9.7 Public Data Network (PDN)

9.7.1 Existing Public Data Network

For the sole and independent infrastructure toward the development of ICT in Ethiopia, ETC has established a fully digitalized Public Data Network (PDN), named **"Ethio Stream"**. The PDN with 17 nodes sites covers Addis Ababa and 9 other major cities in the country as mentioned in Chapter 3.6 The current network layout is illustrated in Figure 9.7-1. The PDN will also have international connections very soon. The Ethio Stream provides WAN solutions and also performs multimedia services incorporating voice, data, video and image using the following services.

1) Dedicated digital circuits within the limits of 2.4 kbps to 512 kbps, PDN provides the customers at any given rate.

2) Frame relay in which point-to-point and/or point-to-multipoint Private Permanent Virtual Circuit (PVC) digital leased lines are availed at any rates ranging from 2.4 kbps to 512 kbps currently. This packet based virtual channel (VC) gives the customers freedom to tunable Committed Information Rates (CIRs) up to the link speed.

3) ISDN which is one of the planned options to connect customers to Internet

The followings are the major portion of the applications supported by the PDN.

- Digital leased circuit connection at (n x 64 kbps)
- Dedicated access to Internet (n x 64 kbps)
- Point-of-Sale applications
- On-line transaction
- Video conferencing
- Virtual private network
- Internetworking (connection among LANs)

In addition to the above, the PDN is used and works as a backbone network to linkup the Central Gateway in Addis Ababa with the ETC's Internet PoPs, which are located at different cities. The PDN is independent National Information & Communications Network (ICN), Internet local ISP as any other end services use the PDN as illustrated in Figure 9.7-2.

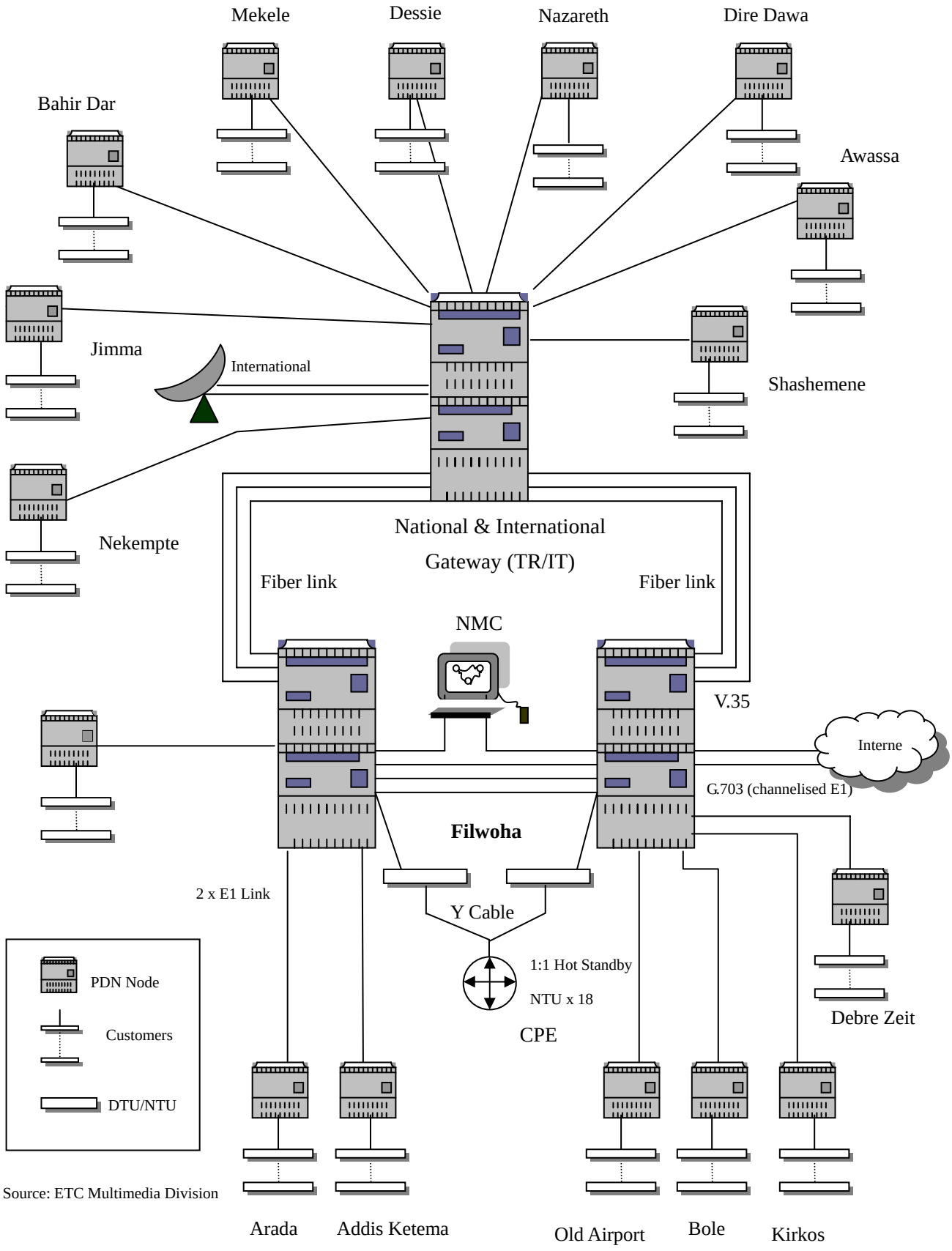


Figure 9.7-1 Public Data Network (Ethio Stream)

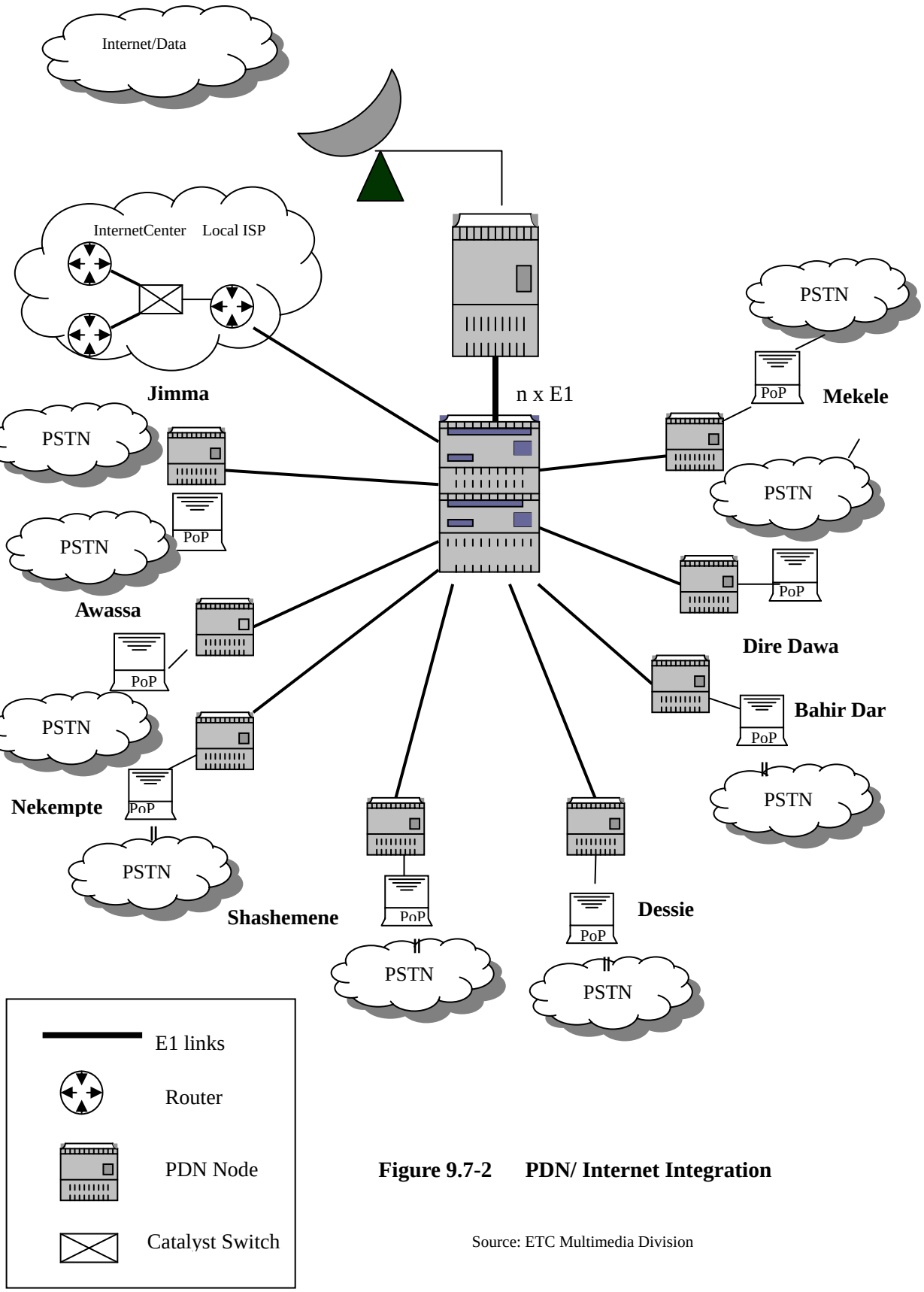


Figure 9.7-2 PDN/ Internet Integration

Source: ETC Multimedia Division

9.7.2 Typical Current Data Networks

To make future upgrade of the Ethio Stream it will be necessary to verify the current networks.

(1) HSD (High Super Digital)

HSD is provided for dedicated leased circuit (64 kbps-6Mbps). It applies International Standard of I-Interface. For subscriber access, it uses metallic cable for below 128 kbps, or optical fiber for more than 192 kbps transmission. In case of LAN or Internet connection HSD requires several additional unit/card so that, those users make transition to FR or ATM.

(2) FR (Frame Relay)

Based on the packet protocol it transports maximum 2 Mbps. By improving reliability of transmission media (like optical fiber) error correcting control is simplified. It realizes construction of an economical data transmission network because of PVC, in which many different users can share the network. The FR is suitable for sporadic and big amount of data communication. However, in a low reliable transmission path the capability greatly deteriorates in most cases at access network.

(3) ATM (Asynchronous Transfer Mode)

Originally ATM technology aimed at utilization of Broadband ISDN. It transfers the fixed frame of cell (53 byte:5 byte header 48 byte payload) and transport different types (low to high speed) of the traffic data such as voice, image and other data at the same time. From here on it is expected to strengthen friendliness with IP network such as IP over ATM.

(4) ADSL (Asymmetric Digital Subscriber Line)

Using existing metallic cable with modem unit ADSL realizes high speed digital access, one of technologies of xDSL, and most popular among Internet users. It presently enables transmission speed of 12 Mbps maximum for downward, 2Mkbps maximum for upward. ADSL also can be used for Video on demand.

(5) FWA (Fixed Wireless Access)

Most customer access to the Ethio Stream is made through the metallic pair cables. FTTH is the perfect solution but it is costly. For wideband transmission, xDSL is effective if the status of the existing cables is suitable for it. Also it is recommended to introduce Fixed Wireless Access (FWA).

The radio frequency bands to be used are 22GHz, 26 GHz, 38GHz and also 1.9 GHz used for PHS. Topology of FWA is as follows:

- Point-to-Point: 1 base station to Customer, 22GHz, 26GHz and 38GHz (Max. 4 km radius, 156Mbps)
- Point-to-Multi point: TDM 26GHz & 38GHz (1 km radius, Maximum 10Mbps)

9.7.3 Trend of Data Network and Strategy

As aforementioned present Ethio Stream service provides independent network from the digital telephone network. In the Master Plan the same concept is to be adopted. In the past the network has been separately and exclusively built based on its specific and objected usage only. Meanwhile, the network is recommended, by ITU standardization, to be integrated as ISDN in the world level digital network. As a result, the public telephone, facsimile, data switching, low speed digital leased circuit are mostly integrated.

However, since the recent diffusion of Internet and development of computer technology requires IP based network, presence of such network will be reconsidered and reviewed.

One of difference between ISDN and IP network is that:

a. The required functions for network is contained in the ISDN,

b. IP network does not have such functions but end terminal such as personal computer and other terminals have the functions, so that telecommunication carrier is required transparent network.

Accordingly, ETC as a carrier, provides high efficiency and high quality transparent network service without thought of ISDN. From the service provider point of view it offers the services of various applications which support IP network.

9.7.4 Data Network Expansion

Present PDN applies Frame Relay (FR) which is economical and suitable for point-to-multipoint data communication of LAN to LAN under always-on connections status. This network plays an important role and still operating in many developed countries.

Increasing the number of LAN computers, or transmission of a large amount of different length of data (video signals or image data etc.), it will require high speed transport network. For this purpose ATM (Asynchronous Transfer Mode) has been developed. ATM enables transmitting from low speed up to high speed data within the same network. In the case of ATM (IP over ATM) IP packet is again divided into cell (53 byte length). There are many cells in one packet and require 5 byte header in each cell. So that transfer efficiency is low, so that, most cases IP over SONET/SDH or IP over WDM are used. ATM is suitable for multimedia data communications, which contains lots of various types of information.

In the Master Plan the IP Network over the microwave system will be gradually introduced from the year 2005 and co-existed with the present PSTN in overlay composition. In case where the microwave radio systems are mainly used nationwide other than optical system, it is noted that the system reliability such as outage due to fading has to be taken into account.

In selecting ETC's long future data network it is noted the fact of the recent rapid technology development especially ICT concerned. Today's new technology will be an old one after several 10

years, then further advanced network will come up one after another.

Although it is unknown a new type of data network that might be drastically changed in the year 2020, the trend of network will be IP based data network.

Concerning Quality of Service (QoS), basically the computer communications have developed having treated the discrete data which occur as burst signals. The typical example is Internet communications. For voice and image, video picture transmission the QoS is considered as a serious problem. ATM is widely introduced in the world. It furnishes a superior performance for the guaranteed service with the most reliable QoS. Frame Relay uses as VPN guarantees with some degree of CIR.

9.7.5 Overview of Network Expansion

(1) Present and Years 2005-2010

The digital data service opened to the public in 2001. Present number of customers of both data and Internet are approx. 20 data customers and 6,000 Internet subs. as listed in Chapter 3.6. As the present PDN composition and applied technology have provided sufficient performance, network expansion against customers increase is to be done in the present data network, also in due consideration of enhancing the profitability of the investment.

(2) After 2010-2020

Growing number of customers and higher transmission speed requirements, it is foreseeable the needs of broadband backbone network. In order to accomplish the broadband network, it is recommended to apply ATM technology to the optical fiber network where applicable (Addis Ababa junction ring, Addis Ababa-Nazareth Link etc.), or IP over SDH (through Microwave Radio Links). For the radio transmission 8 Mbps x 1 or 8Mbps x 2 capacity will be necessary for main links; Nazareth, Bahir Dar, Mekele, Dire Dawa, Jimma, Nekempte, Shashemene Awassa. For the small cities E1 x 1 will be provided with the frame relay.

For the subscriber access network ADSL is recommended. For the rural areas the adoption of low cost high speed internet service is one of choice to be considered for.

In NII (National Information Infrastructure) of the most countries the final goal of ICT network is to realize FTTH, then telephone service will be incorporated with IP service. This is completion of Integrated Digital Service based on IP technology.

9.7.6 Expansion of Ethio Stream

Present number of PDN customers of both data and Internet are a bit small as the service opened to the public in 2001. Data network expansion is to be done to cope with increasing demand. In the Master Plan the trend of increase for the data and Internet subscribers is estimated as follows. For further details refer to Chapter 6 Demand Forecast.

Demand Forecast	2001	2005	2010	2015	2020
a. Data/Internet Subs.	4,000	109,000	191,500	273,100	405,200
b. No. of Nodes/POPs	10	15	20	25	31

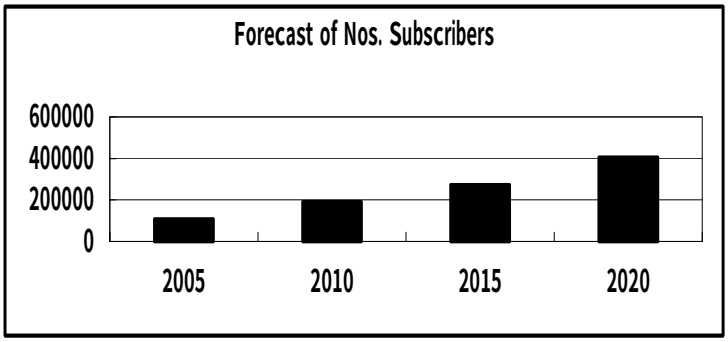


Figure 9.7-3 Forecast of Number of Subscriber (Data/Internet)

However, because of still in the early days of its service of the PDN there are yet nothing helpful data available to estimate trend of the demand, also it might differ from many factors like utilization of data network by the government and business field, a number of computer possessors, affordable internet tariffs, earnings of citizens, degree of people's interest in the Internet. So that it realizes how difficult it is to forecast, then suggested to observe statistically and periodically a trend of demand increase from now on. It is recommended that the forecast will be reviewed every 6 month. However, in conclusion by all means, the Internet users will exactly rise in future according to data in the world trend. There will be prospect and possibility of increasing Internet users from the mobile users, also the private Internet Service Providers break into this business field within a couple of years.

The following new node and PoP locations are selected for extension:

Table 9.7-1 Expansion of Nodes and Point of Presence

Year	Candidate Locations
2005	Yeka, D.Brahan, Akaki, Gerji, Kotobe
2006-2015	Kolfe, Assela, Harar, Goba, Wolaita, Dilla, A. Minch, Muttu, D.Markos, Gondar
2016-2020	Hagere Hiwot, Combolcha, Axum, Butajira, Assola

It is required to review and forecast the requirements of POPs to be established.

(Note): To establish the Government Intranet (G2G) the following Regional Administrative Offices are included in the above.

Gondar, Debre Marcos, Mettu, Arba Minch, Harar and Goba.

The above plan might be revised based on public requirements and ETC's statistics and forecast.

Figures 9.7-4 and 9.7-5 illustrate network composition for reference, but not limited to.

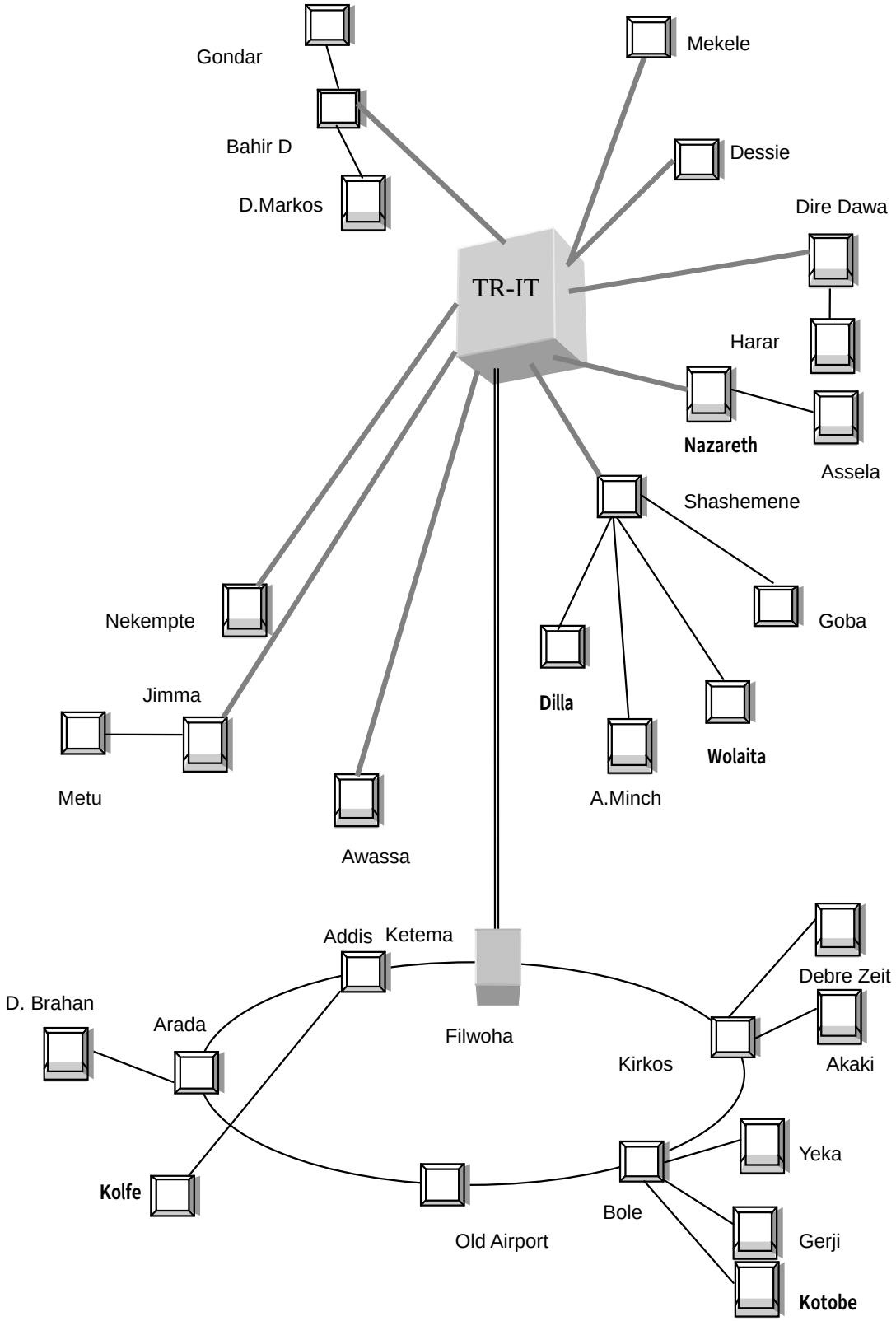
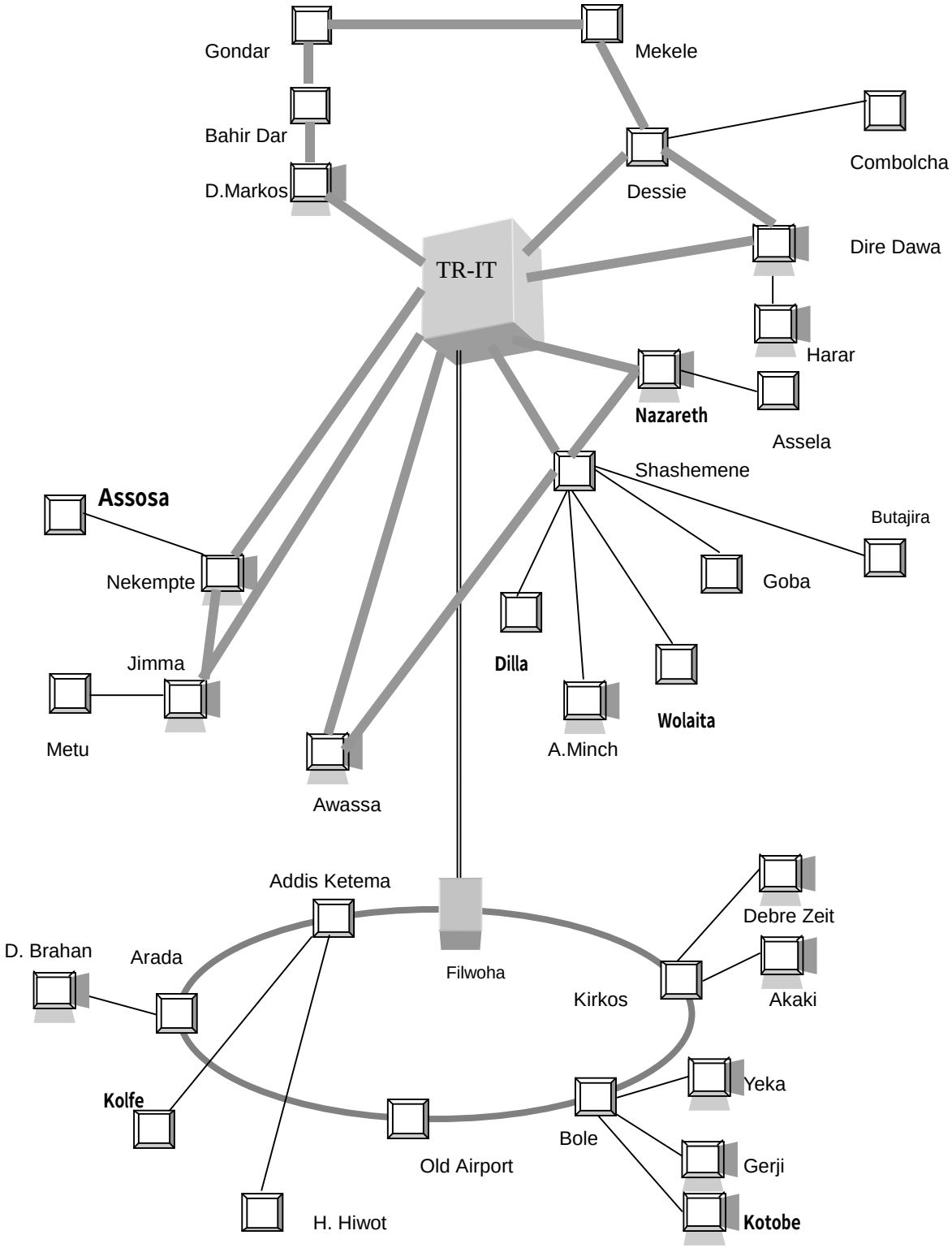


Figure 9.7- 4 Digital Data Network Layout Plan (2005-2010)



(Note) Microwave radio links will have ring composition in several routes around year 2010.

Figure 9.7-5 Digital Data Network Layout Plan (2011-2020)

9.8 Transmission Network

9.8.1 Fundamentals

(a) Network Capacity for Forecast Traffic

Transmission network is fundamentally and generally designed to supply the capacity based on the traffic forecast. The telecommunications traffic consists of public telephone, mobile telephone, PCO traffic, IP service, TV program transmission and international traffic.

Forecast traffic of backbone network, where fixed+IP telephone service, mobile service, Internet service and TV program transmission are contained, is shown in D.Table 9.8-1 of Data File.

Summary of existing links of the forecast regional public telephone traffic is as follows. Details of traffic are shown in D.Table 9.8-2 of Data File.

Table 9.8-1 Existing Link of Public Telephone Traffic

Link＼Area	01	02	03	04	05	06	07	08	Total
MW	7	7	9	8	4	19	12	16	82
UHF	8	0	1	0	1	1	9	1	21
VHF	21	9	10	0	6	11	15	7	79
HF	0	0	4	5	11	5	0	4	29
DRMAS	30	14	11	49	18	33	35	17	207
L.Line	10	7	14	0	1	16	10	13	71
VSAT	8	14	22	4	24	27	23	22	144
Cable	1	0	0	0	0	0	0	0	1
New	0	1	8	0	2	0	1	1	13
Sub-Total	84	52	71	66	65	112	104	81	647
Addis Ababa	21								668

Source: ETC

Roughly 100 stations are missed in the traffic forecast as there exist around 650 stations now though more than 5,000 of new PCOs will be built in the master plan on top of the conventional telephone service. The location of 75 stations out of the 570 of public telephone service is not found, which are listed in D.Table 9.8-4 of Data File. Exact number of PCOs used for transmission designing is shown in D.Table 9.8-6.

D.Table 9.8-3 of Data File shows the estimated traffic of Addis Ababa junction network in 2005 GC. The traffic in 2010, 2015 and 2020 GC is considered to be handled by the ring capacity installed for 2005 GC.

Circuit plan of international telecommunications used for transmission designing is also shown in D.Table 9.8-5 of Data File.

Those traffics are once projected on the ETC's network at the first step of network planning in the master plan. The necessary capacity of 2Mbit/s for each regions of Area-01 through Area-08

in the target years of 2005, 2010, 2015 and 2020 GC is shown in the supporting report "Transmission Capacity based on Forecast Traffic". S.Table 9.8-1-a through -d show the capacity needed in 2005, 2010, 2015 and 2020 GC respectively and the summary is shown in S.Table 9.8-1-e. An image of the network structure is shown in D.Figure 9.8-1, where the network capacity is shown instead of traffic volume.

The expansion capacity necessary for the forecast traffic is calculated comparing to the existing + on-going capacity of the Eighth Development Program. Here all analogue links are to be replaced by the digital. A recommended capacity of network of Eighth Development Program, which capacity is not decided yet, is shown in S. Table 9.8-1-f of the supporting report.

(b) Reliability of Network

Reliability of the network will become more important when the network increases its capacity. In the master plan, the ring configuration such as MSSP (multiplex section shared protection) used in optical fiber transmission system is planned to be employed for the network/route of heavy traffic. The protection channel used in microwave system is as called 1+1, 1:1, n+1 or n:1.

(c) Microwave Resource

ITU-R recommends utilization of 2GHz-band, 4 GHz-band, 5 GHz-band, U6 GHz-band, L6 GHz-band, 7 GHz-band, 8 GHz-band and 11 GHz-band for trunk transmission link. Based on this recommendation the transmission system of STM-1 is manufactured mainly for 4, 5, L6, U6, 7 and 11GHz. However, since 7GHz-band and 11GHz-band cannot transmit so long distance is comparison with 6GHz and lower, they are better to be deployed for spur or short distance link. D.Table 9.8-7 shows the summary of ITU-R recommendation. 2GHz-band should be reserved for mobile telecommunications as recommended by ITU-R, especially in urban area and along main trunk link. Maximum capacity of microwave is consequently limited by such usable frequency-band and other technical issues.

(d) Comparison of Microwave and Optical Fiber Cable

Microwave has an advantage in cost and period of construction/expansion, while optical fiber cable has an advantage in capacity, quality and expandability.

Major advantage and disadvantage of microwave and optical fiber are as follows:

Table 9.8-2 Major Advantage and Disadvantage of Microwave and Optical Fiber

Media	Advantage	Disadvantage
Microwave	Construction/expansion cost is more economical than optical fiber as far as the existing common facilities are available. Spur link to the exchange far from trunk road can be established easier.	Quality degradation due to space propagation. Limit of expansion in capacity. Spur link from micro station on top of mountain to the exchange is necessary. Newly construction of microwave station is generally expensive.
Optical Fiber	High quality. Easily expandable with low cost. Almost no limit of expansion. No necessity of spur link for the exchange along the road.	High initial construction cost. Possibility of damage by civil work on road or by power line trouble. Spur link to the exchange far from trunk road is established by microwave, which is more expensive than microwave only.

In the occasion the demand exceeds the limit capacity of microwave, only the optical fiber is the solution.

9.8.2 National Backbone Link

Major traffic flows to and from the regional center of each region putting the hub on Addis Ababa in a star configuration. The national backbone is composed of such spokes of both-way links between the regional centers and Addis Ababa. Necessary capacity of the national backbone link based on the traffic is shown in S. Table 9.8-1-g of the supporting report "Transmission Capacity based on Forecast Traffic". Expansion plan based on the necessary capacity is shown in S. Table 9.8-1-h of the same report.

Necessary capacity in STM-1 between Addis Ababa and Mt.Furi, which is the most congested microwave link, for north route, east route, south route and south-west route, is as follows.

Table 9.8-3 Necessary Capacity in STM-1 between Addis Ababa and Mt.Furi

Route	2004 GC*	2005 GC	2010 GC	2015 GC	2020 GC
North	1	2	2	2	3
East	2	4	3	4	4
South	1	2	2	2	2
South West	1	2	1	1	2
Total	5	10	8	9	11

* The planned capacity at the completion of Eighth Development Program

As new 5 STM-1s in 2005 GC and further 1 STM-1 in 2020 GC are needed additionally, the OFC (optical fiber cable) system is recommended to introduce in order to ease this congestion and obtain higher transmission quality and flexibility in future expansion. Introduction of OFC from Addis Ababa to Nazareth is most recommendable, because it will contribute to future expansion of OFC network to south and east. The system is required to operate by 2005 GC. The capacity of the new OFC system will suitably be STM-4 and an estimated traffic volume is shown in S.Table 9.8-1-i. After construction of this OFC system the two microwave STM-1s of east route can be

used as a back-up in emergency or for expansion of the other routes. In this plan the microwave link of Adama West-Nazareth may need another STM-1 in 2005 GC since the OFC accommodates the traffic from 05 Area in addition to the intra-area traffic of 01 and 02 areas.

The followings are major construction/expansion plan of SDH microwave, which is 66 links.. Please refer to S.Table 9.8-1-h for details.

Table 9.8-4 Major SDH Construction/Expansion Plan of Microwave

Route	Link (number of STM-1 links)	Year in GC
North	AA – Korke (7), Maichew North – Maichew Town (2), Atebes – Adigrat (2), Morer – Adwa (1)	2005
	Irgofet – Korke (1), Woldia West – Mossobo (5)	2010 & 2015
	AA – Sheno South (2), Ambalay South – Irgofet (2), Tita South – Dessie (1), Korke – Woldia West (1)	2020
East	Nazreth – Adama West (1), Dalecha –Asebe Teferi (2), Mardepass – Kebri Beyah (1)	2005
	Kulbi W – Djibuti (9)	2010
	Adama West – Awash Rep (2)	2020
South	AA – Shashemene (5), Abaro – Awassa (1), Waragelama – Dilla (2), Shashemene - Kersa (1)	2005
	Shashemene – Abaro (1)	2020
Southwest & West	AA – Weliso North – Weliso Town (3), Gore Rep. – Mettu (1), Gara Gordomo – Nekemte (1)	2005
	Fofa – Muja (1), Muja – Sembo West (1), Dembi North – Arjo MW (1)	2020
Northwest	Bahir Dar – Wash Indrias (1), Gara Guda – Fitche (1)	2005
	Wash Indrias – Debre Tabor Rep (1)	2010
	Merawi North – Bahir Dar (1), Wash Indrias – Gondar (2), Girgi North – Wekin (3)	2020

In addition to the above, in order to increase the stability and reliability of the network, STM-I ring configuration may be introduced to:

a) North-East route linkage to East route by connecting

- Mille and Dire Dawa or
- Bure and Djibouti,

whichever realistic and economical taking the cooperation with EEPCO power transmission route into consideration.

b) North route linkage to North-West route by connecting

- Mekele and Gondar or
- Axum and Gondar.

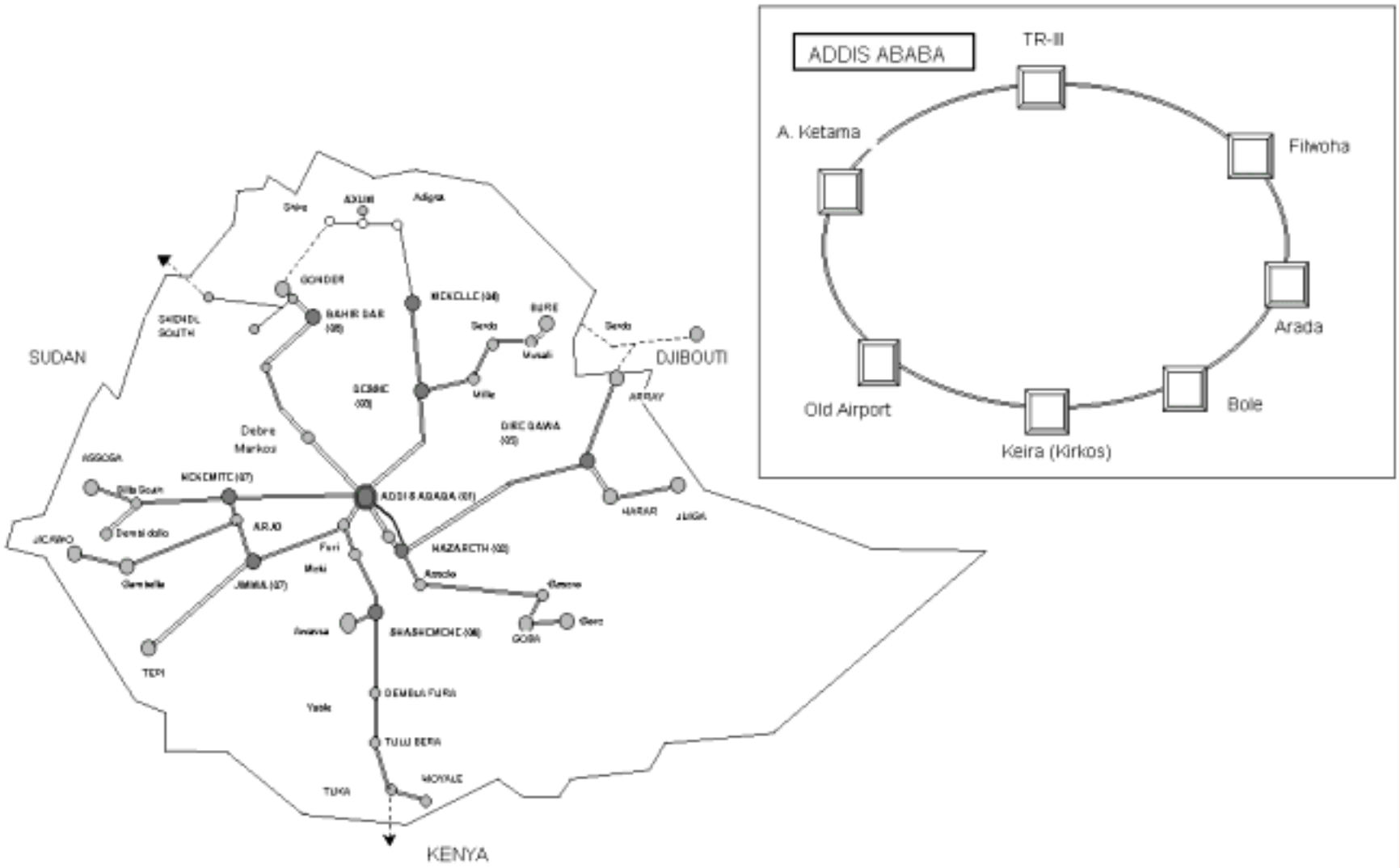
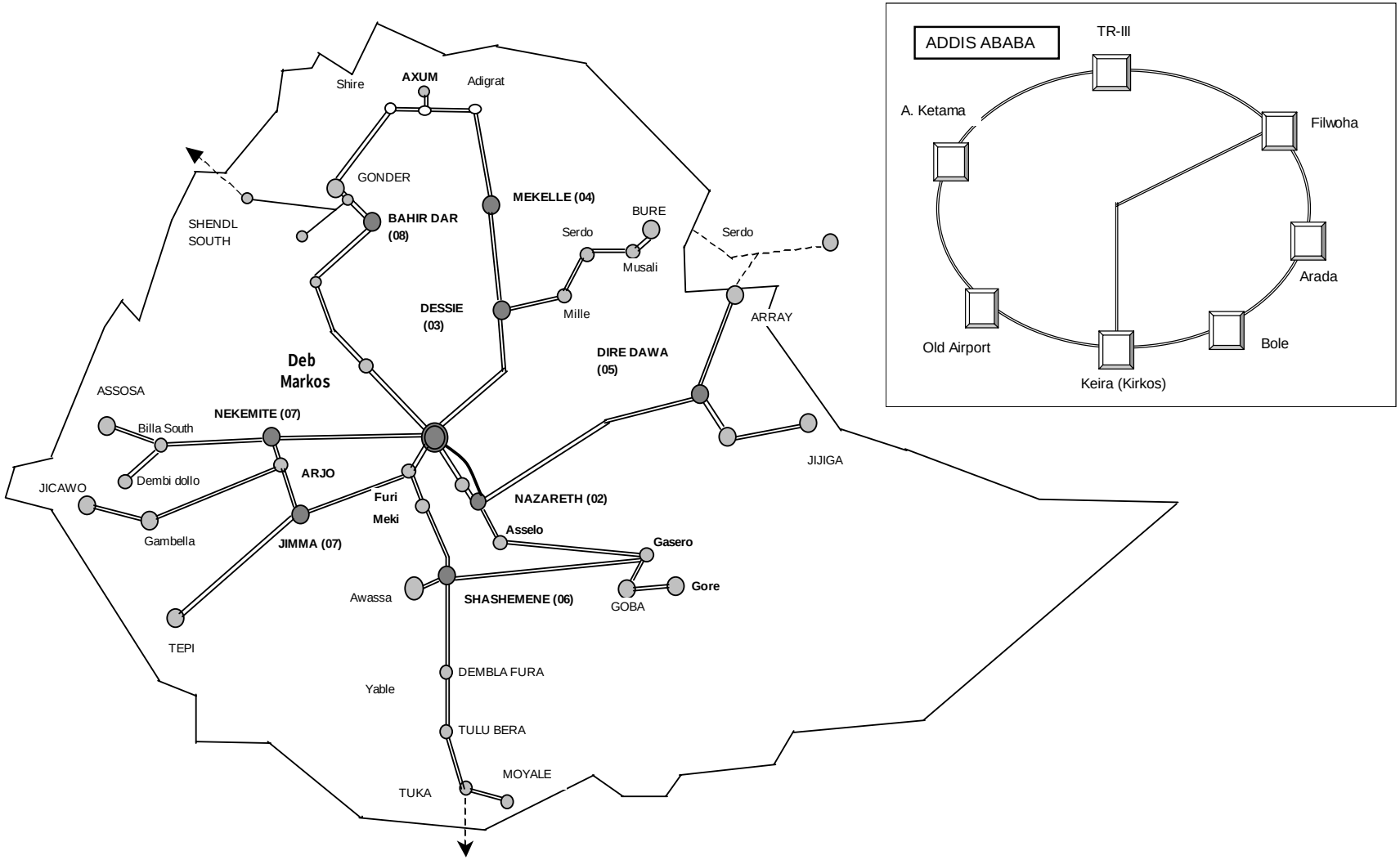
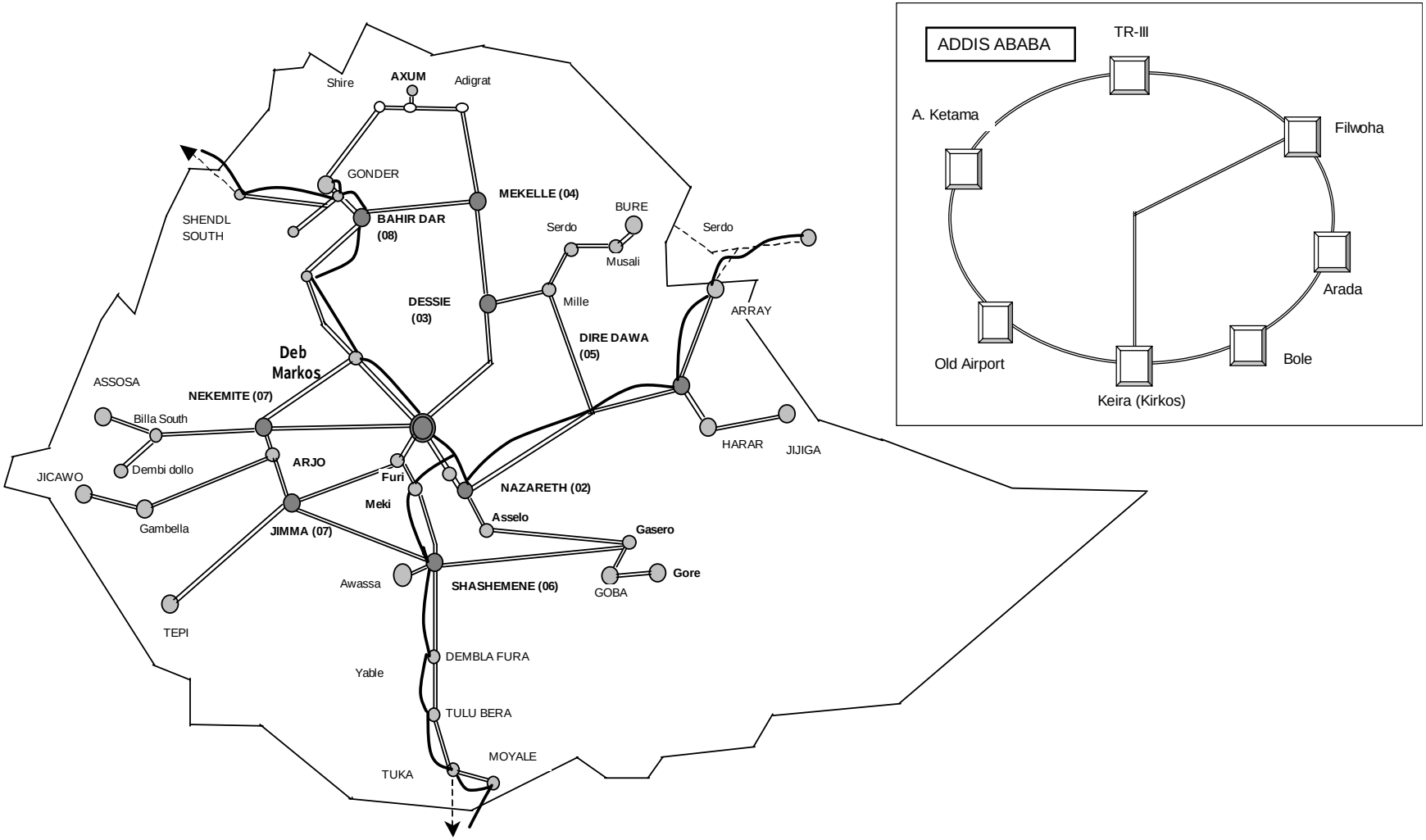


Figure 9.8-1(1/3) Overview of Backbone Network (Year END 2005GC)



CHAPTER 4 Figure 9.8-1 (2/3) Overview of Backbone Network (Year END 2010 GC)



CHAPTER 3 Figure 9.8-1 (3/3) Overview of Backbone Network (Year END 2020 GC)

9.8.3 Domestic Satellite Link

VSAT will basically take the part of providing the most isolated locations in the country with telecommunications access. The number of VSAT remote stations will be 133 of FaraWay and 179 of DialAway at the completion of Eighth Development Program.

In this master plan the 46 existing VSAT stations described in 9.8.1 of this chapter are requested to expand its capacity. Two stations of them are planned to expand in their channel numbers, while the other 44 stations are to be changed to microwave stations by establishing PDH link with the closest terrestrial network. At the same time another 10 VSAT stations will be newly constructed replacing the existing small links of HF, Long Line and so forth. The following table shows these 10 stations and the 2 expansion sites. Construction of 10 VSATs is recommended to planned in Mid-term as the new powerful satellite will be available around 2009 GC, although the traffic requires the additional capacity from 2005 GC.

Table 9.8-5 New VSAT Station for Public Telephone Service

Area	Station	Number
04	Humera	1
05	Gode*, Misrak Gashamo, Segeg, Shilabo, Kelafo, Warder*, Musthil, Adele	8
06	Bare, Dollo Oddo,	2
08	Abderafi	1
Total		12

* Existing VSAT station to be expanded

On the other hand PCO needs another 176 VSATs for rural telecommunications as follows.

Table 9.8-6 New VSAT Station for PCO

Region/ VSAT(Number of Woreda)	Phase-1 2005 GC	Phase-2 2010 GC	Phase-3 2020 GC	Total
Tigrey			7 (1)	7
Oromiya			58 (8)	58
Somari	8 (4)	19 (7)	21 (17)	48
Benishagle-Gumuz	7 (1)			7
SNNP		46 (4)	7 (1)	53
Gambela			3 (1)	3
Total	15 (5)	65 (11)	96 (28)	176

Note: The blanketed figure shows the number of Woredas.

At the final stage of this master plan of 2020 GC the total number of VSATs will become 454.

Table 9.8-7 Number of Remote Stations of VSAT

Year in GC		2004	2005	2010	2020	Total
End of Eighth Development Program		312	0*	0*	0*	312
Spur Link Expansion			-44	10	0	-33
PCO for Rural Telecommunications			15	65	96	176
Total			283	358	454	454
Option**	Spur Link Expansion		-13	-31+10	0	-33
	Total		314	358	454	454

* 179 VSATs of DialAway will be replaced by FaraWay.

** The case that a shift from VSAT to Microwave is scheduled in Mid-term instead of Short-term in order to alleviate a peak of Short-term.

Only one VSAT system operation for public communications purpose, the selection of either DialAway or FaraWay, is recommended as soon as ETC's budgetary circumstances allow. Considering the growth of traffic, FaraWay is suitable to operate for the public telecommunications because of its bigger capacity and mesh network. While DialAway will be used for some limited communications purpose including "Data" transmission considering the use of its low cost and prompt deployment.

The remaining lifetime of the 57-degree satellite (NSS 703) is expected to be about 10 years, though is guaranteed to be available until 2009 GC. ETC is considering the use of a RASCOM satellite in future, while the other satellites seem to be available as well.

Major parameters of future candidate satellites are as follows, though no data for RASCOM here at this moment.

Table 9.8-8 Major Parameter of Candidate Satellite

	Intelsat 901	PAS-10	NSS 703*
Location	342 degree	68.5 degree	57 degree
Frequency Band	C-Band	C-Band	C-Band
Beam	Zone	Vertical/Horizontal	Zone
Polarization	Circular	Linear	Circular
eirp	36 up to 44.1dBW	36 up to 38dBW	31 up to 39.5dBW
G/T	-7.4 up to +5.9dB/K		
SFD	-89.0 to -67.0dBW/m^2		
Launch	Oct. 2001	May 2001	Oct. 1994
End of Life	(about 15 years)	(about 15 years)	March 2009
Ku-Band	Facilitated	Facilitated	Facilitated

* For reference

Any new satellite should be carefully studied in advance before the end of NSS 703's life. It is important to select the satellite, which covers all the country with not lower than the standard e.i.r.p of around 40 dBW or more. The higher the satellite power is, the more economical the ground system is.

South-eastern and southern parts of the country, which are on the beam edge of NSS 703, are expected to have enough number of channels for traffic when a new satellite is introduced.

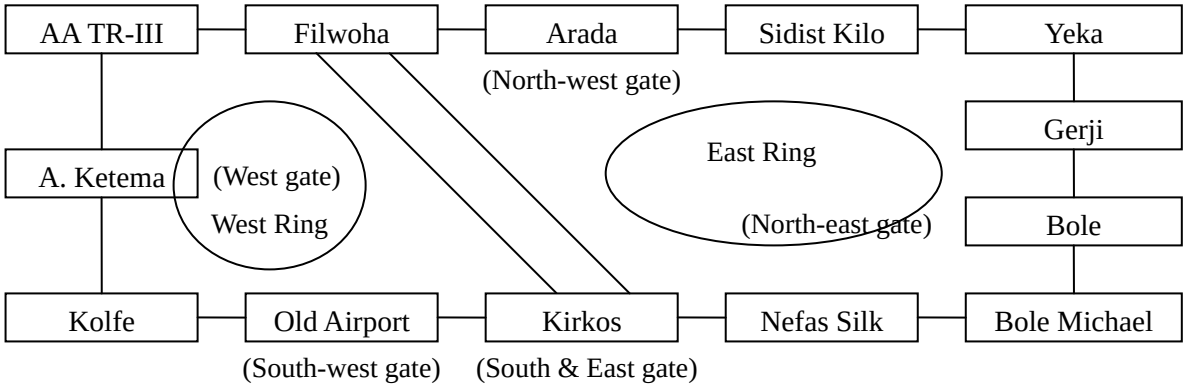
One of the big advantages of satellite is broadcasting. Now 25 TVROs are receiving the TV program from the satellite. Further expansion to countrywide usage of broadcasting is desired. The program can be diversified to many fields such as education, health, AIDS-prevention, welfare, market information and so forth, though they are not telecommunications.

ETC is planning to introduce new services using satellite and has started a trial pilot system of Learning-Away for remote education.

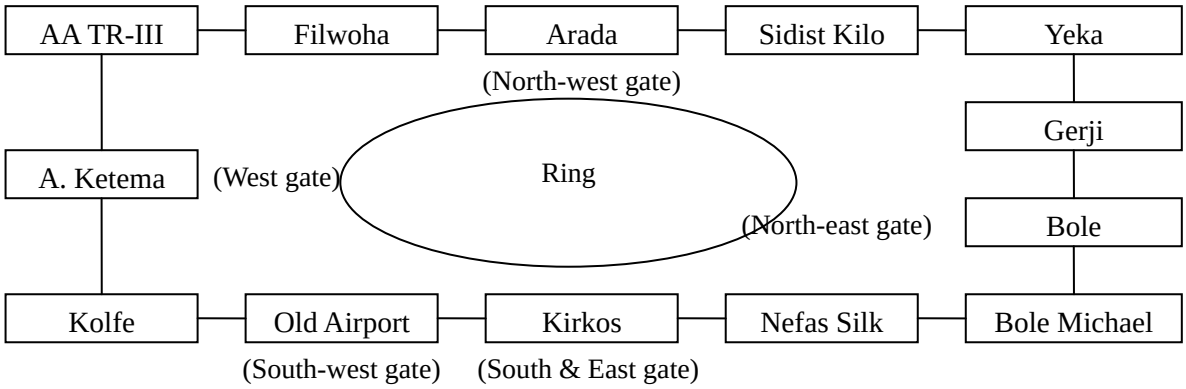
9.8.4 Junction Link

Junction network is basically requested to configure by optical fiber. The reason is its advantage of big capacity and high flexibility for expansion comparing to radio link and metallic cable. The network is proposed to configure the ring, which has high reliability.

In the junction network of Addis Ababa 15 out of 24 links are already or will soon be configured by optical fiber. By construction of duct system and installation of optical fiber cable into the remaining links in the city, a dual-ring configuration is planned by ETC.



A. Dual Ring



B. Single Ring

Figure 9.8-2 Ring Configuration of Addis Ababa Junction Network

The total traffic is estimated at 15 STM-1s as shown in S.Table 9.8-1-k of the supporting report "Transmission Capacity based on Forecast Traffic".

The capacity of the ring necessary for the traffic of 2005 GC is calculated as eight (8) STM-1s at least, in case each traffic between two stations is allocated into CW route and CCW route half by half. A 4-fiber MSSP ring of STM-16 is recommended to be constructed as soon as possible. Either Dual-ring or Single-ring can accommodate the forecast traffic. Merit and demerit of Dual-ring and Single-ring are shown in the supporting report.

9.8.5 Spur Link

Spur link can be configured by microwave or optical fiber, selection of which will be done based on the cost. Breaking point of link length in its selection by cost seems to be roughly a little less than 20 km recently. Here all spur links are designed to configure using microwave, as any link of short distance with considerable capacity does not appear to have an advantage of optical fiber cable.

Summary of microwave links planned to construct or expand is shown in Table 9.8-9. D.Figure 9.8-1 shows an image of the network connection with the capacity at the completion of Eighth Development Program and the expansion capacity of the master plan. Almost all these construction/expansion are requested to be performed in Short-term as the traffic peak concentrates on around 2005 GC. In case manpower, finance and other resources are difficult to be acquired, the second thought is to spread the construction/expansion over short-term and Mid-term.

Table 9.8-9 Spur Link Expansion

Construction/Expansion	Number of links	Capacity
PDH Construction	327*	432 x 2M in total
PDH Expansion	74	239 x 2M in total
MUX Expansion	10**	34 x 2M in total

* Repeater stations in Spur links are not included.

** Number of stations.

It is recommended to construct a quasi-trunk network in Area-03 and extension of trunk network to Kebri Dehar, El Kere and Muggi shown in Table 9.8-10. The 03 Sub-trunk will run from Dessie to north-west, Kon Abo, and to south-west towards Alem Ketema along the main road connecting major towns. Sub-trunks of Kebri Dehar, El Kere and Muggi are extension of the existing trunk by PDH links from Kebri Beyah, Ghinir and Dembi Dolo respectively, which will support further expansion of network to isolated areas in south of the nation in future.

Table 9.8-10 Sub-Trunk Construction

Route	Link (Number of planned links)
03 Sub-Trunk	Connecting Kon Abo, Wegel Tena, Tenta, Aksta, Kabe, Were Ilu, Alem Ketema and Dessie (Sub-trunk PDH:6, Spur PDH:6)
Kebri Dehar	Kebri Beyah, Degeh Bur, Kebri Dehar, Aware, Geladin (Sub-trunk PDH:7, Spur PDH:4)
El Kere	Ghinir, Imi, El Kere, Jara (Sub-trunk PDH:4, Spur PDH:3)
Muggi	Dembi Dollo, Rob Gebeya, Ashu, Muggi (Sub-trunk PDH:3, Spur PDH:3)

In the master plan, more than 5,000 PCOs are planned to be constructed in about 500 Woredas. Since not all the transmission link is contained in this spur-link designing due to an ambiguous location, some additional quasi-trunk networks might be required when detailed designing is progressed in future.

When the above microwave links shown in Table 9.8-9 will be constructed, the existing stations in Table 9.8-1 of this chapter, such as analogue microwave, UHF, VHF, HF, DRMASS and L.Line,

except the digital microwave and two VSATs, will stop their operation. Those replaced equipment can be used for the other stations for the purpose of further network expansion.
Construction of optical fiber cable is proposed for the links as far as the length of which is short enough. Candidates of optical links are shown in D.Table 9.8-8 of Data File. However, further study for feasibility is necessary, especially whether more demand spots can be included along the route.

9.8.6 International Link

(1)Basic Plan

ETC already has the international terrestrial links with neighboring countries of Djibouti and Kenya besides INTELSAT satellite link. Sudan link will soon be open using the new SDH link from Addis Ababa to Dollar Hill of Sudan.

Satellite has an advantage of independent operation by Ethiopia though the time-delay cannot be avoided. Terrestrial link has a risk of being affected by bilateral relations with the linking country while it has no harmful time delay in voice transmission.

Strategy will be set on the balance among each route when expanding according to forecast traffic. This master plan provisionally adopts the present ratio of circuits to the satellite and the terrestrial.

Apart from security of circuits, as bigger capacity and higher quality will be demanded in near future, the digital high speed connection, such as SE-ME-WE 2 or other submarine cable circuits including terrestrial digital links, will surely be required to be expanded. ETC is recommended to increase the number of international high-speed circuits as well as to diversify them to various available routes from now and on.

Circuit plan from 2002 to 2011 GC made by ETC is shown in D.Table9.8-5 of Data File.

For the years after 2011 a recommended circuit plan is also provided in the same table, where the trend of domestic traffic adopted in the master plan is taken into account.

International terrestrial links are configured passing through the national backbones of Dire Dawa, Shashemene and Gonder. The present PDH link from Dire Dawa to Djibouti is planned to be improved to SDH in 2010 GC as explained in 9.8.2 of this chapter. The SDH links to Kenya and Sudan can support the international traffic, as the capacity expansion in backbone and spur link described in 9.8.2 and 9.8.5 of this chapter is planned to account it.

The dedicated link of 7GHz from AA TR-III to Sululta, having the capacity of 140M x 1 and 960ch x 1, can also provide the necessary capacity for the traffic till 2020 GC, though the analogue link should be replaced by SDH.

A DCME (Digital Circuit Multiplex Equipment) is supposed to be employed into the circuit of 2Mbit/s IDR (Intermediate Data Rate) to reduce the rental cost of satellite transponder. DCME is to be used for the circuit with over 60 channels and under 120 channels, while LRE (Low Rate Encoder) is to be deployed for the circuit of over 30 channels and under 60 channels.

Estimated numbers of DCMEs and LREs required are shown in the table below.

Table 9.8-11 DCME and LRE

Year in GC	2005	2010	2015	2020
DCME	3	4	7	10
LRE	3	4	2	2

Type of the equipment should be selected after discussion with the corresponding country so as to keep compatibility.

(2)Back-up and Alternative Plan

Considering the further reliability of the international, the increase of the packetized information exchange TR-Ⅲ and Nazareth, it is recommended to install the second gate way exchange of ATM function at Nazareth, where the second standard clock is to be installed.

(3)Route Diversity to International Terrestrial Links.

In the basic plan of the M/P, the international terrestrial links to Djibouti, Kenya and Sudan are to be established by expanding the microwave links applying STM-I streams, which have no back-up systems.

Considering the globalization and the importance of the relations with the neighboring countries, these terrestrial international links may be configured as an option with the O/F cable back-up (partial diversity), which will be installed in the economical way along the power transmission routes in cooperation with EEPCO.

a) Djibouti route

   Nazareth – Dire Dawa – Djibouti

b) Kenya route

   Nazareth - Shashemene – Tuka

c) Sudan route

   AA – Gondar – Metema

   Note: Partial diversity by O/F cable may be applied in the section practically applicable along the power transmission route.

9.9 Subscriber Access Network Expansion Policy

The installation of the subscriber access network has been delayed, and around 40% of the switching capacities are in the idle condition for more than one year.

In addition,many kinds of malfunctioning facilities are located in the subscriber access network due to either poor workman-ship or poor installation standard.

9.9.1 Designing of the Subscriber Access Network

(1) In-time and Integrated Design for the Subscriber Access Net Work

The installation period of the subscriber access network will be much longer than that of switching / transmission systems. In order to minimize the cort of the subscriber access network ,the application of the remote sub-modes (DLC, RSS etc.) are the current network development trend and shall be taken into consideration.

In addition,the replacement of the malfunctioning facilities shall be integrated into the design.

- Paper insulated lead sheathed cables .
- Cable having more than 2 times faults per annum.
- Faulty DPs
- multi-running drop-wires (more than 3weires)

(2) Standardization of the Design Mannual

a) standard symbol shall be given.
   - MH/HH,ducts, Cabinet, Cable, poles, DP's etc.
   - Cable name shall be given .

b) Concrete poles (design strength 200kgs shall be used as the standard in stead of the wooden poles, which may be used in the limited area / tiled.

c) Duct systems shall be mode byPVC ducts and straight type of the pre-fabricated ones in order to keep the high quality as well as to minimize the site installation period. ZO-T crane will be required.

d) In order to eliminate the reflection point of the digital stream and considering the application of the sub-modes (Fiber to zone) , the copper-loop shall be uniformed to 0.4mm gauge conductors.

e) The standard of the over-head structure design shall be up-dated considering:
   - use of the concrete pole (200kgf)
   - application up to 200 pair cable metalic sheath shall be defined considering the lightening area.

(3) Protection of DSP Facilities

Protective devises mounted on MDF shall have the function against both for over-voltage and over-currrent.

(4) Application of WLL

Considering the high cost, the application of WLL shall be minimized, or to be limited to the emergency relief from the view point of the short installation period.

(5) Application of the Pair-gain System

The system may be applied tentatively for the emergency cases

9.9.2 Method of OSP Installation

(1) Installation Manual (or Specification)

Installation manual (or specification) shall be up-dated taking the current technology into consideration;

- Use of concrete pole
- Use of PVC, bent-PVC duct to avoid the use of L, T shape MH.
- Application of IDC type terminals (CCC, DP)
- Application of the station protector at the connection point of Drop-wire and internal-wire.
- Growing system at the far-end DP and at the Vizer point of the over-head line.
- Standard installation manual of the drop-wire and hanging accessories.
- Maintenable cable chamber.
- Separation of cables/wire from the power line (minimum 30cm, if not, apply the spiral sleeve)
- MH duct stopper (empty duct, occupied duct)

(2) Out-sourcing

Considering the increased volume of subscriber access network expansion (70,000~80、000pairs/anum), the out-sourcing of the installation task force will be essential under the master plan. In this regard,the condition of out-sourcing (ICB or LCB) shall be made clear;

- Compensation or penalty for the damages to ETC' facilities and / or the facilities of the third party including the immediate recovery standard / emergency liaison
- Classification of the local contractors (skilled man-power, tools, measuring equipment, vehicles, etc.)
- Issue of the ID cards, when working for ETC's project
- Clear scope of works including the as-built drawings, which can be used as the plant records.

9.9.3 Selection of Local Access Network

Alternative
1) Copper loop
2) Fiber to zone
3) Wireless Local Loop

4) Passive Optical network

5) Fiber to the home (partially applied for key customers)

(1) Pre-condition for Selection

a) Copper loop is composed of only 0.4 mm gauge cable, and limited to 8dB loss.

b) The length of copper loop shall be minimized so as to allow the broad-band service in future.

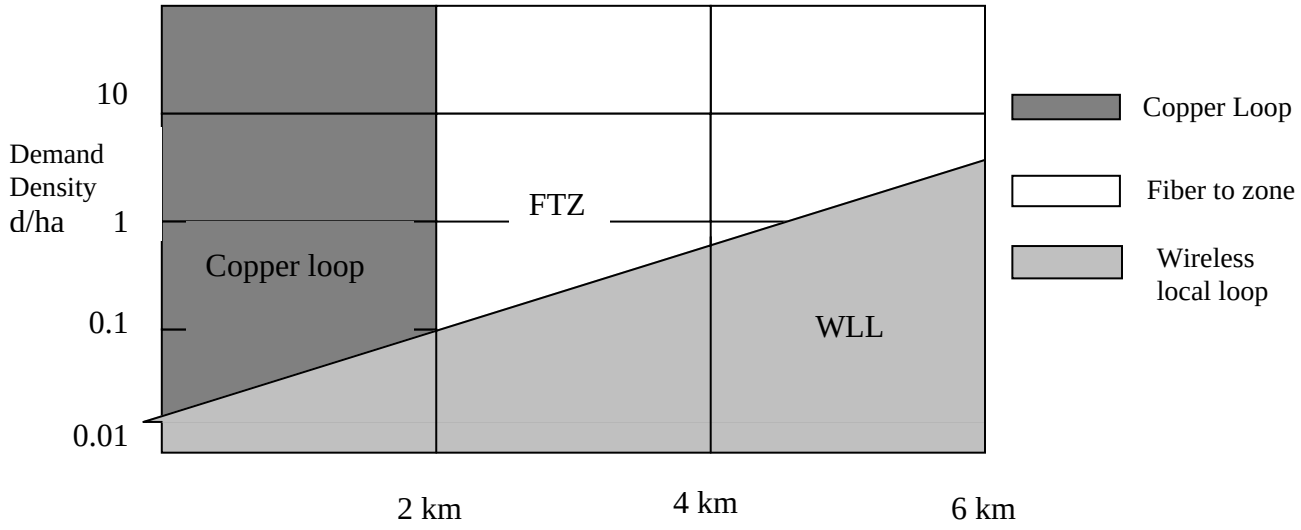
c) Sub-nodes of FTZ are DLC (max. 34Mb/s, 960ch) or Remote switch units (more than 1000 sub).

d) PON and FTTH are to be applicable only to key customers for broad band multi-media services.

Majority of subscribes can access to the services upto 64 kb/s till year 2020.

e) Local access network will be selected through the cost comparison of voice band service.

(2) **Application Standard**



a) Uni-gauged (0.4 mm) copper loop may be applicable upto 4km radius (8dB, 1,500 Ohm Loop)

b) 2 km loop will be preferable considering the broad-band digital services to be required in near future.

c) Sub-node (DLC or RUS) may be applicable in the far-end demand centers with the service area radius of 2km. (higher demand density areas)

d) WLL of wide range service coverage (R> 10km) will be applied to such areas of lower demand density. WLL may be applied over the copper loop/FTZ service areas to pin point the isolated demands.

e) No low demand density area will be in the near-by area of the wire center.

f) Reference cost used for cost comparison

Copper Loop	US$ 250 – 450 /line	(taking 4km service area into consideration)
Fiber To Zone	US$ 250 – 400 /line	(cost variable depending on the size of sub-node)
Wire Local Loop	US$ 600 – 900 /line	

(3) Application Guide Line

a) Basic design of Local Access Network shall be made prior to the procurement of switch nodes.

b) Sub-nodes design shall be made integrated to the switching node design.

c) Priority shall be given to the copper loop

- local access loop design shall be fully depended on the cost comparison.
- Sometimes the shorter installation period (WLL) will have the advantage, however.

d) Provision period of facilities shall be enshorten to the feasible level as much as practically possible. ETC takes rather long period for the preparation of the procurement (more than 1 year, and usually 2 years, which makes the provision period longer than 5 years.

e) Provision period of the local access network

Copper loop	
Primary cable in duct	15 years
Duct capacity	12 years
C.C.C	12 years
Secondary buried cable	12 years
Secondary over-head cable	7 years
Sub-nodes capacity	5 years
WLL base station capacity	7 years
WLL end terminals	annual procurement

f) Procurement cycle (Scalable)

	Current	To be enhanced
Design	6 months	3 months (standardize, packaging, finalize)
Specification	1 month	1 month
Tender approval	2 months	0.5 month
Tender Float	2 months	2 months
Tender evaluation (2 step)	4 months	3 months (2 times clarification)
Approval of evaluation	2 months	1 month
Contract negotiation	1.5 months	1 month
	18.5 months	11.5 months

(4)Optical Fiber Connection

The subscriber(s) within the circle of around 4 km radius from the exchange will basically be connected by the metallic cable. The optical fiber can accommodate the subscriber in far location from the exchange where the metallic cable from the main node cannot reach due to an excessive loss. Beyond the circle of 4 km radius the selection will be made among radio and optical fiber, depending on the demand density.

If the number of subscribers reaches to around 240, a set of LEU (line extension unit) and LC (line concentrator) will be installed and be connected by the optical fiber with the main node. Metallic cable will be used for the connection from LC to the subscriber. Those sets of LEU & LC can be connected up to the maximum number of eight (8). Decision will be made depending on total cable length and number of sets by comparing their cost to the radio loops.

On the other hand the optical fiber has an advantage in connecting concentrated subscribers even if they are in a short distance from the main node because it occupies very small space in the duct and can provide wide-band transmission.

9.10 Supporting Facilities Plan

9.10.1 Power Supply System for Telecommunications

(a) Existing Power Supply Capacities

It seems that the actual load consumed in the existing facilities of power supply system are not checked or recorded at present. The study team will recommend that the actual load recording shall be carried out periodically as a part of operation and maintenance job and the Planning & Engineering Division shall have the actual status of load conditions.

There are so many existing power supply facilities operated throughout the telecommunications stations and offices concerned that the local maintenance staffs in each region or area shall take part in the checking and recording such loads and to inform them to the Head Office timely at the loads changed. It might be helpful to plan and design the power system in the future.

(b) Power Supply Facilities for Rural Areas without Commercial Source

An adequate and reliable energy supply is a prerequisite for the deployment of any modern telecommunication or information technology (IT) system. This is a fundamental problem in rural and remote areas where the commercial power supply is unavailable.

Fuel powered generator sets, although common, have some drawbacks with regard to electricity provision in rural areas. Ensuring regular delivery of fuel to rural areas can be difficult, particularly remote and inaccessible areas. The power facility that is associated with continuous or long operating hours is often incompatible with affordable use of generator sets, whose operating costs are directly related to the number of hours of operation. Finally, the power

requirements of many small systems are far below the scale at which generator sets can be cost-effective.

In contrast, renewable power technologies such as solar photovoltaics (PV), small wind-electric turbines, and micro-hydro systems are often ideal for providing electricity in rural areas, ranging from a few watts to thousands of watts. In particular, PV systems can cost-effectively provide modest amounts of electricity, from a single watt-hour per day to several kilowatt-hours per day, and for lower life-cycle cost than alternatives such as dry cell batteries and generator sets.

The Daily Monitor (Dec. 28, 2001) of Ethiopia reports that from BBC news report, UNEP (United Nations Environment Program) is trying to identify the best sites for wind and solar energy system in Ethiopia. This energy system is a hybrid system with windmill and solar power combined, which is under development.

Wind energy system requires a stable wind velocity and with annual average of more than 5 meters per second from the economical designing point of view. According to an opinion of ETC's Power Engineering Division if experimented, the wind environment may be suitable for wind energy system in Ethiopia. However, it is said that wind energy system requires significant initial investment. The maintenance requires skilled mechanics. Lightning can also be a problem. For these reasons, wind energy system, at present, would not be suitable for telecommunication's power supply system for rural or remote areas but solar power system.

Further, Federal Negarit Gazeta of the Federal Democratic Republic of Ethiopia describes in Council of Minister Regulations No. 47/1999 that in places where commercial power supply is not available, there shall be a solar power system to provide the necessary power required by telecommunication equipment in paragraph No.5), Item No. 33, Power System, of Part Four, Technical Standards, Chapter one, General.

9.10.2 Station Building

The problems faced with in ETC are classified into two categories, one is the alteration of designing criteria for station building due to digitalization of facilities and the other is the standardization of building designing and the improvement of manual for it. These objectives are to economize the process. ETC is eagerly working to the standardization.

(a) Alteration of Designing Criteria for Station Building

The designing criteria for station building shall be altered from the conventional for analogue facilities to the digitalized. There would be some alterations for designing, such as floor space, floor load, and condition of room temperature involving air conditioning facilities etc.

The designing criteria shall be determined by the use of station building. In order to establish those criteria the closer exchange of mutual information shall be indispensable for each Engineering Division concerned.

(b) Standardization and Improvement of Manual for Station Building

It is considered that the standardization for designing of station building and improvement of the manual would urgently be needed. Improvement of the manual would be easily achieved when the designing criteria and types of station building are determined, which are standardized.

Application to dispatch the experts relevant to building construction and civil engineering would be one alternative solution for the prompt operation.

9.11 Information and Communication Technology

9.11.1 ICT

The word IT or ICT is one in fashion but not new nowadays. It is the engine of global growth. The word is versatile on every occasion. Familiar ICTs to us are the telephone, telegraph, facsimile, data communication, mass media, Internet, computer, car navigator as well as postal services. Above all, the Internet and mobile telephone certainly become familiar to the people as one of IT tools. Utilization of ICT will be greatly expanded and penetrate into daily life.

9.11.2 Digital Divide between Countries

Digital divide between countries is growing into a serious problem. One of the problems is 'Access to Technology', a matter whether or not a country has provided with infrastructures for electricity, telephone, personal computer, internet etc. The other divide is 'Social stratification', that is compatibility of languages, cultural background, earning, education level etc. Contents of 80% in the Internet web sites appear in English. There is no user- friendliness if they do not understand English.

9.11.3 ICT Fundamental Policy in Ethiopia

1) ICT Fundamental Policy

In the National ICTs Policy and Strategies (First Draft) issued in January 2001 by The Ethiopian Science and Technology Commission, that will yield significant results. It says as follows (extracted):

- In our current world where information and communication technologies revolution is the order of the day, it is crystal clear fact that a properly planned and managed ICTs capacity building effort for a developing country like Ethiopia would have considerable role in fighting poverty, reducing the isolation of rural communities and educating more people by supporting life-long learning.
- The national development of ICTs also enables the government, among other things, to introduce efficiency and transparency in its governance, increase the effectiveness of its economic reforms, facilitate the establishment of effective and technologically up-to-date national defense and security system as well as in monitoring and protecting the environment.

- Establishment of Information Infrastructure comprising of high speed broadband communication backbone, nodes, access network, distributed data warehouses and service locations to cater the needs of trade, commerce, industry and tourism and also to enhance the delivery of Government Services to the people
- Special attention and support should be given to institutions interested on rural community's service and specific facilities for the disabled and the elderly.
- The rural/Urban imbalance in information and communication flow should be redressed by establishing regional broadcasting stations, newspapers and telephone systems.

For the Telecommunication Strategies:

- ✧ Maintain competitive price for basic telecom and value added services;
- ✧ Provide leased lines for value added networks services and public information gateways;
- ✧ Develop an improved national information infrastructure;
- ✧ Adopt licensing policies for the private sector to facilitate the establishment of private telecom network infrastructure;
- ✧ Identify potential areas manageable to the development of local manufacturing of equipment
- ✧ Develop effective and productive use of national frequency and spectrum resources

2) New Government Plan for ICT

The government of Ethiopia has decided to implement the following projects as an initiative for ICT development in the country.

- School Net to connect 500 High schools throughout Ethiopia.
- Agrinet to connect 37 agricultural research institutions.
- Health-net to introduce telemedicine in selected areas.
- University Wide Area Network to connect 12 Universities.

9.11.4 ICT Tasks

There is no longer any doubt that the fundamentals of ICT require provision of the telecommunication network together with the large variety of applications and contents. To perform and to progress ICT totally with an effective way, it is understood that each portion of the work is allotted as follows.

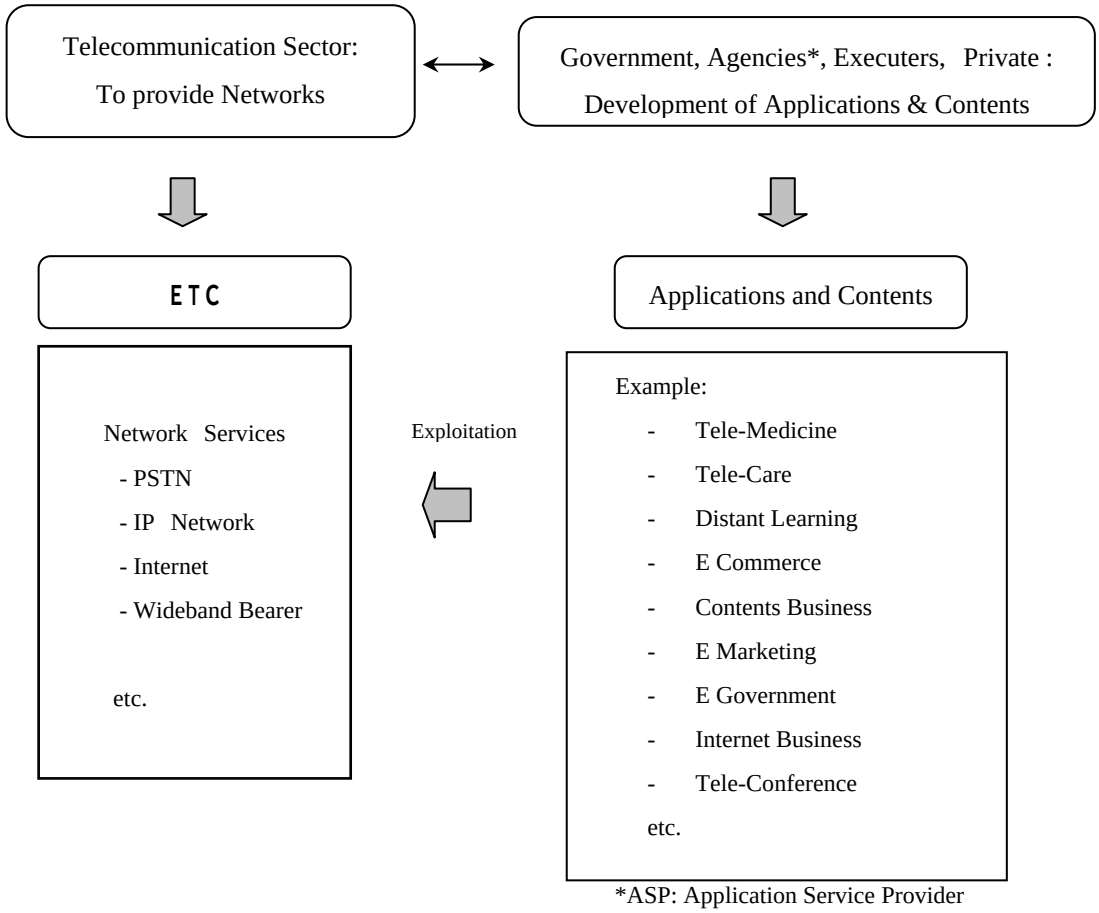


Figure 9.11-1 Applications and Contents

As is generally known, the applications and Contents are fundamental to ICT and a matter of methodology how a communication network is to be utilized for the desired objectives under intention of executers. Some case examples are proposed later.

9.11.5 ICT Development

In the advanced countries expansion of the wideband network is rapidly under progress to accomplish society of the nation's digital opportunity. Tele-density of these countries is more than 30-50. While in the country, tele-density shows less than 0.5 per 100 inhabitants. Since the typical and very basic ICT is the telephone network, it is needed to exert effort to improve the figure of penetration as a primary ICT.

In the remote areas there exist many non-telephone towns. Toward the ICT society one must face up to reality of this fact and status, then proceed to next step making steady progress.

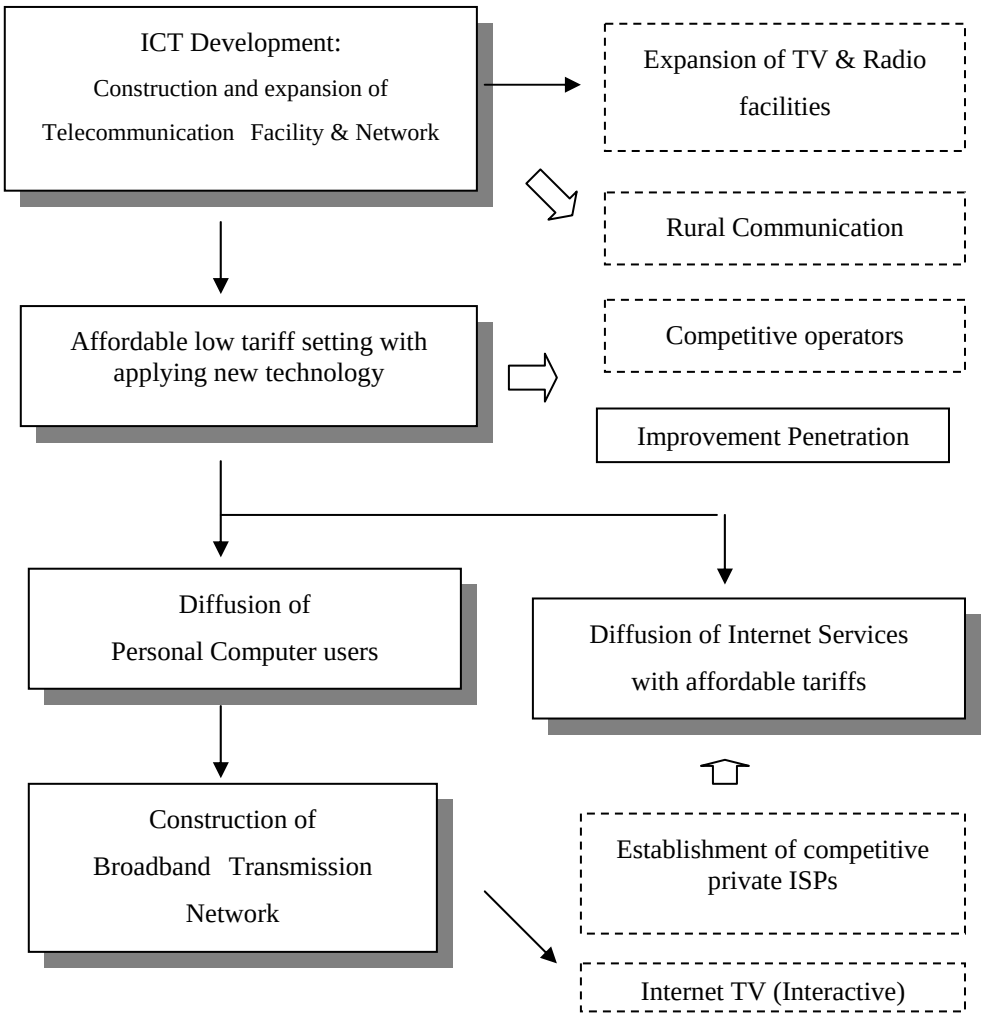


Figure 9.11-2 ICT Development

As a policy with overriding priority in the Master Plan, the tasks to be done by the telecommunication sector are highlighted and focused as follows:

- Development and Improvement of Rural Communication Network;
- IP network capability to cope with ICT requirements in future
- Expansion and improvement of Internet Services
- Preparation for e-government (G2G)

9.11.6 Top Priority Task

(1) Rural Communication Network for Universal Service

To spread out ICT policy and come into force nationwide for the benefit of people, it might be practically not simple in a short time without any aggressive action by both Administration and Telecommunication operator(s). The role of telecommunications sector is of overriding importance to follow up the abovementioned policy. If the rural area telecommunication development program is neglected, the geographical divide will further continue to grow up larger and larger. In the 8th Telecommunication Development Plan there is program for the rural communication development as many as 140. It will be understood that a key to ICT society is first to build up both basic telecommunication network and also commercial power supply infrastructures in all over the country. One of the most important key forces is emphasized to concentrate establishment of rural area communications infrastructure.

Present status of the rural telecommunication network in the country shows up that there are some 10,000 villages where the telecommunication facility is not available, which is corresponding to 85% of the country population with digital divide. Those who live in the remote corner of the country have difficulty in their daily life to access even the telephone set. Small numbers of people living in urban areas only enjoy benefit from telecommunication services. This fact must be serious both the Government and nationals.

There are many eye-catching words in terms of ICT like dot com. business, e-government, B2C, e-money, e-commerce, IT venture etc., that are seemed to be a goal of IT revolution. This will be attained after the government policy and its implementation have been successfully done across the country. Before that time, our action must attend to the most urgent things first. If the Administration is serious to ICT, the rural communication network should be first priority.

Although it is evident that investment on the rural communication is no financial efficiency, the most urgent tasks to be carried out in the country is to establish communication network in the rural community setting up Public Call Offices (PCO or Tele-Center). In the Master Plan, establishment of PCOs is numbered as follows:

Year 2005	700 PCOs	
Year 2010	2,225 PCOs	
Year 2020	2,891 PCOs	(Note: 2-8 circuits are provided in the PCO.)
Total	5,116 PCOs	

The detailed plan appears Chapter 9.5 Universal Service and 9.8.6 Rural Telecom Link.

(2) PCO Facility

The existing PCOs provide voice telephone call service only, but new PCO will be furnished with a fax and personal computer facilities that enable fax and Internet connection services. In case where an addressee does not have fax facility and/or Internet address, people cannot utilize the fax and Internet services, so that the following mail delivery system (New service) may be established after the present government regulations have been revised.

a) Fax message (if sender desired) can be sent to desired Post Office, then Post office delivers it to corresponding PO Box

b) E-mail (if mail sender desired) can be sent to desired Post Office address, and received e-mail is delivered to the corresponding PO Box

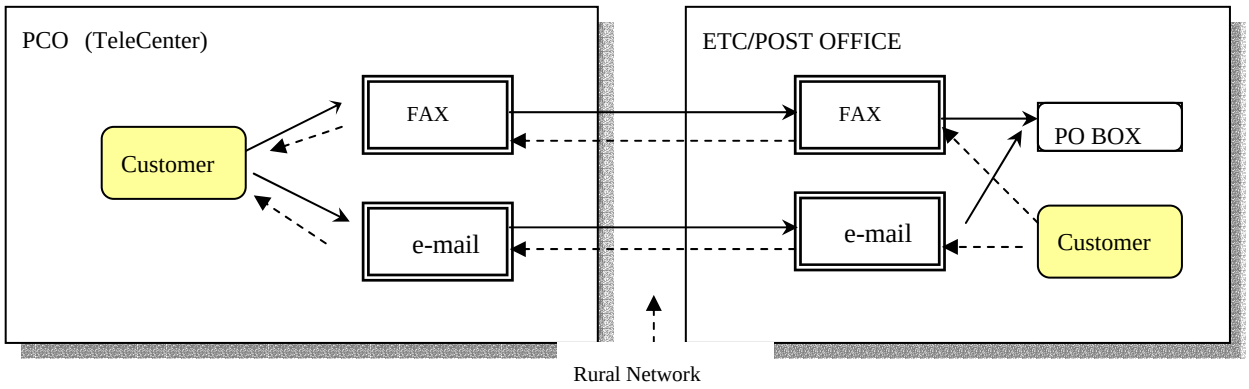


Figure 9.11-3 PCO Facility

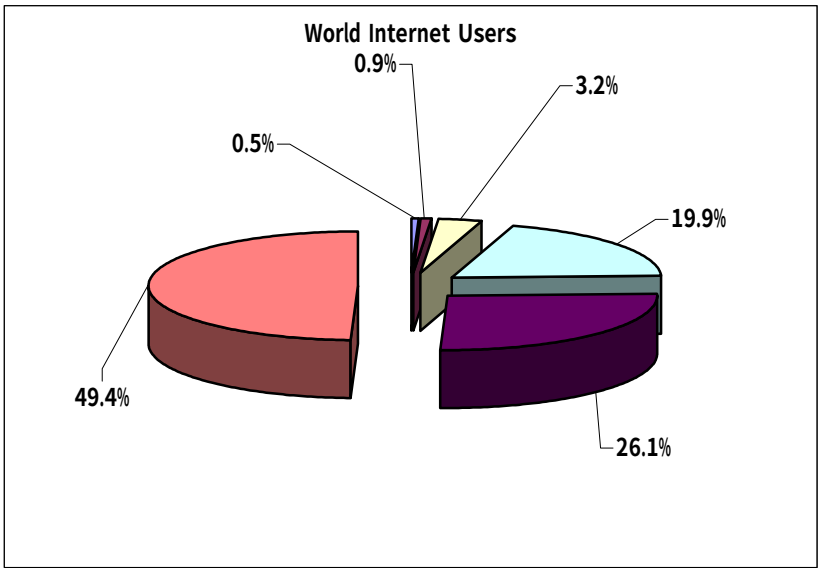
9.11.7 Internet Service

(1) Internet Users

Internet is as the huge worldwide infrastructure as ever existed, and it has given us a great impact which supports IT society. Internet is the network, which connects every world computers with the common rules, and everyone can take part. Such opened network enables exchange of information among business firms, shops, consumers, schools, governments, NPO, NGO etc. The primary importance is how this useful worldwide infrastructure is to be fully utilized. The Internet presents a fundamental revolution in the way the global community gathering information that conducts

world business.

The world Internet users are distributed as illustrated in the following figure. Majority of the



Internet users are United States, Canada and Europe. Users in the African and Middle East countries are still minor yet.

Figure 9.11-4 World Internet Users

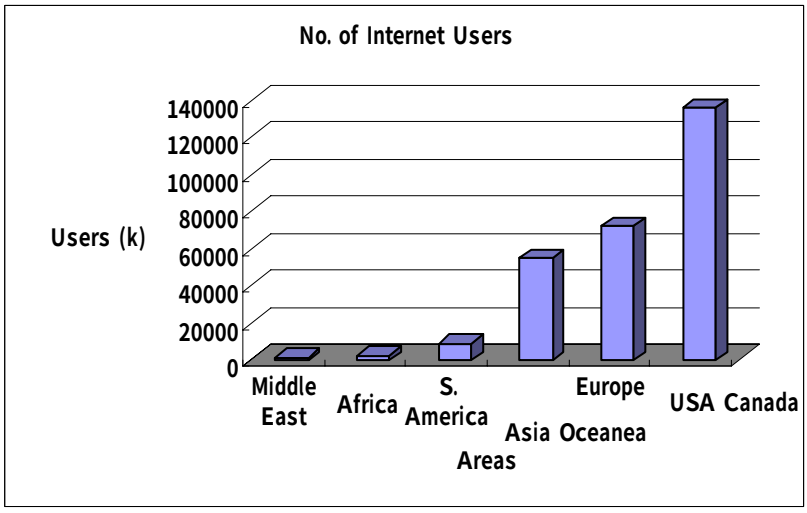


Figure 9.11-5 World Internet Users

Increasing number of e-mail users, they could enjoy communications with remote people. If e-government has been established, a computer through the Internet could do many applications and formality to the local government. To do so, however, firstly it is absolutely needed to have an environment, in which everyone can access to the Internet. For this purpose, the following will be set practical target:

- ✓ A private enterprise (Venture) must take positive initiative to build up the network infrastructure after government deregulation

- ✓ To diffuse personal computer over the country and familiarize to it;
- ✓ To increase Internet POPs;
- ✓ To realize broadband network infrastructure with all-times-connected to Internet
- ✓ To strengthen human resource education
- ✓ To establish e-government

(2) Personal Computer Owners

Because the computers are indispensable and strong ICT core tool for the Internet, it is prerequisite to enhance the number of private computer holders and popularize Internet even in the remote community level, as well as consideration of domestic computer production.

Table 9.11-1 Computer Holders and Internet Users

	Ethiopia	Djibouti	Uganda	Sudan	Kenya
No. of PCs/1,000 people	0.03	9.5	7.5	2.9	4.2
Internet Users/1,000 Total Users (Year 2000) Per Population (Year 2000)	8 10,000 0.02	1 /1,000 0.16	25 25,000 0.11	5 28,000 0.08	35 200,000 0.66
No. of Hosts	10	4	113	N/A	15
GDP/Capita (US$)*	100	790	320	330	360

World Bank Data Book 2001 (Data 1999) *(GDP) UN Statistical Year Book (Data 2000)

(3) Present Internet Service in Ethiopia

In Ethiopia, additional 8 POPs (Points of Presence), 10 access points were established in June 2001 under UNDP through its Internet Initiative by Africa (IIA), providing a framework for partnership between the ETC and UNDP with joint financing to upgrade the internet facilities. However, as shown below, the number of Internet users are still few outside Addis Ababa. These valuable facilities are observed not fully utilized for the time being.

Table 9.11-2 Internet Subscribers

Internet POP	Server Capacity	No. of Subscribers
Addis Ababa *	14,000 (16,000 in 2003)	6,000
Nazareth	384	12
Dire Dawa	720	27
Dessie	384	5
Mekele	720	29
Bahir Dar	384	38
Shashemene	384	21*
Awassa	720	incl. Shashemene*
Jimma	720	7

Internet Center, Addis Ababa, As of Dec. 2001

There will be number of reasons why the Internet subscribers is so small.

- Low number of personal computer holders
- Low number of private subscribers to Internet
- Low speed but high tariff rate
- No access point at rural areas
- Most people are not interested in Internet

The present Internet tariffs are listed below:

The high tariffs seem to be quite difficult to increase the 'Internet population' and it brings low profit to ETC. Most users are C-1 and C-2 (2,385 Subs. 58% in 2001).

Table 9.11-3 Internet Tariffs

A. Tariff of Dial Up Unit: US$

Subscriber Category	Connection Fee	Monthly Fee	Allowed Hours/month	Extra charge per Hour	Free HD Space (MB)
C-1	56	19	8	4	--
C-2	75	34	15	4	1
C-3	56	38	40	2	2
C-4	113	75	40	4	2
C-5	38	25	40	2	2

C-3: International Organization, Business Company, and Embassy
C-4: University, Education, Health and Agriculture Sectors
C-5: Government/Non profitable Organization, Social Institute

B. Leased Line: Unit: US $

Subscriber Category	Connection Fee	Monthly Fee	Allowed Hours/month	Extra charge per Hour	Free HD Space (MB)
--	500	1,000	Unlimited	--	--

The above fees do not include 15% sales tax. Internet Center, Addis Ababa, As of Dec. 2001

(Note) Revised tariffs appear in the Supporting Document, which is applied from August 1, 2002.)

In order to widely spread Internet service in the country, it is desired to take the state measures to take proper policy:

a. The government subsidies to 'cyber café' to be opened in a lot of places in the cities and villages. (Post office, Hotel, City hall, Community hall, Restaurant etc.)
b. Sales tax exemption for computer
c. To develop a computer rental system,
d. To price-cut for Internet service tariff,
e. FAX and e-mail delivery service by Post office and PCO (New service),
f. To expand Internet Host up to middle cities,
g. To increase Internet service providers both ETC and private sectors everywhere in the country and apply low service tariff rate to the users

(4) Improvement of Internet Service

1) All-Time-Connection

Presently, there is no 'all-time-connection service' with dial up. Internet users are difficult to keep Internet connection for long time period because of high tariff rate. The all-time-connection service is flat rate without time limitation, so that computer can be connected with Internet all time.

2) Subscriber Access

Present dial up connection is too slow to access ISP, Web site and download data. It is desired for ISP to apply the following services.

a. Narrow band ISDN (64, 128 kbps)
b. ADSL (1.5-8 Mbps downward, 128-256kbps upward) as illustrated in Figure 9.11-6
c. FTTH (Fiber to the home)

9.11.8 Case Examples for ICT Applications

There are a variety and numerous exploitations of the ICT and Internet. Followings are several case examples of applications applying ICT. Some of them are going to be adopted in Ethiopia.

(1) Tele-Medicine Program

According to UNDP Addis Ababa, the following pilot projects for the medical assistance are presently under progress. It is planned to open the web site at the Black Lion Hospital under preparation of the Addis Ababa University. All medical people are possible to access the site for getting information and instruction concerning all sorts of medicine. This is helpful for the hospitals and doctors in both urban and rural area.

(2) Internet Connectivity Program

Internet facilities are to be furnished between the Ministry of Health and the regional offices (Dire Dawa, Mekele, Awassa and Jimma). The Ministry and regional offices can exchange immediate instructions and information. The program will start September 2002 and completed December 2003.

(3) Distant Medi-Care (Direct patient care, Teleconsultation)

In the urban area the doctor and patient can communicate through Internet.

The ICT for medi-care in the remote areas is recent subject but difficult to spread universally at present status of network. In the year 1999, number of the hospitals*1) is 1,226 (Urban) and 5,021 (Rural). Full medi-care will be realized after the wideband networks have been provided in the remote area. Utilization of Internet is advisable. If realized, it solves medical divide with getting necessary information through internet on real time. It is expected efficiency of direct patient care

based on information (X ray, CT, MRI, electrocardiogram etc.) through Internet. It is also possible to keep the patients medical record

*1) Ethiopia Demographic and Health Survey 2000, Central Statistical Authority Addis Ababa

(4) Government Assisted Cyber Cafe

In Addis Ababa there exist many Cyber Cafes. For the best public diffusion in the regional areas and enhancing experiences on the computer operation and Internet access, the establishment the following facility be proposed.

a) City : Nazareth, Dire Dawa, Dessie, Mekele, Bahir Dar, Nekempte, Awassa and Jimma
(8 Cyber Cafes in each city, 64in total)

b) Location: Telephone Office, Post Office, city hall, Hotels etc

c) Facility at each Cafe: Desk Top Computer (5), Printer (2), Hub (1)

(5) School Training facility on Computer and Internet for Information Literacy

For the purpose of boosting awareness of information literacy, such person must be necessary to support ICT in future who have abilities for handling computer and getting necessary knowledge through Internet. This plan for example, contains to provide 50 desk top computers, 2 printers and Internet connection facility at selected 2 high schools each of above 8 cities. One (1) qualified computer instructor will be assigned in each city for 1 year. It is desired, if possible, that the systems are to be provided by the local enterprises, NPO, students or volunteers like 'Net Day' activity in the US, Europe and Japan.

(6) Distant Learning

(a) Utilization of Mass Media and ETC Network

For the remote education, radio, ground wave and satellite TV broadcasting will be effective for the school education. In Ethiopia, the educational radio and TV programs are already being broadcasted by Educational Media Agency (EMA). Radio broadcasting is operating at Legedadi, Mekele, Dessie, Debre Markos, Gondar, Ghimbi and Robie on every Saturday and Sunday. For the primary and middle schools diffusion of radio program is high (85%). However, educational TV program is not wide spread. The reasons it failed to catch on diffusive are (1) there are no electricity in the school, (2) small number of TV receivers, (3) TV signals reception is of poor quality in some areas.

To settle this problem ETC's TV transmission lines of IP network can be used in future (4Mbps-8Mbps, conventional transmission bit-rate requires 34Mbps) or TV transmission power increase. It is also necessary to expand TV relay stations to cover whole country.

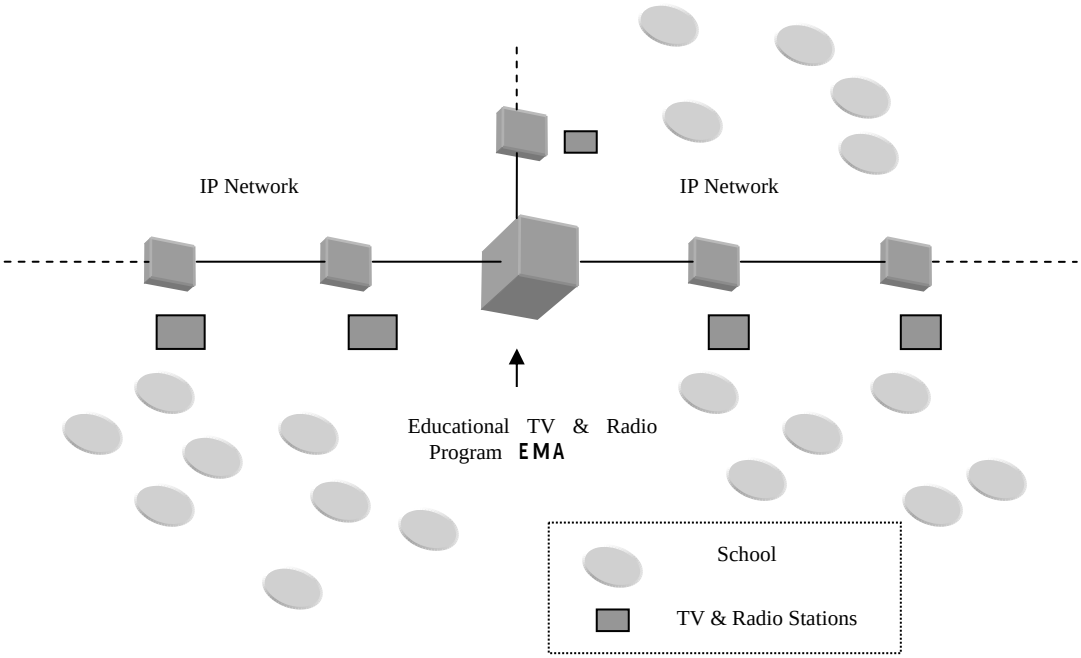


Figure 9.11-6 TV & Radio Transmission (IP)

(b) Utilization of PCO

It is also necessary to study what is possible with the existing and new rural communication facility in the public call office (PCO). Connecting PCO with the school or hospital, Internet and fax communication is proposed as shown in Figure 8.11.8-2. It is noted that the allowable bandwidth of DRCS is limited to 32 kbps or 64kbps.

(c) Education Using DVD Media

A series of the educational program software (DVD software to be created by Ministry of Education and Department concerned such as EMA) distributes it to the schools in the remote area. At school it is displayed on wide screen through personal computer or DVD player.

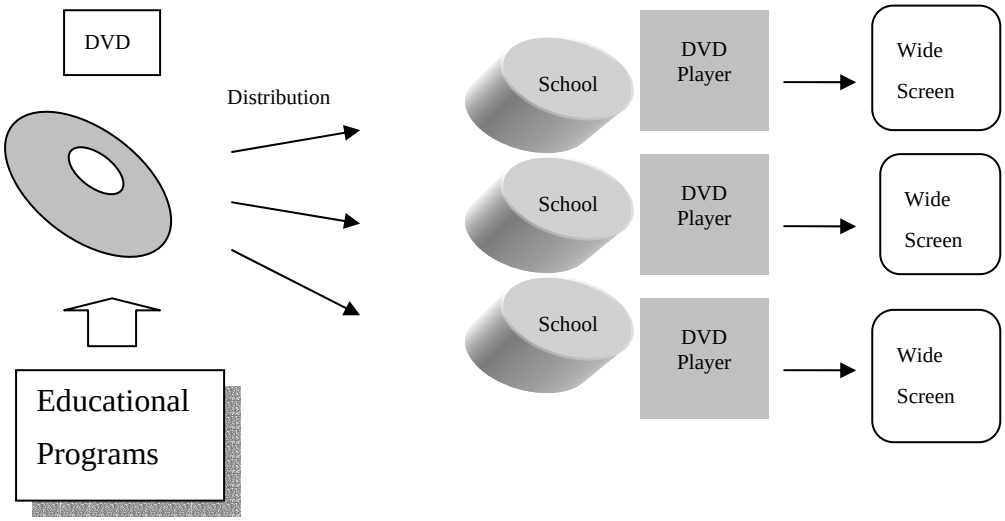


Figure 9.11-7 Use of DVD Media

(d) ITU Information

(ITU Doc. TDAG-4/3-E 8 September 2000)

The Telecommunication Development Bureau (BDT) of ITU is making extensive use of the Internet to deliver on-line training and support. For example, the ITU Virtual Training Center.

(http://www.itu.int/ITU-D/hrd/ and

Global University (http://itu.int/sdffITU-D-HRD/gtugtti/Default.html)

Example of activities includes:

- A series of courses delivered via the Internet, teaching how to use the Internet for distance learning,
- A variety of electronic forums on subjects such as Fixed Wireless Access (EWA), Marketing of Telecom Services, Distance Education, Total Quality Management.
- Online training via the Internet is soon to be provided to several thousand students in ITU member organizations in developing countries, on a wide variety of subjects including IP networks.
- IP Networking workshops for developing countries planned-in collaboration with private Sector Members.

(7) Government Intranet (G2G)

To effectuate effective and speedy transaction for data and information within the government, it is desired to establish the government intranet.

The purposes of e-government are generally known as;

a) To enhance advantage and convenience of citizens of the state

b) To encourage transparency of administrative management

c) To Simplify and promote efficiency of administrative tasks

d) To upgrade administrative measures and policies

In Addis Ababa Central Government, each Ministry office is provided with local area network (LAN) as illustrated in Figure 9.11-10. Each Ministry office is linked by LAN or WAN. Between the Central office and 12 Administrative Regional governments be connected through Internet and/or leased lines.

Then, following outcome is expected;

G2G

- ✧ Computerized documentation (Paperless office)
- ✧ Sharing data/information among Ministries/Local Gov.
- ✧ Office work restructuring (to minimize a nos. of the staff)

Ministry and regional office communication will empower fast transaction of tasks. Providing data format on every sort and kind of report/data from the Regional government such as statistic data, periodical report can be automatically stored in the database file. It is desired that the local government opens its home page for disclosure of official information.

For TV Conference ITU-T Recommendation H.261 uses 64kbps- 2Mbps. For slow motion such as conference usage of 384kbps satisfies performance from a practical standpoint. Recent personal computer employs TV conference function utilizing LAN, WAN and/or Internet through Gateway (ITU-T H.323).

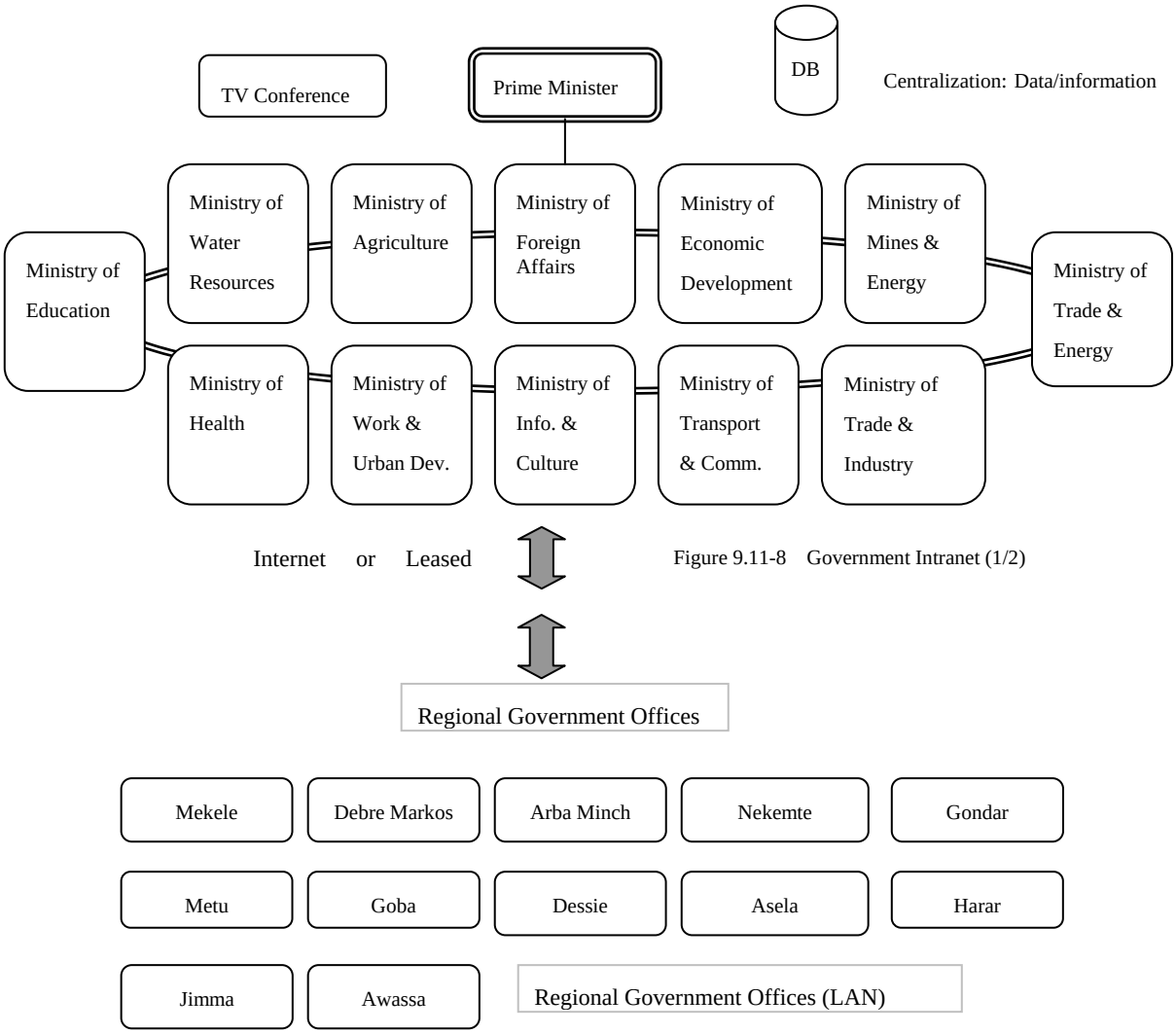


Figure 9.11-8 Government Intranet (1/2)

Figure 9.11-8 Government Intranet

(8) Electronic Government (G2C)

Every citizen is able to access to the Local Government web site through the Internet. As a public services, various applications and procedures such as resident card, driver license registration, tax statement etc. can be processed through Internet. The complicated procedures will be finished in 'One stop & Non stop (24 hours 360 days)' basis.

In this case diffusion of both computer holders and internet subscribers are the most important factor. The contents of the government web site must be attractive enough to the visitors.

G2B, B2C

- ✧ Formality for application & notification
- ✧ Procedures for procurement tendering

G2C (E Democracy)

- ✧ Public comments to Government
- ✧ Forums (Electric bulletin board to exchange opinion)
- ✧ Release of information

The Government discloses all available information to nationals, for example; tendering and tender opening results on public work project.