Photo-No.2-1, Site Photo, Messobo Repeater Station

Photo-No.2-2, Existing Self-Supporting Tower, 10m, Messobo Rep

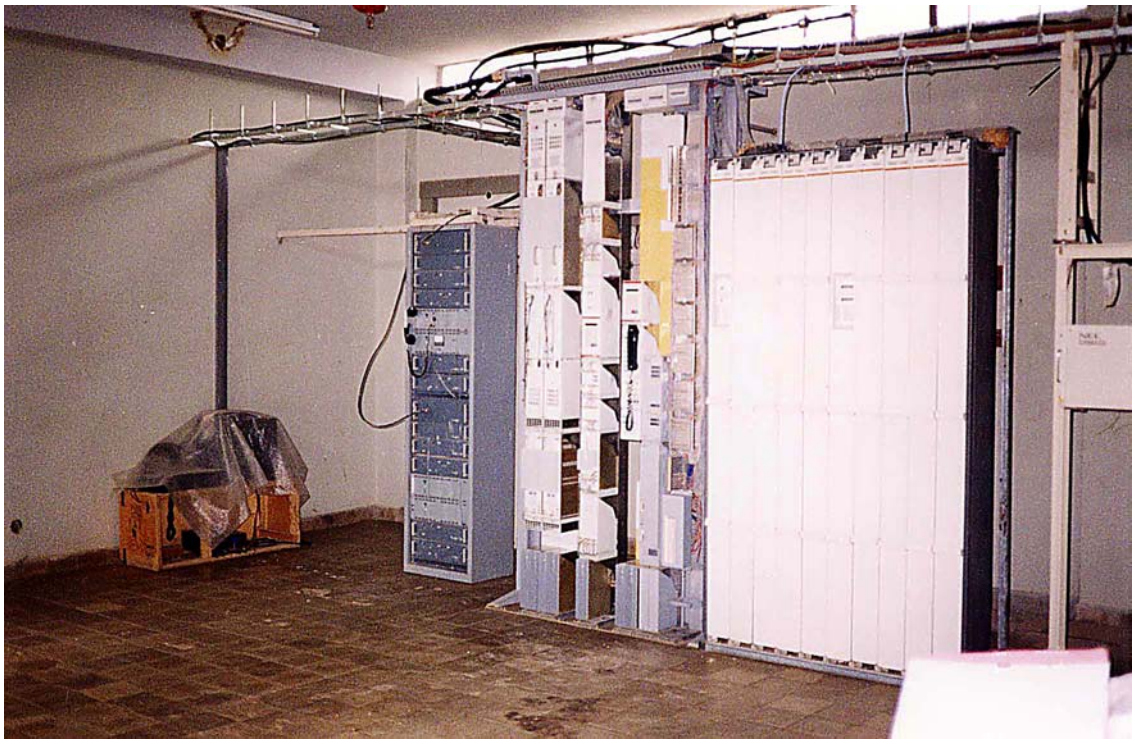


Photo-No.2-3, Equipment Room, Messobo Rep

Photo-No.3-1, Site Photo, Ikotamba Repeater Station

4. FORECAST OF TELEPHONE DEMANDS AND TRAFFIC

4.1 Telephone Demand Forecasting

(1) Macroscopic Demand Forecasting

The figures from the nation-wide macroscopic demand forecast 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 and Table 4.2.

Table 4.1 Nationwide Macroscopic Demand Forecast Figures for Ethiopia (Fixed-telephones)

Region	Year				
	2000	2005	2010	2015	2020
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
Oromia	93,211	129,452	177,529	241,416	322,026
Somali	3,915	8,317	14,490	23,087	34,332
Bnishangul	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 4.2 F/S Applicable Project Regions Macroscopic Demand Forecast Figures (Fixed telephones)

Region	Year				
	2000	2005	2010	2015	2020
Mekele	6,047	7,854	10,216	13,290	17,108
Wukro	1,239	1,609	2,092	2,721	3,502
Total	7,286	9,463	12,308	16,011	20,610

(2) Microscopic Demand Forecasting

The figures from the microscopic nation-wide demand forecast by JICA for the master plan in June 2002 are used as reference.

Microscopic forecast values for the entire nation of Ethiopia, as well as F/S project areas are shown in Table 4.3 and Table 4.4.

Table 4.3 Nationwide Microscopic Demand Forecast Figures for Ethiopia (Fixed telephones)

Region	Year				
	2000	2005	2010	2015	2020
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 4.4 F/S Project Areas Microscopic Demand Forecast Figures (fixed telephones)

Region	Year				
	2000	2005	2010	2015	2020
Mekele	13,721	16,809	23,575	33,065	46,375
Wukro	1,063	1,487	2,125	3,032	4,287
Total	14,784	18,296	25,700	36,097	50,662

(3) Microscopic Forecasting Values for the New Residential Development at Adi-Sumduhum Within the Mekele Exchange Area

The forecasted values of the microscopic demand for the new residential development of Adi-Sumduhum are determined by the results obtained from site surveys, questionnaire investigations, verifications and reviews of city planning documents, as well as opinions provided by ETC's local counterparts (CP).

Since proper city planning has been conducted in this area, number of residences will not fluctuate.

Further, the 10% of the forecast value area added as demands for public telephones and non-telephone services.

The microscopic demand forecast values for the new residential development at Adi-Sumdum are shown in Table 4.5.

Table 4.5 Microscopic Demand Forecasting Values for New Residential Development at Adi-Sumdum

Region	Year			
	2005	2010	2015	2020
FTZNo.1	304	347	391	434
FTZNo.2	295	337	379	421
FTZNo.3	305	348	392	435
FTZNo.4	326	373	419	466
FTZNo.5	319	364	410	455
FTZNo.6	375	428	482	535
Total	1,624	2,197	2,473	2,746

Note: FTZ: Fiber to Zone

(4) Microscopic Demand Forecasting for PCO Installation Areas in Wukro Woreda

Since no telephone services are currently provided in the areas for which PCO installations are planned, no vital data for demand forecast is available. In order to follow the guidelines of the ITU recommendations and the directives of the government of Ethiopia, it is decided to establish PCOs at seven hamlets to obtain telephone accessibility.

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 circuit, 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 lines 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 switch due to difference in call traffic characteristics.

Offered traffic to the trunk links is varied according to the demands. 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 4.6.

Table 4.6 Number of Calls Initiated and Transmission Circuit Lines

	Location		2005			2010			2015			2020		
No.	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
	Mekele													
1	FTZ No.1	Mekele	304	15	1	347	17	1	391	20	1	434	22	1
2	FTZ No.2	Mekele	295	15	1	337	17	1	379	19	1	421	21	1
3	FTZ No.3	Mekele	305	15	1	348	17	1	392	20	1	435	22	1
4	FTZ No.4	Mekele	326	16	1	373	19	1	419	21	1	466	23	1
5	FTZ No.5	Mekele	319	16	1	364	18	1	410	21	1	455	23	1
6	FTZ No.6	Mekele	375	19	1	428	21	1	482	24	1	535	27	1
7	Wukro	Mekele	1,487	74	1	2,125	106	1	3,032	152	2	4,287	214	2

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 NETWORK DEVELOPMENT PLAN

5.1 Framework for Establishing Telecommunications Network Development Plan for the F/S Area

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, and to narrow the gap of telecommunications services offered in larger cities and rural areas:

(1) Mekele Exchange Area

To provide the telecommunications to the part of Mekele exchange area where communications services are not available (the new residential area at Adi-Sumduhum).

(2) Wukro Woreda Rural Area

Approximately 85% of the population of Ethiopia, especially for those engaged in agricultural activities, are not benefited from telecommunications services. The following policy is established in order to prepare plans and programs to minimize areas wherein no telephone services are being offered and to provide socio-economic contributions toward the development of the area:

* Minimization of such non-service regions is sought through provision of telecommunications services by the PCO, considering population conditions, various activities conditions, potential for growth, and development locations.

(3) Study of WLL System in Mekele Exchange Region

According to the result of F/S survey carried out in Mekele PC objective area, the network plan of outside plant in the city area has almost been completed in their designing and partially has commenced their implementation except new residential development area called Adi-Sumduhum. Thus, Adi-Sumduhum area was selected for the project area.

The demand in 2020 is forecasted utmost 2,750 and in consideration of an anticipation of the development of the residential area in the North West direction in future, FTZ (Fiber to Zone) with optical cable is more economical and best solution to be adopted rather than WLL system from the view point of geographical feature and the feasibility of system expansion in future. That is, the WLL is the system to be able to cope with quick and effective operation to the subscribers scattered in wide area but the topography and demand in the objective area conditions will let the merit of WLL definitely loose and WLL is not suitable system in this area.

5.2 Extent of the Service Provision

The following telecommunications networks development plan is established according to the framework set forth in Section 5.1 above:

(1) Mekele Exchange Area

The plan for facilities is established for the new residential area of Adi-Sumduhum in the Mekele Region, in order to accommodate the demand in year 2005, based on the results obtained by generalizing the questionnaire investigations, field surveys, and opinions provided by ETC's local counterparts (CP).

(2) Wukro Woreda Rural Area

1) Location of PCOs

The F/S Survey Group selected following seven locations together with the ETC's counterparts and staff members at the regional government office (Kelete Awelalo Woreda Administration Office) as sites for installing PCOs, depending on their optimum locations and potential for maximizing effects

		Population (*)
1	Debre Tsion PCO Area	6,910
2	Gemad PCO Area	11,000
3	Habes PCO Area	4,000
4	May Kuha PCO Area	12,000
5	Abne Gerima PCO Area	5,000
6	Hadnet (Tsabat) PCO Area	5,000
7	Desea PCO Area	6,245
	Total	50,155
	Wukro city	20,851

(*): Populations in 2001 from the Kelete Awelalo Woreda Administration in Wukro

Please refer to Tables 1 to 10 of the attachments for detailed results of the F/S investigation.

Therefore, the benefits (benefiting population) obtained by the new installation of PCOs can be summarized in the following manner:

50,155/(105,076 − 20,851) x 100 ÷ 60 (%)

As per the master plan, each PCO provides line transmission rate of 256kb/s, and it is also possible to access to the Internet. It is believed that such characteristics will prove to be greatly beneficial for tele-medicine (E-health) and distance learning (E-learning) which are expected in the future at Wukro Woreda. Thus, it is expected that this will become the breakthrough point for social infrastructure, by making possible efforts for the collaboration between Mekele Medical College and remote clinics/infirmaries or for joint education sponsored by schools.

Each PCO shall have capacity equivalent to eight telephone lines, and VoIP telephones shall be installed at PCO. Telephones are terminated at individual PCOs, and used as public telephones. It has already been agreed with ETC's counterparts as well as the staff members of regional

government offices, that should there be future demands, the ETC will use cables or radio systems to extend telephone units to respond to such demands.

2) Facility plan

Village and hamlet areas of the Wukro Woreda are relatively sparsely populated. Through the F/S surveys focused on such isolated regions, a system route configuration for the seven PCO locations, which are believed to be optimum locations, was created and is shown in Figure 5.2.2-1 System Route Configuration.

Site Name	Latitude	Longitude	Above Sea Level	Area Population
1. Mekele Region Primary Center	13°29′54"	39°28′53′	2,085	(Kelete Awelado Woreda Administration Office in 2001)
2. Messobo Microwave Rep. Stn.	13°34′26"	39°31′37"	2,389	
3. Ikotamba Rep. (Wukro PCO Base Stn.)	13°46′15"	39°38′12"	2,624	
4. **Gemad** PCO Subscriber Stn.	13°53′17"	39°33′18"	2,370	11,000
5. **Debre Tsion** PCO Subscriber Stn.:	13°51′30"	39°27′22"	2,152	6,910
6. **Habes** PCO Subscriber Stn.	13°48′23"	39°40′19"	2,498	4,000
7. **May Kuha** PCO Subscriber Stn.	13°47′03"	39°28′05"	2,049	12,000
8. **Abne Gerima** PCO Subscriber Stn.	13°45′16"	39°34′08"	2,000	5,000
9. **Hadnet (Tsabat)** PCO Subscriber Stn.	13°39′53"	39°40′00"	2,240	5,000
10. **Desea** PCO Subscriber Stn.	13°39′00"	39°43′36"	2,440	6,245

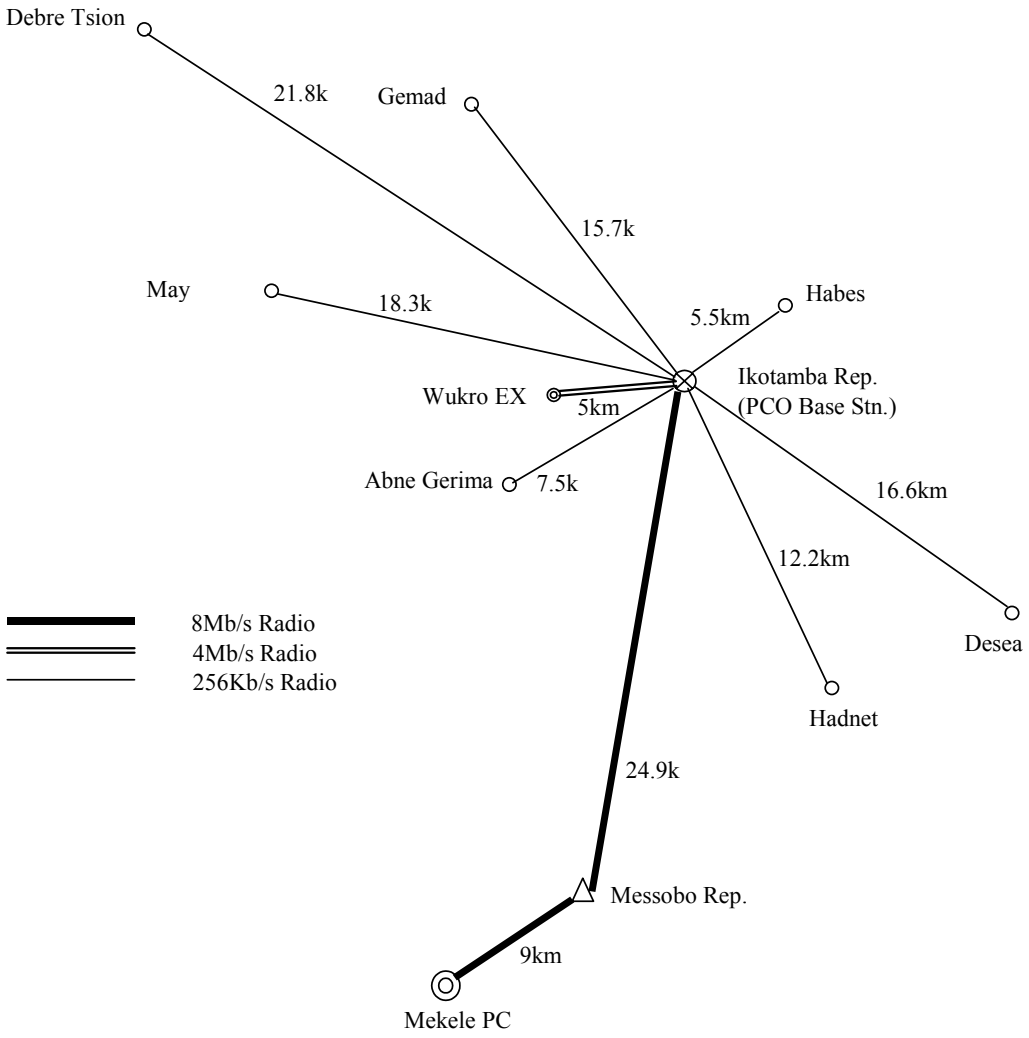


Figure 5.2.2-1 Network Configuration.

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 Final report of FG7 of ITU, "The Internet is the most widely-used platform to deliver multimedia applications in 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 of FG7 of ITU-D, it is further mentioned that "the long term importance of the Internet for developing countries lies in its potential to improve the domestic flow of economic and educational resources between isolated rural communities and urban centers."

a) Microwave radio repeater lines

PCO subscribers in the Wukro Woreda rural area are connected to the network through the point-to-point microwave radio system located between Mekele and Ikotamba Repeaters (refer to Figure 5.2.2-1 Network Configuration). The capacity of the repeater lines will be:

Mekele - Ikotamba Repeater: 8 Mb/s

Ikotamba Repeater - Wukro Exchange: 4 Mb/s

PCO network: 4 Mb/s

b) PCO network

Ikotamba Repeater is connected as a base station to the PCO Subscriber Stations at the seven locations. The PCO Network Configuration is given in Figure 5.2.2-2 Wukro Area PCO Network Configuration. Further, one personal computers (PC) will be connected at each PCO.

The PCO base station of this plan will be capable of connecting maximum 15 PCO subscriber stations. A broadband PCO circuits with a capacity of 256kb/s per PCO will be constructed, making it easier to access to the IP networks.

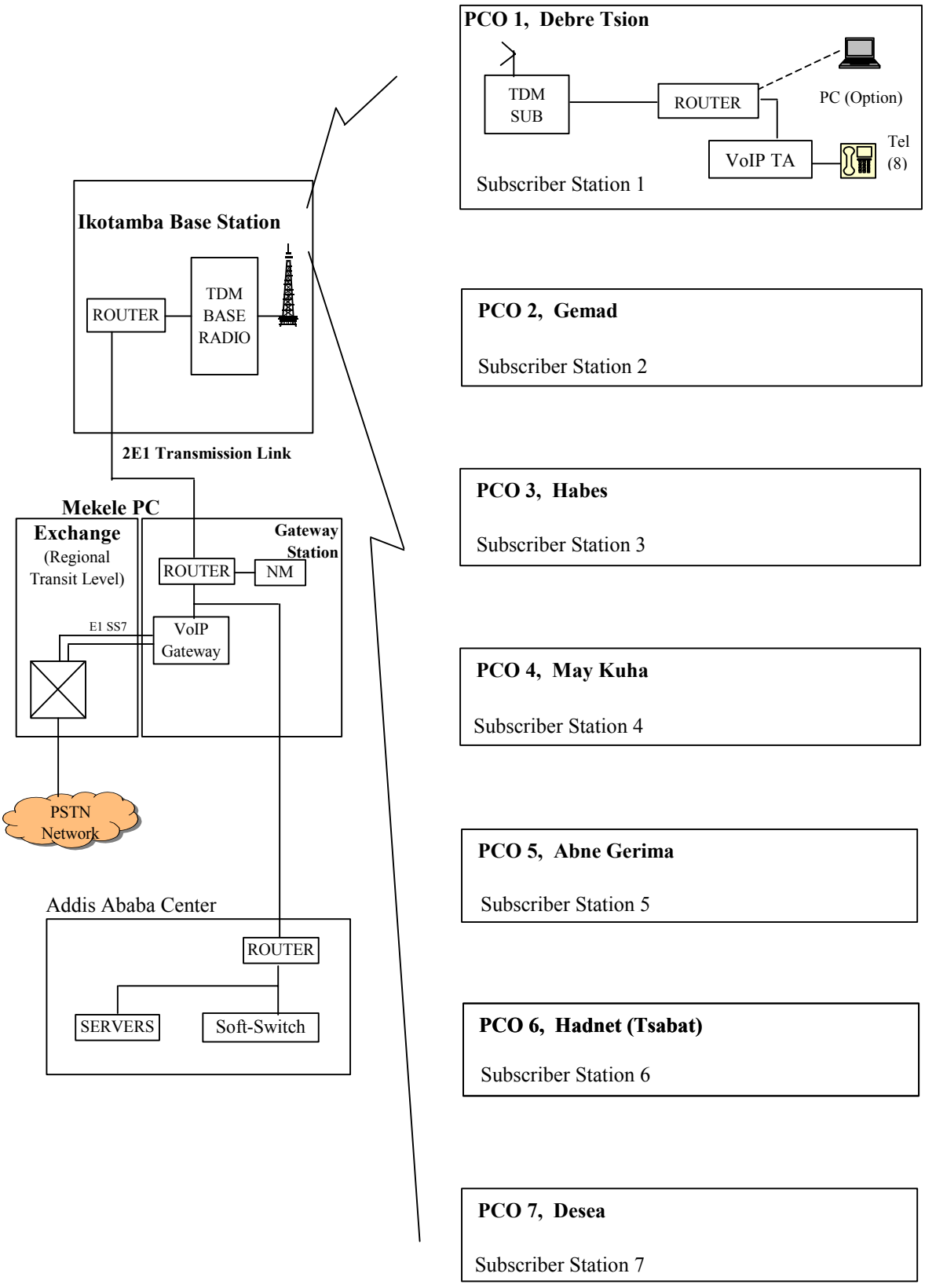


Figure 5.2.2-2 Wukro Area PCO Network

5.3 Technical Standard of Network Planning

5.3.1 Digitization of Telecommunications Networks

The construction of telecommunications networks in the areas covered by this F/S shall be digitized to be able to introduce VoIP networks, which is expected to be deployed throughout Ethiopia in the future.

5.3.2 Numbering Plan

The numbering plan for the regions under this F/S is as follows:

The numbers assigned to VoIP subscribers shall be configured by a two-digit station 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, except for "0." The nation is divided into eight regions. The next two digits are for identifying the exchange of the called party connected.

For VoIP subscribers being called, however, since these two digits is 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 - same as the existing numbering plan.

The station numbers assigned to each F/S area are as follows:

1) Mekele Region and neighboring residential areas: 81
2) Wukro Region and Wukro Woreda rural area: 82

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

5.3.3 Routing Plan

With the existing networks, the route of calls from an originating exchange to a terminating station is determined by the office data 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 header 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 route based on the current status of the network, and sends the packet to the next router. Thus the packets will not send along with the predetermined route but will be sent through any available route. 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 routes is really not an issue. All connections between Mekele and Addis

Ababa of the VoIP systems will always be controlled by the soft switch in Addis Ababa.

5.3.4 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 implemented to reduce construction cost.

5.3.5 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 have become VoIP subscribers.

5.3.6 Charging System

The charging system of the existing networks has been maintained by individual exchange. The charge data is then sent to a dedicated computer in Addis Ababa for processing via online connections or on optical disks.

For the case of the VoIP networks, however, call data is not registered by the VoIP facility (equivalent to exchange) located in each region, but the Gatekeeper/Softswitch collectively manages call data, and the data shall be forwarded to a dedicated computer through online connections. The existing charging system shall be retained.

5.3.7 Network Synchronization

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

5.4 Network 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 station under this feasibility study.

5.4.1 Exchange Facilities

The network is expanded to six cabinet areas in Adi-Sumdum (new residential development) in the

outskirts of Mekele, as well as Wukro located approximately 40km north of Mekele, and the seven Public Call Offices (PCO) located in the rural areas surrounding Wukro.

Facilities to be introduced shall be VoIP-based systems, and the existing digital exchange shall not be applied.

a) Call initiation rate: 0.05 Erl.
b) Voice packet: G.711/G.729a
c) Packet length: 16kbps
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 –48V.
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 Figures 5.1 and 5.2.

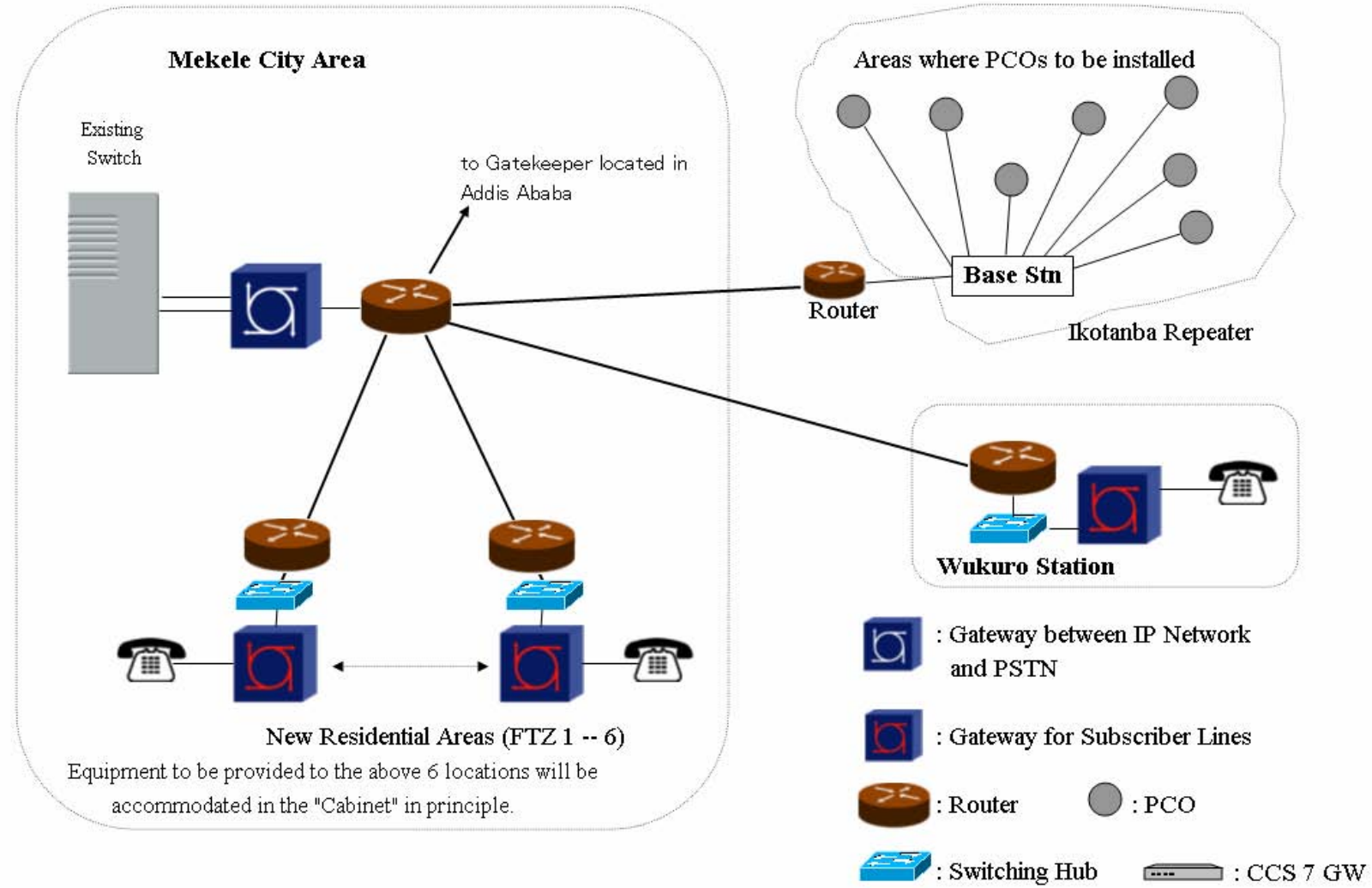


Figure 5.1 VoIP Network Configuration Diagram

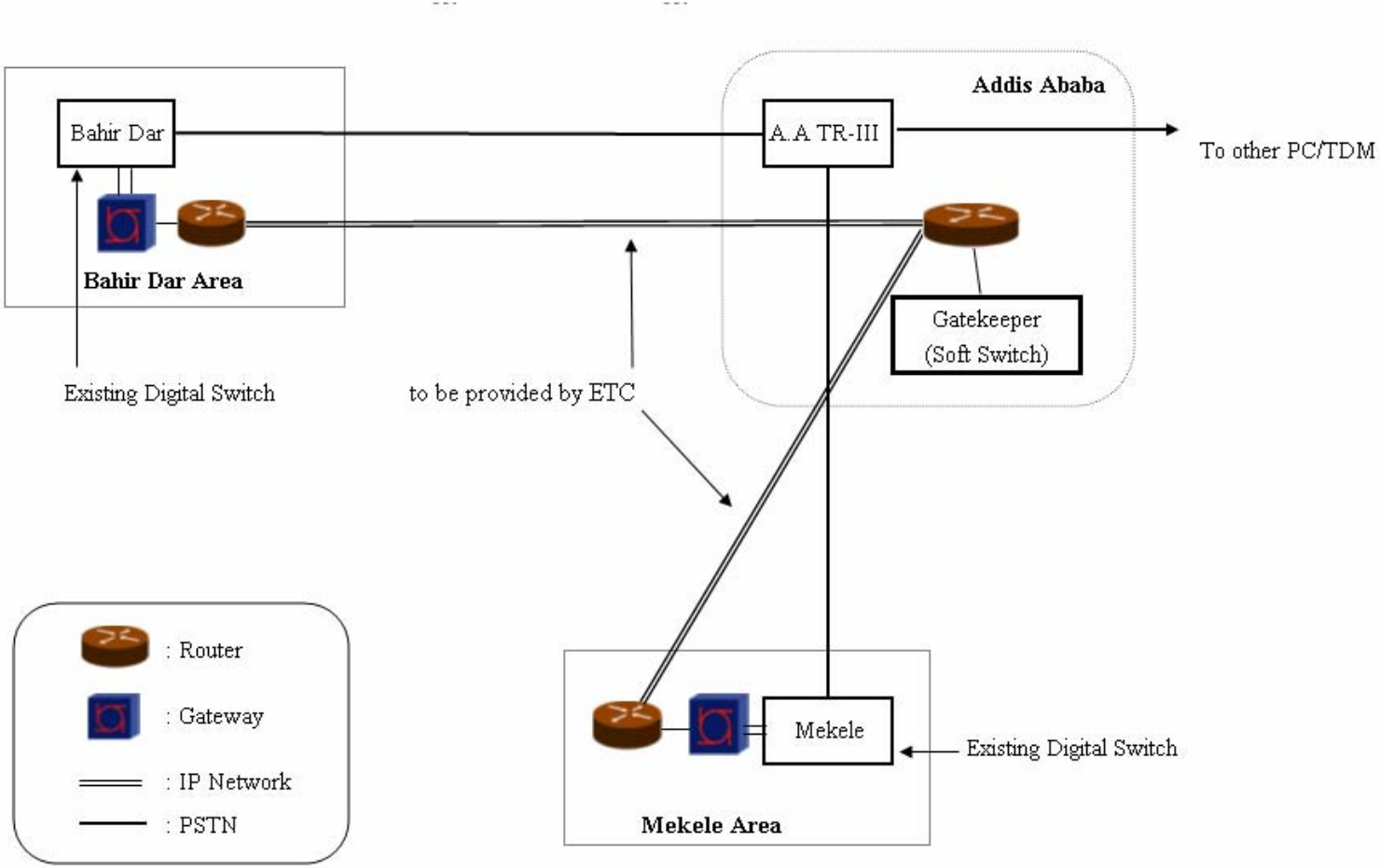


Figure 5.2 VoIP Network Configuration

(1) Mekele Station

1) The facility of the host control station for six areas of the Mekele Station, as well as the Wukro Station, will be installed in the exchange room on the first floor of the Mekele Station.

2) Since thorough city planning has been done on the Adi-Sumdum Area (new residential development), the demands within this area will not be fluctuated. According by six distribution units with 480 subscribers capacity are installed, and connection with optical cables is made to the Mekele Exchange. The VoIP facilities will be contained in the outdoor cabinets.

(2) Wukro Station

VoIP facilities will be installed in the exchange room of the existing Wukro Exchange.

The seven Public Call Offices (PCO) established in the remote areas surrounding the Wukro Exchange will be accommodated by the Mekele Exchange.

5.4.2 Transmission Facilities

Transmission System

For transmissions from the applicable exchange to subscribers, “Fiber to Zone” method and multi-points radio system shall be used. The transmission links to a higher or lower level stations shall be Point to point digital microwave radio system.

a) Subscriber lines

Considering the construction costs, for the high demand density areas located in the far area but within 16km from the exchange, VoIP cabinet with O/F access is to be applied.

The subscriber cable system (metal cable method) shall also be used for subscriber line connections (last one mile).

b) Repeater lines

In order to satisfy the circuit requirement, it will be required to install the new or expansion of the transmission link between Mekele and Wukro. Upon evaluating various systems in terms of technology, economy, and expandability, digital radio system (7GHz band, transmission capacity of 8Mbit/s) is considered to be optimum for the objective transmission link. The radio frequency for this radio system is to be determined in the detailed design stage, based on the radio frequency allocation policy of the ETC, which will be based on the WARC92.

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 duct cabling, direct burying cabling, and aerial cabling 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 with VoIP cabinet will be employed.

(2) Service Period

The outside plant shall satisfy the demands in a period of ten years from the commencement of the service (until 2015).

(3) Components

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

1) Cabling Facilities

a) Primary cables

Optical cable for VoIP cabinet will be laid in ducts. Types of cables used are shown below:

Type	Core diameter	Number of optical cores	
Duct cable	SM optical cable	24C	4C

b) Secondary cables

Self-supporting PE-insulated, PE-coated aerial suspension cables will be used. Number of pairs and conductor gauge of cables are shown below:

Type	Conductor gauge	Number of pairs			
Aerial cable	0.4mm	200	100	50	30

c) Termination and connection of cables

- The office-side termination of primary cables (optical cables) is conducted by installing an optical termination box in the MDF room. The termination on the cabinet side is conducted by terminating the optical cable terminals of the cabinet.

Connections of 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 (copper wire) is conducted on the cabinet side.

- Connections of cables at other locations shall be conducted by using the heat shrinkable tube

Connectors shall connect conductors.

d) Distribution point

Terminal boxes shall be mounted on telephone poles. Such telephone poles must be positioned at locations where drop wires into subscriber households would be easy, where they do not become obstructions to pedestrians and vehicle traffic, and where future relocations will not be

feared, with consideration for maintainability.

e) Telephone poles

Telephone poles used in this construction shall be 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.

The standard pole span shall be 40m.

2) Civil Works

a) Types of ducts

Underground ducts shall ordinarily be made of polyvinyl chloride (PVC), but steel tubes may be used as needed in places where it is necessary to prevent damages that may be caused by construction work of other services, and where suspending cables on bridging devices, or where crossing busy major roads with heavy traffic.

b) Types of manholes

Manholes are installed in locations where cables are connected, distributed, or 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
- Size required satisfying the curvature radius of cables.

The standard dimension of manholes is as follows:

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 span

The standard manhole span for copper loop networks shall be 200m, in consideration of cable branching, cross connection cabinet locations, cabling work, and other geographical conditions, while the maximum span may be up to 250m.

d) Burying depth of underground ducts

In order to avoid damages caused by underground construction of other services, the duct burying depth (from the surface of the ground to the top of duct) shall be as follows:

- Roadway: 120cm or more.
- Pedestrian walk: 80cm or more.

5.4.3.2 Main Works of Outside Plant

(1) Subscriber Lines

The main works for the planned subscriber network are as follows:

Description		Unit	Qty	Remarks
Pole	8.0-200CP	PCs	455	
	8.0-200CP(Stay)	PCs	12	
Stay	Stay	PCs	125	Used Block Type
	Over Head Stay	PCs	67	
Grounding	GU	PCs	161	
Duct Cable	DC-100-4	M	280	
	DC-200-4	M	465	
Aerial Cable	AC- 30-4	M	10,260	
	AC- 50-4	M	3,240	
	AC-100-4	M	2,714	
	AC-200-4	M	3,041	
Distribution Point	DP-10	PCs	257	With Jointing
Cable Jointing	CS-A4-S 30	PCs	88	Without DP. Jointing
	CS-A4-S 50	PCs	0	
	CS-A4-S 100	PCs	1	
	CS-A4-S 200	PCs	0	
	CS-A4-Y 30	PCs	80	
	CS-A4-Y 50	PCs	38	
	CS-A4-Y100	PCs	21	
	CS-A4-Y200	PCs	22	
	CS-A4-W 30	PCs	0	
	CS-A4-W 50	PCs	8	
	CS-A4-W100	PCs	19	
	CS-A4-W200	PCs	16	
Cable Termination	CT-100-4	PCs	9	
	CT-200-4	PCs	14	

(2) Optical Cable

Main works of the planned optical cables are as follows:

Description		Unit	Qty	Remarks
Manhole	MH S-2	PCs	20	
PVC Duct	PVC-2W	M	750	
	PVC-4W	M	3,120	
Duct Cable	DC-O/F- 4C	M	805	
	DC-O/F-24C	M	3,273	
Jointing	J-D-O/F-24-12	PCs	1	MH52,57
	J-D-O/F-24-24	PCs	2	MH58
Cable Termination	CT-O/F-4C	PCs	6	
	CT-O/F-24C	PCs	1	Mekele Ex.
Cabinet	FTZ(DLC)-480ch	PCs	6	Foundation

5.4.3.3 Materials and Equipment for Maintenance

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

- Cables (optical subscriber repeater cables and secondary cables)
- Terminal boxes
- Connecting materials

5.4.3.4 Basic Design Drawings

The following basic design drawings are attached to this document:

1) Guide map
2) Optical cable route map
3) Underground duct route drawing
4) Secondary cable drawing
5) Cable terminating drawing

5.4.4 Power Supply System

Facility plans for power supply system are as follows:

(1) Mekele Exchange Station Region

Power supply for microwave radio repeater lines is required, and existing power supply will be used for this purpose.

(2) Wukro Exchange

(a) Messobo Repeater Station

Power supply for microwave radio repeater is required, and existing power supply will be used for this purpose.

(b) Ikotamba Repeater Station

Power supply for microwave radio repeater and PCO Base Station is required, and a new solar battery power supply facility will be needed.

(c) Wukro Exchange Station

Power supply for microwave radio repeater is required, and existing power supply will be used for this purpose.

(d) PCO Subscriber Station

Since all sites currently have no commercial power supply available, new solar power system shall be provided.

5.4.5 Antenna and Towers

Antenna and steel tower, which will be required for this project, are described below:

(1) Mekele Exchange

Existing steel towers will be used.

(2) Wukro Exchange Region

A new steel tower (32m) is required at the Messobo Repeater Station.

A new steel tower (10m) is required at the Wukro Exchange.

5.4.6 Station Building Facilities

Station building facilities required in this project are as follows:

(1) Mekele Exchange

New radio equipment for microwave repeater will be required, and the equipment will be installed in the existing transmission equipment room. Please refer to the existing transmission equipment layout diagram, Figure 5.2.2-5, "Floor Layout of Mekele Transmission Room (Existing Facilities)."

(2) Wukro Exchange Station Region

(a) Messobo Repeater Station

New radio equipment for microwave repeater will be required, and the equipment will be installed in the existing transmission equipment room. Please refer to the existing transmission equipment room layout diagram, Figure 5.2.2-4, "Floor Layout of Transmission Room in Messobo Repeater Station (Existing Facilities)."

(b) Ikotamba Repeater Station

New radio equipment for microwave repeater and for PCO Base Station will be installed, so a new shelter will be necessary. Please refer to the representative equipment layout diagram (proposal), Figure 5.2.2-5, "Typical Floor Layout Plan for PCO Base Station."

(c) Wukro Exchange Station

New radio equipment for microwave repeater will be required, and the equipment will be installed in the existing transmission equipment room. Please refer to the existing transmission equipment layout diagram, Figure 5.2.2.6, "Floor Layout of Transmission Room in Wukro Exchange (Existing Facilities)."

(d) PCO Subscriber Station

New station buildings (shelters) will be needed at all sites. Please refer to the standard equipment layout diagram (proposal), Figure 5.2.2.7, "Typical Floor Layout Plan for PCO Subscriber Station."

Please refer to the attached document I, for specification summaries of facilities planned in this project.

5.4.7 Terminal Facilities

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

Fig. 5.5, Floor Lay-out of Mekele Transmission Room (Existing Facilities) (Reference)

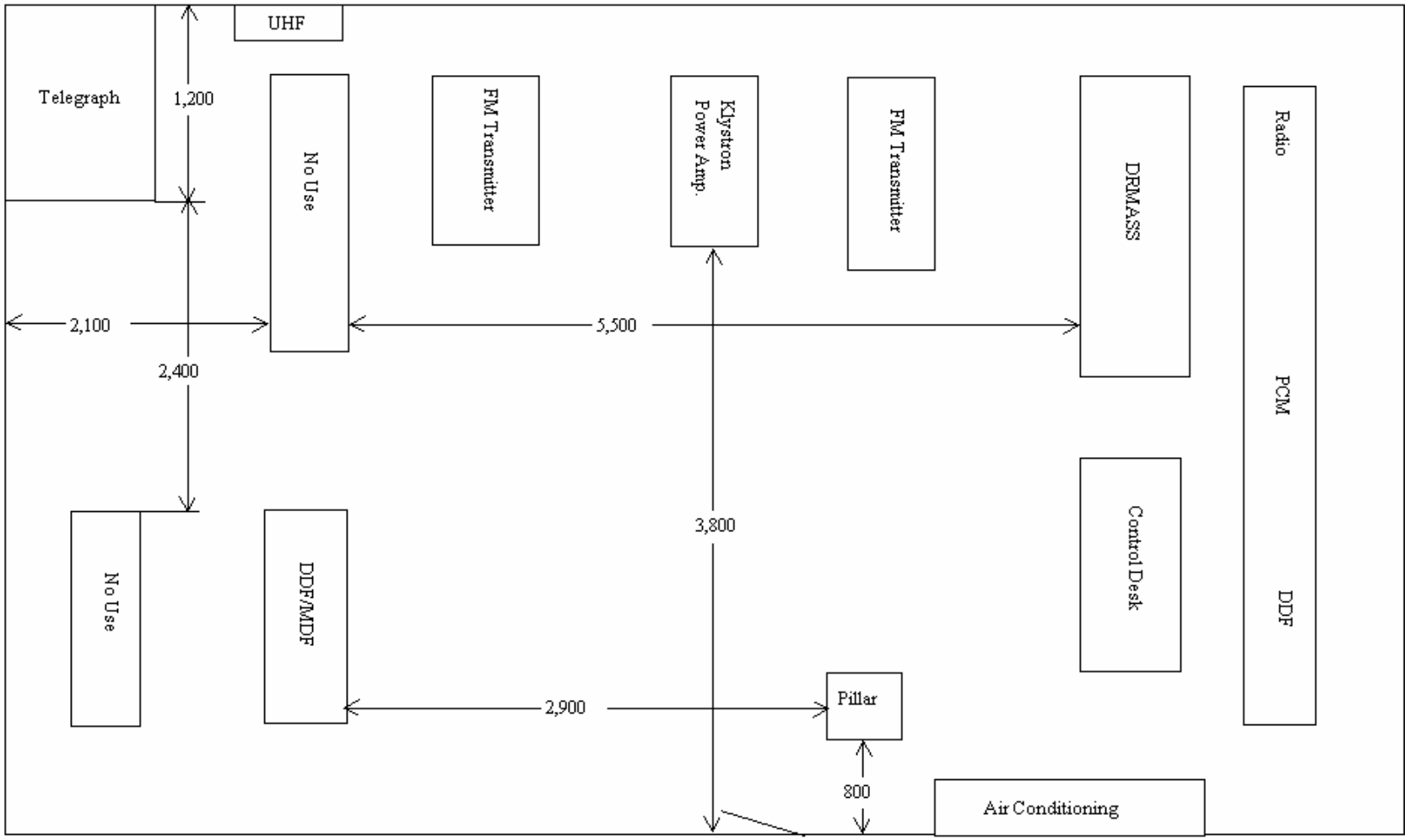


Fig. 5.6, Floor Lay-out of Transmission Room in Messobo Repeater Station (Existing Facilities) (Reference)

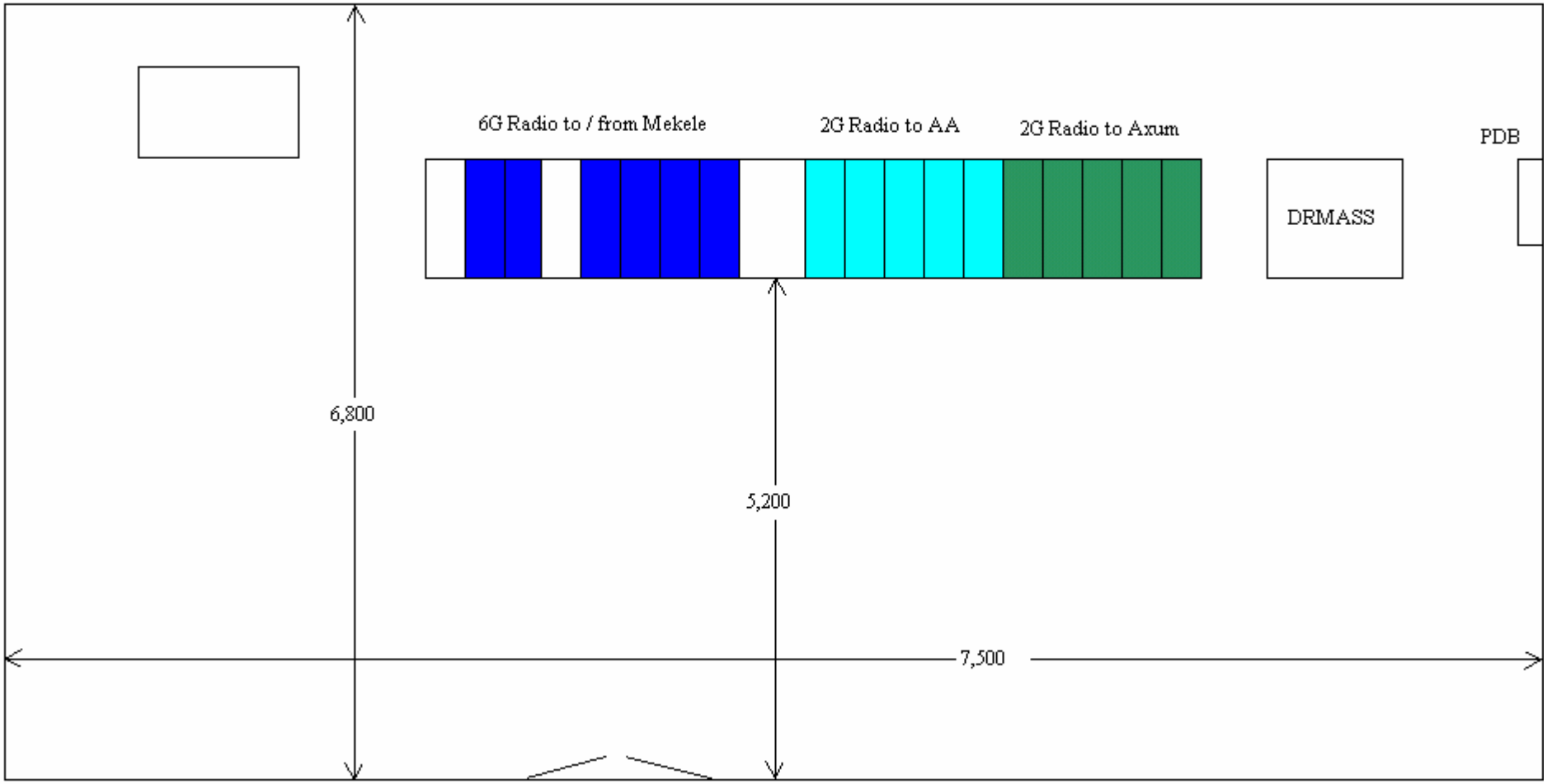


Fig. 5.7, Typical Floor Lay-out Plan for PCO Base Station (Reference)

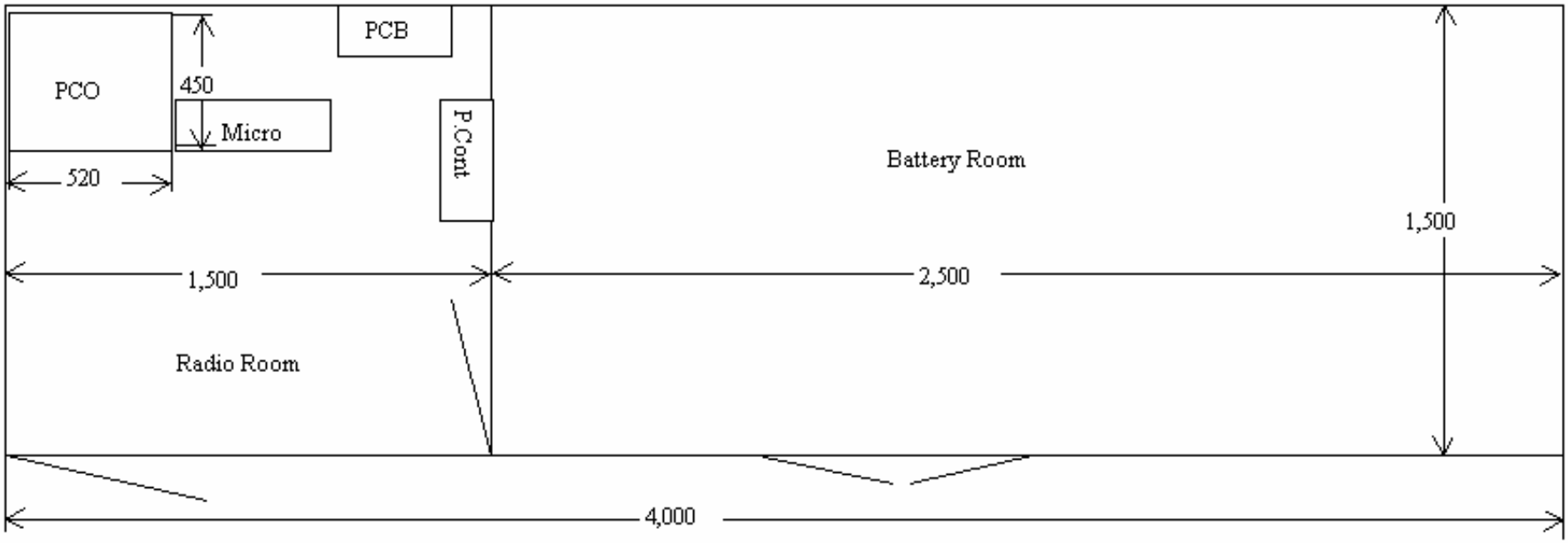


Fig. 5.8, Floor Lay-out of Transmission Room in Wukro Exchange (Existing Facilities) (Reference)

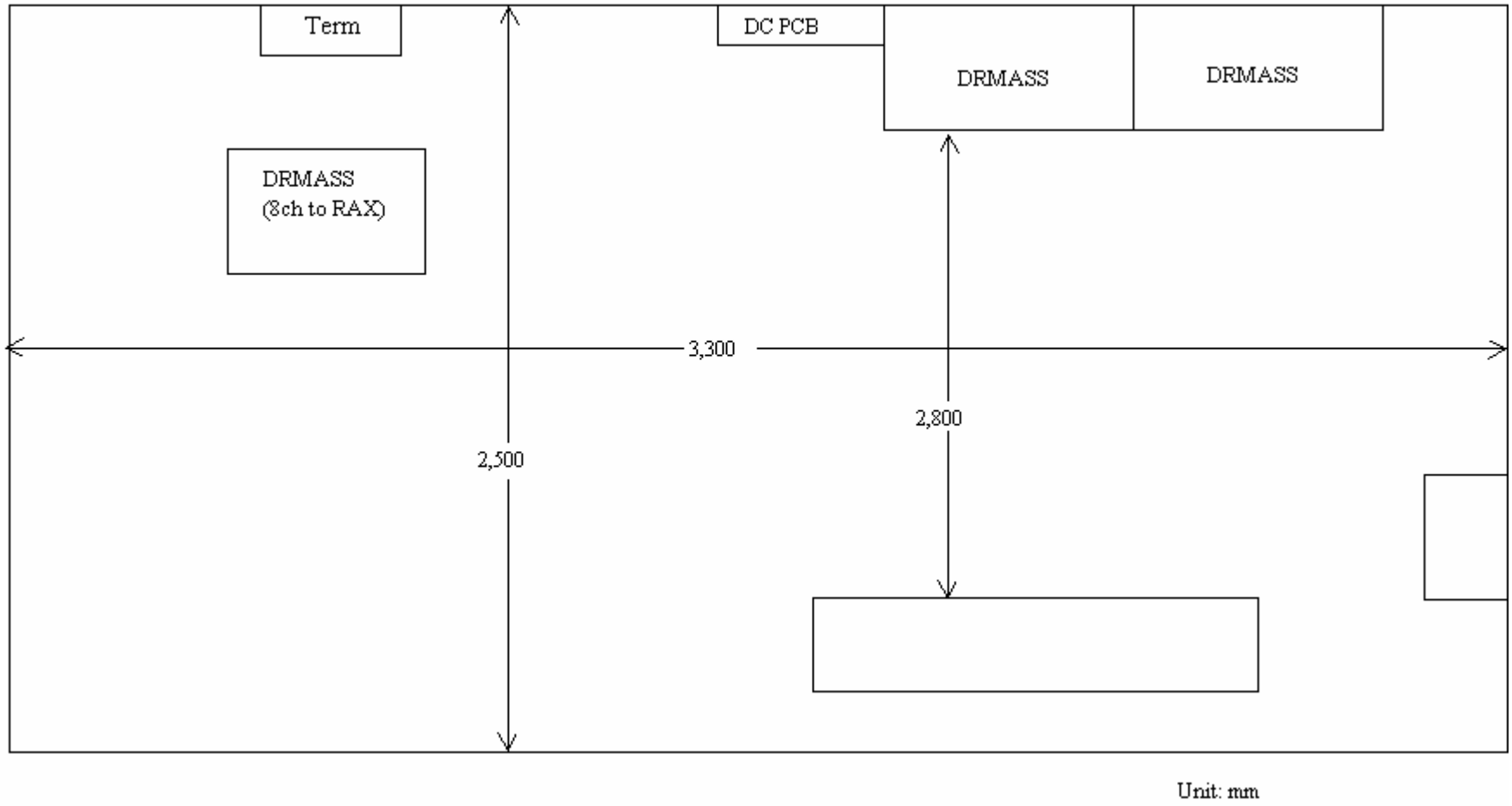
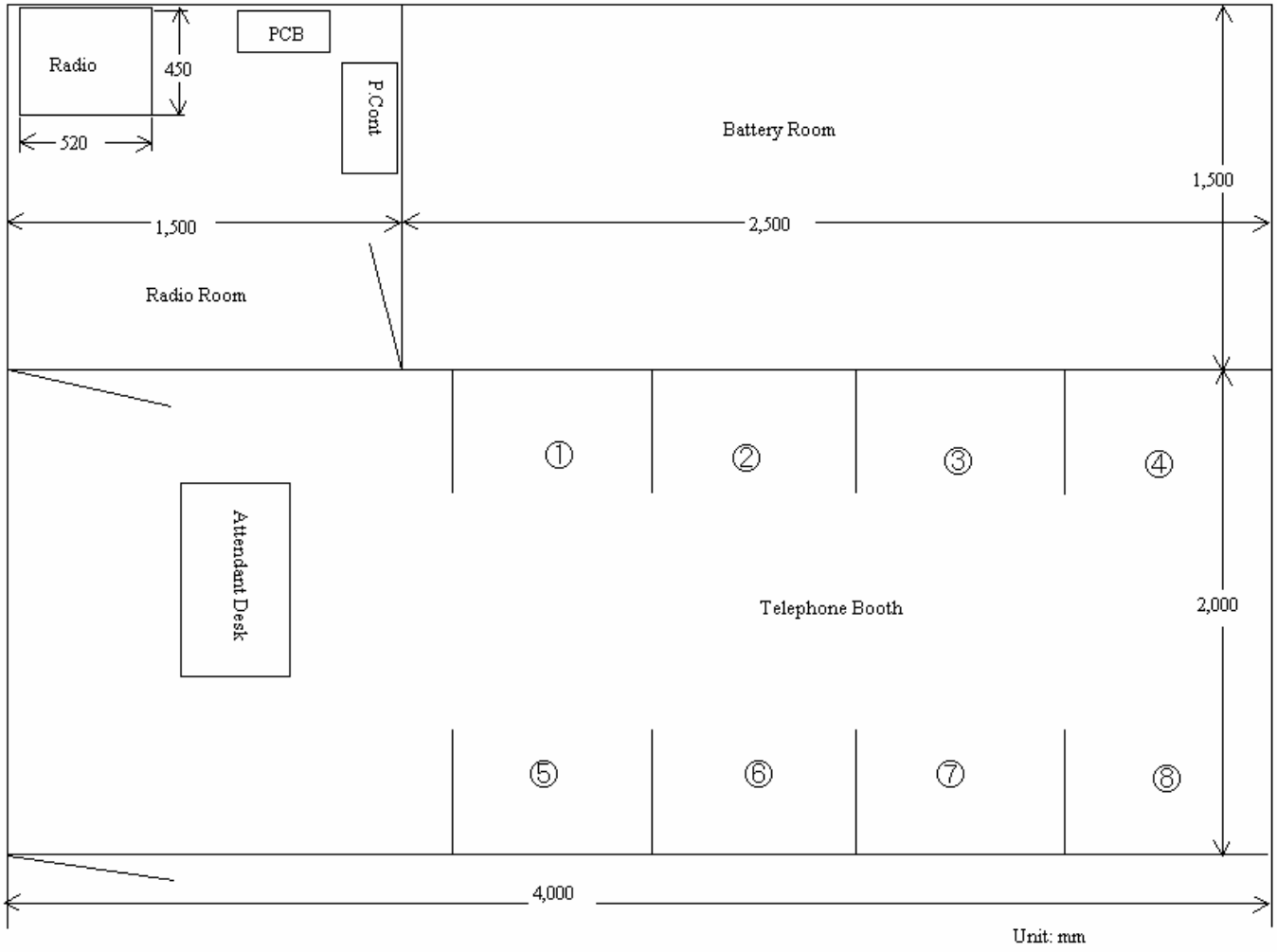


Fig. 5.9, Typical Floor Lay-out Plan for PCO Subscriber Station (Reference)



6. OPERATION AND MAINTENANCE PLAN

Guidelines for operation and maintenance of facilities are described below.

6.1 Exchange Facility

The operation and maintenance system of VoIP (a packet data network) is quite different from those of existing switching networks. The concept of the operation and maintenance is rather similar to that of existing PDN (Public Data Network).

6.1.1 Maintenance Formations and Maintenance Staff

In the case of Mekele, VoIP facilities are installed in the Mekele Exchange, in the neighboring areas, in Wukro, and in rural area.

Equipment installed in the neighboring areas of Mekele (FTZ cabinets) is unattended.

VoIP equipment installed in the Mekele Exchange is not directly connected to subscribers, so it has a simple configuration. A monitoring unit is installed in this station to moniter operating state of unmanned facilities. Maintenance staff, therefore, need to be placed in the station.

On the other hand, important VoIP common facilities are installed in Addis Ababa and are capable of monitoring VoIP facilities installed nation-wide. The Addis Ababa Station is considered to be important as a control station of VoIP.

Taking the above-mentioned situation into account, both Mekele Exchange and Addis Ababa Control Station shall adopt a 24-hour maintenance system and maintenance staff shall be allocated in the station. The number of maintenance staff is as follows:

1). Addis Ababa Control Station

Engineer: 2

Technician: 2

2). Mekele Exchange Station

Engineer: 1

Technician: 2

6.1.2 Training

In principle, equipment supplier shall train maintenance staff etc.

The contents of training are related to hardware and software. However, since most of daily maintenance and operation of IP are related to software, emphasis of the training contents is put on software.

The training is planned to continue for about three months in Ethiopia. Trainees are to take part in on-the-job training during the construction period from equipment installation to the beginning of operation.

6.2 Transmission/Radio Facilities

6.2.1 Maintenance Organization

The following system will be introduced according to the new transmission/radio facility plan in this F/S project.

(1) Mekele Station to Wukro Exchange via Ikotamba Repeater Station

Transmission links, using 7GHz band point-to-point microwave radio system (2x4Mbp/s), to connect Wukro Woreda rural area PCO network (2x2 Mbp/s) at the Ikotamba Repeater Station

(2) Wukro Hamlet Area PCO Network

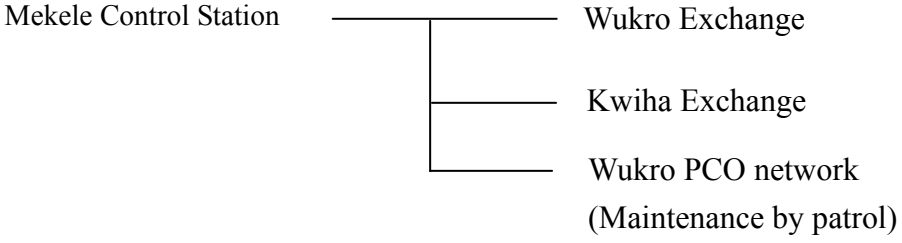
A PCO base station is installed in the Ikotamba Repeater Station. The following seven candidate sites have been selected to install PCO subscriber stations.

1) Debre Tsion village area
2) Gemad village area
3) Habes village area
4) May Kuha village area
5) Abne Gerima village area
6) Hadnet (Tsabat) village area
7) Desea village area

(3) Ikotamba Repeater Station to Wukro Exchange

The exchange (RAX type) having a capacity of 500 line units is currently operating in the Wukro Station. However, the limited transmission capacity to Mekele Station is aggravating the call completion rate. In addition, the operation of RAX is unstable. The expansion of the transmission link (2x2 Mbp/s) and to introduce VoIP telephones by new routers will be made in this project.

The maintenance station for transmission links is currently located in the Mekele Station, and maintenance staff for microwave radio transmission system, DRMASS, etc. are residing in the maintenance station. The existing maintenance center of Mekele Station shall cover the maintenance of unattended exchanges and radio stations.



6.2.2 Maintenance Formations and Maintenance Staff

Maintenance staff shall periodically patrol the objective sites to perform the preventive maintenance as well as according to instructions from the maintenance control station. For measuring instruments, spare parts, tools, etc. necessary for maintenance, the following items shall apply.

1) Measuring instruments to be used frequently are kept in each patrol vehicle and other measuring instruments are kept in the control station.
2) The control station performs centralized management of spare panels, spare parts, etc. Maintenance tools and consumables used constantly are provided for PCO sites or patrol vehicles.
3) A maintenance vehicle is provided to each of Mekele Area and Wukro Area. Periodic

   Inspection and periodic test of systems in the network are carried out under the initiative of the control station. The remote monitoring system is installed in the control station to notify faults that may occur at PCO sites. For faults of radio transmission links, the control station, to rectify such faults, according to the instructions from the control station forms a maintenance team. In case of cable faults, however, the control station notifies the division in charge of outside plant of the faults, the division then takes necessary actions.

To make these maintenance formations, composition of maintenance staff is as follows:

1) Control Station

   Chief: 0

   Engineer: 1

   Technician: 2

   Clerical staff: 0

2) Wukro Woreda area PCO network

   PCO operator: 7 (one person resides in each PCO station to provide site customer services)

6.2.3 Training

Introduction of new technologies to this project requires proper transfer of technology and appropriate training for staff who will be engaged in system operation and maintenance.

Facilities and systems related to the PCO network are comprised of the following:

1) Point-to-point microwave radio system
2) Point-to-multipoint radio access system, and
3) Solar power supply system

Items (1) and (3) are based on existing technologies requiring neither technology transfer nor new training. However, item (2) is a new system requiring technology transfer and training for

maintenance and operation.

Suppliers of equipment and systems shall provide the training. The training is divided into factory training for engineer class and domestic training in Ethiopia for technician class. The factory training shall be performed for a month and the domestic training (mainly on-the-job training) for a month.

6.3 Outside Plants (Cables and Civil Works)

Outside Plants share the large part of telecommunications facilities. Rational and efficient operation of these facilities has great effect on the corporate management.

Different from exchange facilities, outside plant facilities are placed under severe conditions, and have many problems in terms of design, construction and maintenance.

Though faults in outside plant can automatically be detected to some extent, rectification of faults requires human power. Many types of and large quantity of outside plant require various types of clerical management work, daily maintenance under serious work condition. Restructure of the organization aiming at the improvement of the work management and provision of tools/equipment/materials/vehicles will be required.

6.3.1 Maintenance Level

Maintenance level indicating maintenance service level is determined in consideration of the economical efficiency of ETC.

It is important to evaluate maintenance activities to prevent faults on a routine basis and to minimize repairing hours and days in the event of faults.

In particular, preventive maintenance is required to decrease customer's complaints such as disconnection of calls, wrong connections or bad cross talk.

Since subscribers always expect to receive favorable maintenance services from ETC, large cost and labor are required for ETC to maintain a good maintenance level.

The following three targets shall be placed to improve maintenance level.

1) Decrease the number of faults.
2) Shorten repair time.
3) Improve maintenance management system.

6.3.2 Current Situation of Facilities

Many obsolete facilities are co-existing with the newly installed facilities in the objective areas.

Many aerial cables and subscriber wires are being laid without fixture, and are being connected using temporary connection method without using proper materials. Most of faults are coming from cable connection parts. Further, most cabinets and terminal boxes have no moisture-proof treatment at cable fixing points of terminal blocks.

Drop-wires and internal wires are deteriorated. Cables are not laid using formal installation methods in many cases, and protective devices for subscribers are not mounted.

6.3.3 Current Situation of Maintenance

The fault rate in Mekele Area is 12/month per 100 telephone units. More than 90 % of faults are due to facilities of outside Plant. Most of repairing work of them requires many hours or days.

In Mekele Area, since detailed management data on the number of faults per day, distribution by day of the week, average repair time and the number of open faults is limited, and has not been analyzed, the data is not fully reflected in the maintenance activities.

Though maintenance vehicles seem to be modestly provided, parts, materials and tools necessary for repair are insufficient.

Due to inadequate repairing skill of maintenance staff and insufficient measuring tools, it is requiring excessive time to locate faults and their rectification.

Scarce spare parts and materials prevent proper and prompt repair work and may cause recurrence of same faults as a result of long-time leaving of tentative repair state.

Insufficient facility records are causing inconveniences in planning, design, construction, and maintenance.

6.3.4 Improvement and Modernization of Facilities

To improve maintenance services for subscribers is a trend of the era, and to improve and modernize facilities of outside plants and customer service management will raise economical efficiency of operators.

Through the examination of current status, features and problems of outside plant facilities, the following possible goals are considered for the modernization in the maintenance of outside plant facilities.

1) Establishment of desired construction and maintenance systems
2) Setup of maintenance management target
3) Optimum disposition of vehicles
4) Maintaining measuring instruments and work tools in good conditions
5) Preparation of appropriate maintenance materials
6) Formulation of facility records
7) Improvement of fault management (including cause analysis)
8) Improvement of material management
9) Training

To attain the above targets in an efficient and economical manner, we recommend to establish a lineman center as the transit stage to OPMC in Mekele Region in order to initiate centralized

construction/maintenance work of outside plant facilities and for the smooth introduction of OPMC in the near future.

6.3.5 Features of Lineman Center

In order to provide good services of outside plant facilities efficiently to subscribers, the formation of a lineman center for construction and maintenance of outside plant facilities is recommendable.

This lineman center will be provided with the following functions;

1) Initiate adequate maintenance and facility management, and grasp facility conditions.
2) Initiate inventory control so that materials necessary for daily operation can be obtained at any time.
3) Maintain vehicles, measuring instruments and tools in good conditions to improve operating efficiency.
4) Give staff members training directly related to their work to improve their skills.
5) Initiate prompt correction of facility records following new installation and upgrades of facilities due to maintenance work, construction work, and new subscriber connections.

6.3.6 Size of Lineman Center

The number of subscribers in Mekele Region was approximately 7,637 in 2002. According to the demand estimate and the supply plan, the number of subscribers is estimated to be 16,809 in 2005, and about 33,065 in 2015.

The current average fault rate is 12/month per 100 telephone units. However, the fault rate is expected to decrease to 5/month in 2010 and 3/month in 2015 through the improvement and expansion of subscriber lines and customer's terminals promoted under this project and future plan.

Though the number of fault repaired per repair-man is 0.7 per day, it is desired that the number of repair times will become 1.5 in 2010 and 2 or more in 2015 through the training for improving repair skills due to the establishment of the lineman center, and the reinforcement of mobility by adopting more vehicles. If this is achieved, the number of repairing staff engaged in subscriber lines and customer's terminals can be altered from 25 to about 20 in 2010 and 30 in 2015.

A total number of indirect and management staff members required for design, materials and facility records will be needed about 15. The number of staff members of the lineman center is therefore estimated to be 35 in 2010 and near 40 in 2015.

6.3.7 Training

The equipment suppliers shall provide training to maintenance staff. The training is divided into overseas training for cultivating engineer class and domestic training in Ethiopia for cultivating technician class.

The domestic training shall be carried out by dividing trainees into two groups for subscriber optical cable and for subscriber copper loops.

Training period of both overseas training and two groups of domestic training shall be one month.

7. IMPLEMENTATION PLAN

7.1 Project Implementation Plan

Table 7.1 shows the implementation schedule for Wukro PCO network, and Table 7.2 shows the implementation schedule in the Mekele Exchange Area.

As shown in the project implementation schedule, site survey by consultants and engineering service (including detail design) will be conducted for preparing documents for bidding.

Table 7.1 Implementation Schedule (Mekele Project)

(cost in 1000 US$)

Serial month from E/N	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Year			'03	/04								'04	/05										'05	/06		
Calender month	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10
1 Preparation stage																										
Exchange of note	▲																									
Consul Agreement	▲																									
Detailed survey	→																									
Design & cost estimation	—																									
Preparation of Tender Doc.	—																									
Tender floating			—																							
Tender Evaluation				—																						
Contract negotiation					—																					
Approval of Contract						▲																				
2 ETC's work																										
Land acquisition		—																								
Shelter (Rep. st & PCO)			—																							
New subs. Connection																										
Permit from reletive authority								▲																		
Payment of road reinstatement								▲																		
3 Project implementation																										
Construction design								—																		
Design Review meeting								▲																		
Manufacturing								—																		
VoIP								- - -																		
OSP								- - -																		
Tr & PCO								- - -																		
Transportation upto site												—														
Site implementation																										
Civil work								—																		
Cable work												—														
VoIP															—											
Transmission															—											
PCO																—										
Acceptance test & commissioning																	—									
4 Issuance of ATP																			▲							

7.2 Implementation Policy

(1) Frame Work of the Project Management

Paying attention on the policy of the decentralization, the key function of the "Project Management" is to be organized in the respective "Region". The functions for the project implementation are to be divided into "Head Quarter responsible" portion and "Project site responsible" portion.

Head Quarter is to manage the integrated input/output of the project from the corporate level target/schedule, while the site project management is to be responsible on the procedures of the project implementation from the "Implementation Contract" up to the "Project Transfer" to the operation and maintenance division.

Head Quarter is responsible on:

1) Annual/mid-term project implementation planning including the budget acquisition/allocation.
2) Preparation of the standard specification (General/Technical).
3) Tendering, tender evaluation and contract negotiation.
4) Overall monitoring of the projects implementation to ensure;
   a) In-time project implementation.
   b) Achievement of the annual (broken down to monthly) corporate targets.
      - New subscriber connections.
      - Network performance (call completion rate).
      - Grade of services (fault rate, fault recovery time, etc.).
   c) Facility balance (minimize the idle period of facilities).
   d) Network balance.
   e) Achievement of Tele-access
   f) Sound O/M for the project output.
   g) Corporate level solution to the problems through the bi-monthly (or monthly) project implementation meeting, which will be chaired by the Deputy Managing Director and be arranged by "Telecommunications Infrastructure Development Department".

The site project management (Deputy Regional Manager will be assigned as the Project Manager) is responsible on;

1) Detailed design of the project satisfying the site demand and request (replacement of malfunctioning facilities, etc.).
2) Review and approval on the construction design, the local sub-contractors, and the local materials/equipment.
3) Daily supervision of the project implementation and site-instructions to the contractor.
4) Implementation of ETC's responsible works.
   a) Custom clearance.
   b) Building/Tower construction.

c) Commercial power supply.

d) Coordination with and receiving permit from the related authorities (municipality, police, immigration, ETA, etc.).

e) Implementation of the related local projects

f) Etc.

5) Semi-monthly reporting of the project implementation status to H.Q. (through CIMIS)

6) Weekly meeting for the project progress/problems, and updating implementation schedule.

7) Witness to the progress check, site test and the acceptance test in cooperation with O/M division.

8) Draft scheduling of new subscriber connections with customer service division.

9) Solution to the site oriented problems.

10) Receiving the technology transfer from the contractor and the consultant.

11) Issuance of the acceptance certificate, authorization to pay and other supporting documents.

12) Management of the project account.

The consultant is to mainly support the site project management and to attend to the bi-monthly project implementation meeting in H.Q.

The resultant is to share, to monitor and to advise on all the responsible work of the "Site Project Management".

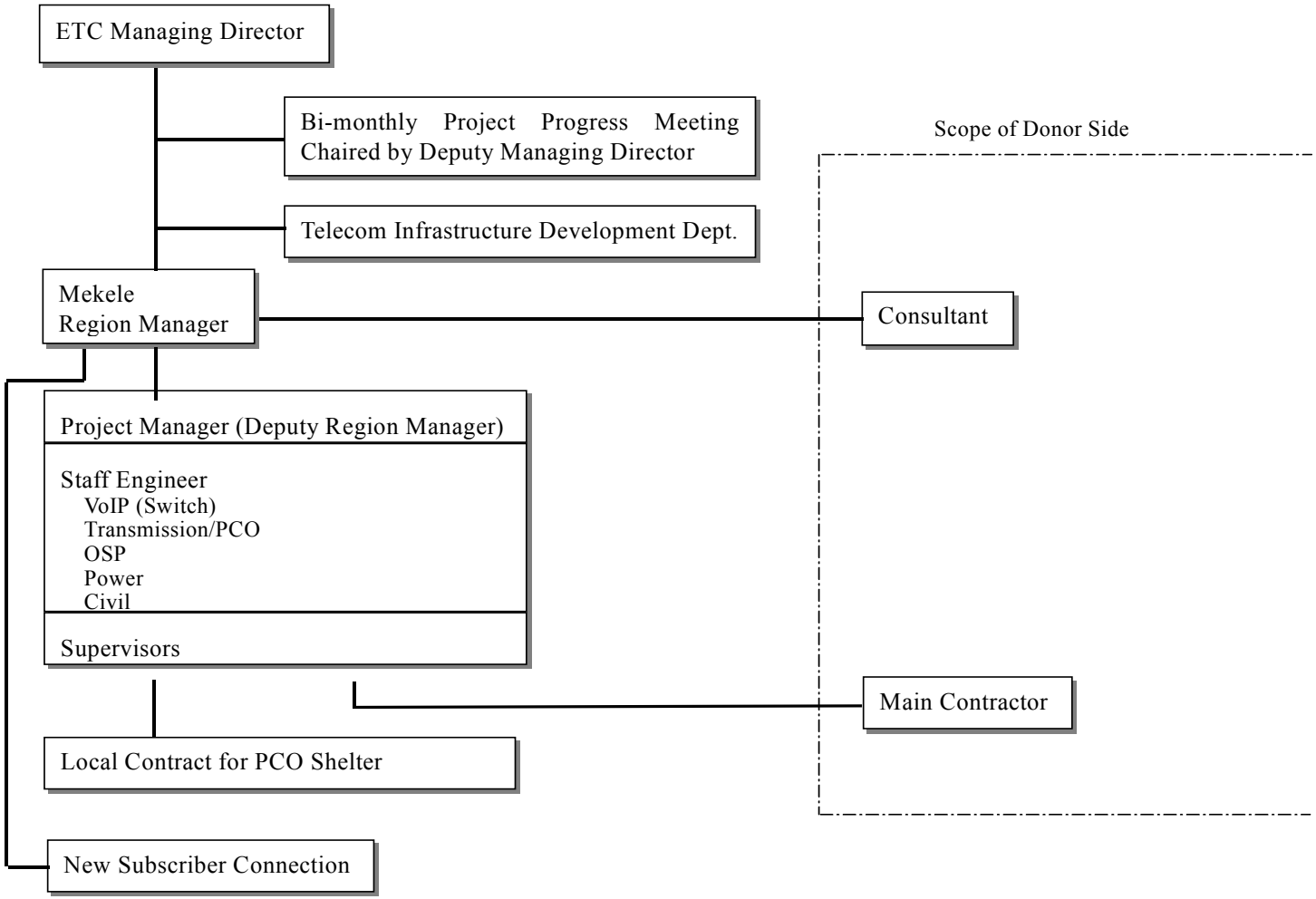


Fig.7-2 Mekele Project Implementation Management

7.3 Demarcation of Scope of Works

Scope of works of donor country and ETC for this project is as follows:

(1) Donor Country

1) Construction design of exchange facilities, transmission/radio facilities, and OSP/civil works
2) Supply of main equipment and materials
3) Local purchase of construction parts and materials
4) Installation of VoIP facility
5) Installation of transmission/radio facilities
6) Construction of manholes and underground ducts
7) Cable laying and connection of optical cables (ducts)
8) Cable laying and connection of secondary cables
9) Installation of FTZ (DLC)
10) Installation of terminal boxes
11) Provisional restoration (dust-proofing pavement) after road excavation
12) Preparation of as built drawing
13) Testing of Installed facilities
14) Delivery of maintenance materials/equipment, tools, and measuring instruments

(2) ETC

1) Reservation of warehouses for storing materials and equipment of contractors
2) Acquisition of PCO installation sites and construction of buildings
3) Acquisition of permission for occupation and excavation of roads prior to civil work or aerial cable facility construction
4) Payment of road restoration cost to the road manager after excavation of paved roads

To efficiently proceed with this project and accomplish it as quickly as possible, construction work of the donor side shall be conducted by the turnkey basis.

7.4 Supervision and Management Plan

(1) Details of Supervision and Management

In order to properly supervise and manage this project, implementation management body (shown in Figure 7.2) configured with the ETC staff and consultants will be established to coordinate opinions from related departments for accomplishing this project. The consultants shall conduct supervision and management of this project (including control of the progress) as follows:

1) Tasks concerning construction contracts

Site survey, creation of detailed design, preparation of bidding documents, examination of

qualifications of bidders, publication of bidding, evaluation of bidding documents, assistance for selection of nominated contractors, preparation of agreements, witness at conclusion of agreements, etc. The consultants shall share these tasks and report the results to the ETC.

2) Examination of documents submitted by contractors

The consultants shall examine construction drawings, samples, equipment/material manufacturers, other documents submitted by contractors and, and then advise to approve them.

3) Witness inspection at plant

Prior to shipment of equipment and materials, the consultants shall conduct witness inspection at respective manufacturer's plants in donor country to verify that such equipment and materials meet the contracted specifications. The contractor can ship equipment and materials after they are approved.

4) Progress control

The consultant shall examine construction methods and processes provided by contractors, and give necessary instructions. The consultant shall also dispatch supervisors to construction sites to check whether construction is going according to the contracted specifications and to monitor the progress of construction.

5) Cooperation for payment procedures

With respect to contract amount paid during or after construction, the consultant shall examine bills submitted by contractor and extend cooperation for payment procedures.

6) Acceptance

Upon completion of construction by contractor, the consultants shall observe the acceptance inspection and examine facilities by verifying them with their drawings.

(2) Supervision Staff Plan

1) Civil work supervision

Since the construction areas of this project contains many rocks underground, it is anticipated that ducts will be laid underground without reserving the depth specified in the specifications. Therefore, accurate supervision for civil works is required.

2) Overall adjustment of progress

In order to grasp overall progress constantly to strictly keep the schedule while maintaining the quality of each piece of work, the supervision and management by the consultant are focused on continuous offering of guidance and suggestions to contractor and the ETC staff in charge.

3) Dispatching staff

Dispatching supervisors to the installation sites constantly is essential. To adhere to the strict

schedule, staff schedule shall be established including spot dispatch of supervisors and staff for inspection of materials and equipment at their plants.

7.5 Materials/Equipment Procurement Plan

(1) Procurement of Main Materials and Equipment

Almost all of the main materials and equipment (exchange, transmission/radio equipment, cables, connecting materials, and other materials) are not manufactured in Ethiopia. They must be procured from foreign countries.

(2) Procurement Plan for Locally Manufactured Materials/Equipment

1) Cements, sand, gravel, broken stones, reinforcing bars, frame-forming materials necessary for this project shall be procured in Ethiopia, because materials having the same specifications as those of ordinary materials can be obtained locally.

2) Regarding the use of hard polyvinyl chloride (PVC) pipes and concrete poles (CP)

Hard PVC pipes and concrete poles (CP) can be procured locally provided that their quality meet the specifications and their production capacity and test equipment are assured. Otherwise, they shall be procured from foreign countries.

7.6 Additional Tasks on the Side of ETC

In addition to the scope of works described in 7.3 (2), the following tasks are added.

1) Exemption from taxation for materials/equipment, customs clearing, import taxes, and durable materials procured locally
2) Provision of conveniences for communication means (local/out-of-town calls), construction office, heat and light expenses, etc.
3) Acquisition of permission for occupation and excavation of roads
4) Issuance of "authorization to pay" certificates

Detail design, preparation of bidding documents, procurement, and supervision/management of ETC's are conducted by the ETC and the project implementation management body.

8. PROJECTCOST ESTIMATE

The total cost necessary for this project is 6 million US Dollar (Donor country side expenses). According to the scope of works described above, expenses on the donor and ETC sides are estimated as shown below.

8.1 Initial Investment

The project's initial investment cost required for the construction of telecommunications networks is described in Table 8.1 below.

Table 8.1 Project Cost Estimate (Donor side expenses) （Unit: 1,000US$）

	S.W.	PCO	O.S.P.	Total
1． Construction Cost	923	1,116	1,196	3,235
2． Others	-	-	-	614
Total	-	-	-	3,849

Table 8.1-1 Project Cost Estimate (Donor side expenses) Year 2003（Unit:US1,000$）

	S.W.	PCO	O.S.P.	Total
1． Construction Cost	259	353	257	869
2． Others	-	-	-	225
Total	-	-	-	1,094

Table 8.1-2 Project Cost Estimate (Donor side expenses) Year 2004（Unit:US1,000$）

	S.W.	PCO	O.S.P.	Total
1． Construction Cost	664	763	939	2,366
2． Others	-	-	-	389
Total	-	-	-	2,755

The project cost was estimated on the following conditions.

a) Construction work will be conducted by contractors based on the Turn-Key Basis, except for new subscriber connection work (between terminal box to telephone sets), according to the detail design and bidding specifications prepared by consultant and under supervision of consultant. New subscriber line connection will be directly conducted by the ETC.

b) The procurement cost of materials and equipment are estimated based on FOB prices. Therefore, marine transportation costs and insurance expenses up to Djibouti Port (the Republic of Djibouti) and land transportation costs and insurance expenses for transportation between Djibouti Port and Mekele will be separately estimated. Currency

exchange rate shall be 1US$=120 yen.

c) Costs occurring in Ethiopia (locally procured materials/equipment costs, domestic transportation cost, wages for locally hired construction workers, etc.) are calculated in US dollars. In this case, currency exchange rate shall be 1US$=8.56 Birr

d) Calculate spare parts costs on conditions that they will be retained for three years.

e) Calculate all costs using prices in 2002 and no escalation clause is taken into account.

f) If it is judged that the transmission capacity between Mekele Station and NSC stations will be insufficient, the ETC will expand before start of service provision of telecommunications networks to be constructed in this project.

g) The ETC conducts the following with its own fund.

- Acquisition of lands and construction of buildings (7 places) necessary for providing PCO services
- Reinstatement of excavated road.
- Construction of a steel tower (22m) at Messobo Repeater Station
- New subscriber connections

8.2 Expenditure Plan

Expenses for each year in the early stage of the project, under the above-mentioned conditions, are shown in Table 8.2 Expenditure Plan (Expenses of ETC).

The expenses are classified into two; one is preparation expenses (for buildings, etc.) born by the ETC for the project, and the other is required for construction of rural telecommunications networks in the objective area subject to this project (Road reinstatement, new subscriber connection, etc.).

Table8.2 Expenditure Plan（Expenses of Ethiopia side）（2004）（Unit : 1,000US$）

	S.W.	MUX.	O.S.P.	Total
1. New Subscribers Connections	0	0	126	126
2. Tel Sets for PCO	0	2		2
3. Shelter	0	24		24
4. Reinstatement	0	0	54	54
Total	0	26	180	206

These expenses are further classified into foreign-currency expenses required for materials/equipment procured from outside countries, and local-currency expenses for materials/equipment procured in Ethiopia.

8.3 Operation and Maintenance Costs

Costs required for operation and maintenance of telecommunications systems are configured with direct costs and indirect costs.

These costs are composed of labor cost, facility maintenance vehicle running cost, and maintenance

parts/materials procurement cost, and other general costs.

Table 8.3 shows the operation and maintenance costs of each fiscal year. These costs were estimated on condition that 1US$=120.00 yen.

In addition, insurance expenses for constructed facilities are required, which account for approximately 0.1% of the total list price of all equipment and facilities constructed in the objective area subject to this project, according to the ETC's current insurance system.

Table 8.3 Maintenance and Operating Costs (Unit : US$)

Year	Staff Cost	General Exp.	Total
2005/06	39,000	58,000	97,000
2006/07	44,000	66,000	110,000
2007/08	46,000	69,000	115,000
2008/09	48,000	72,000	120,000
2009/10	50,000	75,000	125,000
2010/11	52,000	78,000	130,000
2011/12	53,000	79,000	132,000
2012/13	54,000	81,000	135,000
2013/14	55,000	82,000	137,000
2014/15	56,000	84,000	140,000
2015/16	57,000	85,000	142,000
2016/17	58,000	86,000	144,000
2017/18	58,000	88,000	146,000
2018/19	59,000	89,000	148,000
2019/20	60,000	91,000	151,000
Total	789,000	1,183,000	1,972,000