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ETC/Mekele Exchange		Sheet No. 1/26
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ETC	MEKELE FIBER CABLE JUNCTION	
CHD	PLAN FOR MEKELE EXCHANGE	
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Attachment 2

2. VoIP Network Configuration in Mekele

Figure 2.1 VoIP Network in Mekele Area

Figure 2.2 VoIP Network

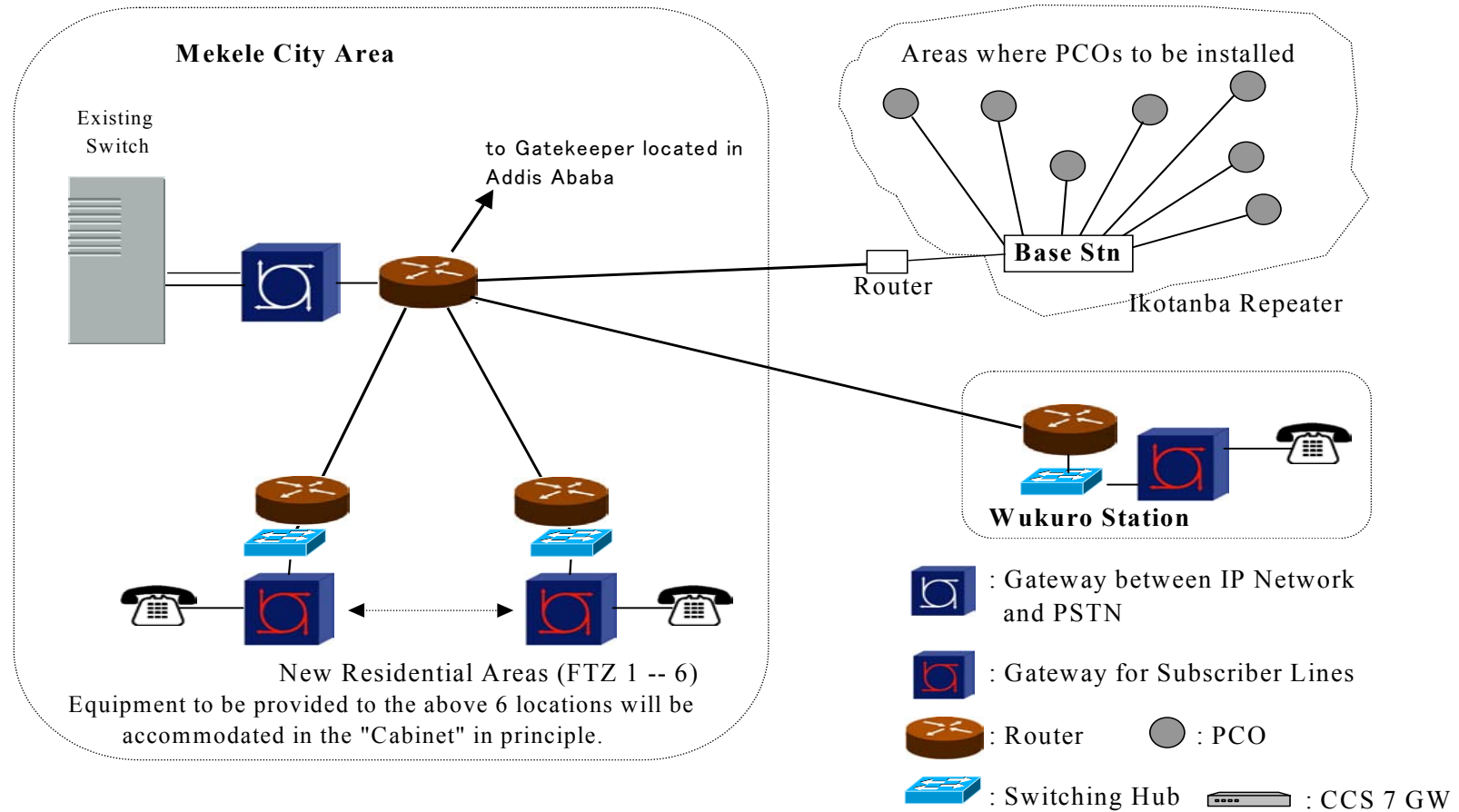


Figure 2.1 VoIP Network Configuration Diagram

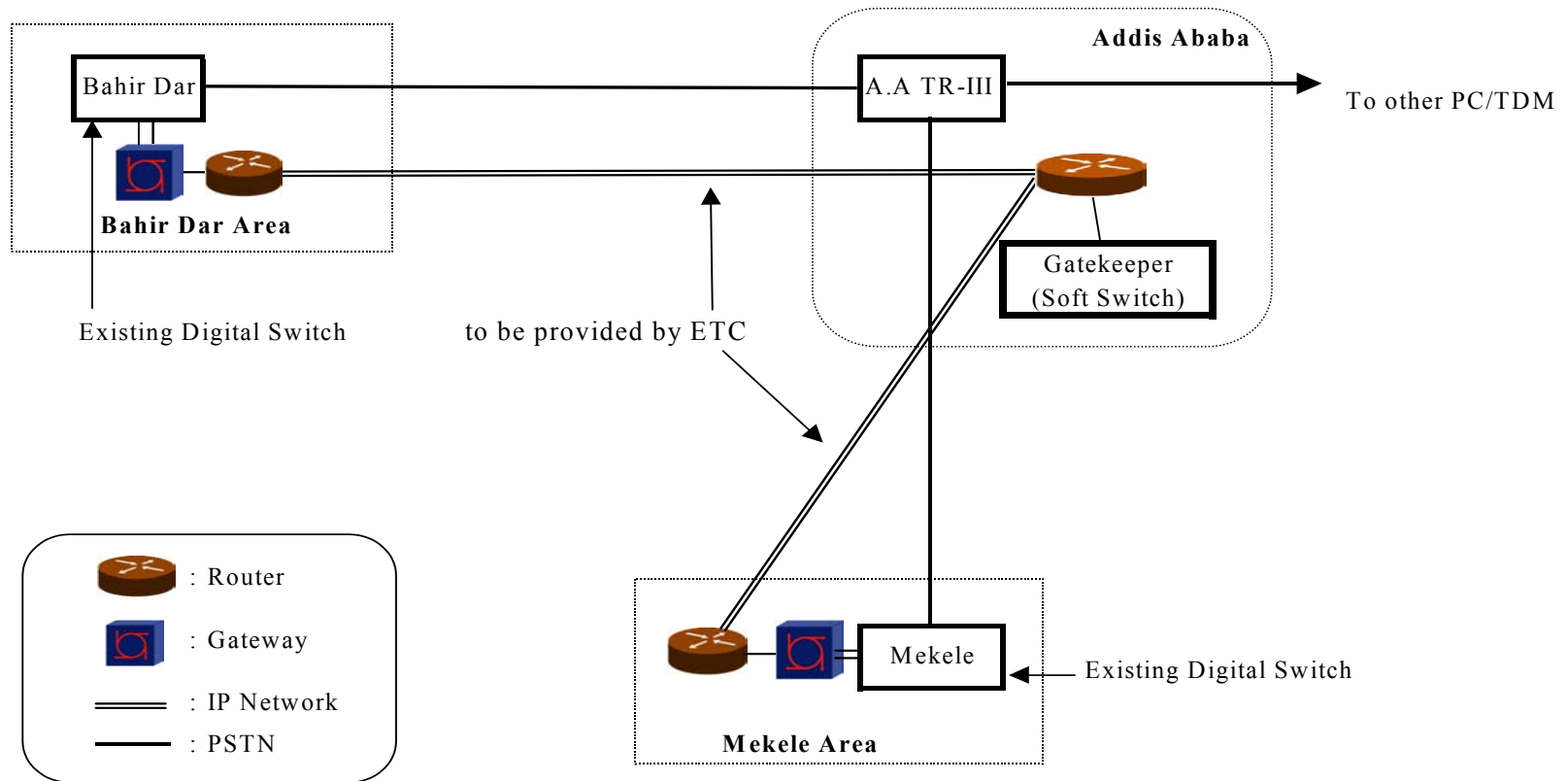


Figure 2.2 VoIP Network Configuration

Attachment 3

3. Implementation Schedule

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																										▲

Attachment 4

Mekele

- 4.1 Technical Specifications for VoIP System
- 4.2 Point to Point Microwave Radio Link
- 4.3 Point to Multi-Point Microwave Radio Link
- 4.4 Solar Power for PCO Network
- 4.5 Outside Plant

Note:

Technical Specifications for Outside Plant is given in Volume IV “Supporting Document”.

Technical Specifications for VoIP

1. VoIP (Voice over Internet Protocol)

1.1 General

This specification covers for main specification of VoIP network to be applied in Ethiopia. The equipment and materials to be supplied shall be in conformity with the technical specifications described hereunder.

1.2 Voice CODEC

VoIP shall have the voice compression facility which is adopted ITU-T Recommendation G.711 (~16kb/s) and shall have the facility to automatically select the compression method according to the communication status.

1.3 AGC (Automatic Gain Control)

VoIP shall have AGC facility to automatically control voice level to the most suitable extent.

1.4 T.38 Real Time FAX communication

T.38 FAX communication system shall be adopted to reduce jitter of the network.

1.5 Support for TOS Field

Voice shall be controlled with the priority by TOS (Type of Service) of IP header.

VoIP shall have the facility to cope with priority routing such as Multi-protocol Label Switching for router facility.

1.5 First Connect

1.5.1 The facility shall be provided for rapid call connection by simplifying call control process with H.245.

2. Interface

2.1 VoIP Gateway – Subscriber : Analog interface,

Power Supply at Subscriber Side : -24V~-48VDC (applicable to analog Telephone)

2.2 VoIP Gateway – Soft Switch : H.323 or SIP (Session Initiation Protocol)

2.3 Media Gateway – VoIP Gateway: RTP (Real Transport Protocol) Packet

2.4 Media Gateway – Existing Exchange: E1 Digital interface (Capacity: more than 4 E1), and 10/100 Base T (Ethernet) for LAN (Local Area Network) and E1, STM-1 for WAN (Wide Area Network)

2.5 VoIP Gateway

Interface: 10/100 Base-T (Ethernet)

Protocol: H.323 or SIP

Capacity: 30 or more (16 for PCO networks)

2.6 Soft Switch

Interface Protocol: H.323 and SIP

Signaling System: SS 7 over IP

Facility: SCCP (Signaling Control Channel Protocol)/TCAP (Traffic Control Address Protocol), G733.

2.7 Charging Facility

Real time CDR (Call Detail Record) shall be installed in Addis Ababa PC (Primary Center), has interchangeability with the existing system and be programmable format.

The charging information shall be connected to the existing computer of ITCD in ETC.

2.8 Call Control Facility

Following facilities shall be provided.

- a) Hunting
- b) Call Screening
- c) Three-way Calling
- d) Call Hold
- e) Call Forwarding

2.9 Gateway in Addis Ababa Primary Center shall have the capacity of 10,000 BHCA (Busy Hour Call Attempt) or more with a capability of up-grade.

2.10 Exchange Facility (VoIP system)

- a) Calling Rate: 0.05 Erl.
- b) Packet Length of Voice: G.729 / G.729a
- c) Packet Length: 16 kb/s or more
- d) Interval of Packet: within 40 msec.

3. General Information

3.1 Power Supply for VoIP

- a) PC and Exchange: 230 V AC, 50 Hz, nominal and UPS (4 hours or more) shall be provided.
- b) PCO: -24 V DC

3.2 Equipment Composition

- a) PC: Indoor Type
- b) Exchange: Outdoor Cabinet Type
- c) PCO: Indoor Type

3.3 Numbering

- a) Special numbering facility shall be provided.
- b) Calling number shall be displayed in case of call to police and fire station.

3.4 Network supervision for VoIP shall be carried out at any station.

3.5 Applicable Standards

- a) Relevant IEEE Standards
- b) Relevant ITU-R and ITU-T Recommendations
- c) The manufacturing facilities for the proposed equipment shall be certified to the ISO 9000 series quality standard.

Specifications for Point to Point Microwave Radio Link

1. General Specifications

1.1 General

This document covers specification for the Plesiochronous Digital Hierarchy (PDH) digital radio equipment associated multiplex equipment and antenna systems to be supplied. The equipment and materials to be supplied shall be in conformity with the technical specifications described hereunder.

1.2 Route Configuration

The PDH Digital Microwave Transmission System shall be established for the route between Mekele PC and Ikotamba Repeater Station, and Ikotamba Repeater Station to Wukro Exchange Office in Tigrey Region.

Mekele PC – Ikotamba Repeater Station Route

<u>Route</u>	<u>Capacity</u>
Mekele PC – Messobo Rep. – Ikotamba Rep.	(1+1) 4x2 Mb/s
Ikotamba Rep. – Wukro Exchange Office	(1+1) 2x2 Mb/s

Route data are given in Annexes,

(1) System Route Configuration	Annex 1
(2) Floor Lay-out of Equipment	Annex 2
(3) Existing Radio Frequency Plan	Annex 3

1.3 Operating Radio Frequency

The radio frequency shall be in 7GHz band as defined in the ITU Recommendations.

The existing frequency plan is attached in Annex 2.

1.4 Multiplex System

The multiplex system requirement shall be in accordance with the technical specification.

1.5 Network Management System (NMS), Supervisory and Control System, and Service Channels shall be provided.

1.6 Power Supplies

Existing power supplies are as follows,

	Actual Load	Capacity	Voltage
Mekele PC	13 A	90 A	-48 V
Messobo Rep.	17.5 A	50 A	-48 V
Wukro Exchange Office	4 A	25 A	-48 V

If the load of proposed equipment will exceeds the capacities above, new rectifier and battery floating system shall be provided.

Ikotamba repeater station shall have a new solar power system.

1.7 Tower, Antennas and Mounting Structures

Existing self supporting tower is available in Mekele PC (42 m high) and in Ikotamba repeater station (22 m high). New self supporting tower of 22 meters of height shall be provided for Messobo repeater station. The new tower in Messobo Rep. shall be able to support four antennas with their diameters of 3 meters each.

1.8 Applicable Specifications and Standards

The proposed system shall be within the framework of and in accordance with the relevant ITU-R and ITU-T Recommendations.

The manufacturing facilities for the proposed equipment shall be certified to the ISO 9000 series quality standard.

1.9 Schedule of Requirements

Equipment to be supplied for point-to-point microwave system are listed below.

Table 1.9-1, Schedule of Equipment Required

No.	Station	Radio	Solar Power	Antenna & Feeder	Tower	DDF
1	Mekele PC	x		x		x
2	Messobo Rep.	x		x	x(22m)	x
3	Ikotamba Rep.	x	x	x		x
4	Wukro Ex.	x		x	x(10m)	x

2. System Specifications

Frequency Band : 7,100 – 7,750 MHz

Interface : 4 x E1, PDH System

Payload : 8.129 Mb/s

Modulation : QPSK

Occupied Bandwidth : 6.3 MHz

Allocated RF Bandwidth : 7 MHz

Transmitting Output : 30 dBm

Receiver Noise Figure : 5dB

Frequency Stability : ± 7 ppm

Overall Performance : -84.6 dBm

(Required Receiving Level for BER= 1×10^{-6})

Environmental Conditions :

a) Temperature

OUTDOOR Unit : -20~+55°C

INDOOR Unit : 0~+55°C

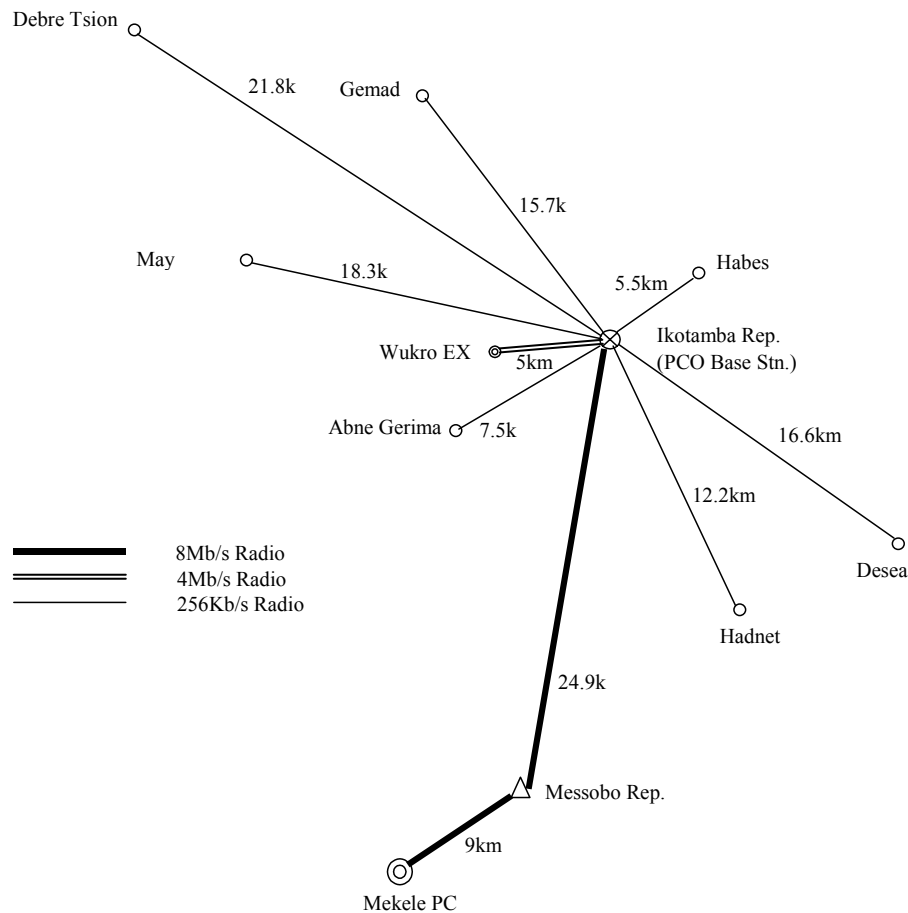
b) Humidity : up to +95%

Input Voltage : DC-48 V $\pm 10\%$

Supervisory and Control by PC

Annex 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



Annex 2 Floor Lay-out of Equipment

- Floor Lay-out of Mekele Transmission Room
- Floor Lay-out of Transmission Room in Messobo Repeater Station
- Typical Floor Lay-out Plan for Ikotamba Repeater Station (PCO Base Station)
- Floor Lay-out of Transmission Room in Wukro Exchange
- Typical Floor Lay-out Plan for PCO Subscriber Station

(For PCO station, sample Drawing is shown below.)

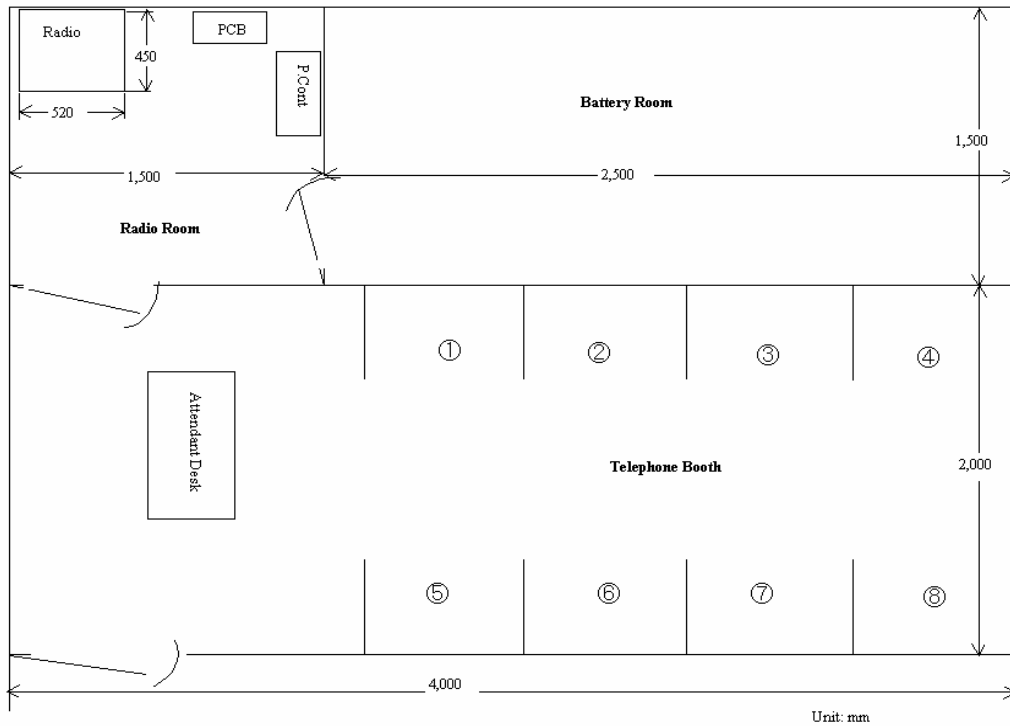


Fig. 1.2-5 Typical Floor Layout Plan for PCO Subscriber Station (Reference)

Annex 3 Existing Radio Frequency Plan

- a) Mekele-Messobo Rep.
ALCATEL, Model 140HTGU-16, 140Mb/s
Tx: 6460 MHz (Working), 6540 MHz (Stand-by)
Rx: 6800 MHz (Working), 6880 MHz (Stand-by)
NEC DRMASS
Tx: 1529.50 MHz (Working), 1529.50 MHz (Stand-by)
Rx: 1464.00 MHz (Working), 1464.00 MHz (Stand-by)
- b) Addis Ababa-Mossobo Rep.
ALCATEL, 34Mb/s
Tx: 1980.00 MHz (Working), 1922.00 MHz (Stand-by)
Rx: 2193.00 MHz (Working), 2135.00 MHz (Stand-by)
- c) Axum-Mossobo Rep.
Tx: 2069.00 MHz (Working), 2009.00 MHz (Stand-by)
Rx: 2280.00 MHz (Working), 2222.00 MHz (Stand-by)
- d) Messobo Rep.-Ikotamba Rep.
Tx: 1512.00 MHz (Working), 1512.00 MHz (Stand-by)
Rx: 1464.50 MHz (Working), 1464.50 MHz (Stand-by)
- e) Ikotamba Rep.-Wukro Exchange
Tx: 1494.50 MHz (Working), 1494.50 MHz (Stand-by)
Rx: 1429.00 MHz (Working), 1429.00 MHz (Stand-by)

Specifications for Point to Multipoint Radio Link for PCO Network

1. General Specifications

1.1 General

This specification covers for Point to Multipoint radio system for PCO network in rural areas. The equipment and materials to be supplied shall be in conformity with the technical specifications described hereunder.

1.2 Network Configuration

Point to Multipoint radio system shall be established for the PCO network in Wukro Woreda area in Tigrey Region.

<u>PCO Base Station</u>	<u>PCO Subscriber Station</u>	<u>Capacity</u>	<u>VoIP Telephone Line</u>
Ikotamba	Debre Tsion	256 kb/s	8
	Gemad	256 kb/s	8
	Habes	256 kb/s	8
	May Kuha	256 kb/s	8
	Abne Gerima	256 kb/s	8
	Hadnet (Tsabat)	256 kb/s	8
	Desea	256 kb/s	8

Route data are given in Annexes.

- | | |
|--------------------------------|---------|
| (1) System Route Configuration | Annex 1 |
| (2) Floor Lay-out of Equipment | Annex 2 |

1.3 Operating Radio Frequency

The radio frequency shall be in 2.3 -2.5GHz band as defined in the ITU Recommendation F. 746-1, Annex 2.

1.4 Network Management System (NMS), Supervisory and Control System, and Service Channels shall be provided.

1.5 Power Supplies

There are no commercial power supplies available in each PCO Subscriber Station and Base Station (Ikotamba Repeater Station). Solar power systems, therefore, shall be

provided. Base Station shall have the capacity of power supply for point to point radio equipment and for base station as well.

1.6 Poles and Antennas

Concrete or wooden pole with 5 meters high shall be provided for each PCO subscriber station. Antenna for base station shall be omni-directional type and for PCO subscriber station shall be yagi type or grid parabolic type antenna depending upon the distance.

1.7 Applicable Specifications and Standards

The proposed system shall be within the framework of and in accordance with the relevant ITU-R and ITU-T Recommendations.

The manufacturing facilities for the proposed equipment shall be certified to the ISO 9000 series quality standard.

1.8 Schedule of Requirements

Equipment to be supplied for Point to Multipoint radio system are listed below.

Table 1.8-1 Schedule of Equipment Required

No.	Station	Base Station Equipment	Subscriber Station Equipment	Solar Power	Antenna & Feeder	Pole
1	Ikotamba Rep.	x		x	x	
2	Debre Tsion		x	x	x	x
3	Gemad		x	x	x	x
4	Habes		x	x	x	x
5	May Kuha		x	x	x	x
6	Abne Gerima		x	x	x	x
7	Hadnet (Tsabat)		x	x	x	x
8	Desea		x	x	x	x

2. System Specifications

2.1 Base Station Equipment

2.1.1 RF Transmitter/Receiver Characteristics

- (1) System Operation : +1, hot standby
- (2) Radio Frequency Band : 2.3 – 2.5 GHz band (Rec. ITU-R F.746-1, Annex 2)
- (3) RF Channel Bandwidth : Not more than 3.5 MHz
- (4) RF Channel Spacing : Not more than 4 MHz
- (5) Transmission Capacity : 2 x 2 Mb/s
- (6) Mod./Demod. Method : QPSK (with roll off filter)
- (7) Output Power : 30 dBm at the output terminal of Tx unit
- (8) Output Frequency Stability : $\pm 5 \times 10^{-6}$
- (9) Output Impedance : 50 ohms, unbalanced
- (10) Spurious Radiation : -60 dB or more, at the ANT port of the equipment
- (11) Overall BER : -90 dBm or less, in BER= 10^{-3} at input terminal of Rx unit

Specifications for Solar Power System for PCO Network

1. Solar Modules

1.1 General

This specification covers for Solar power System for PCO network in rural areas. The equipment and materials to be supplied shall be in conformity with the technical specifications described hereunder.

1.2 Type of Solar Modules

- (1) The solar cell efficiency shall be as follows;

Cell efficiency: at least 14%

Module efficiency: better than 12%

- (2) Each solar module shall be constructed on the basis of normal 12V DC output and easy for series – parallel connection which can fulfill the load requirement of the transmission equipment.
- (3) Solar module shall have by-pass diodes for each or string of solar cells in order to avoid energy loss due to partial shading and bird dropping.
- (4) Junction boxes at the back of each solar module shall be resistant to water and atmospheric condition.

1.3 Solar Array and Supporting Structure

- (1) The 12V modules shall be assembled into array of convenient dimensions using rigid frames incorporated into the principal supporting structure.
- (2) When supporting structure mounted on the ground-based foundation, the lower edge of the solar array shall be at least 1.5 meters above ground level.
- (3) Array supporting structure shall resist a wind speed up to 150 km/h.
- (4) Array supporting structure shall have a fixed 10 degree tilt design

1.4 System Sizing

The system sizing shall be done based on the average insolation level of 465 Langley.

2. Charge Regulator

- (1) Charge regulator shall be designed for nominal voltage of,
- a) –48V DC for PCO Base station equipment and for the point to point microwave radio equipment in Ikotamba repeater station

b) -24V DC for PCO Subscriber station equipment.

- (2) The voltage to the load terminals shall be isolated in case of battery reverse polarity connection.

1.5 Regulator Facilities

- (1) The regulator shall incorporate an automatic boost charging facility.
- (2) The regulator shall have a built-in measuring instrument that is used to measure array current, load current, battery and load voltage each having manually operated push button and switch to disconnect them when not in use.
- (3) The regulator shall have necessary protection facilities to protect from damages.

3. Storage Battery for Solar Power System

3.1 Type of Battery

- (1) Storage batteries shall be of an enclosed lead-acid and dry-charged type.
- (2) The container shall be preferably see-through transparent type.

3.2 Operating Condition

The cells will be operated under float and boost charge modes and shall be able to supply the load for three (3) days in case of failure or bad weather condition.

4. Power Distribution Board

- (1) The DC power distribution board shall have built-in automatic circuit breakers, which are sized on the load requirement of different transmission equipment with at least one (1) extra breaker for an expansion.
- (2) The DC power distribution board shall be designed for in-door use and to be fixed on the wall.

5. Schedule of Requirement

Equipment to be supplied for solar power system is as follows,

<u>Station (Power Consumption)</u>	<u>Solar Module</u>		<u>Storage Battery</u>	
	Cap. (W)	Q'ty	Cap.(Ah)	Q'ty (Bank)
Ikotamba (700 W)	120	18 (48V)	1,500	1
Debre Tsion (70 W)	60	7 (24V)	500	1
Gemad (70 W)	60	7 (24V)	500	1
Habes (70W)	60	7 (24V)	500	1
May Kuha (70 W)	60	7 (24V)	500	1
Abne Gerima (70W)	60	7 (24V)	500	1
Hadnet (Tsabat) (70 W)	60	7 (24V)	500	1
Desea (70 W)	60	7 (24V)	500	1

Remarks: The capacities of solar modules and batteries in the above table show preliminary values for the references.