5. BACKBONE CONSTRUCTION PLAN

5.1 Basic Design Policy

The backbone transmission links in Ethiopia are built as a star-network over nationwide, which almost exclusively consists of microwave transmission links. While, the ETC is moving forward with a project to expand and replace the transmission links in regions where communications traffic is feared to face congestion, as already mentioned in the previous section (3. Current Situation of Telecommunications Services in the Relevant Regions). The current ETC's expansion project plan is based on constructing transmission links that are all using SDH microwaves system, so that they must pass through the microwave repeater station (Mt. Furi) in the neighborhood of the capital. Because of this, the congestion at Mt. Furi microwave repeater station that connects the capital Addis Ababa with the East, South-East and the South is getting even worse, and the network is more concentrated in one site.

The following basic policies are applied in this F/S, in order to eliminate the above mentioned traffic congestion on the backbone route and improve the reliability of the network.

(1) Newly construct transmission links to bypass Mt. Furi microwave repeater station

Aimed to distribute the traffic concentrating on the transmission link between Addis Ababa and Mt. Furi microwave repeater station to the other routes.

(2) For the transmission links, use optical fiber to allow the construction of large-capacity transmission links

Newly construct a backup transmission link for Addis Ababa and the East, Southeast and South, using a separate route from the existing microwave transmission links.

This enables to reroute the accommodated lines to the newly built optical fiber transmission link to keep the influence on the network at a minimum in case a fault occurs in an existing microwave transmission link, and a microwave transmission link under construction (on-going project).

5.2 Expected Improvement Effects

Based on the above policy, the site survey group of this F/S planned the optical fiber transmission routes where the highest effect can be expected, in consideration of projects under construction (on-going projects), projects whose budget is approved (planned projects) and scheduled projects (future projects), upon discussions with ETC counterpart. The improvement effect of an optical fiber transmission link at the selected section between Addis Ababa and Nazareth is shown below.

(1) Securing Route Diversity

By adopting the transmission capacity STM-16 for the backbone between Addis Ababa and Nazareth, it can provide a backup not only for the existing transmission links shown below to the East, South-East and South, but also for transmission links that are currently under construction (on-going projects). In the future, ETC can further easily expand the

transmission capacity using Wavelength Division Multiplexing technology (WDM), just by adding the required the transmission Multiplex subsystem, without replacing the optical fiber cables.

At the far end termination points of above-mentioned transmission links, route diversity can be secured for (the relevant areas are shown in Figure 5.2.1):

Dire Dawa	: (East)/connection to Djibouti (International link)
Goba	: (South-East)
Shashemene	: (South)/connection to Moyale, Kenya (International link)

(2) Related Projects and Transmission Links That Can Receive Profit from This Plan

Below is a list of projects under construction (on-going projects), projects whose budget is approved (planned projects) and scheduled projects (future projects) for whom route diversity will be secured in this plan. The planned transmission capacity is also shown below.

(1) Nazareth－Adama West, STM-1 (3+1) [On-going]

(On-going ETC SDH M/W project)

In detailed transmission route is shown in Figure 5.2.2.

(2) Nazareth－Goba (via Sebesibe Washa), STM-1(1+1) [Planned]

(2002 JICS Project, SDH M/W system)

In detailed transmission route is shown in Figure 5.2.3.

(3) Addis Ababa－Adama West－Dire Dawa, STM-1 (2+1) [On-going]

(On-going ETC SDH MW project)

In detailed transmission route is shown in Figure 5.2.2.

(4) Shashemene － Moyale, STM-1 (1+1) [Planned]

(2001 JICS Project)

In detailed transmission route is shown in Figure 5.2.4.

(5) Sebesibe Washa － Shashemene, STM-1 (1+1) [Future]

(This project will replace the existing analogue M/W link to SDH M/W system)

In detailed transmission route is shown in Figure 5.2.5.

(3) Securing Flexible Scalability (Advance Execution of Part of the Future Plan)

Optical fiber transmission links (STM-16*) can secure backup transmission capacity of the SDH microwave transmission links from Addis Ababa to the East, the South-East and the South, which are to be expanded in (STM-1).

This is able to provide backup for the existing microwave transmission links and

for those which are currently under construction (on-going projects). This project can sufficiently respond to future increases in traffic.

Note *): STM-16 is a transmission capacity that equals 16 x STM-1.
STM-1 is equivalent to 1,890 x 64kbps bearer channels.
STM-16 is equivalent to 30,240 x 64kbps bearer channels.

(4) Acceleration of the Construction Plan for an Optical Fiber Rings in the Capital (Addis Ababa)

Since the construction plan for an optical fiber ring circuit in Addis Ababa is scheduled for 2005 in the master plan, and the optical fiber transmission link of this plan can partly be shared, future construction costs can be reduced substantially. Also, by constructing a segment of this ring (approximately 6km between Filwoha and Nefas Silk) in advance, this project can accelerate the construction plan of an optical fiber ring in Addis Ababa.

(Reduction of future construction costs): Sharing of approximately 6km between Filwoha and Nefas Silk segment

- Costs for duct construction
- Costs for laying sub-ducts

(Preparation under this construction plan):

Under consideration of the future connection to the fiber ring circuit, this project will draw optical fiber cables into the Filwoha and Nefas Silk stations, and implement an optical transit connection using LDFs (Light Distribution Frames).

5.3 Equipment Plan for the Backbone Transmission Links

(1) System Outline

(Optical fiber transmission link between Addis Ababa and Nazareth)

This project will construct an optical fiber backbone (98km) between Addis Ababa and Nazareth. The route for laying the optical fiber backbone, and the repeater stations, are as shown below:

(Route)

Addis Ababa (IR/ITE) ~ Addis Ababa (Filwoha) ~ Addis Ababa (Nefas Silk) ~Debre Zeit ~ Adama West M/W Rep. ~ Nazareth

A connection diagram of the transmission links is shown in Figure 5.3.1 “Transmission Configuration of Addis Ababa -Nazareth Optical Backbone”.

(Intermediate stations)

Filwoha Station (2km) : Optical cable connection
Nefas Silk Station (8km) : Optical cable connection
Debre Zeit Station (47km) : Repeater with add/drop function

(2) Interface Points of the Optical Fiber Backbone with the Existing Microwave

As shown in Figure 5.3.1 Transmission Configuration of Addis Ababa - Nazareth Optical Backbone, the Addis Ababa (IR/ITE) station and the Adama West M/W Rep. station shall be the interface points, to enable an efficient route diversity with the existing microwave backbone, for securing stable and reliable network configuration.

a) Addis Ababa (IR/ITE) Telecommunications Center

The IR/ITE station is the gateway to the Mt. Furi microwave repeater station.

By installation of an optical fiber backbone into this IR/ITE station, and connecting the lines at the STM-1 level, the routing can be changed from the existing microwave transmission links to the new optical fiber transmission links.

b) Adama West M/W Rep. Station

The Adama West M/W Rep. station is a transit gateway to Dire Dawa (East), Goba (Southeast) and Shashemene (South). By connecting optical fiber transmission links and the digital microwave transmission links at this point, this plan can make use of the optical fiber backbone to three trunk routes with the microwave link back up.

(3) Outside Plant (Cable Plant)

a) Construction section within Addis Ababa city

Within Addis Ababa city zone where the Optical fiber backbone is planned, the vehicle traffic is heavy, and over-head structure could be accidentally damaged. It is further not economical to repeat the digging of the city roads for each cable construction work. For this reason, F/S team decided to construct a 10 km 6-way duct for the city area on the route Addis Ababa (IR/ITE) ~ Addis Ababa (Filwoha) ~ Addis Ababa (Nefas Silk), where the digging work and cable-laying work can be split, the future demand for cable ducts will be satisfied. A detailed illustration of the routes for the optical fiber in the city of Addis Ababa is shown in Figure 5.3.2 “Optical Fiber Laying Route (Addis Ababa Area)”.

b) Construction section in the suburbs

The trunk road between Addis Ababa and Nazareth is an asphalt road that was constructed with economic aid from abroad. It has one lane per side (with a road shoulder), and is of extremely high quality compared with the regional roads in Ethiopia. The following methods are studied for laying cables in this suburban area: the duct method (duct cable method), the directly burying method (directly buried cable method), and the aerial method (aerial cable method).

In the field survey, it is found that in part of the section, the road shoulder is narrow, and higher than the surrounding area. Because of this, if the duct method or the

directly-burying method is applied, it will be difficult to secure enough space to dig at the road shoulder, and in times of heavy rainfall, the dug place for cable laying may be washed with muddy flash flood, causing that the cables will be exposed and the road shoulder will be broken and fallen.

For this reason, F/S team decided to apply the aerial cable method, which will make the construction cost-down as well as shorten the time required for the construction.

An aerial optical fiber cable (over head cable) will be installed on concrete poles (height: 8m) standing at intervals of 50m for the segment Addis Ababa (Nefas Silk) ~ Debre Zeit ~ Adama West M/W Rep. ~ Nazareth (85.4km in total).

A detailed illustration of the routes for the optical fiber between Addis Ababa and Nazareth is shown in Figure 5.3.3 1/3-3/3 “Optical Fiber Laying Route (Addis Ababa – Nazareth/Outer city)”. For reference, the suburban trunk road view is shown in following picture.

Photo No.14: The Suburban Trunk Road Shoulder Condition of Optical Fiber Laying Route between Addis Ababa (Nefas silk) and Nazareth

c) Construction segment in Nazareth city

Due to the same vehicle traffic condition within the city area of Nazareth, the application of the duct system is to be the most beneficial. F/S team decided to install duct system in the 1,100m segment within the city from the Nazareth P.C. station (add a duct pipe while leaving the manholes as they are), and to newly construct a 6-way duct in the approximately 1,500m segment between the points at 1,100m and 2,600m from the

Nazareth P.C. station. A detailed illustration of the routes for the optical fiber in the city of Nazareth is shown in Figure 5.3.4 “Optical Fiber Laying Route (Nazareth Area)”.

d) Construction materials

Details on the optical fiber cables and the construction materials required for this project are shown in Table 5.3.1 (2/2) “Optical and Material List”.

(4) Transmission Equipment

a) Functional requirements / electrical requirements (outline)

The equipment for the optical fiber backbone between Addis Ababa and Nazareth shall meet the following functional and electrical requirements. Details on the transmission equipment required for this project are shown in Table 5.3.1 (1/2) “STM-16 Optical Transmission System”.

(Outline of the optical fiber cable)

- The optical fiber shall be of 24 cores.
  (Wave length 1,310nm /Single mode fiber/ Ribbon type)
- Optical fiber cable laid in duct: 12.6km
- Aerial optical fiber cable: 85.4km

(Transmission Multiplex Subsystem outline)

- Racks with ETSI specifications
- STM-16 interface unit
- Tributary interface unit (Add & Drop STM-1 and/or 2M)
- Control and Monitoring system (Local Management System)
- Distribution Frame (DDF& LDF)
- Installation drawings, Operation and Maintenance manuals
- Spare parts
- Measuring instrument
- Installation materials

b) Installation work and installation space

Figures 5.3.5-1 to 5.3.5-6 shows the routes plan to install optical fiber cables into the station buildings. Figures 5.3.6-1 to 5.3.6-6 show the equipment installation layout of the end transmission stations.

Routes plan for the optical fiber cable laying work:

Fig 5.3.5-1: Addis Ababa IR/ITE Center Cable Laying Point

Fig 5.3.5-2: Addis Ababa FILWOHA Center Cable Laying Point

Fig 5.3.5-3: Addis Ababa NEFAS SILK Cable Laying Point

(5) Building / Power Facilities

(a) Addis Ababa IR/ITE Telecommunications Center (existing building)

As shown in the layout plan of the equipment room (Figure 5.3.6-1), sufficient space for new equipment installation can be secured. As for power facilities, commercial power subsystem (220V/50Hz) and diesel engine generator are in place, so there is no particular problem in power supply. However, as ETC is currently doing installation work for radio system and transmission multiplex subsystem in the Eighth Development Program, it needs to reconfirm if there are any free NFB (non fuse breaker) terminals on the secondary power distribution board (PDB) when doing the detailed design.

(b) Addis Ababa FILWOHA Telecommunications Center (existing building)

As shown in the layout plan of the equipment room (Figure 5.3.6-2), sufficient space for new equipment installation can be secured. As for power facilities, since commercial power subsystem (220V/50Hz) and diesel engine generator are in place, so there is no particular problem in power supply. However, it need to confirm whether this project need additional DC power supply devices and whether there are any free NFB (non fuse breaker) terminals on the secondary power distribution board (PDB) when doing the detailed design.

(c) Addis Ababa Nefas Silk (existing building)

As shown in the layout plan of the equipment room (Figure 5.3.6-3), sufficient space for new equipment installation can be secured. As for power Facilities, since commercial power subsystem (220V/50Hz) and diesel engine generator are in place, so there is no particular problem in power supply. However, it need to confirm whether this project need additional DC power supply devices and whether there are any free NFB (non fuse breaker) terminals on the secondary power distribution board (PDB) when doing the detailed design.

(d) Debre Zeit (existing building)

As shown in the layout plan of the equipment room (Figure 5.3.6-4), sufficient space for new equipment installation can be secured. However, ETC is currently proceeding the installation work (spur lines) of radio system and transmission multiplex subsystem under the Eighth Development Program assigning the removed space of obsolete equipment that became superfluous.

As for power facilities, commercial power subsystem (220V/50Hz) and diesel engine generator are in place, so there is no particular problem. However, it need to confirm whether this project need additional DC power supply devices and whether there are any free NFB (non fuse breaker) terminals on the secondary power distribution board (PDB) in the same way as the floor space for equipment - during the detailed design.

In detail superfluous equipment space is shown in next picture.

Photo No.15 : Superfluous Equipment Space in the Second Equipment Room in Debre Zeit

(e) Adama West Rep. (existing building)

As shown in the layout plan of the equipment room (Figure 5.3.6-5), space for new equipment installation can be secured by moving idle equipment (Siemens bay). During the field survey, F/S team asked the ETC staff to do so. As for power source equipment, since commercial power subsystem (220V/50Hz) and diesel engine generator are in place, so there is no particular problem. However, it need to confirm whether this project need additional DC power supply devices and whether there are any free NFB (non fuse breaker) terminals on the secondary power distribution board (PDB) as well as the floor space for equipment

For your reference, above-mentioned idle equipment (Siemens bay) is shown in next picture.

Photo No.16 : The Idle Equipment (Siemens bay) in Adama West Rep., Which need to be moved in Advance.

(f) Nazareth P.C. (existing building)

As shown in the layout plan of the building and the equipment room (Figure 5.3.6-6), space for new equipment installation can be secured by removing obsolete equipment (old M/W / not removed yet). The requirement of this removal was explained to the ETC staff. As for power source equipment, since commercial power subsystem (220V/50Hz) and Diesel engine generator are in place, so there is no particular problem. However, it need to confirm whether this project need additional DC power supply devices and whether there are any free NFB (non fuse breaker) terminals on the secondary power distribution board (PDB) as well as the space for equipment during the detailed design.

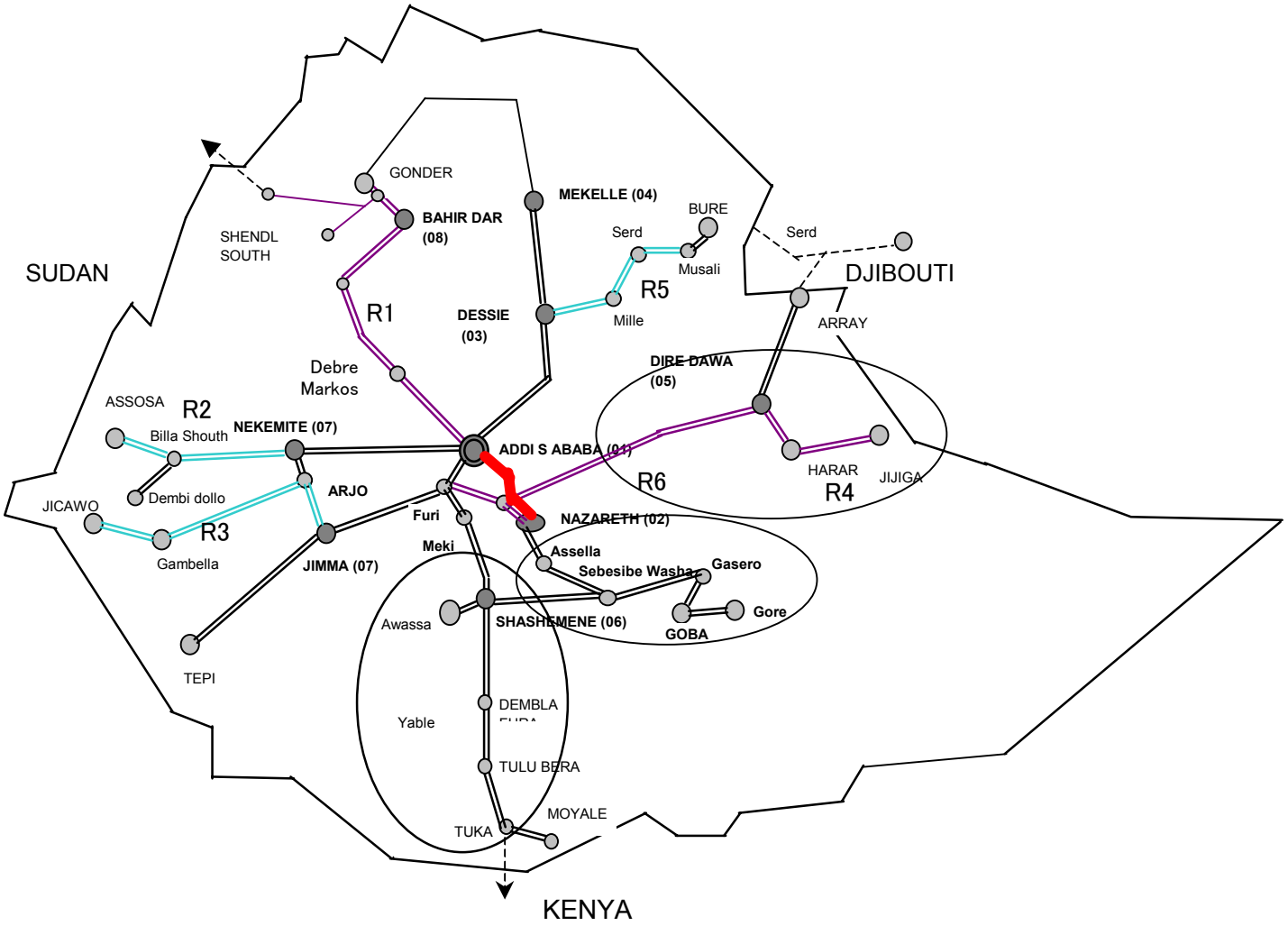
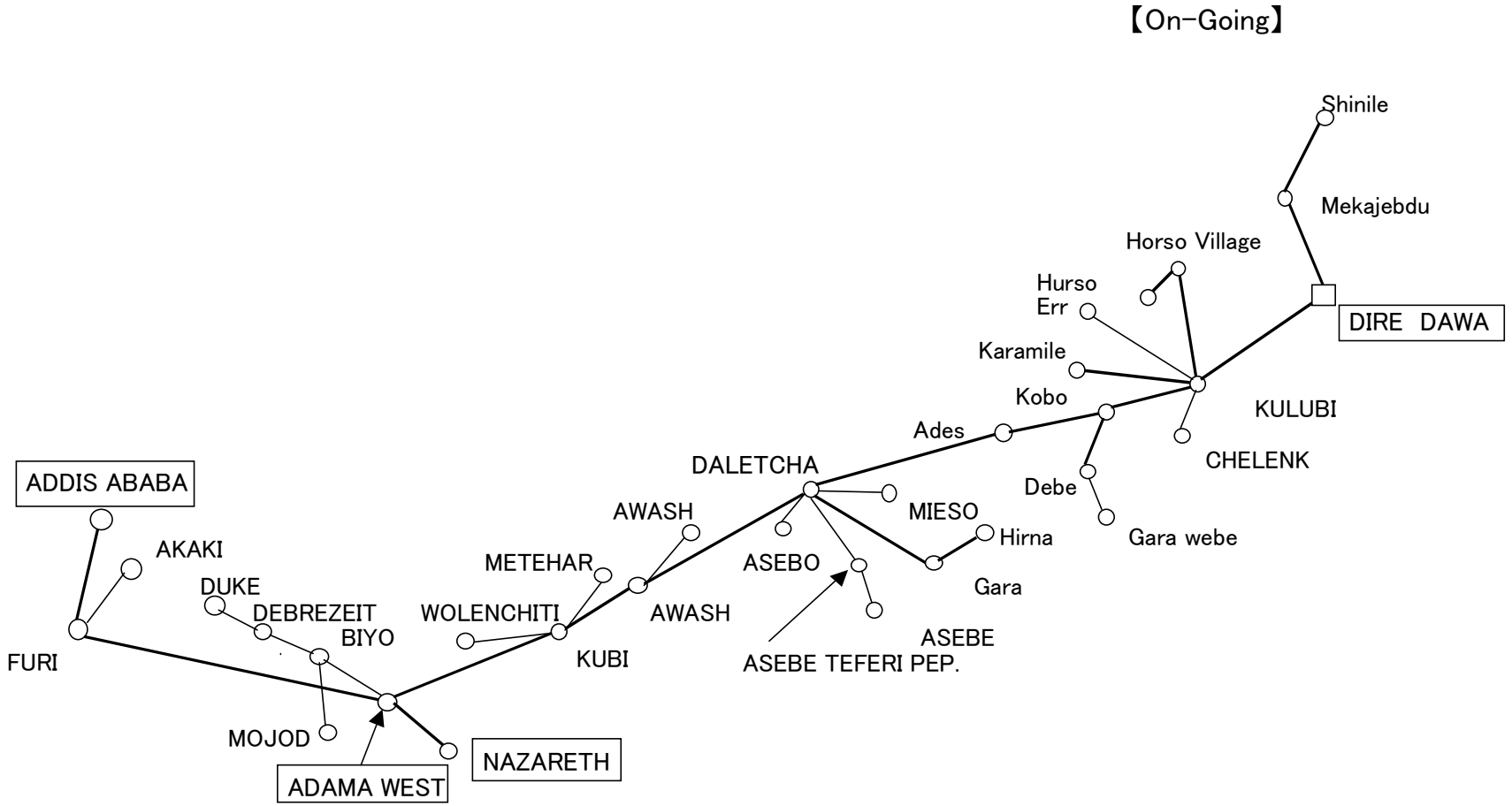
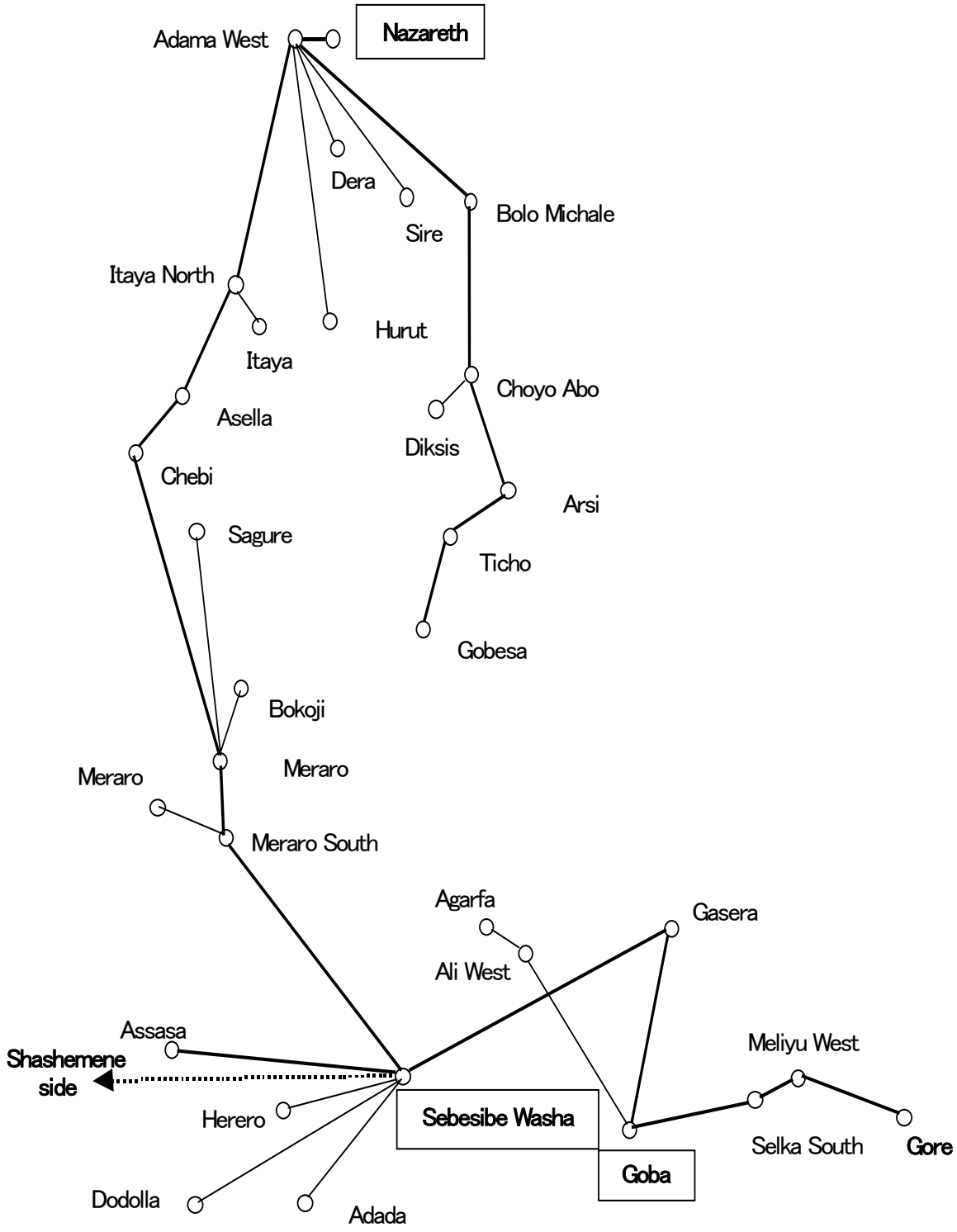


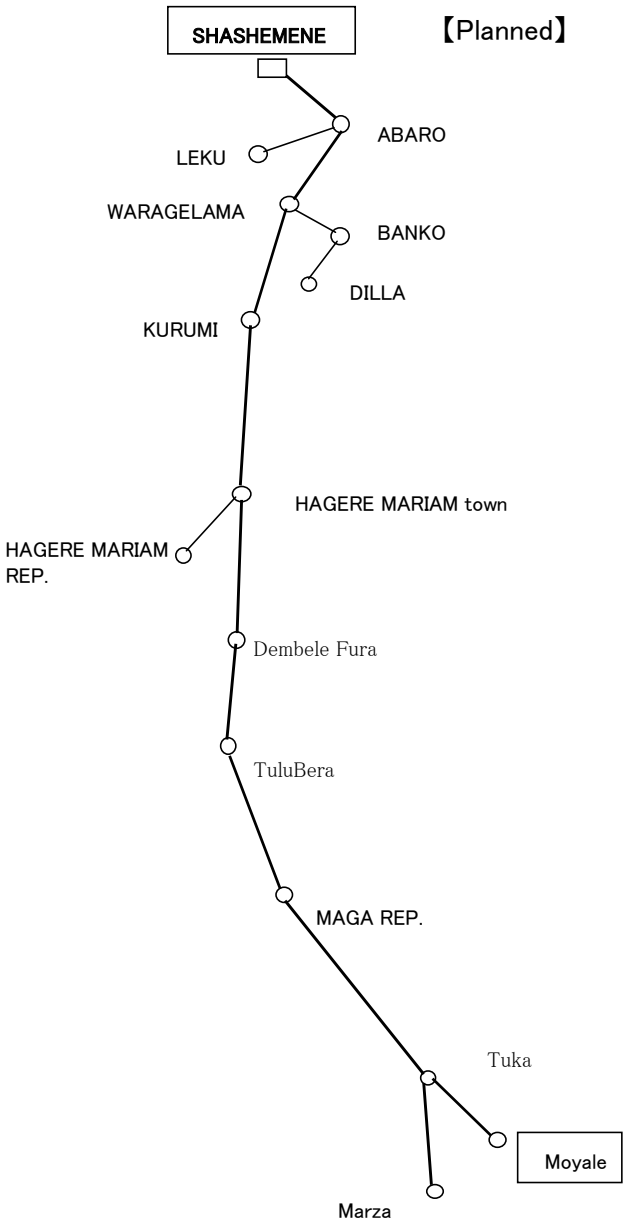
Figure-5.2.1 Beneficial Telecommunications Zone by new Optical Fiber Backbone project



①③ Figure 5.2.2 Addis Ababa-Dire Dawa project links after Survey (On-going ETC SDH M/W Project)



③ Figure 5.2.3 Nazareth-Goba new Project (2002 JICS Project by SDH M/W Sys)



④ Figure 5.2.4　Shashemene-Moyale (2001JICS Project)

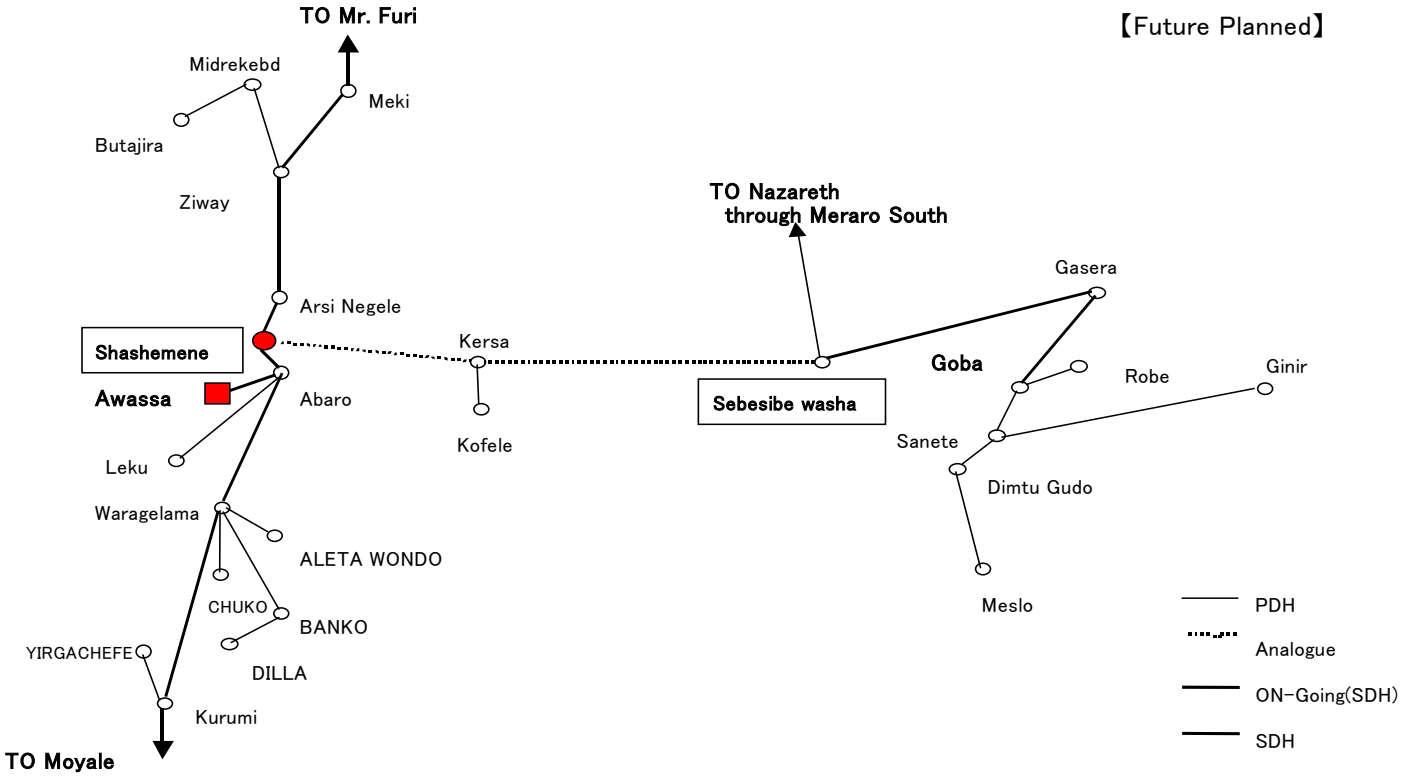


Figure 5.2.5 Sebeside Washa Shashemene Planned Project

(This project will replace the existing analog M/W system.)

Expected LINK
Connection Route

Mt.Furi

Start Point

TR-ITE

2KM

6KM

14KM

25KM

39KM

8KM

Station Name	Distance
TR-ITE	0 km
FILWOHA	2 Km
Nefas Silk	8 Km
AKAKI	22 Km
Duken	
DEBRE ZEIT	47 Km
Mojo	
ADAMA WEST MW REP.	86 Km
NAZARETH	98 km

FILWOHA

Nefas Silk

AKAKI

Optical Fiber Laying Route
(Road Condition)

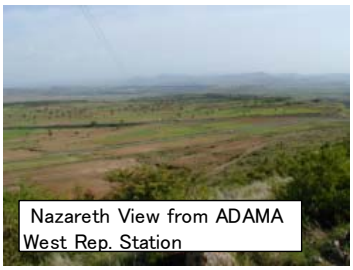
Note:

: Connection or repeater by STM-1
(Or Add/Drop) node

: Connection by lightwave connector

Duken

DEBRE ZEIT



Mojo

ADAMA WEST MW REP.

①Eastern region

②South-eastern region

NAZARETH

Fig.5.3.1 Transmission Configuration of AA – Nazareth Optical Backbone