

Power supply for microwave radio system is required, and power supply (on-going project) will be used for this purpose.

b) Woreta PCO Base Station (newly established)

Power supply for optical fiber cable transmission system and PCO base station facilities is needed. Commercial power supply (220V AC) can be led from Woreta city.

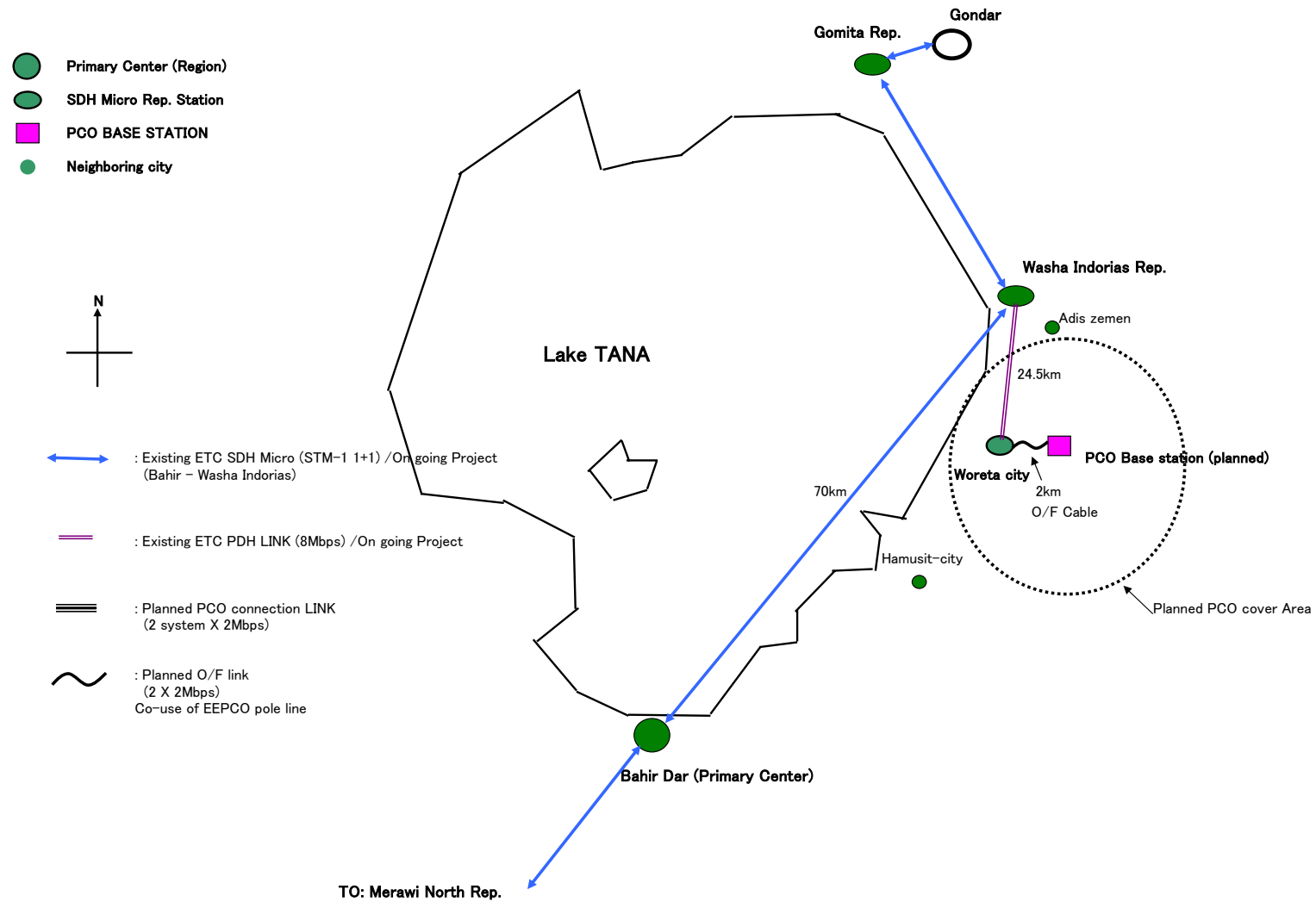


Figure 5.2.2-3 Transmission system configuration for Woreta PCO Station

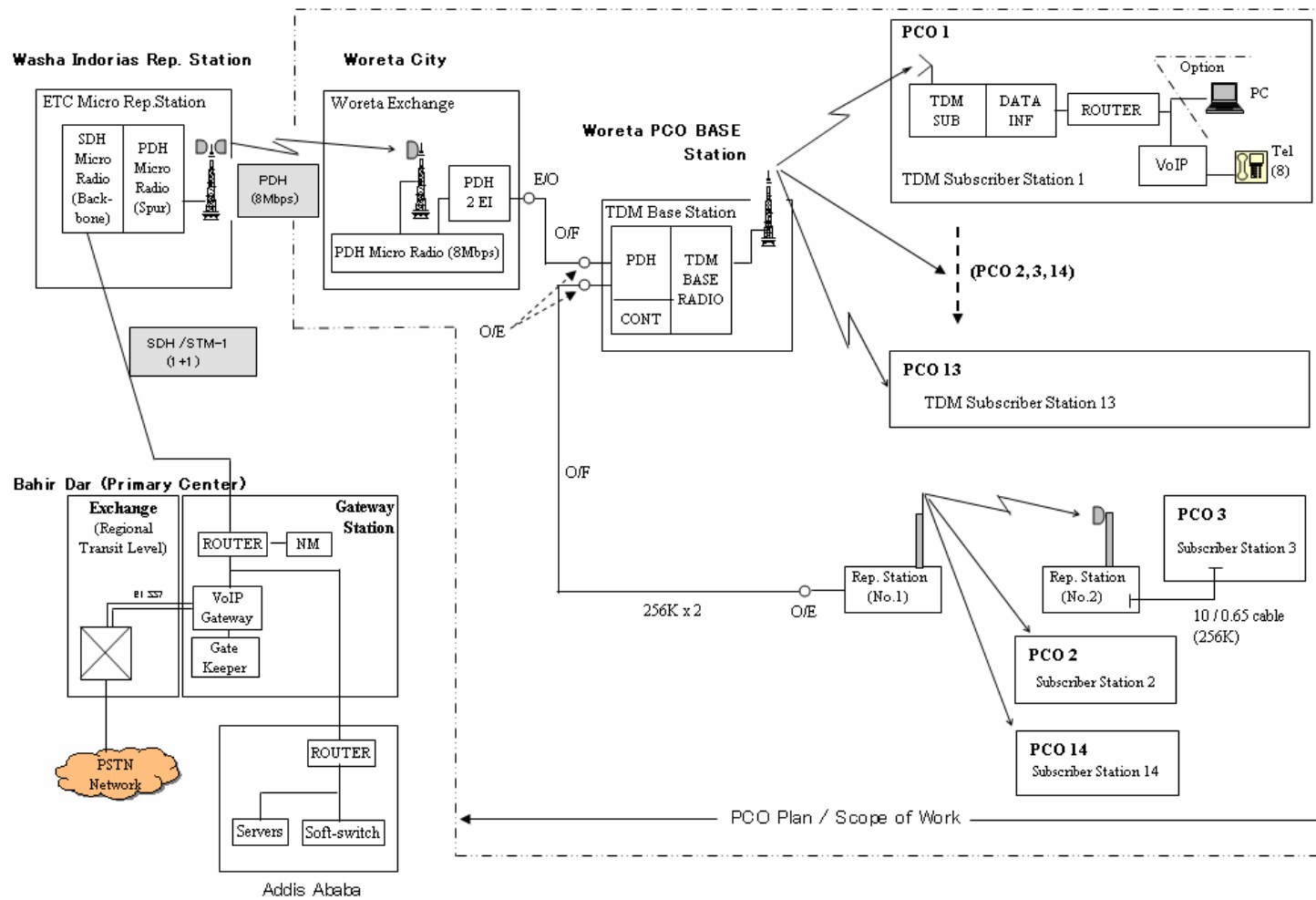


Fig. 5.2.2-4 Woreta Area PCO Configuration

c) PCO Subscriber Station (newly established)

Since most of this area is not supplied with commercial power, solar power system is employed.

For the PCO areas shown below, however, existing commercial power supply is available.

- Mobil Gas Station (PCO No.6) and Woreta ATVET College (PCO No.7)

(iv) Station building and antenna supporting structures (tower/pole)

a) Woreta Local Exchange (existing)

To accommodate relay transmission equipment to be installed, space in the building is required. However, since the new exchange building construction plan (on-going project) is not yet started, reconfirmation of the situation is needed before starting the rural telecom project.

b) Woreta PCO Base Station (newly established)

Station building and antenna supporting tower (H=40m) are necessary to install radio transmission equipment, PCO Base facilities, and antenna sub-system.

c) PCO Subscriber Station (newly established)

Simple station building (shelter) for housing PCO subscriber facilities and antenna mounting poles (H=10 to 20m) conforming to each site plan are required. Figure 5.2.2-5 shows a typical equipment layout plan.

d) PCO Repeater Station (newly established)

Simple station building (shelter) for housing PCO line repeater facilities and antenna mounting poles (H=10 to 20m) are required.

(2) Merawi Rural Area

The Merawi rural area, with a comparative low population density, is scattered with communities and is a fertile agricultural ground. Since access roads become muddy in rain seasons, the area is isolated from telecommunications facilities as a result. The feasibility study was conducted focusing on such isolated areas. Figure 5.2.2-6 shows PCO candidates, and Table 5.2.2-2 provides station data.

As described above, implementation of point-to-multipoint radio systems is recommended as communication method intended for areas with scattered hamlets and villages.

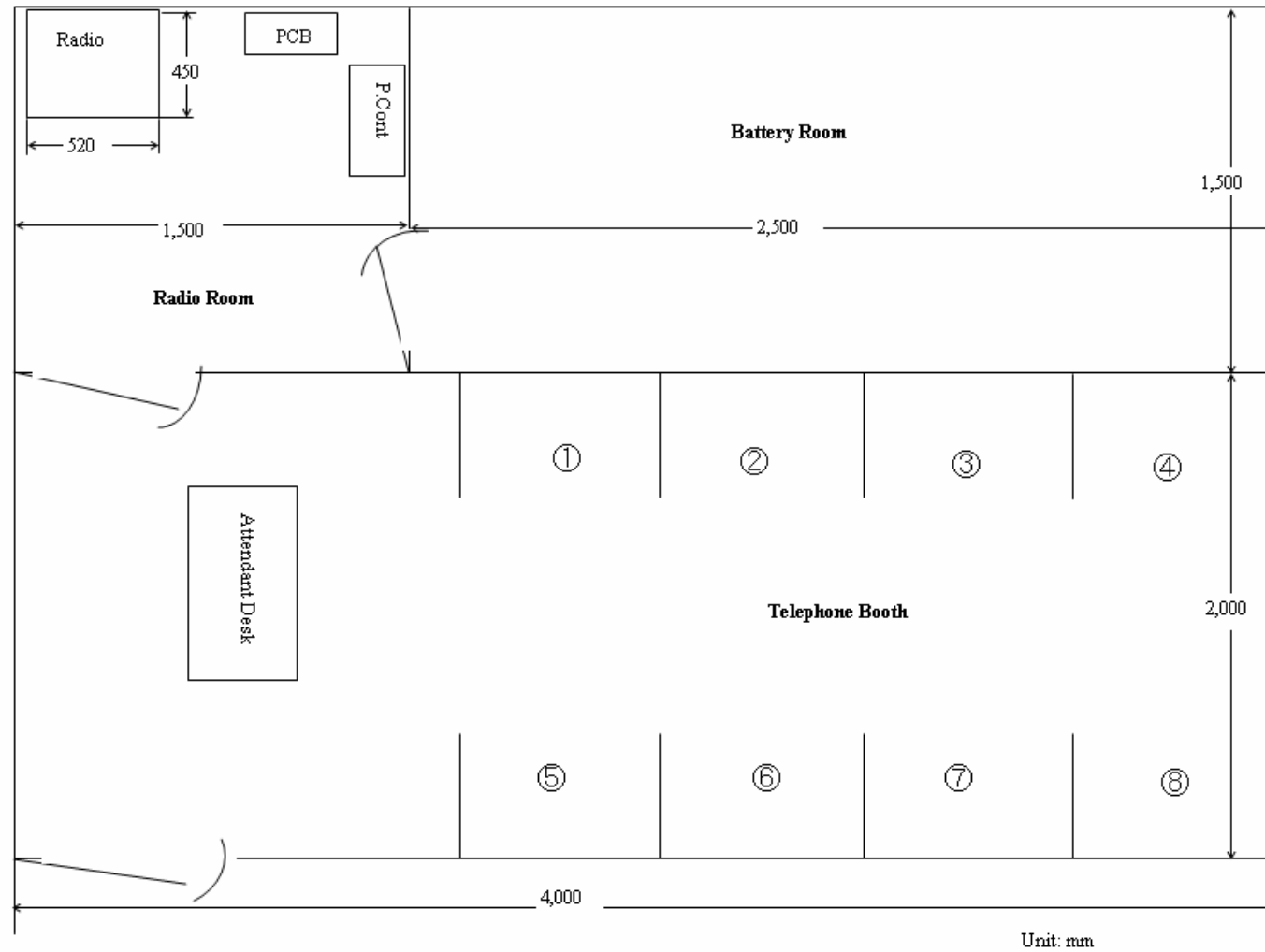


Fig 5.2.2-5 Typical Floor Layout Plan for PCO Subscriber Station (Reference)

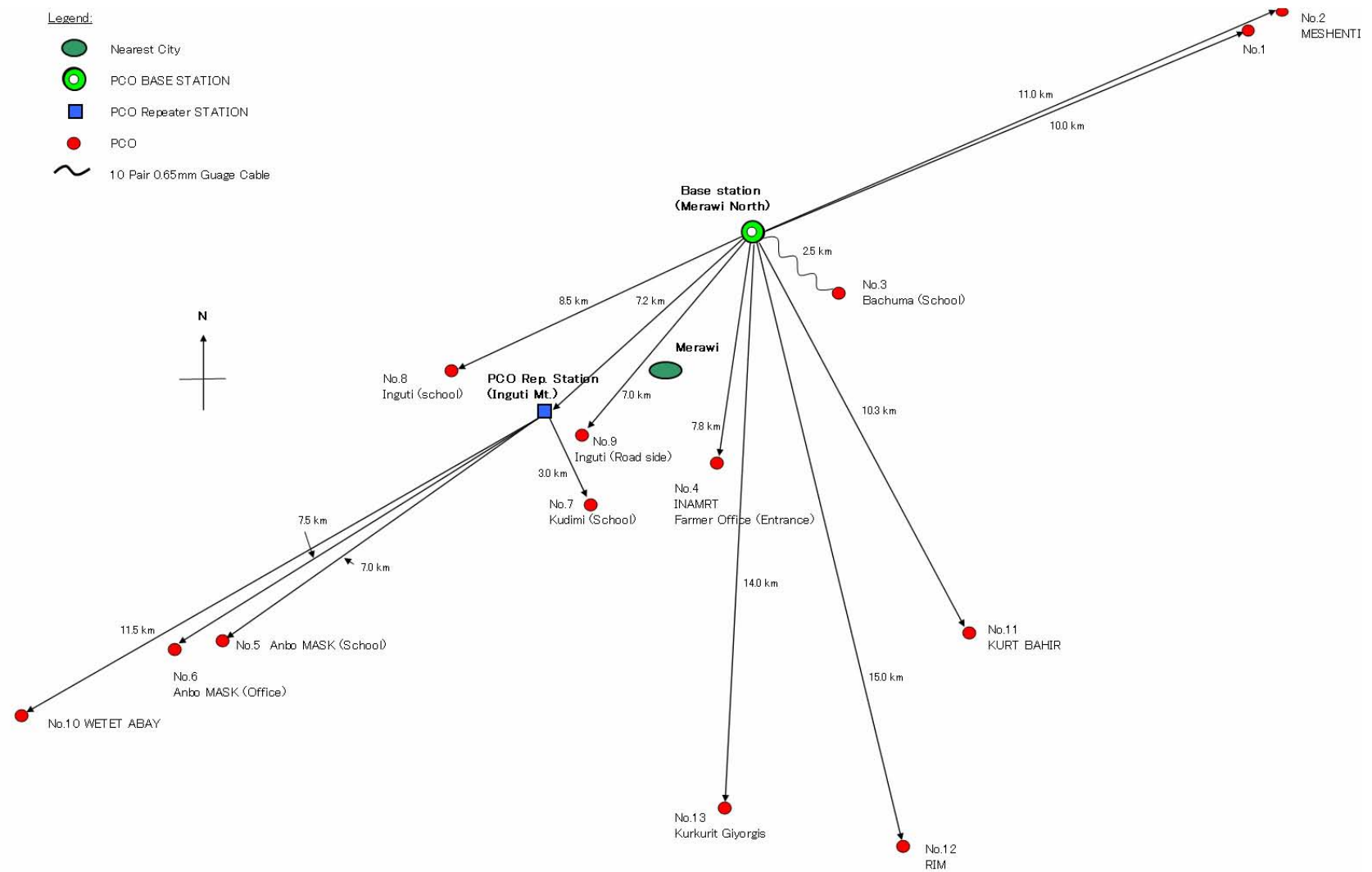


Figure 5.2.2-6 Merawi PCO Station Site Layout Design

Table 5.2.2-2 Merawi PCO Station List (Planned)

No.	PCO	Station Name	Latitude (N)	Longitude (E)	Height (m)	Distance (Km)	Required Tower Height (m)	Remarks
	A	Merawi /North	11° 26' 57"	37° 11' 25"	2146		40m (existing)	SDH Repeater
	B	Merawi City (Tel House)				N/A	N/A	ETC Tel House
1	C	Merawi/North PCO(BASE)	11° 26' 57"	37° 11' 25"	2146	0	N/A	PCO BASE
2	D	PCO Inguti Rep. (Rep No.1)	11° 25' 14"	37° 07' 50"	2060	7.2	20	From PCO BASE
3	*1	Meshenti (PCO No.1)	11° 28' 04"	37° 16' 57"	1980	10	10	
4	2	Meshenti (PCO No.2)	11° 28' 48"	37° 17' 30"	1980	11	10	
5	*3	Bachuma (PCO No.3)	11° 26' 07"	37° 12' 37"	2020	2.5		Connected by Cable
6	4	INAMRT Farmer Office (PCO No.4)	11° 23' 04"	37° 10' 00"	2040	7.8	10	
7	5	Anbo Mask School (PCO No.5)	11° 23' 37"	37° 04' 27"	1940	14.2 (7.2+7)	30	
8	6	Anbo Mask Farmer Office (PCO No.6)	11° 23' 24"	37° 04' 10"	1920	14.7 (7.2+7.5)	30	
9	7	Kudimi School (PCO No.7)	11° 23' 45"	37° 07' 30"	1999	10.7 (7.2+3)	30	
10	*8	Inguti School (PCO No.8)	11° 25' 45"	37° 06' 53"	1990	8.5	10	
11	9	Inguti (Road side) (PCO No.9)	11° 24' 30"	37° 08' 12"	2000	7	10	
12	*10	Wetet ABAY (PCO No.10)	11° 22' 02"	37° 02' 14"	1920	18.7 (7.2+11.5)	30	
13	*11	KURT BAHIR (PCO No.11)	11° 21' 34"	37° 13' 12"	2080	10.3	20	
14	*12	RIM (PCO No.12)	11° 18' 47"	37° 12' 10"	2040	15	20	
15	*13	Kurkurit Giyorgis (PCO No.13)	11° 19' 40"	37° 10' 00"	2050	14	20	

Note:

7 sites with * marks are PCO candidates to be established under the "Optional Plan".

(i) Microwave Radio Transmission Link

The PCO subscribers in the Merawi rural area, as a Bahir Dar PC subscriber, uses a part of transmission link (4Mbps) from Merawi North to Merawi city, which are branched from digital transmission link (under construction) between Bahir Dar PC and Merawi North Rep, for the Merawi North PCO Base Station. The relay capacity is as shown below. Figure 5.2.2-7 shows the system connection diagram (Transmission System Configuration for Mearwi).

a) Existing Transmission Link

Bahir Dar - Merawi North Rep.: (STM- 1 x 3sys)

Merawi North Rep.- Merawi City: (8Mbps)

b) Transmission Link for PCO (Effective use of existing link)

Merawi City - Merawi North PCO Base: (4Mbps) capacity circuits for PCO network

(ii) PCO Network

This network is comprised of the Merawi PCO Base Station additionally installed in Merawi North Rep. station commanding a panoramic view of Merawi Woreda, a PCO repeater Station newly constructed in Mt. Inguti, and above-mentioned 13 PCO subscriber stations. Please see Figure 5.2.2-8 “PCO Network Diagram”. Further, personal computers (PC) will be treated as options, and will be implemented by ETC as needed.

The PCO network established by this plan would be capable of connecting a maximum of 15 PCO subscriber stations for each base station. A wide-band PCO circuits with a capacity of 256kb/s per PCO will be constructed, making easier to access to the IP based services.

In addition to the plan (main plan), an optional plan was studied to set put 7 PCOs out of above mentioned 13 candidates for establishing the network economically. Distance to PCO becomes longer compared with 14 PCOs for some of the communities located in a distant PCO coverage area, however, it is still within a walking distance range discribed in the M/P (5-10km). Therefore, estimated tele-access and beneficiaries will remain unchanged. The 7 PCOs considered in the optional plan is listed in Table 5.2.2-2.

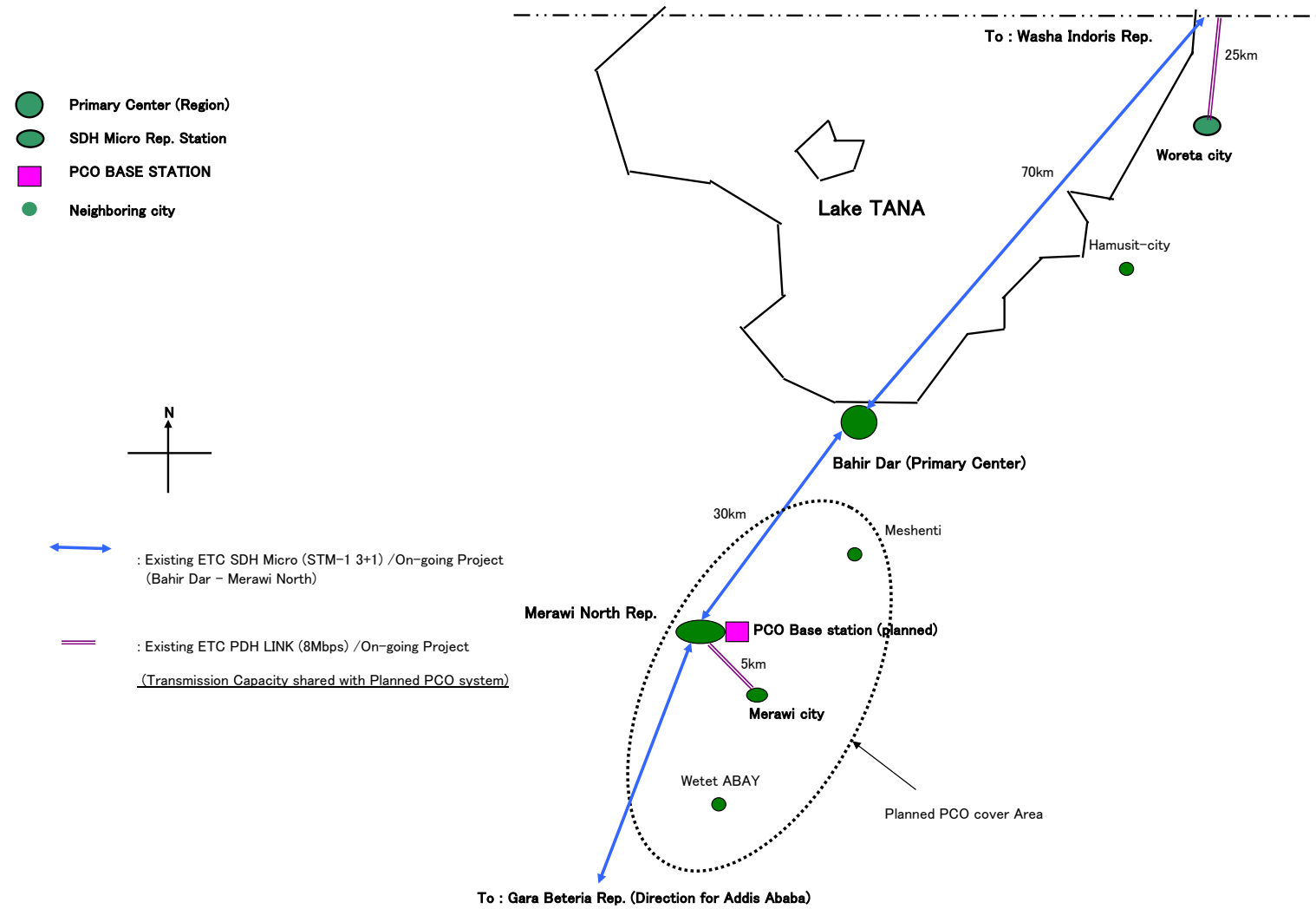


Figure 5.2.2-7 Transmission system configuration for Merawi PCO Station

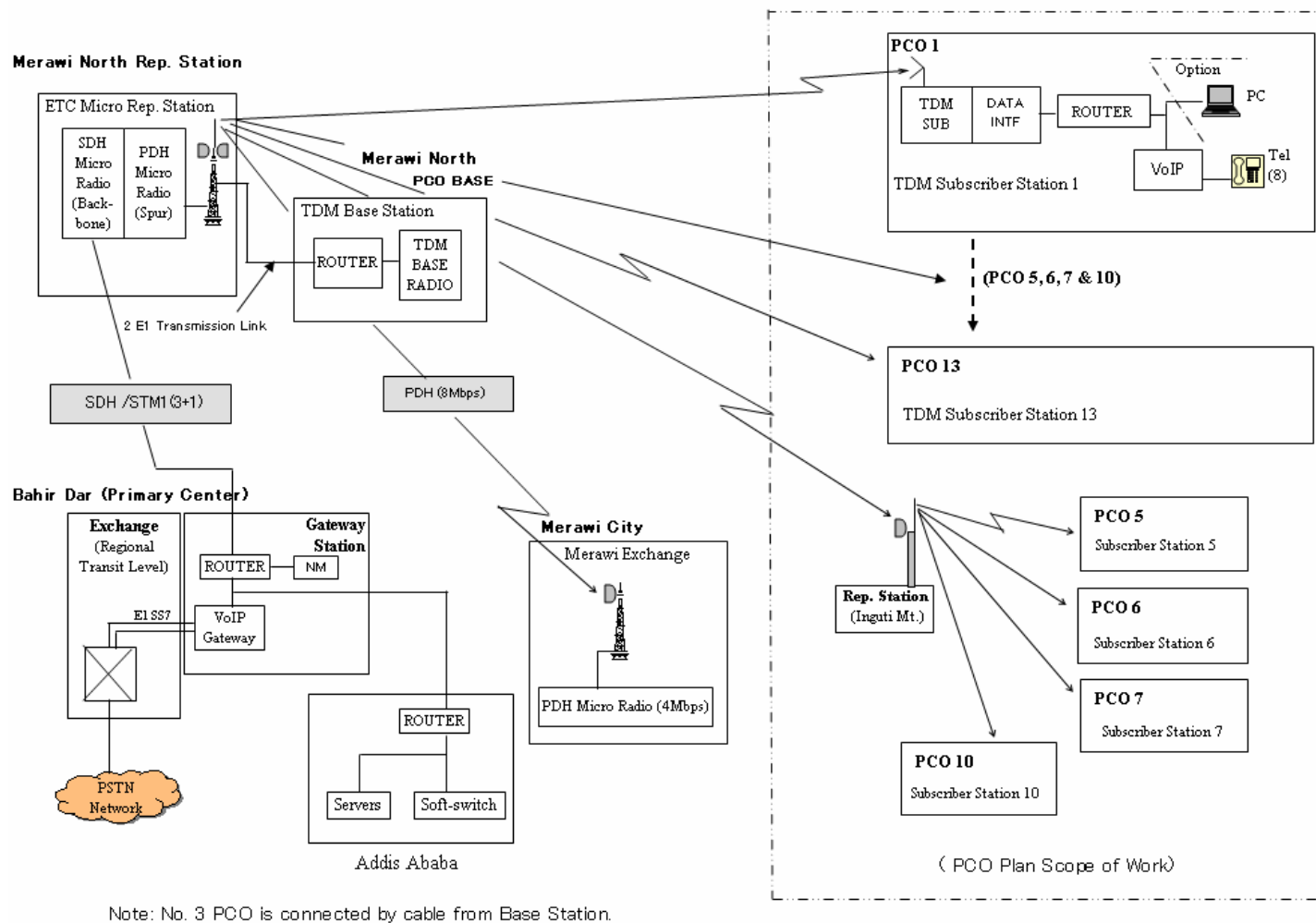


Fig. 5.2.2-8 Merawi Area PCO Configuration

(iii) Power Supply Facilities

Power supply facilities required for this plan are as follows:

a) Merawi North PCO Base Station (newly established)

Power supply for PCO base station facilities is necessary. For DC power supply (-24V DC), the existing power supply of the Merawi North Rep. Station will be used.

b) PCO Subscriber Station (newly established)

Since most of this region is not supplied with commercial power, solar battery system is employed.

For the PCO areas shown below, however, existing commercial power supply is available.

- Meshenti No.1 (PCO No.1), Meshenti No.2 (PCO No.2), Anbo MASK Farmer Office (PCO No.6), Wetet ABAY (PCO No.10)

(iv) Station Building and Antenna Supporting Structures (pole/tower)

a) Merawi North PCO Base Station (newly established)

Though space in the building is needed to accommodate PCO base station facilities to be installed, the existing (on-going project) station building will be used.

b) PCO Subscriber Station (newly established)

Simple building (shelter) for housing PCO subscriber facilities and antenna mounting poles (H=10 to 20m) conforming to each site plan are required. Figure 5.2.2-5 shows a typical equipment layout plan.

c) Repeater Station (newly established)

Simple building (shelter) for housing PCO line repeater facilities and antenna mounting poles (H=10 to 20m) are required.

5.2.3 Proposed Implementation Plan

Table 7.1 shows the overall project implementation schedule.

As shown in this schedule, engineering services including a field survey, detailed design and creation of bidding documents, bidding, evaluation of tenders, etc. will be done by a consultant.

In the implementation of this project, ETC will be responsible for carrying out the following items:

- 1) Preparation and acquisition of PCO sites in each objective area
- 2) Securing of new station building space in Woreta City (central office)
- 3) Preparation and arrangement of simple station building (shelter) for PCO and a shelter for repeater stations

- 4) Preparation of new station building (shelter) for Woreta PCO Base
- 5) Preparation of antenna poles (H=10 to 20 or 30m) conforming to basic design of each PCO site
- 6) Improvement of access roads to sites
- 7) Custom clearance of equipment and materials
- 8) Transport within the country to each site
- 9) Various permissions and approvals required for the construction work of the project
- 10) Tax exemption arrangement with the offices concerned for imported equipment and materials
- 11) Supply of commercial power to the Woreta PCO Base Station (including commercial power lead-in installation work and applications for power company)
- 12) Power feeding to the Merawi North PCO Base Station (including expansion of existing power supply)

5.3 Technical Standard for Network Planning

5.3.1 VoIP Network Plan

The F/S targets, the Bahir Dar region is far away from the capital. This project constructs an IP network utilizing routers, instead of conventional circuit switching system. However, the target regions are small, the scale of the IP network will be limited at the initial stage.

In Ethiopia, construction of VoIP network is the first experience. The components installed in the objective areas are not sufficient for functioning the network. Common basic facilities are required as mentioned below. Because VoIP is a packeted voice signal, it is basically handled in the same manner as other data packets, but has special elements to be considered, that is, voice quality and continuity of voice data. Further, telephone calls must be connected normally to the subscribers of the existing network. For these reasons, basic common facilities dedicated for VoIP (gatekeeper, CCS No.7 related equipment, etc.) shall be provided under this Project. Figure 5.3.1 shows a network including such common facilities.

(1) Bahir Dar Region

As shown in Figure 5.2.2-1, the network of this region consists of 3 areas in the vicinity of Bahir Dar city, 13 PCOs installed in Merawi located about 35km southwest of Bahir Dar and in the surrounding unpopulated area, and 14 PCOs installed in Woreta located about 50km northeast of Bahir Dar and in the surrounding unpopulated area.

As in the Bahir Dar city, distributors with a small capacity are installed in Kebele11 area, airport road and airport, and connected to the Bahir Dar Exchange via optical fiber cables.

Table 5.3.1 shows the equipment list for Bahir Dar Exchange, Kebele 11, Airport Road, Airport, Woreta Exchange and Merawi Exchange.

Table 5.3.1 List of Equipment in Bahir Dar Area

	Router(300K)	Gate way Trunk	VoIP Gate way	Router(50K)	SW Hub
Bahir Dar PC	1	1			
Kebelle 11			8	1	1
Airport			8	1	1
Airport Road			4	1	1
Woreta Ex			28	1	2
Merawi EX			26	1	2
Total	1	1	74	5	7

(2) VoIP Center

Bahir Dar Region and VoIP Center are the main components of the VoIP network that will be implemented. However, since the entire network does not function with these individual components only, the above-mentioned common facilities are essential. The common facilities include Soft Switch including signaling server for CCS No.7, and transmission lines for connecting such equipment to networks, or connecting between networks. Under consideration of reservation of required engineers and maintainability, appropriate installation place of these common facilities seems to be the support center in Addis Ababa where TR-III and mobile exchanges are installed. The place is named VoIP Center.

Among those common facilities other than the VoIP Center facilities, necessary transmission circuits are to be secured by ETC, i.e., transmission circuits connecting Bahir Dar and Addis Ababa, and Bahir Dar – Woreta exchange/Merawi exchange sections before (or the same time when) facilities (1) and (2) are installed. Figure 5.3.1 shows a conceptual diagram.

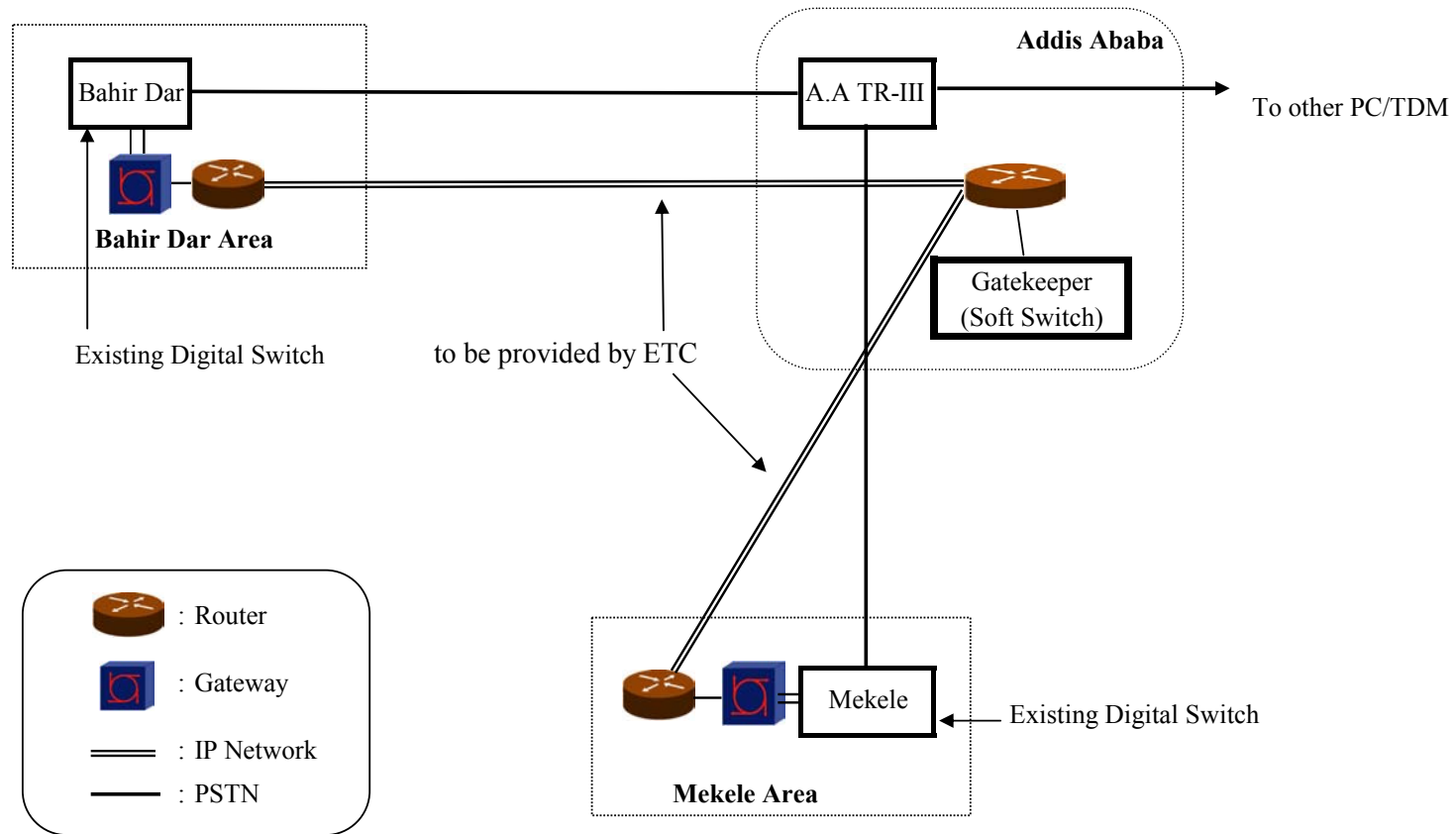


Figure 5.3.1 VoIP Network Configuration

5.3.2 Numbering Plan

The numbers assigned to VoIP subscribers shall be configured by a two-digit exchange number and a four-digit subscriber number as the immediate and first alternative.

In the switched networks for long-distance calls, regions are identified by the first digit (area code), except for “0.” The nation is divided into eight regions, and the primary centers of respective regions deal with the next two digits to identify the exchange to which the called party is connected.

For VoIP subscribers being called, however, since these two digits are used to distinguish subscribers of existing systems from VoIP systems, it is necessary to recognize three digits (including area code), even for the calls initiated from the existing exchange to the IP networks. This recognition of the three digits must be handled by all existing exchanges throughout the country.

The Exchange numbers assigned to each F/S applicable region are as follows:

Bahir Dar Region

Kebele11 and areas toward the airport:	81
Merawi area and Merawi woreda rural area:	82
Woreta area and Woreta woreda rural area:	83

As for the long term numbering plan, the provision of the specific service code will be recommendable as given in Master Plan.

5.3.3 Routing Plan

With the existing networks, the route of calls from an originating Exchange to a terminating Exchange was determined by the exchange in advance. Once a call is established between the calling subscriber and called subscriber, the line is occupied until the call is terminated.

With the IP networks, on the other hand, a router determines the destination but does not set the routing of calls. Each packet (including voice which is handled as data packets) contains information on its destination, and the router decides the routing based on the current status of the network, and sends the packet off to the next router. Thus the packets do not come with predetermined routing. In other words, even when packets are being passed between identical subscribers A and B, these packets do not necessarily go through the same route.

The IP network in Ethiopia, however, is in the initial stage. Since the network is configured in a simple manner, selection of route is really not an issue. [All connections between Mekele/Bahir Dar and Addis Ababa of the VoIP systems will always be controlled by the soft switch in Addis Ababa.]

5.3.4 Signaling System

1) Data transmissions

The basic protocol of TCP/IP is to be used.

2) Connection information with the existing networks

The ITU-T CCS No.7 ISUP, which is in common use with the existing networks, shall continuously be used. This is necessary for connecting existing network subscribers and VoIP subscribers, and will become obsolete only after all subscribers will become VoIP subscribers.

5.3.5 Charging System

Individual exchanges have maintained the charging system of the existing networks. The charge data is then sent to a dedicated computer in Addis Ababa for processing via on-line connections or on optical disks.

For the case of the VoIP networks, however, call data are not registered in the VoIP facility (equivalent to exchange) located in each region. But the gatekeeper / soft switch collectively manages call data, and the data shall be forwarded to a dedicated computer through on-line connections. The existing charging system shall be retained.

5.3.6 Network Synchronization

There is no problem concerning the supply of clock signal from the existing facility of the network, since IP networks are asynchronous. Only transmission lines require the supply of clock signal.

5.3.7 Transmission Standards

The ETC transmission standards are implemented to assure favorable communication quality of calls from all subscribers anywhere in the country.

For the digital Multi-Access Radio System (MARS), however, the bit error rate (BER) specified in the ITU-R Rep. 380-3 for the line length of 500km or less shall be applied to keep the construction cost at the reasonable level.

5.4 Networks Improvement and Expansion Plan

The following proposal, formulated with consideration for number of telephones in demand, traffic volume, geographical conditions, environment, conditions of existing communication facilities, ease of equipment purchases, and trends of communications technologies, is offered to construct optimum communications facilities for the switching exchange areas under this feasibility study.

5.4.1 Exchange Facilities

Facilities to be introduced shall be VoIP-based systems, and the existing digital exchanges shall be excluded. The VoIP system specifications are as follows:

- a) Call originating rate: 0.05 Erl.
- b) Voice packet: G.729/G.711
- c) Packet length: (Pay load 40 byte + Header 40 byte)
- d) Packet interval: 40msec
- e) Nodes for subscriber lines shall be compatible with analog telephone units, and the voltage applied on subscriber lines shall be DC-48V, in principle.
- f) Call charges are calculated by real-time CDR (Call Detail Record) that is on line connected to the billing computer of ITCD (Information Technology Center Div.)

The applicable VoIP network configuration diagram is shown in Fig.5.2.2-1 and Fig. 5.3.1-1.

(1) Three Bahir Dar Areas

Considering that, in the Kebele 11, airport road, airport areas, even the area with the high demand is about 750, and that the routes of subscriber cables and optical fiber cables from Bahir Dar, VoIP facilities is to be installed in an outdoor cabinet, in principle. Taking into account the characteristics of equipment, however, it is important to prevent the ambient temperature from rising.

Equipment of host center that controls these three areas will be installed in the equipment room of the existing Bahir Dar Exchange 1F (second floor). Please refer to Figure 5.4.1.

(2) Woreta Exchange and Merawi Exchange

Build a small building and install VoIP facilities for these Exchanges. Equipment to be installed in the building include transmission equipment, switching hubs, routers, gateways, and their power units. In addition, a small manual exchange will also be installed as required.

Floor space for VoIP shall be kept for 3,000 subscriber ports. The numbers of ports to be installed under the project are;

Woreta: 840 ports (28 units G.W.)

Merawi: 780 ports (26 units G.W.)

5.4.2 Transmission Facilities

(1) Selection of Transmission System

For transmissions from the applicable exchange to subscribers, optical fiber cable transmission system and subscriber multi-access radio system shall be used. The repeater line to connect the exchanges shall be by Point-to-Point digital radio system.

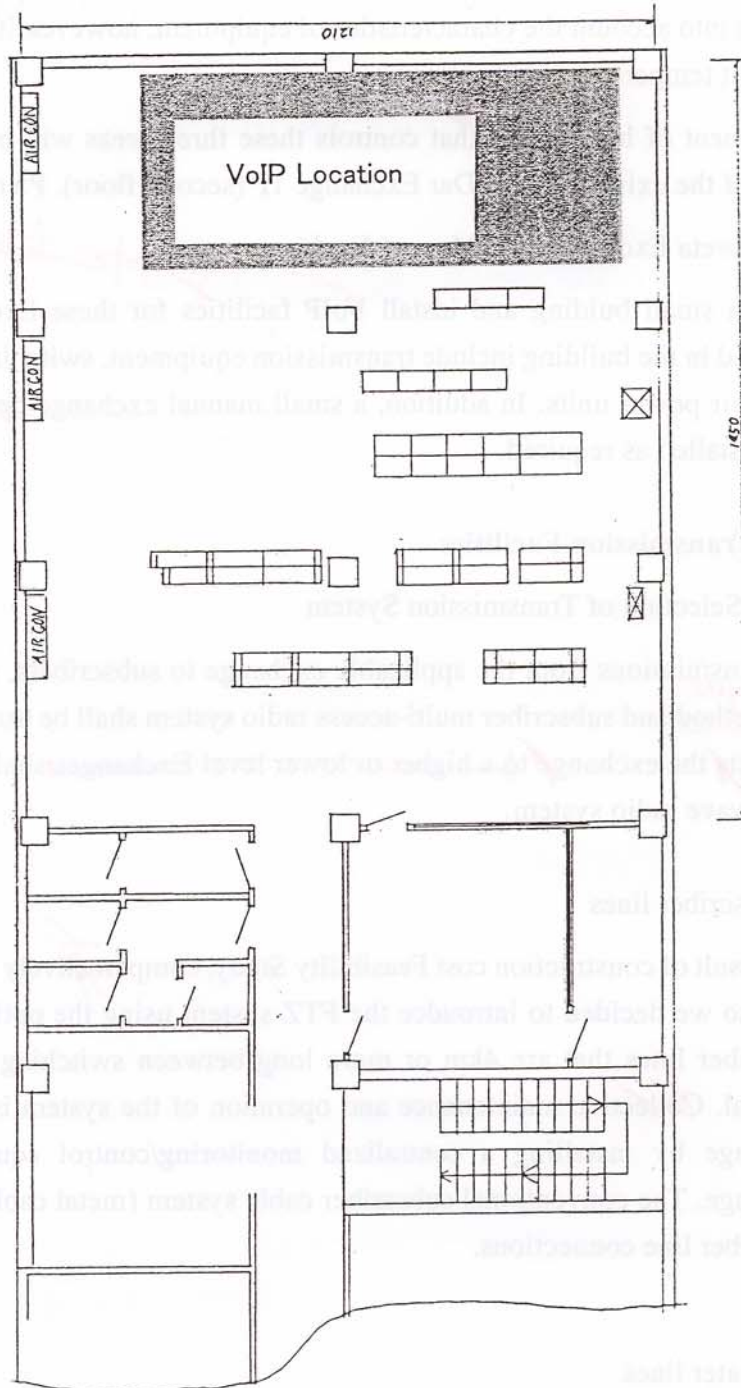
a) Subscriber lines

As a result of construction cost study, comparatively many concentrated demands are made clear, so Study Team decided to introduce the FTZ system using the optical fiber cable transmission system for subscriber access network that are 4km or more long between switching exchange and subscribers. Corrective maintenance and operation of the system is enabled at the exchange by installing a centralized monitoring/control equipment in the exchange. The conventional subscriber cable system (metal cable method) is also used for subscriber line connections.

b) Repeater lines

In order to satisfy the required number of lines, it will become necessary to increase the number of the current transmission lines or install new lines between Bahir Dar and Woreta and between Bahir Dar and Merawi. After evaluating various system in terms of technology, economy, and expandability, digital radio system (7GHz band with a transmission capacity of 8Mbit/s) is considered as an optimum system for the transmission lines. The actual radio frequency used with this radio method is planned to be determined in the detailed design stage, based on the radio frequency allocation policy of ETC, which in turn will be based on the determination made at the WARC-92.

Figure 5.4-1



Drawing 5.4-1 Floor Layout plan for the VoIP equipment

5.4.3 Outside Plant

5.4.3.1 Basic Plan

(1) Configuration

The best method for cabling of subscriber lines will be selected from among direct burying cabling and aerial distribution methods, considering the demands of the respective areas, conditions of the areas, and road conditions. For ordinary cabling, in cases where remote subscribers for which line loss and loop resistance exceed acceptable level, the FTZ method that uses subscriber optical fiber cable transmission system will be employed.

(2) Provision Period

The provision period of outside plant shall be adequate to provide the capacity for demands in a period of five years from the commencement of the service (until 2010).

(3) Components

Materials to be provided and major equipment to be constructed in this project are composed of in-duct cables, overhead cables and cable-related facilities. Details of these facilities are described below.

1) Cabling facilities

a) Primary cables

Optical fiber cable will be installed in duct under ground. Types of cables used are shown below:

Type	Core diameter	Number of optical cable cores	
In-duct cable	SM optical cable	12C	

b) Secondary cables

Self-supporting PE-insulated, PE-sheathed aerial cables will be used. Number of pairs and core diameter of cables used are shown below:

Type	Core diameter	Number of pairs			
Aerial cable	0.4mm	200	100	50	30

c) Termination and connection of cables

- The VoIP office-side termination of optical fiber cables is connected by installing an optical termination box in the MDF room. The termination on the FTZ cabinet side is conducted by terminating the optical cable terminals of the FTZ. Connections of O/F cables at other locations shall be conducted by using mechanical closures (mechanical connection materials) in order to assure fast and uniform work quality.

- The termination of the secondary cables (metal) is conducted on the FTZ side.

Connection of cables at other locations shall be made by the heat shrinkable equipment.

d) Distribution Points

Distribution points shall be mounted on telephone poles (on-pole type) or installed in buildings (in-house type). Such telephone poles must be positioned at locations where drop wires installation into subscriber households would be easy, where they do not become obstructions to pedestrians and vehicle traffic, and where future relocations will not be expected, with consideration for maintainability. For places requiring a PBX an in-house type distribution point will be mounted on the wall.

e) Telephone poles

Telephone poles used in this construction shall be all of concrete poles.

The length of the poles shall be 8.0m, with design strength of 200kg. The one-sixth of the length shall be buried underground.

2) Civil Works

a) Types of ducts

Steel ducts shall be used in places where it is necessary to prevent damages that may be caused by construction work of other services, when suspending cables on bridging devices, or when cabling across busy major roads with heavy traffic.

b) Types of manholes

Manholes are installed in locations where cables are connected, distributed, or otherwise required for construction or maintenance. The capacity (size) of manhole shall be determined in consideration of the items below:

- Required number of ducts
- Necessary working space
- Existence or nonexistence of cable connections

However, since manholes to be used in this project are located at cable connecting portions or FTZ base portions, S-2 type manholes shall be used.

The standard for manholes used are as follows: Table 5.4.3-1

Table 5.4.3 - 1 Manhole Standard

Manhole type	Length (m)	Width (m)	Depth (m)	Number of ducts
S-1	1.80	1.00	1.80	4
S-2	2.30	1.30	1.80	8
S-3	3.00	1.40	1.80	16

c) Manhole interval

The interval of manholes for copper loop networks shall be up to 250m considering cable branching, cross connection cabinet locations, cabling work, and other geographical conditions. However, manholes will be located only at optical fiber connecting portions, the interval shall be approximately 2km.

d) Burying depth of direct buried cable

For direct buried cables, warning tape shall be buried 10 – 15cm above the top of cable in order to avoid any damages caused by underground construction of other services. If cables occupy the road, the burying depth from the surface of the ground to the top of the cable shall be as follows:

- Roadway: 120cm or more
- Sidewalk: 80cm or more

e) Protection of direct buried cables

For bridge attachment, cable installation method is to be determined through discussions with Bahir Dar City. However, cables shall be completely protected in a steel pipe. Also, for portions of crossing a road, cables shall be completely protected in a steel pipe. Further, when ETC gives an instruction to protect cables by placing a flat concrete plate above buried cables, the instruction shall be respected.

5.4.3.2 Main Works of Outside Plant

(1) Subscriber Lines

The main works for the planned subscriber lines are shown in Table 5.4.3-2.

Table 5.4.3-2 Main Works of Subscriber Line Facilities

Description		Unit	Q'ty	Remarks
Pole	8.0-200CP	PCs	112	
	8.0-200CP(Stay)	PCs	8	
Stay	Stay	PCs	18	Used Block Type
	Over Head Stay	PCs		
Grounding	GU	PCs	39	
Aerial Cable	AC- 30-4	M		
	AC- 50-4	M	900	
	AC-100-4	M	1,755	
	AC-200-4	M	1,840	
Distribution Point	DP-10	PCs	29	With Jointing
Jointing	J-A-200-200-4	PCs		Without DP. Jointing
	J-A-200-100-4	PCs	5	
	J-A-200-50-4	PCs	3	
	J-A-200-30-4	PCs		
	J-A-100-100-4	PCs	1	
	J-A-100-50-4	PCs	1	
	J-A-100-30-4	PCs		
	J-A-50-50-4	PCs		
	J-A-50-30-4	PCs		
J-A-30-30-4	PCs			
Cable Termination	CT-100-4	PCs	5	
	CT-200-4	PCs	1	

(2) Optical Access Network

Main works of the planned optical access network are shown in Table 5.4.3-3.

Table 5.4.3-3 Main Works of Optical Access Network

Description		Unit	Q'ty	Remarks
Manhole	MH S-2	PCs	6	
DUCT	ST PIPE 100mm ϕ	M	410	
In Duct Cable	DB-OFJ-12C	M	12,110	
Jointing · Mechanical Joint	DB-OFJ-12C	PCs	3	MH1,3,4,5
Cable Termination	DB-OFJ-12C	PCs	4	VoIP1,2,3
	DB-OFJ-12C	PCs	2	Bahir Dar Ex.
Cabinet	FTZ-750ch Capacity Installed 240 x 2 120 x 2	PCs	3	With Foundation

5.4.3.3 Materials and Equipment for Maintenance

The following spare materials and equipment are provided for the purpose of maintenance of cables and civil works of this plan:

- Cables (optical fiber cables and secondary metal cables)
- Distribution points
- Mechanical closures
- Connecting materials and tools
- One maintenance vehicle (Truck)

5.4.3.4 Basic Design Drawings

The following basic design drawings are attached to this document:

- 1) Key map
- 2) OFC Guide Map
- 3) OF Cable Map
- 4) FTZ Area (Drawing 1)
- 5) FTZ Area (Drawings 2 and 3)

5.4.4 PCO

(1) PCO Sites

PCO network configuration and candidate sites are given in item 5.2.2.

PCOs to be installed under the project is selected from the candidates given in item 5.2.2.

1) Woreta area

Woreta Base Station:	connected to Woreta City by O/F cable (2M x 2)
Repeater station No.1:	connected to Woreta Base Station by O/F cable (2M x 2)
Repeater station No.2:	linked to repeater station No.1 by point to multi-point radio system

PCOs:

No.1 Gala Minder:	from base station
No.2 Wore Meda:	from Rep. No.1
No.3 Arbaba:	linked by 10/0.65 cable from Rep. No.2
No.4 Seleko Medhne:	from base station
No.5 Anguko:	from base station
No.6 Mobile Station:	linked by 10/0.65 cable from Woreta Exchange
No.7 Atvet College:	from base station
No.8 Bawabat:	from base station

No.9 Shiga Maryam:	from base station
No.10 S. T. Haymanot:	from base station
No.11 Hod Gebeya:	from base station
No.12 Kidiste Hana:	from base station
No.13 Rice Research:	from base station
No.14 Sefatra:	linked by radio from Rep. No.1

2) Merawi area

Merawi North Base Station: connected to Merawi City by Point-Point radio system (2M x 2)

Repeater station (Mt. Inguti): linked to base station by point to multi-point radio system

PCOs:

No.1 Meshenti:	from base station
No.2 Meshenti:	from base station
No.3 Bachuma:	linked by 10/0.65 cable from base station
No.4 Inamrt:	from base station
No.5 A. Mask	from base station
No.6 A. Mask (school)	from Rep. station
No.7 A. Mask (Office)	from Rep. station
No.8 Inguti School:	from base station
No.9 Inguti road side	from base station
No.10 Wetet Abay:	from Rep. Station
No.11 Kurt Bahir:	from base station
No.12 Rim:	from base station
No.13 K. Giyorgis:	from base station

(2) Equipment and Materials

Equipment and materials for PCO network are given in table 5.4.4-1~2. (-1 for Woreta, -2 for Merawi)

Table 5.4.4-1 (1/2) Equipment and Material for Woreta PCO (Main Plan)

Item	Description	Unit	Base Station	PCO/Sub.	Total	Remarks
A	Base Station (TDM, 1+1) Hot Standby					
1	Omni-directional antenna with Mounting hardware	set	1		1	
2	2.4 GHz band, TDM Base station	set	1		1	
2.1	Installation Materials	lot	1		1	
2.2	Instruction Manuals	vol	1		1	
2.3	Network Management System					
2.3.1	Desk-top Computer	set	1		1	
3	Coaxial Feeder & Connector					
3.1	Coaxial Feeder, (70m/stn.)	m	1		70	
3.2	Coaxial Connector, NP&NJ	lot	1		1	
3.3	Coaxial Earth Kit	lot	1		1	
3.4	Coaxial Arrester	pcs.	1		1	
3.5	Jumper Cable for Antenna side	pcs.	1		1	
B	Repeater/Subscriber Station (TDM, 1+0) No Standby					
1	2.4 GHz band, TDM Subscriber station	set		12 + 2	14	
1.1	Grid parabolic or Corner antenna	pcs.		12 + 2	14	
1.2	Coaxial Feeder (30m/stn.)	m		12 + 2	420	
1.3	Coaxial Connector, NP&NJ	pcs.		12 + 2	14	
1.4	Coaxial Earth Kit	pcs.		12 + 2	14	
1.5	Coaxial Arrester	pcs.		12 + 2	14	
1.6	Installation Materials	lot		12 + 2	14	
1.7	Jumper Cable for Antenna side	pcs.		12 + 2	14	
2	Interface Module					
2.1	2 Wire interface card (5 lines / card)	pcs.		2	2	
2.2	High speed data interface card	pcs.		14	14	
C	VoIP Network					
1	Gate Keeper	set				
2	Application Server	set				
3	Router serial upto 768 kbit/s	set	3	2 + 14	19	
4	Switching HUB, 8 Port	set		14	14	
5	VoIP TA (1PCO=8CH)	set		70	70	
D	Solar Power Supply System					
1	for Base Station	set	1		1	
2	for Repeater Station	set		2	2	
3	for Subscriber Station	set		12	12	
4	Installation Materials for Base Station	lot	1		1	
5	Installation Materials for Repeater Station	lot		2	2	
6	Installation Materials for PCO/Subscriber Station	lot		12	12	
E	Installation S/V					
1	for Equipment	lot			1	
2	for Power Supply	lot			1	
F	Tower/Pole					
1	40m Tower for PCO BASE Station	set		1	1	
2	20/30m Tower for PCO/Repeater Station	set		2	2	
3	20m Tower for PCO/Subscriber Station	set		4	4	
4	10m Pole for PCO/Subscriber Station	set		8	8	
5	Tower/Pole Foundation for the Above	set		15	15	
6	Installation Materials	lot		15	15	
G	Installation Fee					
1	Equipment & Materials	lot		1	1	
2	Antenna Mounting for Base Station	lot		1	1	
3	Tower/Pole for PCO/Subscriber Station					
3.1	Tower/Pole Foundation	lot		15	15	
3.2	Tower/Pole Installation	lot		15	15	
4	Solar Power Supply					
4.1	Solar Power Installation	lot	1	14	15	
4.2	Solar Power Foundation	lot	1	14	15	
H	Spares	lot			1	
I	Shelter					
1	Shelter for Repeater Station		2		2	
2	Shelter for PCO/Subscriber Station			14	14	
J	Engineering Consultant Fee	lot			1	

Table 5.4.4-1 (2/2) Equipment and Material for Woreta PCO (Optional Plan)

Item	Description	Unit	Base Station	PCO/Sub.	Total	Remarks
A	Base Station (TDM, 1+1) Hot Standby					
1	Omni-directional antenna with Mounting hardware	set	1		1	
2	2.4 GHz band, TDM Base station	set	1		1	
2.1	Installation Materials	lot	1		1	
2.2	Instruction Manuals	vol	1		1	
2.3	Network Management System					
2.3.1	Desk-top Computer	set	1		1	
3	Coaxial Feeder & Connector					
3.1	Coaxial Feeder, (70m/stn.)	m	1		70	
3.2	Coaxial Connector, NP&NJ	lot	1		1	
3.3	Coaxial Earth Kit	lot	1		1	
3.4	Coaxial Arrester	pcs.	1		1	
3.5	Jumper Cable for Antenna side	pcs.	1		1	
B	Repeater/Subscriber Station (TDM, 1+0) No Standby					
1	2.4 GHz band, TDM Subscriber station	set		6 + 2	8	
1.1	Grid parabolic or Corner antenna	pcs.		6 + 2	8	
1.2	Coaxial Feeder (30m/stn.)	m		6 + 2	240	
1.3	Coaxial Connector, NP&NJ	pcs.		6 + 2	8	
1.4	Coaxial Earth Kit	pcs.		6 + 2	8	
1.5	Coaxial Arrester	pcs.		6 + 2	8	
1.6	Installation Materials	lot		6 + 2	8	
1.7	Jumper Cable for Antenna side	pcs.		6 + 2	8	
2	Interface Module					
2.1	2 Wire interface card (5 lines / card)	pcs.		2	2	
2.2	High speed data interface card	pcs.		7	7	
C	VoIP Network					
1	Gate Keeper	set				
2	Application Server	set				
3	Router serial upto 768 kbit/s	set	3	2 + 7	12	
4	Switching HUB, 8 Port	set		7	7	
5	VoIP TA (1PCO=8CH)	set		35	35	
6	Installation Materials	lot				
D	Solar Power Supply System					
1	for Base Station	set	1		1	
2	for Repeater Station	set		2	2	
3	for Subscriber Station	set		7	7	
4	Installation Materials for Base Station	lot	1		1	
5	Installation Materials for Repeater Station	lot		2	2	
6	Installation Materials for PCO/Subscriber Station	lot		7	7	
E	Installation S/V					
1	for Equipment	lot			1	
2	for Power Supply	lot			1	
F	Tower/Pole					
1	40m Tower for PCO BASE Station	set		1	1	
2	20/30m Tower for PCO/Repeater Station	set		2	2	
3	20m Tower for PCO/Subscriber Station	set		3	3	
4	10m Pole for PCO/Subscriber Station	set		3	3	
5	Tower/Pole Foundation for the Above	set		9	9	
6	Installation Materials	lot		9	9	
G	Installation Fee					
1	Equipment & Materials	lot		1	1	
2	Antenna Mounting for Base Station	lot		1	1	
3	Tower/Pole for PCO/Subscriber Station					
3.1	Tower/Pole Foundation	lot		9	9	
3.2	Tower/Pole Installation	lot		9	9	
4	Solar Power Supply					
4.1	Solar Power Installation	lot	1	9	10	
4.2	Solar Power Foundation	lot	1	9	10	
H	Spares	lot			1	
I	Shelter					
1	Shelter for Repeater Station		2		2	
2	Shelter for PCO/Subscriber Station			7	7	
J	Engineering Consultant Fee	lot			1	

Table 5.4.4-2 (1/2) Equipment and Material for Merawi PCO (Main Plan)

Item	Description	Unit	Base Station	PCO/Sub.	Total	Remarks
A	Base Station (TDM, 1+1) Hot Standby					
1	Omni-directional antenna with Mounting hardware	set	1		1	
2	2.4 GHz band, TDM Base station	set	1		1	
2.1	Installation Materials	lot	1		1	
2.2	Instruction Manuals	vol	1		1	
2.3	Network Management System					
2.3.1	Desk-top Computer	set	1		1	
3	Coaxial Feeder & Connector					
3.1	Coaxial Feeder, (70m/stn.)	m	1		70	
3.2	Coaxial Connector, NP&NJ	lot	1		1	
3.3	Coaxial Earth Kit	lot	1		1	
3.4	Coaxial Arrester	pcs.	1		1	
3.5	Jumper Cable for Antenna side	pcs.	1		1	
B	Repeater/Subscriber Station (TDM, 1+0)					
1	2.4 GHz band, TDM Subscriber station	set		14	14	
1.1	Grid parabolic or Corner antenna	pcs.		14	14	
1.2	Coaxial Feeder (30m/stn.)	m		14	520	
1.3	Coaxial Connector, NP&NJ	pcs.		14	14	
1.4	Coaxial Earth Kit	pcs.		14	14	
1.5	Coaxial Arrester	pcs.		14	14	
1.6	Installation Materials	lot		14	14	
1.7	Jumper Cable for Antenna side	pcs.		14	14	
2	Interface Module					
2.1	2 Wire interface card (5 lines / card)	pcs.		2	2	
2.2	High speed data interface card	pcs.		14	14	
C	VoIP Network					
1	Gate Keeper	set				
2	Application Server	set				
3	Router serial upto 768 kbit/s	set	3	2 + 7	12	
4	Switching HUB, 8 Port	set		7	7	
5	VoIP TA (1PCO=8CH)	set		35	35	
6	Installation Materials	lot				
D	Solar Power Supply System					
1	for Base Station	set	1		1	
2	for Repeater Station	set		1	1	
3	for Subscriber Station	set		10	10	
4	Installation Materials for Base Station	lot	1		1	
5	Installation Materials for Repeater Station	lot		1	1	
6	Installation Materials for PCO/Subscriber Station	lot		10	10	
E	Installation S/V					
1	for Equipment	lot			1	
2	for Power Supply	lot			1	
F	Tower/Pole					
1	40m Tower for PCO BASE Station	set				
2	20m Tower for PCO/Repeater Station	set		2	2	
3	20/30m Tower for PCO/Subscriber Station	set		5	5	
4	10m Pole for PCO/Subscriber Station	set		5	5	
5	Tower/Pole Foundation for the Above	set		12	12	
6	Installation Materials	lot		12	12	
G	Installation Fee					
1	Equipment & Materials	lot			1	
2	Antenna Mounting for Base Station	lot			1	
3	Tower/Pole for PCO/Subscriber Station					
3.1	Tower/Pole Foundation	lot		12	12	
3.2	Tower/Pole Installation	lot		12	12	
4	Solar Power Supply					
4.1	Solar Power Installation	lot	1	11	12	
4.2	Solar Power Foundation	lot	1	11	12	
H	Spares	lot			1	
I	Shelter					
1	Shelter for Repeater Station			1	1	
2	Shelter for PCO/Subscriber Station			13	13	
J	Engineering Consultant Fee	lot			1	

Table 5.4.4-2 (2/2) Equipment and Material for Merawi PCO (Optional Plan)

Item	Description	Unit	Base Station	PCO/Sub.	Total	Remarks
A	Base Station (TDM, 1+1) Hot Standby					
1	Omni-directional antenna with Mounting hardware	set	1		1	
2	2.4 GHz band, TDM Base station	set	1		1	
2.1	Installation Materials	lot	1		1	
2.2	Instruction Manuals	vol	1		1	
2.3	Network Management System					
2.3.1	Desk-top Computer	set	1		1	
3	Coaxial Feeder & Connector					
3.1	Coaxial Feeder, (70m/stn.)	m	1		70	
3.2	Coaxial Connector, NP&NJ	lot	1		1	
3.3	Coaxial Earth Kit	lot	1		1	
3.4	Coaxial Arrestor	pcs.	1		1	
3.5	Jumper Cable for Antenna side	pcs.	1		1	
B	Repeater/Subscriber Station (TDM, 1+0) No Standby					
1	2.4 GHz band, TDM Subscriber station	set		8	8	
1.1	Grid parabolic or Corner antenna	pcs.		8	8	
1.2	Coaxial Feeder (30m/stn.)	m		8	240	
1.3	Coaxial Connector, NP&NJ	pcs.		8	8	
1.4	Coaxial Earth Kit	pcs.		8	8	
1.5	Coaxial Arrestor	pcs.		8	8	
1.6	Installation Materials	lot		8	8	
1.7	Jumper Cable for Antenna side	pcs.		8	8	
2	Interface Module					
2.1	2 Wire interface card (5 lines / card)	pcs.		2	2	
2.2	High speed data interface card	pcs.		7	7	
C	VoIP Network					
1	Gate Keeper	set				
2	Application Server	set				
3	Router serial upto 768 kbit/s	set	3	2 + 7	12	
4	Switching HUB, 8 Port	set		7	7	
5	VoIP TA (1PCO=8CH)	set		35	35	
6	Installation Materials	lot				
D	Solar Power Supply System					
1	for Base Station	set	1		1	
2	for Repeater Station	set		1	1	
3	for Subscriber Station	set		6	6	
4	Installation Materials for Base Station	lot	1		1	
5	Installation Materials for Repeater Station	lot		1	1	
6	Installation Materials for PCO/Subscriber Station	lot		6	6	
E	Installation S/V					
1	for Equipment	lot			1	
2	for Power Supply	lot			1	
F	Tower/Pole					
1	40m Tower for PCO BASE Station	set				
2	20m Tower for PCO/Repeater Station	set		2	2	
3	20/30m Tower for PCO/Subscriber Station	set		3	3	
4	10m Pole for PCO/Subscriber Station	set		2	2	
5	Tower/Pole Foundation for the Above	set		7	7	
6	Installation Materials	lot		7	7	
G	Installation Fee					
1	Equipment & Materials	lot			1	
2	Antenna Mounting for Base Station	lot			1	
3	Tower/Pole for PCO/Subscriber Station					
3.1	Tower/Pole Foundation	lot		7	7	
3.2	Tower/Pole Installation	lot		7	7	
4	Solar Power Supply					
4.1	Solar Power Installation	lot	1	7	8	
4.2	Solar Power Foundation	lot	1	7	8	
H	Spares	lot			1	
I	Shelter					
1	Shelter for Repeater Station			1	1	
2	Shelter for PCO/Subscriber Station			7	7	
J	Engineering Consultant Fee	lot			1	

5.4.5 Power Supply System

Facility plans for power supply system are as follows:

(1) Bahir Dar Exchange

Power supply for microwave radio system is required, and existing power supply will be used for this purpose. Power for FTZ is to be supplied by the commercial power with the rectifier and the back-up batteries contained in FTZ.

(2) Woreta Exchange

Power supply for system required, and existing power supply will be used for this purpose. Power system composed of the rectifier and back-up batteries for VoIP to be installed under the project.

(3) Merawi Exchange

Power supply system composed of the rectifier and back-up batteries is to be installed for VoIP. Existing power system is available for microwave systems.

(4) PCO Subscriber Station

Since most of areas currently have no commercial power supply available, new solar power system shall be provided. For the areas where commercial power supply is available, rectifier and buck-up batteries are installed.

5.4.6 Antenna and Towers

Steel poles/towers are constructed depending on the antennas to be loaded.

5.4.7 Building Facilities

A simple building/shelter is required for installing equipment and telephone booth as well as for operator at PCO site. Equipment required for the project will be installed in the existing exchange building at **Woreta Exchange, Merawi Exchange, Merawi Exchange**

5.4.8 Terminal Facilities

Subscriber terminal facilities such as telephone units (for general subscribers as well as public use), facsimile equipment and subscriber line connecting materials (drop wire into subscriber households, subscriber protection units, and indoor wires) will be procured by the ETC.