The Republic of the Union of Myanmar
Ministry of Communications and Information Technology(MCIT)
Myanma Posts and Telecommunications(MPT)

PREPARATORY SURVEY REPORT

ON

THE PROJECT FOR IMPROVEMENT

OF

COMMUNICATION NETWORKS

IN

THE REPUBLIC OF THE UNION OF MYANMAR

JULY 2014

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

PANTEL INTERNATIONAL CO., LTD.
NIPPON KOEI CO., LTD.
YACHIYO ENGINEERING CO., LTD.

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Preparatory Survey on the Project for Improvement of Communication Neworks
In the Republic of the Union of Myanmar

Contents

Chapter 5 Mid-Term Development Plan

Chapter 6 Review of Works Subject to ODA Loans

Chapter 7 Outline of Scope of Works

Project Sites

Figures and Tables List

Chapter 1 Introduction

Chapter 2 Background of the Project

Chapter 3 Development Status and Problem in ICT Sector

Chapter 4 Trend on Communication Technology

Chapter 5 Mid-Term Development Plan

Chapter 8 Project Implementation Plan

Chapter 9 Environmental and Social Considerations

Abbreviations

AAE1	Asia Africa Europe1
ADB	Asian Development Bank
ADSL	Asymmetric Digital Subscriber Line
AMPS	Advanced Mobile Phone System
ASEAN	Association of South-East Asian Nation
B/S	Balance Sheet
BGP	Border Gateway Protocol
BHN	Basic Human Needs
BPSK	Binary Phase Shift Keying
BT	Broadband Transmission
CCNA	Cisco Certified Network Associate
CDMA	Code Division Multiple Access
CISSP	Certification Information Systems Security Professional
CSO	Central Statistical Organization
CWDM	Coarse Wavelength Division Multiplexing
D-AMPS	Digital Advanced Mobile Phone System
DCF	Discount Cash Flow
DDoS	Distributed Denial of Service
DFID	Department for International Development (UK)
DL	Down Link
DMS-300	International Gateway Switch by Nortel
DNS	Domain Name System
DSSS	Direct Sequence Spread Spectrum
DWDM	Dense Wavelength Division Multiplexing
E/N	Exchange of Note
EDCF	The Economic Development Cooperation Fund of the Export-Import Bank of Korea
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EMP	Environmental Management Plan
EMS	Element Management System
EPC	Evolved Packet Core
ERP	Ethernet Ring Protection
FEC	Foreign Exchange Certificate
FEP	Foreign Exchange Premium
FERD	Foreign Economic Relations Department
FIRR	Financial Internal Rate of Return
FTTB	Fiber To The Building
FTTC	Fiber To The Curb/Cabinet
FTTH	Fiber To The Home
FW	Fire Wall
FWA	Fixed Wireless Access
FY	Fiscal Year

G/A	Grant Agreement
GDP	Gross Domestic Product
GMPLS	Generalized Multi-Protocol Label Switching
GSM	Global System for Mobile Communications
GbE	Giga bit Ethernet
Gbps	Gigabit per second
HF	High Frequency
HRD	Human Resource Development
HSS	Home Subscriber Server
HTTP	Hyper Text Transfer Protocol
ICB	International Competitive Bidding
ICCAN	Internet Corporation for Assigned Names and Numbers
ICT	Information and Communication Technology
IDC	Interest During Construction
IDU	In Door Unit
IEE	Initial Environmental Examination
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IGW	International Gate Way
IMF	International Monetary Funds
IP	Internet Protocol
IPTV	Internet Protocol Television
IPv4	Internet Protocol Version 4
IPv6	Internet Protocol Version 6
ISP	Internet Service Provider
ITMC	International Transmission Maintenance Center
ITU	International Telecommunication Union
IXP	Internet Exchange Point
JICA	Japan International Cooperation Agency
JPY	Japanese Yen
KISDI	Korea Information Society Development Institute
KOICA	Korea International Cooperation Agency
kbps	kilobit per second
Kyat (MMK)	Myanmar Kyat
L/A	Loan Agreement
LC	Local Consultant
LCB	Local Competitive Bidding
LTE	Long Term Evolution
MCIT	Ministry of Communications and Information Technology
MCPT	Ministry of Communications, Posts and Telegraphs
MIMO	Multiple-Input and Multiple-Output
MISO	Multiple-Input and Single-Output
MOT	Management of Technology
MP	Master Plan

MPLS	Multi-Protocol Label Switching
MPLS-TP	Multi-Protocol Label Switching – Transport Profile
MPT	Myanma Posts and Telecommunications
Mbps	Megabit per second
NANOG	North American Network Operators' Group
NAT	Network Address Translation
NGN	Next Generation Network
NOC	Network Operation Center
NP	National Parameter
NPV	Net Present Value
O&M	Operation and Maintenance
ODA	Official Development Assistance
ODU	Out Door Unit
OFDMA	Orthogonal Frequency Division Multiple Access
OJT	On-the-Job Training
OPEC	Outside Plant Engineering Center
OTDR	Optical Time Domain Reflectometer
P/L	Profit Loss Table
P/Q	Prequalification
PCRF	Policy and Charging Rule Function
PMP	Project Management Professional
PMU	Project Management Unit
POP	Point Of Presence
PSTN	Public Switched Telephone Network
PTD	Post and Telecommunications Department
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
QoS	Quality of Service
SC-FDMA	Single-Carrier Frequency Division Multiple Access
SCPC	Single-Channel Per Carrier
SDH	Synchronous Digital Hierarchy
SEA-Games	Southeast Asian Games
SEA-ME-WE3	South-East Asia - Middle East - Western Europe 3
SEZ	Special Economic Zone
SIM	Subscriber Identification Module
SISO	Single-Input and Single-Output
SOC	Security Operation Center
STM	Synchronous Transport Module
SWOT	Strength Weakness Opportunity Threat
TCP/IP	Transmission Control Protocol/Internet Protocol
TDD	Time Division Duplex
TDMA	Time Division Multiple Access
Tbps	Terabit per second
UHF	Ultra-High Frequency

UL	Up Link
UNHCR	United Nations High Commissioner for Refugees
USD	United State Dollar
VAT	Value Added Tax
VDSL	Very High-bit-rate Digital Subscriber Line
VoIP	Voice Over Internet Protocol
W-CDMA	Wideband Code Division Multiple Access
WBB	Wireless Broadband
WDM	Wavelength Division Multiplexing
WLL	Wireless Local Loop
WTO	World Trade Organization
WiFi	Wireless Fidelity
WiMAX	Worldwide Interoperability for Microwave Access
YTC	Yatanarpon Teleport Co.,Ltd.
eNodeB	LTE infrastructure equipment

CHAPTER 1 INTRODUCTION

1.1 Background of Survey

In accordance with presentation by MPT (Myanma Posts and Telecommunications) at Japan-Myanmar ICT Workshop held in Myanmar on January 2013, current ICT infrastructure status in Myanmar is as follows:

- Telephone Service Density by the end of 2012:
  - Fixed communications: 1%;
  - Mobile communications: 10%
- Internet Service Density (Users): 1%

Due to import restriction and lack of funds under many years of economic sanction, improvement of communication infrastructure had not been implemented properly. Furthermore, due to lack of efficient network design under aging facilities, there are some problems in speech quality (comfort and accuracy), connection quality (swiftness in information transmission) and stability quality (stability in communication).

Reform in the political and economic spheres by Thein Sein's administration extended to telecommunication service and substantial reduction of the usage fees resulted to rapid increase of users of communication services. It is expected that the demand of communication services will expand at an accelerating rate from now on, while current status of the development of the communication network is delayed even in major cities including Yangon, Mandalay and Nayptitaw. This situation is one of factors preventing the improvement of civil life and economic development. In addition, an international gateway is currently only one in Yangon with lacking in backup system. Since provision of stable communication service is a base for all economic activities and civil life, nation-wide improvement of the communication network is required for balanced development of the nation. Among them, the improvement of the communication network in major cities (Yangon, Mandalay and Nayptitaw) at the center of economic and commercial activities is an urgent need.

Under the above circumstances, Ministry of Communications and Information Technology (MCIT) in Myanmar set a goal to increase telecommunication density including mobile phone up to 75% to 80% by the end of 2016. At Japan-Myanmar top-level meeting held on April 2012, bilateral cooperation in ICT sector was discussed as high priority and agreed on cooperation in ICT sector.

Following the agreement at top-level meeting, Japanese Government decided to carry out the Preparatory Survey on The Project for Improvement of Communication Networks, consisting the following:

- Urgent Improvement of Telecommunication Networks covering major 3 cities (Yangon, Mandalay, and Nayptitaw) to be implemented under Japan Grant Aid; and
- Improvement of Telecommunication Networks covering telecommunication networks to be implemented under Japanese ODA Loan.

This report describes the result of the preparatory survey for improvement of Telecommunication Networks covering telecommunication networks to be implemented under

Japanese ODA Loan.

1.2 Purpose of Survey

The purpose of the survey is to improve the communication infrastructure at nation-wide major cities in Myanmar and to formulate an effective project. Implementation of the project is to support the economic growth by enhancing the communication environment which is indispensable as industrial infrastructure.

1.3 Survey Area

The survey area consists of Myanmar's major cities aiming at improving nationwide communication networks.

1.4 Scope of Survey

The scope of the survey is summarized as follows:

(1) Confirm the information on background of the project
- Policy, administration and related laws in ICT sector
- Development plan in ICT sector
- Status on private investments and assistances by other donors than Japan

(2) Survey on current status for improvement of ICT sector and confirm the issues to be resolved
(3) Study and propose Medium-term Development Plan
(4) Schematic design on the Project (Select the optimal plan)
(5) Survey on international communication backbone
(6) Confirm the preliminary design and project impact
(7) Collect information on environmental and social considerations according to Myanmar's domestic laws and JICA Guidelines

1.5 Members of Survey Team

The survey team consists of following experts as shown below:

Name	Assignment	Affiliated to
TAKEI Makoto	Team Leader/Network Development Plan	Pantel International Co., Ltd.
MATSUOKA Takashi	Network Design No.1 (Network Design)	Pantel International Co., Ltd.
TOJO Sadayoshi	Network Design No.2 (Until February 2013) （Facilities/Implementation Plan）	Nippon Koei Co., Ltd.
NAGASAKI Taro	Network Design 2 (from March 2013) (Facilities/Implementation Plan)	Pantel International Co., Ltd.
KOSUGE Toshio	Policy, Regulations, Laws	Digital Hollywood University
KURODA Tomoyuki	Financial/Economic Analysis/Evaluation	IDC of Japan Inc.
SAKAGAMI Masahiro	Procurement, Cost Estimates No.1	Nippon Koei Co., Ltd.
KOBAYASHI Masanori	Procurement, Cost Estimates No.1 (Work in Japan only)	Nippon Koei Co., Ltd.
TANAKA Norifumi	Environmental and Social Consideration	Pantel International Co., Ltd.

1.6 Schedule of the Survey

The survey team started their activities in December 2012 by preparatory work in Japan. After preparation of draft Inception Report, the team visited to Myanmar for first field survey and discussed with counterpart officials assigned to the survey work from MPT and confirmed the scope of work and schedule of the survey.

The team carried out the first work in Japan analyzing the results of first field survey and prepared the basic concept of medium-term development framework for selecting the candidate projects to be implemented by Japanese ODA Loan.

The second field survey was started at the end of February 2013 for further confirmation of existing condition of network components such as transmission media, switching nodes and supporting facilities as well. The team also discussed with counterpart officials for confirmation of basic concept and requirements from Myanmar side. The Progress Report was prepared after the second field survey covering draft medium-term communication development programs and list of candidate projects to support sound development of communication networks in Myanmar.

The team carried out the third field survey from the end of April 2013 and discussed with MPT for the scope of works on telecommunication network development project proposed in the Progress Report.

After coming back from the third field survey, the Interim Report was prepared taking the result of third field survey into account.

Based on the Interim Report, the team carried out the network design and cost estimates on each component of proposed project. By reviewing the estimated cost, effect of proposed project implementation was confirmed and accordingly, Draft Final Report was prepared.

The team carried out the fourth field survey from the end of August 2013 and made presentation of Draft Final Report and discussed the contents of the report with Myanmar side.

After coming back from the fourth field survey, the team prepared the Final Report taking the results of the discussion during the fourth field survey into account.

CHAPTER 2 BACKGROUND OF THE PROJECT

2.1 Socio-Economic Index and Population of Each City

2.1.1 National Land and Ethnic Composition

The Union of Myanmar is situated between latitude 10 degrees and 28 degrees north and characterized by a national land extending long from north to south. The land borders on China, Thailand, Laos, India, and Bangladesh, and the total length of the border line reaches about 4,600 km. At the sea side, it faces the Gulf of Martaban, the Bay of Bengal, and the Indian Ocean, and the total length of its shoreline is about 2,000 km. The greater part of the national land belongs to a tropical zone or a subtropical zone, but temperature and precipitation differ greatly area by area. The Ayeyarwady River (total length 2,400 km) flows from north to south through the central area between two mountain ranges extending from north to south and located in the east and west of the national land. The vicinity of its river mouth (Ayeyarwady Region) forms a vast delta area (area about 31,000 km^2), and is the largest rice production area of the country. In addition, in the east side, the Thalwin River (total length 2,400 km) is situated. Headstream of it from Tibet far-off north of Myanmar flows through Yunnan Province, China and through Shan plateau of the northeast part of Myanmar, and reaches Andaman Sea. The Thalwin River has a lot of rapid streams and only allows a ship to navigate it to a 119 km point from its river mouth. Because of it, an economic effect from waterway traffic is not expected in its river basin.

2.1.2 Administrative Division

Myanmar is divided into 7 Regions (tyne) and 7 States (pyi-ne) as administrative areas. Region is an area where a lot of Burmese (share about 7 out of 10 people) mainly reside in, and State is an area where ethnic minorities other than Burmese mainly reside in. The capital city is Nayptitaw (meaning king's city, relocated from old capital Yangon in November 2005) situated in the southern part of Mandalay Region.

	Region	Region capital	State	State capital
1	Ayeyarwady	Pathein	Kachin	Myit-kyi-na
2	Sagaing	Sagaing	Kayah	Loikaw
3	Tanintharyi	Dawei	Kayin	Hpa-an
4	Bago	Bago	Shan	Taunggyi
5	Magway	Magway	Chin	Hakha
6	Mandalay	Mandalay	Mon	Maw-la-myine
7	Yangon	Yangon	Rakhine	Sittwe

Fig. 2.1-1 Local administrative division of Myanmar

Myanmar is a multiethnic nation, and it is said that Burmese account for 2/3 of the population, and more than 100 ethnic minorities account for 1/3 (Shan 9%, Kayin 7%, Rakhine 3.5%, Chinese descent 2.5%, Mon 2%, Kachin 1.5%, Indian descent 1.25%,

Kayah 0.75%, Others 4.5%) (Source: Minorities in Burma, Minority Rights Group International, and others). However, it is said that the population of each tribe is under estimated, and as recent conflict reports and the like indicate, there are tribes, such as the Rohingya, who are not fully recognized as Myanmar people (UNHCR terms them stateless people). Nearly 90% of Myanmar people are Buddhists, and it is said there are Christians 4%, Muslims 4%, Hindus 1%, and others 1%.

2.1.3 Population Distribution

The population size of Myanmar is about 59,780 thousand (CSO release*, the growth rate of population is about 1.3%), the area is 680 thousand km^2. The capital city is Nayptitaw with an area population of about 900 thousand (confirmation required), to which the capital is relocated from Yangon City in 2005 and which is an inland area north (360 km) of Yangon City. The largest city is Yangon with the population of 5,400 thousand, and the second city is Mandalay. However, the actual population distribution needs to wait the result of national census scheduled in 2014. For example, the population of Nayptitaw is not accurately known. Its reason is that registered address of public servants is kept at the place before the capital relocation.

Table 2.1-1 Estimated regional population (as of Oct. 2010: announced Jan. 2013)

	Region and State	Pop. (1,000)		Region and State	Pop. (1,000)
1	Kachin State	1,579	8	Magway Region	5,623
2	Kayah State	359	9	Mandalay Region	8,422
3	Kayin State	1,816	10	Mon State	3,137
4	Chin State	554	11	Rakhine State	3,306
5	Sagaing Region	6,541	12	Yangon Region	7,023
6	Tanintharyi Region	1,714	13	Shan State	5,660
7	Bago Region	6,008	14	Ayeyarwady Region	8,041
				National	**59,780**

Source: CSO (Central Statistical Organization)

2.1.4 Economic Situation

Table 2.1-2 lists key economic indicators. The GDP as of 2012 is 44.6 billion USD. According to IMF estimates, it was predicted the real GDP growth rate would be 5.46% in 2011, and 6.2% in 2012. It is considered its economy is on the expansion trend compared to 2009 when it was affected by the global recession. (The economic growth rate announced by CSO is highly predicted as a whole; therefore, this report applies values until 2017 estimated by IMF. See Table 2.1-3.)

Table 2.1-2 Key economic indicators

Item	2007/08	2008/09	2009/10	2010/11	2011/12[*1]
Nominal GDP（1 bil kyats）	3,336	28,778	32,351	36,436	39,805
Nominal GDP（1 mil dollars）	20,182	31,367	35,225	45,380	51,925
GDP growth rate (%) (government announcement)	12.0	10.3	10.6	10.4	n.a.
GDP growth rate (IMF estimation) (%)	5.5	3.6	5.1	5.3	5.46
Per capita GDP (USD)	351	537	575[*2]	705[*2]	768[*2]
Exchange rate (real) (kyat/USD)	1,110	992	1,004	861	810
Breakdown of GDP[*3]					
Agriculture	44%	42%	40%	38%	
Mining	1%	1%	1%	1%	
Manufacturing	15%	16%	17%	19%	
Electric, gas, water	0%	0%	0%	0%	
Construction	4%	4%	4%	5%	---
Transportation, communication	12%	13%	14%	14%	
Finance	0%	0%	0%	0%	
Administration	1%	1%	1%	1%	
Commerce	22%	21%	21%	21%	
Others	2%	2%	2%	2%	

Remarks：*1: estimated value, *2: values in 2009-2001 are estimated values calculated on the assumption of the population growth rate of 1.5% after 2008, and
*3: ratios based on production prices in 2005.
Source：IMF Country Report Myanmar 2011, ADB Key Indicators 2011

Table 2.1-3 Economic growth rate announced by IMF

Year	2013	2014	2015	2016	2017
Economic growth rate (estimation)	6.3%	6.4%	6.5%	6.5%	6.5%

Source：IMF

International trade in 2007 (April 2007-March 2008) before transition to civilian rule, which was realized in 2011, expanded to 35,296.8 million kyats in export with a 17.6% increase over the previous year, and to 18,418.9 million kyats in import with a 9.4 % increase over the previous year. Balance of trade is in the black for 6 consecutive years, and balance of current account is in the black of 16,877.9 million kyats. Main export items are: natural gas 13,937.9 million kyats with a 19.4% increase over the previous year, a beans group 3,462.5 million kyats with a 1.0% decrease over the previous year, and sewn products 1,554.6 million kyats also with a 2.9% decrease. On the other hand, main import items are: general and transport machines (extracting machinery for natural gas, containers, trucks, etc.) being the largest with 2,718.2 million kyats with a 53.1% increase over the previous year; next essential oil (mainly diesel oil) with 2,034 million kyats with a 48.7% decrease; and then nonmetal and nonmetal products with 1,206.2 million kyats with a

1.9% increase.

After transition to civilian rule (after 2010), vigorously continued investments to the energy field such as mainly hydraulic power generation, natural gas, and oil, and surge in sightseers and inspection tourists looking for investment opportunities have contributed to the economic growth and are factors to continue a stable nearly 6% growth. Regarding the international trade in 2011, exports are 49.2 billion kyats with a 0.4% increase over the previous year, and imports 48.7 billion kyats with a 37.3% increase, showing noticeable expansion of imports. The reason for this is that the government employs "export first doctrine" admitting import within earned foreign currencies, and trade surplus is recorded for 10 consecutive terms. In 2011, however, accompanied with relaxation of regulations, a substantial increase in import has started, and amounts of export and import are almost the same, bringing in the result of contraction of surplus (524 million kyats).

2.1.5 Unified Exchange Rate

Myanmar shifted to a dirty floating rate system in April 2012. Before then, exchange rates applied to the actual business were not an official parity rate of 5.4 kyats per dollar, but a market rate of 830 kyats per dollar (January 2013), and the market rate has appreciated more than 15% over about a year. In August 2011, the rate came close to 1 dollar=700 kyats. This variation causes large impacts on the export business. Table 2.1-4 describes transition of the official parity rate.

Table 2.1-4 Transition of exchange rate

	US$	JPY (100Yen)
2008-2009	5.4510	5.4305
2009-2010	5.4553	5.8504
2010-2011	5.5450	6.3997
2011-2012	5.3990	6.8052
2012-2013 (April-Nov)	849.49	1065.03

Source：CSO（Central Statistical Organization）

On the other hand, Foreign Exchange Certificate (FEC) had been abandoned in July 2013. Myanmar nationals had been prohibited to get foreign money and permitted to get only FEC until official announcement of new Foreign Exchange Law in August 10 2012. Foreigner had not been permitted to withdraw the money remitted from foreign country by US dollar but only permitted to withdraw by FEC principally. By 2003, even foreign tourist entering into Myanmar had been requested to change from US dollar into FEC without exception. Considering those past conditions, abolishment of FEC would be a big change.

2.2 Assistance Trend of Japan

2.2.1 Assistance Policy of Japan

Japan traditionally examined and implemented on a case-by-case basis with a focus on projects in basic human needs (BHN) while keeping eye on democratization and improvement of human rights situations regarding economic cooperation with Myanmar. Japan changed its economic

cooperation policy in April 2012, however, on the grounds that the Myanmar government has taken measures, since 2011, such as release of political prisoners, direct talks between President Thein Sein and Ms. Aung San Suu Kyi, and suspension of hostilities with minority armed groups, and realization of political participation by a broad range of interested persons including Ms. Aung San Suu Kyi as a result of congressional by-election on April 1, 2012.

Under the new economic cooperation policy, Japan intends to implement assistance with a focus on the following fields, in order to support efforts in rapidly progressing reform in the broad range of fields in Myanmar toward democratization, national reconciliation and sustained development, so that a wide range of people in Myanmar can realize democratization, national reconciliation, and dividend of economic reform, while continuing to keep an eye on progress of reform efforts.

(1) Assistance for developing the infrastructure, institution, etc. necessary for the sustained economic growth;
(2) Assistance for improving living standard of the people (including support for minority and the poor, agriculture development, and community development); and
(3) Assistance for human resources development and institution development supporting socio-economy (including support for promotion of democratization).

This project is to implement improvement of the communication network, which is a basic infrastructure, according to the "(1) Assistance for developing the infrastructure, institution, etc. necessary for the sustained economic growth" among the above policies.

2.2.2 Related Assistance Plan of Japan

Past assistance to the communication sector similar to the project includes several projects more than 25 years ago, but recently only one project which is "Software and network engineer training project (Technical assistance project)", while the assistance from India, Korea and China become noticeable recently.

Table 2.2-1 Past record of technical cooperation, loan assistance and grant aid by Japan (ICT sector)

Cooperation type	Implementation year	Subject	Amount	Description
Dispatch of Expert (ODA Loan Expert)	Dispatched on Nov. 2013	Advisor for improvement of ICT infrastructures	-	Requested from MCIT for support by Japanese expert for promotion on ICT infrastructure improvement plan and its implementation.
Technical assistance project	Dec. 2006-Nov. 2011	Software and network engineer training project	730 mil yen	Supported starting up training courses with a purpose for Information and Communication Technology Training Center subordinate to Ministry of Science and Technology to be able to implement ICT technology training mainly targeting graduates from ICT related universities.

Cooperation type	Implementation year	Subject	Amount	Description
Loan assistance	Nov. 20, 1979 （E/N signed）	Communication plan	2,220 million yen	Implemented expansion of capacity of exchanges in automatic telephone exchange offices, expansion of toll communication exchanges, expansion of the microwave network amount in order to further expand capacity of facilities introduced by the first modernization project (World Bank).
Grant aid	2012	Project for Urgent Improvement of Communication Networks	1.71 billion yen	Contribute the growth of socio-economy in Myanmar and life style by improvement of the capability of communication against the increasing communication demand by improving the metro network, backbone network in three major cities such as Yangon, Naypyitaw and Mandalay.
	1987	Provincial city telephone exchange improvement plan (phase 1)	733 million yen	Installed digital exchanges and line facilities in 8 regional nucleated cities along the existing microwave transmission lines (Phases 2, 3 were not implemented due to political affairs in Myanmar after 1988).
	1976	Plan for providing telephone devices and expanding telephone network system	600 million yen	Installed crossbar system automatic exchangers corresponding to 2,000 lines in Mayangon and 400 lines in Pyin Oo Lwin in order to introduce automatic exchangers in local telephone offices in Yangon (Mayangon office) and Pyin Oo Lwin and bring about automatization and increase in lines that were not included in the first modernization project (World Bank).

Source： Foreign Ministry ODA website, country-by-country data book

2.3 Private Investment and Assistance Trend of Other Donors

Assistance situations up to now to the communication sector in Myanmar from other donors, international organizations, etc. are described in Table 2.3-1 below. The ICT Development Master Plan assisted by Korea International Cooperation Agency/Korea Information Society Development Institute (KOICA/KISDI) is not authenticated yet, and it is not a development plan or guideline in the sector in the current situation.

Table 2.3-1 Assistance record by other donor countries and international organizations (ICT sector)

Implementation year	Donor name	Subject	Amount	Description
Aug. 2004 - Aug. 2005	South Korea(KOICA, KISDI)	Assistance for creation of Myanmar ICT Development Master Plan	About 0.95 (mil USD) (grant aid)	Assisted creation of Myanmar ICT Master Plan (2010-2015) for targeting e-National Task Force (e-NTF).
2007-	India Department of Information Technology (DIT)	India-Myanmar e-Learning and Research Center	Unexplained	Target is e-NTF.
Oct. 2008-	India (USCY)	Software Technique Training Center	Unexplained	Technical cooperation by dispatching instructors and accepting trainees.
2007-	India, China	Construction of Yadanabon Ciber City		India assisted software and China assisted hardware. Teleport Center (Dec. 2007 operation) Incubation Center (Dec. 2008 operation)

Source：JTEC lecture material, first in 2012 (Jan. 18, 2012) http://www.jtec.or.jp/2012.1.18kouenkai_kouno2.pdf

Regarding the development plan on core networks throughout Myanmar, Fiber Optic Cable Installation is under planning in the following sections by financial assistance from the Economic Development Cooperation Fund of the Export-Import Bank of Korea (EDCF) and by the China Unicom:

(1) Installation Plan under EDCF assistance

- Dawei – Myaeik – Bokepyin – Kawthong
- Taunggyi – Namsan – Kunhein – Minepyin – Kyaington – Minephyat – Tarchileik
- Magwe – Ann – Minpya – Kyauktaw – Sittwe
- Shwebo – Kanbalu – Kawlin – Moehnyinn – Moegaung – Myitkyina

(2) Installation Plan by China Unicom

- Muse – Kutkai – Kyaukme – Pyinoolwi – Mandalay – Kyaukse – Meikhtila – Pyawbwe – Nayptitaw – Taungoo – Penwego – Yangon – Pantanaw – Pathein - Ngwehsaung

The above, however, are under planning stage and are some possibility to be modified.

CHAPTER 3 DEVELOPMENT STATUS AND PROBLEM IN ICT SECTOR

3.1 Policy, Administration, Relevant Law for ICT Sector

3.1.1 National Development Policy

Myanmar broke away from Britain as a republican federal nation "Union of Burma" in 1948, changed its name to "Union of Myanmar" in 1989 and continues up to the present date. Political turmoil and confusion due to socialistic economic policies after independent delayed the economic development. In addition, import restriction and capital shortfall due to economic sanctions against the military government from international society did not allow an enough infrastructure to be built, and the implementation of its development policy was delayed among Asian countries. In 2008, the current constitution was approved by national referendum, and in 2010 general election was held first time in 20 years. The government selected by national legislature started in 2011, and Mr. Thein Sein assumed a post of President. In his presidential speech in June, he declared as a target an annual rate of 7.7 % economic growth in terms of GDP for 5 years from 2011/2012 to 2015/2016, and making per capita GDP by 2015 as large as three times. (1) However, it is expected to stay a 1.7-fold increase considering actual economic indicators in the past 5 years. In order to achieve the target, it is expected that the ratio of the agriculture sector to the whole industry should be lowered, and the ratios of the industrial sector and service sector should be upped. The serious problem in facilitating the economic growth is that the infrastructure is not developed. The government is opening a market to private businesses including the PPP (Public Private Partnership) and the like, and encouraging new entry in need of dramatic increase in investment into electric power, communication, deep water ports, railways, logistics, and financial services.

(1) IMF statistics in April 2012: IMF Country Report Myanmar 2011

3.2 Development Plan in ICT Sector

Ministry of Communications and Information Technology (MCIT) and Myanmar Computer Science Society Development Committee (established in 1996) made a policy plan of the information and communication field. They drew up ICT Master Plan Framework (2000-2005) in the past, but the plan only described purposes to promote informatization and strategies, and lacked concrete action plans, and so drew up Myanmar ICT Development Master Plan and Action Plan in 2006-2010 in assistance of South Korea (KOICA). Then, they announced Myanmar ICT Master Plan (MCIT, KOICA) as its revised edition in July 2011. The Master Plan proposed action plans in 4 areas -- (1) ICT infrastructure, (2) ICT industry, (3) ICT human resources development, and (4) ICT education (e-education) -- by comparing them with examples in South Korea through SWOT analysis and Bench Marking Study. However, the Master plan was not officially approved by the Myanmar government and MPT has suggested referring it for only concept and vision. Main goals described in Myanmar ICT Master Plan 2011 are as follows:

- To raise the telephone density to 50% by 2015 (the current value is changed to 80% in 2016);
- To strengthen ICT society;
- To build an ICT infrastructure actively;
- To draw up policies to shift the communication carrier to private entities; and

- To develop e-Governance.

Regarding the above-mentioned (1) ICT infrastructure, the target is to raise telephone density to 50% by 2015 (increase of about 30 million lines in 5 years).

In 2012, a new target of raising the phone density in fixed and mobile phone density on step by step up to 80% by 2016 was hammered out.

- 10% by 2013;
- 27% by 2014;
- 50% by 2015; and
- 75-80% by 2016,

Even if development is centered on mobile phones, it is assumed that achievement of the telephone density of 80% will be accompanied by many difficulties in Myanmar where the urbanization ratio is about 30%. However, while paying attention to the fact that this density of 80% has already started going about itself, it is required to study contents of this project.

In Japan and Myanmar summit held in April 2012, information and communication was discussed as an important issue, and cooperation in the information and communication field was confirmed by heads of both states.

Development of laws was picked out as one of main targets of the Myanmar ICT Development Master Plan and Action Plan previously compiled by KOICA, but description about it was reduced in the Myanmar ICT Master Plan in 2011 as the result of considering processes of development of related laws. Reform of the information and communication sector in Myanmar has been progressing at a speed never experienced before. Under this situation, priority issues MPT executives consider are: (1) nation-wide development of Internet environments, (2) development of e-Government, and (3) HRD. In the speed of reform Myanmar faces, the environment is changing to such a degree that a plan will become obsolete within a half year. A variety of players act in the information communication sector, and their characters are starting to show up. The situation will be complicated from now on.

An important thing at this time is to draw up an intermediate and long term plan hammering out strong vision and concept centring on the Myanmar people. The key is the scale and speed.

It seems that description on information security related items was dropped out of the Master Plan. Actually, in the workshop hosted by Ministry of Internal Affairs and Communications of Japan on January 22-23, 2013, there was no presentation on information security from Myanmar side.

Table 3.2-1 shows the list of Master Plan Study prepared in Myanmar up to the present.

The government of Myanmar drew up an action plan described in Table 3.2-2 and has already been acting. In the meaning of developing a competitive environment, invitation to tender for giving licenses to new two communication carriers was announced in January 2013 in efforts to achieve the telephone density (50%) by 2015. 91 (Ninety one) entities from all over the world had submitted their expression of interest and 11 entities submitted their proposal. The Telecommunication Operator Tender Evaluation and Selection Committee established by the government on neutral position announced on July 27, 2013 the result of selection for two operators, i.e., Telenor Mobile Communications from Norway and Ooredoo from Qatar. Some

obligations would be given to two operators, such that commencement of serviced should be within 9 months from the date of licence and service area should be throughout Myanmar and 75% penetration should be achieved for telephone services in urban area and its surrounding areas within 5 years and 50% for data communication service. Detail conditions of license for these two operators would be settled in accordance with Telecommunication Law and its related regulations such as licensing, interconnection rules as well as numbering rules.

Table 3.2-1 List of Master Plan Study for Myanmar

No.	Title	Prepared by	Prepared on	Status
1	ICT Master Plan Framework	MCPT	2000	2000~2005
2	Myanmar ICT Development Master Plan and Action Plan	MCIT KOICA	2005	2006~2010
3	Myanmar ICT Master Plan 2011	MCIT KOICA	July 2011	Revision of the above
4	Wireless Broadband Master Plan for the Union of Myanmar	ITU	Sep 2012	Part of ITU Master Plan in the Asia-Pacific region

Table 3.2-2 Action plan

Schedule	Action plan
Medium term in 2012	・Proposal of new communication law (draft)
Later term in 2012	・Relocation of frequencies for 2nd generation mobile phones (D-AMPS) ・Relocation of 900 MHz band from MPT to (other carriers) ・Auction for (two) new mobile communication carriers
Earliest in 2013	・ Start of public offering for (two) new mobile communication carriers
In 2013（confirmation required）	・ Start of service by (two) new mobile communication carriers
3rd quarter in 2014	・ Evaluation of (two) new mobile communication carriers regarding transitional two years ・Allocation of 700 MHz band
Earliest in 2015	・study of allocation of remaining 1,800 MHz and 2,100 MHz
In 2015	・Achieving the goal in 2015 (density 50%)

Source: Prepared by survey team

3.2.1 ICT Sector Development Policy

(1) Outline

Regarding policies related to the communication sector in Myanmar, ICT Master Plan Framework (2000-2005) was drawn up in the period of Ministry of Communications, Posts and Telegraph (MCPT), but its contents described purposes of and strategies for informatization promotion, and did not make clear policies to realize them. Because of that, Myanmar ICT Development Master Plan and Action Plan was drawn up between 2006 and 2010 with an assistance from South Korea. After that, in July 2011, the Follow-up Project of the Establishment of ICT Master Plan in Myanmar was announced. In the presidential message related to development policies of President Thein Sein in 2012, three fields including energy, communication, and finance were picked out as industries required and given priority in the socioeconomic field. The communication infrastructure especially including rural areas and reinforcement of the related advanced human resources training organization were pointed out. Especially, the target of the telephone density was specifically determined to be 27% in 2013-2014, 50% in 2014-2015, and 75%-80% in 2015-16, aiming at giving rights to selectively use communication and the Internet service to the people.

In "ICT Master Plan 15" presented by ITU (International Telecommunication Union) in 2012, ITU made clear the master plan of mobile communication for Myanmar. After that, the government of Myanmar presented a new action plan. The Myanmar government plans to newly accept two communication carriers and make the total number of mobile phones 30 million by 2015, which will make the density 45% and the total telephone density also including fixed phones 50%. (2)

(2) Telecommunication Sector Reform Plan

A telecommunication reform plan model in 2013-2014 was revealed by related people in the country at a workshop related to ICT held in Myanmar in January 2013. (3) According to the reform plan, the current structure of PTD (Posts & Telecommunications Department), MPT (Myanma Posts &Telecommunications), and YTC (Yatanarpon Teleport Co., Ltd.) subordinate to MCIT (Ministry of Communications and Information Technology, which is the current organization and the name was changed in November 2012) is assumed to be changed that MCIT will be above PTD, and PTD will be above MPT and YTC and new two domestic and international carriers. These communication carriers are expected to be able to enter competitive businesses including fixed, mobile, communication network, IT, and Internet service. A broad range of IT field such as the infrastructure, network, application, and content will be opened as a new market. The following are required as policies to implement reform.

1) To modify existing laws and regulations related to post, telegraph, and telephone to meet new systems and situations, and get approval;
2) To approve and increase further investment from both domestic and international businesses in order to construct and provide service of post, telegraph, and telephone by use of the PPP model;

(2) Telecoms Sector Reform Plan in Myanmar, by U Kyaw Soe, MPT (Jan. 22, 2013) Japan-Myanmar ICT workshop material
(3) Telecoms Sector Reform Plan in Myanmar by Mr.U Kyaw Soe, MPT (Jan. 22, 2013), Legal & Regulatory Framework (Jan. 22, 2013) Japan-Myanmar ICT Workshop material

3) To search for tactics and measures to solicit introduction of foreign fund in order to provide communication services in accordance with international standards;
4) To cooperate with foreign communication companies excellent internationally;
5) To cooperate with communication companies having international experience which can gradually reduce communication fees, provide a mobile telephone service in accordance with international standards, and provide mobile phones for people in rural areas;
6) To provide adequate investment opportunities to the communication device manufacturing business for domestic and international investors;
7) To improve service quality of domestic and international post mail by utilization of IT, utilization of new devices, and cooperation with the public sector; and
8) To improve a communication and post training center in order to bring up highly skilled and qualified engineers and staff.

These items are brought up as issues in the implementation of specific policies.

(3) Legal System and Legal Regulation

Regarding a communication law system in Myanmar, PTD controls post, telecommunication, and broadcast fields. Main mandate office duties are: policy planning, and administration and supervision of telecommunication services; various licenses and collection of license fees; standardization of communication devices and communication systems; international negotiation; and survey and study related to telecommunications. As basic laws related to current telecommunication necessary to execute these duties, Telegraph Law was enacted in 1885 and Radio Communication Law was enacted in 1934. At the time of enactment in 1934, the department then in charge published a public notice document based on the Telegraph Law, which has become the grounds of the current telecommunication system. Accompanied with the development of telecommunication technology, Computer Science Development Law (1996) and Electronic Commerce Law (2004) were enacted. Regarding post, Myanmar Post Office Act (1898) was enacted. MPT and others are regulated by Government-Owned Company Law (1989) governing government-owned business entities. In order to study telecommunication reform, caution should be paid for laws such as four laws (patent right, industrial copy right in registered design, trademark right, and literacy copyright) related to protection of intellectual property and Foreign Investment Law. Actual situations of sequence of events of enactment of these laws and their operation require verification.

The biggest challenge in Myanmar is to enact a Telecommunication Law (Draft) as a basic law to realize policies of the current telecommunication sector. This new Telecommunication Law has been approved by the Diet in August 2013. In this event, Myanmar will be able to build a large foundation to develop telecommunications. Previous law specified the country's role and Government power to control the free competition on telecommunication services. On the contrary, objective of new "Telecommunication Law" is to develop various environments for free competition of telecommunication services, but not to strengthen the Government power to control the activities of the telecommunication carriers. Main points of telecommunication reform to be brought in by this law are determined. (4)

(4) Legal & Regulatory Framework （January 22, 2013）Japan-Myanmar ICT Workshop material

1) Promoting universal access;
2) Bringing in competition, and preventing abuse of market force;
3) Bringing in an environment facilitating investment in the telecommunication sector;
4) Wining public trust through regulation and license process with transparency;
5) Protecting consumers' rights;
6) Promoting efficient interconnection and shared operation; and
7) Promoting the maximum utilization of precious resources.

The reform program of PTD (Posts and Telecommunications Department) is one of Telecom Sector Reform Plan and role of PTD is to implement the law and regulations receiving the authority from MCIT. PTD, as an independent regulatory body from MCIT, will implement the issues related to business license and approval and permissions related to telecom activities as well as maintenance of law and order such as business operation and protection of users. PTD also is aiming at having a function of settlement of dispute and this means that PTD will be so-called "Telecom Commission" independent d from both government and operator.

As one of the major issues on Telecom Sector Reform Plan, selection process is started in 2013 to permit the new operators to enter into telecom business in Myanmar. Government of Myanmar established neutral selection committee. In response to the invitation 91 entities from foreign countries (one entity from Japan) submitted the expression of interest and 11 entities submitted their proposals and two entities had been selected on the end of June 2013, i.e., Telenor Mobile Communications from Norway and Ooredoo from Qatar. The selection was made prior to the passage of new Telecom Law and some arguments were placed for such selection process. Parliament made an opinion that selection should be made after passage of new Telecom Law, while president gave decision that selection was possible under current Telecom Law and Selection Committee decided to announce the result of selection. In this situation, it opens the door for competition environment in telecommunication sector in Myanmar.

MCIT and PTD have to immediately take actions for establishment of related regulations and directives within 3 months after the passage of New Telecom Law. PTD prepared related regulations required such as regulations on license, radio act, interconnection rules between different operators and numbering plan as well. It would become necessary to establish the rules and regulations for the protection of users along with the sophistication and diversification of ICT and services. Cyber Law was established in Myanmar on 1994 under the directive of other governmental organizations and it requires the consolidation of legal systems related to information security. Legal system relating to the settlement of dispute is also required for the settlement by the decision of PTD and good order's sake for rights and obligations of telecommunication operators as well as protection of users. From now on, since Myanmar is required to settle the international common issues in ICT sector, promotion of technical assistance in these aspects between Myanmar and Japan is important subject.

3.2.2 Trend of Privatization and Competition Introduction into Communication Sector

(1) Telecommunication Carrier

Regarding the telecommunication undertaking in Myanmar, MCIT acts as supervisory authority,

PTD draws up policies and various regulations, and based on those, state-owned MPT offers services such as fixed phone, mobile phone, and international communication as an operator. On the other hand, about the Internet, two businesses -- Yatanarpon Teleport (YTP) established in 2001 and Myanma Posts and Telecommunications (MPT) -- provide an Internet connection service.

Table 3.2-3 Outline of Internet connection service by MPT

Service name	Outline
Internet connection service	・Dial-up connection ・Broadband connection
Internet data centre service	・Rental server ・Domain name service ・Public IP address allocation

Source：http://www.mpt.net.mm/departments/it-department

Table 3.2-4 Outline of Internet connection service by Yatnarpon Teleport

Service name	Outline
Internet connection service	・Dial-up connection ・Broadband connection
Internet data centre service	・Rental server ・Domain name service ・Housing service
Corporate service	・Virtual private network service
Additional service	・E-mail ・IPTV ・VOIP

Source：http://www.yatanarpon.net.mm/isp-services

(2) MPT Movement to Corporate Organization

In 2012, MCIT determined the policy that the communication business run by Myanma Posts and Telecommunications (MPT) will become MPT Co. by corporate organizations which government owns 100% share under four-company structure by adding two new private companies and Yatanarpon Telecom Company (YTC). This policy aims at telephone density through a drop in prices brought by competition.

In the ICT seminar held on January 23, 2013, it was announced that the telephone density (including mobile phones) was raised to 75% to 80% by 2015/2016, accompanied with MPT's change to a corporate organization. For the moment, formulation of new regulations and rules accompanying with change to the corporate organization is carried forward.

(3) Trend of Privatization and Competition Introduction into Communication Sector

The business form of telecommunication services was shifted to privatization in many countries from the end of 20th century to the beginning of 21st century. In developing countries not to mention developed countries, there are increasing cases that competition was introduced at the same time as shift from state monopoly to privatization.

Myanmar has hammered out shift to corporate business (business organization including a stock company and the like other than a state organization) of telecommunication undertaking as a pillar of national telecommunication reform as a measure to realize relaxation of regulations of telecommunication business and services for promoting construction and utilization of the information and communication infrastructure indicated in the national policies. Specifically, as mentioned in 3.2.1 (2), it made clear as a pillar of the telecommunication reform policies that Myanmar will widely open the ICT market to the domestic and international businesses starting with shift of current MPT and YTC to corporate businesses and entry of new two telecommunication carriers. (5)

In accordance with the hearing survey from persons relating to MPT and YTC, the telecom reform plan is basically corporatization plan within framework of government but not become to the private company. Ratio of shares by the government and management level by the government will be further study. 51 % of shares of YTC owned by government and 49% by limited 85 private companies and this status would be modified because telecom reform plan does not allow the split of shares by government and private sector.

It would not be clear whether YTC continues as present organizations, and its position as domestic operator is also not clear. 2nd telecommunication operator in Myanmar is corresponded to 1st class operator within the framework of telecommunication law in Japan, which means he offers services by his own network facilities or by leasing the network from other operators. For MPT and another one domestic operator, it would be inevitable to have an enough ability to compete with 2 operators from foreign countries. Myanmar government also expects to domestic operators for such abilities as focus on president message addressed to domestic operators as outlined below.

President gave a message in the note (6) to the parliament on May 25, 2013 that telecom operator licenses would be given to the domestic operators MPT (Joint venture of MPT and Myanma Economic Corporation) and YTC by reorganization to the public company. At present, shareholders of YTC should be limited to 85 companies and is planning to expand other domestic companies with mutual discussion is underway. This plan is one of the strengthen plan for domestic operators. Myanmar Government also expects the joining foreign investors or partners to such domestic operators for dealing with the competition with foreign two operators. (7)

(5) Telecoms Sector Reform Plan in Myanmar, MPT, (Jan. 22, 2013), material cited above

(6) The President Message date 27-5-2013, serial number 108(1)/8 President Office to Pyithu Hluttaw Speaker

(7) Republic of the Union of Myanmar Information Team Press Release No. (9/2013)

3.3 Current Status and Problem in Communication Sector

3.3.1 Telephone Density

ITU (International Telecommunication Union) announced "Wireless Broadband Master Plan for the Union of Myanmar" in October 2012 and reported the outline of Myanmar in the document as in Table 3.3-1. However, it should be noted that this is not officially approved by the Myanmar government as the ICT Master Plan drawn up by KOICA was not. In addition, it was made as part of "Asia Pacific ICT Master Plan 2015: Object countries Nepal, Samoa, Viet Nam, and Myanmar."

At the time of 2012 when the report was compiled, Myanmar set forth 30 million subscribers (mobile phones) in 5 years between 2011 and 2015 as its target. Furthermore, the mobile phone business was planned to be run by private carriers, and names of ZTE and Huawei were already cited.

Table 3.3-1 Communication infrastructure in Myanmar (as of 2012)

Indicators	Statistic
Telephone density(*)	10.0%
Telephone line number(*)	Fixed：604,464 Mobile：5,437,450
Backbone line	Major cities are connected with optical fibre
International optical fibre	India, China, Thailand, Laos
International line	Marine cable and satellite
Last-mile line	Dedicated WBB access and MPT satellite
Internet host	25,690
Internet backbone capacity	4.385 Gbit/s
Internet connection	52, 071 FTTH users (6,500)
Internet user	0.44 %（per whole capita）
Public access centre	2,500+
International gateway	2 (NGN-IP-IGW / DMS-300 with IP trunk 500(E1)
International line number	4,627
Internet gateway	1
IPS（communication carrier）	2 (MPT & YPT)
PSTN exchange office	913
Mobile switching centre	14
Transit exchange office	11
Microwave station	340
Satellite communication	2,065 (MPT satellite terminals)/ 1 (INTELSAT ES) + 11 VSAT stations

Source：Wireless Broad Band Master Plan for the Union of Myanmar
(*) as of 2012, http://itu.int/ITU-D/ict/statistics, MPT statistical data

As of 2012, the subscriber numbers of fixed phones and mobile phones in the whole of

Myanmar were about 609 thousand including international circuit and 544 thousand, respectively, and the total number of telephone subscribers was 6,040 thousand. In addition, the density of fixed phones and mobile phones were 0.99% and 8.90%, respectively. Because the fixed phone density in 2001 was 0.65%, it only increased 1.7 times in 10 years, whereas the mobile phone density increased 178 times from 0.05%. It is understood that the utilization of mobile phones is expanding rapidly.

As seen in the figures in the above table, it is understood that along with rapid diffusion of SIM card, diffusion of smart phone is starting and number of internet users are also increasing rapidly. (refer to para. 3.3.2)

On the other hand, when it is compared with neighbor ASEAN countries, the density of fixed phones, mobile phones, and the Internet are all the lowest among these neighbor countries. Especially as for mobile phones, the density of each country exceeds 100% whereas the density of Myanmar stays at 8.9%.

Table 3.3-2 Telephone density and Internet in ASEAN countries (2012)

Country name	Fixed phone subscriber number (subscriber)	Fixed phone density (%)	Mobile phone subscriber number (subscriber)	Mobile phone density (%)	Internet density (%)
Cambodia	584,475	4.04	19,105,115	131.96	4.94
Laos	112,000	1.76	6,492,000	101.85	10.75
Malaysia	4,588,900	15.65	41,324,700	140.94	65.80
Singapore	1,989,500	37.85	8,063,000	153.40	74.18
Thailand	6,391,030	9.14	84,075,036	120.29	26.50
Viet Nam	10,191,049	11.36	134,066,000	149.41	39.49
Philippines	3,939,000	4.08	103,000,000	106.77	36.24
Indonesia	37,982,855	15.52	281,963,665	115.20	15.36
Brunei	70,933	17.18	469,740	113.77	60.72
Myanmar	604,464	0.99	5,437,450	8.90	1.07

Source：http://www.itu.int/ITU-D/ict/statistics/

Under the above, situation in Myanmar will become remarkable change due to the President message that telephone density is become 80% by the year 2016 in addition to the price down of SIM card, the privatization of telecommunication sector is accelerating in 2013.

In the event of setting the target of telephone density at 80%, telecommunication sector in Myanmar is facing big challenges. Table 3.3-3 shows the period of reaching 80% density from 10% in ASEAN countries. It is understood that average period of reaching 80% density is around 6 years except the case of Viet Nam. Myanmar is trying to achieve it by 4 years by utilizing the private investment, even in the insufficient infrastructures conditions in suburban and rural areas.

Table 3.3-3 Transition of Telephone Density

Country name	10% Density (year)	80% Density (year)	Period of Achieve (year)
Cambodia	12.74% (2006)	96.17% (2011)	5
Indonesia	13.51% (2004)	88.08% (2010)	6
Laos	11.43% (2005)	87.16% (2011)	6
Philippines	15.40% (2001)	82.43% (2009)	8
Thailand	11.82% (2001)	78.14% (2007)	6
Viet Nam	11.54% (2005)	87.11% (2008)	3
Myanmar	10.00% (2013)	80.00% (2016)	4

Source: prepared by survey team based on the data of ITU (http://www.itu.int/ITU-D/ict/statistics/)

As an exceptional case, Viet Nam achieved the target only by 3 years and reasons and background are considered in comparison with the Myanmar case. Viet Nam started the mobile phone service in 1992 and MobiPhone and Vinaphone provided the services in 1990s. In 2002, private carriers started to enter into the service providers and 7 (seven) carriers were providing services in 2012. The period rapidly increasing the density from 2005 to 2007, low price terminal devices and package tariff system had been introduced by new carriers which were the market-oriented strategy for getting new customers. This is the main reason why 80% density target was achieved only on 3 (three) years period.

During the year between 2005 and 2008 of high economic growth (nominal GDP started to increase with quadratic curve), mobile phone density had been increasing. Viet Nam completed to join in WTO in 2007 and under the rising economic situation in Viet Nam caused high growth rate of mobile phone density. It would be expected that setting up the target of 50% in 2015, 80% in 2016 by President Thein Sein would be announced based on achievement in Viet Nam (52.9% in 2007 to 87% in 2008) as the background. As seen from Table 3.3-2, Viet Nam is also one of the typical countries where the penetration of fixed phone was stopped and shifted to mobile phone which had become dominant telecommunication means. Now let consider whether Myanmar is also able to follow up the same development process as Viet Nam based on the figures in Table 3.3-4 and 3.3-5.

Firstly, purchasing power parity (PPP) in Viet Nam in 2005 is USD 2,142, while USD1,405 in Myanmar in 2012. In consideration of disposable income, the difference of USD700 is considered rather big. Next, in comparison with economic growth rate, Viet Nam grew 8% or more annually from 2005 to 2007, while annual economic growth rate in Myanmar is estimated by 6% or more from 2013 to 2015 in accordance with IMF evaluation. In case that economic growth rate differs for more than 1.5% during 3 (three) continuous years, the difference of actual economy would be larger than expected. On the other hand, in Viet Nam it took 3 (three) years for starting rapid increase of subscribers by joining new carriers in 2002 and another 3 (three) years was passed from 10% density to 80% density. It would be evaluated that total period for achieving 80% density required for 6 (six) years. Judging from these data, it seems very challengeable target to achieve 80% density for 4 (four) years, even under the various different components in Myanmar.

Table 3.3-4 Comparison of Economic Status between Myanmar and Viet Nam

Items	Myanmar	Viet Nam
Population	59.7 million	90.39 million
GDP growth rate	6.3% (2012)	5.02% (2012) 8.0% or more (2005-2007)
Purchasing power parity (PPP)	USD1,405 (2012)	USD3,547 (2012)
PPP > USD2,000	n.a.	USD2,141 (2005)
Number of mobile subscribers	5,437,450 (2012)	9,593,200 (2005) 134,066,000 (2012)
Mobile Phone Carriers	MPT (until June 2013) 4 operators (under plan) ・MPT (Public) ・Domestic operator (Ytanarpon?) ・2 Foreign operators	7 operators in 2012 Open market in 2002 ・MobiPhone (Private: 41% share) ・Vittel (Public: 34% share) ・Vinaphone (Public: 20% share) ・others

Source: Prepared by Survey Team based on the data from IMF, ITU, etc.

Table 3.3-5 Relation between Mobile Phone Density and Economic Growth Rate in Viet Nam

	2003	2004	2005	2006	2007	2008	2012
Mobile Phone Density (%)	3.37	6.03	11.54	22.47	52.96	87.11	149.11
Fixed Phone Density (%)	5.41	12.31	n.a.	10.19	13.13	17.18	11.36
Economic Growth Rate (%)	7.34	7.79	8.44	8.23	8.46	6.31	5.02

Source: IMF, ITU

3.3.2 Fee Structure

This section shows the relations between increase of mobile phone subscribers and change of SIM card price offered by MPT.

Grow-up process in Myanmar telecommunication is different from that in developed countries, i.e., mobile phone and internet service were starting to grow up even under insufficient penetration of fixed phone services. In particular, fixed phone subscriber connection did not increase after 2007 when mobile phone service was growing on a full scale and number of internet users via fixed line had not been increasing. This caused by delayed investment to the communication infrastructures. One of the features in mobile subscribers is that 90% of mobile phone subscribers used the prepaid phone and it will become easy for fee collection. Price of SIM card in 2000, when mobile phone service was started, was remarkably high in comparison with life level of ordinary citizens. Ordinary citizens other than politicians and business owners purchased the SIM card under loan assistance. 10 years has been passed in 2011, the crustal movement in telecommunication sector was starting in connection with political and economic reforms. Although telecommunication sector in Myanmar is still monopoly environment by MPT, price of SIM card become lower from 2010. (1.5 million kyat at maximum) The price reduced to 500 thousand kyat in 2011 and number

of subscribers increased to be doubled in the area of Yangon. However, in this stage, it was impossible to buy SIM card for the citizens whose average monthly income was less than USD100 and increase of subscribers was limited only by affluent population. Coming into 2012, the price of SIM cared further reduced to 200 thousand kyat (corresponding to 20 thousand yen). A part of suppressed demand immediately become actual, resulting the subscribers increase by 5 times in one year. In January 2013, number of subscribers exceeded 6 million. Main purchasers were business man and student in affluent population. It is clear that the reduction of SIM card price has contributed to actualization of suppressed demand in these periods. It is understood that SIM card price has a certain elasticity, however provision of low price SIM card resulted to the increase of subscribers under the condition that sufficient provision of communication infrastructures. Present condition of communication infrastructure in Myanmar is not enough capacity to carry the increased traffic by increase mobile subscribers of 80% density.

Table 3.3-6 Relations between SIM Card Price and No. of Subscribers

Year	Price (kyat)	No. of Subs.
2000	200,000	13,397
2009	1,500,000	502,000
2010	1,500,000	594,000
2011(GSM/CDMA)	500,000	1,243,619
2012(GSM/CDMA)	200,000	5,440,000
2013(GSM/CDMA)	200,000	>6,000,000
2013(CDMA)	1,500	

In communication sector in Myanmar, government decided open the market to private enterprises (foreign fund) and selected two foreign carriers.

It would be required to invest to rural area for the achievement of 80% target because 75% of population is in rural area in Myanmar. However, the disposal income in rural area would be law. In order to solve this issue, lots of very low price SIM card with 1,500 kyat becomes on sale as indicated in Table 3.3-6. It was planned initially that 350 thousand cards to sell from April 2013 and 4.2 million cards are scheduled to be sold out and then total subscribers become 10 million during one year. However, due to some reasons, selling was delayed and stared the distribution in a drawing at te end of April 2013.

From now on, various issues are anticipated due to rapid increase of subscribers. It becomes concern that present network capacity cannot meet the traffic requirements. Subscribers will increase by 350 thousand monthly, while network capacity increase project is not planned at this moment.

CHAPTER 4 TREND ON COMMUNICATION TECHNOLOGY

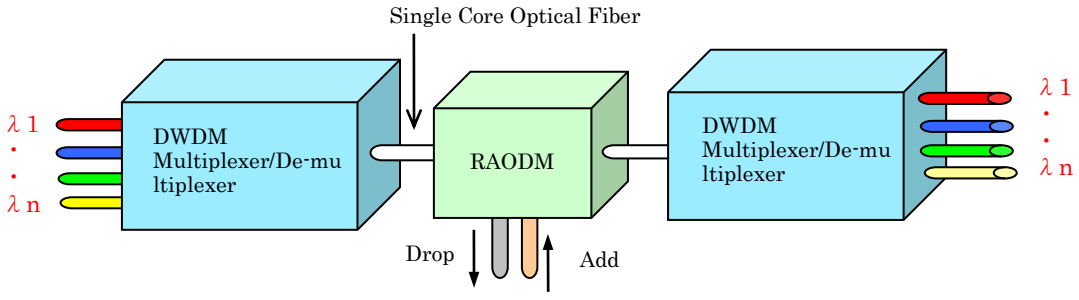
4.1 Basic Transmission Technology

Due to the prevalence of the internet and the growing number of users and use applications, the majority of services are extra high volume imaging services requiring broadband. Compared with the coaxial cables system and the radio communication system in the past media, advanced fiber optic cable system has become main stream due to the spread of broadband and a large increase in speed.

Optical transmission of 1.55μm has become possible by broadband (several 10s THz) at a low transmission loss (0.2 dB/km) by using fiber optic cables in conjunction with semiconductor laser technology. Wavelength Division Multiplex technology, originally developed to cut down on the enormous time and expense required for laying optical fiber submarine cable has become universal as a fast transmission method that can handle extra large volumes.

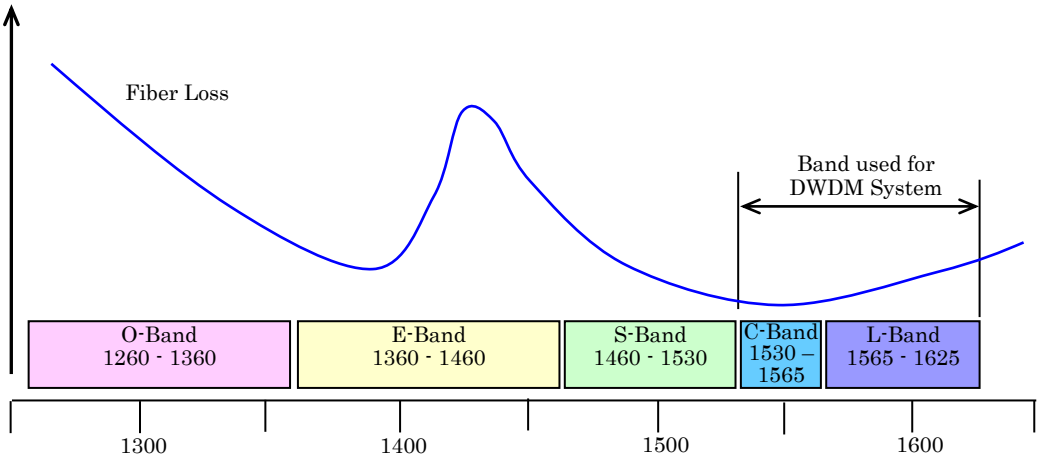
By paraphrasing the equipment at both ends, the fiber optic cable can utilized effectively with the Wavelength Division Multiplex (WDM) communication system, avoiding additional costs for the fiber optic cables. It will be able to handle a great increase in network traffic caused by the prevalence of broadband. Following a growing trend of FTTH application, it can be used by separating uplink and down link signals, connecting superimposed composite signals of telecommunication and broadcasting networks to a single core. There are two kinds of technical solutions as follows:

- CWDM (Coarse WDM)
  Multiplexing optical signals up to 16 wavelength with 20 nm separation from 1410nm to 1610 nm (Multiplexing equipment up to 8 wavelength is commonly used)
- DWDM (Dense WDM)
  Since it can combine more than tens of wavelengths, it is used by telecommunication providers as a backbone. Long distance transmission is made possible by the availability of special optical amplifier and dispersion compensator. Reusable optical Add-Drop Multiplexers, (ROADM: Re-configurable Optical Add/Drop Multiplexer) have recently become available. Configuration of DWDM system is given in Figure 4.1-1 and Figure 4.1-2.



Source: prepared by Survey Team

Figure 4.1-1 Configuration of the DWDM System



Source: prepared by Survey Team

Figure 4.1-2 Frequency Band used for DWDM System

4.2 Subscriber Access Technology

The access network is an essential element of the telecommunication system, connecting the subscribers with the network providers. At present, the access network consists of wireless networks, xDSL, FTTx etc. which will be summarized below:

4.2.1. Wireless Subscriber Network

(1) FWA (Fixed Wireless Access)

FWA is a point-to-multipoint wireless broadband telecommunication system with a capacity to handle 239 subscribers (high speed IP access-80 Mb/s, service area approx. 2.5 km that can reach up to 10 km for point-to-point systems). Its radio frequency band is 24～26 GHz.

(2) WiMAX

Compared to WiFi, WiMAX is a new generation technology, which provides upgraded high speed ultra high volume, high quality wireless transmission services to subscribers and mobile users as well at an economic rate. Its fixed and mobile applications are supported by IEEE 802.16‐2004/802.16d and IEEE 802.16-2005/802.16e.

(3) WiFi

Short distance wireless services in compliance with standard IEEE 802.11. License is not required. However, since industrial frequency band and frequency spectrum are shared, transmission quality cannot be guaranteed.

(4) LTE

LTE is a groundbreaking new technology that evolved from broadband to mobile communication. Fourth Generation Mobile Communication Technology, e.g. Orthogonal Frequency Division Multiple Access (OFDMA） and Multiple Input Multiple Output (MIMO) applications, currently undergoing trial on the field, are used for the LTE. Current LTE standards are:

- Transmission speed for up-link: more than 100Mb/s;
- Occupied bandwidth: 1.4MHz to 20MHz for more than 50Mb/s up-link (available TDD or FDD)

Comparison for the above technologies is given in Table 4.2-1 below.

Table 4.2-1 Comparison of Wireless Technologies

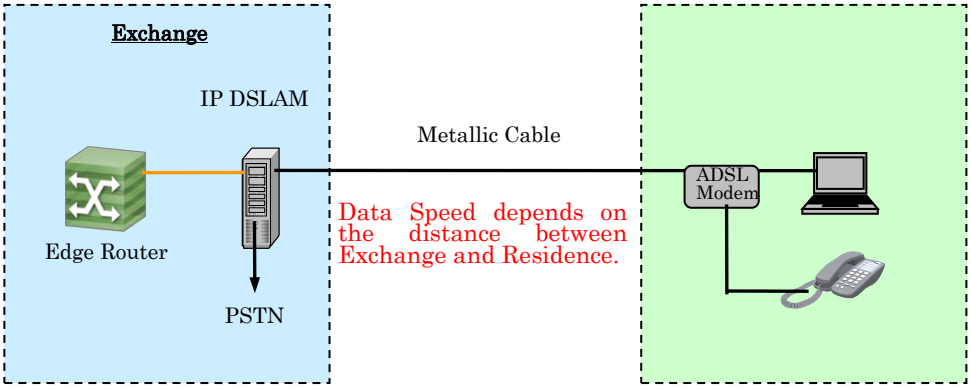
Item	FWA	WiMAX	LTE	WiFi
Legacy	IEEE802.1Q	IEEE802.16a	GPRS/EDGE/UMTS	IEEE802.11a/11g/n
Primary Application	Broadband Wireless Access (Fixed)	Broadband Wireless Access (Fixed)	Broadband Wireless Access (Mobile)	Wireless LAN
Frequency Band	24 to 27 GHz	2G to 11GHz	700M to 2.6GHz	2.4 GHz, 5 GHz
Bandwidth	20 MHz	Scalable 1.25M to 20MHz	Scalable 1.25M to 20MHz	20 MHz/40 MHz
Access Technology	TDD/DTMA	DL: OFDMA UL: OFDMA	DL: OFDMA UL: SC-FDMA	DSSS and OFDM
Access Mode	TDD / TDMA	TDD and FDD	TDD and FDD	TDD / SDMA
Modulation	QPSK / 16 QAM	BPSK, QPSK, 16QAM, 64QMA	BPSK, QPSK, 16QAM, 64QMA	BPSK, QPSK, 16QAM, 64QAM
Peak Data Rate	Point to multi-point: 6Mb/s Point to point: 64Mb/s	DL: 75Mb/s UL: 25Mb/s	DL: 100 to 326.4Mb/s UL: 50 to 86.4Mb/s	11, 54, 150, Mb/s
Cell Radius	Max. 10km	20 km for 3.5 or 7MHz BW, 8km for 5 or 10MHz BW	5 km	5 km
Antenna Scheme	Omni / Sectoral / Flat Gain Antenna	MIMO	MIMO	SISO, MISO, MIMO
Cell Capacity	Up to 239 Users	100 to 200 Users	200 Users 5 MHz BW 400 Users 10 MHz	Usually 10 to 20 Clients

Prepared by Survey Team

4.2.2 Subscriber Network by Metallic Cables

(1) ADSL (Asymmetric Digital Subscriber Line)

ADSL is the most commonly used technology. Its service area is a few kilometers from the exchange office. At the exchange office, a digital subscriber line access multiplexer (DSLAM) terminates the ADSL circuits and aggregates them, where they are handed off onto IP networking transports. Data speed between down link and up link is asymmetric. ADSL2 and ADSL2+ are improved versions that can provide higher speeds than ADSL.



DSLAM: Digital Service Line Access Multiplexer

Source: prepared by Survey Team

Figure 4.2-1 ADSL Configuration

(2) VDSL (Very high-bit-rate Digital Subscriber Line)

VDSL provides very high speed transmission services for a short distance. It is mostly used in combination with FTTC and FTTB configurations. Moreover, it has become last one mile solution for FTTB.

(3) SDSL（Symmetric Digital Subscriber Line）

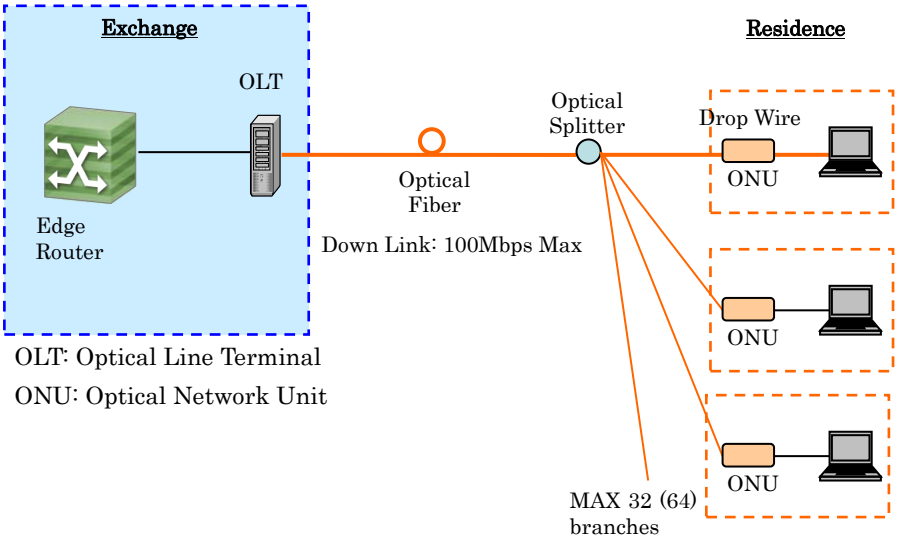
Its data speed on down link and up link is the same, at 2Mb/s. Its other characteristics are the same as those of ADSL, which is recommended as ITU-T G.991 standard.

4.2.3 FTTx Solution

FTT x is a term for any broadband network architecture that uses fiber optic cable to replace all or part of the usual metallic local loop sued for last one mile communications. The terms most widely used are described below:

(1) FTTH (Fiber To The Home)

Fiber optic cable is laid until the subscribers' home and ONU (Optical Network Unit) is nstalled. FTTH is realized with the technology of PON (Passive Optical Network). It consists OLT (Optical Line Terminal), ONU and optical splitter as shown in Figure 4.2-2.



Source: prepared by Survey Team

Figure 4.2-2 System Configuration of FTTH

In PON system, there are two (2) standards available as shown in Table 4.2-2.

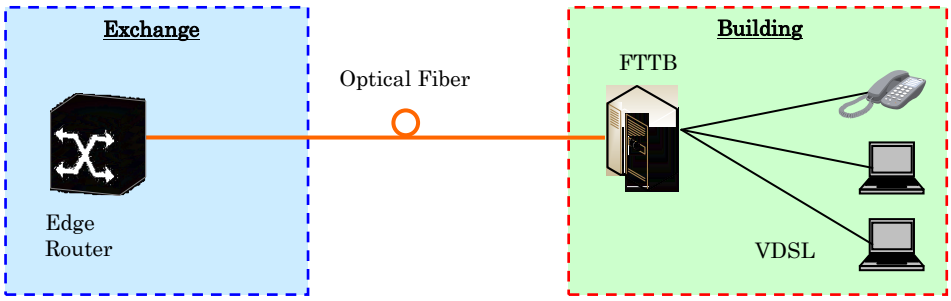
Table 4.2-2 Comparison between G-PON and GE-PON

	G-PON	GE-PON
Standard	ITU-T G.984	IEEE 802.3h
Data Speed	1.25 Gbit/s	1 Gbit/s
Branches	32 (64)	32
Distance	20 km	20 km

Prepared by Survey Team

(2) FTTB (Fiber To The Building)

Fiber optic cable is carried inside of the building directly from the exchange office as shown in Figure 4.2-3. This will be applied to the office buildings with a demand for high speed data transmissions.

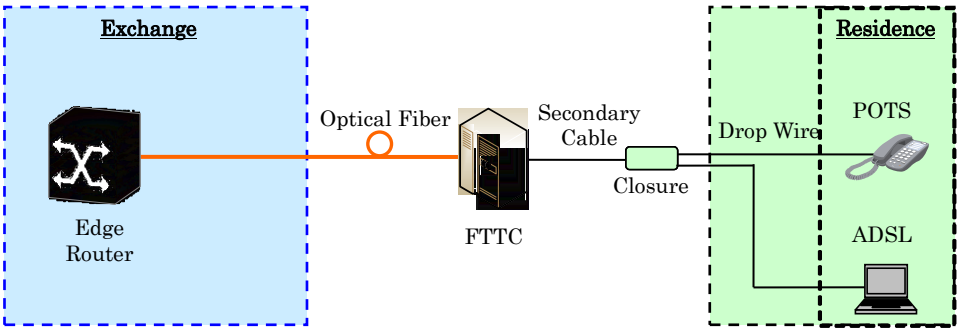


Prepared by Survey Team

Figure 4.2-3 System Configuration of FTTB

(3) FTTC (Fiber To The Curb/Cabinet)

As illustrated in Figure 4.2-4, the fiber optic cable is carried from the exchange office until the curb/cabinet on the curbside, and extends up to subscriber premises with metallic cable as the last one mile connection. This system supports broadband services such as high speed internet. The area served by the cabinet is usually a few hundred meter range.



prepared by Survey Team

Figure 4.2-4 System Configuration of FTTC

4.3 IP Technology

Transmitting all the information signals integrated into IP packets has been gaining a wide recognition among info-communication technology experts. In the background of this trend is the ultra-high capacity of the routers, the IP transmission's basic elements together with an ever increasing pace of fiber optic transmission development. IP users will form the main client base for the telecommunication providers.

This technological revolution has initiated a move away from conventional circuit switching into IP switching and telecommunication businesses, following the worldwide trend, have been focusing their efforts on investing in the research and development of telecommunication equipment. Prices for network gear are very likely to fall in this business environment.

GMPLS/MPLS is the key technology for the IP communication network and has a high efficiency in transmitting data. It can establish point-to-point links by adding IP headers to labels, thus encapsulating them. The characteristics of IP network are as follows:

- Packet based transmission;
- Separation of control function from transport function and application function;
- Separation of service function from transport function
- Provision of broadband services by keeping end-to-end QoS and transparency;
- Integration of fixed and mobile communications;
- Compatibility with legacy networks via open interface;
- Support of a variety of multimedia services e.g. real-time, non-real-time, streaming communications, etc.;
- Conforms to rules and regulations of emergency and confidential communications.

CHAPTER 5 MID-TERM DEVELOPMENT PLAN

5.1 Three Dimensional Strategy on Communication Networks of MPT

As mentioned in para.3.1.1, the Government of Myanmar considers needs of investment especially for the fields of powers, communications, deep port facilities, rail roads, transportations of goods, services for money market

This survey aims at forming effective works for improving communication infrastructures in Myanmar. Through this improvement in communication infrastructures, acceleration of economic growth will be attained. Needless to say, incomplete communication infrastructures will become cause of disturbing civilian investment, improvement in information and communication is urgent.

In communication network, the information to handle will be voices, internets, pictures, etc., each having different requirement and complicated. In order to complete and expand the systems, it is important to take strategic approaches. In addition, the Myanmar communication sector has many independent sub-networks which have never employed the coaxial cables. That is quite different from the other countries. Consequently, a strategic approach will be much important to take from now on.

According to Myanmar's National Program, a number of telephone set per capita is set at 80% by the end of 2015/2016. To pushing afford such a national program on developing communication services to realize the national program yet to maintain an appropriate level of services, the subjects to tackle by the MPT may be three items, i.e. (1) provision of infra-structures such as repeating facilities required for plural communication services, (2) provision of facilities required for individual communication services and (3) consolidating and training of human resources, and facilities and also improving efficient managing power to utilize such human resources, facilities and services.

Taking these three items, studies have been made on mid-term plan based on "three

1. To complete the communication infrastructures owned by MPT
2. To develop and improve communication services by MPT
3. To improve the business management including human resources of MPT

Through introducing these three axes management strategies,

(1) We are able to draw a future of MPT centered on communication networks, yet maintaining a total balancing.
(2) Starting from the item with a higher priority, the road map for next step may be easy to draw
(3) Through combining these three axes, it is easy to form a multi-purpose project and make it a solution with additional values.

As mentioned above, through proceeding the national programs relating developing communication services in the Republic of Myanmar and to accept a competitive market principles, it is urgent and important subjects for the MPT. Whereas the communication infrastructures will provide a foundations for providing communication services and the communication services will

produce direct incomes to MPT and the business management functions to operate every resources efficiently and effectively.

Target for three axes management strategy is a realization of telephone popularization of 80%, and through the aids by Japanese Government will improve the domestic communication networks in Myanmar, thereby helps to improve the democracy.

For the infrastructures and human resources, completion and improving resources for communication networks will not only produces interest for MPT, but also a good effect for communication sectors in Myanmar.

This mid term development program, as mentioned hereunder, where the "mid-term" assumes as approximately, 10-year period.

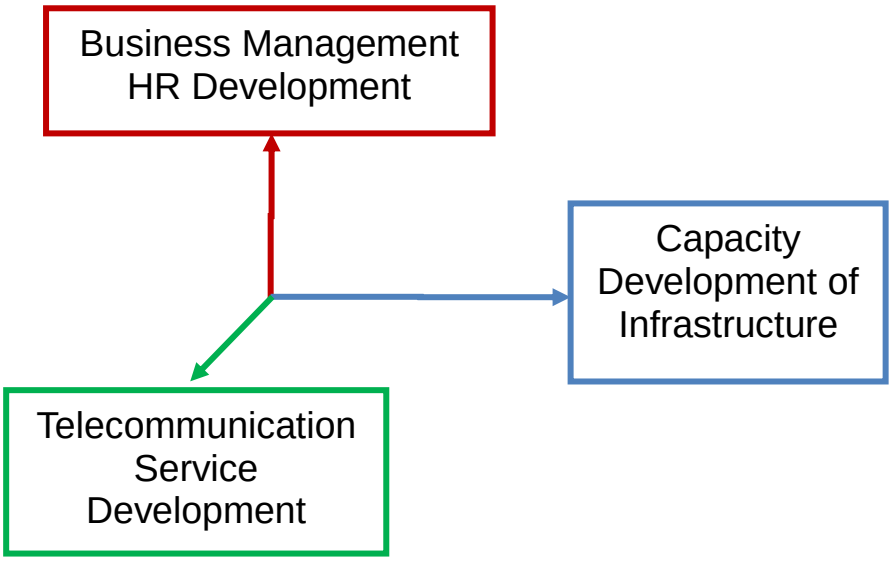


Figure 5.1-1 Three-dimensional strategy for MPT network development

Now, the contents of the program are divided into programs prepared by MPT themselves, and also a program prepared by the survey team, where, the programs prepared by MPT themselves are noted there.

5.2 Consolidation of Communication Infrastructures

The Communication infrastructures are divided into the access network which will connect directly to the subscribers and junction networks to connect between an access network and other networks including other access networks.

5.2.1 Present Status of Junction Networks

The junction networks are categorized into backbone network, core network and metro-network. Table 5.2-1 gives the outline of the junction communication networks. In the junction communication networks, transmitting all round of signals including international communications are handled.

Table 5.2-1 Outlines of Junction Networks

Name of Networks	Outlines
Backbone Network	. Backbone circuits connecting three big cities Yangon, Naypyitaw and Mandalay . At present, connection is made through microwave radio links and fiber optic cable links
Core Network	. Communication paths connecting all cities in the countries including backbone networks. . At present the microwave radio links are used mainly.
Metro Network	. Loop networks connecting exchanges within the cities . At present, the networks are provided in Yangon, Naypyitaw and Mandalay metropolitan areas. . At present, the fiber optic cable links are provided.

Source: Prepared by the Survey Team.

5.2.2 Backbone Network

(1) Present Status and Subject To be solved

The backbone networks connecting main cities, Yangon, Naypyitaw and Mandalay are provided through the microwave radio links and the fiber optic cable links at present. Installation and the maintenance and control are provided by Long Distance Communications at present.

The microwave radio links are provided over three routes, i.e., the western route, the central route and the eastern route.

In the western route are provided the oldest system. The capacity is 126E1 (252Mbps) in which 63E1 (126Mbps) is branched at every repeater stations, and connected to the subscriber exchanges. The remaining 63E1 (126Mbps) from Yangon are passes each repeater stations and reaches to Mandalay. The frequencies used are in 6GHz band and 9GHz band (Sub), therefore no influences through rainfalls, however, there remains some problems in lack of spare parts, therefore there remains drops of the reliability of the equipment. The actual route is indicated by the red dotted lines in Figure 5.2-1. The transmission capacity of the central route is 1.2Gbps and operated at IP+64E1 (128Mbps) at present. The frequency used are from 6GHz band. This route are shown in blue color and the Figure 5.2-1

The eastern route gives the capacity of 1.2Gbps and is operated in IP+64E1 (128Mbps). The radio frequency used is from 11 GHz, that is easily affected by rain falls, it is operated in 64E1 (128Mbps), because the band of 1.2Gbps could not be maintained continuously. This route is shown in green color in the figure. The repeater station in the Eastern route utilizes commonly the repeater stations of the fiber optic cable link. This route is shown in green color in the Figure 5.2-1.

The fiber-optic cable link are provided along the national road (Route A in the Figure 5.2-2) and along the high way (Route B in the Figure 5.2-2). Along the national road, 12-shin cables are buried. The existing wave-length division multiplex equipment (WDM) used are made in Huawei (China) or Optelian (Canada), and occupy bandwidth, IP20Gbps + 16STM1 (16X155Mbps), and IP10Gbps+64STM1 (64X155Mbps), respectively. At present, the Optelian is on the way to

replace them to IP10Gbps+STM64 (1Gbps). It should be noted that along the highway, there are buried the 96-core fiber optic cables are buried.

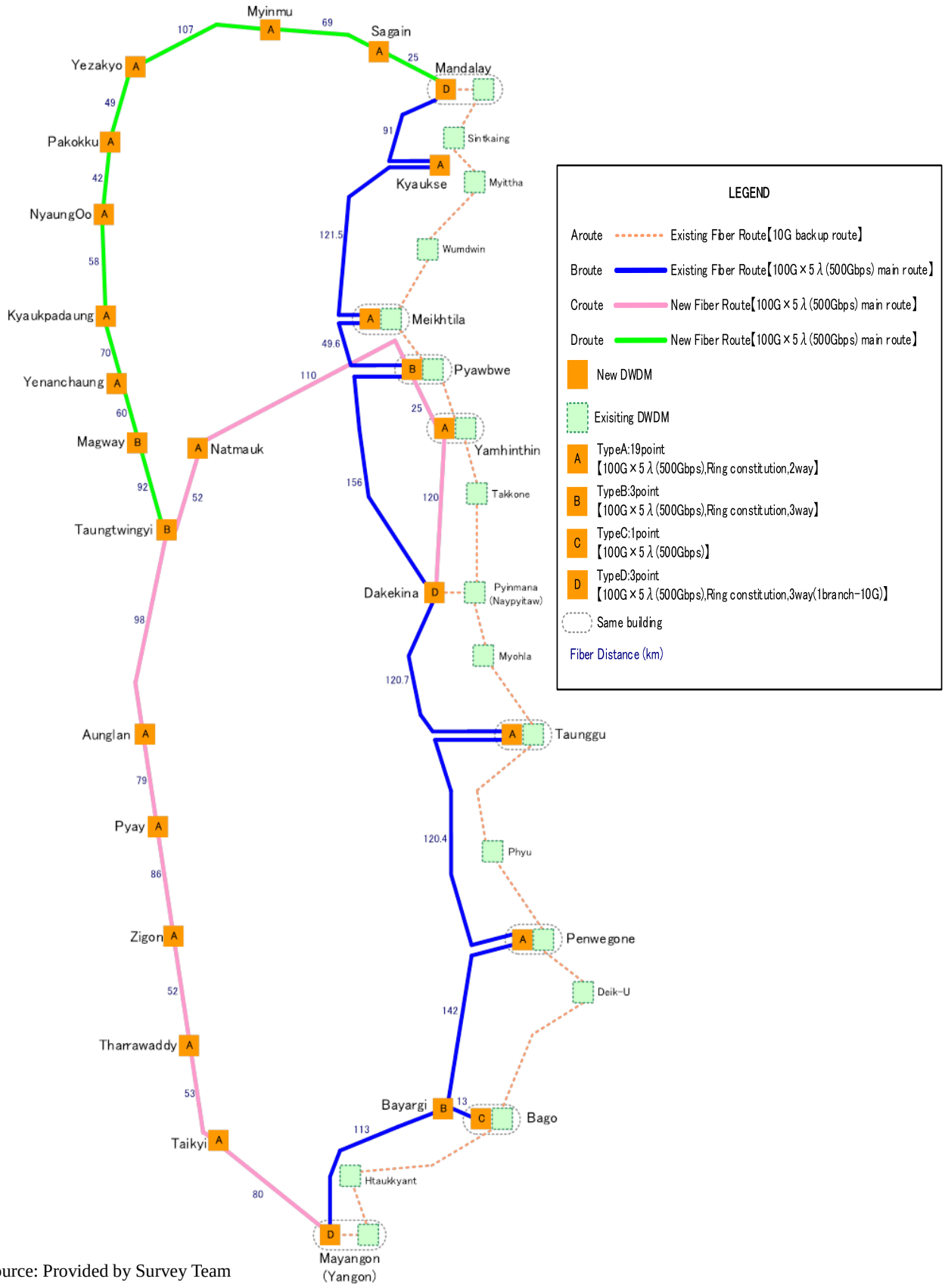
The backbone circuits normally use the fiber optic cables for the main circuits, whereas in case of the failures occurred in the fiber-optic cables, the cables are switched over to the microwave links.

In case of the failures occurred in the fiber-optic cables, though the available band-width to be used for the backbone becomes narrower, they try to keep circuits connecting the mobile telephone switches (MSC) and public switched telephone networks (PSTN).

As mentioned above, the backbone circuits are provided, however, the transmission equipment for the 96-core fiber optic cables have never been sufficiently enough, and the microwave radio circuits, as a whole, too much aged. Also, to be noted is the switching over to the back-up circuits is made not automatically, but manually. In other words, it is not sufficient, in the capability, nor in the qualities. And it is predicted that in the future, there should be a big shortage in quantitatively,

Source: Provided by MPT

Figure 5.2-1 Backbone Network (Microwave Radio Link)



Source: Provided by Survey Team

Figure 5.2-2 Backbone Network (Fiber Optic Cable Link)

(2) Consolidation Program

The backbone network linking Yangon, Naypyitaw and Mandalay should be a basic network that corresponds to the frame in the building works, therefore, it should be networks that are of a high capacity and a high reliability.

At present these backbone networks are composed of a microwave radio link and two routes of the fiber-optic cable links as shown in Figure 5.2-1 and in Figure 5.2-2 (A-route and B-route by fiber optic cables). Among these two routes of the fiber-optic cable links, the route along the highway (B-route in Figure 5.2-2) will be scheduled to be provided the wave-length division multiplex (WDM) equipment having 30Gbps bandwidth, which is scheduled to be completed by the end of December 2013, thus strengthening somehow the capacity of the backbone link.

MPT plans to provide two more new routes in addition to the existing two routes (C route and D route in Figure 5.2-2) thereby to complete "optical ring construction".

Provided that when this plan be completed, the backbone network will be completed to have four routes of the fiber-optic cable system. Thus these three big cities will have been connected through the fiber optic cables of more the 200 cores. At present, the fiber optic multiplex equipment, available is able to transmit 100Gbps per unit wave length, therefore, utilizing 100 wave lengths per fiber core and in case, all of the cores are equipped the multiplex equipment, then, the total capacity will becomes 2000Tbps or more, and this fiber-optic cable route will be usable for very long period to come. In addition, considering possible progress in the fiber-optic cable's technology, the total capacity may increase further. However, this multiplex transmission equipment should be installed and expanded according to the demand. Also to be expected, is to become four route composition, thereby to improve the system reliability.

From now on, it is necessary to introduce switchover equipment or routers, according to request within the system.

5.2.3 Core Network

(1) Present Situation and Subject to be solved

The core network including the backbone networks indicates the toll transmission routes connecting every cities each other within Myanmar, and provided mainly by microwave radio links at present. As shown in Figure 5.2-3, the microwave radio links are functioning as an important role so far.

To these core networks, the local telephone exchanges (approximately 900 in number) are connected and reached anywhere in Myanmar.

The core networks may become annoyed usually due to shortage of networks as in the case of the backbone networks at least. In the case of the microwave radio links, there is a limit for expansion of the capacity, use of the optical fiber cable system should be utilized.

Figure 5.2-4 shows the expansion plan of the fiber-optic cables by MPT.

Installation and the maintenance control of the communication facilities of the core networks are furnished by the Long Distance Communications.

Source: Provided by MPT

Figure 5.2-3 Core Network (Microwave Radio Link)

Source: Provided by MPT

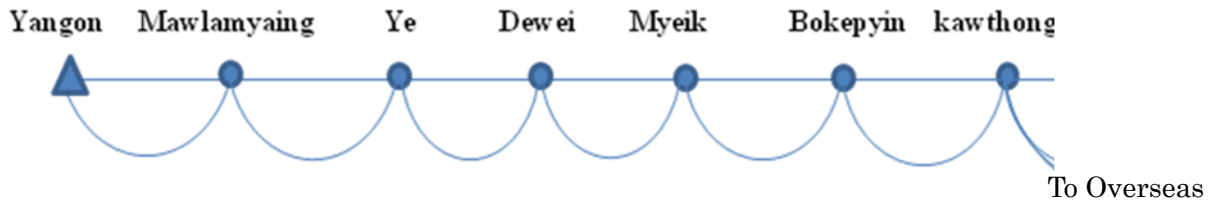
Figure 5.2-4 Core Networks (Fiber Optic Cable Link) as of May 2013

(2) Consolidation Program

Although the core networks connecting main cities and rural areas have been made mainly through the microwave radio links, use of optical fiber cable links are proceeded. The core network program in future is as shown in Figure 5.2-4. As shown in the figure, the core networks are proceeded with the assistance through China, Korea and so on.

Presently, the core networks are taking the star construction, however, recently, it start taking two route diversity configuration partly. The core networks give very important networks connecting with main cities and also with main local cities and it may be one of the subjects to proceeding the double route plan.

In this respect, through landing at several points, the international submarine cable extending southward may be utilized as a domestic core network, the double route plan will be realized. Referring the Figure 5.2-5, in this southern area of Myanmar, forming narrow area extending north-south area where installing double route plan seems to be very difficult. Therefore such secondary use of the International Submarine Cables may be an efficient utilization of the international submarine cables.



Source: Provided by MPT

Figure 5.2-5 Use of the International Submarine Cable for Domestic Purpose

5.2.4 Metro Network

(1) Present Status and Subject to be solved

The metro network is the networks to connect the switching stations each others, they are found only in Yangon, Naypyitaw and Mandalay. The metro-networks are connected to the access networks to provide the intra-city communication and also connected with the backbone network each other in the main switching stations for inter-city communications.

Table 5.2-2 shows the present situations of the metro networks in city of Yangon. As found in this table, there are a number of sections where no spare fiber core is available. As it is, the metro-networks are having problem of shortage of capacity.

Installation and maintenance control of communication equipment of the metro-networks are provided by the Auto Telephone Department.

Table 5.2-2 Present situations of the Metro Networks in Yangon（No. of Cores）

NO.	Route	Dist.(km)	Total Cores	Used Cores	Unused Cores
1	MTL - YEA	3.0	72	58	14
2	MTL - YWE	4.0	72	56	16
3	MTL - HTD	6.3	60	56	4
4	MTL - YRC	0.2	12	8	4
5	YEA - TPTC	2.0	12	8	4
6	YEA - BHN	4.0	48	34	14
7	BHN - SGD	2.5	36	32	4
8	BHN - TGG	5.5	48	30	18
9	BHN - TYL	14.5	36	18	18
10	HTD - WLW	1.5	48	48	0
11	HTD - MYG	7.6	24	24	0
12	HTD - ITMC (MYG)	8.0	291	141	150
13	HTD - ISN	10.5	12	10	2
14	MYG - ITMC (MYG)	0.4	48	48	0
15	MYG - ISN	6.0	36	26	10
16	MYG - TGG	9.0	48	48	0
17	HTD - SGD	4.0	36	34	2
18	MYG - SGD	9.0	12	10	2
19	HTD - BHN	5.5	48	40	8
20	YWE - HTD	8.0	24	24	0
21	HTD - BYN	11.5	12	10	2
22	BYN - WLW	10.0	24	20	4
23	SGD - YEA	6.5	24	6	18
24	BYN - ISN	6.5	36	16	20
25	BYN - MYG	6.5	48	38	10
26	ISN - SPT	11.5	36	24	12
27	ISN - MGD	7.6	12	12	0
28	MYG - N/OKA	6.3	52	36	16
29	MGD - SPT	8.5	36	26	10
30	MGD - HTK (micro)	6.0	28	28	0
31	MGD – N/OKA	7.2	24	24	0
32	HTK - HTK (micro)	7.2	28	20	8
33	HTK (micro) - N/OKA	7.2	24	16	8
34	HTK - NNP	12.0	12	12	0
35	N/OKA - SPK	3.2	12	12	0
36	N/OKA - NDGN	8.3	24	10	14
37	MYG - NDGN	13.0	12	8	4
38	NDGN - EDGN	3.7	12	12	0
39	TGG - NDGN	10.0	16	16	0
40	EDGN - LDK	13.5	12	12	0
41	NDGN - TGL	8.0	36	28	8
42	NDGN - SDGN	6.0	12	10	2
43	SDGN - TGL	4.0	24	8	16
44	TGG - SDGN	6.0	12	10	2

Source: MPT

Table 5.2-3 List of Repeater Stations of Metro Network in Yangon

No.	Abbreviation	Name of Repeater Station
1	NNP	Nyaung Hna Pin Exchange
2	HTK	Htauk Kyant Exchange
3	HTK (MICRO)	Htauk Kyant (MICRO)
4	SPT	Shwe Pyi Thar Exchange
5	SPK	Shwe Pauk Kan Exchange
6	MGD	Mingaladon Exchange
7	ISN	Insein Exchange
8	BYN	Bayint Naung Exchange
9	MYG	Mayangone ITMC
10	ITMC	Mayangone Exchange
11	N/OKA	North Okklapa Exchange
12	NGDN	North Dagon Exchange
13	TKKL	Toe Kyaung Kalay Exchange
14	EDGN	East Dagon Exchange
15	SDGN	South Dagon Exchange
16	TGG	Thingangyun Exchange
17	TELEPORT	Yadanarpone Teleport
18	WLW	Wailuwun Exchange
19	HTD	Hantharwaddy Exchange
20	BHN	Bahan Exchange
21	YEA	Yangon East Exchange (Pazundaung Exchange)
22	MTL	Maung Htaw Lay Exchange
23	YWE	Yangon West Exchange (Ahlone Exchange)
24	TYL	Thanlyin Exchange
25	YRC	Yangon Regional Centre
26	TPTC	Telecommunications and Postal Training Center
27	LDK	Lay Dauk Kan Exchange

Source: MPT

(2) Consolidation Program

Among three large cities having the metro networks, the city Naypyitaw where the town development programs to provide a ring-shaped networks through optical fiber cables are actively being continued, and when these facilities be completed, the total volume of the optical fiber cables will be enough for considerably long period to come from now on. However, the transmission equipment is needed to provide according to the demands. And the looping of cable facilities will be realized and thus the reliability of the facilities should also be improved.

On the other hand, Yangon and Mandalay are big cities from very long time ago, and provision of the ring-shaped the metro-networks and the expansion of the cable capacity, and changing into the optical fiber cable network will be an important subject. Also to be seen in these two cities, the relating facilities such as ducts, manholes, poles are aged or shorted in quantities, MPT will add or replace them one by one steadily. In the same way, the overhead wires should be renewed step by step.

In case the metro networks are developed, MPT intends to use the optical fiber cable system in principle. In this occasion, the metro networks in these three cities, are proceeded toward IP and Ethernet for improving network utilizing efficient.

For the other cities, where no optical fiber cable system or microwave link have not been

used at present, introduction of the metro network may be one of the subject to be considered. In this occasion, In this occasion, the priority should be set considering whether it is a capital of the state or not, etc.

In the same way of the metro networks in three big cities, the other cities are also recommendable to proceed for IP when the fiber-optic cable be introduced, towards Ethernet within country aiming at improving utility-efficiency of the networks.

5.2.5 Access Network

(1) Present Status and Subject to be solved

So called "last one mile" to reach the subscriber house, the metallic cables and the mobile communication are main networks at present. For some remote place, the satellite communication networks are utilized. This satellite communication network can provide functions as relay circuit and also functions as an access circuit.

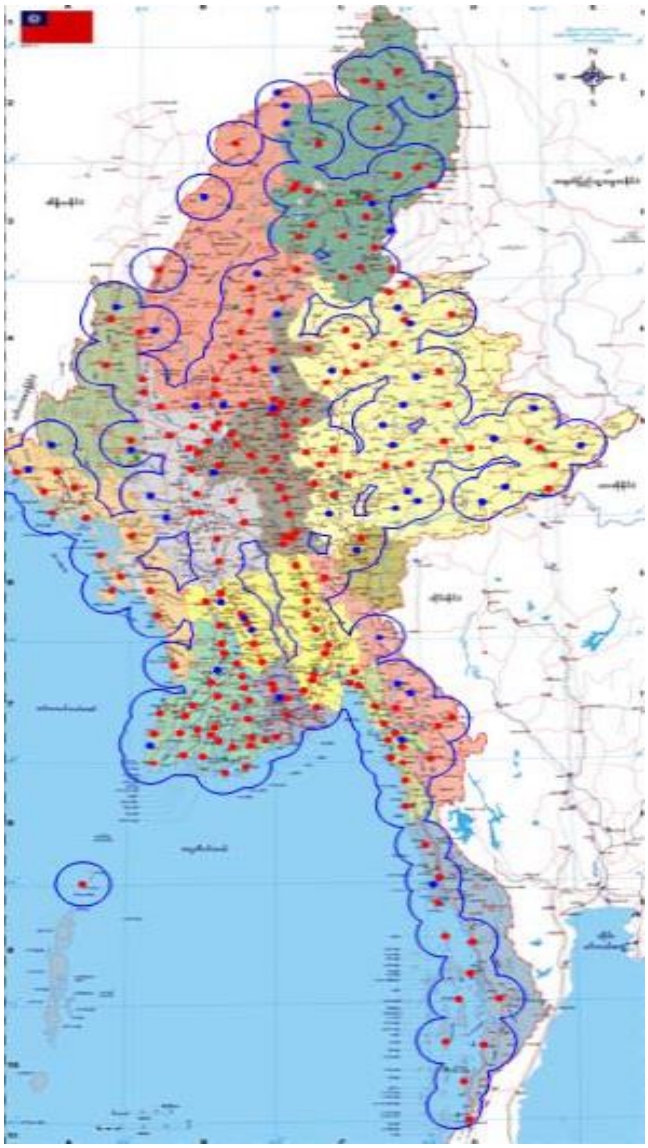
Among them, the number of the metallic cable network is limited. Recent increase of number of mobile phone communication is outstanding, however, in Myanmar, D-AMPS, CDMA450, CDMA800, GSM, WCDMA are provided in service as if to cover "in-mature growth of communications. No. of user and year of commencing services are given in Table 5.2-4. The service areas are not only Yangon, Naypyitaw and Mandalay, but cover also some areas along the sea shore and some deep land areas and covers all of the cities in Myanmar. (Refer to Figure 5.2-6) It is considered the number of users is expected to rise quickly.

However, it is necessary to expand the capacity to cope with the increase of the number of users in addition to the expansion of the service area.

Table 5.2-4 No. of Users for Mobile Phone（unit:1000）
and Years to starting use

System	No. of Users	Years to stating use
CDMA	1,085	2008(CDMA450), 1999(CDMA800)
GSM	3,615	2001 - 2002
WCDMA	738	2008
Total	5,438	

Source: Tender Documents for New Operator Licenses（as of Dec 2012）、Starting year: KOICA



Source: Japan-Myanmar ICT Workshop (Jan 22, 2013)

Figure 5.2-6 Service areas of Mobile Phone

For the rural remote areas where no repeating communication network such as the core network and so on, the domestic satellite communication are providing the broadband services. In Myanmar, VSAT (Telephone circuit) and IPSTAR (Broadband) are provided.

The IPSTAR terminals provide four channels of telephone and one circuit of Internet. (Frequency bands used are Ku-band and C-band. At present, the IPSTAR which can be used for the broadband is increasing. According to the home page of the MPT (February, 2013), total number of the VSAT terminals is 13 and the total number of the IPSTAR is 900, however, according to the staff there, 10 terminals and approx. 2800 terminals, respectively. (It is 11 terminals and 2,065 terminals according to ITU MP)

Satellites, earth stations in use are given in Table 5.2-5. In addition, composition of the domestic satellite communication is shown in Figure 5.2-7.

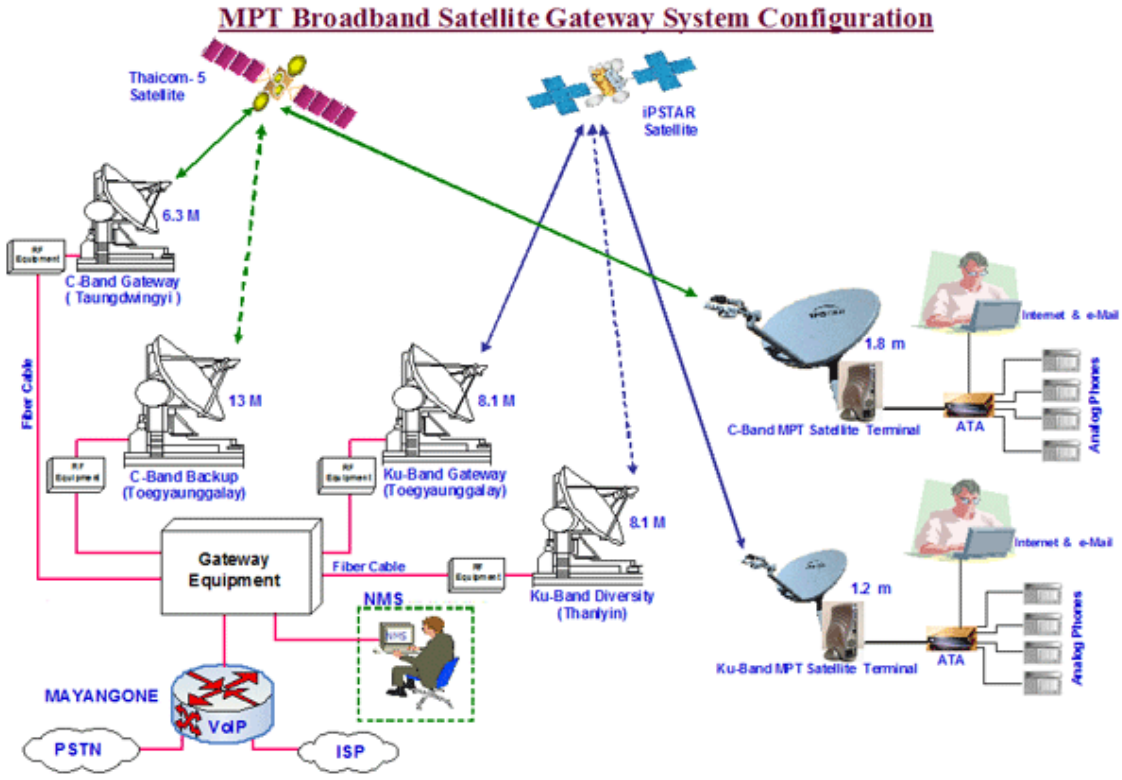
Table 5.2-5 Satellite, Earth Stations

(1)	Satellite	THAICOM-1A (120.°E)
	Transponder Bandwidth	7MHz
	Usage	VSAT Link
	Service area	All Myanmar
	VSAT Sytem	13 Stations (62 Channels + 4E1)
	E/S Location	Toegyaunggalay Yangon

(2)	Satellite	THAICOM-4 (119.5.°E) for Ku-Band
	Transponder Bandwidth	16.5Mbps (Ku-Band)
	Usage	Broadband Satellite system Ku-Band
	Service area	Myanmar center area
	MPT Satellite Terminal	655 Ku-Band Terminal
	E/S Location	Toegyaunggalay Yangon
	E/S Location (Back-up)	Thanlyin Yangon

(3)	Satellite	THAICOM-5 (78.5.°E) for C-Band
	Transponder Bandwidth	16.5Mbps (C-Band)
	Usage	Broadband Satellite system C-Band
	Service area	Myanmar north and south area
	MPT Satellite Terminal	345 C-Band Terminal
	E/S Location	TaungDwinGyi Magway
	E/S Location (Back-up)	Toegyaunggalay Yangon

Source: MPT Home Page



Source: MPT Home Page

Figure 5.2-7 Compositions of Domestic Satellite Communications

(2) Consolidation Program

Coping with the demand expected to expand very quickly, i, e, the demand for broadband, the access networks should be effective to expand by means of the optical fiber cables (FTTx), FWA (Fixed Wireless Access), LTE (Long Term Evolution), and so on.

For examples, FTTx is applied to Government, public organizations, financial organs, which need broad area communications, commercial areas, shopping areas, large-scale shopping areas, densely built housing areas. The FWA and LTE apply to individual persons, and small-scale enterprises. The metallic cables (used as existing lines in the cities so far) will be maintained as it is and will be utilized for fixed telephones and for the ADLS services. Using for the wider areas, organs of Government, public organizations, monitory organizations, i.e., that require important and wider area communications are given the preference and expansion of areas will increase number of access circuits by means of introducing FWA and/or LTE. Expansion of capacity is an urgent subject in the large city areas.

In the areas of villages under the middle class of towns, such a large amount of traffics as seen in a large city areas won't happen, no metro-networks won't be provided, and directly connected to the access networks. The average length of such access networks in such areas will become longer. Consequently, from now on, appropriate combination of optical fiber cable, IP microwave radio link, FWA, LTE and so on will become necessary to provide. For example, in cases where houses are found scarcely along the roads, use of the FWA communication system will be appropriate to cover such areas, and whereas houses in the villages are found as a cluster, it might be better to adopt the LTE system might be appropriate to adopt. For connecting these FWA and/or LTE with main core networks, the IP microwave radio link or the optical fiber cable system will be appropriate.

In such areas, where the core networks are not available, the satellite communication is used at present, however, for such areas, the satellite communication system will be used continuously, for the time being. However, according to development of the core and access networks to cover such rural areas, it is necessary to expand the capacity and to improve the quality. In this case, the existing satellite communication facilities should be maintained and this will enhance the reliability of communication thereby preventing the isolation of the rural areas.

5.2.6 International Communication Network

The international communications of Myanmar are provided through communication satellite, submarine cables and terrestrial fiber optic cable systems at present.

(1) Present Statuses of Communication Satellites

International communications in Myanmar started at the communication satellite. In 1979, "Standard B" earth station (NXE-20 made in NEC) was built at Yangon, then in 1994, "Standard A" earth station (Satellite to access is Intelsat IX) was completed and then no. of circuits to be used was expanded in 1996. In August in 2000 the international circuits (International Gateway) were expanded with 14 countries (mainly various countries in Asia, Australia, Middle East, several countries in Europe) through EWSD made in Siemens). Capacity of these international circuits corresponds to 900 in digital voices, thus expanded to 2,940 channels. It is noted that in 2006,

another international gateway (DMS300 by TELRAD) in Naypyitaw.

(2) Present Status of Submarine Cables

The international submarine cable is the SEA-ME-WE3 (South East Asia - Middle East - Western Europe3: completed in 1999) only. The adjacent landing points of this SEA-ME-WE3 are Mumbai, India and Singapore (Landing point in Myanmar is Pyapon.).

(3) Present Status of Cross Border Networks

The cross border networks consist the microwave radio communication and terrestrial optical fiber cables. Outlines are given in Table 5.2-6. MPT is under planning to utilize a part of core network by optical fiber cables (Muse, Tamu, Tarchileit, Myanwaddy) as international communication circuit.

(4) Present Status of Capacity of International Circuits

Number of circuits for international communications through satellite communications, submarine cables and terrestrial optical fiber cables are given in Table 5.2-6. In Myanmar, the submarine cables provide the widest bandwidth, i.e., 298E1 (596Mbps) for voices, or approx. 7.5Gbps for internet circuits. On the other hand, the satellite communication circuits provide narrowest bandwidth providing 4E1 (approx. 8Mbps).

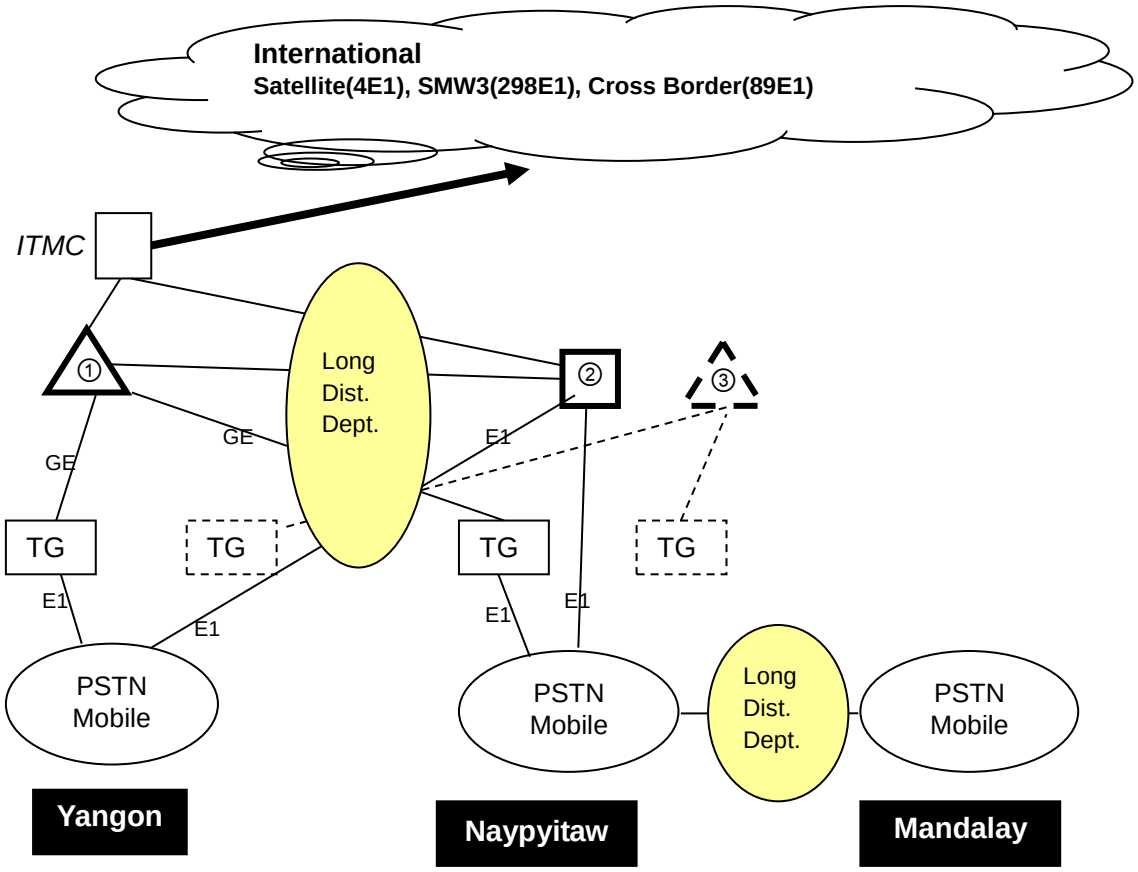
Table 5.2-6 International Communication Circuits

No.	種類	E1（2Mbps）Interface			Internet Capacity (Gbps)	No. Channels
		IGW Naypyitaw	EWSD (ITMC Yangon)	NGN (Ahlone Yangon)		
1	Satellite			4×E1		115
2	SEA-ME-WE3	15×E1	1×E1	282×E1	7.50996	7137+1×VoIP E1 +1×VoIP STM1
3	Cross Border	20×E1		69×E1	6.37632	2,727
	TOTAL	35×E1	1×E1	355×E1	13.88628	9979+1×VoIP E1 +1×VoIP STM1

Source: Provided by MPT

(5) Present Status of International Circuit Switching Networks

Composition of the international switching networks is shown in Figure 5.2-8. The switching equipment for international circuit are provided at five locations, i.e., at Ahlone station in Yangon and also at the IGW station in Naypyitaw. Through these stations it becomes possible to provide the redundant composition and to improve the reliability. The switching equipment in Yangon has been renewed at the software switch providing a large capacity and having completed approximately 90% of the international telephone calls. The switching equipment in Naypyitaw using rather old hardware and a new switching equipment is under construction and expected to be available within the year 2013.



凡　例
① Huawei Soft X3000 (Software SW)　upgraded in 2012 (Ahlone)
② DMS300 TDM(Hardware SW) (IGW)
③ New Software SW(Dekikena New Building)
TG: Trunk Gateway

Source: Prepared by Survey Team

Figure 5.2-8 Composition of the International Switching Networks

(6) Problems and Programs of International Communication Networks

Total bandwidth of the international circuit will be approximately13.9Gbps in total to/from Myanmar. According to progresses of the democracy in Myanmar, the total volume of the international communication network to/from other countries will become necessary.

Although the demand will be given in next paragraph, 5.2.7, the predicted demand shows much less tan figures predicted. In addition, accidental cutting occurred on 22, July, 2013 of the SEA-MEWE3 submarine cables has made it unusable for some period, however, in this case, the speed of the Internet dropped about half of the speed of the Internet dropped about half of the normal speed. Though the bandwidth of the Internet signal is 14 GB, however, it dropped down to 7 GHz. It shows much less bandwidth at the time of August, 2013.

Expansion of the international communication networks is possible through communication satellite, submarine cables and terrestrial (international) optical fiber cables. Among them, the

communication satellite provides could provide only finite transmission capacity and finite no. of satellite, i.e., there is a limit. For the terrestrial (international) optical fiber cables, there are a program to extend them towards Thailand, China and India. As to the submarine cables that provide a larger transmission capacity MPT has studied to join the SEA-ME-WE5 or AAE1 (Asia Africa Europe1) submarine cable Programs or introduction of new submarine cables for two countries.

5.2.7 Quantitative Plan of Telecommunication Infrastructure

Total volume of the communication infrastructures to be provided depends largely upon the number of users to be connected there, logically. However, the utilization means of the Internet is changing very quickly, therefore, the transmitted capacity of communication, in addition to changes in number of users, changes very quickly. Hence, to predict the total volume of the communication infrastructures is very difficult. Therefore, to prepare this Mid-Term Development Program, together with the MPT task force team, the joint assumption which is needed in estimation of the communication infrastructures have been prepared as Tables 5.2-7 through 5.2-9 have been prepared.

(1) Total Numbers of Subscribers and Volume of Information to be transmitted

The joint assumption assumes that the total number of subscribers of both mobile and fixed telephone (voice) assuming to be 80% of the total population. Table 5.2-7 gives those assumptions.

Table 5.2-7 Tables of Communication Speeds (Bit Stream)

				Subscriber Target		Usage		Bit Stream		International	
Fixed & Mobile Phones (Voice)	Assumptions	Population (Million)	60	Tele-density (%)	80	Min./line/ Day For Fixed Phone	10	kbps/user for Voice (kbps)	16	Int'l Rate for Voice (%)	5
				No change of Fixed Phone (Million)	3	Min./line/ Day For Mobile Phone	5				
						Total duration per day (Million sec./day)		Total Speed (Gbps)	Speed per user (kbps)	Total International Bit stream (Gbps)	
	Fixed Phone			No. of users (Million)	3.0	1,800		0.33	0.11	0.02	
	Mobile Phone			No. of users (Million)	45.0	13,500		2.50	0.06	0.13	
	Voice Total			Total Target (Million)	48.0	15,300		2.83		0.14	
Internet (Data)	Assumption	Subscriber Target from MPT (Million)	30	Fixed Broadband Users (%)	5	Gbps/user/ day for Fixed (Gbps)	5.00			International Rate for Data (%)	70
						Gbps/user/ day for Mobile (Gbps)	1.00				
								Total Speed (Gbps)	Speed per user (kbps)	International Connection Speed (Gbps)	
	Fixed Broadband Line			Users (Million)	1.5			86.81	57.87	60.76	
	Mobile phone			Users (Million)	28.5			329.86	11.57	230.90	
	Data Trans. Total (Million)		30		30.0			416.67	13.89	291.67	
Grand Total					78.0			**419.50**		**291.81**	
Ave/Max Ratio			1.5					**629.25**		**437.71**	

Source: Joint preparation by MPT Task Force and Survey Team

In predicting the number of users of each services and the amount of information to be transmitted, the basic assumptions and the assumptions produced from the basic assumptions have been called as "secondary assumption". This can be explained as followed:

VOICES

Basic assumptions:

Target no. of subscribers: Mobile, Fixed Telephone …….80%

Fixed Telephone ……3 million

Duration of talking per day, (per from the fixed telephone)…. ……..10 minutes

Duration of talking per day, (per from the mobile phone)…….5 minutes

Communication speed per day, per subscriber……..……16kbps

Rate of using the international telephone ……..…….5%

Derived assumptions

Average duration of using fixed telephone per day: 3,000,000 x 10 x 60 = 1,800 (mil. sec.)

Average duration of using mobile phone per day: 45,000,000 x 5 x 60 = 13,500 (mil. sec.)

Total of communication speed per fixed telephone subscriber (Gbps):

1,800 x 16/ 24 / 3600 = 0.33Gbps

Total of communication speed per mobile phone subscriber (Gbps):

13,500 x 16/24/3600 = 2.5Gbps

Communication speed per fixed phone subscriber (kbps):

0.33/3,000,000 x 1,000,000 = 0.06kbps

Communication speed per mobile phone subscriber (kbps):

2.50/45,000,000 x 1,000,000 = 0.06kbps

Total speed of communication for international service by fixed phone (Gbps):

0.33 x 0.05 = 0.02Gbps

Total speed of communication for international service by mobile phone (Gbps):

2.50 x 0.05 = 0.13Gbps

INTERNET (DATA)

Basic assumptions:

Target for subscribers：Fixed broadband…….……. 5%

Subscriber using broadband per day ……..5Gbps

Mobile phone user per day …..……..……..1Gbps

Rate of using international data……..70%

Derived assumptions:

Total communication speed of the fixed phone subscribers in broad areas (Gbps):

1,500,000 x 500/24/3600 = 86.81Gbps

Total communication speed of mobile phone subscribers (Gbps):

28,500,000 x 100/24/3600 = 329.86Gbps

Communication speed per fixed phone subscriber in broad areas (kbps):

86.81/1,500,000 x 1,000,000 = 57.87kbps

Communication speed per mobile phone subscriber (kbps):

329.86/28,500,000 x 1,000,000 = 11.57kbps

Total communication speed to international telephone from fixed phone subscriber (Gbps):

57.87 x 15 x 0.7 = 60.76Gbps

Total communication speed to international telephone from mobile phone subscriber (Gbps):

11.57 x 28.5 x 0.7 = 230.90Gbps

The communication speed or amount of information indicates the average values. In the real networks, these communication speed or amount of information should accept such variation with time. Therefore, in designing the networks, we use a larger figures than these values. The ratio to be applied has used '1.5 '.

From this table, it has been understood that the communication capacity and the international communication capacity are affected largely by the traffic of Internet (data).

(2) Regional Distributions of Population and Subscribers

Table 5.2-8 gives the assumptions to predict the regional distributions and popularity of the mobile phones and the fixed telephones by region and the degrees of popularity of them predicted under these assumptions.

Table 5.2-8 Subscriber Number Forecast

	Population		Number of Users/Lines/Subscribers				
	Ratio (%)	Pop (Million)	Ratio (%)	Voice (Million)	Penet. (%)	Data (Million)	Penet. (%)
3 Metro	20.0	12.0	30.0	14.4	120.0	9.0	75.0
Small City	10.0	6.0	12.0	5.76	96.0	3.6	60.0
Province	70.0	42.0	58.0	27.84	66.29	17.4	41.43
Total	100.0	60.0	100.0	48.0		30.0	
Total (Table 5.2-7)		60.0		48.0		30.0	

Source: Prepared by Survey Team

The Table 5.2-8 gives the basic assumptions and thereby produced assumptions. They are explained as follows, when explained according to Table 5.2-8.

Basic assumptions

No. of subscribers :

Voice: 48.0 (million) subscribers

Data: 30.0 (million) subscribers

Ratios of populations:

3 Metros: 20.0%, Small cities: 10.0%, Provinces: 70%

Ratio of Subscribers (Voice, Data)

3 Metros: 30.0%, Small cities: 12%, Provinces: 58%

Derived assumptions

(1) Regional distribution of total population, 60(million)

(a) 60(x million) x 20% =12.0 (x million): 3 Metros

(b) 60(x million) x 10% =6.0 (x million): Small Cities

(c) 60(x million) x 70% =42.0 (x million): Provinces

(2) Regional ratios of Total Voice Subscribers including fixed and mobile phones (x million)
  (a) Voice subscribers in 3 Metros: 48 (x million) x 30% = 14.4 (x million)
  (b) Voice subscribers in the small cities: 48 (x million) x 12% =5.76(x million)
  (c) Voice subscribers in provinces: 48 (x million) x 58% = 27.84 (x million)

(3) Popularity of Total Voice Subscribers
  (a) 3 Metros: 14.40 (x million) / 12.0 (x million) x 100 = 120.0%
  (b) Small cities: 5.76 (x million) / 6.0 (x million) x 100 = 96.0%
  (c) Provinces* 27.84 (x million) ?42.0 (x million) x 100 =66.29%

(4) Regional ratios for Total Data Subscribers
  (a) 3 Metros: 30 (x million) x 30% = 9.0 (x million)
  (b) Small cities: 30 (x million) x 12%=3.6 (x million)
  (c) Provinces: 30 (x million) x 58%=17.4 (x million)

(5) Popularity of Total Data subscribers
  (a) 3 Metros: 9.0 (x million) / 12.0 (x million) x 100 = 75%
  (b) Small cities: 36 (x million) / 6.0 (x million) x 100 =60.0%
  (c) Provinces: 17.4 (x million) / 42.0 (x million) x 100=41.43%

(3) Meaning of Table 5.2-8

Comparing the rate of popularity of the fixed telephone subscribers by region shown in Table 5.2-8 with the popularity of the fixed telephone by countries, the result are given in the Table 5.2-9.

Table 5.2-9 Estimated Telephone Density by Region

Region	Telephone Density (%)
3 Metros and cities between 3 Metro	120: refer to Table 3.3-2: Average in Thailand and Indonesia
Small cities	96: refer to Table 3.3-2 Average in Philippines and Laos
Provinces	66: refer to Table 3.3-2 Approx.30% lower than average in Laos

Source: Prepared by Survey Team

5.2.8 Time-wise Factors in Programs for Communication Infrastructure Volume

In Paragraph 5.2.7, the assumptions under which the number of users of various services and the amount of the transmitted amount of information are predicted, at the time when the total number of the fixed telephone and mobile phone subscribers may reach 80% of the population, and the amount of transmitted information required under such assumptions has been estimated. Then, the probable time of the total subscribers may come to 80% (Popularity of telephone subscribers reach 80% of population) of the population will be studied.

As described above, Myanmar Government has announced the plan the number of telephone subscribers may become 75~80% within 2015/2016. It means that the target of 80% will be attained before the Yen credit program will be terminated.

Government of Myanmar, this target is to be attained through increasing of mobile phone subscribers. Presently, in Myanmar, total number of the fixed telephone subscribers is 600,000, and total number of mobile phone subscribers are 5,500,000 approximately. (at the time of Year 2012), however, in order to accomplish the target for popularity of telephone through increasing the mobile phones only, the popularity of the mobile phone should increase from less 10% to be increased a little less than 80%.

On the other hand, Table 5.2-10 gives changes of the rate of mobile phone users, however, most of countries needed approximately 7 years or so. In Myanmar, it will be around Year 2020 or so, to realize 80% target.

Table 5.2-10 Transition of Mobile Phone Density in Various Countries in South-East Asia (%)

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Cambodia	1.05	1.77	2.96	3.83	6.53	7.95	12.74	18.90	30.65	44.84	57.65	96.17	131.96
Laos	0.24	0.55	1.00	2.01	3.60	11.43	17.28	24.93	33.58	52.92	64.56	87.16	101.85
Malaysia	21.87	30.82	36.93	44.39	57.10	74.88	73.21	86.31	100.77	107.85	119.22	127.04	140.94
Singapore	70.10	75.15	82.16	87.54	95.93	102.78	108.59	129.21	134.42	139.21	145.18	150.24	153.40
Thailand	4.84	11.82	26.99	33.07	40.82	45.67	59.64	78.14	90.58	95.99	103.77	111.63	120.29
Viet Nam	1.00	1.57	2.36	3.37	6.03	11.54	22.47	52.96	87.11	113.03	127.00	143.39	149.41
Philippines	8.35	15.40	19.08	27.35	39.24	40.66	49.21	64.68	75.54	82.43	89.16	99.30	106.77
Indonesia	1.72	3.02	5.34	8.34	13.51	20.64	27.75	40.17	59.83	68.94	88.08	102.49	115.20
Brunei	29.05	42.77	44.98	50.85	56.88	64.14	81.39	96.99	103.68	105.37	109.07	109.17	113.77
Myanmar(*)	0.03	0.04	0.09	0.12	0.17	0.23	0.38	0.43	0.63	0.85	0.99	2.06	8.90

Source：http://www.itu.int/ITU-D/ict/statistics/

(*) Statistical Year Book 2010 (CSO Naypyitaw, Myanmar 2012)

5.3 Improvement of Communication Services

5.3.1 Fixed Telephone Services

It is a general tendency observed in many countries in the world that the number of subscribers of the fixed telephone is decreased and the number of mobile phone subscribers and internet users increase rapidly in the world. In Myanmar, though use of the mobile phones and internet, are observed to increase rapidly, however, considering the absolute number of the fixed telephone are less compared with that in neighboring countries, the subscribers of the fixed telephone subscribers may increase gradually from now on. Such tendency may happen in the areas where the access networks have not been sufficiently available so far, we proceed according to the programs given in paragraph (2) of 5.2.5.

5.3.2 Mobile Phone Communication Services

Provision of the mobile phone communication services, it is necessary to provide the core networks, connecting points with the other networks such as the fixed telephones, internets and so on, and also the radio networks (corresponding to the access networks.

The core networks for the mobile communications will be developed through the core networks and utilizing the Ethernet. Accordingly, to realize such programs, it is necessary to follow the programs mentioned in Paragraph 5.2.3.

Regarding to the mobile communication system, there exists many types of communication systems such as D-AMPS, CDMA, GSM and so on. These systems may continue to be used, however, from now on, coping with rapid increase of subscribers, and with improvement of the reliability, it should be developed making the LTE/LTE Advanced system as the main system, from now on. To begin with, toward the SEA Game to be held in December, 2013, and ASEAN Summit Conference to be held in 2014 the introduction of the radio networks through the LTE will be introduced.

Next step to be taken is to expand the service areas of the LTE, for the SEA Games and ASEAN Summit to the other areas. Expanding the areas to other areas, will be made in a similar way as mentioned in paragraph 5.2.5. Therefore, expanding the service areas will be proceeded according to the method given in Paragraph 5.2.5.

Points of connections with the other networks may differ according to the system of mobile phone. In case of the LTE system, the connection points given in the SEA Game and the ASEAN Summit may be used as it is, then the expansion will be developed economically.

5.3.3 Internet Services

(1) General

At present, MPT and Yatanapon Teleport are the ISP in Myanmar, providing the Internet Services, each. Though it is an information not yet confirmed yet, however, from now on, four (4) enterprises (Elite Co., Ltd, Fortune Co. Ltd, Digicon Co. Ltd and Red Link Co., Ltd) will be permitted to join to this services (informed from Foreign Economic Relations Department (FERD) in Myanmar). In addition, new two companies who have been given the licenses (Telenor and Ooredoo) will be expected to provide the internet services. Therefore MPT should fulfill the three

axes of the business management, to cover the communication infrastructure, communication services and personal training, thereby enhancing the efficiency is urgent and important subjects.

The internet services will be developed entirely in Myanmar, according to expansion of the core networks as mentioned in 5.2.3 and the access networks as mentioned in 5.2.5 to be provided entirely in Myanmar. Therefore the development of the internet services should proceed in similar way of the access networks.

However, it may be needed to have some specific program for the internet services.

(2) Access Circuit for Internet Services

As the access circuit for Internet Services, though optical fiber is in use partly, the ADSL are in use widely as the main system. From now on, use of the optical fiber cable system will proceed. The use of LTE/LTE Advanced will proceed. The time-wise program of them are as mentioned as in (1). On the other hand, where the fiber optic cables are utilized widely, reuse of the ADSL and widely use of the ADSL should be considered.

(3) Improvement of Service Quality

Demand for the internet・services start to increase here, and it may become an obstacle in maintaining the service quality to an appropriate level. Keeping the internet service level at an appropriate level is an urgent subject. The first step for maintaining service quality is to provide a sufficient transmission capacity. Against this urgent subject, the Project for Urgent Improvement of Communication Networks in Myanmar under Japan Grant Aid is applied, and intended to expand the economy in Myanmar and thereby improve the living levels of Myanmar nationals. Figures 5.3-1 through Figure 5.3-3, the compositions of the Metro Networks are illustrated through the Project for Urgent Improvement of Communication Network.

On the other hand, even when the actual demand of the internet services may be overcome through the Project for Urgent Improvement of Communication Networks in Myanmar under Japan Grant Aid, however, it may not be so effective for the ever increasing demand for Internet. Therefore, the IPv6 should be introduced as the first step, to expand the service capability, to improve the quality. Also, in the three large cities including Yangon, we have to expand the capacity of the metro-networks and improving the router's capability, thereby to expand the capacity of the internet services and to improve the quality of internet.

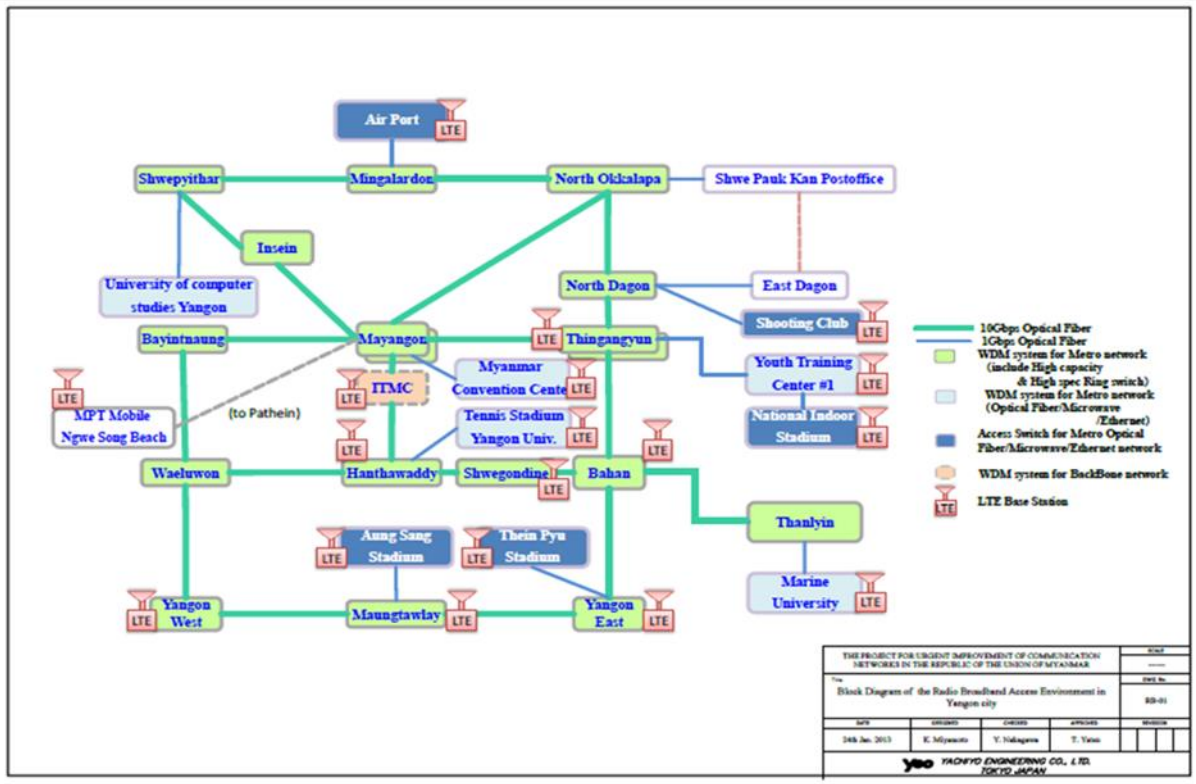


Figure 5.3-1 Strengthening of Metro-Networks and LTE Networks in Yangon Area

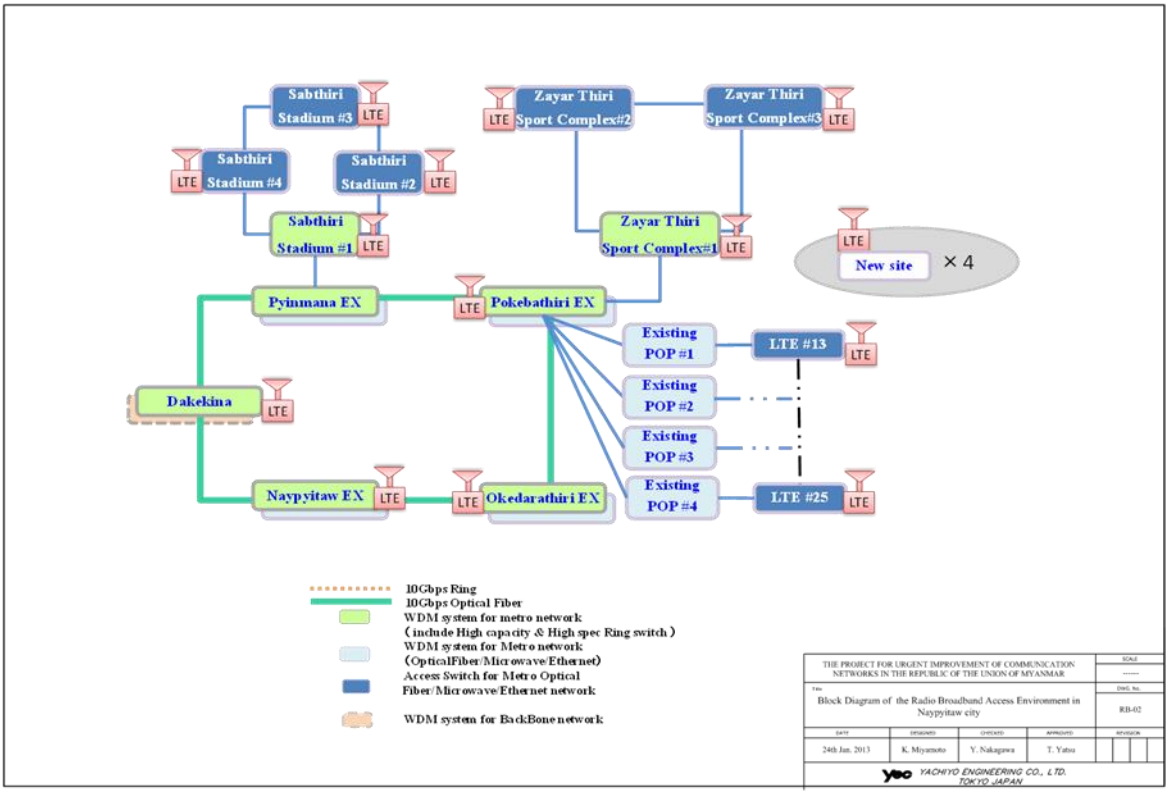


Figure 5.3-2 Strengthening of Metro Networks and LTE Networks in Naypyitaw Area

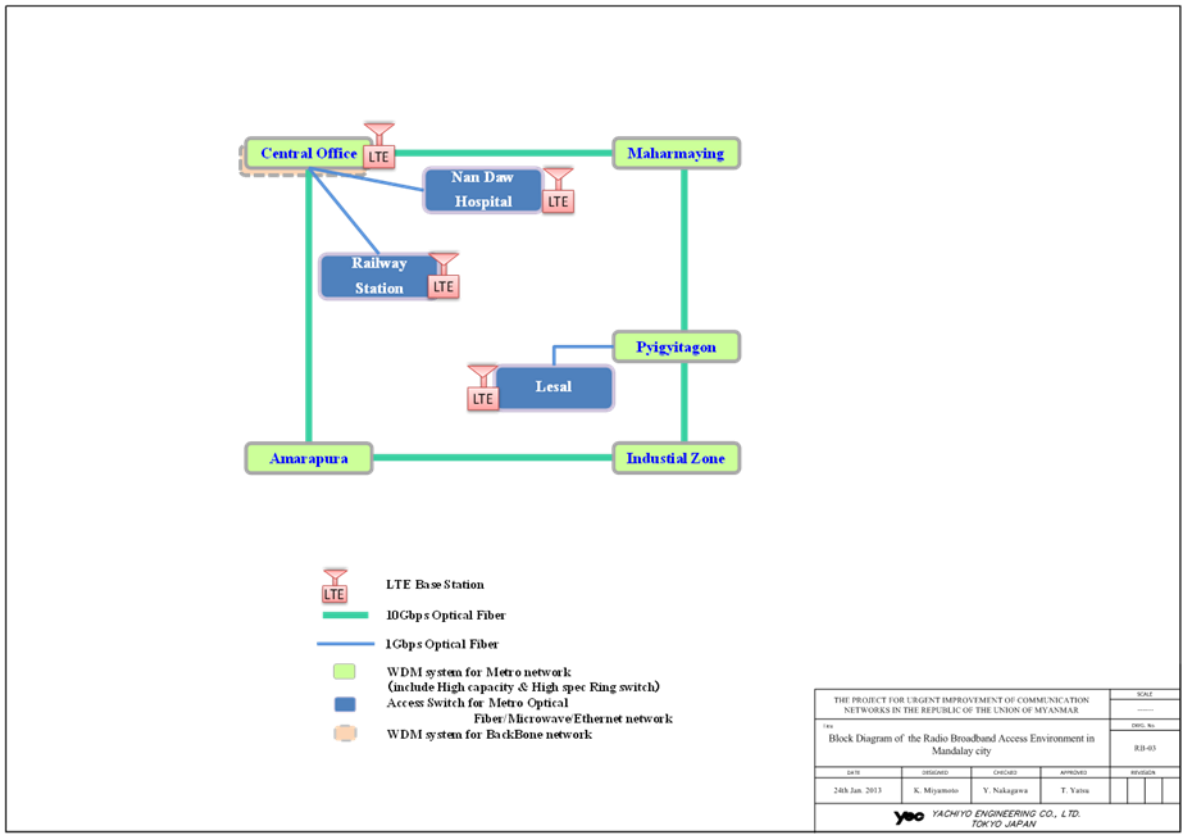


Figure 5.3-3 Strengthening of Metro-Networks and LTE Networks in Mandalay Area

One more important point to respond the rapid increase of the demand for internet services is in the capability of National Gateway (NGW). Comparing with the voice telephone, the internet service that uses the international circuit very frequently, requires to enhance the capability of the NGW.

Enhancing capability of the NGW can be realized through the network urgent improvement program Myanmar prepared by Japan. However, it is not enough for ever increasing demand of internet services, though it can be enough for one-time increase of demand in internet services. Consequently, as the first step, Yangon's NGW should be strengthen, however, it is preferred that these three large cities should have the NGW respectively in the mid-term program.

As to internet, after expanding the capacity of the internet services and improving their quality, up to the other cities, and rural areas, the internet services are to be extended to the whole country keeping improved quality, however, such method may be the same as in the core networks or in the access network.

(4) IP Address

At present internet services are provided through IPv4, the number of v4 global address assigned to this country is extremely low. At present, through widely use of the private addresses and tide over a crisis.

According to the above mentioned Communication Network Urgent Improvement Program, expansion of the sub-network (32bit from 30 bit) is planned to study. However, there should be a

limit to apply this system continuously, and it may affect badly to the service quality. Therefore it is necessary to introduce devices workable with IPv6.

Introduction of IPv6 requires the engineer who can maintain and manage the devices workable with v6, no. of such engineers are not so sufficient in the world, at present, therefore promoting such engineers should be required. This problems will be discussed in Paragraph 5.4.

(5) Improvement of Social Values of Internet

Differing from the other telephone services, the user of the internet is required to have some degree of the IT literacy. Within the cities, the individual persons may have a lot of opportunity to enhance the literacy, however, in the rural areas, it is very difficult and may produce problems, such as "digital divide"or the problem of difference between locations. To solve such problems, it will be important to accelerate the use of the internet. This can be an initiator to induce the local activity. This problem should also be described in Paragraph 5.4 Improvement in personal training and Business Management.

5.3.4 International Communication Services

According to expansion of domestic communication services, the demand for the international services will also be increased further. Especially, increase of internet service demand will become increase of international communication demand. Regarding the enhancement of the capability of the NGW (National Gate Way), it has been described in (3) of Paragraph 5.3.3.

It is necessary to expand the transmission paths for international communication services. The transmission paths of the international communication is divided into the international communication path for domestic portion and the transmission path over the national border.. The transmission paths running over the border may be divided into the cross-border portion, circuits through the submarine cable and the circuits by the satellite communications.

Among them, the domestic portion of the terrestrial cross-border transmission path are shown as a core network in Figure 5.2-4 (Route to Muse, Tama, Tarchileit, Myanwaddy). These routes will be developed as a part of the core networks.

As for the international communication services by the sub-marine cable, as the first step, the existing submarine cable (SEA-ME-WE3) will be utilized up to the maximal range. To do so, the range of the route as shown in Figure 5.3-4 will be expanded through introduction of DWDM. Because of using the existing fiber optic, it should be proceeded earlier.

For increasing traffic in international communications, use of a new submarine cable is studied. One of the possible cases is to join SEAMEWE 5. The transmission path in Myanmar including the landing point in Myanmar is shown in Figure 5.2-5 Core Network (Route to Ngwehsaung).

A part of the route from the landing point, Ngwehsaung to Muse close to China of a part of the optical fiber cable cores will be a property of China to be employed as a terrestrial portion of SEA-ME-WE5 to be used for connecting the cable with China.

The other possibility is to lay a new submarine cable between two countries. Assuming laying such a new submarine cable between two countries, the transmission path in Myanmar including the landing station may be same as shown in Figure 5.3-4. Countries sharing this cable are probably, Thailand, Malaysia, and/or Singapore. This cable will also employed also as a portion of

the domestic use for the southern area of Myanmar.

Figure 5.3-4 Domestic Transmission Path of Existing Submarine Cable (SEA-ME-WE3)

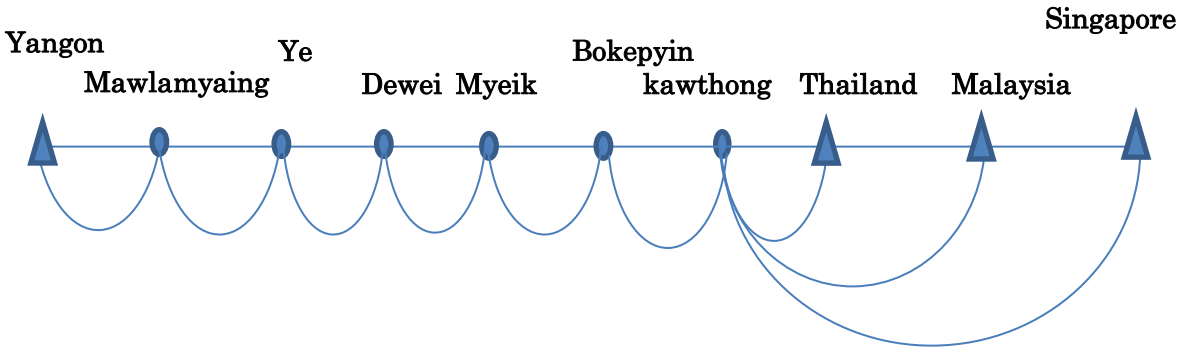


Figure 5.3-5 Route of the Submarine Cable under Study

Domestic transmission paths of the international communication services, through the satellite communication, and the transmission paths are shown in Figure 5.3-6. Expansion of this transmission path is planned to realize through introduction of the DWDM. In addition, the circuits for international communication service through the satellite should be studied continuously.

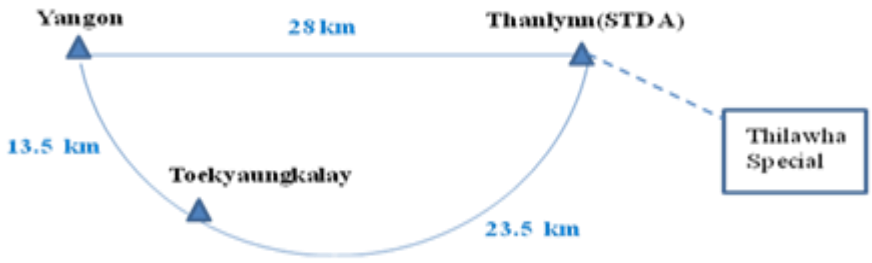


Figure 5.3-6 Domestic Transmission paths using Existing Satellite Communication Circuits

5.3.5 Subjects in Improving Communication Services

For the MPT that have provided the communication services monopolistically and entirely in Myanmar, they are supposed to be insufficient in functions in marketing, developing services, and so on. For improvement of communication services, strengthening various functions other than technical or facility expansion programs will be indispensable. These are to be included in management strategy or problems in managing organization, to be excluded from this report. Considering, however, in MPT, there is not available such specialist, therefore it must be an urgent problem to have such specialists in MPT.

Also, in order to proceed improvement in communication facilities, there is another important subject, security. There are a number of news, such as malicious attacks or stealing of some information are reported in TV or news papers, every days. In general, weakness in security may affect to the communication services greatly. On the other hand, keeping the security require a tremendous costs and how far to be considered may be "subject" to be discussed continuously. Therefore, it is necessary to organize a group of such specialists and to prepare the security policy, and it is necessary to make the studies in technical phases, managing phases, and human resources.

5.4 Training of Human Resources and Improvement in Business Management

5.4.1 Environment around MPT and Business Management

As mentioned before, for MPT, the technical stuff have been proficient for operation of existing facilities and maintenance and control of them, and no special and technical problem is found. However, the facilities and materials to be procured from now on, it may be assumed that the facilities and materials to be procured from now on, are presumed that they are presumed that those facilities and materials to be procured require a high level of technique to handle them in its installing, testing, controlling and operating. In order to operate, maintain, and control these communication facilities, it is important to reinforce the control system. It is important to strengthening the maintenance and controlling system against these communication facilities including the existing facilities and the overall management system so that the communication facilities to be provided should continue to be implemented keeping an appropriate quality of facilities provided.

5.4.2 Reduction in Cost

Pursuing normal management, reduction of cost should occupy a large portion. While MPT is improving and prepare a number of communication networks positively, not to be neglected are operation, maintenance and control of the communication facilities. The operation, maintenance and controlling of the communication facilities are a kind of routine tasks to be performed, every days, therefore the effect by reducing their costs may be great.

One of the elements to realize the cost reduction is grouping of each element. MPT has a program to group the watching and controlling tasks.

Also, grouping human resources in operation, maintenance and controlling the communication facilities may produce not only the efficient use of the human resources, but also realize the improvement in efficiency for training of the human resources.

5.4.3 Human Resources and Training required for Improvement and Expansion of Communication Networks

Government of Myanmar has established the target for communication services, to be 75~80% approximately, by the year 2016, and the introduction of IP Networks and Number fourth generation in mobile phone started already. In other words, number of staff in MPT is expected to increase according to the increase of the subscribers.

Figure 5.4-1 shows the relation between the number of subscribers and the number of staff in Laos, Cambodia, Indonesia, Malaysia, Philippine and Thailand to the number of staff engaged in their respective communication sector for the period,

2000 through 2011 according to World Telecommunication/ICT Indicators 2012, and according to this graph, in case, the total number of subscribers is assumed as 50 million, the total number of staff engaged in the communication sector will be approx. 350,000.

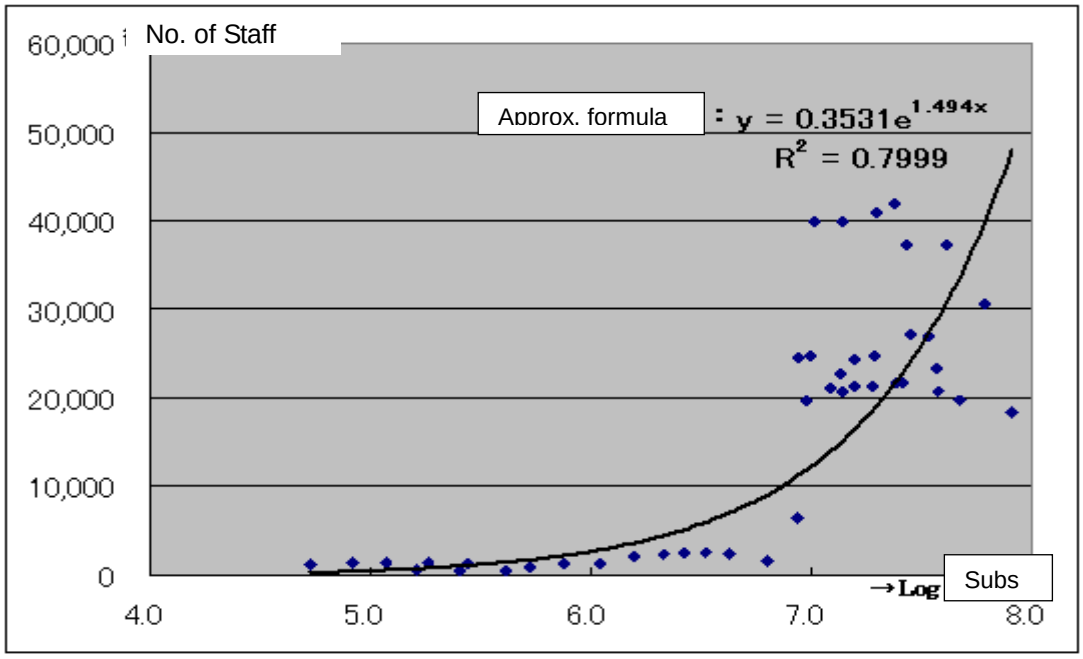


Figure 5.4-1 Relation between Total logarithmic no. of subscribers (fixed + mobile) vs. Total no. of staff in communication sector in Each Countries in ASEAN nations excluding Vietnam

Source: Japanese Survey Team has taken from World Telecommunication /ICT Indicators 2012 to show the relation between Total no. of subscribers (Fixed + Mobile) and No. of staff in communication sector.

According to ITU World Telecommunication/ICT Indicators 2012, the total no. of staff engaged in communication sector is reported as 12,107, then the total no. of staff required will be three times of the present no. of staff.

Present status of human training system in MPT is provided through TPTC (Telecommunication and Postal Training Center)

This training center was established in 1968 to provide a radio course and a telegraph controller course, and in 1977 through 1993, training project for telecommunication engineers through the aid by United Nation. At present, there are 71 courses for ICT and 23 courses for trainers. Total no. of staff trained in 2012 reaches 3,825 persons. No. of student are selected from staff of MPT, the short-term training and the mid-term training are provided. Thus, the training center has been responsible for train the staff to handle the communication infrastructures in Myanmar.

Table 5.4-1 Total no. of days joining the training of MPT staff in 2012

No.	Course	Training Record (Man-day)	Training Summary
1	Electronics・IT	1,280	MPT Training Center in Naypyitaw, Yangon
2	Outside Plant Facility	590	MPT Training Center
3	Telegraph/Data	130	MPT Training Center
4	Switching System	230	MPT Training Center /External Trainer
5	Mobile Comm, Radio Transmission	240	MPT Training Center /External Trainer
6	Postal, Telegram	540	MPT Training Center
7	Test Equipment	325	MPT Training Center
8	Administration	490	MPT Training Center /External Trainer
	TOTAL Record	3,825	

Source: Prepared by Survey Team

Total no. of average days of receiving the training of the information communication engineering, i.e., Off-the Job training is reported as 1.32 days /staff, [1)] while in Myanmar, it is 0.26 day/staff, therefore, there correspond to approximately 1/5 to the figure in Japan. Therefore, much more fulfillment of the staff training is desirous at present.

According to the grant aid program for urgent improving program of the communication network, agreed with Japanese Government and the Republic of the Union of Myanmar, reinforcement of the trunk communication networks connecting Yangon, Mandalay and Nepytaw, reinforcement of the intra-city communication networks, improvement of radio-access points, improvement of broadband communication environment, and strengthening the international gate station function, the newest transmission facilities and the mobile radio facilities and IP equipment, so on will be installed, in addition, staff engaging at the post, necessary technical training will be provided. In addition, knowledge in designing of the networks, construction, operation and maintenance are transferred. However, these trainings are provided for designing of the relating facilities, technique required for operation and maintenance. However, it may be still insufficient for strengthening overall function.

In the same time of improving, adding and finalizing the providing systems of communication services, the demand for the internet and the broadband system will be increased accordingly. Under such circumstances, knowledge on new technologies such as the transmission networks through optical fiber cables, the access networks through optical fiber cable network and the radio access networks are indispensable for communication technicians and engineers. However, in MPT, no sufficient number of such senior engineers are available, the senior engineers given below should be available as soon as possible.

1) Human resource management and productivity in Japanese enterprise

- Engineering, providing, operating and maintenance of IP fixed communication networks
- Engineering, providing, operating and maintenance of IP mobile communication networks
- Communication protocol
- Providing security, and so on

The training center should fulfill the functions for training human resources not only for MPT but also entirely for Myanmar.

On the other hand, the training subjects that have been provided in the training center, a part of the on-the-job training is preferred to be provided in the actual job site. Though in this program, establishment of the outside portion engineering center (OPEC), for operation and maintenance is included, the actual training function should be given to this center.

5.5 Other Subjects in Mid-Term Development Plan

In proceeding the Mid-Term Development Plan, the market function, development of new services, functions to increase the number of customers and the security function have been explained. These items are subjects relating with the management strategies, and the company structures.

In addition to these two subjects, there are three large subjects. One of them is a problem on the right of ownership of the existing MPT networks, next problem is the rules (for methods, technique, charging of required cost, cost for connection) and the last ones for the universal services (rules, method for charging, main and responsible party). These subjects relate with the management strategies and managing systems, but also the subjects relating with the national strategy, and the subject relating with construction of the communication sector, therefore, it is required for MPT to take actions positively.

CHAPTER 6 REVIEW OF WORKS SUBJECT TO ODA LOAN

6.1 Wish List submitted by MPT and Recommendations made on the Basis of the Mid-Term Plan

Initially MPT did not have an adequate understanding of Japan's ODA scheme, while Japan's understanding of the situation regarding telecommunications in Myanmar and the environment in which MPT is placed was also inadequate. As a result, changes were made to the wish list submitted by MPT and to the recommendations made by the study team as the selection process moved forward.

As the study progressed, however, mutual understanding deepened. Meanwhile, as the mid-term plan was further developed by the study team, works that should be implemented in addition to those included in the wish list submitted by MPT were defined and during the last half of the study period, the works shown in Table 6.1-1 were selected and became subject to review. These works also were classified on the basis of the three strategic axes described in Chapter 5, and their consistency with the mid-term plan was also confirmed.

Table 6.1-1 Wish List submitted by MPT and Recommendations made by the Study Team

Item	Candidates				Location	3 Axis Class	Remarks
	No.	Division	Work Proposal	Object			
Proposed Items by MPT	1	Long Distance	Establishment of NOC（w/o Building）	NW Monitoring	NPT, Yangon	Business Management	
	2		DWDM Transmission Equipment to Existing or on-going FOC	Increase od Backbone NW Capacity	All country	Infrastructure	
	3		FOC installation with DWDM Transmission Equipment	Increase of Core NW capacity	All country	Infrastructure	
	4	Overseas	DWDM Transmission Equipment to Submarine Cable approach route	Increase of International Circuits Capacity	Yangon – Landing Station	Telecom Service	Decided by MPT own fund
	5		DWDM Transmission Equipment to Satellite Communication link	Increase of International Circuits Capacity	Yangon – Earth Station	Telecom Service	
	6		Submarine Cable Installation (Myanmar＝Neighboring country）	Increase of International Circuits Capacity	Open Sea	Infrastructure	
	7	Auto-Tele	Improvement of OSP facilities (such as cable duct, MH and Pole, etc.) for Metro Network in 3 Major cities	Improvement of Metro Network	Naypyitaw, Yangon, Mandalay	Infrastructure	
	8		Improvement of FOC NW and FWA within Metro Cities			Infrastructure	
	9		Expansion of Broadband access in Metro Cities ((FTTH、FWA and LTE)	Improvement of broadband access NW		Infrastructure	
	10		Installation of Metro NW in 17 provinces other than 3 major cities (FOC and FWA, etc.)	Improvement of Metro Network	17 Provinces	Infrastructure	
	11	IT	Improvement of ISP with Introduction of IPv6	Increase IP address for improving Internet use	Yangon	Telecom Service	
	12		Establish Data Center（w/o Building）	Business development	3 Major Cities	Data Center Service (out of 3 Axis)	withdrawn due to out of 3 Axis
	13		Establishment of Internet Exchange（IX)	Improve Internet service	Mandalay	Infrastructure	

	14		Replacement of GW in Yangon	Improve Internet service	Yangon	Telecom Service	
	15	Mobile	LTE Expansion in 3 Major Cities	Improve Mobile Communication Services	3 major cities	Infrastructure	
Proposed Items by Survey Team	21		Access NW Expansion in Medium and Small cities	Increase of subscribers for fixed, mobile and Internet services	Medium and Small Cities	Infrastructure	
	22		Increase of subscribers in rural areas	Development of rural area and increase of subscribers	Rural areas	Telecom Service	
	23		Network Security	Strengthen Network functions	3 major cities	Infrastructure	
	24		Access to Thilawa SEZ	Support SEZ Project	Yangon to Thilawa SEZ	Contribute to National Project	Out of 3 Axis
	25		Deployment of LTE to Provinces	Increase of Mobile Subscribers	Provinces	Telecom Service	
	26		Improvement if infrastructures for IFC (Internet For Community) in Rural Area	Development of rural area and increase of internet users	Rural and Urban area	Telecom Service	
	27		Introduction of CS-Info and Data Management System	Improvement of Business Efficiency	Naypyitaw	Business Management	
	28		Establishment of Customer Service Center and Call Center	Improvement of Communication Service	Naypyitaw	Telecom Service	
	29		Strengthening of Training Center (TPTC)	Improvement of HRD	Urban area	Business Management	
	30		Establishment of Outside Plant Engineering Center (OPEC) in 3 major cities	Upgrade of engineering and technical skill for O&M	3 major cities	Business Management	

6.2 Filtering and Selection of Works

The works included in the wish list submitted by MPT and the recommendations made by the Japanese side shown in Table 6.1-1, excluding the 4th, 12th and 24th works, were filtered and narrowed down to a total of 22 works classified on the basis of the three strategic axes, taking into account the following conditions.

1. MPT's priority

2. Expected time the work should be completed using the ODA loan

3. Generally expected results of ODA loan, including expression of effect

Table 6.2-1 is the result of a review of the various conditions of the works included in the MPT wish list and the recommendations made by the Japanese side shown in Table 6.1-1. In Table 6.2-1 works that were selected for continued review through filtering are indicated with a circle in the Result column.

Table 6.2-1 Selection from Works in the MPT Wish List and Recommendations made by the Study Team

No	Work Selected	Priority by MPT	Expected Completion	Fitting to ODA Loan	Result ○: selected work
1	Establishment of NOC	High	Attention: not enough time for detail planning	Equipment to be procured by ODA Loan should be on priority	○
2	DWDM Transmission Equipment to existing or on-going FOC	High	Long period of time are required to implement all proposed routes by MPT	Concentrate to Backbone routes between 3 major cities	○ 3 routes between 3 major cities(*)
3	FOC Installation with DWDM	High	MPT is not able to wait the completion by ODA Loan		
5	DWDM to satellite communication link	High	No obstruction	Relation to work No.14	○
6	Submarine Cable Installation	High	Long period is required to settlement of environmental issues and negotiation with foreign operator	Work will be formulated as sole project	
7	Improvement of OSP facilities for Metro NW in 3 major cities	High	No obstruction	Integration with Work No. 8	○

8	Improvement of FOC NW and FWA within Metro Cities	High	No obstruction	Integration with Work No.7	○
9	Expansion of broadband access in Metro Cities (FTTH, FWA and LTE)	High	Long period is required for area selection and environmental assessment	Work will be formulated as sole project	
10	Installation of Metro NW in 17 provinces other than 3 major cities (FOC and FWA, etc,)	High		Review in Work No.21	Implement in Work No. 21
11	Improvement of ISP with Introduction of IPv6	High	No obstruction	Integration with Work No.14	○
13	Establishment of Internet Exchange （IX)	Law			
14	Replacement of GW in Yangon	High	No obstruction	Integration with Work No.11	○
15	LTE Expansion in 3 Major Cities	High		Continuation from Grant Aid Project	○
21	Access NW Expansion in Medium and Small cities	High	Selection of objective areas is required	Areas along with Work No.2 routes	○（areas along with Work No. 2 routes）
22	Increase of subscribers in rural areas	Law			
23	Network Security	Middle			
25	Deployment of LTE to Provinces	Law			
26	Improvement if infrastructures for IFC (Internet For Community) in Rural Area	Law			
27	Introduction of CS-Info and Data Management System	High	Same as Work No.1	Integration with Work No.1	○ （with Work No.1）
28	Establishment of Customer Service Center and Call Center	Law			
29	Strengthening of Training Center (TPTC)	High	Long period is required	Fitting to Technical Assistance Framework	

30	Establishment of Outside Plant Engineering Center (OPEC) in 3 major cities	High	No Objection	Equipment to be procured by ODA Loan should be on priority	○

(*) : 3 routes between 3 major cities are the following routes:
Yangon－Pyay－Magwe－Natmauk－Pyawbwe－Naypyitaw
Yangon aNaypyitaw -Mandalay : along with highway
Mandalay － Bagan － Magwe

6.3 Three Strategic Axes and Selected Works

The number of works was narrowed down in the above-mentioned way to a total of 12. These works were again reviewed according to four strategic axes made up of the previous three strategic axes plus a newly added 4th axis, "National Development Project Assistance." In this review, a new serial number was given to each work and the titles of some works were changed to more appropriately represent their content. Table 6.3-1 shows the new and old serial numbers given to the works along with their names, in the form of a comparison table.

Table 6.3-1 Comparison Table for New and Old Serial Numbers and Titles of Works

Old No.	Work Item	Location	3 Axis Class	New No.	New Work Name
2	DWDM Transmission Equipment to existing or on-going FOC	Between 3 Major cities	Infrastructure	1	Transmission Equipment for the Backbone Connecting the Three Metro-cities
7	Improvement of OSP facilities (such as cable duct, MH and Pole, etc.) for Metro Network in 3 Major cities	3 Major Cities	Infrastructure	2	Outside Plant Extension in the three Metro Cities
8	Improvement of FOC NW and FWA within Metro Cities		Infrastructure	3	High Speed Optical Fiber Network in three Metro Cities
15	LTE Expansion in 3 Major Cities	3 Major Cities	Infrastructure	4	LTE Expansion in three Metro Cities
21	Access NW Expansion in Medium and Small cities	Medium and Small Cities	Infrastructure	5	Network Plan Towns along the Backbone Network between Connecting the Three Metro-Cities
5	DWDM Transmission Equipment to Satellite Communication link	Yangon – Earth Station	Telecom Service	6	Install Transmission Equipment for the Yangon – Thanlin Circuit (International Satellite Earth Station)
14	Replacement of GW in Yangon	Yangon Naypyitaw	Telecom Service	7	National Gateway Overhaul
11	Improvement of ISP with Introduction of IPv6	Yangon	Telecom Service	8	Upgrading of ISP Services and Introducing IPv6 in Yangon
1	Establishment of NOC（w/o Building）	Naypyitaw	Business Management	9	Network Operation Center (NOC) Construction
27	Introduction of CS-Info and Data Management System	Naypyitaw	Business Management		
30	Establishment of Outside Plant Engineering Center (OPEC) in 3 major cities	3 Major Cities	Business Management	10	Outside Plant Engineering Center (OPEC) in the Three Metro Cities
				11	Outside Plant Engineering Center Building
24	Access to Thilawa SEZ	Yangon – Thilawa SEZ	Contribute to National Project	12	Thilawa SEZ Circuit

Source: Survey Team

In addition, Figure 6.3-1 shows the newly-assigned serial numbers and work titles.

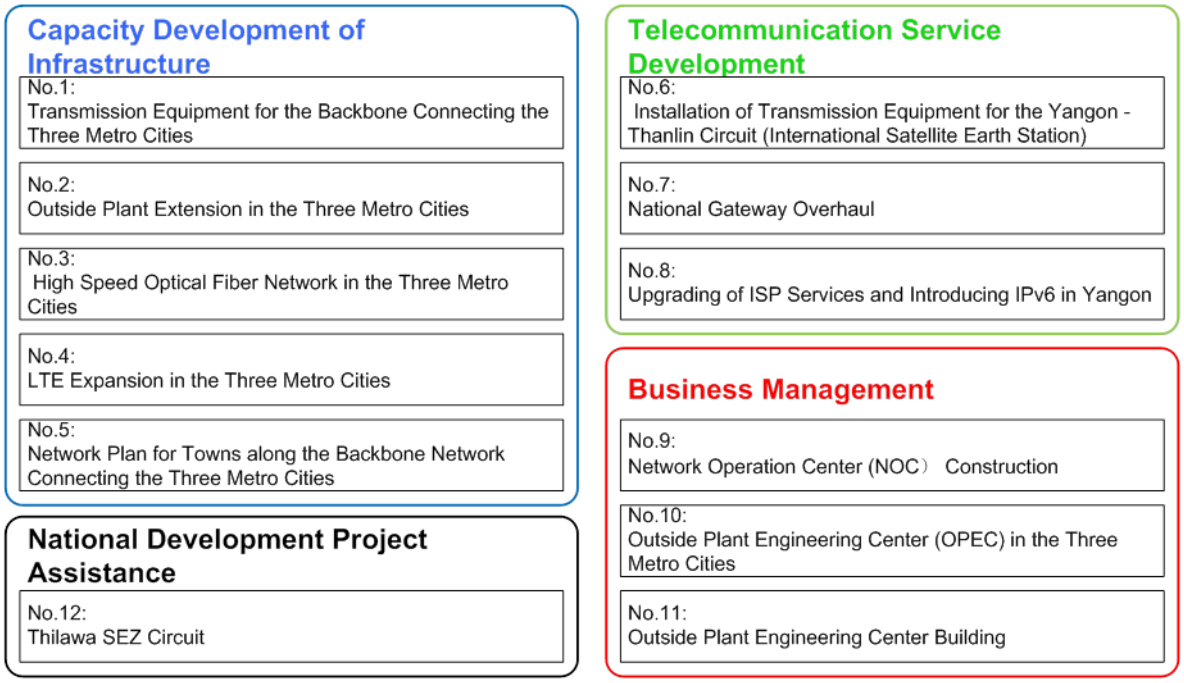


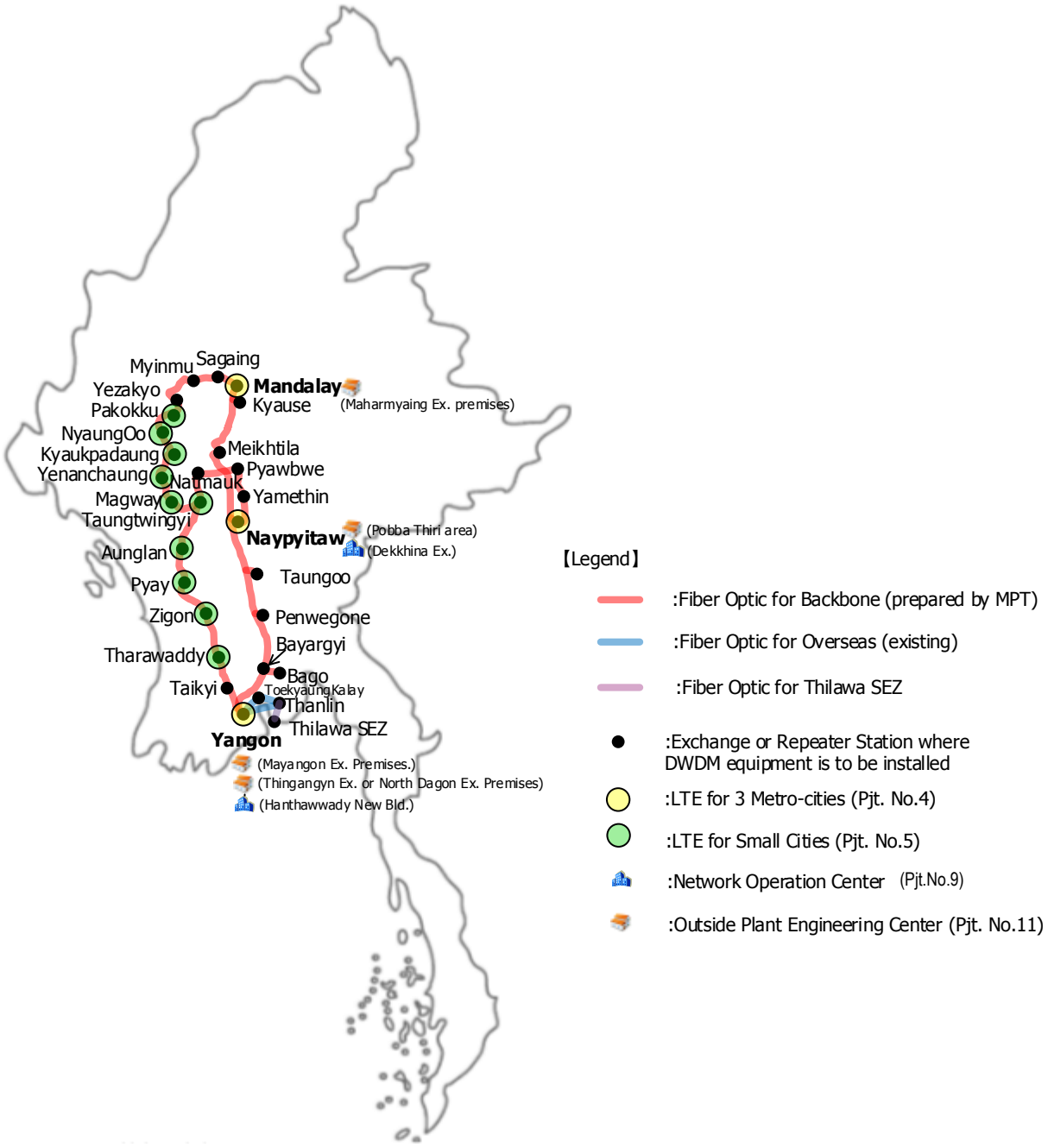
Figure 6.3-1 Project Summary

Of these works, three works, No.4 "LTE Expansion in Three Metro Cities, " No.5 " Network Plan for Towns along the Backbone Network Connecting the Three Metro Cities" and No.12 "Thilawa SEZ Circuit," have all, for various reasons, been prepared and reviewed using a desk outline design method. As a result, because of the tight time constraints it has been difficult to sufficiently take the actual implementation environment into account in creating designs.

In addition, it is highly possible that these works will be operated and managed by multiple divisions/departments of MPT, and based on this assumption, it was expected that discussions with MPT would take a significantly long time. Therefore, in this preparatory study, with respect to these three works, although some field study and discussions with MPT will be implemented, a desk outline designing process and a quantity survey based on the outline design only have been completed. So, the designing of works that take the actual introductory environment into account will be carried out during the detailed design process. In the report of this preparatory study, the preconditions used in the desk outline designing process will be clearly defined so as to prevent the occurrence of any confusion during the detailed design process due to the existence of any unclear preconditions.

6.4 Project site/Target areas

Figure 6.4-1 shows the major contents and sites of the project components.



Source: Suvey Team

Figure 6.4-1 Major Contents and Sites of Project Components

6.5 Effects Expected to be Gained through Implementation of Works

Table 6.5-1 shows the effects expected to be achieved through the implementation of these 12 works.

Table 6.5-1 Effects Expected to be achieved through Implementation of the Works

Work Item	Work No.	Benefit to MPT	Benefit to Users
Transmission Equipment for the Backbone Connecting the Three Metro-cities	No. 1	Traffic increase carrying all kinds of services between 3 Metro Cities	Improve the service level regarding fixed phone, mobile phone and internet throughout the country
Network Improvement in three Metro Cities	No. 2,3	Traffic increase carrying all kinds of services to/from three Metro Cities	Improve the service level for all services to/from three Metro Cities
LTE Expansion in three Metro Cities	No. 4	Traffic increase for mobile phone and internet to/from three Metro Cities	Expansion of service areas regarding the services for mobile phone and internet to/from three Metro Cities
Network Improvement in Towns along the Backbone Network between Connecting the Three	No. 5	Effective use of improved communication infrastructures (backbone between three Metro Cities)	Improvement of service level for mobile phone and internet to users in the objective medium and small cities
Install Transmission Equipment for the Yangon – Thanlin Circuit (International Satellite Earth Station)	No. 6	Increase international traffic (need to increase the circuit volume for overseas portions)	Improvement of service level of telephone an internet for overseas communication users throughout the country
Upgrading of ISP Services and Introducing IPv6 in Yangon	No. 7,8	Improvement of quality and reliability of internet service	Improvement of service level of internet users throughout the country
Network Operation Center (NOC) Construction	No. 9	Cost reduction, improvement of operation and maintenance effectiveness for national level infrastructure and collection of basic data for further improvement	Quick response to user complaint for network failure and improvement of service level
Outside Plant Engineering Center (OPEC) in the Three Metro Cities	No. 10,11	Cost reduction, improvement of effectiveness and speeding up of the outside plant maintenance with HRD	Quick response to user complaint for network failure and improvement of service level
Thilawa SEZ Circuit	No. 12	Cooperation with National Development Project	Improvement of service level to Tenants inside Thilawa SEZ

6.6 Recommendation for Next Projects

As mentioned above, in the recommendations made for this project, it was decided that a major

focus should be placed on the improvement of the telecommunication network within and between the 3 metropolitan cities of Yangon, Naypyitaw and Mandalay as well as smaller cities located between these three metropolitan cities. As shown in the mid-term plan described in Chapter 5, however, Myanmar plans to improve its telephone density up to 80% in its national program. Works planned for this project will not be adequate to reach this targeted telephone density without a deterioration in the level of service. It is obvious that, although self-help endeavors have to be made by MPT, support should be provided from other countries, too. In addition, it is expected that Japan will continue to offer support. In view of the circumstances, it was decided to recommend that works which had been excluded from this project but which are considered necessary for the further development of the communication network in Myanmar should be made components of successive projects.

(1) Development of communication infrastructure

1. Extending communication infrastructure to the regions
2. Further increasing international transmission capacity
3. Installation of new bi-country submarine cables as an option for 2 above

(2) Improvement in communication service

1. Extending IPv6 from Yangon to other areas
2. Improving network security

(3) Improvement in management

1. NOC phase 2 (the project scope of this preparatory study should become phase 1)
2. Extending outside plant engineer centers (OPEC) to the regions
3. Strengthening the training center

CHAPTER 7 OUTLINE OF SCOPE OF WORKS

7.1 Outline of Project Plan

7.1.1 Transmission equipment for the backbone network connecting the three metro cities

(1) Current situation

The backbone network currently connecting the three metro-cities of Yangon, Naypyitaw and Mandalay is constructed of microwave radio links and fiber optic cable links. The microwave radio links are provided on three routes in the west, center and east, while 12-core fiber optic cable has been laid along national roads and 96-core fiber optic cable has been laid along the highways. However, the transmission equipment for the fiber optic cables is insufficient and the microwave radio links are decrepit and inadequate in terms of quality. (For details, refer to 5.2.2(1).) MPT therefore has introduced wavelength division multiplexing (WDM) equipment with a bandwidth of 30Gbps and strengthen the backbone network using 96-core optical fiber along the highways through the Project for Urgent Improvement of Communication Networks under Japanese Government grant aid. MPT is also currently constructing new fiber optic cables between the three metro-cities, called the backbone network, and further expansion is planned with existing optical fiber routes.

(2) Necessity (Relevance)

After considering the capacity requested by MPT, it was judged to be appropriate and a backbone network plan was formulated as shown below. When calculating the capacity of the transmission line in relation to the transmission speed values shown in Table 5.2-7 in Section 5.2.7, as well as the need to estimate double the capacity in order to cope with two-way incoming and outgoing traffic, it is also necessary to make allowance for double the capacity in order to ensure redundancy in a ring configuration. Therefore, the total transmission capacity will be 2.5Tbps or more, four times the "total communication speed" shown in Table 5.2-7. When this is distributed on the three routes currently planned, approximately 800Gbps is required per route, so the 500Gbps requested by MPT is not excessive.

On the other hand, as the total two-way incoming and outgoing capacity for average traffic demand (419.50Gbps) is about double at 840Gbps, the planned capacity to be introduced in this project (500Gbps) is approximately 60% of total average demand and is judged to be capable of coping with increased demand for the foreseeable future. As the transmission equipment can easily be expanded, it would be not urgent to cope with 100% of average traffic demand at present and in consideration of improvement status of communication networks, appropriate steps can be taken as necessary in future.

As the wavelength division multiplexing equipment (30Gbps) which was introduced through the grant aid project is operated as it is, the total route (route B) capacity becomes 530Gbps.

(3) Scope of upgrade

The scope of the upgrade plan is shown in the backbone network link configuration for the three metro-cities in Figure 7.1-1.

(4) Equipment to be introduced

DWDM multiplexing equipment for increase in existing fiber optic cable links between the three metro-cities: 100Gbps x 5 wavelengths.

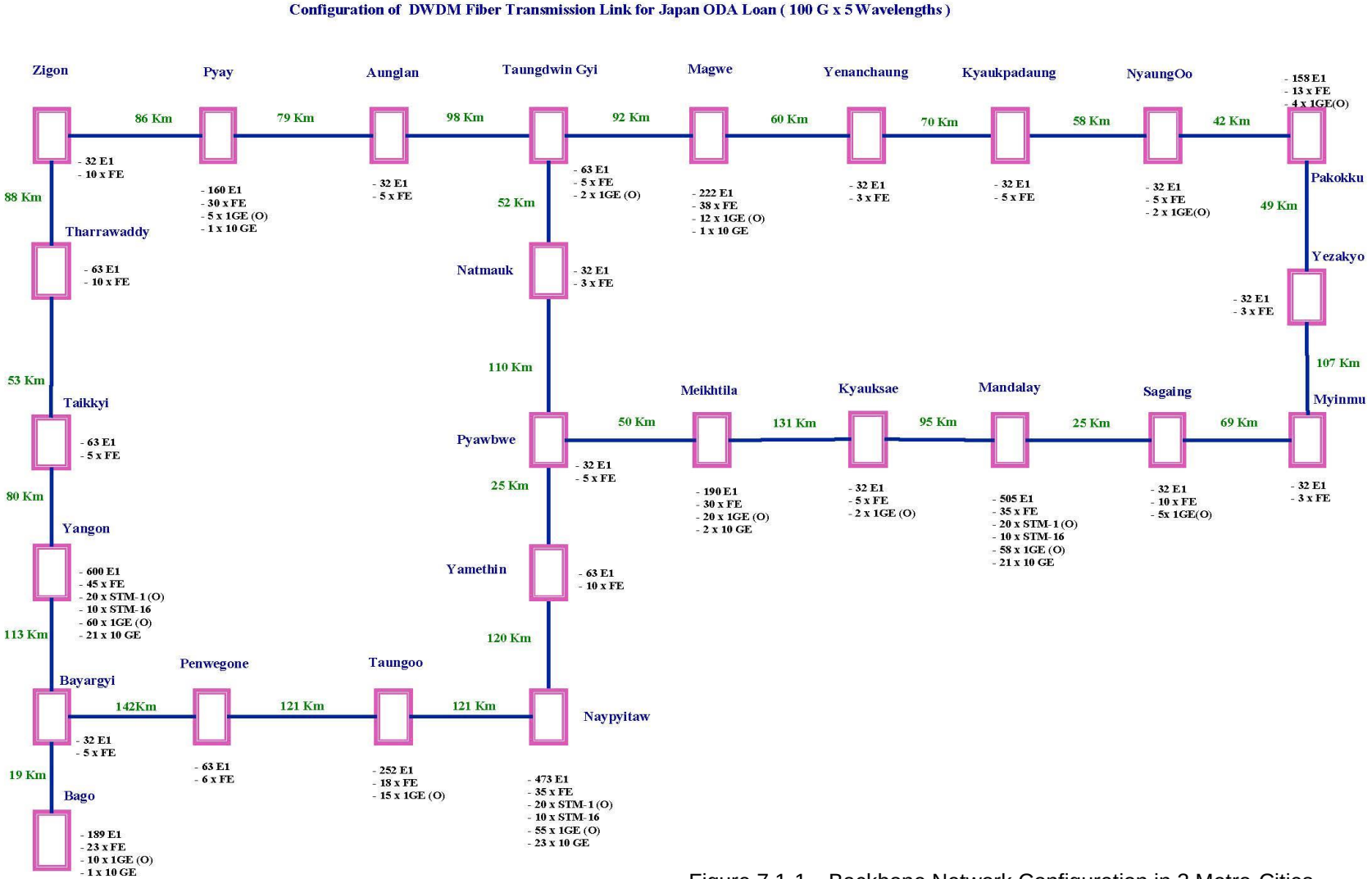


Figure 7.1-1 Backbone Network Configuration in 3 Metro-Cities

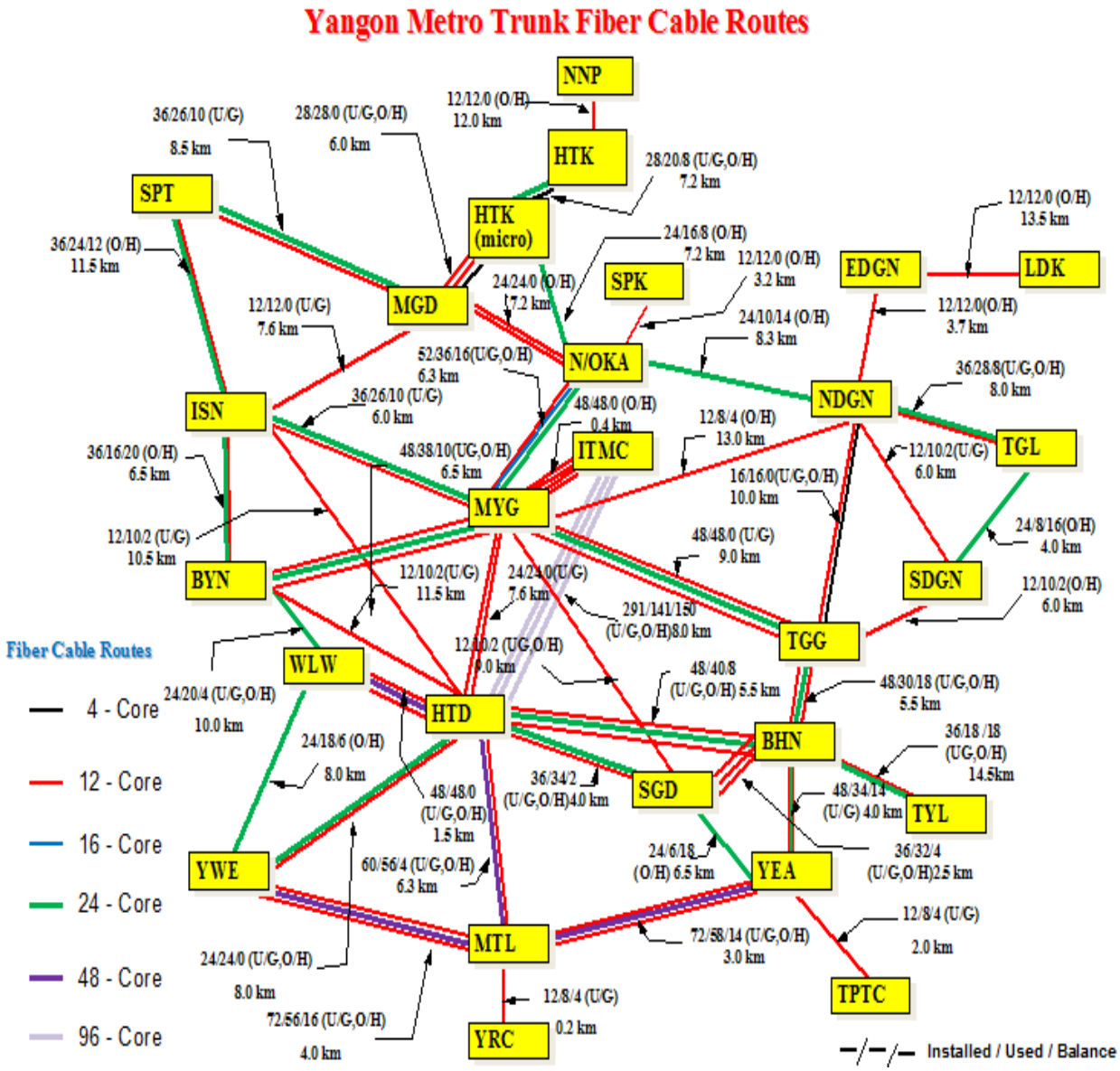
Source: MPT & Survey Team

7.1.2 Outside plant extension in the three metro cities

(1) Current situation

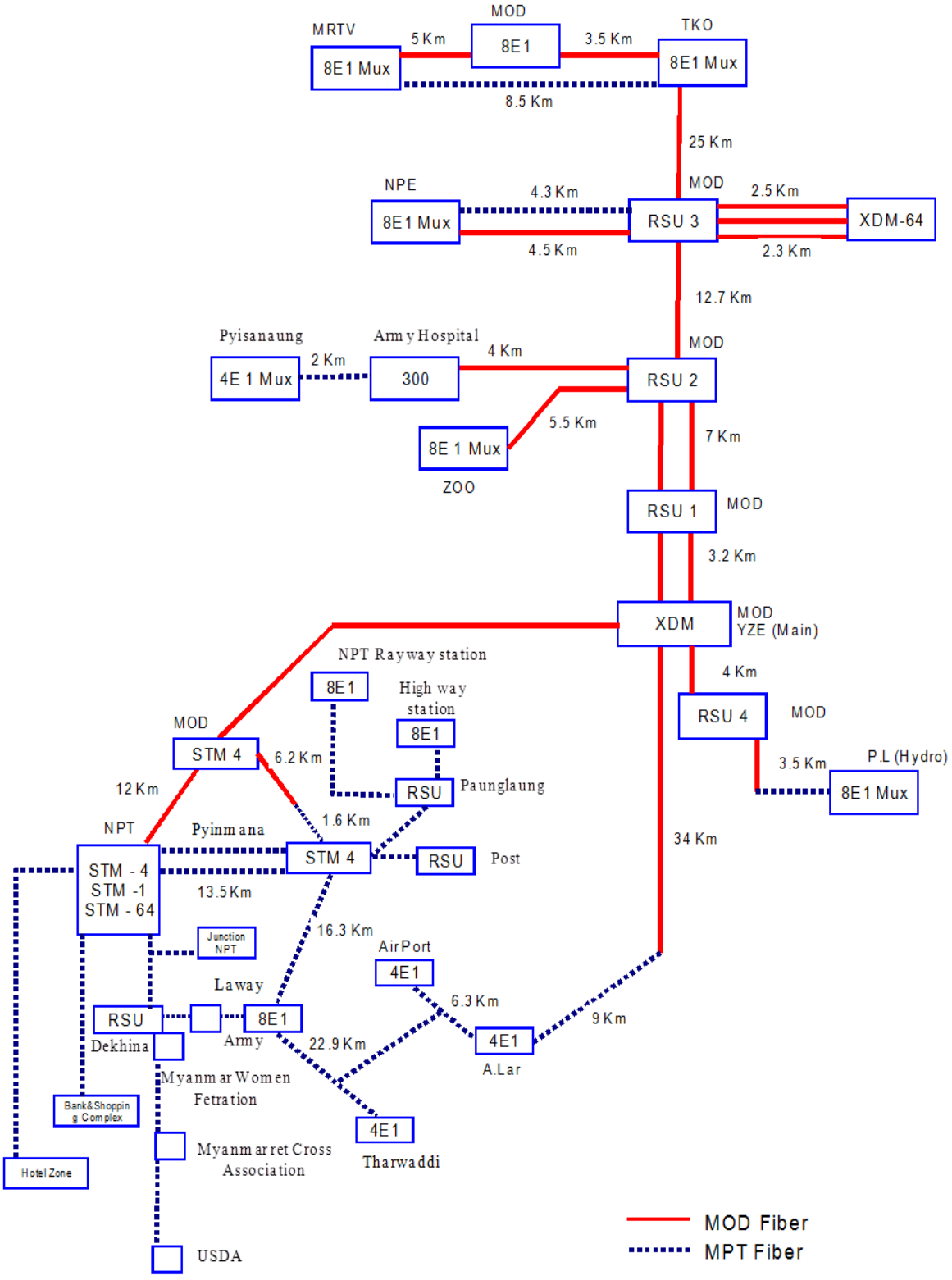
It will be necessary to lay fiber optic cables for the metro network as described in Section 7.1.3, but it will also be necessary to lay cable ducts at the same time. The current situation of the metro network in Yangon, Naypyitaw and Mandalay is shown in the figures below.

- Figure 7.1-2 Yangon Metro Trunk Fiber Cable Routes
- Figure 7.1-3 Naypyitaw Metro Trunk Fiber Cable Routes
- Figure 7.1-4 Mandalay Metro Trunk Fiber Cable Routes



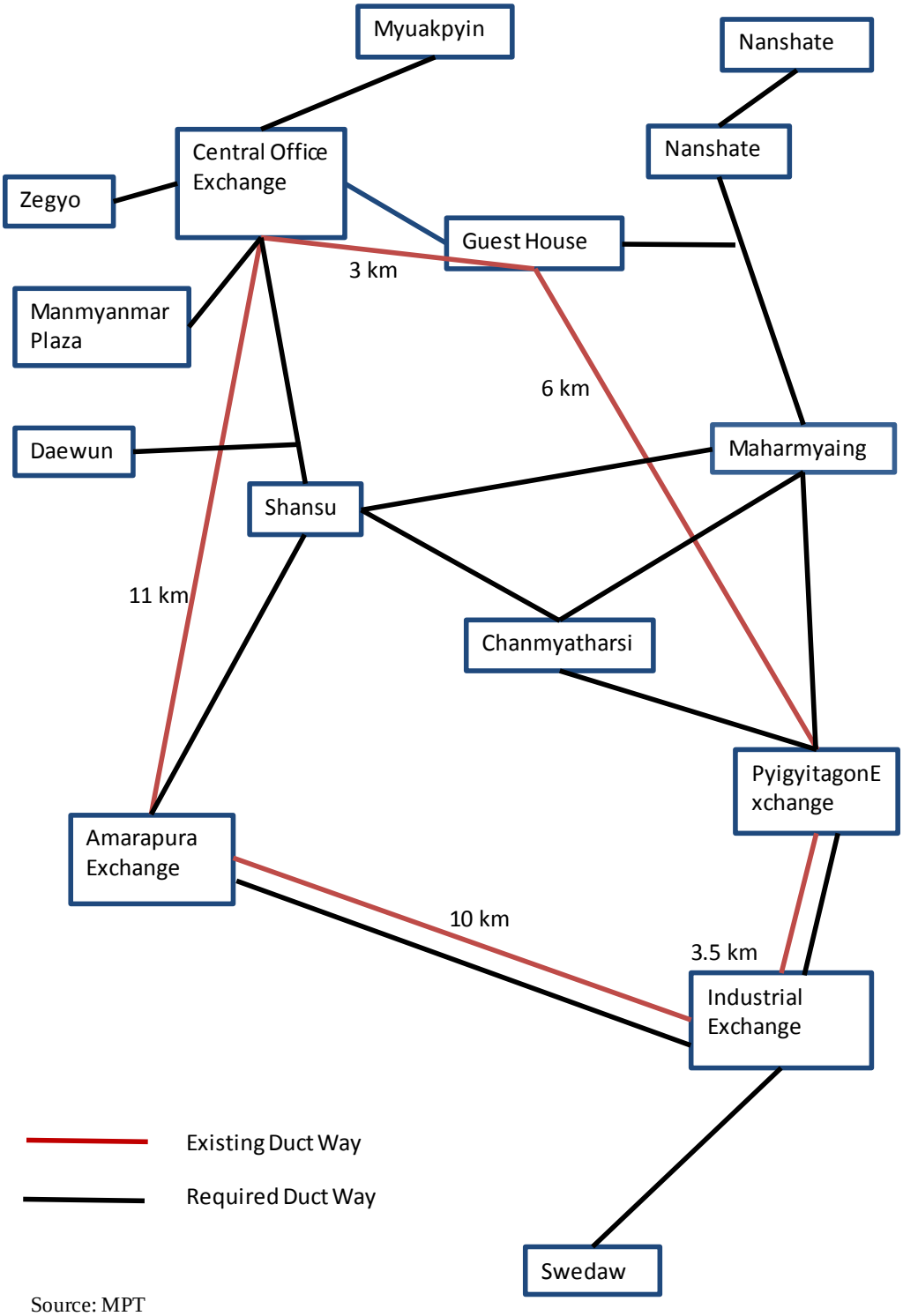
Source: MPT

Figure 7.1-2 Yangon Metro Trunk Fiber Cable Routes



Source: MPT

Figure 7.1-3 Naypyitaw Metro Trunk Fiber Cable Routes



Source: MPT

Figure 7.1-4 Mandalay Metro Trunk Fiber Cable Routes

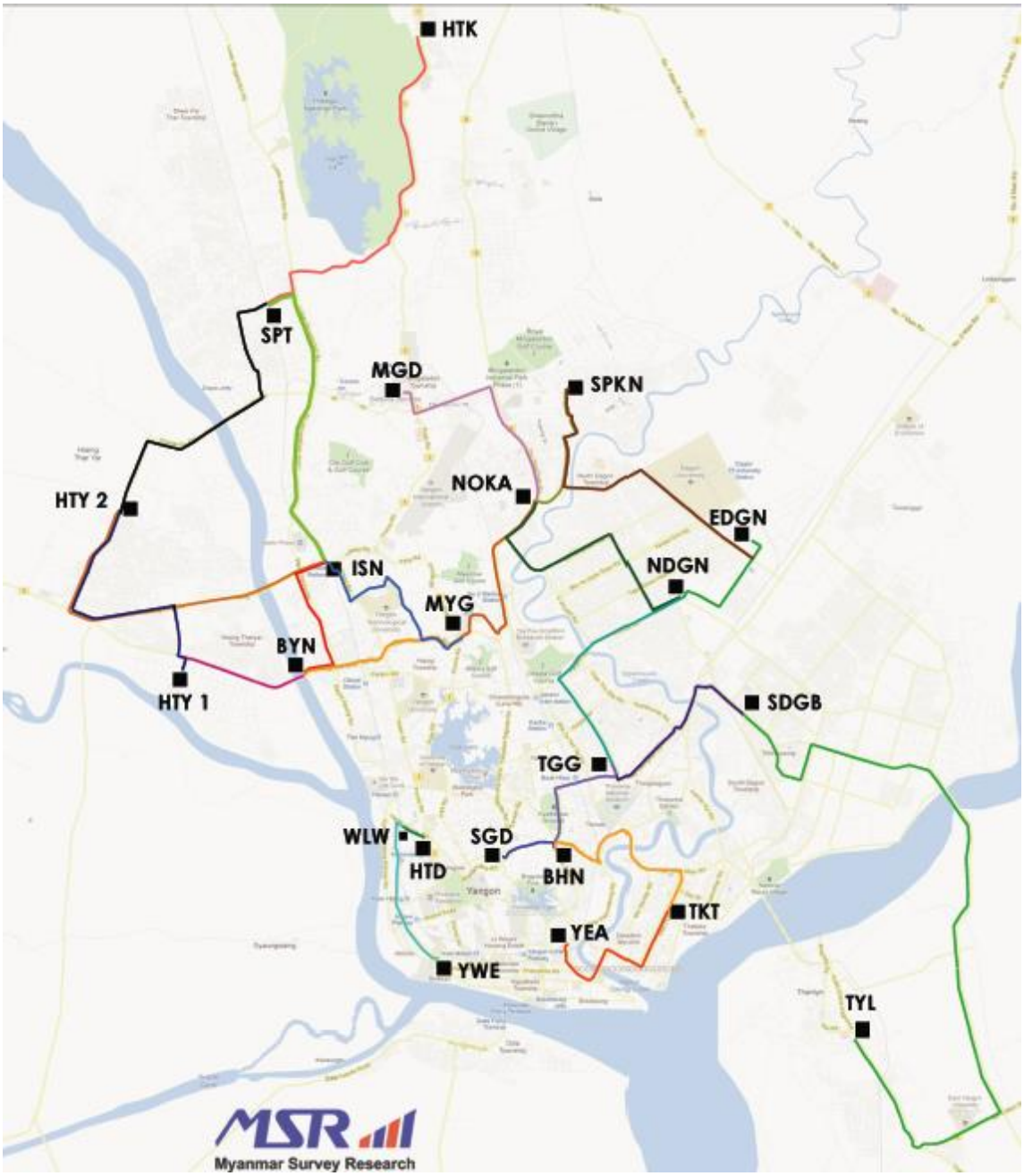
(2) Necessity (Relevance)

MPT uses an underground duct system when laying cables in urban areas. As described in Section 7.1.3, it plans to expand the metro network using fiber optic cables, but as there is no available space in the existing ducts, more new underground embedded ducts will have to be installed.

(3) Scope of upgrade

The scope of the upgrade plan is shown in the metro network planned duct route in each of the following cities.

(a) Figure 7.1-5 Yangon Metro Network Planned Duct Route
(b) Figure 7.1-6 Naypyitaw Metro Network Planned Duct Route (1/2)
(c) Figure 7.1-7 Naypyitaw Metro Network Planned Duct Route (2/2)
(d) Figure 7.1-8 Mandalay Metro Network Planned Duct Route

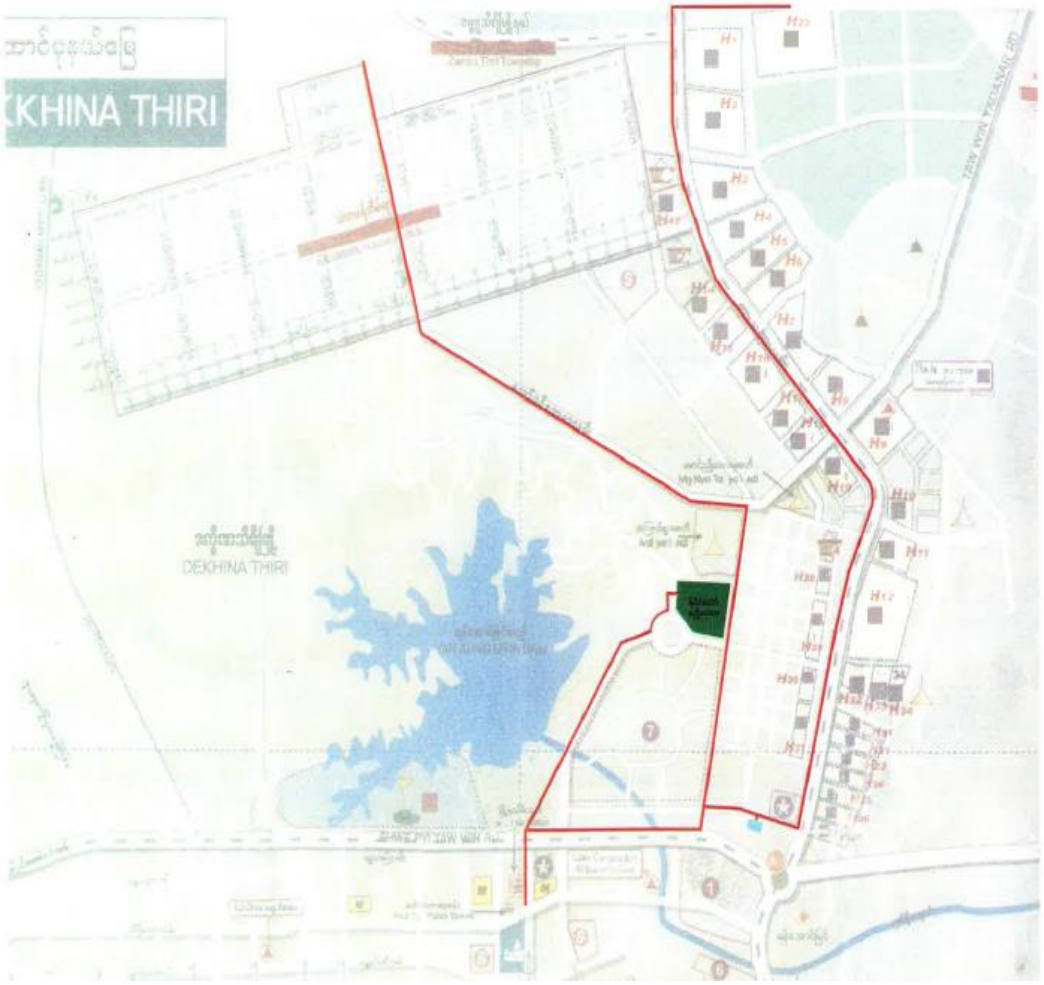


Source: Survey Team

Figure 7.1-5 Yangon Metro Network Planned Duct Route

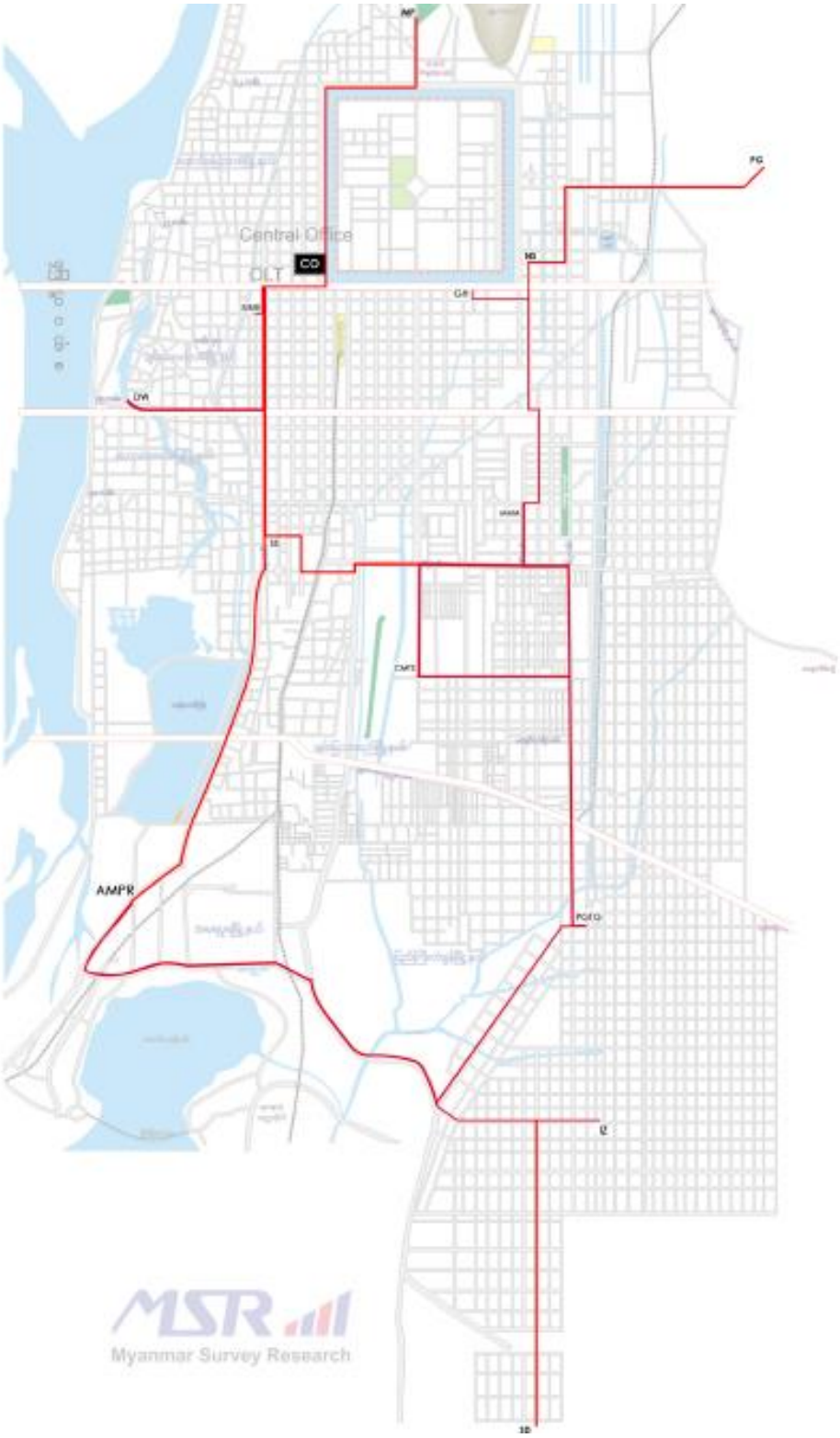
Source: Survey Team

Figure 7.1-6 Naypyitaw Metro Network Planned Duct Route (1/2)



Source: Survey Team

Figure 7.1-7 Naypyitaw Metro Network Planned Duct Route (2/2)



Source: Survey Team

Figure 7.1-8 Mandalay Metro Network Planned Duct Route

(4) Equipment to be introduced

Details of the ducts to be constructed in each city are shown in the following cable duct tables.

- Table 7.1-1 Cable Ducts Column in the Table of Yangon Metro New Fiber Route Table
- Table 7.1-2 Cable Ducts Column in the Naypyitaw Metro New Fiber Route Table
- Table 7.1-3 Cable Ducts Column in the Mandalay Metro New Fiber Route Table

Table 7.1-1 Yangon Metro New Fiber Routes

No.	Routes	Distance (km)	Ducts (Note 1) (mm × pipe)	Optical Cables	Laying Method	Spare Cores in existing cable (Note 2)
1	MGD - NOKA	7.2	100φ×4	48 Core	U/G Laying	0
2	HTD - WLW	1.5	100φ×4	48 Core	U/G Laying	0
3	NDGN - TGG	10.0	100φ×4	48 Core	U/G Laying	0
4	NDGN - EDGN	3.7	100φ×4	48 Core	U/G Laying	0
5	BYN - HTY-1	5.5	100φ×4	48 Core	U/G Laying	New installation
6	HTY-1 - HTY-2	5.0	100φ×4	48 Core	U/G Laying	New installation
7	ISN - HTY-2	5.5	100φ×4	48 Core	U/G Laying	New installation
8	YEA - TKT	6.0	100φ×4	48 Core	U/G Laying	New installation
9	SPT - ISN	11.5	100φ×4	48 Core	U/G Laying	12 (Aerial Laying)
10	ISN - BYN	6.5	100φ×4	48 Core	U/G Laying	20 (Aerial Laying)
11	NOKA - NDGN	8.3	100φ×4	48 Core	U/G Laying	14 (Aerial Laying)
12	TGG - SDGN	6.0	100φ×4	48 Core	U/G Laying	0
13	TGG - BHN	5.5	100φ×4	48 Core	U/G Laying	18 (Aerial Laying)
14	WLW - YWE	8.0	100φ×4	48 Core	U/G Laying	6 (Aerial Laying)
15	SGD - BHN	2.5	100φ×4	48 Core	U/G Laying	2 (Aerial Laying)
16	BHN - TKT	6.9	100φ×4	48 Core	U/G Laying	New installation
17	MYG - ISN	7.3	100φ×4	48 Core	U/G Laying	10
	Sub Total 48 core	**106.9**				
18	BYN - MYG	6.5	100φ×4	96 Core	U/G Laying	10 (Aerial Laying)
19	MYG - NOKA	6.3	100φ×4	96 Core	U/G Laying	16 (Aerial Laying)
	Sub Total 96 core	**12.8**				
20	EDGN - SPKN	10.8		24 Core	Aerial	New installation
21	NOKA - SPKN	4.7		24 Core	Aerial	0
22	SPT - HTY-2	13.0		24 Core	Aerial	New installation
23	SDGN - TYL	27.0		24 Core	Aerial	New installation
24	SPT-HTK	18.0		24 Core	Aerial	New installation
	Sub Total 24core	**73.5**				
	Summary					
	Fiber Optic 24core	73.5				
	Fiber Optic 48core	106.9				
	Fiber Optic 96core	12.8				
	Cable duct 100φ×4	119.7				

(Note 1): Unit for 100 is mm and φshows diameter.
(Note 2): 63% of cable routes are fully occupied (no spare cores) or new installation is required. 37% area aerial cables which are planned to be replaced to the U/G (underground) newly installed one by one because of being decrepit.

Table 7.1-2 Naypyitaw Metro New Fiber Routes

No.	Routes	Distance (km)	Ducts (Note 1) (mm× pipe)	Optical Cables	Laying Method	Spare Core in existing cable
1	PMN - LW Ex:	17.0		24 Core	Aerial	0ew installation
2	LW - EL Ex;	25.0		24 Core	Aerial	New installation
3	TK - IGW	25.0		24 Core	Aerial	New installation
4	ZYTR (Pyi San Aung BTS) - YZ BTS	20.0		24 Core	Aerial	New installation
5	YZ - PL BTS	25.0		24 Core	Aerial	New installation
6	DKNTR - EL Ex;	35.0		24 Core	Aerial	New installation
7	ZYTR PSA - IGW	15		24 Core	Aerial	New installation
8	PBTR - TK Micro	40		24 Core	Aerial	New installation
	Sub Total 24 core	**202.0**				
9	PMN - PL BTS	5.0	100 ϕ× 4	48 Core	U/G Laying	New installation
10	PMN -NPT Council	3.5	100 ϕ× 4	48 Core	U/G Laying	New installation
11	NPT Council - DKNTR	30.0	100 ϕ× 4	48 Core	U/G Laying	New installation
12	LW - DKNTR	10.0	100 ϕ× 4	48 Core	U/G Laying	New installation
13	DKNTR - BK RSU1	30.0	100 ϕ× 4	48 Core	U/G Laying	New installation
14	DKNTR - RSU13	30.0	100 ϕ× 4	48 Core	U/G Laying	New installation
15	RSU 3 - RSU 13	4.5	100 ϕ× 4	48 Core	U/G Laying	New installation
16	PMN - PBTR	20	100 ϕ× 4	48 Core	U/G Laying	New installation
17	PMN - TPK RSU 22	13	100 ϕ× 4	48 Core	U/G Laying	New installation
18	BK RSU1 - RSU 13	10	100 ϕ× 4	48 Core	U/G Laying	New installation
19	PBTR - ZYTR PSA	20	100 ϕ× 4	48 Core	U/G Laying	New installation
20	DKNTR - NPT S12	15.0	100 ϕ× 4	48 Core	U/G Laying	New installation
21	TPK RSU22 - NPT S12	10.0	100 ϕ× 4	48 Core	U/G Laying	New installation
22	PBTR - OTRTR	12.0	100 ϕ× 4	48 Core	U/G Laying	New installation
23	OTRTR - NPT S12	35	100 ϕ× 4	48 Core	U/G Laying	New installation
24	NPT S12 - RSU 3	10	100 ϕ× 4	48 Core	U/G Laying	New installation
	Sub Total 48core	**258.0**				
	Summary					
	Fiber Optic 24core	202.0				
	Fiber Optic 48core	258.0				
	Cable duct 100φ×4	258.0				

(Note 1): Unit for 100 is mm and ϕshows diameter.

Table 7.1-3 Mandalay Metro New Fiber Routes

No.	Routes	Distance (km)	Ducts (Note 1) (mm× pipe)	Optical Cables	Remark	Spare Cores in existing cable (Note 2)
1	Central Office-Pygyitagon	13.0		96 Core	Aerial	0
	Sub Total 96core	**13.0**				
2	Central Office-Nan Shate	4.0		48 Core	Aerial	16 (Aerial Laying)
3	Central Office-Chanmyatharsi	10.0		48 Core	Aerial	0
4	Central Office-Shansu	4.5	100ϕ×4	48 Core	U/G Laying	18 (Aerial Laying)
5	Central Office-Daewun	6.0	100ϕ×4	48 Core	U/G Laying	0
6	Central Office-Myuak Pyin	6	100ϕ×4	48 Core	U/G Laying	0
7	Central Office-Guest House	3	100ϕ×4	48 Core	U/G Laying	0
8	Central Office - Manmyanmar	1.5	100ϕ×4	48 Core	U/G Laying	2 (Aerial Laying)
9	Pygyitagon-Amarapura	10.0	100ϕ×4	48 Core	U/G Laying	New installation
10	Pygyitagon-Chanmyatharsi	6.0	100ϕ×4	48 Core	U/G Laying	4 (Aerial Laying)
11	Pygyitagon-Mahar Myaing	6.0	100ϕ×4	48 Core	U/G Laying	12(Aerial Laying)
12	Amarapura-Shansu	6.0	100ϕ×4	48 Core	U/G Laying	18 (Aerial Laying)
13	Amarapura-Industrial Zone	10.0	100ϕ×4	48 Core	U/G Laying	18 (Aerial Laying)
14	Industrial Zone-Swe Daw	5	100ϕ×4	48 Core	U/G Laying	0
15	Nan Shate-Mahar Myaing	5	100ϕ×4	48 Core	U/G Laying	
16	Chanmyatharsi-Mahar Myaing	6	100ϕ×4	48 Core	U/G Laying	6 (Aerial Laying)
17	Chanmyatharsi-Shansu	5	100ϕ×4	48 Core	U/G Laying	New installation
18	Mahar Myaing-Shansu	7	100ϕ×4	48 Core	U/G Laying	New installation
19	Daewun-Shansu	6.0	100ϕ×4	48 Core	U/G Laying	0
20	Nan Shate- Pathein Gyi	8.0	100ϕ×4	48 Core	U/G Laying	0
	Sub Total 48core	**115.0**				
	Summary					
	Fiber Optic 48core	115.0				
	Fiber Optic 96core	13.0				
	Cable duct 100φ×4	101.0				

(Note 1): Unit for 100 is mm and ϕshows diameter.
(Note 2): 60% of cable routes are fully occupied (no spare cores) or new installation is required. 40% area aerial cables which are planned to be replaced to the U/G (underground) newly installed one by one because of being decrepit.

7.1.3 High speed optical fiber network in three metro cities

(1) Current situation

There is no room for expansion using the existing cables of the metro network in the three metro-cities, aerial cables are used in many places and the lack of stability is a problem. On the other hand, trunk lines are also in short supply.

(2) Necessity (Relevance)

In order to improve the situation described above and build a stable network toward future privatization, MPT will have to install more fiber optic cables.

From Table 5.2-8 the number of data subscribers in the three metro-cities is estimated at 9 million. As more than a dozen ring configurations are planned for the metro network in the three metro-cities, an average 500,000-1 million subscribers per ring can be accommodated. The "communication capability" is greatly affected by internet (data) traffic. Based on Table 5.2-7, the average data communication speed per user is approximately 14kbps (or more precisely 13.89), so the access system will be 7-14Gbps per ring. The metro network will also have a ring configuration, so it will be necessary to secure fourfold capacity, the same as the backbone network.

The required capacity, therefore, is 28-56Gbps. In addition, the metro network is used not only for access but as a relay transmission route and the percentage varies from place to place. On non-relay rings, the access capacity becomes the required capacity as it is. On the other hand, on rings with many relays, if relay is three times access, the required capacity might be as high as 170Gbps in some places. Based on the above, the required capacity of the metro network varies greatly from place to place and is largely in the range of 30-170Gbps. To convert this average value into the design value, 1.5 times means that the capacity must be in the region of 45-250Gbps.

(3) Scope of upgrade

The scope of the upgrade plan is shown in the planned network line route in each city as follows.

(a) Figure 7.1-9 Yangon Metro Network Expansion
(b) Figure 7.1-10 Naypyitaw Metro Network Expansion
(c) Figure 7.1-11 Mandalay Metro Network Expansion

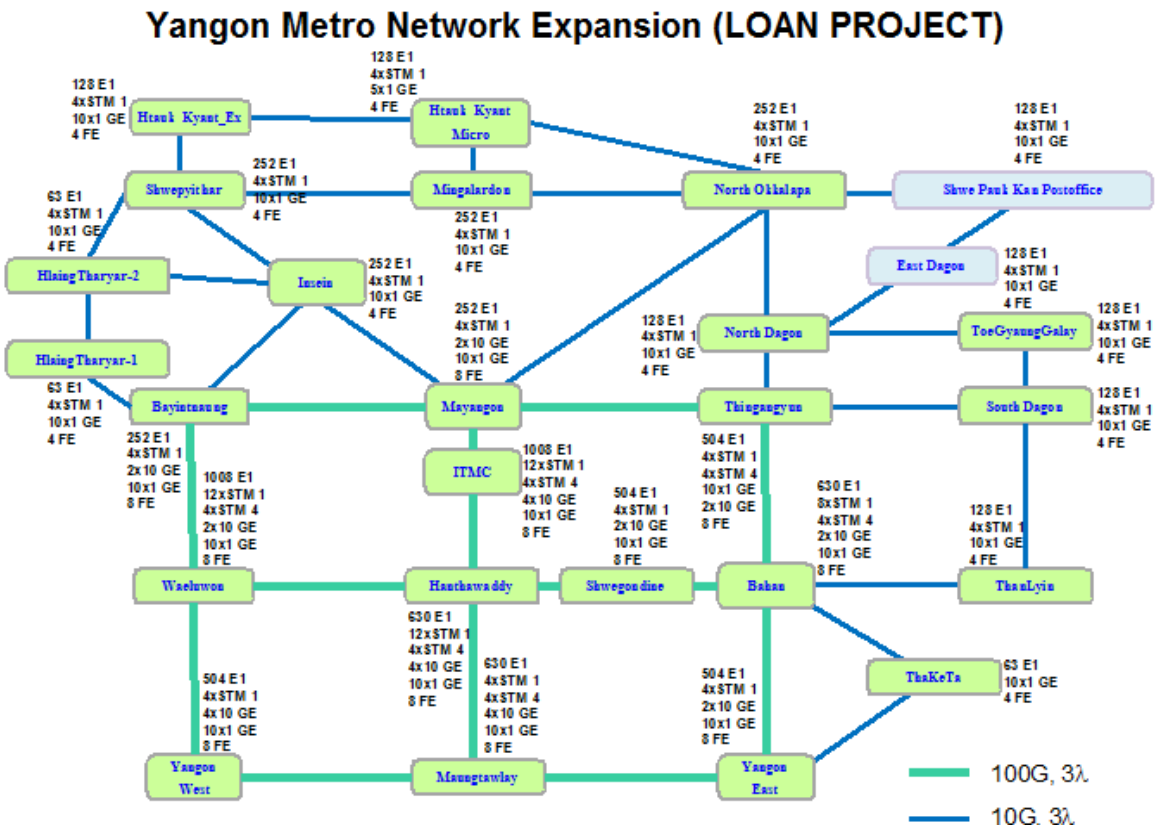


Figure 7.1-9 Yangon Metro Network Expansion

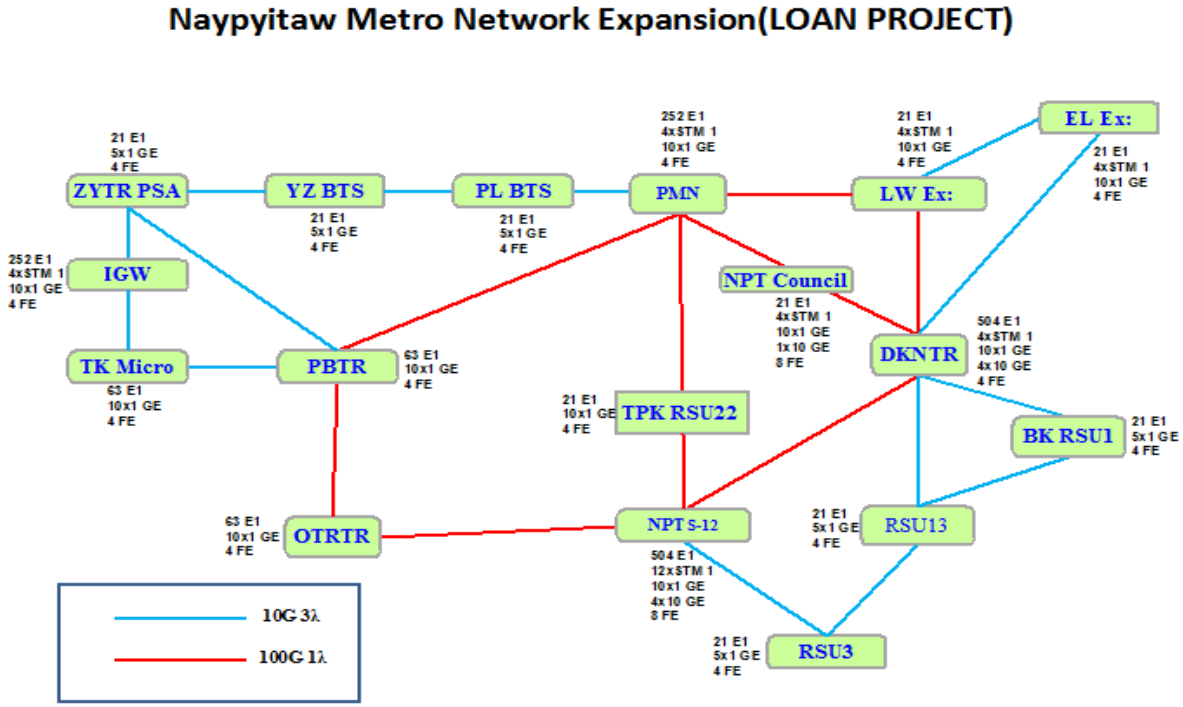


Figure 7.1-10 Naypyitaw Metro Network Expansion

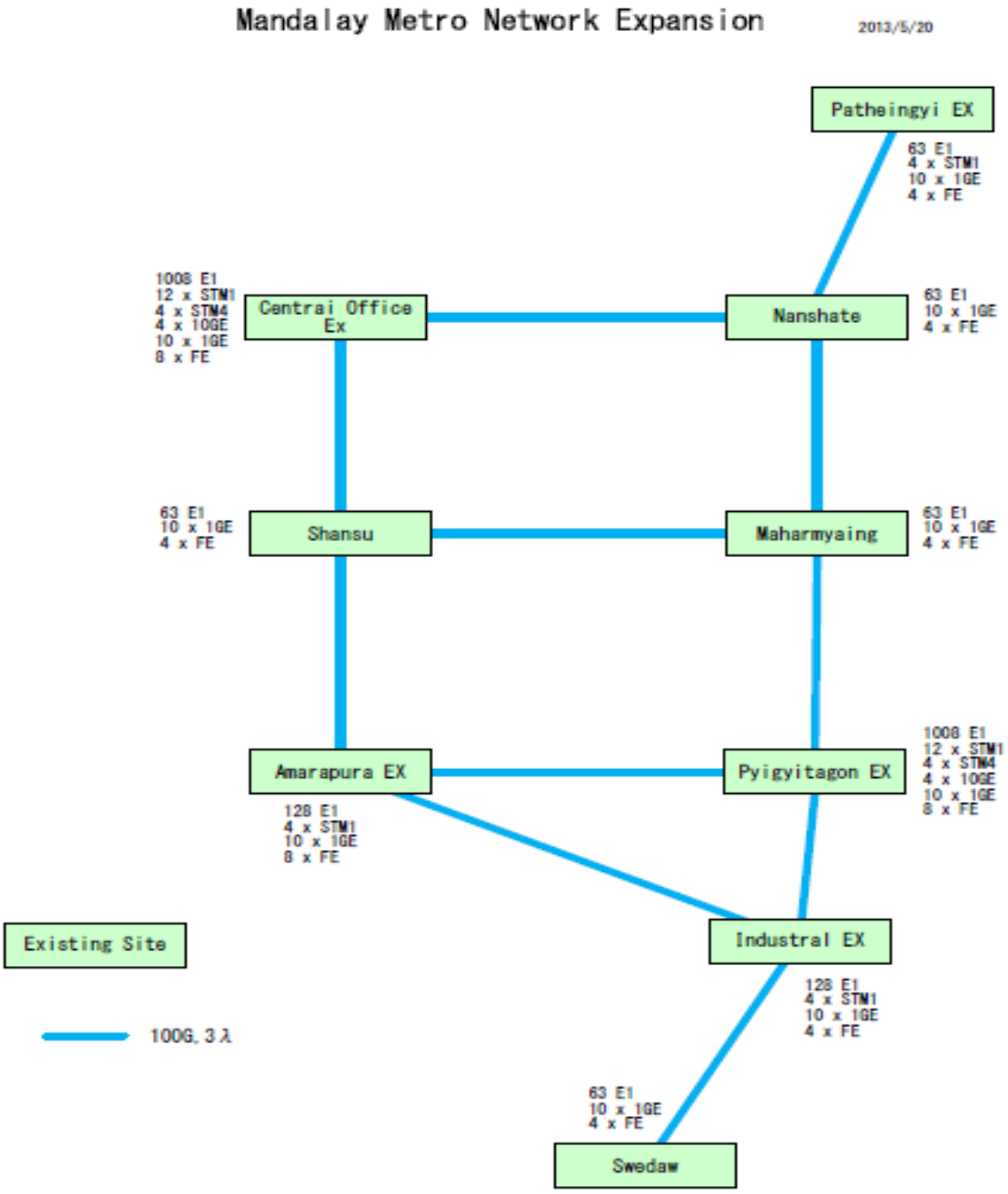


Figure 7.1-11 Mandalay Metro Network Expansion

(4) Equipment to be introduced

Details of the fiber optic cables planned to be introduced in each city are shown in the optical cables column in the following tables in Section 7.1.2.

(a) Table 7.1-1 Yangon Metro New Fiber Routes
(b) Table 7.1-2 Naypyitaw Metro New Fiber Routes
(c) Table 7.1-3 Mandalay Metro New Fiber Routes

At the same time, to increase the transmission capacity, the following DWDM transmission equipment will be introduced in each city's metro network.

(d) Yangon：100Gbps x 3 wavelengths, 10Gbps x 3 wavelengths
(e) Naypyitaw：100Gbps x 1 wavelength, 10Gbps x 3 wavelengths
(f) Mandalay：100Gbps x 3 wavelengths

7.1.4 LTE expansion in three metro cities

(1) Current situation

In Myanmar, LTE access networks will be established by construction of 17 (Node B) base stations in Yangon, 28 (Node B) base stations in Naypyitaw and 5 (Node B) base stations in Mandalay under the Project for Urgent Improvement of Communication Networks implemented with Japanese Government grant aid which was completed in December 2013.

(2) Necessity (Relevance)

To effectively utilize the cities' LTE base stations constructed under the Project for Urgent Improvement of Communication Networks mentioned above and to meet future growth in data communication subscribers, it is desirable to build as many more LTE base stations as possible and expand the subscriber capacity.

To design the required number of (Node B) base stations in each city, the functions of each city were categorized into city center, intermediate area and residential area and the area ratio was calculated. The number of LTE base stations (Node B) required in each city calculated from the results is shown in Table 7.1-4. The expansion plan for each city is shown below.

(a) Yangon：17 → 615 (Node B) base stations
(b) Naypyitaw：28 → 465 (Node B) base stations
(c) Mandalay：5 → 420 (Node B) base stations

Compared with fixed-line communication services, LTE communication services have the following advantages and will be an effective means of achieving early services.

1) The construction period for subscriber access and costs can be reduced.
   - Subscribers can connect to the internet using an all-purpose Wi-Fi adaptor simply by signing a contract with the network provider.

- The provider does not need to draw the cable into the subscriber's house or install a terminating device, modem, etc. in the house, cutting the start time for subscribers and reducing the required workforce.

2) Any terminal will do.
   - Based on IEEE 802.11x, the Wi-Fi standard offers connectivity not only via a computer but on a smartphone or tablet.

3) It can be used anywhere.
   - As no cables are required for connecting, users can connect to the internet "anytime, anywhere" by moving the Wi-Fi terminal.
   - LTE system to be introduced will provide data communication service, and voice service will be served through conventional mobile service (3G) with dual terminal system.

Table 7.1-4 Outline of LTE base station construction in three metro-cities

		Category in the City			
Yangon	unit	City Center	Intermediate Area	Residential Area	Total
Ratio of area in each category	%	20	40	40	100
Area in each category	km^2	140	280	280	700
No. of NodeB	unit	315	186	114	615
No. of Base Station (3 sector＝NodeB)	site	105	62	38	205
Nay Pyi Taw					
Ratio of area in each category	%	15	35	50	100
Area in each category	km^2	90	210	300	600
No. of NodeB	unit	204	138	123	465
No. of Base Station (3 sector＝NodeB)	site	68	46	41	155
Mandalay					
Ratio of area in each category	%	20	30	50	100
Area in each category	km^2	100	150	250	500
No. of NodeB	unit	222	96	102	420
No. of Base Station (3 sector＝NodeB)	site	74	32	34	140

Source: Prepared by Survey Team

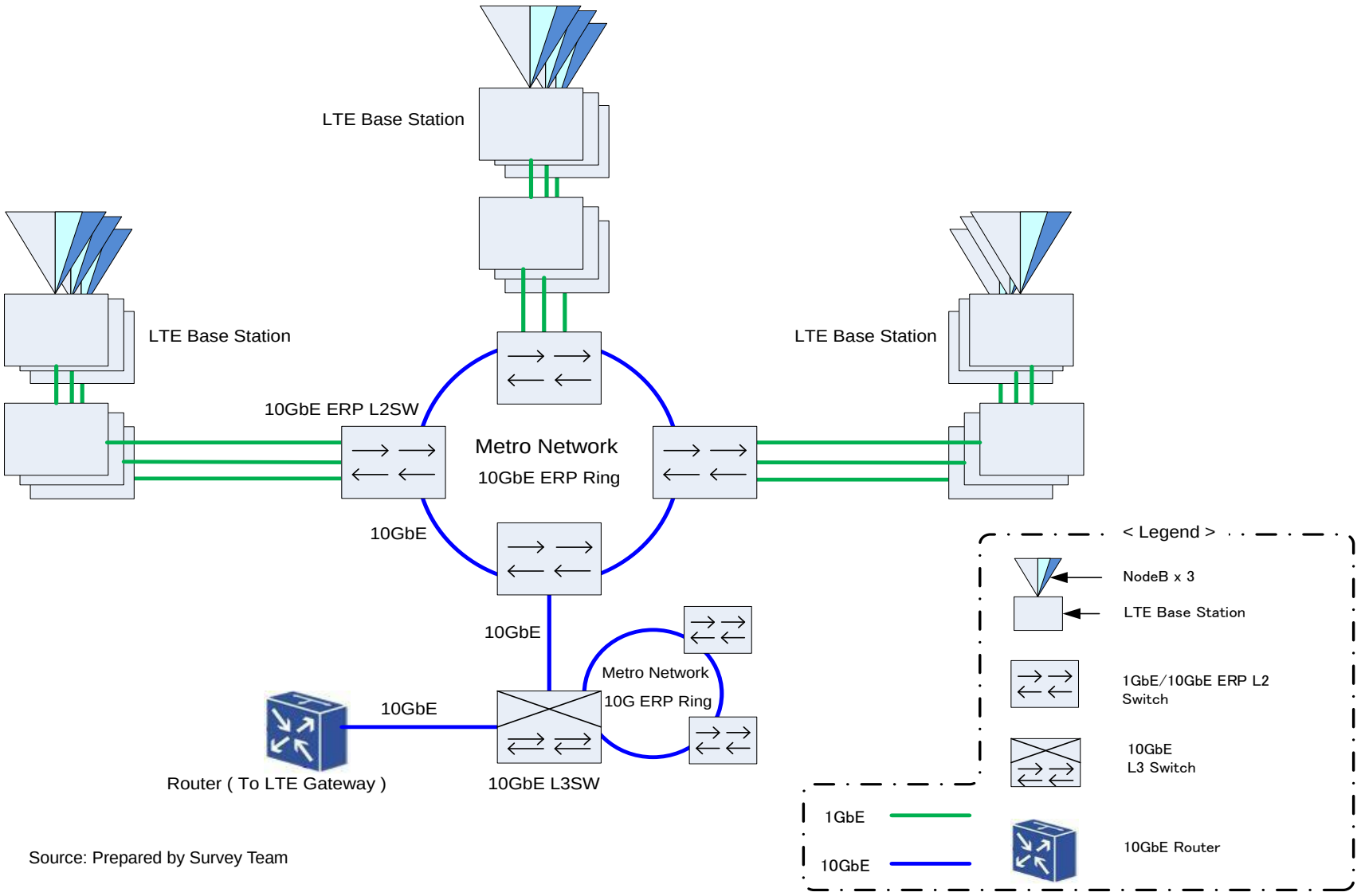
(3) Scope of upgrade

An outline of LTE base station construction in the three metro-cities is shown in Figure 7.1-12.

(4) Equipment to be introduced

A summary of the equipment that is planned to be introduced is shown below.

(a) LTE small-sized radio base station（Node B） equipment：
1,500（Node B）base stations (total for 3 metro-cities)
(b) LTE/Wi-Fi router： 1 set
(c) LTE transmission equipment： 1 set
(d) Fiber optic cable between repeater station and LTE base station:
Yangon: 615 km
Naypyitaw: 465 km
Mandalay: 420 km



Source: Prepared by Survey Team

Figure 7.1-12 Outline of LTE base station construction in the three metro-cities

7.1.5 Network plan for towns along the backbone network connecting the three metro cities

(1) Current situation

In Myanmar, the density of communication services at national level is low, but there is also a huge regional divide and the density of fixed-line telephones outside the three metro-cities is especially low. With regard to the internet, although some broadband services are provided by ADSL or domestic satellite communication, density of services is far from that in three metro cities.

(2) Necessity (Relevance)

Improvement of communication services in small regional cities is an urgent issue for the development of Myanmar by the political and economic reforms currently promoted by the Thein Sein administration. Construction of a communication network and improvement of communication services will be easier in those small cities located along the backbone network between the three metro-cities than in other provincial cities and suitable for the construction of model case for telecommunications in local cities.

Therefore, by selecting a sample cities from the mid and small cites surrounded in backbone network of 3 Metro cities and by constructing internet communications network in those cities, model case of telecommunications network in local cities for future shall be built.

Average traffics per subscriber from Bit Stream shown in Table 5.2-7, are projected as follows,

- Internet speed per user of fixed broadband: 57.8 kbps
- Internet speed per user of mobile phone: 11.57 kbps

These cities being classified small cities, from Table 5.2-8, Subscriber Number Forecast

- Voice subscriber penetration: 96.0%
- Data subscriber penetration: 60.0% (Fixed broadband subs. 3% (= 60 % x 1.5/30), Mobile phone subs. 57% (= 60% x 28.5/30))

Then, theoretically, per 100,000 population

- mobile subs. data: 11.57 (kbps) x 100 (thousand) x 0.57 = **659.5 (Mbps),**

Considering average/max. Ratio of 1.5, the necessary capacity is as follows:

- mobile subs. data: 659.5 (Mbps) x 1.5 = 989.2 (Mbps) ≒**1,000 Mbps**

Where, supposing maximum radio transmission capacity of 200 Mbps per LTE, 5 LTEs (1,000/200=5) shall be provided, i.e., 1xLTE shall be provided for 20,000 of population.

For the fixed broadband line, FTTx shall be applied and the capacity per 100,000 population is calculated as follows:

- Capacity for fixed broadband subs.: 57.87 (kbps) x 100 (thousand) x 0.03 x 1.5 = 260.4 (Mbps)

(3) Scope of upgrade

With regard to the upgrade plan for small cities, overview design on paper is underway as described in Chapter 6 Section 6.3, and as the actual situation is not clear, the following preconditions were established and an improvement plan was formulated.

Precondition: Selection of target area

(a) At present, towns with a population of around 50,000 or over located near a relay station on the backbone optical fiber route currently underway in the Project for Urgent Improvement of Communication Networks implemented by the Japanese Government have been chosen as small cities. An overview of the 10 selected cities is shown in Table 7.1.5-1.

(b) The town center is less than 10km from the relay station on the optical fiber route mentioned above.

(c) The area has a commercial power supply.

Improvement Plan

(a) Construction of LTE access network

- The backbone relay stations are connected to the LTE base station in the target area by optical fiber cable (aerial system).
- The LTE base station and LTE terminals are connected by direct communication and Wi-Fi routers.

(b) The network configuration will be such as to allow construction of an optical fiber subscriber network (FTTx) in preparation for future demand.

The network configuration described above is shown in Fig. 7.1.-13.

(4) Survey results of medium and small cities scattered in 3 metro cities

10 medium and small cities which might be satisfied with the above mentioned precondition are surveyed at the final stage of the series of the study (survey) and the outline of survey result is shown in the Table 7.1-5 Medium and Small cities surveyed. The detail data is shown in the Attachment.

The survey result has turned out the following:

(a) Surveyed 10 cities except Zegone are satisfied with previously mentioned precondition.

(b) Surveyed 10 cities are satisfied with previously mentioned precondition of (b) and (c).

(c) Surveyed 10 cities will have not big problems for the implementation on previously mentioned planning to be upgraded.

(d) 5 cities out of 10 have no internet subscribers and one city (Taungtwinkyi) out of another 5 cities has only 5 internet cafés but no ordinal subscribers. 2 cities have at most 30 subscribers (ADSL) each and remained 2 cities where are comparatively high populated areas have 100 – 200 subscribers only. Thus, IT network composed of LTE is concluded to be very appropriate and important plan in these area.

(e) There are some cities to be expected to develop into industries and agricultures. For

example, Nyaung U, neighboring to sightseeing spot of Gaban, efforts to develop to construct and to expand hotel zone. From these standpoints, rapid expansion of telecommunications network is indispensable.

(f) Numbers of LTE are shown in Table 7.1-5 in which has been calculated necessary numbers of LTE using from the formula described in section (2), Necessity (Relevance).

Table 7.1-5 Selected middle and small cities

No.	State	City	Population	Distance between the station and center of city (km)	Commercial power supply	Internet subscribers	Numbers of LTE station
1	Bago	Pyay	45,490	0.5	Available	200 (incl. Internet Café:25)	3
2		Tharyawaddy	49,197	0	Available	0	3
3		Zegone	14,845	0.5	Available	0	1
4	Magway	Aunglan	49,092	0.1	Available	0	3
5		Taungtwinkyi	45,490	0.4	Available	5 Internet cafes (using IP STAR)	3
6		Magway	80,600	0	Available	118	5
7		Yenanchaung	50,000	0.8	Available	0	3
8		Pakokku	116,000	1.7	Available	24	6
9	Mandalay	Kyaukpadung	79,654	0	Available	0	4
10		Nyaung U	70,000	1.0	Available	30	4

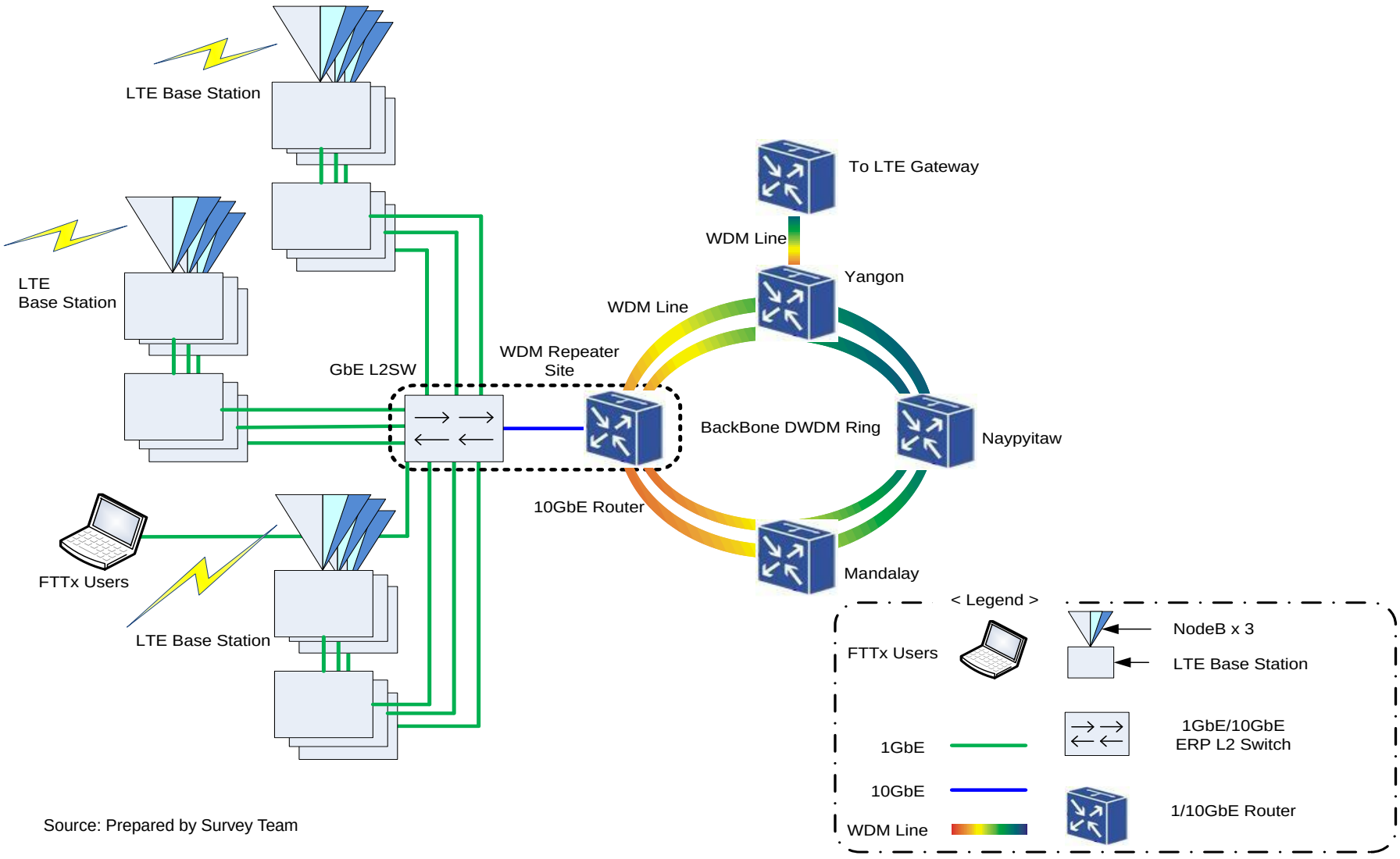
Note: Population is that of down town in the city obtained from MPT Exchange by hearing.
Source: Prepared by Survey Team

(5) Equipment to be introduced

Summary of the equipment planned to be introduced for the above-mentioned network configuration is shown below.

(a) LTE small-size radio base station equipment (Node B): 1 set
(b) LTE/Wi-Fi Router: 1 set
(c) LTE transmission equipment: 1 set
(d) Fiber optic cable between repeater stations and LTE base station

Network configuration for medium and small cities is illustrated in Figure 7.1-13.



Source: Prepared by Survey Team

Figure 7.1-13 Network configuration for Medium and Small Cities along Backbone

7.1.6 Installation of transmission equipment for the Yangon-Thanlyin circuit (International Satellite Earth Station)

(1) Current Situation

An international satellite communications earth station (Ku-band) is located in Thanlyin near Yangon and is connected to the international gateway exchange (ITMC) in Yangon by 12-core fiber optic cable.

On the other hand, an international satellite earth station (Ku-band) and domestic satellite earth station (C-band) are located in Toe Kyaung Galay, and like the Thanlyin and Yangon international gateway exchange, are connected by 12-core fiber optic cable, and Thanlyin and Toe Kyaung Galay have a mutual backup function for international satellite communications and have a diversity configuration. The configuration is shown in Figure 7.1-14.

(2) Necessity (Relevance)

More lines will be provided between the Yangon international gateway exchange and the satellite earth station with the aim of maintaining and improving the level of service against increased nationwide phone and internet traffic engaging in international communications.

(3) Scope of upgrade

As shown in Figure 7.1-14, more lines are planned by installing DWDM transmission equipment on 2 cores of the existing 12-core fiber optic cable laid between Yangon (ITMC), Thanlyin and Toe Kyaung Galay.

(4) Equipment to be introduced

The equipment to be introduced is as shown below.

(a) Yangon - Thanlyin：DWDM (10Gbps x 4 wavelengths)
(b) Thanlyin - Toe Kyaung Galay：DWDM (10Gbps x 4 wavelengths)
(c) Toe Kyaung Galay - Yangon：DWDM (10Gbps x 8 wavelengths)

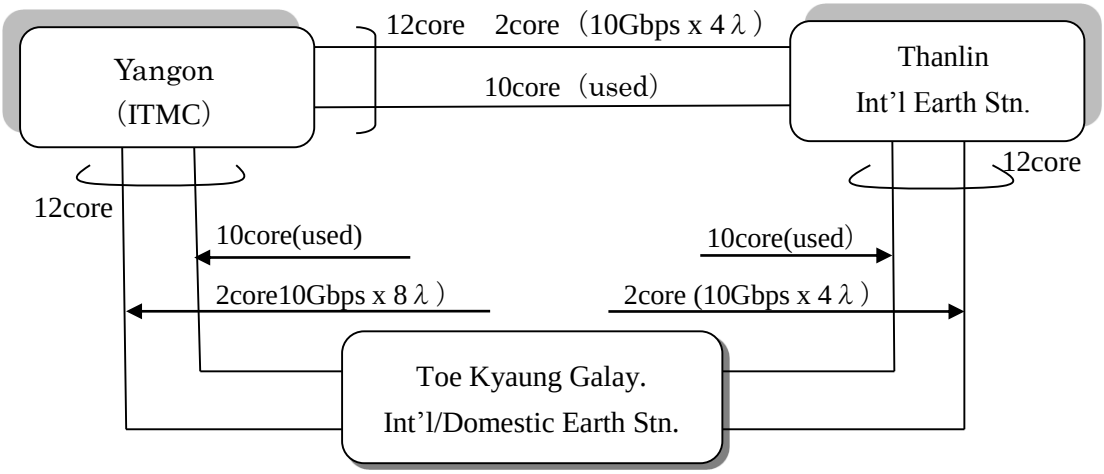


Figure 7.1-14 Circuit Configuration for Yangon-Thanlin Link

7.1.7 National Gateway Overhaul

(1) Current situation

The national gateway in Myanmar is currently provided by equipment with a transmission capacity of 13.3Gbps located in Yangon. Two pairs of IX routers with a capacity of 10GbE have been installed in Yangon and Naypyitaw respectively by December 2013 under the Project for Urgent Improvement of Communications Networks implemented with Japanese Government grant aid.

(2) Necessity (Relevance)

Under this project, it is planned to install a 100Gbps router in Yangon and in Naypyitaw as a national gateway.

With regard to the relevance of the plan, as shown in Table 5.2-7 in Chapter 5, the total international communication speed (design value) is 437.71Gbps. This is the value needed as the total for all transmission routes across national borders. Presuming that a gateway exchange is established in all three metro-cities, approximately 150Gbps will be required as the processing capacity required for each gateway exchange. Therefore, the 100Gbps capacity of the routers to be installed in this plan is not excessive.

(3) Scope of upgrade

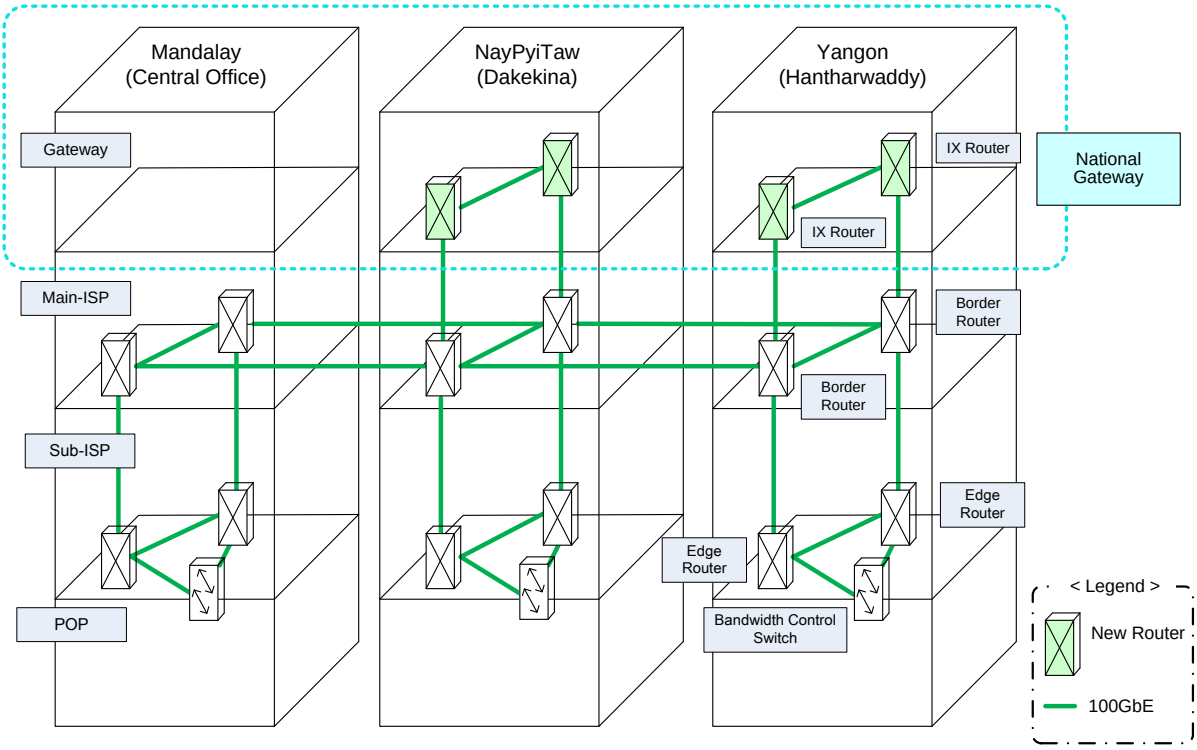
The network configuration is described in Figure 7.1-15 Outline of International Gateway Exchange. It will be installed in the Hantharwaddy Exchange in Yangon and the new Dakekina Exchange in Naypyitaw.

(4) Equipment to be introduced

Routers capable of meeting 100GbE standards (IEEE 802.3ba) will be installed. In addition, considering the importance of the international gateway exchange, one spare router will be added in an effort to enhance reliability by a duplex configuration. An outline is given below.

- Yangon: Two IX Routers (100Gbps), one will be for backup
- Naypyitaw: Two IX Routers (100Gbps), one will be for backup

Block Diagram of National gateway



Prepared by Survey Team

Figure 7.1-15 Outline of International Gateway

7.1.8 Upgrading of ISP services and introducing IPv6 in Yangon

(1) Current Situation

At present there is no IPv6 service in Myanmar. In order to meet future growth in internet demand, it is desirable to introduce an IPv6 network in Yangon. It is also planned to introduce 10 GbE core routers in three places, Yangon, Naypyitaw and Mandalay, under the Project for Urgent Improvement of Communication Networks scheduled to be completed at the end of 2013 in order to expand ISP services.

(2) Necessity (Relevance)

IPv4 address which is allocated in Myanmar at present is very few comparing to other ASEAN countries as shown in Table 7.1-6. IPv6-enabled devices and IPv4 IPv6 interconnection model (translation model that allows direct connection between IPv4v6 end users) will be introduced against the depletion of IPv4 addresses allocated to Myanmar. In addition, the IPv6 core routers and gateway exchange equipment to be introduced in Yangon under the Project for Urgent Improvement of Communication Networks will be utilized.

Core router composing of IPS carries out data communications between the cities for internet and controls the route. Internet traffic is forecasted up to 629.25 Gbps as described in Table 5.2-7.

In case that this traffic is processed by distributing equally to ISP of core router group in 3 metro cities, processing capacity in each metro city will be 209.75 Gbps. The router capacity of 100 Gbps which is planned to be introduced, therefore, will not be over-provision.

As 100 Gbps router is being to be installed to National Gateway in Yangon and Naypytaw as described in section 7.1.7, ISP core router with same capacity will be indispensable.

Table 7.1-6 IPv4 Allocation in ASEAN Countries

Country	IPv4 Allocation	Population
Cambodia	238,592	14,864,600
Laos	57,856	6,645,800
Malaysia	6,363,904	29,239,900
Singapore	6,245,632	5,312,400
Thailand	8,571,392	66,785,000
Vietnam	15,574,784	88,775,500
Philippine	5,381,376	96,706,800
Indonesia	17,491,120	246,864,200
Brunei	197,120	412,238
Myanmar	28,672	52,797,300

Source: APNIC/World Bank

(3) Scope of upgrade

As the backbone network, metro network and international gateway exchange will be interconnected, with regard to the core routers (border routers and edge routers) that make up ISP, 100GbE (IEEE802.3ba)-enabled core routers will be introduced in Yangon, Naypyitaw and Mandalay for increased speed (10Gbps→100Gbps). Moreover, a caching device (proxy server) or bandwidth limiting switch (bandwidth control switch) will be introduced for band reduction.

An outline of the IPv6 transition is shown in Figure 7.1-16 and an outline of the ISP service upgrading plan including the IPv6 network is shown in Figure 7.1-17. The stations targeted for upgrading are as shown below.

(a) Yangon: Hantharwaddy Station
(b) Naypyitaw: New Dakekina Station building
(c) Mandalay: Mandalay Main Exchange

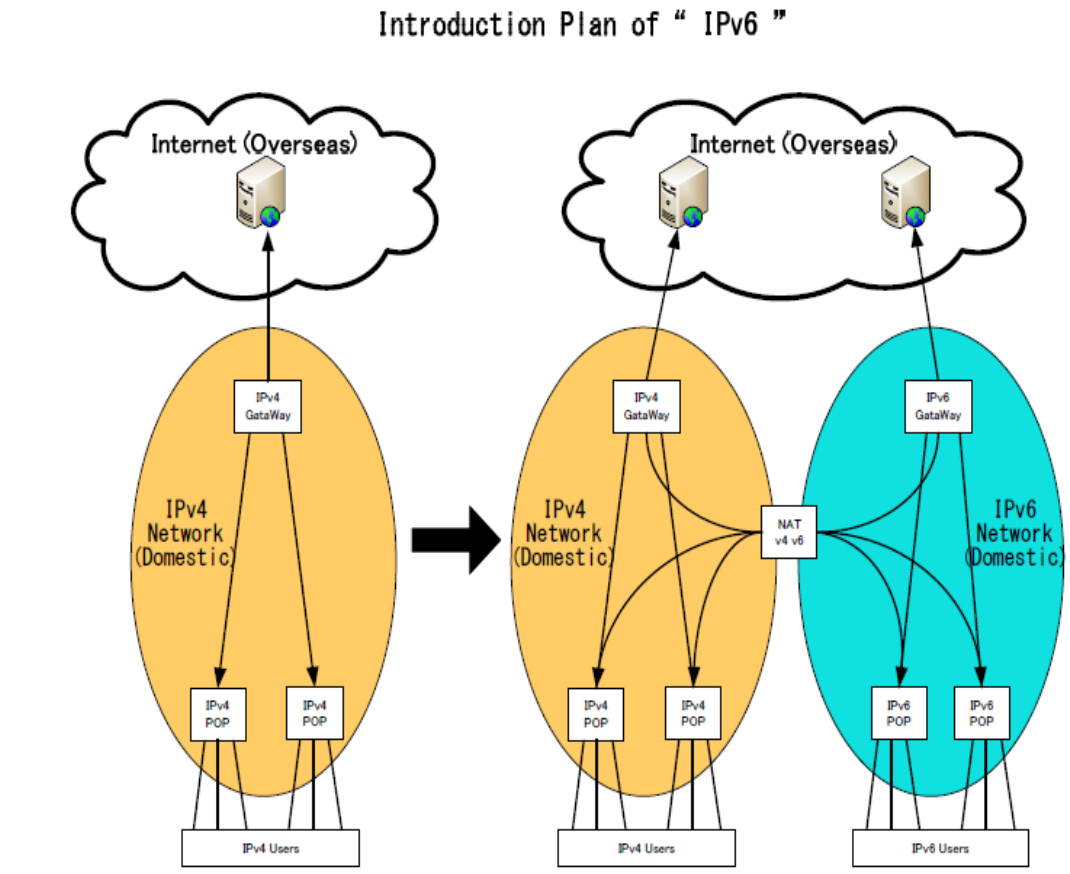
(4) Equipment to be introduced

A summary of the main equipment to be installed in Yangon, Naypyitaw and Mandalay is given below.

Table 7.1-7 List of Equipment to be provided

	Yangon	Nay Pyi Taw	Mandalay
Border Router 100G	2	2	2
Edge Router 100G	2	2	2
NAT	2	--	--
Proxy Server	1	1	1
Bandwidth Control Switch	1	1	1

With regard to other incidental equipment (security devices, customer switches), equipment introduced under the Project for Urgent Improvement of Communication Networks continues to be used.



Prepared by Survey Team

Figure 7.1-16 Outline of the IPv6 Transition Process

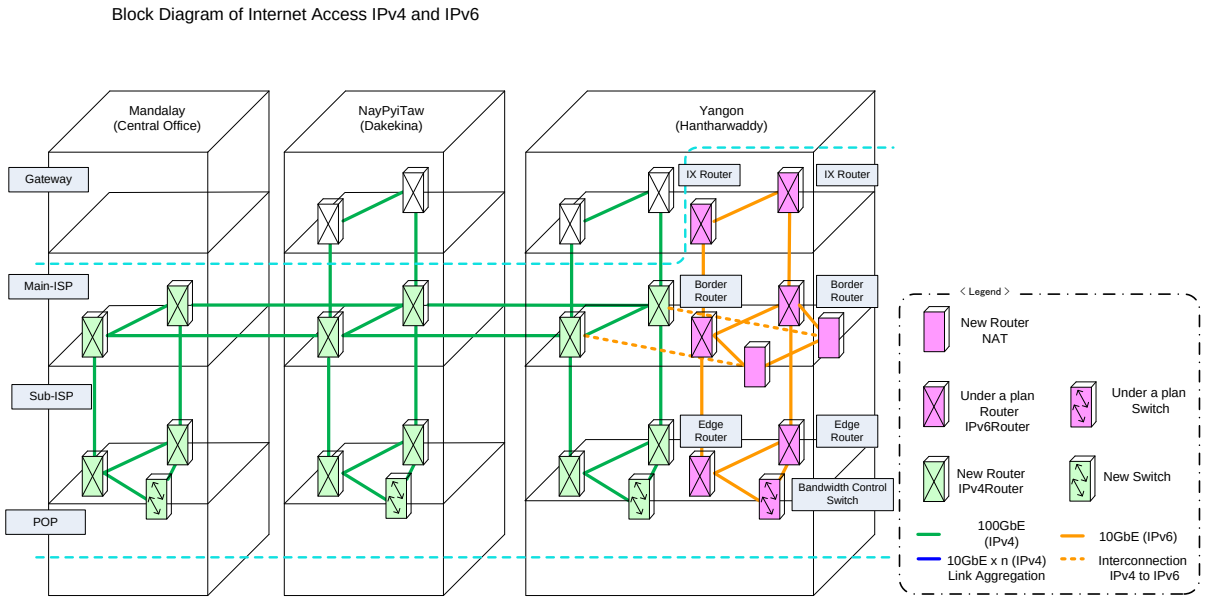


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Figure 7.1-17 Outline of the ISP service upgrading plan including the IPv6 network

7.1.9 Network Operation Center (NOC) construction

(1) Current situation

With regard to network monitoring, MPT has no integrated monitoring system. Each department, each vendor and each area installs and runs their own monitoring system. As a result, there is no consolidation of the monitoring information from each department and each vendor, making failure demarcation across the department difficult and obstructing efficient operation.

(2) Necessity (Relevance)

NOC can provide following user functions efficiently by integration of Network Management System (NMS) and Equipment Management System (EMS) which are now decentralized everywhere.

(a) Network monitoring
(b) Incident response
(c) Data analysis for communications management
(d) Reporting

Necessity (Relevance) of each function is as follows:

(a) Network monitoring

Monitoring information from each department or division shall be integrated and managed. Engineers in charge from 5 technical departments and/or divisions shall be

attended on full time basis in NOC, resulting in shortening the communication time between the related departments and at the same time, the phenomena difficult to be identified by the individual supervising operation could be visualized. This operation can realize not only alive monitoring but also simplify to identify what is a bottle-neck problem of the system and result to an efficient Operation and Maintenance.

(b) Incident response

Fault recovery time can be reduced by reducing communication time between departments through integrated processing of monitoring information that is split among the departments and deployment of five technical department managers to the NOC building. Balanced maintenance organization that is free from numbers of local personnel can be established by using remote control technology and VPN (Virtual Private Network) etc. with local test and setting change.

(c) Data analysis for communications management

Management information from NMS shall be accumulated to Data Base. It shall be unified and managed to Graphical User Interface (GUI) to inform to NOC staffs.

(d) Reporting

Monitoring by using statics information, electronic reporting of performance information and e-mail at faulty occurred make for reduction of operation cost and the staffs loads.

(3) Scope of upgrade

The main functions of the integrated network monitoring system (NOC) to be furnished for the provision of user functions are as follows.

(a) Network Monitoring

Alive monitoring of network and system
Monitoring of traffic
Alarm log management/GUI display

(b) Incident response

Remote control
VPN, Access control technology

(c) Data analysis for communications management

Correction and analysis of statistical information using NOC platform (Application/Data base)

(d) Reporting

Accumulation of fault records and auto generation. Information facility to staffs by e-mail etc. using NOC platform (Application/Data base)

An outline of NOC functions is shown in Figure 7.1-18.

Present monitoring systems are individually operated by each department, each vender and each area. Proposed NOC system, however, would be difficult to cover to integrate and analyze all information data which is generated from different monitor systems mentioned above. The scope of facility to cover for the project, therefore, would be as follows,

The proposed NOC system shall cover to manage only for newly constructed network. However, the system can be integrated in the particular case that the existing network applies standard technology of SNMP (Simple Network Management Protocol) etc., and MPT would supply the necessary information for integration. For the network not to being integrated, remote monitoring would be available by separating the monitoring device in NOC, using the signal sent through the monitoring network (DCN: Data Communication Network).

Main process necessary to offer those facilities is as follows,

- Installation of servers and monitors
- Setting and maintenance of monitoring network (An outline of the monitoring network is shown in Figure 7.1-19.)
- Monitoring control operated in the existing NMS shall be set up to be able to operate at the servers and monitors which are installed in NOC.
- Building up data base and data analysis system
- Building up reporting system

NOC will be established in the new Hantharwaddy building in Yangon as a backup station for improving reliability.

(4) Equipment to be introduced

NOC will be constructed by the following three processes.

(a) Construction of main station (Naypyitaw, Dekkhina Exchange):
- Main equipment (hardware): PC server, Network devices
- Software: Platform, Database, Applications, Interface
- Incidental facilities: Power supply system, Air conditioning system
- Security: Physical, logical

(b) Establishment of backup station (Yangon, Hantharwaddy Station):
- Main equipment (hardware): PC server, Network devices
- Software: Platform, Database, Applications, Interface
- Incidental facilities: Power supply system, Air conditioning system
- Security: Physical, logical

(c) System integration
- Main station: for backup station functional integration, testing
- Main station: for backup station general coordination testing

(5) Others

Since introduction of integrated network operation system is first challenge for MPT, it is preferable to appoint and deploy 3-5 engineers on full time basis from each technical department to run NOC.

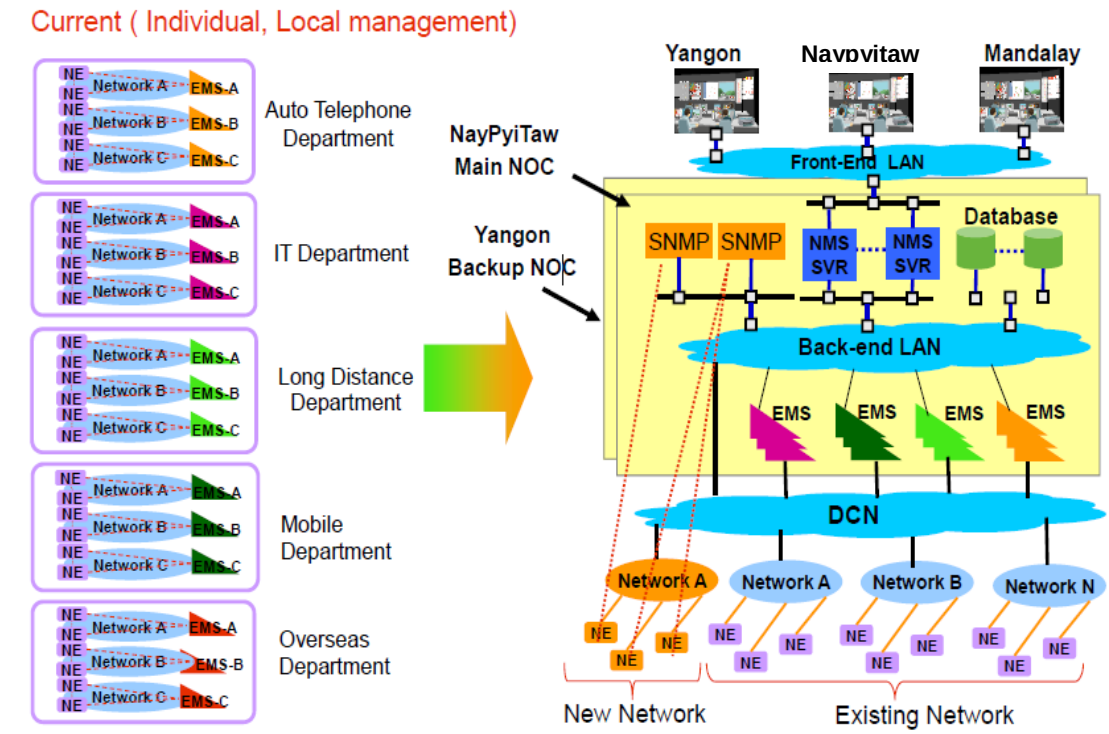

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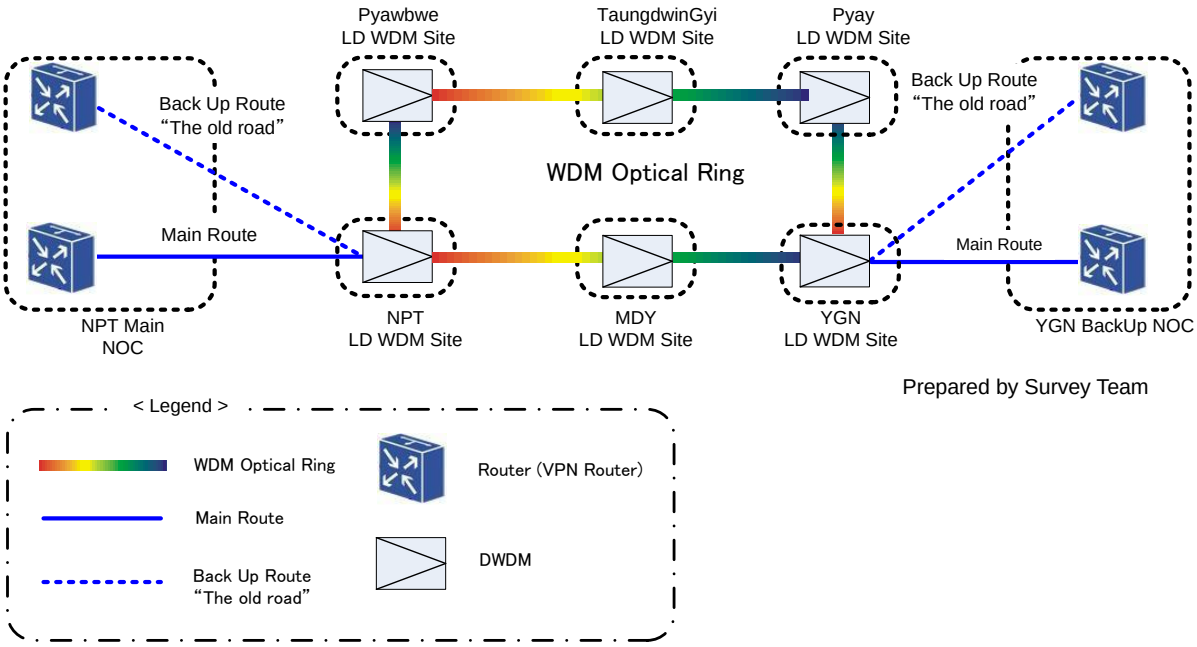
Figure 7.1-18 Outline of NOC functions



Prepared by Survey Team

Figure 7.1-19 Outline of the monitoring network

7.1.10 Outside Plant Engineering Center (OPEC) in the three metro cities

(1) Current situation

At present, exchange staff assigned to each exchange office are responsible for repairs in the event of failure in the city network, but if there is a major problem, maintenance personnel are dispatched from the main exchange office in each metro-city to handle repairs. However, if advanced techniques are required such as especially repair of the fiber optic cable, the exchange office attached to the metro-city is unable to handle it and maintenance personnel are dispatched from the exchange office in Yangon.

(2) Necessity (Relevance)

In order to improve the situation described above, it is planned to introduce the Outside Plant Engineer Center (OPEC) as a means of cutting costs incurred in construction, operation, maintenance and management of the communication facilities.

OPEC will be centers where engineers engaged in outside plant construction and maintenance will be stationed. OPEC will be established in suitable locations that enable speedy transfer to sites in the area covered by the center to carry out construction or maintenance. By establishing this kind of OPEC, compared with the existing system, construction of communication facilities as well as operation, maintenance and management can be carried out much more efficiently and it will be possible to reduce not only personnel expenses but material storage and administration costs. Introduction of OPEC will not simply reduce costs, but also improve the level of service by reducing the time to get to the repair site, and it will also play a role in human resources development by providing training space for outside plant engineers in the center. The establishment of OPEC will therefore bring multifaceted advantages.

(3) Scope of upgrade

OPEC will be established in two locations in Yangon metro-network area, one location in Naypyitaw and one location in Mandalay.

(4) Equipment to be introduced

The image of OPEC utilization (1) is shown in Figure 7.1-20 and the image of OPEC utilization (2) is shown in Figure 7.1-21, respectively.

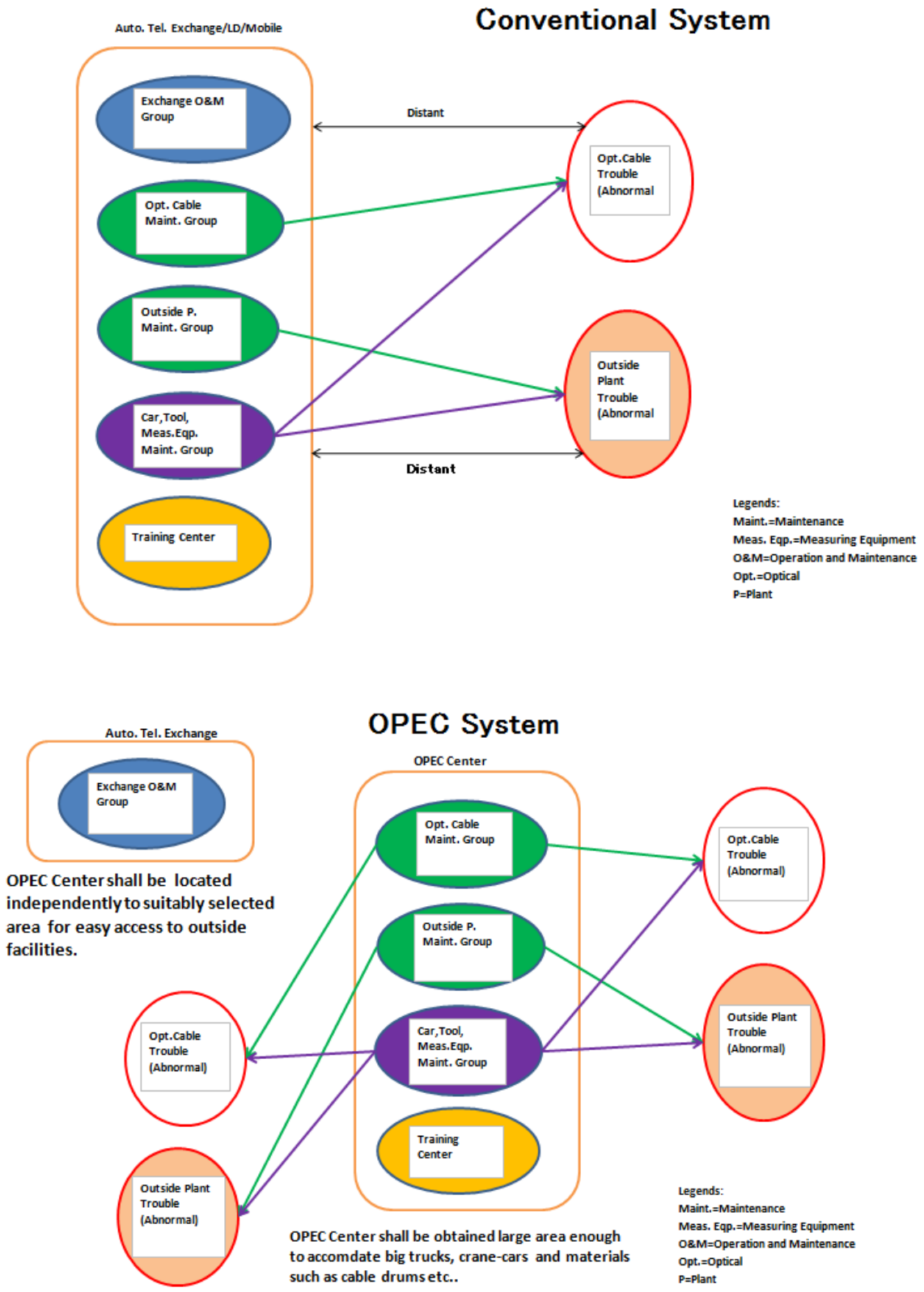


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Figure 7.1-20 Image of OPEC utilization (1)

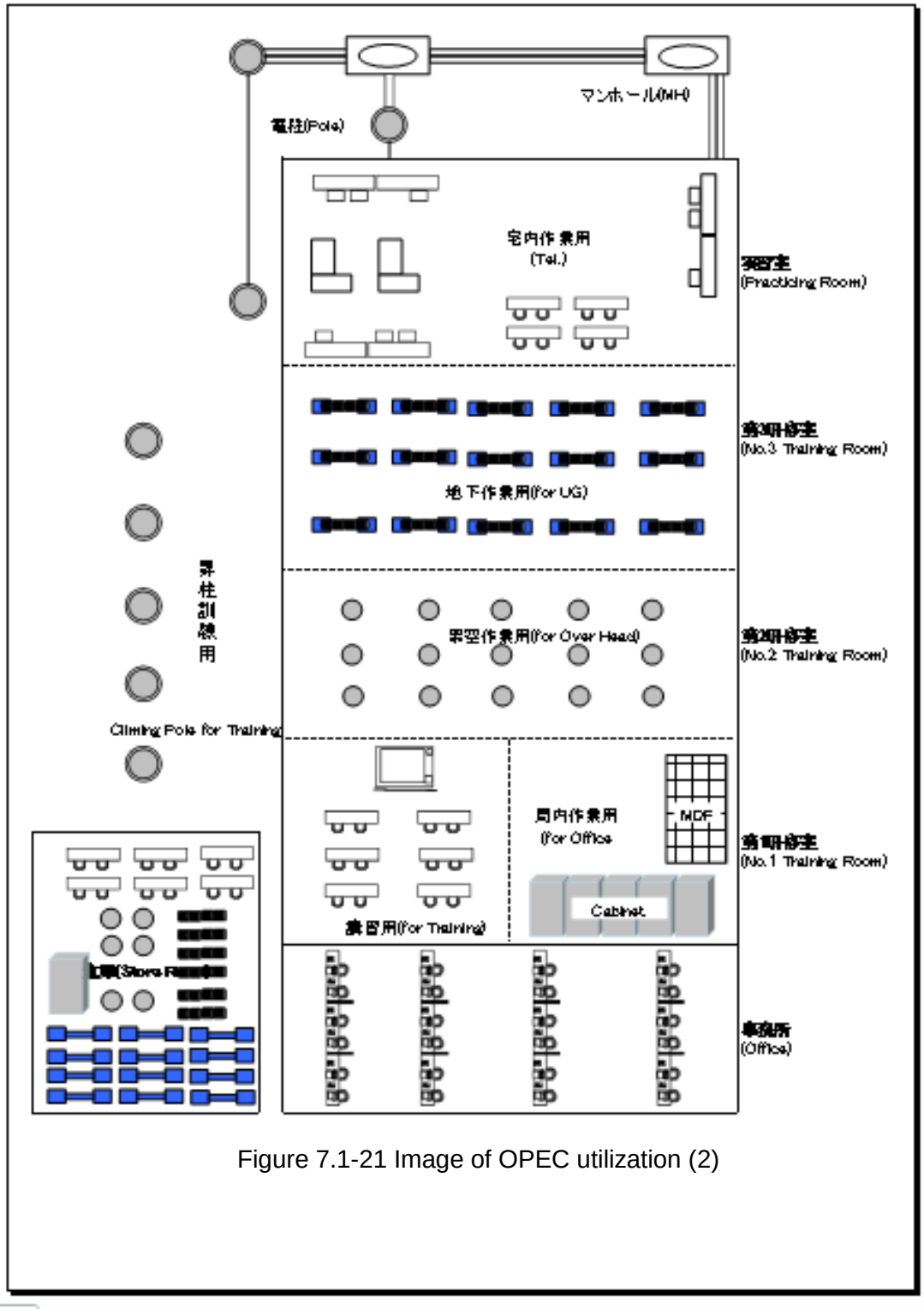

Figure 7.1-21 Image of OPEC utilization (2)

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7.1.11 Outside Plant Engineering Center (OPEC) Building

(1) Current situation

It is planned to build the OPEC centers using the sites of the existing exchange offices.

(2) Necessity (Relevance)

As described in the preceding Section 7.1.10, as OPEC needs space to store equipment, materials, etc. for construction and repair of outside plant facilities and staff offices and training rooms are also required, an independent building will be necessary. Space for construction will be prepared on the MPT sites.

(3) Scope of upgrade

As the candidate sites for each center are wasteland, land development will be necessary. The candidate sites for each center are as shown below.

(a) Yangon and metro-city network OPEC candidate sites:
- Mayangon Exchange Office grounds (area: approx. 38m x 34m)
- Thingangyun Exchange Office grounds (area: approx. 55m x 30m)

(b) Naypyitaw metro-city network OPEC candidate site
- District government-owned land (area: approx. 30m x 50m)

(c) Mandalay metro-city network OPEC candidate site:
- Maharmying RSU Exchange Office grounds (area: approx. 34m x 41m)

(4) Equipment to be introduced

A tentative floor layout plan for OPEC is shown in Fig. 7.1-22.

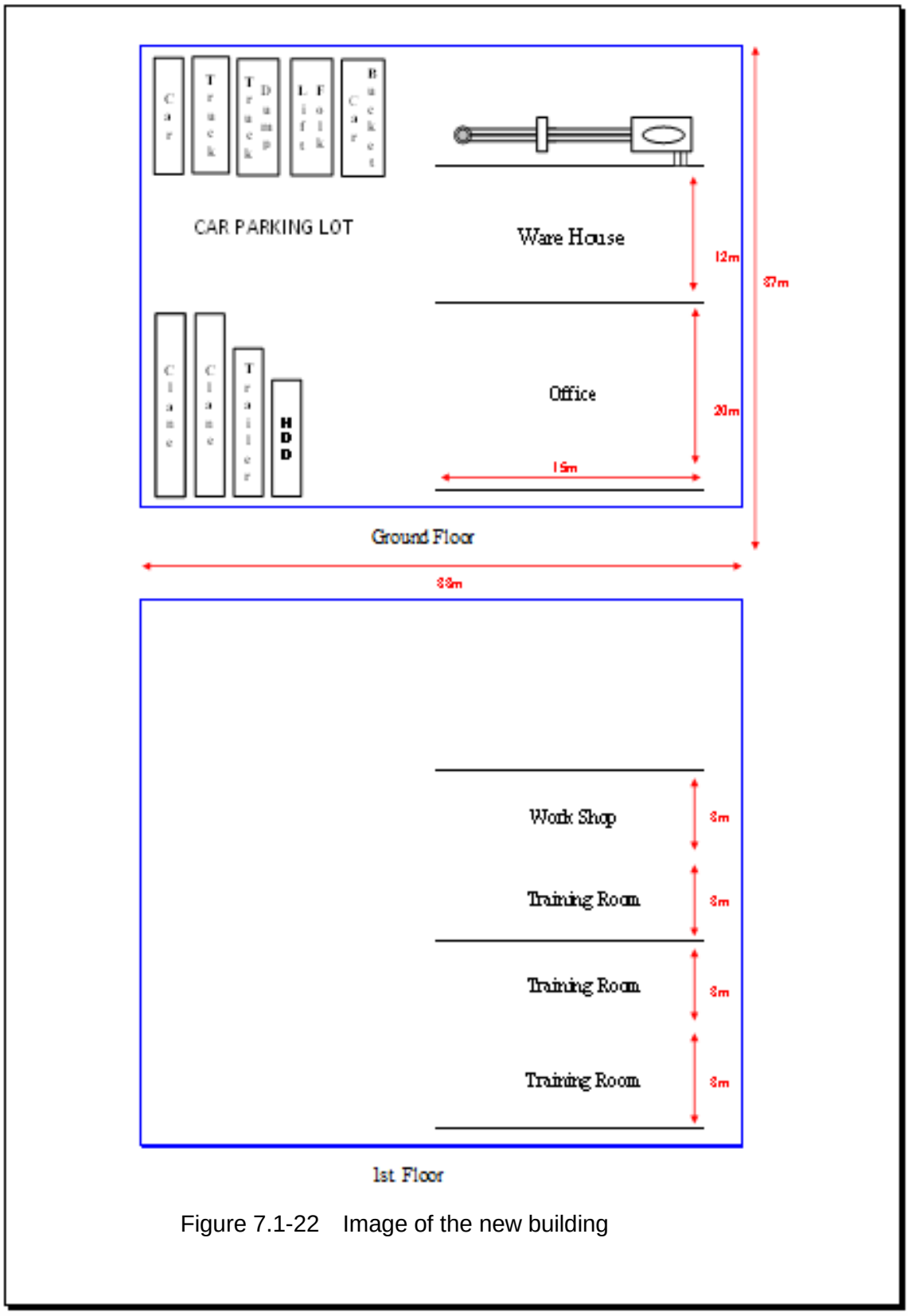

Figure 7.1-22 Image of the new building

Prepared by Survey Team

7.1.12 Thilawa SEZ Circuit

(1) Current situation

Optical fiber equipment with a transmission capacity of 1Gbps and an LTE base station were installed at Marine University under the Project for Urgent Improvement of Communication Networks implemented with Japanese government grant aid by December 2013, but other communication equipment has yet to be upgraded.

(2) Necessity (Relevance)

Thilawa SEZ is currently in the planning stage and plant layout in the area and the state of infrastructure development are not clear, but in order to provide communication services promptly upon the opening of SEZ, effective use of the current communication infrastructure is desirable. The current situation is described from that perspective. It is meaningful to strengthen the functions of the transmission equipment at Marine University, which was installed under the Project for the Urgent Improvement of Communication Networks implemented with Japanese Government grant, while it would be useful to install fiber optic communication lines to the Thilawa SEZ boundary.

Fiber optic cable to be laid to Thilawa SEZ boundary, transmission equipment to be connected, routers and switches shall all correspond to the capacity of 10Gbps. The capacity shall be judged adequate for the following reasons:

Average traffic of one subscriber from the communication speed shown in Table 5.2-7 is;

- Voice by mobile telephone: 0.06 (kbps)
- Data communication by fixed broadband: 57.87 (kbps)
- Data communication by mobile telephone: 11.57 (kbps)

Thilawa SEZ populated approx. 334 thousand, is classified as a small city from the Table 5.2-8 shown in Chapter 5 and subscriber predicted is;

- Voice subscriber: 96 %
- Data subscriber: 60 % (Fixed broadband:3 %, Data mobile: 57 %)

The traffic data of Thilawa SEZ populated 334 thousand will be theoretically calculated as follows:

- Voice: 0.06 (kbps) x 334 (thousand) x 0.96 = 19.2 (Mbps)
- Data mobile: 11.57 (kbps) x 334 (thousand) x 0.57 = 2,202.7 (Mbps)
- Data fixed broadband: 57.87 (kbps) x 334 (thousand) x 0.03 = 579.9 (Mbps)
- (Voice + Data) x 1.5 (Ave/Max Ratio) = 4,202.7 (Mbps)

The equipment facility, however, shall have a twice capacity of calculated data of 4,202.7 (Mbps), that is, 8.405Gbps, which is expected to be concentrated the traffic in day time.

(3) Scope of upgrade

The speed of the communications equipment introduced under the Project for the Urgent Improvement of Communication Networks towards the achievement of Thilawa SEZ Class A will be increased (to 10Gbps between Yangon and Thilawa), and reliability will be enhanced (by introduction of optical fiber rings and L2 switch STP functions). Therefore, transmission equipment (CWDM, 10GbE router) will be installed in the Thanlyin Station and optical fiber communication lines will be laid to Thilawa SEZ. An outline of the Thilawa SEZ communication equipment is shown in Figure 7.1-23 and a map of the target area is shown in Figure 7.1-24.

The Thilawa SEZ development plan is currently ongoing. The plot has not been decided yet and the electric power supply system plan is still undecided, so a design was drawn up based on the following preconditions.

1) Precondition 1: Basic topographical data
   - Class A area: 400ha = 4km^2 (interviews with the trading company consortium who are the Thilawa SEZ developers) (Reference: SEZ area: 2,400 ha = 24km^2)
   - Class A final planned population 40,000-50,000 (Same as above) (Reference: SEZ population: 333,600)

2) Precondition 2: Preconditions for deciding line configuration
   - For the foreseeable future, no power supply will be available around Tilawa SEZ. (Marine University and Thanlyin Station have a power supply)
   - Incoming tenants will be responsible for SEZ internal line construction, line application, etc. whenever required.
   - LTE installed in Marine University under grant aid cooperation will also be utilized.
   - Consideration will be given to providing FTTx services in future.
   - The transmission route between SEZ and Yangon city will adequately meet Class A demand.
   - The transmission route will have a highly reliable line configuration.

3) Line configuration
   - The transmission equipment will be connected to the existing fiber optic cable in Thanlyin Station and a transmission route for Yangon = Thanlyin = Thilawa SEZ will be installed.
   - The transmission route will be a loop configuration using fiber optic cable.
   - The necessary switches, etc. for loop configuration will be installed in Marine University. (Reason: Time until transmission route construction and cost can be reduced by adopting this method.)

(4) Equipment to be introduced

The main equipment required for construction of the Thilawa SEZ communication facilities is as shown below.

(a) CWDM multiplex transmission equipment x 2 (Note: CWDM will not be necessary when DWDM of 30 Gbps is installed in Thanlin station planned under Yangon Metro network

component.)

(b) 10GbE Router x 1

(c) L2 Switch (1GbE/10GbE) x 2

(d) Optical fiber cable：10km

(5) Others

For the installed communication equipment in Marine University

The communication equipment supplied by the Project for Urgent Improvement of Communication Networks by Japan grant aid is temporarily installed at the corridor between the class rooms in the university. Communication equipment under the loan project is also planned to be installed there. In this connection, suitable air conditioning facility is desirable for securing equipment operation and suitable partition is to be provided for security.

For construction of optical fiber cable connecting between Thilawa SEZ and Thanlyin Exchange

Existing overhead fiber optic cables connected from Thanlyin exchange to Khauktan exchange have 24 and 12 cores. A manhole shall be constructed at the suitable point about 10 km off from Thanlyin exchange to the south (at latitude 16 °41′ 09.276″ N and at longitude 96°18′ 32.328″ E) along the existing cables and new underground fiber optic cable to be connected to existing optical fiber cable at the said manhole point. The manhole point is confirmed to be free from passages and a public area. The optical fiber cable route which is planned to be laid for ring road around Thilawa SEZ area has so narrow pedestrian and shoulder that the attention shall be taken to the passers to prevent accidents with consideration of taking a distance from the road with a bank etc. in case that any structure such as manhole or cabinet for connecting cables would be constructed.

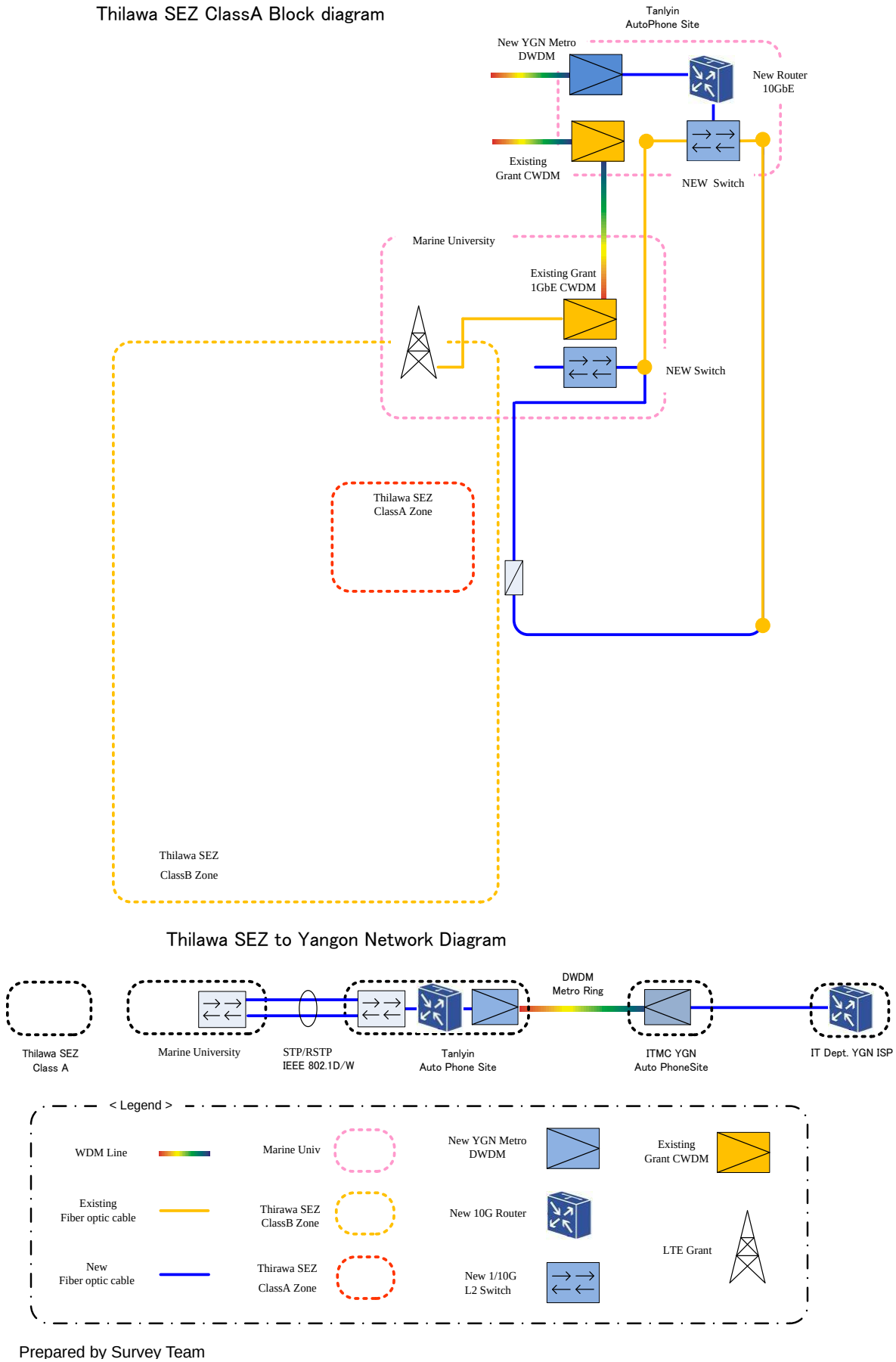

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Figure 7.1-23 Outline of the Thilawa SEZ communication

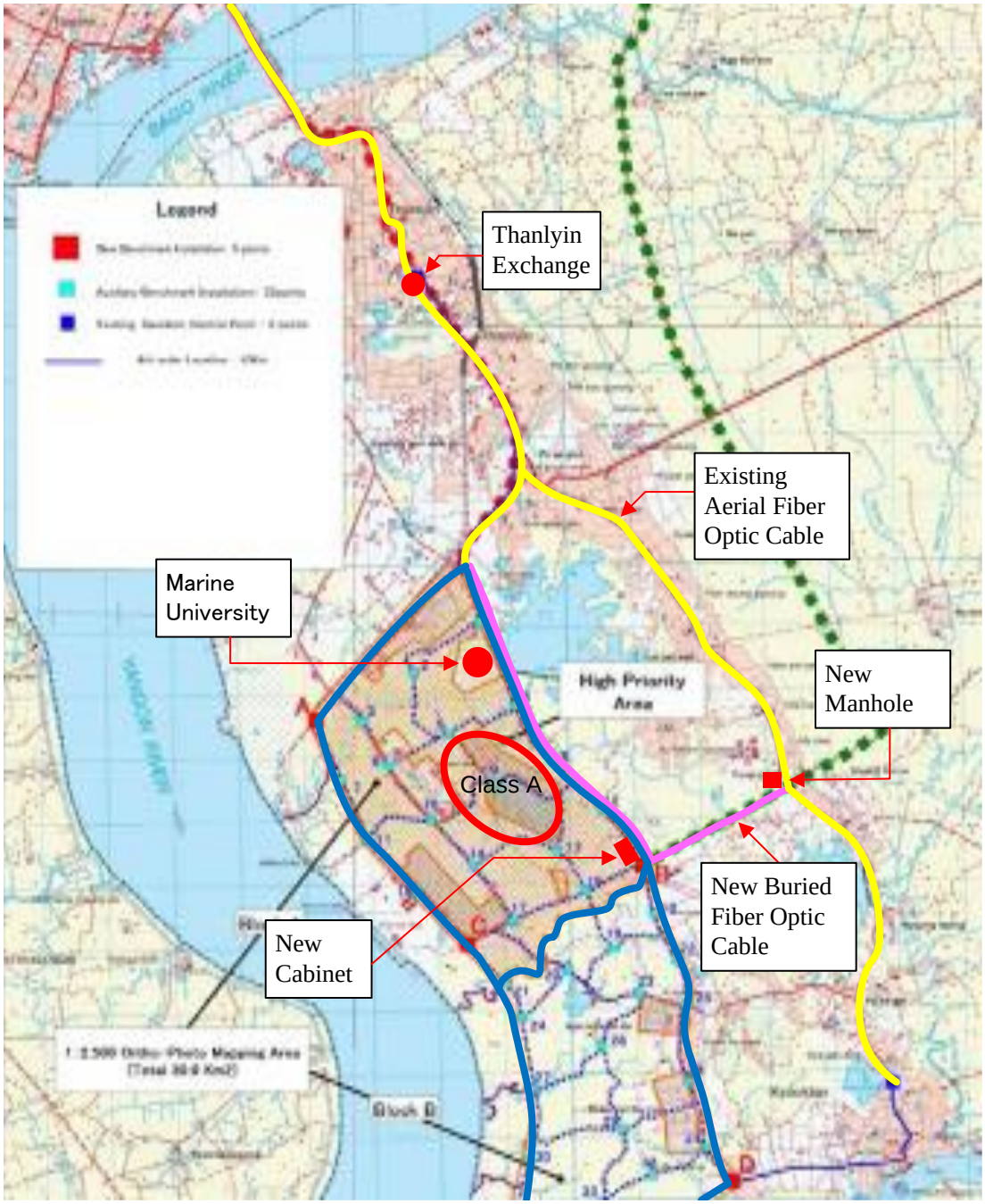

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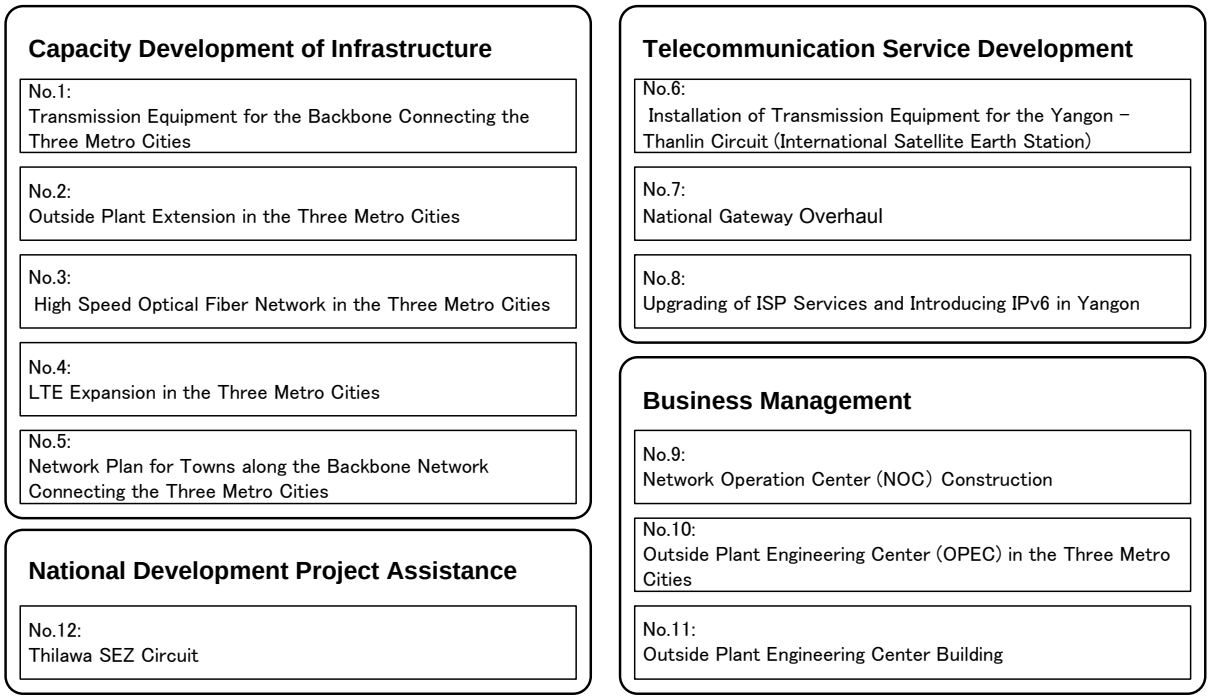
Figure 7.1-24 Map of the target area at Thilawa SEZ

7.2 Procurement and Civil Works

The project consists of 12 subprojects divided among four development schemes as shown in Figure 7.2-1. The subprojects are outlined in this sub clause.



Source: Survey team

Figure 7.2-1 Project Scope (tentative)

(1) Transmission Equipment for the Backbone Connecting the Three Metro Cities

Outline of Subproject

- Development of three 500G backbone routes connecting the three metropolitan cities (fiber optic cables have already been installed by MPT.)

Table 7.2-1 Equipment List

No	Name	Specification	Note	Q'ty
1	DWDM (Type 1A)	Function: Optical Multiplexing Capacity:100G×5λ Configuration:2 way ROADM providing SDH, Ethernet interface included NMS integration	High speed network establishment	19set
2	DWDM(Type 1B)	Function: Optical Multiplexing Capacity: 100G×5λ Configuration: 3 way ROADM providing SDH, Ethernet interface included NMS integration	Ditto	3 set
3	DWDM (Type 1C)	Function: Optical Multiplexing Capacity: 100G×5λ	Ditto	1 set

4	DWDM (Type 1D)	Function: Optical Multiplexing Capacity: 100G×5λ Configuration: DWDM Terminal configuration providing SDH , Ethernet interface included NMS integration	Ditto	3 set
5	Amplifying Device for DWDM(Type 1A)	Amplifying the signal suitably at receiving side	Repeater for DWDM	10 set
6	Amplifying Device for DWDM(Type 1B)	Amplifying the signal suitably at receiving side	Ditto	3 set
7	Amplifying Device for DWDM(Type 1D)	Amplifying the signal suitably at receiving side	Ditto	3 set

Source: Survey team

(2) Outside Plant Extension in the Three Metro Cities

Outline of Subproject

- Construction of underground conduits and hand holes for the outside plants to establish a metro network connecting the exchanges of the three metro cities

Table 7.2-2 Equipment List

No	Name	Specification	Note	Q'ty
1	Yangon Conduits for underground installation	Installation: Buried Diameter: 100φx 4 conduits	Conduits for introducing fiber optic metro network	119.7 km
2	Mandalay Conduits for underground installation	Ditto	Ditto	101.0 km
3	Naypyitaw Conduits for underground installation	Ditto	Ditto	258.0 km

Source: Survey team

(3) High Speed Optical Fiber Network in Three Metro Cities

Outline of Subproject

- Establishment of metro networks upgrading the capacity (Yangon: 300G, Napyitaw: 100G, Mandalay: 300G) through dense wavelength division multiplexing (DWDM) equipment with fiber optic cables connecting the exchanges

Table 7.2-3 Equipment List

No	Name	Specification	Note	Q'ty
1	Yangon			
1-1	DWDM(Type 3A)	Function: Optical Multiplexing Capacity: 100G×3λ Configuration: 3 way ROADM providing SDH, Ethernet interface included NMS integration	High speed network establishment	3set
1-2	DWDM(Type 3B)	Function: Optical Multiplexing Capacity: 100G×3λ Configuration: 4 way ROADM providing SDH, Ethernet interface included NMS integration	Ditto	1 set
1-3	DWDM(Type 3C)	Function: Optical Multiplexing Capacity: 100G×3λ Configuration:3 way ROADM	Ditto	2 set

		providing SDH, Ethernet interface included NMS integration		
1-4	DWDM(Type 3D)	Function: Optical Multiplexing Capacity: 100G×3λ Configuration: 5 (3+2) way ROADM providing SDH, Ethernet interface included NMS integration	Ditto	2 set
1-5	DWDM(Type 3E)	Function: Optical Multiplexing Capacity: 100G×3λ Configuration: 4 (2+2) way ROADM providing SDH, Ethernet interface included NMS integration	Ditto	2 set
1-6	DWDM(Type 3F)	Function: Optical Multiplexing Capacity: 10G×3λ Configuration: 3 (2+1) way ROADM providing SDH, Ethernet interface included NMS integration	Ditto	1 set
1-7		Function: Optical Multiplexing Capacity:10G×3λ Configuration: 2 way ROADM providing SDH, Ethernet interface included NMS integration	Ditto	7 set
1-8	DWDM(Type 3H)	Function: Optical Multiplexing Capacity:10G×3λ Configuration: 5 way ROADM providing SDH, Ethernet interface included NMS integration	Ditto	1 set
1-9	DWDM(Type 3I)	Function: Optical Multiplexing Capacity: 10G×3λ Configuration: 4 way ROADM providing SDH, Ethernet interface included NMS integration	Ditto	3 set
1-10	DWDM(Type 3J)	Function: Optical Multiplexing Capacity: 10G×3λ Configuration: 4 way ROADM providing SDH, Ethernet interface included NMS integration	Ditto	4 set
2	Mandalay			
2-1	DWDM(Type 3K)	Function: Optical Multiplexing Capacity: 100G×3λ Configuration: 2 way ROADM providing SDH, Ethernet interface included NMS integration	Ditto	1 set
2-2	DWDM(Type 3L)	Function: Optical Multiplexing Capacity: 100G×3λ Configuration: 3 way ROADM providing SDH, Ethernet interface included NMS integration	Ditto	6 set
2-3	DWDM(Type 3M)	Function: Optical Multiplexing Capacity: 100G×3λ Configuration: WDM Terminal providing SDH, Ethernet interface included NMS integration	Ditto	2 set
3	Naypyitaw			
3-1	DWDM(Type 3N)	Function: Optical Multiplexing Capacity: 100G×1λ Configuration: 2 way ROADM providing SDH, Ethernet interface included NMS integration	Ditto	3 set
3-2	DWDM(Type 3O)	Function: Optical Multiplexing Capacity: 100G×1λ +10G x 3λ Configuration: 4 (2+2) way ROADM providing SDH, Ethernet interface included NMS integration	Ditto	1 set
3-3	DWDM(Type 3P)	Function: Optical Multiplexing	Ditto	1 set

		Capacity: 100G×1 λ +10G x 3 λ Configuration: 4 (3+1) way ROADM providing SDH, Ethernet interface included NMS integration		
3-4	DWDM(Type 3Q)	Function: Optical Multiplexing Capacity: 100G×1 λ +10G x 3 λ Configuration: 6 (3+3) way ROADM providing SDH, Ethernet interface included NMS integration	Ditto	1 set
3-5	DWDM(Type 3R)	Function: Optical Multiplexing Capacity: 100G×1 λ +10G x 3 λ Configuration:3 (2+1) way ROADM providing SDH, Ethernet interface included NMS integration	Ditto	1 set
3-6	DWDM(Type 3S)	Function: Optical Multiplexing Capacity: 100G×1 λ +10G x 3 λ Configuration:5 (4+1) way ROADM providing SDH, Ethernet interface included NMS integration	Ditto	1 set
3-7	DWDM(Type 3T)	Function: Optical Multiplexing Capacity: 10G×1 λ Configuration: 2 way ROADM providing SDH, Ethernet interface included NMS integration	Ditto	7 set
3-8	DWDM(Type 3U)	Function: Optical Multiplexing Capacity: 10G×1 λ Configuration: 3 way ROADM providing SDH, Ethernet interface included NMS integration	Ditto	2 set

Source: Survey team

(4) LTE Expansion in the Three Metro Cities

Outline of Subproject

- Deploy LTE to enhance wireless internet access in the three metro cities

Table 7.2-4 Equipment List

No	Name	Specification	Note	Q'ty
1	Yangon			
1-1	LTE base station system	LTE Base Frequency : Band3 1.8GHz Rated Power : 5w	Equipment for LTE communication	205 set
1-2	Media Converter	Function:1Gbps Single Mode Media Converter Capacity:1Gbps Configuration:1000BaseTX to 1000BaseLX	Function:1Gbps Electrical signal to Single Mode Fiber Media Converter	205 set
1-3	ERP Switch	Function: L2 Switch Capacity: 1Gbps/10Gbps Configuration: 1000BaseTX x 24 Port 10G-BaseER/LR x 4Port(Optical) Support Ethernet Ring Protection G.8032	Establishing high reliable ring network	25 set
1-4	L3 Switch	Function: L3 Switch Capacity: 10Gbps Configuration: 10G-BaseER/LR x 6Port(Optical) Support Ethernet Ring Protection G.8032	Improving efficiency and stability of ring network composed of ring switch	5 set

1-5	O-ADM-DWDM 10GbE Line Card	Function: Optical Multiplexing Capacity:10G x 1 Configuration: 10GEthernet interface	Expanding capacity of metro network corresponding to expanding LTE traffic	25 set
2	Naypyitaw			
2-1	LTE base station system	LTE Base Frequency : Band3 1.8GHz Rated Power : 5w	Supplying LTE communications facilities	155 set
2-2	Media Converter	Function:1Gbps Single Mode Media Converter Capacity:1Gbps Configuration:1000BaseTX to 1000BaseLX	Function:1Gbps Electrical signal to Single Mode Fiber Media Converter	155 set
2-3	ERP Switch	Function: L2 Switch Capacity: 1Gbps/10Gbps Configuration: 1000BaseTX x 24 Port 10G-BaseER/LR x 4Port(Optical) Support Ethernet Ring Protection G.8032	Establishing high reliable ring network	16 set
2-4	L3 Switch	Function: L3 Switch Capacity: 10Gbps Configuration: 10G-BaseER/LR x 6Port(Optical) Support Ethernet Ring Protection G.8032	Improving efficiency and stability of ring network composed of ring switch	3 set
2-5	O-ADM-DWDM 10GbE Line Card	Function: Optical Multiplexing Capacity:10G x 1 Configuration: 10GEthernet interface	Expanding capacity of metro network corresponding to expanding LTE traffic	16 set
3	Mandalay			
3-1	LTE base station system	LTE Base Frequency : Band3 1.8GHz Rated Power : 5w	Supplying LTE communications facilities	140 set
3-2	Media Converter	Function:1Gbps Single Mode Media Converter Capacity:1Gbps Configuration:1000BaseTX to 1000BaseLX	Function:1Gbps Electrical signal to Single Mode Fiber Media Converter	140 set
3-3	ERP Switch	Function: L2 Switch Capacity: 1Gbps/10Gbps Configuration: 1000BaseTX x 24 Port 10G-BaseER/LR x 4Port(Optical) Support Ethernet Ring Protection G.8032	Establishing high reliable ring network	9 set
3-4	L3 Switch	Function: L3 Switch Capacity: 10Gbps Configuration: 10G-BaseER/LR x 6Port(Optical) Support Ethernet Ring Protection G.8032	Improving efficiency and stability of ring network composed of ring switch	2 set
3-5	O-ADM-DWDM 10GbE Line Card	Function: Optical Multiplexing Capacity:10G x 1 Configuration: 10GEthernet interface	Expanding capacity of metro network corresponding to expanding LTE traffic	9 set
4	Common			
4-1	Transmission for Internet (IT Dept.)	Function: 10GbE Router Capacity: 10Gbps Configuration: Support 1000Base-TX/LX 10G-BaseER/LR	Connecting with backbone network and internet gateway signals	2set
4-2	Transmission Equipment for Core LTE（Router)	Function: 10GbE Router Capacity: 10Gbps Configuration: Support 1000Base-TX/LX 10G-BaseER/LR	Connecting with core LTE	2set
4-3	Core LTE Server Upgrade	Function: Core LTE	Accommodating small type base station, managing movement and confirmation of LTE terminals, transmission of user data, facility of gateway to outside network and management of subscriber data	1lot

4-4	Security Equipment	Function: Fire Wall Capacity: Throughput Max58Gbps Configuration: Support 10GbE	Security for server	1lot
4-5	LTE-WiFi Router	LTE Base Frequency : Band3 1.8GHz WiFi Configuration: IEEE802.11 n/g/b	Supplying high speed radio broadband connection through LTE network for Wi-Fi users	5000set

Source: Survey team

(5) Network Plan for Towns along the Backbone Network Connecting the Three Metro Cities

Outline of Subproject

- Deploy LTE to enhance wireless internet access in towns within the target area of the three metro cities
- Development sites: Pyay, Tharyawaddy, Zegone, Aunglan, Taungtwinkyi, Magway, Yenanchaung, Pakokku, Kyaukpadung, Nyaung U -10 towns

Table 7.2-5 Equipment List

No	Name	Specification	Note	Q'ty
1	Pyay			
1-1	LTE Base station system	LTE Base Frequency : Band3 1.8GHz Rated Power : 5w Multiplexing System: FDD	Supplying LTE communications facilities	4 set
1-2	Media Converter	Function:1Gbps Single Mode Media Converter Capacity:1Gbps Configuration:1000BaseTX to 1000BaseLX	Converting electrical to optical signal for LTE base station	4 set
1-3	L2 Switch	Function: L2 Switch Capacity: 1Gbps/10Gbps Configuration: 1000BaseTX x 24 Port 10G-BaseER/LR x 2Port(Optical)	Integrating communication signals from LTE base station	1 set
1-4	10GbE Router	Function: 10GbE Router Capacity: 10Gbps Configuration: Support 1000Base-TX/LX 10G-BaseER/LR	Connecting with backbone network and internet gateway signals	1 set
2	Tharyawaddy			
2-1	LTE Base station system	LTE Base Frequency : Band3 1.8GHz Rated Power : 5w Multiplexing System: FDD	Supplying LTE communications facilities	3 set
2-2	Media Converter	Function:1Gbps Single Mode Media Converter Capacity:1Gbps Configuration:1000BaseTX to 1000BaseLX	Converting electrical to optical signal for LTE base station	3 set
2-3	L2 Switch	Function: L2 Switch Capacity: 1Gbps Configuration: 1000BaseTX x 24 Port 1000BaseLX x 2Port(Optical)	Integrating communication signals from LTE base station	1 set
2-4	1GbE Router	Function: 1GbE Router Capacity: 1Gbps Configuration: Support 1000Base-TX/1000BaseLX	Connecting with backbone network and internet gateway signals	1 set
3	Zegon			
3-1	LTE Base station system	LTE Base Frequency : Band3 1.8GHz Rated Power : 5w Multiplexing System: FDD	Supplying LTE communications facilities	3 set

3-2	Media Converter	Function:1Gbps Single Mode Media Converter Capacity:1Gbps Configuration:1000BaseTX to 1000BaseLX	Converting electrical to optical signal for LTE base station	3 set
3-3	L2 Switch	Function: L2 Switch Capacity: 1Gbps Configuration: 1000BaseTX x 24 Port 1000BaseLX x 2Port(Optical)	Integrating communication signals from LTE base station	1 set
3-4	1GbE Router	Function: 1GbE Router Capacity: 1Gbps Configuration: Support 1000Base-TX/1000BaseLX	Connecting with backbone network and internet gateway signals	1 set
4	Aunglan			
4-1	LTE Base station system	LTE Base Frequency : Band3 1.8GHz Rated Power : 5w Multiplexing System: FDD	Supplying LTE communications facilities	3 set
4-2	Media Converter	Function:1Gbps Single Mode Media Converter Capacity:1Gbps Configuration:1000BaseTX to 1000BaseLX	Transferring electrical to optical signal for LTE base station	3 set
4-3	L2 Switch	Function: L2 Switch Capacity: 1Gbps Configuration: 1000BaseTX x 24 Port 1000BaseLX x 2Port(Optical)	Integrating communication signals from LTE base station	1 set
4-4	1GbE Router	Function: 1GbE Router Capacity: 1Gbps Configuration: Support 1000Base-TX/1000BaseLX	Connecting with backbone network and internet gateway signals	1 set
5	Taungtwinkyi			
5-1	LTE Base station system	LTE Base Frequency : Band3 1.8GHz Rated Power : 5w Multiplexing System: FDD	Supplying LTE communications facilities	8 set
5-2	Media Converter	Function:1Gbps Single Mode Media Converter Capacity:1Gbps Configuration:1000BaseTX to 1000BaseLX	Converting electrical to optical signal for LTE base station	8 set
5-3	L2 Switch	Function: L2 Switch Capacity: 1Gbps/10Gbps Configuration: 1000BaseTX x 24 Port 10G-BaseER/LR x 2Port(Optical)	Integrating communication signals from LTE base station	1 set
5-4	10GE Router	Function: 10GbE Router Capacity: 10Gbps Configuration: Support 1000Base-TX/LX 10G-BaseER/LR	Connecting with backbone network and internet gateway signals	1 set
6	Magway			
6-1	LTE Base station system	LTE Base Frequency : Band3 1.8GHz Rated Power : 5w Multiplexing System: FDD	Supplying LTE communications facilities	3 set
6-2	Media Converter	Function:1Gbps Single Mode Media Converter Capacity:1Gbps Configuration:1000BaseTX to 1000BaseLX	Converting electrical to optical signal for LTE base station	3 set
6-3	L2 Switch	Function: L2 Switch Capacity: 1Gbps Configuration: 1000BaseTX x 24 Port 1000BaseLX x 2Port(Optical)	Integrating communication signals from LTE base station	1 set
6-4	1GbE Router	Function: 1GbE Router Capacity: 1Gbps Configuration: Support 1000Base-TX/1000BaseLX	Connecting with backbone network and internet gateway signals	1 set

7	Yenanchaung			
7-1	LTE Base station system	LTE Base Frequency : Band3 1.8GHz Rated Power : 5w Multiplexing System: FDD	Supplying LTE communications facilities	3 set
7-2	Media Converter	Function:1Gbps Single Mode Media Converter Capacity:1Gbps Configuration:1000BaseTX to 1000BaseLX	Converting electrical to optical signal for LTE base station	3 set
7-3	L2 Switch	Function: L2 Switch Capacity: 1Gbps Configuration: 1000BaseTX x 24 Port 1000BaseLX x 2Port(Optical)	Integrating communication signals from LTE base station	1 set
7-4	1GbE Router	Function: 1GbE Router Capacity: 1Gbps Configuration: Support 1000Base-TX/1000BaseLX	Connecting with backbone network and internet gateway signals	1 set
8	Pakokku			
8-1	LTE Base station system	LTE Base Frequency : Band3 1.8GHz Rated Power : 5w Multiplexing System: FDD	Supplying LTE communications facilities	3 set
8-2	Media Converter	Function:1Gbps Single Mode Media Converter Capacity:1Gbps Configuration:1000BaseTX to 1000BaseLX	Converting electrical to optical signal for LTE base station	3 set
8-3	L2 Switch	Function: L2 Switch Capacity: 1Gbps Configuration: 1000BaseTX x 24 Port 1000BaseLX x 2Port(Optical)	Integrating communication signals from LTE base station	1 set
8-4	1GbE Router	Function: 1GbE Router Capacity: 1Gbps Configuration: Support 1000Base-TX/1000BaseLX	Connecting with backbone network and internet gateway signals	1 set
9	Kyaukpadung			
9-1	LTE Base station system	LTE Base Frequency : Band3 1.8GHz Rated Power : 5w Multiplexing System: FDD	Supplying LTE communications facilities	3set
9-2	Media Converter	Function:1Gbps Single Mode Media Converter Capacity:1Gbps Configuration:1000BaseTX to 1000BaseLX	Converting electrical to optical signal for LTE base station	3 set
9-3	L2 Switch	Function: L2 Switch Capacity: 1Gbps Configuration: 1000BaseTX x 24 Port 1000BaseLX x 2Port(Optical)	Integrating communication signals from LTE base station	1set
9-4	1GbE Router	Function: 1GbE Router Capacity: 1Gbps Configuration: Support 1000Base-TX/1000BaseLX	Connecting with backbone network and internet gateway signals	1set
10	Nyaung U			
10-1	LTE Base station system	LTE Base Frequency : Band3 1.8GHz Rated Power : 5w Multiplexing System: FDD	Supplying LTE communications facilities	3set
10-2	Media Converter	Function:1Gbps Single Mode Media Converter Capacity:1Gbps Configuration:1000BaseTX to 1000BaseLX	Converting electrical to optical signal for LTE base station	3set
10-3	L2 Switch	Function: L2 Switch Capacity: 1Gbps Configuration: 1000BaseTX x 24 Port 1000BaseLX x 2Port(Optical)	Integrating communication signals from LTE base station	1set

10-4	1GbE Router	Function: 1GbE Router Capacity: 1Gbps Configuration: Support 1000Base-TX/1000BaseLX	Connecting with backbone network and internet gateway signals	1set
11	Common			
11-1	LTE-WiFi Router	LTE Base Frequency : Band3 1.8GHz WiFi Configuration: IEEE802.11 n/g/b	Supplying high speed radio broadband connection through LTE network for Wi-Fi users	3000set
11-2	LTE Core enlargement	Function: Core LTE	Improvement in LTE Server capability	1set
11-3	Optical Cable for 10 cities (note) Concrete poles and materials for fixing cables are supplied by MPT.	Overhead cables of 12 cores	Connection for Backbone DWDM station to LTE BTS	180 km

Source: Survey team

(6) Installation of Transmission Equipment for the Yangon - Thanlin Circuit (International Satellite Earth Station)

Outline of Subproject

- Upgrading the domestic line's capacity to 40G through dense wavelength division multiplexing (DWDM) equipment between the ITMC in Yangon and the international satellite earth station in Thanlin.

Table 7.2-6 Equipment List

No	Name	Specification	Note	Q'ty
1	DWDM(Type 8A)	Function: Optical Multiplexing Capacity:10G×4λ Configuration: Terminal, included NMS integration	High speed network establishment	2set
2	DWDM(Type 8B)	Function: Optical Multiplexing Capacity: 10G×4λ Configuration: Terminal /Repeater, included NMS integration	Ditto	1set

Source: Survey team

(7) National Gateway Overhaul

Outline of Subproject

- Upgrading the capacity of the gateway equipment (routers, switches etc.) to 100G to resolve the bottleneck of the outbound internet access

Table 7.2-7 Equipment List

No	Name	Specification	Note	Q'ty
1	Yangon			
1-1	IX-Router	Function: 100GbE Router Configuration: Support Interface 1/GbE/10GbE/100GbE(IEEE802.3ba) STM-4/16/64	Cross Border Gateway Router	2set
2	NayPyiTaw			

2-1	IX-Router	Function: 100GbE Router Configuration: Support Interface 1/GbE/10GbE/100GbE(IEEE802.3ba) STM-4/16/64	Cross Border Gateway Router	2set

Source: Survey team

(8) Upgrade ISP Services and Introduce IPv6 in Yangon

Outline of Subproject

- Introduction of NAT(Network Address Translator) to relieve shortages in IPv4 global addresses
- Upgrading ISP services and introducing high-performance IP transmission equipment

Table 7.2-8 Equipment List

No	Name	Specification	Note	Q'ty
1	Upgrading of ISP Services			
1-1	Yangon			
1-1-1	Border Router	Function: 100GbE Router Configuration: Support Interface 1GbE/10GbE/100GbE(IEEE802.3ba)	Connecting to IX router and edge router	2 set
1-1-2	Edge Router	Function: 100GbE Router Configuration: Support Interface 1GbE/10GbE/100GbE(IEEE802.3ba)	Connecting to boarder router and subscriber network	2 set
1-1-3	Bandwidth Control Switch(for POP)	Function: Bandwidth Controller Capacity: Up to 32,000,000 (Unidirectional Flows)	Controlling communication bandwidth and detecting other communication signals not to be affected	4 set
1-1-4	Load Balancer	Function: Load Balancer Capacity: HTTP Request /sec Over 4,000,000	Dispersing loads of communication signals to servers	4 set
1-1-5	Firewall	Function: Fire Wall Capacity: Throughput 60Gbps	Firewall to servers	4 set
1-1-6	DNS Server (Domain Name Server)	Function: DNS Server Capacity: DNS Query /sec Over 200,000 Configuration: Support DNSSEC	Solution for internet connection	2 set
1-1-7	DNS Caching Server	Function: DNS Cache Server Capacity: Disk Cash SAS HDD x 4 DNS Query /sec Over 200,000 Configuration: Support DNSSEC	Solution for internet connection	1 set
1-1-8	Proxy Server	Function: Proxy Server Capacity: Disk Cash SAS HDD x 10 Max Connection Over 100,000 Configuration: Support DNSSEC	Reducing traffic by accumulating Web contents on server	4 set
1-2	Naypyitaw			
1-2-1	Border Router	Function: 100GbE Router Configuration: Support Interface 1GbE/10GbE/100GbE(IEEE802.3ba)	Connecting to IX router and edge router	2 set
1-2-2	Edge Router	Function: 100GbE Router Configuration: Support Interface 1GbE/10GbE/100GbE(IEEE802.3ba)	Connecting to boarder router and subscriber network	2 set
1-2-3	Bandwidth Control Switch(Product for POP)	Function: Bandwidth Controller Capacity: Up to 32,000,000 (Unidirectional Flows)	Controlling communication bandwidth and detecting other communication signals not to be affected	4 set
1-2-4	Load Balancer	Function: Load Balancer	Dispersing loads of	4 set

		Capacity: HTTP Request /sec Over 4,000,000	communication signals to servers	
1-2-5	Firewall	Function: Fire Wall Capacity: Throughput 60Gbps	Firewall to servers	4 set
1-2-6	DNS Server	Function: DNS Server Capacity: DNS Query /sec Over 200,000 Configuration: Support DNSSEC	Solution for internet connection	2 set
1-2-7	DNS Caching Server	Function: DNS Cache Server Capacity: Disk Cache SAS HDD x 4 DNS Query /sec Over 200,000 Configuration: Support DNSSEC	Solution for internet connection	1 set
1-2-8	Proxy Server	Function: Proxy Server Capacity: Disk Cache SAS HDD x 10 Max Connection Over 100,000 Configuration: Support DNSSEC	Reducing traffic by accumulating Web contents on server	4 set
1-3	Mandalay			
1-3-1	Border Router	Function: 100GbE Router Configuration: Support Interface 1GbE/10GbE/100GbE(IEEE802.3ba)	Connecting to IX router and edge router	2 set
1-3-2	Edge Router	Function: 100GbE Router Configuration: Support Interface 1GbE/10GbE/100GbE(IEEE802.3ba)	Connecting to boarder router and subscriber network	2 set
1-3-3	Bandwidth Control Switch(Product for POP)	Function: Bandwidth Controller Capacity: Up to 32,000,000 (Unidirectional Flows)	Controlling communication bandwidth and detecting other communication signals not to be affected	4 set
1-3-4	Load Balancer	Function: Load Balancer Capacity: HTTP Request /sec Over 4,000,000	Dispersing loads of communication signals to servers	4 set
1-3-5	Firewall	Function: Fire Wall Capacity: Throughput 60Gbps	Firewall to servers	4 set
1-3-6	Proxy Server	Function: Proxy Server Capacity: Disk Cash SAS HDD x 10 Max Connection Over 100,000 Configuration: Support DNSSEC	Reducing traffic by accumulating Web contents on server	4 set
2	Introduction IPv6			
2-1	Yangon			
2-1-1	NAT	Function: NAT (Carrier Grade) Configuration: Support Translation IPv4/IPv6 Function NAT44,NAT64&DNS64,Application Layer Gateway(ALG) Deterministic NAT	An Internet Protocol (IP) translation process that allows a network with IPv4/IPv6 addresses to access information on the Internet.	2set

Source: Survey team

(9) Network Operation Center (NOC) Construction

Outline of Subproject

- Introduction of a central monitoring and operating system for the network to expedite trouble shooting and to take countermeasures, to make maintenance work more efficient and to improve customer services
- Location

  Main NOC: Dekkhina Exchange, Naypyitaw

  Backup NOC: Hanthawaddy New Building, Yangon

Table 7.2-9 List of Equipment

No	Name	Specification	Note	Q'ty
1	Planning and Designing Service	system architecture design(Network Management), system integration design	Planning for transfer, switch-over, operation flow accompanied by integration of network management	1 lot
2	NayPyiTaw main NOC			
2-1	Main NOC Facilities	Power supply , Air-conditioning , Security gate	NOC inner Platform	1 lot
2-2	Main NOC Hardware	Network Equipment , Servers , LCD , Client PC ,	NOC Hardware Platform	1 lot
2-3	Main NOC Software	NOC Core Application , DB Application	NOC Software Platform	1 lot
2-4	Main NOC Secure	VPN Monitoring Network Network Security IDS/IPS Application Security Fire Wall Physical Security CCTV/Access control Equipment	NOC Security Platform	1 lot
3	Yangon Backup NOC			
3-1	Backup NOC Facilities	Power supply , Air-conditioning , Security gate	NOC inner Platform	1 lot
3-2	Backup NOC Hardware	Network Equipment , Servers , LCD , Client PC ,	NOC Hardware Platform	1 lot
3-3	Backup NOC Software	NOC Core Application , DB Application	NOC Software Platform	1 lot
3-4	Backup NOC Secure	VPN Monitoring Network Network Security IDS/IPS Application Security Firewall Physical Security CCTV/Access control Equipment	NOC Security Platform	1 lot
4	Overall Integration	Main NOC , Backup NOC Server Synchronization , Both NOC system integration	Process of NOC main/backup integration, synchronization of data base and arrangement between NOC network	1 lot

Source: Survey team

(10) Outside Plant Engineering Center (OPEC) Construction in the Three Metro Cities

Outline of Subproject

- Introduction of Outside Plant Engineering center to train resident engineers and technicians, to install, operate and maintain the communication facilities in an effective manner, to store tools and to park the maintenance vehicles
- Procurement of tools and maintenance vehicles

Table 7.2-10 Equipment List

No	Name	Specification	Note	Q'ty
1	Equipment			
1-1	Measuring Instruments and Working Tools			
1-1-1	Digital Cluster	Measurement for voltage, power, resistance, capacitance, etc.	Electric characteristics test	3 sets
1-1-2	Cable Analyzer	Test for LAN (CAT) cable	Quality test for cable	6 sets
1-1-3	Cable Tester for LAN (100G)	Performance test and defect analysis for LAN network	Test for network environment	2 sets
1-1-4	Packet Generator	Performance test and protocol analysis at failure for LAN network	Test for network environment	1 set

1-1-5	Underground Detect Radar	Finding Obstacles laid underground and the locations	Finding Obstacles, pipes etc. the locations and routes	3 sets
1-1-6	Fusion Splicer	Splicing optical cables	Optical cables connecting	30 sets
1-1-7	OTDR (Optical Time-Domain Reflectometer)	Measurement for Optical cable loss, loss of distance to connection and reflection loss and distance to defect point	Measurement for long distance optical cable	30 sets
1-2	Training Equipment			
1-2-1	CAD software	Software for drawings	Merit for large scale of drawing	1 set
1-3	Office Equipment			
1-3-1	Desktop Computer	Desktop computer for trainees	Desktop computer for trainees	20 sets
2	Vehicles			
2-1	Crane Truck	Truck with crane	For laying areal cable	1 car
2-2	Forklift Truck	Transportation for various materials	Mainly for ground use	1 car
2-3	Bucket Car	Wagon car for working in, such as cable splicing etc.	Processing materials and material transportation	1 car
2-4	Dump Truck	Transportation for heavy materials, such as soils, gravels, machineries and materials	Transporting excavated soils etc. for cable duct installation	1car
2-5	VAN for engineers	Transportation for materials and workers	Taking action speedy to defect points	1 car
2-6	HDD (Horizontal Directional Drilling) Machine			
2-6-1	HDD Machine (25-30ton)	Horizontal Drilling Machine underground for cable duct laying	Merit is without damaging face of land	1car
2-6-2	Trailer (10 wheels)	Transportation for HDD and heavy materials	Transporting heavy and/or long materials	1 car
2-6-3	Crane Truck (5 ton)	Transportation for long materials and heavy materials, such as duct pipes and pumping machine for mud soils	Suitable for transporting cable drums etc.	1 car
2-7	Fiber Splicing Vehicle	For splicing Fiber Optic cable	Splicing inside vehicle	3 cars

Source: Survey team

(11) Outside Plant Engineering Center (OPEC) Building

Outline of Subproject (Procured under separate lot)

- Construction of a building for outside plant engineering center
- Building Construction

  Training center building (approximately 960m^2 for 80 outside plant trainees, 20 CAD trainees)

  Yangon: 2 sites, Naypyitaw: 1 site, Mandalay: 1 site

Table 7.2-11 Equipment List

No	Name	Specification	Note	Q'ty
1	Building Construction			
1-1	Training Center	Gross floor area :960m^2	Building for 80 outside plant trainees and 20 CAD trainees	4site
1-2	Diesel Generator	Rated power:50kVA	Emergency generator for backup power supply in case of commercial power failure	4set

Source: Survey team

(12) Thilawa SEZ Circuit

Outline of Subproject

- Establish a 10G fiber optic network between Thilawa SEZ and Thanlin

Table 7.2-12 Equipment List

No	Name	Specification	Note	Q'ty
1	CWDM	Function: Optical Multiplexing Capacity:10G x 1 Configuration: 10GEthernet interface	WDM Transmission for Metro network between Thanlin and ITMC(Yangon City)	2set
2	10G Router	Function: 10GbE Router Capacity: 10Gbps Configuration: Support 1000Base-TX/LX 10G-BaseER/LR	IP Transmission network between Thilawa and YangonI SP (POP)	2set
3	L2 Switch	Function: L2 Switch Capacity: 1Gbps/10Gbps Configuration: 1000BaseTX x 24 Port 10G-BaseER/LR x 4Port(Optical) Support STP(IEEE802.1D)/RSTP(IEEE802.1W)	Integrating communication signals for access network	2set
4	Fiber Optic Cable			
4-1	SEZ to Thanlyin	Function: Fiber Optical Cable Capacity: 8 core Configuration: ITU-T G.652	Installing optical cable between Thilawa (SEZ) and Thanlin station	3km
4-2	SEZ to Marin University	Function: Fiber Optic Cable Capacity: 8 core Configuration: ITU-T G.652	Installing optical cable between Thilawa (SEZ) and Marine University	7km
5	Conduits for underground installation	Installation: Buried Diameter: 100φx 4 conduits	Conduits for introducing fiber optic network between Thanlin and Thilawa SEZ	10km
6	Terminal box for fiber optic cable	Outside construction with terminal blocks with pedestal	Terminating optical cables	1set

Source: Survey team

7.3 TOR for Consulting Services

The project component described in Section 7.1 is an upgrade plan for an information and telecommunications network that will serve as an important foundation for economic development in Myanmar. It comprises diverse specialist fields such as transmission equipment, IP network plans and route engineering work. Based on the above, when implementing this project, engineering services such as appropriate design and work supervision by consultants composed of engineers in diverse areas of specialization will be necessary. Selection of the consultants will be the responsibility of the MPT which is the implementing agency for this project and will be conducted based on the Guidelines for the Employment of Consultants under Japanese ODA Loans (April 2012) established by JICA. TOR for selection of the consultants is shown below.

(1) Scope of consulting services

The consulting services applied to this project are divided into three stages, detailed design stage, bidding support stage and construction stage, based on the project implementation schedule

described later in Section 7.5. The main tasks at each stage are as shown below.

1) Detailed design stage

(a) Review of preparatory study report and available documents
(b) Determination of design standards
(c) Carrying out the field survey
(d) Preparation of implementation schedule, forms of progress report
(e) Detail design, project cost estimates, bill of quantity and specifications

2) Bidding support stage

(a) Support for pre-qualification (P/Q)
- Determination of qualification requirements
- Preparation of pre-qualification documents
- Support for pre-qualification announcement
- Support for pre-qualification evaluation
- Support for preparation of evaluation report

(b) Support for bidding
- Preparation of tender documents
- Support for sending out invitations, holding pre-bid conference, issuing addendum and preparing answers to questions
- Support for evaluation of tender documents and preparation of evaluation report
- Support for contract negotiations
- Support for preparation of contract agreement

3) Construction stage

(a) Advice on approval of performance security, prepayment guarantee, etc.
(b) Advice on confirmation and approval of implementation schedule, construction guidelines and construction drawings, etc.
(c) Briefing on inconsistencies in contract documents
(d) Communication and coordination with related organizations
(e) Invoice and payment management
(f) Quality control, process control, safety control
(g) Attendance at inspection and issuing of certificate
(h) Advice on confirmation and approval of as-built drawings
(i) Project completion report for MPT
(j) Technology transfer
(k) Preparation and submission of various reports
- Evaluation report on constructor's construction drawings
- Monthly progress report
- Quarterly progress report
- Report on attendance at plant inspection
- Report on attendance at site acceptance inspection

- Project completion report

(2) Consulting service schedule and personnel plan

The consultants shall comprise foreign experts and Myanmar experts. The service period shall be 50 months and the required number of personnel shall be 466 man-months for foreign experts and 382 man-months for Myanmar experts, giving a total of 848 man-months. The consulting service schedule and personnel plan are shown in Table 7.3-1.

Table 7.3-1 Schedule of Consulting Services and Required M/M

No. of Months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	
Calendar Year	2014						2015												2016												2017												2018												
Calendar Month	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
<Foreign Engineer>																																																							M/M
1. Project Manager (F)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1					1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1					45
2. IP System Engineer/Assistant Project Manage (F)	3	3	3	3	3	3	3	3	3	3				1	1	1	1						3	3	3	3	3		3	3	3	3	3	3	3	3	3	3	3	3			3	3	3	3	3	3	3	3					109
3. Transmission Engineer (F)	2	2	2	2	2	2	2	2	2	2				1	1	1	1						2	2	2	2	2		2	2	2	2	2	2	2	2	2	2			2	2	2	2	2	2	2	2	2	2					74
4. Access Network Engineer (F)	2	2	2	2	2	2	2	2	2	2				1	1	1	1						2	2	2	2	2		2	2	2	2	2	2	2	2	2	2			2	2	2	2	2	2	2	2	2	2					74
5. Civil Engineer (F)	2	2	2	2	2	2	2	2	2	2				1	1	1	1						2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2					2	2	2	2	2	2	2	2					72
6. Electrical Engineer (F)	1	1	1	1	1	1	1	1	1	1				1	1	1	1						1	1				1	1				1	1				1	1				1	1				1	1	1					27
7. Building Engineer (F)	2	2	2				2	2	2	2				1	1	1	1						2	2				2	2	2	2	2	2	2	2	2														1					41
8. Cost Work Engineer/Implementation Plan (F)				1	1	1	1	1	1	1				1	1	1	1																																						11
9. O & M Specialist (F)																																														1	1	1	1	1					5
10. Training Engineer 1 (Transmission) (F)																																														1	1								2
11. Training Engineer 2 (IP) (F)																																														1	1								2
12. Training Engineer 3 (NOC) (F)																																														1	1								2
13. Training Engineer 4 (Civil) (F)																																														1	1								2
	75						91												87												114												99												466
<Local Engineer>																																																							
1. Team Leader (IP System Engineer) (L)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1					46
2. Transmission Engineer (L)	1	2	2	2	2	2	2	2	2	2				1	1	1	1					2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2					81
3. Access Network Engineer (L)	2	2	2	2	2	2	2	2	2	2				1	1	1	1					2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2					82
4. Civil Engineer (L)	2	2	2	2	2	2	2	2	2	2				1	1	1	1					2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2					82
5. Electical Engineer (L)	1	1	1				1	1	1	1				1	1	1	1					1	1	1	1	1			1	1	1	1			1	1	1	1	1			1	1			1	1	1							30
6. Building Engineer (L)	2	2	2				2	2	2	2				1	1	1	1					2	2	2	2	2	2	2	2	2	2	2	2	2	2	2													1	1					50
7. Cost Work Engineer/Implementation Plan (L)				1	1	1	1	1	1	1				1	1	1	1																																						11
	53						75												88												104												62												382
	128						166												175												218												161												848

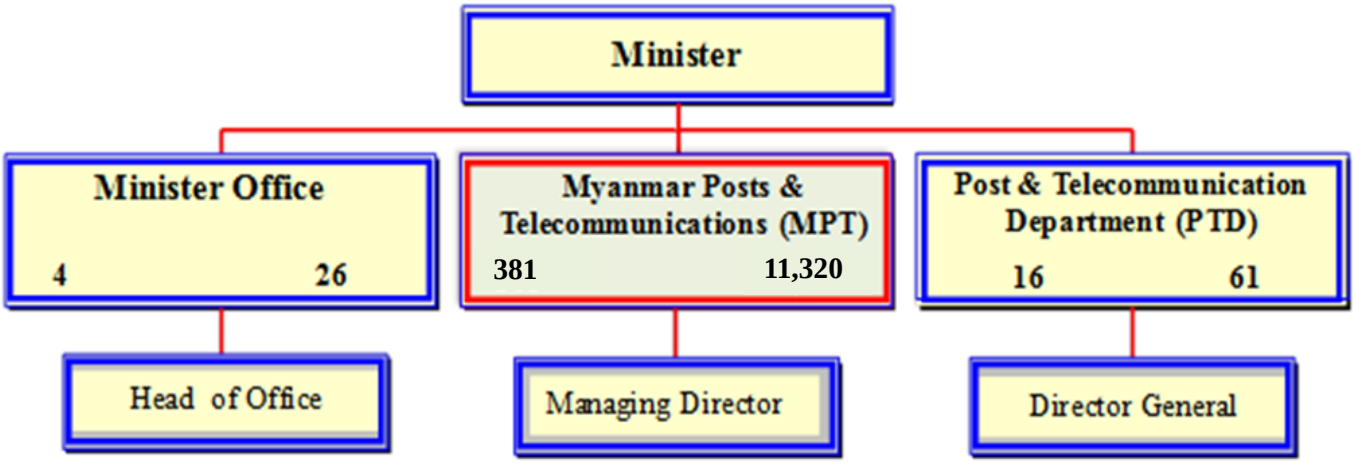
CHAPTER 8 PROJECT IMPLEMENTATION PLAN

8.1 Project Implementation Plan

8.1.1 Project implementing agency

(1) Summary

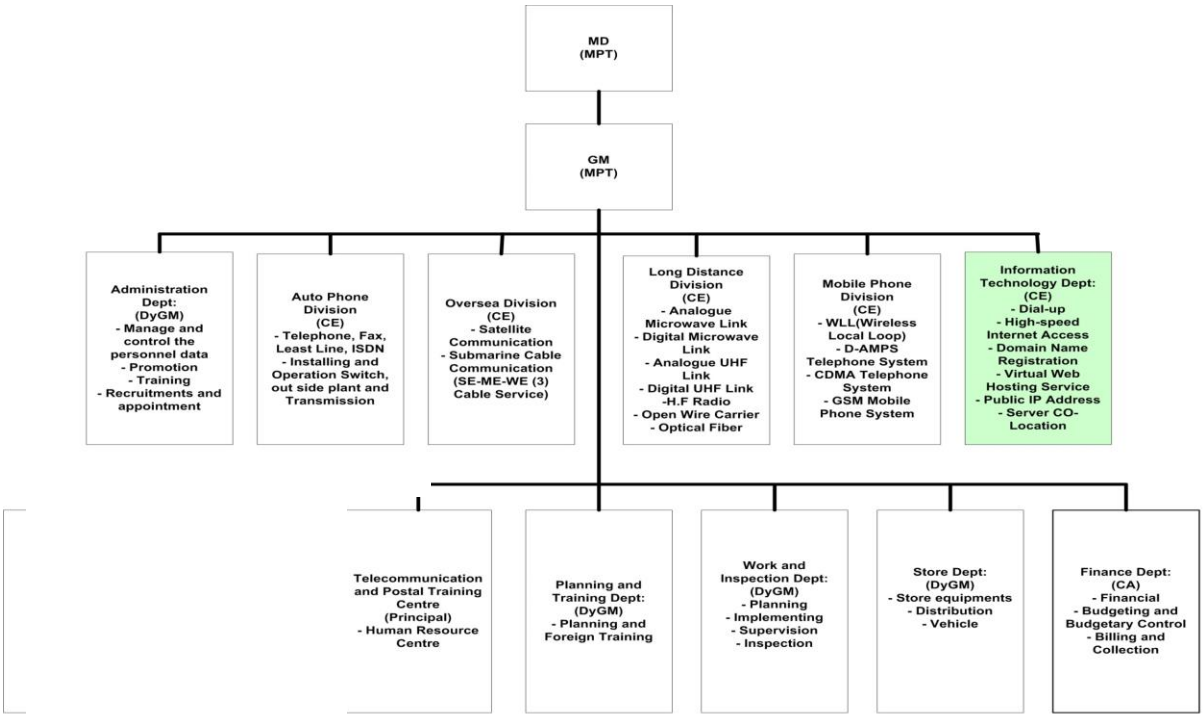
The main organization in charge of this project is the Myanma Posts and Telecommunications (MPT) under Ministry of Communications and Information Technology (MCIT). MPT, under the control of MCIT, provides telecommunications services, while Post and Telecommunications Department (PTD) is in charge of postal mail, telecommunications and broadcasting; its major activities are the development of policies, the management and supervision of telecommunications services, assignment of licences/collection of license fees, standardization of telecommunications equipment and systems, international negotiations, and research and study related to telecommunications.



Source: MPT

Figure 8.1-1 Organizational Structure of Ministry of Communications and Information Technology (MCIT)

MPT has been a government organization since its establishment. As the only operator in the telecommunications market, MPT has a total of 11 departments. The departments taking part in or supporting this project are five technical units; the Information Technology Department (IT), the Mobile Phone Division (mobile telecommunications), the Long Distance Communication Department (long-distance telecommunications), the Auto Phone Department (fixed-line phone) and the Overseas Communication Department (international telecommunications). MPT has a total of 381 executive officials and 11,320 employees, making a total of 11,701 personnel as of 2013.



Source: MPT

Figure 8.1-2 Organizational Chart of Myanmar Posts and Telecommunications (MPT)

As shown below, technical employees in the above divisions/departments are classified into a total of 9 categories of official positions, headed by the position of Chief Engineer.

Table 8.1-1 Official Positions at MPT

No.	Position	Abbr
1	Chief Engineer	CE
2	Deputy Chief Engineer	DYCE
3	Executive Engineer	EE
4	Assistant Engineer	AE
5	Junior Engineer Level 1	JE1
6	Junior Engineer Level 2	JE2
7	Technician Level 3	T3
8	Technician Level 4	T4
9	Technician Level 5	T5

Source: Hearing survey of MPT employees

The role of Chief Engineers is to control the technical divisions/departments in their charge as well as to present development plans to a higher level. The role of Deputy Chief Engineers is to assist the Chief Engineers.

Executive Engineers and Assistant Engineers are in charge of facilities maintenance, while engineers at the level of Junior Engineer Level 1 or lower are workers who carry out the actual maintenance and inspection of telecommunications facilities and provide a night watch service at

exchange centres and wireless base stations. MPT now uses its own employees for all maintenance and inspection works and no longer outsources those tasks. This system resulted in an inability to offer a stable service as it was not always possible to respond properly to breakdowns.

(2) Technical capability

In Myanmar, the full-scale introduction of digital technology has taken place very recently. Due to the influence of economic sanctions, the country has had not many opportunities to be exposed to advanced technology, and therefore it cannot be said that the country has acquired sufficient information and knowledge of digital technology.

In addition, the level of knowledge of equipment on the part of the field staff varies. As a result, the individual employees' knowledge and memory can have a great effect on how equipment is designed, constructed, operated and maintained. For example, at the Long Distance Division, there are some engineers who have the technical capability to operate and maintain the existing construction equipment, but the number of such engineers is not adequate and there is a poor balance in the workloads of individual engineers.

As described above, the introduction of new digital technology under this project will necessitate an improvement of the technical level of MPT employees. Below is a detailed description of the divisions/departments to be involved in the works to be implemented under this project.

1) Backbone network

The backbone network connecting the 3 metropolitan cities is managed by the Long Distance Division (LD Division), which is generally in charge of the operation of networks including planning, design, construction supervision and maintenance. Under this project, a quantity of equipment and facilities based on new technology such as DWDM and router systems will be employed to construct the backbone network connecting the 3 metropolitan cities. Currently, the LD Division has a total of 957 employees. Of these employees, 351 are engaged in technical affairs and the remainder in administrative affairs. Of those working in technical affairs, the largest group, 337 employees, comprises microwave communications engineers, while there are only 14 fiber optics cable transmission engineers.

At present, major technical works are undertaken in the following manner:

- Construction specifications: In principle, this type of work is outsourced to independent vendors. Vendors conduct surveys in conjunction with MPT employees, while documents are prepared by the vendors.
- Construction: Normally, the work is outsourced to suppliers and supervised by local MPT engineers.
- Supervision/testing: A testing team is set up, with participation by local engineers and engineers from headquarters.
- Maintenance/operation: Regular operation, supervision and maintenance are carried out by MPT employees.

As described above, a look at the LD Division's capability to implement works reveals an inadequate number of personnel capable of handling new technology, with a total of only 14 engineers working in fiber optic cable transmission. In order to improve this situation, it will be necessary to deploy personnel from the microwave communications unit and provide them with the necessary training.

2) Metro networks within the 3 metropolitan cities

Metro networks within the 3 metropolitan cities are managed by the Auto Phone Division, which is composed of a local telecommunications line unit and an exchange facilities unit. These units are responsible for the planning, design, supervision (construction works) and maintenance/operation of telecommunication lines and exchange facilities, respectively.

- Exchange facilities unit
  - Construction specifications: In principle, MPT employees and vendors work together in execution design, and documents and drawings including specifications are also prepared jointly under the supervision of MPT.
  - Construction: Normally, suppliers carry out construction work, while MPT employees participate in the work along with the suppliers partly for the purpose of OJT.
  - Supervision/testing: A testing team is set up, with participation by local engineers and suppliers.
  - Maintenance/operation: Regular operation, supervision and scheduled maintenance are carried out by MPT employees.
- Communication line facilities unit
  - Construction specifications: In principle, MPT employees carry out the execution design, and documents and drawings including specifications are also prepared by MPT.
  - Construction: Constructors and suppliers take joint charge of construction works.
  - Supervision/test: Skilled engineers conduct tests.
  - Maintenance/operation: Regular operation, supervision and scheduled maintenance are carried out by MPT employees.

Under this project, it is planned that new fiber optical cables will be installed and for that reason, it is necessary to have personnel who can understand new technology, due to the planned introduction of DWDM. It is also necessary to develop human resources able to deal with new technology in a consistent manner for works ranging from cable laying to equipment testing. (See Chapter 11.)

3) IT network

The ISP group in the Information Technology Department (IT Department) manages the nation-wide network with a total of 12 employees including EEs. The Internet in Myanmar is expected to grow in the future, and due to the shortage of human resources it is necessary to make plans to increase the number of personnel and to develop human resources.

As mentioned above, it cannot be denied that in general human resources are inadequate for dealing with new technology. In order to improve this situation, the following measures should be taken.

MPT employees have the knowledge needed for the existing facilities, as well as a certain level of basic knowledge. Therefore, during the processes to be implemented under this project including construction and equipment testing, the shortage of human resources will be tackled through appropriate training, mainly offered by manufacturers on the introduction of new facilities/equipment.

Since design work requires higher technical knowledge than is required in construction or testing work, training will be given by consultants. In the case of the LD Division in particular, it is expected that in the future there will be a need to train up engineers with a good knowledge of new technology so that the networks proposed for the smaller cities can be designed. Further, it is believed that the IT Department needs to meet the demand for increasingly higher Internet access speeds as well as increase the number of personnel.

In addition, as described above, it is considered that many of the personnel in charge have not had sufficient opportunities to acquire a general knowledge of digital technology. In order to meet various demands in the future, long-term plans for human resource development need to be drawn up. To this end, as described in Chapter 11, there is a need for further improvement of the training provided at training centers.

(3) Financial capability

1) National budget

When a hearing survey was conducted for the Director of Central Statistical Organization (CSO) concerning budgets, we were told that the 2011-2015 budget plan had been taken back to the drawing board. Study Team obtained profit/loss statements (P/L) and balance sheets (B/S) for FY2010 to 2012.

2) Financial indicators

In this section, the financial indicators provided by MPT will be described. Tables 8.1-2 to 8.1-4 show the financial indicators, P/L and B/S.

In order to confirm their repayment capability, the growth potential of MPT was evaluated. A trial calculation was made by applying the formula of Sustainable Growth Rate (SGR) (SGR is the maximum growth rate at which a corporation can grow continuously using its own internal cash flow and without obtaining funds externally, such as a loan or capital increase).

An evaluation of the financial indicators shown in Table 8.1-2 clearly shows that almost no funds have been raised externally for the past 3 years and the Net Profit Margin, Total Assets Turnover, Equity Multiplier and Retention Ratio are all stable, which indicates that MPT has been continuously on a growing trend thanks to its internal cash flow.

The figure of around 55% found in Net Profit Margin can be considered the result of MPT being a public corporation under the direct control of MCIT and required to pay a certain amount of money in addition to the relevant taxes. To determine whether the rate of about 55% is reasonable or not, it is necessary to make an evaluation from multiple viewpoints, including the attributes of subscribers, the propriety of pricing and its relationship with the phone penetration rate. It can be said that the rate is apparently produced with no consideration given to market demand, considering that Myanmar has had a monopolized telecommunication sector for a long time; that with a phone penetration rate as low as 10% the country has a large-scale hidden demand; that sufficient investment has not been made in rural areas; that most subscribers are affluent; that overseas grant aid from China, etc., is used even for investment in the 3 metro cities; and that private companies are slow to enter into the market.

Both Total Assets Turnover and Equity Multiplier have been within a normal range during the evaluation period. The SGR value which we wanted to confirm was at a rate of over 40% during the evaluation period.

Calculation of year-on-year growth of Sales (Total Income), Net Profit, Total Assets and Equity confirmed that the largest growth rate recorded for these elements was at just the same rate as the SGR. This indicates that MPT almost reached the limit of its ability to operate with its own funds only, and that in order to respond to the expected growth of the telecommunications sector, MPT needs to raise funds externally; for example, it should make use of ODA, an increase in capital to be made by the Myanmar government, PPP (Public-Private Partnership), etc.

Next, the Liquidity Rate shows that the short-term repayment capability has improved from 144% (2009/10) to 269% (2011/12). From the Balance Sheet provided by MPT, it is apparent that Sundry Debtors increased by 29%, while Sundry Creditors decreased by 29%.

In general, it can be said that the financial condition of MPT is fairly sound. The management at MPT perhaps thinks that it would be best for them to maintain the status quo. The new subscribers who must be acquired so that investment in rural areas can be increased and the phone penetration rate can reach 80% possess different attributes from those of existing subscribers. It is expected that MPT's financial condition will deteriorate from its current peak level.

Table 8.1-2 Financial Indicators of MPT (2009/10-2011/12)

Particular		2009/10	2010/11	2011/12
Financial Ratios <R>				
L-T Debt to Total Capital R	%	0.6	0.3	0.4
Debt to Equity R	%	0.5	0.3	0.3
Return on net Fix Assets	%	131	92	111
Current Ratio	%	144	186	269
Fix Assets Turnover Ratio	times	2.2	1.7	2.0
Activity R				
Operating R	%	15.6	23.4	21.4
Selected performance indicators (Kyats mill)				
Revenues from operation		279,144	317,108	415,821
Total Operation Exp (excl finance chg)		43,579	74,203	88,768
Gross profits		235,565	242,904	327,053
Interest Charge		58	58	34
Net Profits after tax		164,854	169,993	228,913
Internal Cash Generation		245,553	257,727	344,586

		2009/10	2010/11	2011/12
Stability Ratio				
Debt / Equity	%	0.5	0.3	0.3
Interest Coverage Ratio	times	4,029	4,210	9,497
Liquidity Ratio				
Current Ratio	%	144	186	269
Profitability Ratio				
Profit margin	%	84	77	79
Growth Ratio				
Sustainable Growth Rate	%	n.a.	48	42
1) Net Profit margin	%	59	54	55
2)Total Assets turnover	times	0.99	0.86	0.82
3)Equity multiplier	times	1.54	1.36	1.31
4)EarningsRetention Rate	%	33	52	50
5) 1- 1)*2)*3)*4) for calc.		0.70	0.67	0.70
6) 1)*2)*3)*4) / 5) = SGR	%	42	48	42
Actual Growth Ratio				
Total income	%	7	14	31
Net profit	%	8	3	35
Total assets	%	30	31	36
Equity	%	**42**	**48**	**42**

Table 8.1-3 Profit-Loss Statement of MPT (2008/09-2011/12)

(Kyats In Million)

Particular	2008/09	2009/10	2010/11	2011/12
Income				
(a) Postal Income	603.3	584.6	632.4	2,295.3
(b) Telephone Revenue	258,768.3	277,241.8	314,894.4	404,369.4
(c) Telegraph	421.7	83.6	108.5	120.3
(d) Telex	0.8	0.0	503.5	8,146.7
(e) International Accounts Settlement	637.0	340.1	968.8	889.2
(f) Other Income		893.7		
Total Income	**260,431.1**	**279,143.8**	**317,107.5**	**415,820.9**
Expenditure				
(a) Operating Cost	31,751.0	29,283.3	54,681.0	66,068.3
(b) Administrative Cost	4,196.1	4,307.2	4,699.7	5,166.3
(c) Financial Expenses	137.7	58.5	57.7	34.4
(d) Depreciation	7,083.0	9,988.5	14,822.3	17,533.2
Total Expenditure	**43,167.8**	**43,637.5**	**74,260.7**	**88,802.2**
Profit Before Tax	**217,263.3**	**235,506.2**	**242,846.8**	**327,018.7**
Income Tax (30 %)	**65,179.0**	**70,651.9**	**72,854.0**	**98,105.6**
State Contribution (70 %)	**152,084.3**	**164,854.4**	**169,992.7**	**228,913.1**
Operating Ratio	**16. 6 %**	**15. 6 %**	**23. 4 %**	**21. 4 %**

Table 8.1-4 Balance Sheet of MPT (2008/09-2011/12)

Myanma Posts & Telecommunications
Balance Sheet (B) as at 31st March'2009-2012

(Kyats In Million)

Particular	2008/09	2009/10	2010/11	2011/12
Fixed Assets	**86,498.349**	**125,777.000**	**185,123.148**	**205,381.456**
(a) Land & Buildings	25,655.282	36,339.460	43,804.011	41,741.632
(b) Machineries & Equipments	53,893.393	82,654.633	134,832.312	156,987.385
(c) Vehicles	754.741	742.171	969.334	1,275.541
(d) Office Furniture	276.494	375.840	488.698	666.747
(e) Office Equipments	5,715.671	5,428.691	4,808.112	4,504.994
(f) Tools & Equipments for Training	202.768	236.205	220.681	205.157
Works in Process (Projects)	**23,016.165**	**35,418.275**	**57,668.411**	**44,596.206**
Investment in Myanmar DHL	**2.040**	**2.040**	**2.040**	**2.040**
Government Accounts(Investment for operation)	**75,417.724**	**81,527.430**	**81,603.745**	**7,304.409**
Current Assets	**32,094.757**	**40,038.308**	**46,401.290**	**52,003.261**
(a) Inventories	239.411	221.257	291.304	412.241
(b) Payments in Advance	6.929	4.651	24.865	29.434
(c) Sundry Debtors	31,773.228	39,739.551	46,017.479	51,432.946
(d) Cash in Hand	75.189	72.849	67.642	128.640
Total Assets	***217,029.035***	***282,763.053***	***370,798.634***	***309,287.372***
Short Term Liabilities	**87,136.465**	**98,396.577**	**97,810.821**	**117,423.026**
Income Tax payable restated	**65,178.990**	**70,651.870**	**72,854.034**	**98,105.619**
(a) Sundry Creditors	20,049.511	23,651.976	22,943.387	16,907.264
(b) Remittance in Transit	106.972	99.034	72.731	30.064
(c) Suspense Accounts	1,800.992	3,993.697	1,940.669	2,380.079
Net Assets	**129,892.570**	**184,366.476**	**272,987.813**	**191,864.346**

Equity

Particular	2008/09	2009/10	2010/11	2011/12
Capital	**12,090.185**	**37,233.321**	**91,424.225**	**79,500.519**
Reserved Fund restated	**116,627.039**	**146,079.721**	**180,629.293**	**111,525.205**
(State Contribution,Bad Debt)				
Long - Term Liabilities	**1,175.346**	**1,053.434**	**934.295**	**838.622**
Fixed Deposit	179.009	189.625	183.639	187.813
Loans	996.337	863.809	750.656	650.809
Total Capitalization	**129,892.570**	**184,366.476**	**272,987.813**	**191,864.346**

(Note) Equity in each year is indicated in accordance with international standard and in order to keep continuity and consistency between years, some corrections have been made that corporate tax values have been deducted from the reserved fund in MPT BS and indicated as Income Tax payable restated.

3) Issues encountered by the operator (MPT)

As described above, the management status of MPT is good in terms of its financial situation. This means that if the management environment to date is maintained, it can be said that the

implementation of this project will not cause MPT to suffer any significant financial problems. Currently, however, Myanmar is shifting direction and trying to implement significant changes in the management environment of MPT. One such change that is clearly predicted is that MPT will possibly be placed in competition with private foreign companies starting the latter half of 2013. This change will pose quite a few issues for MPT. One such issue is that MPT's lack of marketing and service units could have a significant effect on the financial situation of MPT. It is clear that an organization with no properly functioning marketing and service units will face difficulties not only in acquiring new customers but also in preventing the loss of existing customers. As already mentioned in 5.3.5, this change is within the scope of MPT's own management strategy and organizational policy, and is not subject to this study. Therefore, study team only mention that there may be such an issue. It need not be said, however, that the roles of these units in the management of a telecommunication business are inseparable from both technical/ facility aspects. In view of the fact that MPT does not have its own experts in these fields, the securing of the necessary human resources is a pressing issue. In order to survive in a competitive environment, one alternative strategy is to obtain the cooperation of private foreign partners that have expertise in the management of a telecommunications business. We consider this to be a highly possible alternative. In similar cases, where the government's investment has exceeded half of the overall project cost (more than 51%), Japan has offered ODA.

8.1.2 Project implementation plan

As described in Section of 8.1.1 (1), each of the technical divisions/departments at MPT has a high degree of independence, and projects have been planned and implemented independently. However, the scope of this project must extend across those divisions/departments and therefore, we recommend the establishment of a project management unit (PMU) that can manage different technical divisions/departments horizontally so that this project can be implemented efficiently.

The PMU will be responsible for the following in the implementation of this project.

(1) Executing Agency (E/A)

MPT shall be the Executing Agency (hereinafter referred as 'E/A') and responsible for overall supervision and execution of the Project. Following Departments will be mainly responsible:

- Information Technology Department;
- Mobile Phone Division;
- Long Distance Division;
- Auto Phone Division (in charge of fixed-line phone); and
- Overseas Division (in charge of international telecommunications).

Main role and duty of the E/A is to supervise overall activities during the project implementation. In addition, all of the departments will be responsible for management and monitoring of the project activities by their expertise and specialized knowledge from the technical view point.

The main functions of E/A will be shown as follows:

- ✓ To be comprehensively responsible for the project implementation in accordance with a loan agreement;
- ✓ To coordinate and manage the Project activities;
- ✓ To establish a monitoring and evaluation system that would track the progress of the Project;
- ✓ To support the PMU for planning and implementation of project activities technically and financially;
- ✓ To provide timely feedback on project planning and implementation to PMU;
- ✓ To monitor the overall progress of the Project; and
- ✓ To call regular meetings for the duration of the Project, and special meetings should arise when it is necessary.

(2) Project Management Unit (PMU)

1) Organization Structure

A PMU shall be established within MPT and shall be created in the MPT as a principle entity for the project implementation. PMU is an ad hoc entity to be established for the project implementation. PMU is aimed at enhancing management and monitoring of the project, and be an independent organization to implement the specified project during the limited period. It will be headed and staffed by a Project Director (hereinafter referred as 'PD'), probably by the General Manager, and creates the project office consisting of the staff members of technical section, management section, and administration section in MPT. PMU shall be tasked with managing and monitoring the day-to-day activities of the project at the field level. The Project Director has a responsibility and authority for overall activities including coordination between sections and construction companies to ensure the progress of the project within the implementation period. PMU will be managed under E/A.

Administration section should be included so that function of finance and accounting for ensuring financial resources and smooth payment works, of legal and contract management.

Main functions of PMU are shown as follows.

- ✓ Supervising and monitoring the day-to-day project activities
- ✓ Preparing project implementation and work plan and reporting the progress of the Project with the assistance of the consultant;
- ✓ Arranging and supervising construction works
- ✓ Arranging procurement of goods, works and services for the project
- ✓ Organizing monitoring and evaluation activities;
- ✓ Receiving and distributing funds for project activities
- ✓ Maintaining accounts of the project and arrange audit

2) Duties and Staffing of PMU

PMU should be created in order to ensure a smooth works for ODA loan and project implementation. The composition of PMU likely consists of administration, financial and technical sections. It will be effective to employ expert or specialized consultants in order to enhance the ODA procedure smoothly. PMU generally consists of project manager, engineering manager, technical engineers, procurement manager, financial manager, administration manager, and accountants.

Project Director (PD) should have responsibility and authority of all activities such as planning, coordination between sections, its management and so on. Also PD should have an authority to coordinate private companies and supervise financial and accounting section of PMU as well in order to secure sufficient financial resources and appropriate payment for smooth construction works.

The following staffing for PMU is recommended. The duty of PD may be taken by General Manager and that of project manager may be played by Deputy General Manager. It is desirable that these personnel is appointed from MPT from the viewpoint of capacity development of staff members and synergy effects. The number of persons are not necessarily limited to Table 8.1-5, are just indication. Figure 8.1-3 shows the organizational structure of the PMU.

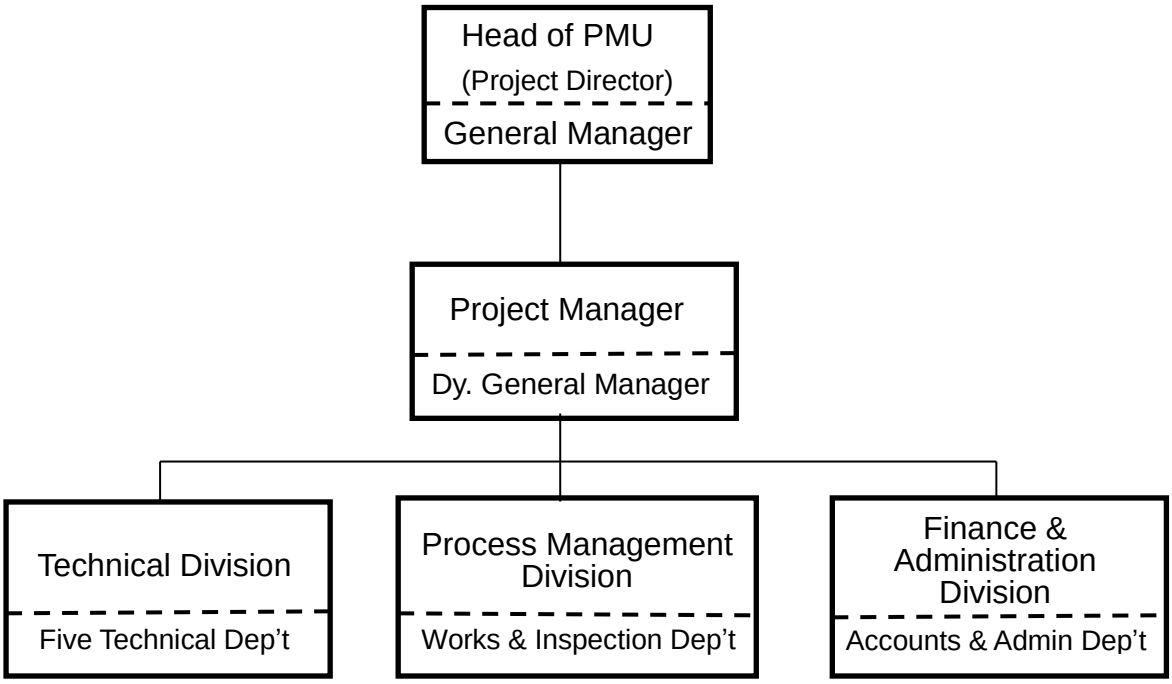


Figure 8.1-3 Proposed Organization of PMU

Table 8.1-5 Personnel Plan for PMU

Management				
1	Project Director	General Manager	Part time	1
2	Project Manager	Deputy General Manager	Part time	1
3	Assistant Project Manager	Project Engineer from Project Dep't (*)	Full Time	1
Technical Division				
4	Chief Engineer	from Each of Five Departments	Part Time	5
5	Deputy Chief Engineer	from Each of Five Departments	Part Time	5
6	Executive Engineer	from Each of Five Departments	Full Time	5
Process Management Division				
7	Procurement and Process Management	from Works & Inspection Dep't	Full Time	1
		from Store Dep't	Full Time	1
Finance and Administration Division				
8	Finance and accounting	from Accounts Dep't	Full Time	2
10	Administration	from Administration Dep't	Full Time	2
NOC Group				
11	Assistant Engineer	from Each of Five Departments	Full Time	5
			Total	29

(Note) All of the members will be basically assigned from MPT and no outsource is necessary.

(*) Project Department will be organized which will be in charge of overseas loans. The candidate Project Engineer is currently assigned in Mobile Department.

8.1.3 Points to note

(1) Technical capability of the organization

Although the technical capability to implement the project, in terms of the employees' technical level, has already been described in Section 8.1.1 (2), there are also other points requiring attention concerning the collective technical capability of the organization.

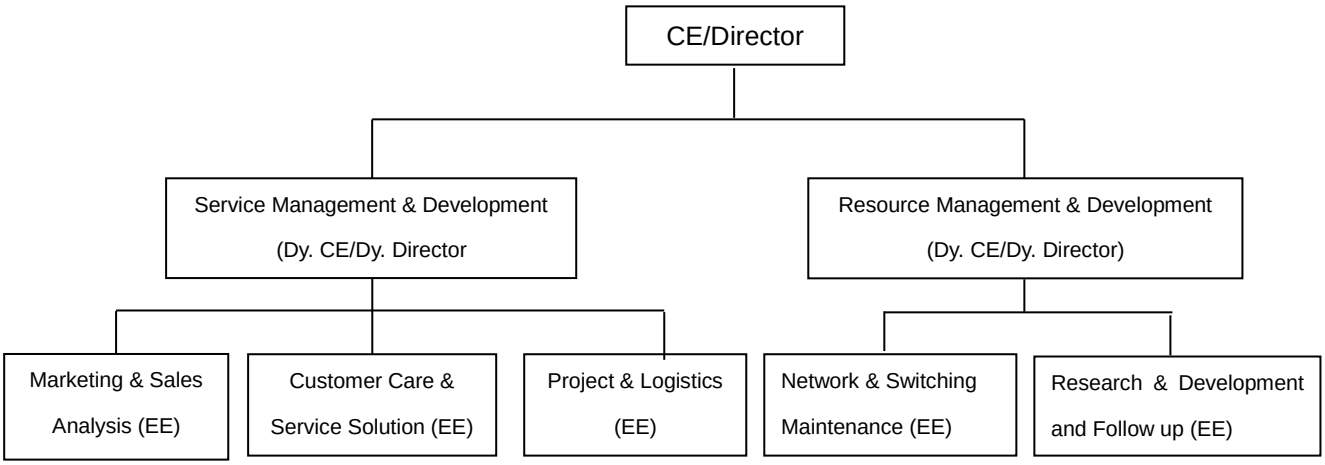
For example, for equipment maintenance, in the existing fiber optics systems only measures to tackle communication failure are in place, and the operational process is often found to be highly complicated. There are many aspects in which improvement is desirable; for example, even MPT employees do not have an accurate understanding of which facilities are functioning, and there is no recording of important parameters such as transmission loss in fiber optics systems or optical transmission equipment. In addition, it is often found that equipment manuals and system configuration drawings have not been kept and maintained in the field. Furthermore, it came to light in the hearing survey carried out for MPT that in recent years, a number of Chinese-produced products have been installed that are often found not to have been properly set up or adjusted, resulting in unstable system operation.

In order to improve this situation, in terms of the soft component to be introduced under grant aid, it is planned to offer MPT employees lectures and workshops in order that "the divisions/departments of MPT might have a shared awareness of some common rules for the planning, design and implementation processes needed to secure a certain level of quality in the

facilities and equipment to be added to or introduced, and for the preparation of drawings and technical documents." It is also essential to confirm that the above-mentioned targeted outcomes have been achieved appropriately and that such outcomes are disseminated through MPT.

(2) Organizational change at Auto Phone Division

The organizational change shown below has been proposed with respect to the framework for the implementation of construction works (construction design, construction, construction management and testing) and for maintenance and operation. Specifically, the Auto Phone Division currently separated into a local line unit and an exchange switch unit, but under the proposed change these units will be integrated so that the Auto Phone Division has a service unit and a technical human resources unit. This can be considered an organizational change to provide the "marketing function and service/customer development function" described in Section 5.3.5 as being a challenge in the improvement of the telecommunications service. It can be considered a new organizational plan looking ahead to privatization. The planned organizational structure is shown in Fig. 8.1-3. It will be necessary, however, to closely monitor the results of this kind of organizational restructuring process.



Source: Hearing survey from MPT employees

Figure 8.1-4 Proposed New Organizational Structure of Auto Phone Division

8.2 O&M and Management

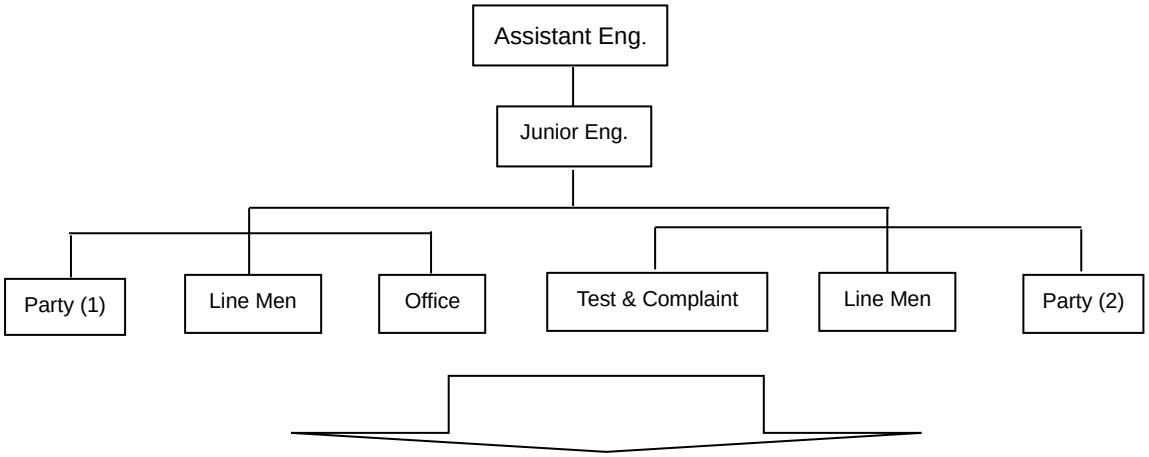
In the preceding Section 8.1 Project Implementation Plan, the shortage of human resources needed to implement this project has already been noted. It can easily be imagined that there will be a shortage of operating/maintenance and management personnel following the implementation process. With regard to the shortfall in human resources for operation and management, hearing surveys and discussions were held with the management and field-level employees at MPT.

8.2.1 O&M and Management at Present MPT

The present situation of O&M and Management in MPT is pieced out by hearings from several main organizations.

(1) Existing Organization / Structure and Training in Yangon West Exchange

Existing organizational structures for local network facilities differ from exchange office to exchange office. For example, the organization of field personnel at Yangon West Ex. (YWE) of Yangon Metro is as follows.



Technician-3: 7persons

Technician-4 10 persons

Technician-5: 8 persons

Day Workers: 9 persons

Total: 36 Persons

(Note) Party (1), (2): Installation & Maintenance
Line Men: Repair
Source: Hearing survey from MPT employees

Figure 8.2-1 Organization of personnel at Yangon West Exchange (YWE)

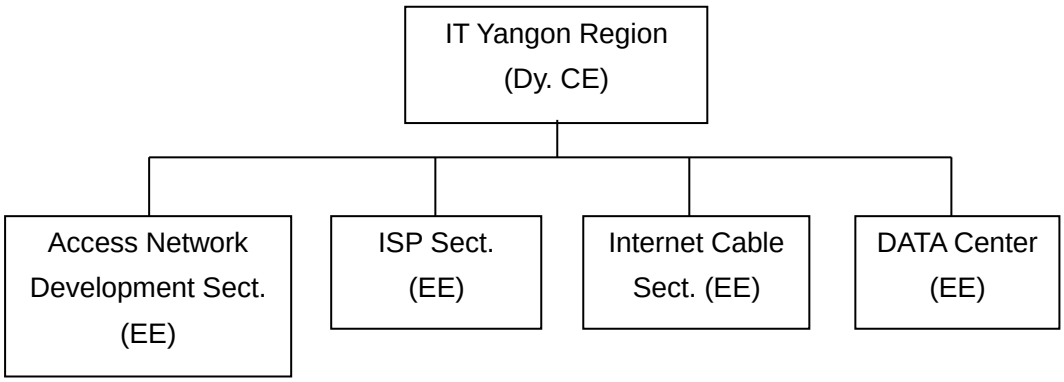
As this shows, it is necessary to have a certain level of personnel at each exchange office if the exchange office is to operate independently. If the necessary personnel are not there, dealing with any breakdown can take a huge amount of time. The OPECs to be introduced under this project are intended to deal with this issue and when the OPECs are introduced, issues relating to personnel shortages and development needed for the operation and maintenance of local and core networks can be resolved. In addition, when the OPECs are introduced, it is important that a close contact system be established and operated not only between engineers not working at the exchange offices in question but also between other exchange offices and transmission units.

A Network Operations Centre (NOC) is a core unit of the network and plays an important role, while the operation and management of NOCs are complicated, as the operation must cover multiple elements. MPT, however, has never introduced NOCs, and therefore it is considered that MPT will need of a significant amount of training, including inspection visits to actual operation and management sites. To this end, it has been decided that training in NOC operation and management will be given in Japan under the scope of the yen loan scheme, to personnel who will take leadership positions. Later, the personnel who receive training in Japan will provide lectures and OJT to other MPT employees so as to develop and expand human resources.

(2) Existing Organization/Structure and Training in IT Department of Yangon Region

1) O&M and Organization

The organization of field personnel at Yangon region is as follows. The total members except managements (EE or above) are 47 and working with 3 rotations a day. Commented on the lack of members, IT field would be expected to be greatly developed hereafter, should increase their staffs and improve the quality of O&M by proper training.



	Access Network Development Sect. (EE)	ISP Sect. (EE)	Internet Cable Sect. (EE)	DATA Center (EE)
Present Staffs	AE: 2	AE: 1	AE: 1	AE: 1
	JE1: 1	JE1: 2	JE1: 2	JE1: 1
	JE2: 5	JE2: 5	JE2: 1	JE2: 2
	Tech: 5	Tech: 6	Tech.: 6	Tech.: 6
Total	13	14	10	10

Source: Hearing survey from MPT employees

Figure 8.2-2 Organization of IT Departmeent in Yangon Region

2) Operation of each section

(i) Access Network Development Section
Main operations are installation, O&M and services for ADSL subscribers. (Max. speed: 2.5 Mbps).

(ii) IP Section / Internet Cable Section (National Gate Way)
Project and O&M are jointly operated but repair of optical cables are carried out by Internet Cable Section.

(iii) DATA Center
DATA Center covers O&M for the equipment and facilities.

3) Installation system

Installation designing, installation supervising, commissioning and trouble shootings are jointly operated by MPT staffs and venders. This section is usually so involved in software concerned that MPT's self-operation would have a little difficulty.

4) O&M System

O&M activities for the daily and the periodical is carried out by MPT staffs.

5) Procedure of trouble reporting

MPT staffs generally cope with the troubles but for serious problems venders would support to cope with. The group in charge will report to the superior according to the trouble happened. The group in charge will handle any logic troubles but for the physical troubles of the transmission line, LD or Auto Tel staffs would support to solve the problems.

6) Training

More staffs in new technology field would be necessary for MPT to cope with the introduction of new equipment with new technology, especially, Server/Core Router/Security (Firewall) etc. Proper training, therefore, would be indispensable. Strengthening, in future, supervising structure of network in Yangon, Nypyitaw and Mandalay, MPT shall increase his staffs.

7) Training Program

Long term program with consistent logic would be needed for new engineer's training program as described above in 6) and it would be necessary to have 3 to 6 months of training periods or one year as the case. The request of training from IT Department in Yangon region is as follows:

(i) Training Course

(a) Customer Handling Course

- Trouble Shooting
- Capacity Dimensioning & Expansion

(b) System Designing Course

- Security (Firewall etc.)
- IPv4 to IPv6
- Cloud

(ii) Staff for Training

IT dDepartment in Yangon region desires to make training for their staffs (incl. new) of each section as requested in the table below which is proposed to high places as a staff training plan

Table 8.2-1 Staff Training Plan of IT in Yangon Region

Staffs	Access Network	ISP	Internet Cable	DATA Center
AE1	2	3	2	1
JE1	2	4	3	1
JE2	6	8	5	5
Technician	10	16	5	5

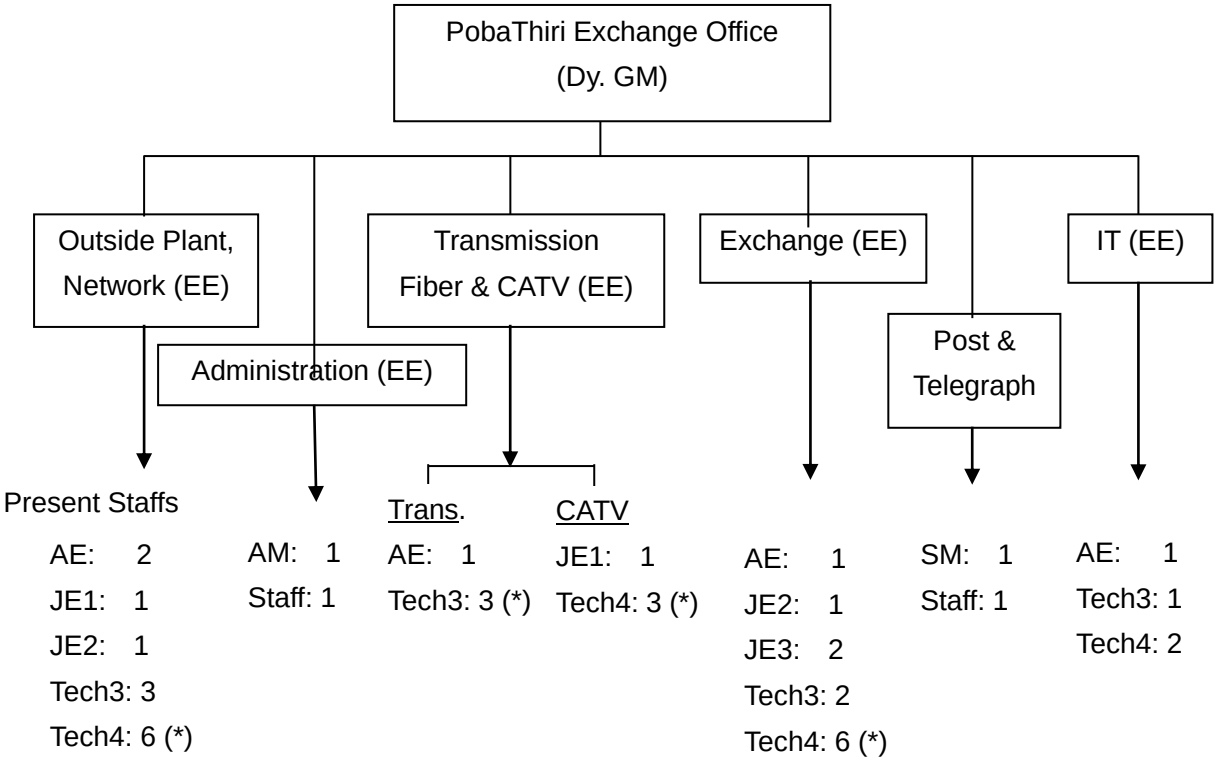
Notes, AE: Assistant Engineer
JE: Junior Engineer

Source: Hearing survey from MPT employees

(3) Existing Organization/Structure and Training in Poba Thiri Exchange Office in Naypyitaw Region

1) O&M and Organization

The organization of Poba Thiri Exchange Office in NayPyitaw Region is shown in Figure 8.2-3. It consists of 6 divisions with Dy. GM, Mr. Thein Hoke as a top. The total members except managements (EE or above) are 39 and wanted to increase them by 3 times in future. NayPyitaw Region will be expected to be developed more in future, so that to be planned for expansion of staffs and to be improved the quality of O&M by proper training.



Notes, AE: Assistant Manager JE: Junior Engineer Tech: Technician,
AM: Assistant Manager SM: System Manager
(*): Daily Basis

Source: Hearing survey from MPT employees

Figure 8.2-3 Organization of PobaThiri Exchange Office in Naypyitaw Region

2) Operation of each section

(i) Outside Plant & Network Section

Main operation is installation designing for metro network.

(ii) Transmission, Fiber & CATV Section

The duty is Installation and O&M for metro optical cable network including CATV.

(iii) Exchange Section

The duty is O&M for exchange equipment and facilities.

(iv) IT Section

The duty is O&M for internet etc. which is IT related.

(v) Administration Section

The duty is general affairs and office work.

(vi) Post & Telegraph Section

The duty is a window related to post office

3) Installation system

The duty is installation designing, installation supervising, commissioning and trouble shootings.

4) O&M System

The duty is O&M operation for the daily and the periodical.

5) Training

Engineering staffs are insufficient at present. More staffs for new technology field would be necessary to increase to cope with the introduction of new equipment with new technology. Proper training, therefore, would be indispensable. MPT desires to carry out following training programs.

(i) Installation Designing

(ii) Operation and Maintenance

- Testing
- Repairing

8.2.2 Personnel Plan for O&M and Management concerned for Introduction of New Technology

With regard to shortfall in human resources for operation and management, hearing surveys and discussions were held with the management and field-level employees at MPT. Table 8.2-2 sets out a personnel plan for the introduction of new technology based on the results of the hearing surveys and discussions.

Table 8.2-2 Personnel Plan for Introduction of New Technology

Item & Components	Target Facilities	Department	In Charge	Position	Personnel			Remarks
					Y	N	M	
1. Transmission Equipment for the Backbone Connecting the Three Metro Cities	Optical Cable and Transmission Equipment	Long Distance	Network Designing for solving problems which will be detected through operation	EE	1			
			Measuring Characteristics and Repairing Transmission Equipment (DWDM, Router)	EE or AE	2	2	1	
			Measuring Characteristics and Repairing for Optical Cable (Fusion splicing, Attenuation etc.)	EE or AE	2	2	1	
			Monitoring of Network Operation	EE	2	2	1	
2. Outside Plant Expansion in Yangon Metro City	UG Ducts Construction	Auto Phone	Construction Designing of UG Ducts	EE or AE	1	1	1	
	Overhead Cable Construction		Construction Designing of Overhead Cable	EE or AE	1	1	1	
3. High Speed Optical Cable Network in Yangon Metro City	Optical Cable & Transmission Equipment	Auto Phone	Monitoring of Metro Network Operation	AE	4	3	3	
			Measuring Characteristics and Repairing for Optical Cable (Fusion splicing, Attenuation etc.)	EE or AE	4	3	3	

			Measuring Characteristics and Repairing Transmission Equipment (WDM)	EE or AE	4	3	3	
4. LTE Expansion in three Metro Cities	LTE Access Network Transmission Equipment(Router, L2SW)	Mobile Phone	Project Management/Planning	Dy. CF or EE	1	1	1	
			Network Planning (Optical Cable, Transmission Equipment and Radio System)	AE	3	1	1	
5. Network Plan for Towns along the Backbone Network Connecting the Three Metro Cities	Access Line LTE	Auto Phone	Measuring Characteristics and Repairing for Optical Cable (Fusion splicing, Attenuation etc.)	AE or JE	15			15 staffs/10cities
	LTE Base Station Equipment Transmission Equipment(Router , L2SW)	Mobile Phone	Measuring Characteristics and Repairing LTE ,Transmission Equipment and Radio System	AE or JE	15			15 staffs/10cities
7. National Gateway Overhaul	Transmission Equipment (IX-Router), IPv6 Security,	IT	Monitoring, Measuring Characteristics and Repairing Transmission Equipment	Technician	2	2		IPv6 shall be provided.

8. ISP and IPv6	Transmission Equipment (Border Router, Edge Router), IPv6, Server, Security	IT	Monitoring, Measuring Characteristics and Repairing Transmission Equipment	Technician	2	1	1	IPv6 shall be provided.
9. NOC (Network Operation Center)	Planning and Designing Service, Main NOC Facilities Main NOC Hardware Main NOC Software Main NOC Security	Auto Phone, Long Distance, Mobile Phone IT, Overseas	Management of Operation	Dy. CE	1			
			Monitoring, Controlling and Analyzing of Network Operation, Repairing and Measuring Facilities	EE or AE	15			3 staffs/Dept.
10. Thilawa SEZ	Optical Cable		Measuring Characteristics and Repairing for Optical Cable (Fusion splicing, Attenuation etc.)	AE				Covered by Auto Phone
	Router, L2 Switch		Measuring Characteristics and Repairing Transmission Equipment (Router, L2 Switch)	AE	1			
					46	51	18	

Notes:

Dy.CE = Deputy Chief Engineer、
EE = Executive Engineer
AE = Assistant Engineer
JE = Junior Engineer
Source：Hearing to MPT

Y: Yangon
N: Naypyitaw
M: Mandalay

Total: 115

In the future, MPT will need to secure the required number of personnel before actual operation of the various facilities begins. As described in 8.1.1 (2), it is desirable that existing personnel will receive appropriate training, mainly given by manufacturers on the introduction of the facilities and that the employee base will be broadened through OJT which will be provided later through MPT's self-help initiative.

CHAPTER 9 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

9.1 Causal Factors of Impacts of this Project on Environmental and Social Considerations

The causal factors of possible impacts on the environmental and social considerations from the procurement of equipment and the execution of civil engineering works described in Section 7.3.2 are shown in Table 9.1-1.

Table 9.1-1 Causal Factors of Impacts on Main Work Processes and Environmental and Social Considerations

Work Item	Location	Causal Factors of Impacts	
		Construction	Operation
(1) Transmission Equipment for Backbone in Three Metro Cities	MPT Premises	・ Disposal such as packaging materials	
(2) Outside Plant Extension in the Three Metro Cities	Public road	・ Open cut sidewalk Put duct Reinstatement	
Yangon Duct 119.7km			
Naypyitaw Duct 258.0km			
Mandalay Duct 101.5km			
(3) FOC on Aerial installation	Public road	・ Pole erection on 10m to 20m distance	
Yangon Pole 73.5km			
Naypyitaw Pole 16.5km			
Mandalay Pole 202.0km			
(4) LTE Expansion in Three Metro Cities	Public Road	・ Packing materials ・ Use existing facilities and items (2) and (3)	
Yangon FOC 615km			
Naypyitaw FOC 465km			
Mandalay FOC 420km			
(5) Network along Backbone between three Metro Cities (10 cities)			
FOC on Aerial Installation 180km	Public road	・ Pole erection	
LTE Installation	MPT Premises	・ Disposal of packing materials	
(6) Yangon – Thanlin Circuits	MPT Premises	・ Disposal of packing materials	
(7)National Gateway Replacement	MPT Premises	・ Disposal of packing materials	
(8) Upgrading ISP Services	MPT Premises	・ Disposal of packing materials	
(9) NOC Construction	MPT Premises	・ Disposal of packing materials	
(10) Materials for OPEC	Inside MPT New Buildings Under item (11)	・ Disposal of packing material	
Yangon 2 sites			
Naypyitaw 1 site			
Mandalay 1 site			

(11) Building construction for OPEC	MPT Premises	・ Land leveling ・ Construct building	
Yangon 960 ㎡× 2 buildings			
Naypyitaw 960 ㎡×1 building			
Mandalay 960 ㎡× 1 building			
(12) Thilawa Circuit			
Duct construction 10.0km	Public road	・ Open cut ・ Duct laying ・ Reinstatement	

As shown in Table 9.1-1, the work sites for the work processes to be carried out in this project are limited to the premises of the MPT facility and public lands, and factors making an impact on the environmental and social considerations are ① pipe laying work and erection of telephone poles; ② land restoration within the MPT facility and station construction (See Figure 9.1-1.); and ③ disposal of packing materials during the period of construction.

The construction/installation sites to be used during the construction work and after completion of the work are public roads, public lands and the premises of the MPT facility, where the land use has already been determined. No involuntary relocation of residents will be required for the implementation of this project.

Figure 9.1-1 Planned construction sites for OPEC
(Upper left: Yangon I; upper right: Yangon II; lower left: Naypyitaw; lower right: Mandalay)

These construction/installation sites are not included in nature-protection areas or cultural heritage protection areas, and are not designated as ecologically important habitats or areas of historical and/or cultural value.

9.2 Framework of Environmental and Social Considerations

Comprehensive environmental conservation measures in Myanmar began with the establishment in 1990 of the National Commission for Environmental Affairs (NCEA) under the control of the Ministry of Foreign Affairs. The NCEA has undertaken the education of the people and carried out environmental policies. In addition, the "National Environmental Policy" was enacted in 1994 to develop the comprehensive environmental policies of the state, but this was limited to a setting out of guidelines. In 1997, the general policy for sustainable development "Myanmar Agenda 21" was formulated, covering in addition the report of the environmental impact assessment. However, no comprehensive legislation for public hazards and waste was established. The regulations to curb public hazards and waste were partially covered by various laws and regulations including not only the Mining Law, the Water Resource and River Conservation Law and the Forest Law, but also the Law for the Protection of Wildlife and the Conservation of Natural Areas (1994), the Law for Obstacles on Routes (1881), the Vehicle Law (1964), the Factory Law (1961), the Insecticide Law (1990), the Public Health Law (1972) and the Law for Civil Manufacturing Companies (1990). The Myanmar Investment Commission (MIC) issues business licenses for overseas companies expanding into Myanmar. A Directive was enforced in 1994[1] that obligates companies licensed by MIC to operate their businesses under the condition that their businesses shall not damage the environment in and around their area of operation.

As to overall environmental conservation measures, after the inauguration in April 2011 of the new Government led by President Thein Sein, the policy of an open-door economy was promoted and the policy for the development of economic infrastructure in some urban and rural areas was enforced. In September 2011 the Ministry of Forestry was restructured as the Ministry of Environmental Conservation and Forestry in order to alleviate the burden of regional development on the environment and local communities. After that, the Environmental Conservation Law was enacted in March 2012. This Environmental Conservation Law comprises 14 chapters, as described below[2].

1 Reference literature: Report on the Overseas Projects in the Private Sector and the Study of Strengthened Environmental and Social Considerations under Japan's ODA, commissioned in 2009 by the Ministry of Environment, Global Environmental Forum, March 2010

2 Reference literature: OECC Report No. 67, December 2012, Environmental Cooperation to Myanmar <"Foreword" Masahiko Tanaka, Head of JICA Myanmar Office>

Table 9.2-1 Composition of Myanmar's Environmental Conservation Law

Chapter 1	Title and Definition
Chapter 2	Objectives
Chapter 3	Formation of Environmental Conservation Committee
Chapter 4	Duties and Power of Minister
Chapter 5	Environmental Emergency
Chapter 6	Environmental Quality Standard
Chapter 7	Environmental Conservation
Chapter 8	Management of Urban Environment
Chapter 9	Conservation of Natural Resources and Cultural Heritage
Chapter 10	Price Permission
Chapter 11	Insurance
Chapter 12	Prohibitions
Chapter 13	Offences and Penalty
Chapter 14	Miscellaneous

The Environmental Conservation Law provides only an overall framework; the provisions for actual enforcement are defined in the Environmental Conservation Rules, which the Government of Myanmar is at present finalizing[3].

A company about to implement a project should acquire prior approval through an environmental impact assessment. This procedure is also still being finalized by the Government of Myanmar. The Ministry of Environmental Conservation and Forestry has called for the establishment of environmental criteria for water, air, noise and vibration as well as exhaust gases and wastewater, but these environmental criteria have not yet been established[4].

On the other hand, from the social viewpoint, the Development of Border Areas and National Races Law was enacted in 1993 in order to improve the economic and social conditions of the ethnic groups in the border areas, to develop the roads and means of communication, to protect and conserve the culture, literature and customs of the ethnic groups, and to strengthen friendly relations between the different ethnic groups. The relevant authority is the Ministry of Progress of Border Areas & National Races and Development Affairs, which has the overall duty and authority to formulate and enforce policies for regional industrial development and special projects to promote medical care and reconstruction in the areas to be developed. Thus, measures for environmental conservation and social and regional measures are implemented in accordance with the provisions of these laws and regulations.

3 Reference literature: Same as 2 aforementioned

4 Reference literature: OECC Report No. 67, December 2012, Environmental Cooperation to Myanmar <Feasibility Study of the Project of Assistance in Formation of Recycling Type Society and Waste Power Generation in Greater Yangon, Myanmar, Tomoki Uematsu, Deputy General Manager of Overseas Division, JFE Engineering Co., Ltd.>

As described above, a basic law for environmental conservation has been drawn up, but the planned projects must comply with the applicable provisions of the existing laws for environmental conservation.

9.2.1 Outline of Environmental Impact Assessment rules

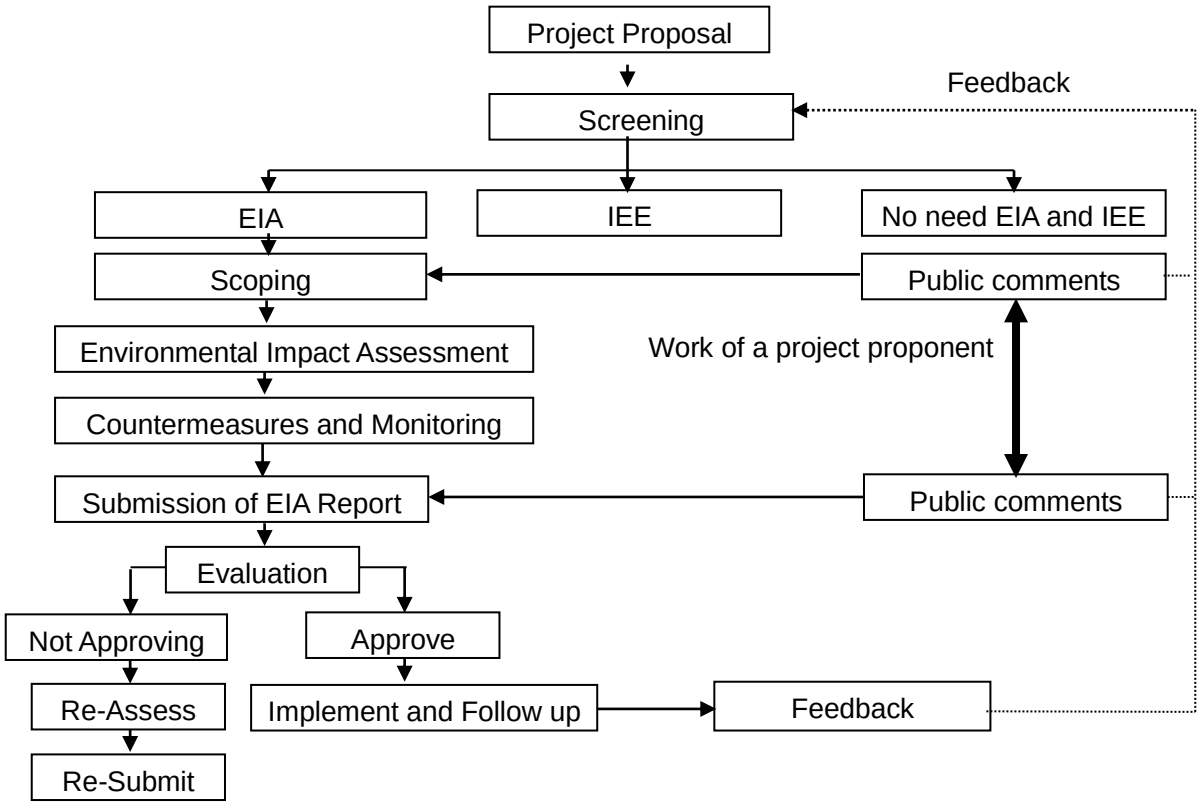
In considering the period of implementation for this project, the environmental impact assessment has to be carried out in accordance with the procedure set out under the Rules.

The environmental impact assessment procedure sets out the procedure and working method for the assessment, and is outlined in Table 9.2-2.

Table 9.2-2 Composition of Myanmar's Environmental Impact Assessment Procedure

Chapter 1	Terms and Definitions
Chapter 2	Environmental Impact Assessment Procedure
Chapter 3	Screening
Chapter 4	Scoping
Chapter 5	Inspection
Chapter 6	Application, Revision and Approval
Chapter 7	Monitoring

The flow of the general of environmental impact assessment procedure is shown in Figure 9.2-1.



Source: UNEP Generalized flowchart of EIA, UNEP EIA Training Manual

Figure 9.2-1 General flow of Environmental Impact Assessment Procedure

The environmental impact assessment procedure drafted by the Ministry of Environmental Conservation and Forestry is similar to the above flow, and its main provisions are as follows:

- Environmental Impact Assessment Process
  - ✓ The Ministry of Environmental Conservation and Forestry is responsible for the planning and formulation of the policies for general environmental conservation services including screening, Initial Environmental Examination (IEE), Environmental Impact Assessment (EIA), permits and licenses, approval, supervision and monitoring in accordance with the relevant laws and regulations.
  - ✓ If there is the necessity for resettlement and/or the possibility of an adverse impact on indigenous people, the relevant authority will handle the case in accordance with the stipulated procedures.
  - ✓ The EIA/IEE shall be implemented only by survey organizations which are assessed and registered by the Ministry of Environmental Conservation and Forestry.
- Screening
  - ✓ The proposals for all projects shall be submitted to the Ministry of Environmental Conservation and Forestry for screening, and projects shall be classified into EIA type projects (where there is concern about the environmental impact), IEE type projects (where

there is any environmental impact) and projects with no need for environmental assessment.

- Initial Environmental Examination (IEE)
  - ✓ The proposer of a project shall employ a survey company registered by the Ministry of Environmental Conservation and Forestry to make the examination and shall provide an explanation of the outline of the project and of the environmental protection measures to be taken to related parties or residents of the local communities in order to gather their opinions.
  - ✓ The proposer shall submit to the Ministry of Environmental Conservation and Forestry an IEE report reflecting the results of the opinion gathering; the Ministry shall make this report public in order to gather opinions and shall approve or reject the implementation of the project on the basis of the opinions gathered.
- Environmental Impact Assessment (IEA)
  - ✓ The proposer of a project shall notify the Ministry of Environmental Conservation and Forestry of the EIA survey company chosen, and shall commission the said survey company to survey the project.
  - ✓ The proposer of the project shall, if the project is classified an EIA type project, carry out a scoping assessment from the following viewpoints:
    - Survey areas and range of impact
    - Methods of monitoring the regulations, criteria and standards adopted for the proposed project
    - Estimate of impact on the environment(description, degree)
    - Information necessary for the assessment, and method of collecting said information
    - Specification of parties or persons related to the project, the municipalities and local residents on which the project may have an impact, and how their opinions are to be gathered
    - Presentation of a comprehensive and efficient assessment process
  - ✓ The scoping report, based on the results of the scoping assessment and the survey specifications shall be prepared and submitted to the Ministry of Environmental Conservation and Forestry. The Ministry will request any necessary corrections to the scoping report and the survey specifications and will approve the same.
  - ✓ The EIA survey shall be assessed assuming all detrimental impacts and risks that may result from the proposed project. The assessment shall cover all biophysical, social, economic, health, cultural and appearance elements as well as all legal matters related to the environment.
  - ✓ Within the framework of the EIA survey, the outline of the proposed project, the possibility of detrimental impacts and measures for the alleviation of any such impacts shall be disclosed to the public through the media and the Internet, and explained not only to those affected by the project, the local authority, community-based organizations and the civil society, but also at the central, state and local government levels to the Ministry of Environmental Conservation and Forestry, related ministries and agencies, local governmental authorities.

- ✓ The EIA report shall cover the following matters:
  - Brief introduction of the project implementing agency/developer and environmental and social experts
  - Policies and legal/institutional framework
  - Explanation of the project and selection of alternatives
  - Explanation of the local environment
  - Impact and risk assessment and alleviating measures
  - Cumulative impact assessment
  - Environmental Management Plan (EMP)
  - Public consultation and disclosure
- ✓ The EIA report shall be submitted to the Ministry of Environmental Conservation and Forestry, which shall announce the availability of the EIA report on its website and invite comments and recommendations on the EIA report from related agencies and society at large so that the final decision regarding approval of the proposed report can be made on the basis of such comments and recommendations. This decision-making process shall also be made public.

➢ Approval of the Project

- ✓ The Ministry of Environmental Conservation and Forestry will issue an Environmental Compliance Certificate (ECC) (valid for 2 years), and the Myanmar Investment Commission (MIC) and other related agencies may not approve any project for which no ECC has been issued.
- ✓ The Ministry of Environmental Conservation and Forestry may require a review of the Environmental Management Plan (EMP) in which case the project implementing agency shall submit a revised EMP.
- ✓ The project owner shall employ its contractors, subcontractors, officers, employees, agents, representatives and consultants, and represent the project in the execution of the works for the project for which the EMP has been approved, and shall take full legal and financial responsibility for all detrimental impacts, actions and omissions occurring under the project.
- ✓ The project owner shall carry out in their entirety the EMP, all project commitments and requirements, and shall take responsibility for ensuring that all the contractors and subcontractors for the project conform in full to all the applicable laws, the EMP, the project contracts and requirements.
- ✓ The project implementing agency/project owner shall be responsible for all the requirements as provided in the Environmental Compliance Certificate, and in the applicable laws and standards.

➢ Monitoring

- ✓ The project owner shall monitor the environmental impacts of the project in accordance with the ECC, the EMP and applicable laws and standards during the period of implementation of the project (before construction, during construction and operation, on abolition and termination, and after termination), and shall submit the monitoring report in the form

specified by the Ministry of Environmental Conservation and Forestry and in accordance with the schedule specified in the EMP.

- ✓ The Ministry of Environmental Conservation and Forestry will carry out the audit and inspection of the project through the central or local offices under its control by making inspection visits to the project sites or by means of documents.

- ➢ Penalty
  - ✓ Should the project differ greatly in any way from the statements of the EMP and the Environmental Compliance Certificate for whatever reason, the Ministry of Environmental Conservation and Forestry may impose a penalty on the project implementing agency.

9.2.2 Land acquisition and relocation of residents

In Myanmar, the Government is the absolute owner of land and land ownership by a person or company is not permitted under the Constitution of the Republic of the Union of Myanmar, 2008. A person or company may have the right to use land.

The registration of the right to use land is made at the Office of the Registration of Deeds and Assurances, Settlement and Land Records Department in accordance with the Registration Act, 1909. However, the central governmental agency and the local governmental agencies have jurisdiction over the right to use real estate according to the purpose of use (farming, residential or industrial use) and the location of the real estate (industrial complex, special economic district, etc.) For instance, the City of Yangon Development Committee is the contact window for registration of land located in Yangon City, and the Ministry of Agriculture and Irrigation is the contact window for the registration of agricultural land. Therefore, it is possible to undertake the survey of land use rights at the authority that has jurisdiction. The land users have to pay land rent to the Government, as determined by the purpose for which the land is used[5].

With regard to land use rights of the Government, on the other hand, the United Nations Human Rights Council has pointed out[6] that the development of mines and ports in the areas of minority ethnic groups forces the residents of the surrounding areas to relocate to other areas and deprives them of their living base; also that the registration system approving the acquisition of the "agricultural right" of a citizen aged 18 or above who is continuously engaged in agriculture to farm a piece of land, was established by the Government in accordance with the Agricultural Land Act enacted on March 30, 2012, but this legislation is not widely known to farmers as a safeguard to protect their farm lands.

If a piece of agricultural land or residential area is used as a project area, in general the land use right has to be assigned or leased through negotiation with the resident who has the right to use the

5 Reference literature: Base of Real Estate Legislation in Asian Countries (4), ARES The Association for Real Estate Securitization Journal Vol. 12

6 UN Human Rights Council 22nd Ordinary Session (2/25 – 3/25/2013), Item 4: "About the problems with human rights to which the Council is to pay a special attention" Statement by Human Rights Now (HRN),

land. Especially in an area where several ethnic groups are living, it is necessary that in the area of such minority races the project be promoted and their forced relocation undertaken with care so as to obtain the full understanding of the residents and their communities.

9.2.3 Organizations for environmental and social considerations

The main works in this project are the laying of optical fiber cables along main roads in the greater city areas of Yangon, Naypyitaw and Mandalay and in the small cities along the national roads between the 3 metro cities, the installation of communication equipment in MPT's main stations, and the construction of 2-story station buildings in the MPT-owned premises in Yangon, Naypyitaw and Mandalay. The organizations involved in the environmental and social considerations of these works are shown in Table 9.2-2.

Table 9.2-3 Organizations involved in Environmental and Social Considerations

Organizations	Responsible Item
Bureau of Environment Protection Ministry of Forestry	Evaluation of Screening, Approval for IEE、EIA、EMP
Bureau of Public Works Ministry of Construction	Approval for underground construction and recovery
Yangon Development Committee	Approval for underground construction and recovery
Naypyitaw Development Committee	Approval for underground construction and recovery
Mandalay Development Committee	Approval for underground construction and recovery

9.3 Review of Main Work Processes and Alternatives (incl. Zero Options)

This project will be implemented in order to increase the diffusion rate of communication service from less than 10% of the population in 2012 to 80% in 2015/16, this being the development target set by the Government of Myanmar. The benefits of communication services are widely understood as allowing the people of Myanmar, by using the communication services as a means of information exchange, to reduce the time and expense spent in movement by vehicle and public transportation. The implementation of this project means that benefits currently enjoyed by 10% of the people of Myanmar can be expanded to 80% of the population. Were this project not to be implemented, the current very low diffusion rate of communication services would not be improved and the infrastructure necessary for the future economic growth of Myanmar would not be developed. Thus, it is deemed mandatory that this project be implemented in Myanmar.

The communication networks can be largely categorized into fixed-line communication network and mobile communication networks, but both types of network are physically divided into transmission routes, nodes (divided into large type and small type by exchange, router and processing capacity, and equivalent to the base stations in mobile networks), and access links (optical fiber, paired cable, wireless access, etc.) The transmission routes are divided into backbone

routes interlinking large type switching nodes, core transmission routes connecting large type switching nodes and small type nodes within a city, and metro transmission routes connecting telephone offices in a large city. In this project, it is planned to make the most of existing MPT facilities, but public roads will be used for some transmission routes and access links.

In terms of environmental and social considerations, for transmission routes, the optical fiber system (underground duct system or aerial cable system) and the point-to-point radio system between nodes, for access links, the optical fiber system for access link use (underground cable system or aerial cable system) and the point-to-multipoint radio system between node users are available as alternative routes and are still to be selected.

A comparison of transmission routes is shown in Table 9.3-1.

Table 9.3-1 Applicable Technologies/Alternative Routes and Operating Methods

		Fiber Optic Cable		Radio System (Point to Point)
		Underground	Aerial	
Capacity		1 ～1,000 Gbps/core		100～150 Mbps/Sys
MPT Application		48 core or more	48 core or less	
Security		Strong	Weak	Strong
Location of Construction (Public Road)	Method of construction	・Side walk ・Side strip ・Open cut at Public road and lay duct and recovery of road	・Side Strip ・Pole erection on 10-20m distance ・Attach to pole	None
	Construction route	・Minimum distance route related to distribution of demand area	・Minimum distance route related to distribution of demand area	None
	Construction timing	・Duct construction in advance ・FOC installation on demand	・On demand	None
Applied Sections		・Core, Metro Network in Metro Cities ・Backbone network	・Metro Cities' surrounding areas ・Suburban areas	・Rural areas ・Branch to small sized cities from backbone ・MSC to small base station
Installation Cost		Yen 2 Mil/km (48 core cable)	Yen 1.6 Mil/km (24 core cable)	Yen1.5 Mil/section
Environment	Social Environment	No relocation of residents	No relocation of resident	No impact
	Natural Environment	・Impact to plant at side walk ・Recovery after completion	No impact	No impact
Application to proposed project		Apply to Center of cities	Apply to suburban cities	Not applicable

Source: Prepared by the Study Team.

The optimum routes for laying optical fiber cables in this project will be selected on a

case-by-case basis in accordance with the applicable standards of MPT, taking into account the node distribution and condition of existing MPT facilities as well as road traffic conditions and traffic volumes. The wireless system can be considered an alternative means, but its transmission capacity is too low to cover the high transmission volumes within a large city or between cities.

A comparison of access links is shown in Table 9.3-2.

Table 9.3-2 Applicable Access Technologies/Alternative Routes and Operating Methods

		Fiber Optic Cable		Radio System (Point to Multipoint)
		Underground	Aerial	
Capacity		1 ～1,000 Gbps/core		64 kbps～100 Mbps/sys.
MPT Application		48 core or more	48 core or less	
Security		Strong	Weak	Strong
Location of Construction (Public Road)	Method of construction	・Side walk ・Side strip ・Open cut at Public road and lay duct and recovery of road	・Side Strip ・Pole erection on 10-20m distance ・Attach to pole	None
	Construction route	・Minimum distance route related to distribution of demand area	・Minimum distance route related to distribution of demand area	None
	Construction timing	・Duct construction in advance ・FOC installation on demand	・On demand	None
Allied Section		・Major Cities and Medium City Center	・Suburban Area ・Province	・Mobile base station to Users ・Scattered demand area
Environment	Social Environment	No relocation of residents	No relocation of resident	No impact
	Natural Environment	・Impact to plant at side walk ・Recovery after completion	No impact	No impact
Application to proposed project		Not applicable	Not applicable	Applied to Cities and suburban area

Source: Prepared by the Study Team

The access links for this project are specified under LTE and employ the point-to-multipoint radio system, as shown in Table 9.3-2. Thus in this project there are no problems to be considered in terms of the environmental aspect.

9.4 Scoping and TOR for Study of Environmental and Social Considerations

9.4.1 Scoping

The main work processes and the causal factors of impacts on environmental and social aspects are shown in Table 9.1-1. The possible impacts are classified into categories A, B, C and D and arranged in Table 9.4-1.

Table 9.4-1 Scoping of Impacts of Proposed Project on Environmental and Social Aspects

Category	Impact Items		Classification		Reason for Classification
			Construction	Operation	
Pollution Control Measures	1	Air pollution	B-	D	Construction: Increase of air pollutant from construction vehicle and machinery on temporary base. Operation: No working of construction vehicle and machinery
	2	Water pollution	D	D	No impact due to no emission of heavy metal and chemical agent and heated water discharge even in construction period
	3	Waste	B-	D	Construction: Emission of disposal from packing materials Operation: No disposal
	4	Soil pollution	D	D	No impact due to no emission of heavy metal and chemical agent and heated water discharge even in construction period
	5	Noise and vibration	B-	D	Construction: Occurrence of noise by construction vehicle and machinery in temporary base Operation: No working of construction vehicle and machinery
	6	Ground subsidence	D	D	No water abstraction even in construction stage
	7	Offensive odors	D	D	No emission of odors due to no chemical agent and combustion working
	8	Bottom sediment	D	D	No impact due to no emission of heavy metal and chemical agent and heated water discharge even in construction period
Natural Environment	9	Protected areas	D	D	No protected area within objective area of the project
	10	Ecosystem	D	D	No areas required protection of ecosystem

Category	Impact Items		Classification		Reason for Classification
			Construction	Operation	
	11	Hydrology	D	D	No water abstraction and emission even in construction stage
	12	Topography and geology	D	D	No impact due to no soil usage (only construction of building with 960m2 floor space and use right of way along public road
Social Environment	13	Resettlement	D	D	No living area and economic activity in the objective area
	14	Poverty	D	D	No impact to poverty
	15	Ethnic minorities and indigenous people	D	D	No ethnic minorities and indigenous people living areas in the project objective area
	16	Lifestyle and livelihood	D	B^+	Construction：No negative impact is foreseen to employment and lifestyle and livelihood Operation：Direct effect is not expected , while some possibility to activate regional socio-economy is expected due to improvement of communication services
	17	Land use and regional resource	D	D	No use of new land and use of regional resources
	18	Water use	D	D	No water use plan during construction and operation period
	19	Existing social infrastructure and social service	D	B^+	Construction：No negative impact is not foreseen to social services Operation: Positive impact is expected to improve communication service quality
	20	Social capital and regional organization on decision making	D	B^+	Construction：No negative impact is foreseen to social related investment or local decision making organizations. Operation: Positive impact is expected to improve the speed of social communication through higher telecommunication service quality.
	21	Uneven distribution on damage and benefit	D	D	Construction： No damage and benefit by construction work Operation: Improvement of communication service is neutral to damage and benefit

Category	Impact Items		Classification		Reason for Classification
			Construction	Operation	
	22	Regional conflict of interest	D	D	Not cause regional conflict of interest by the implementation of the project
	23	Heritage	D	D	No heritage is available in the objective area.
	24	Landscape	D	D	Building is constructed inside the existing MPT premises and no negative impact to land scape
	25	Gender	D	D	Negative impact from the project to gender is not foreseen
	26	Children's right	D	D	No negative impact to children's right
	27	Infection such as HIV/AID	C^-	D	Construction: Extension of infection disease by the labors having some infection is matter of concern. Operation: No extension of infections is expected.
	28	Working condition (including safety)	C^-	C^+	Construction: Labor accident in construction sites is matter of concern. Operation: Improvement of working environment of MPT staff is expected due to mechanization of maintenance work by OPEC.
Others	29	Accident	B^-	D	Construction: Traffic accidents during FOC laying along public road are the matters of concern. Operation: No influence to road traffic by installation under the ground and side of public road.
	30	Impacts of cross border and climate change	D	D	Construction: No negative impact s to cross border countries and climate change due to no emission of chemical agents and dust. Operation: Same as above.

A+/-: Serious positive/negative impacts are foreseen
B+/-: Several impacts with positive/negative impacts are foreseen.
C+/-: Not clear whether positive/negative impact is expected.(Further survey is required to be cleared during survey period.)
D: No impact is expected.

9.4.2 TOR for study of environmental and social considerations

For the Terms of Reference (TOR) for the study of environmental and social considerations, the study items and study methods for the negative assessment items as defined in the scoping are shown

in Table 9.4-2.

Table 9.4-2 TOR for Study of Environmental and Social Considerations

Class	Impact Item	Survey Item	Survey Measure
Pollution	Air pollution	① Outline of work items ② living conditions along the construction route	① Outline of work expecting the impact to air pollution ② Impact projection based on the past cases
	Disposal	① Outline of work items	② Outline of work items and working routes ② Impact projection based on past similar case
	Noise, Vibration	① Outline of work items ② living conditions along the construction route	② Outline of work items and working routes ② Impact projection based on past similar case
Social environment	Infections such as HIV/AID	① Outline of work items	① Forecast impact and measures based on the past case
	Working condition (including safety)	① Safety measures	② Forecast impact and measures based on the past case
Others	Accident	① Safety measures ② Outline of work items	① Forecast impact and measures based on the past case

9.4.3 Results of study of environmental and social considerations, and results of assessment

With regard to assessment categories A, B and C as defined in the scoping, the results of the study of the environmental and social considerations and the results of the assessment of the impacts on environmental and social aspects are shown in Table 9.4-3 and Table 9.4-4, respectively.

Table 9.4-3 Results of Study of Environmental and Social Considerations

Class	Impact item	Survey result
Pollution	Air pollution	In the part of project area inside Yangon city, air pollution measurement value has already exceeded the WHO reference value in accordance with the survey report by private institute. Peoples living along the roads in Yangon and Mandalay does not see such air pollution as a problem, but car exhaust and dust are more than those along the main road in Japan. It was found that some measures should be required to use construction machinery with low emission and to reduce the operation time.
	Disposal	In the past case, the reusable waste such as wooden frame produced during the construction period was reused and non-reusable waste was processed in accordance with the instructions by City Development Commission.
	Noise ,Vibration	As same as air pollution, noise and vibration level by city traffic exceeded the value along the main roads in Japan. It was found that it is required to use law nose machinery and to reduce operation time by reviewing the construction method and procedures.

Class	Impact item	Survey result
Social Environment	Regional economy such as employment and life stile	Sidewalk vender is available along the part of FOC laying routes.
	Infection such as HIV/AID	Although In the past case, it was not reported the occurrence of infection disease during the construction period, it was found that preventive measures for expanding the infection diseases should be required in this project as JICA is implementing the preventive measure project in Myanmar focusing on 3 major infections like HIV/AIDS, tuberculosis and malaria.
	Working condition (including safety)	In the past case, work accident was not reported during the construction period and past case was not available in the questionnaire to MPT. However, work accident is possible to happen every time and it should be required to take preventive measures including the training.
Others	Traffic accident	MPT does not recognize the traffic accident during road digging, pole erection and fiber optic cable laying construction period. However, traffic accident is possible to happen every time and it should be required to take preventive measures including the training.

Table 9.4-4 Results of Assessment of Impacts on Environmental and Social Aspects

Category	Impact Item	Classification In Scoping		Classification Based on Survey		Reasons of Classification
		Construction	Operation	Construction	Operation	
Pollution	Air pollution	B^-	D	B^-	D	Construction：Increase of air pollutant from construction vehicle and machinery.
	Disposal	B^-	D	B^-	D	Construction： ① Waste by packing materials for facilities ② No impact due to recovery of cutting of road surface. ③ No waste soil for leveling work within MPT premises ④ Temporary materials for construction of building are able to reuse.
	Noise, Vibration	B^-	D	B^-	D	Construction：Noise and vibration are expected by construction machinery.
Social Environment	Regional economy such as employment and life stile	C^-	B^+	B^-	B^+	Construction：Impact to sidewalk venders along the part of construction routes is concerned.
	Infections such as HIV/AID	C^-	D	C^-	D	Construction：Expansion of infections by unskilled labors is concerned.

Category	Impact Item	Classification In Scoping		Classification Based on Survey		Reasons of Classification
		Construction	Operation	Construction	Operation	
	Working condition (including safety)	C^-	C^+	C^-	C^+	Construction: Safety and health should be taken to construction labors.
Others	Traffic Accident	B^-	D	B^-	D	Construction: Preventive measures against traffic accident in construction at public road.

9.4.4 Impact-alleviating measures and costs of the measures

The measures to alleviate the impact on the items assessed as categories A, B and C, and the costs of those measures, are shown in Table 9.4-5. The costs of the impact-alleviating measures will be estimated at the detailed design stage. In this table, the necessary items are set out.

Table 9.4-5 Measures to Alleviate Impact and Costs of the Measures

Category	Impact Item	Stage	Work	Reduction measure	Executing Agency	Responsible Agency	Cost bearing
Pollution	Air pollution	Construction	Duct laying Pole erection Building	① Use low emission machinery ② Effective use of machinery	Contractor	MPT	Contractor
	Disposal	Construction	Packing material	Appropriate procedure for packing material	Contractor	MPT	Contractor
			Duct laying Pole erection	Recovery of road surface	Authorized Road maintenance company	MPT	Contractor
			Building	No waste soil within MPT premises	Contractor	MPT	Contractor
				Reuse of temporary materials	Contractor	MPT	Contractor
	Noise, Vibration	Construction	Duct laying Pole erection Building	Use of low noise and low vibration machinery	Contractor	MPT	Contractor
Social Environment	Regional economy such as employment and life stile	Construction	Duct laying	① Working hour adjustment such as use of holiday ② Construction is required only 2 days with 50m interval. Sidewalk vender is possible to temporary	Contractor	MPT	Contractor

Category	Impact Item	Stage	Work	Reduction measure	Executing Agency	Responsible Agency	Cost bearing
				relocation for activities. After recovery, possible to return original location.			
	Infections such as HIV/AID	Construction	Duct laying Pole erection Building	① Instruction and enlightenment to workers ② Medical check in advance for temporary labors.	Contractor	MPT	Contractor
	Working condition (including safety)	Construction	Duct laying Pole erection Building	Safety training and provision of safety equipment	Contractor	MPT	Contractor
Others	Traffic Accident	Construction	Duct laying Pole erection	Implementation of Traffic safety measures	Contractor	MPT	Contractor

9.4.5 Monitoring plan and monitoring form (draft)

In order to check the effects of the impact-alleviating measures, the situation will be monitored before the start of work, during the work and at the time of completion of the work. The monitoring items, frequencies and locations, and the agency responsible are shown in Table 9.4-6. It is planned that the report on the monitoring results will be submitted to the project implementing agency, MPT.

Table 9.4-6 Monitoring Plan

Impact Item	Procedure	Work	Location	Timing	Responsible
Common	Monitoring for reduction measures	All work	All construction sites	Before commencement Once/month during construction At completion	MPT
Air pollution	NOｘ、SPM、CO	Duct lying Building	① Yangon, Naypyitaw, Mandalay ② Select 3 routes on heavy traffic roads(Detai design period) ③ Bld construction site in MPT	Before commencement 3 times during machinery use At completion	MPT
Disposal	Disposal of packing material	Equipment installation	Installation site	At completion	MPT
	Duct laying, pole erection, Soil disposal	Duct laying Pole erection	Construction site on public roads	At completion	MPT

Impact Item	Procedure	Work	Location	Timing	Responsible
	Land leveling	Building construction	No soil disposal within MPT premises	Before commencement Once/month during construction After completion	MPT
	Building Construction		Reuse of temporary materials at building construction	Before commencement Once/month during construction After completion	MPT
Noise, vibration	Construction	Duct laying Building construction	① Select 3 routes on heavy traffic roads(detail design period) in Yangon, Naypyitaw, Mandalay ② Building construction site in MPT	Before commencement 3 times during machinery use After completion	MPT
Regional economy such as employment and life stile	Construction	Duct laying	① Sidewalk vender activity sites in Yangon, Naypyitaw, Mandalay（Note）	Before commencement at sidewalk vender location and after recovery	MPT
Infections such as HIV/AID	Construction	Duct laying Pole erection Building construction	Instruction to workers	Before commencement Once/month during construction After completion	MPT
Working condition (including safety)	Construction	Duct laying Pole erection Building construction	Safety training and provision of safety equipment	Before commencement Once/month during construction After completion	MPT
Accident	Construction	Duct laying Pole erection	Implementation of Traffic safety measures	Before commencement Once/month during construction After completion	MPT

（Note） Along the planned construction area, sidewalk venders are available at Baw Ga Street, Shwegondein Street, Lower Pazurdaung Street, Myin Taw Thar Street, Wai Za Yan Tar Street in Yangon city and No.84 Street in Mandalay.

9.5 Other Items

9.5.1 Environmental checklist

The checklist (draft) for the study of environmental and social considerations which will be required in the next stage of study is shown in Table 9.5-1. This was drafted with reference to the

checklist shown in the JICA Guidelines for Environmental and Social Considerations.

9.5.2 Other Items

The materials and information relating to the environmental and social considerations have been made available from MPT, the JICA Office in Yangon and are based on other literature available on the Internet.

Table 9.5-1 Checklist

Category	Impact Item	Main Check Item	Y/N	Environmental and Social Consideration (Reasons of Yes/No, Reduction measures, etc.)
1. Permissions and Explanation	(1) EIA and Permissions	(a) EIA Report is prepared?	N	Need to submit screening sheet to Ministry of Environmental and Forestry to be judged IEE, EIA, Environmental evaluation before project starting.
		(b) Permission of EIA Report is obtained from Government?	N	After the judgment of IEE、EIA type project, implementation will start.
		(c) Permission of EIA Report is issued with collateral conditions. If so, comply with collateral conditions?	N	Respond to the Ministry decision of IEE、EIA review.
		(d) Necessary permissions other than the above are obtained from local authority?	N	Need permissions from Ministry of Public Works and City Development committee in Yangon, Naypyitaw.
	(2) Explanation to Stakeholder	(a) Contents of the project and its impacts including disclosure of information have been properly explained to local stakeholders with their satisfaction?	N	Explanation is required regional society and obtain their understanding,.
		(b) Feedback the comments from local stakeholders to project contents?	N	Same as as above
	(3)Review of alternatives	(a) Reviewed several alternative plans including environmental and social considerations?	Y	Apply the measures for minimum impacts to environmental society.
2. Pollution Control Measures	(1)Air pollution	(a) Air pollution items (Sox, NOx, Duct , etc.) emitted from projected infrastructures meet to the required values and environmental standard?	Y	Temporary increase by construction vehicle and construction vehicle and machinery.
		(b) Low emission fuel to heating facilities have been applied in accommodation facilities? (CO2, NOx, Sox, etc.)	N	No plan to setting accommodation
	(2)Water pollution	(a) Discharged water or seeping water from the projected infrastructures meet the required limit and environmental standard?	N	No emission of water from the project.
	(3)Waste	(a) Waste materials from the project has been possessed adequately in accordance with National standard and rules?	N	No disposal from the project.
	(4)Soil pollution	(a) Discharged water or seeping water is protected against negative impact to soil and underground water?	N	No discharged water from the project
	(5)Noise and vibration	(a) Noise and vibration level meet the required values in the country?	Y	Necessary measures for noise and vibration are to be taken.
	(6)Ground subsidence	(a) In case of large number of underground water piping up, is there some possibilities for ground subsidence?	N	No use of ground water

Category	Impact Item	Main Check Item	Y/N	Environmental and Social Consideration (Reasons of Yes/No, Reduction measures, etc.)
	(7)Offensive odors	(a)Emission of offensive odors or preventive measures have been taken?	N	No offensive odors are available.
3. Natural environment	(1)Protected areas	(a) Project sites are located inside protected areas defined by law and/or international treaty? Project gives some impacts to the protected areas?	N	No protected areas in project area.
	(2)Ecosystem	(a) Project site is inside native bush area or tropical forest as well as valuable area of coral, mangrove, muddy flat, etc.?	N	No related areas
		(b) Project site includes the protected area for endangered species recognized by national law and international treaty?	N	No protected areas
		(c) In case of impact is concerned to ecosystem, impact reduction measure has been taken?	N	No big damage to ecosystem
		(d) Water use in the project (ground water, surface water and rivers causes impacts to ecosystem or countermeasures for reduction has been taken?	N	No water use
	(3)Hydrology	(a) Change of water flow by project water use causes the negative impacts to ground and surface water?	N	No wter use
	(4)Topography and geology	(a) Geographical condition or geological structure was changed by the project?	N	Use public roads and MPT premises.
4. Social Considerations	(1) Resettlement	(a) Resettlement is required by implementation of the project? If required, reduction measures of negative impact have been taken?	N	No resettlement by the project
		(b) Explanation to the residents including lifestyle compensation had been taken before resettlement?	N	Same as above
		(c) Necessary survey had been carried out for resettlement and planning had been drawn up?	N	Same as above
		(d) Payment of compensation is made before moving?	N	Same as above
		(e) Compensation plan is made in writing?	N	Same as above
		(f) Proper consideration had been taken to the residents, especially gender, children, aged person and poverty?	N	Same as above
		(g) Agreement is taken before moving?	N	Same as above
		(h) Implementation system has been established wit sufficient manpower and budget?	N	Same as above
		(i) Monitoring plan is available?	N	Same as above
		(j) Complaint handling system has been organized?	N	Same as above
	(2)Lifestyle and livelihood	(a) Negative impact is expected to lifestyle and livelihood or negative impact reduction plan has neen taken?	N	Work plan is made in consideration of holiday working to reduce traffic impacts and road safety. Sidewalk vendors is possible to return to original position after recovery of cutting surface of road.

Category	Impact Item	Main Check Item	Y/N	Environmental and Social Consideration (Reasons of Yes/No, Reduction measures, etc.)
	(3)Cultural heritage	(a) Possibilities to cause negative impacts to cultural, historical, archaeology and religious heritage are foreseen or necessary process has been considered?	N	No heritage is available in project area
	(4)Landscape	(a) Negative impacts to valuable landscape is available or negative impacts reduction measures had been taken?	N	No landscape protection area in and surrounding area of the project.
		(b) Negative impacts by big sized accommodation facilities to landscape is considered?	N	No negative impact to landscape even construction of 2 storied building inside MPT premises.
	(5)Ethnic minority and indigenous people	(a)) Influence to ethnic minority and indigenous people is reduced?	N	No change in lifestyle in regional residents.
		(b) Power and rights of ethnic minority and indigenous people are prized?	N	Same as above
	(6)Working Environment	(a) Working environment meets the law and implemented the related law?	Y	Construct based on the standard applied to ordinary building.
		(b) Preventive measures against work accident such as provision of safety facilities, management of harmful articles had been taken in terms of hardware?	Y	Same as above
		(c) Safety and healthy planning and education to workers (Traffic safety and public health) had been taken in terms of software.	Y	Same as above
		(d) Appropriate measures have been taken to neighboring residents for the protection against the security persons not causing negative actions to the residents?	Y	Same as above

Source：Prepared by Survey Team

9.6 Main Points regarding Environmental and Social Considerations Assuming the Laying of Submarine Cable

In 1999, MPT connected the communication services in Myanmar to SEA-ME-WE3 that was then considered to have a high capacity. The landing point of the submarine cable is at Pyapon.

Given the continuing trend for traffic to increase rapidly not only in the domestic communication networks but also in the international communication networks, the resolution of the problem of insufficient capacity is considered a priority task in this Study. Thus the laying of a submarine cable SEA-ME-WE5 (with its landing point at Ngwehsaung) and of another submarine cable (the landing point of which would be Pyapon, the same as SEA-ME-WE3) is under consideration as a new route to the region including Singapore and Malaysia.

MPT has not grasped the negative environmental and social impacts, including the impact on the ecosystem, the obstruction of the economic activities of local residents (fishermen), the relocation of residents and marine contamination, since the submarine cable SEA-ME-WE3 was laid in 1999. At that time, the Environmental Conservation Law was not in effect and circumstances were different from what they are at the present time.

Assuming that a new submarine cable will be laid, an environmental assessment will have to be carried out in accordance with the Environmental Conservation Law and an Environmental Compliance Certificate will have to be obtained from the Ministry of Environmental Conservation and Forestry by means of the environmental impact assessment procedure. The permit from the Ministry of Livestock, Fisheries and Rural Development and the Ministry of Transport is also required.

According to the Guidelines for Environmental and Social Considerations (by Japan International Cooperation Agency in April 2010), on the other hand, there are no concrete examples of sectors, characteristics and areas which are likely to be impacted in relation to communications; but power transmission and transformation/distribution (resulting in large-scale involuntary relocation of residents, large-scale deforestation and the laying of submarine power transmission lines) are classified as category A. In laying the submarine cable, the method of digging the sea bottom to submerge the submarine cable in the shallow water around the cable landing station is used to take into account any unexpected shipping accident. This method may cause contamination of the sea bottom and pollution of the seawater. In laying the submarine cable, therefore, an engineering method similar to the method used for laying power transmission lines will be used, and the impact may be classified as category A.

CHAPTER 10 ASSESSMENT OF THE PROJECT

10.1 Operation/Assessment Indices

Table 10.1-1 Assessment Indices and Target Values

Indices	Reference Value（at 2013）	Target Value
Improvement of Transmission Speed for Backbone Network	Approx.30Gbps	Approx.500Gbps
Transmission Speed for Metro Network	Yangon: Approx.10Gbps Naypyitaw: Approx.10Gbps Mandalay: Approx.10Gbps	Yangon: Approx.300Gbps Naypyitaw:Approx.100Gbps Mandalay: Approx.300Gbps
Improvement of National Gateway	Yangon: Approx.13Gbps Naypyitaw: Approx.10Gbps	Yangon: Approx.100Gbps Naypyitaw: Approx.100Gbps
Improvement of Thilawa Circuit	None（zero）	Approx.10Gbps

Source; Prepared by the Survey Team

10.2 Qualitative Assessment

The communications networks that are represented by the Internet have a wide-ranging and direct influence on today's society. Their influence ranges from commerce and businesses to medical care, education, governments and their related organizations. The influence of modern telecommunications networks will tend to grow in the future. Therefore, following its completion this project is expected to bring the following benefits to the society of Myanmar:

- Reliable telecommunications networks will accelerate economic activities.
- Reliable telecommunications networks will make the people's lives more convenient.
- The Metropolitan area communications network will stimulate activities in the urban areas.
- The extension of the telecommunications network will promote rural development.
- The development of the IT industry will increase job opportunities in this field.

The qualitative effects described above will be apparent according to the increase in the number of telephone subscribers. However, the increase or decrease in the number of subscribers will depend upon many external factors, and it is difficult to measure only the effects of this project. Therefore, the indices described below will be used for the qualitative assessment, though they cannot be used for the quantitative assessment.

(1) Development of Communications Infrastructure

1) How to select an index

The traffic to and from most telephone subscribers (fixed-line and mobile) will flow through the backbone network and the Metropolitan network, the capacity of which will be increased through the development of the communications infrastructure. The increase in capacity will enable the net increase in the number of telephone subscribers (fixed-line and mobile) to be covered.

The development of communications networks in small and medium-sized cities will also enable the net increase in the number of telephone subscribers (fixed-line and mobile) to be covered.

The LTE (Long Term Evolution) infrastructure will mainly result in a net increase in the number of Internet subscribers, and also lead to a net increase in the number of mobile phone subscribers.

Therefore, the net increase in the number of telephone subscribers (fixed-line and mobile) will be used as the main index for assessment of communications infrastructure development.

2) How to determine the target value

As described in Chapter 7, the capacities to be increased in this project are as follows:
Backbone: 500Gbps
Metropolitan network: 700Gbps (Yangon; 300 + Naypyitaw: 100 + Mandalay: 300)

However, the average traffic capacities required to meet the demand on achieving a diffusion rate of 80% are as described in Chapter 7:

Backbone: 420Gbps (419.50Gbps)×2 = 840Gbps (non-ring structure is assumed, and the capacity is half as high as the ring structure.)

Metropolitan network: 45 to 250Gbps in each city

As described above, the Metropolitan network will provide a supply capacity of 700Gbps (Yangon 300 + Naypyitaw 100 + Mandalay 300) for the demand capacity of 45 to 250Gbps in each city so as to obtain a balance between supply and demand. Demand can be satisfied 100%.

As the supply capacity of the backbone network is 500Gbps against a demand of 840Gbps (non-ring structure), approximately 60% (500/840) of the total demand will be satisfied.

If the calculation method to cope with the bottleneck (conservative calculation) is used, the net increase in the number of telephone subscribers (fixed-line and mobile) allowable to maintain the current level of service is:

48 million×0.6 = 29 (28.8) million

This number is deemed to be the target value. (The total demand= 48 million, as shown in Table 5.2-7.)

This target number includes the net increase in the number of telephone subscribers (fixed-line and mobile) that will result from the addition of the LTE systems and the development of communications networks in small and medium-sized cities.

If it is permissible for the level of service to be lower than the present level, theoretically, it is possible for the increase in number of telephone subscribers to be higher than the target number.

(2) Improvement of Communications Services

1) How to select an index

As can be seen from Table 5.2-7, Internet users will be able to enjoy significant benefits such as increased capacity for each item of improvement in the communications services.

2) How the target value is determined

As described in Chapter 7, the capacities to be increased in this project are as follows:

International gateway exchange: 200Gbps (Yangon 100 Gbps+ Naypyitaw 100 Gbps)

However, the average demand for Internet traffic capacity that is expected when a tele-density of 80% has been achieved will be, as described in Chapter 7:

International gateway exchange: 290 (291.81) Gbps × 2 = 580Gbps

As a supply capacity of 200Gbps is provided for a demand of 580Gbps for the international gateway exchange, the total demand will be satisfied to a level of 34% (200/580).

In addition, the possible number of new Internet subscribers is related to the increase in capacity not only of the international gateway exchange but also of the backbone network and the Metropolitan networks as described in item 1) above, and this is also considered in 1). The number of addresses can be increased by introducing private addresses and V6, and the increase in capacity for the international gateway exchange will dictate the possible number of new Internet subscribers. Therefore, the increase in the number of Internet subscribers that allows the existing level of service to be maintained is:

30 million × 0.34 = 10 (10.2) million, which is determined to be the target number.
(The total number of demand= 30 million, as shown in Table 5.2-7.)

If it is permissible for the level of service to be lower than the present level, theoretically, it is possible for the increase in the number of Internet subscribers to be higher than the target number.

The above is summarized in Table 10.2-1.

Table 10.2-1 Indices for Qualitative Assessment

Axe	Indices	Reference Value	Target Value	Means
Development of Infrastructure	Number of telephone subscribers (Fixed and Mobile)	Number of telephone subscribers before the project starts	Increase by 29 million two years after the completion of the project	ICT Facts and Figures by ITU
Telecommunication Service Development	Number of internet subscribers	Number of internet subscribers before the project starts	Increase by 10 million two years after the completion of the project	ICT Facts and Figures by ITU

CHAPTER 11 CONCLUSIONS AND RECOMMENDATIONS

11.1 Conclusions

(1) Necessity and Relevance from viewpoint of PESTEL

In this section, we will present the results of a cooperative preparatory study for the Project for the Improvement of Communication Wide-area Networks in the Republic of the Union of Myanmar (through application of the fast track scheme). The results of the study were obtained through PESTEL analysis, a contemporary strategic management review method.

PESTEL analysis is based on the traditional PEST analysis with the addition of two new review items. This analysis is made using the 6 factors listed below and is considered particularly effective when used to make a judgment as to whether the implementation of a project is feasible. The six factors are political, economic, social, technological, environmental and legal factors.

1) Political factors:

In Myanmar, the phone penetration rate was as low as 10% as of the end of fiscal 2012, including both fixed-line phones and mobile phones. In view of the current situation, the country plans in its national development program to improve this rate to between 75% and 80% by 2016. To promote this kind of national program, the Myanmar government has been working proactively in the promotion of this project, since it is essential that the telecommunications networks be developed if the targeted goal is to be achieved.

2) Economic factors:

One aim of this project is the construction of telecommunications networks that are more reliable and have greater transmission capability. The wide-scale use of such reliable networks will accelerate economic activities. At the same time, the economic community in Myanmar definitely has high expectations for the construction of telecommunications networks that are more reliable and efficient. In particular, it is expected that economic activities in urban areas will be stimulated through the development of telecommunications networks connecting metropolitan regions, and that more jobs will be created as the information and telecommunications industry grows. The project is expected to bring about immeasurable economic effects.

Also, as described in Chapter 10, there are high expectations that the implementation of this project will produce satisfactory outcomes and returns on investment, including those outcomes ensured through microeconomic analysis of this project.

3) Social factors:

A wealth of case studies from around the world indicates that the construction of reliable, high-capacity telecommunications networks makes the lives of the people of that country more

convenient. Rural areas will also be developed further when the networks are expanded into those rural areas. In Myanmar in particular, it is expected that better distribution of information will accelerate the democratization of the country.

4) Technical factors:

The extensive introduction of digital technology into Myanmar is a relatively recent occurrence. As a result, the existing telecommunications networks operated by MPT are often found to be inadequate in both capacity and quality. It is, therefore, essential that this project be used to develop high-capacity, reliable telecommunications networks based on the latest digital technology. Fortunately, Japan has already introduced the world's highest-level digital technology and is in a position to use the technical expertise, experience and knowledge accumulated through the use of such technology.

Myanmar cannot be said to have acquired sufficient knowledge and information regarding digital technology, as economic sanctions have stood in the way of exposure to the latest technology. The introduction of digital technology planned in this project will not only provide a number of opportunities for MPT employees to improve their technical capabilities but is also expected to offer wide-ranging impacts including enhancement of the nation's IT literacy.

5) Environmental factors:

Further development of the information and telecommunications industry will proactively enhance disaster prevention mechanisms in preparation for natural disasters and conservation of the natural environment. Meanwhile, as described in Chapter 9, there are no major works that impede the environmental and social considerations and almost no major negative factors that would prevent this project from being implemented.

6) Legal factors:

One of the largest challenges for Myanmar is the enactment of the "Telecommunications Law" (currently being drafted) as a basic law for the implementation of the current policies of the telecommunications sector. If the Law is enacted, it will become a major foundation for the further development of telecommunications in Myanmar. Currently, the draft law is once again under review. The previous draft gave the national government a significant role with greater authority to regulate the free use of telecommunications and to manage related facilities. In the revised draft, the "Telecommunications Law" is basically defined as a law for the development of an environment that enables free operation and competition between the telecommunications services, not one that enhances the national government's authority to regulate the activities of service providers. The major improvements in the telecommunications sector expected to be achieved by this law have already been defined. The enactment of this law, therefore, is expected to further promote the use of telecommunications networks.

(2) Points to note regarding project implementation

On the one hand, Myanmar has many diverse issues common to developing countries with regard to its telecommunications networks; on the other, attention should be paid to the fact that the country has distinctive issues arising from the specific nature of its politics and the resulting specific nature of how its telecommunication networks have been developed. In implementing this project, failure to pay sufficient attention to this fact and to take appropriate measures may nullify all efforts made in the project. Taking this into consideration, the points to note are set out clearly as follows, in line with one of the latest management strategy review methods, management resource analysis:

1) Human resources:

In implementing this project, no insufficiency has been found in the total number of MPT employees but there are quite a few issues in terms of their expertise, quality and technical level. The level of knowledge of equipment on the part of the field staff varies. As a result, the individual employees' knowledge and memory can have a great effect on how equipment is designed, constructed, operated and maintained. For example, at the Long Distance Division, there are some engineers who have the technical capability to operate and maintain the existing construction equipment, but the number of such engineers is not adequate and there is a poor balance in the workloads of individual engineers. We will not go into detail here, since these issues have already been described in Chapter 8; but personnel must be offered opportunities to acquire new technologies if this issue is to be resolved. The suppliers and consultants are expected to provide training relating to the equipment and systems to be introduced under this project, and the results of such training sessions should be monitored.

In addition, in view of the fact that many MPT employees in positions of authority have not had sufficient opportunity to acquire a general knowledge of digital technology, in order to resolve this issue it will be necessary in the long run to develop human resources. To this end, offering support for the improvement of training centers as well as support through technical cooperation projects will be highly effective. This will be discussed later.

2) Telecommunication network and service:

It can be said that the physical objects involved in this project are the telecommunications networks and the telecommunications services offered via those networks. As has already been mentioned, the existing telecommunications networks of MPT have a complicated configuration and plenty of unsolved quality-related issues. These issues, however, can be mitigated to a certain degree by using the NOCs and OPECs to be introduced under this project. Still, these issues cannot be fully resolved by means only of the technology or systems to be introduced under this project; superior management and advice will also be required. It is expected that consultants and independent experts will be able to offer the required management support and advice, while support via technical cooperation projects will also be effective.

3) Financial resources:

As has already been mentioned, no particular problems have been found in the current funding of MPT. Up to now, however, MPT has not made much investment in network development and rural areas, as a result of which MPT has become an operator that is vulnerable to a sudden increase in subscriber numbers. If no reforms are made to improve the situation, MPT will continue to be an instable corporation. It is essential, therefore, to continue to pay attention to how MPT is reforming its financial management, and to offer the necessary advice.

4) Information:

Currently, information is not shared appropriately within MPT. One reason for this is that MPT has a vertically-structured organization of 5 technical divisions/departments. For the implementation of this project, we have recommended that a Project Management Unit (PMU) be organized to resolve this issue. In addition, monitoring and the provision of advice should be carried out regularly to ensure that the PMU functions effectively.

5) Knowledge management:

Knowledge management at MPT is less extensive than information management. For example, it is often found that maintenance of equipment for existing optical cables consists of dealing with breakdowns on an ad hoc basis, as a result of which operation is very complicated. Even MPT employees do not have an accurate understanding of which equipment is currently functioning. In addition, as can be seen from the fact that no records have been kept of important parameters such as transmission loss of fiber-optic cables and optical transmission systems, there are many more matters that require improvement. Furthermore, equipment manuals and system configuration drawings are often not kept and maintained on site. In order to improve this situation, in terms of the soft component to be introduced under grant aid, it is planned to offer MPT employees lectures and workshops in order that "the divisions/departments of MPT might have a shared awareness of some common rules for the planning, design and implementation processes needed to secure a certain level of quality in the facilities and equipment to be added to or introduced, and for the preparation of drawings and technical documents." It is essential to confirm that the targeted outcomes have been achieved appropriately and that such outcomes are disseminated throughout MPT.

In order for knowledge management to be implemented widely at MPT so as to improve management efficiency, it is necessary to promote the spread of knowledge in the form of experts' activities and awareness-building activities through technical cooperation, in addition to the above specific training sessions.

6) Organization:

MPT does not possess adequate marketing and service/customer development functions, as it has enjoyed a monopoly in the provision of telecommunications. In order to improve the

telecommunications service as a whole, it is necessary to make plans to enhance the above-mentioned functions, in addition to plans related to technology and facilities. It goes without saying, however, that in the management of a telecommunications business these issues cannot be separated from technology and facilities. In view of the fact that MPT does not have its own experts in these fields, the securing of the necessary human resources is a pressing issue. One strategy will be to obtain support under technical cooperation projects and to develop human resources equipped with the relevant expertise.

As explained below, there are some important external factors that this project cannot deal with but that should be paid attention to as they can affect the success of this project.

There are 3 major issues that can be considered important external factors. The first of these is the issue of where the existing MPT networks belong in the planned reform of the telecommunications sector. The second issue concerns rules for interconnection (including methods, technology, cost sharing and fees). The last issue concerns universal service (including systems, cost sharing and service providers). These issues relate to not only management strategies and organizational structures but also national strategies and the structure of the telecommunications sector; therefore it is necessary to continue monitoring the direction in which they move.

(3) Conclusions

This project for improving wide-area communication networks can be considered relevant. Positive impacts can be expected for every factor of the PESTEL analysis, and implementation of this project will bring multiple benefits to Myanmar. There are high expectations for the project in various sectors and it can be concluded that the implementation of this project is highly relevant. In other words, MPT has a significantly large role to play in promoting the improvement of the entire information and communications sector of Myanmar, which has an extremely low phone penetration rate and an environment that has been undergoing dramatic changes, in order to enable multiple telecommunications providers to offer communications services. There is sufficient relevance for this project to be implemented with the aim of improving management resources at MPT.

Meanwhile, there are also a number of points to which attention must be paid. There is a risk that this project will not succeed if these points are not dealt with appropriately, for example in relation to the country's capability for self-development. It is however possible for all the above-mentioned issues to be resolved and, therefore, it is judged that there is no element that inhibits the implementation of the project.

11.2 Recommendations

(1) Factors to be considered in implementing this project

Factors that need to be considered in implementing the above-mentioned development projects are as follows:

1) Ensuring well-balanced development in accordance with the strategic 3 axes for management strategies described in the mid-term plan;

2) Moving forward with an awareness of the points requiring attention that are described in (2) above;

3) Production of a master plan as soon as the management mechanism and roles of MPT in the information and communications sector have been clearly defined, since currently there is no master plan that offers guidelines for management strategy. Until a master plan is produced, telecommunications networks should be developed in accordance with the mid-term plan developed in the process of this study; and

4) Ensuring the continued effects of this project and a review of how support can be provided through continued projects, so that more significant effects can be achieved.

It goes without saying that attention should be paid to general issues commonly found in other projects, as listed below:

1) Coordination with other donors and care taken to avoid redundant or unnecessary investment to ensure that the project will be implemented effectively; and

2) Organization of a Project Management Unit (PMU) in order to develop an effective project implementation mechanism.

(2) It is recommended that the following projects should be implemented for the development of communications networks in accordance with the strategic 3 axes, in the form of projects in which Japan will provide continuous support to Myanmar.

1) Development of communication infrastructure

   1. Extending communication infrastructure to the regions

   2. Further increasing international transmission capacity

   3. Installation of new bi-country submarine cables as an option for 2 above

2) Improvement in communication service

   1. Extending IPv6 from Yangon to other areas

   2. Improving network security

3) Improvement in management

   1. NOC phase 2 (the project scope of this preparatory study should become phase 1)

2. Extending outside plant engineer centers (OPEC) to the regions

3. Strengthening the training center

(3) Recommendations concerning technical cooperation projects for human resource development and training center enhancement

1) Background

Under the aggressive sector development policy implemented since the start of the Thein Sein Administration, the Myanmar government plans to increase its phone penetration rate from under 10% as of the end of 2012 to 80% (a total of about 48 million subscribers) by 2015-16, by promoting aggressive capital investment and approving the entry into the mobile phone market of 2 new companies. Meanwhile, it is known that many carriers are shifting their network technology from conventional circuit switching to IP format as the global demand for Internet use grows rapidly. MPT also is introducing the IP packet communication format in their newly developed communications networks.

2) Difficulties and issues

Although MPT has its own training centers for the development of human resources, these are traditional training facilities that offer training on conventional circuit switching networks. In addition, the centers have only a limited number of personnel and offer limited opportunities for instructors to acquire new technology. At the frontline of MPT, even recently network development projects have been carried out by foreign engineers, and there are only a few engineers who understand new technology and communications methods. Therefore, it is expected that MPT will not be able to cope, in terms of either quantity or quality, with the new technology and methods to be introduced from now.

If the target of 48 million subscribers is to be achieved, a total of about 35,000 employees, or three times the current level, will be required at MPT. In addition, there are fears that communications engineers will leave MPT as new companies are allowed to enter into the mobile communications market. In this regard, it is essential that human resources development projects be implemented in order to be able to cope with the introduction of new technology and communications methods using Japanese ODA, with a focus on the development of engineers for Myanmar's communications sector as a whole.

3) Summary of project-type technical cooperation projects

This project requires the following conditions, the aim being to supply good-quality engineers capable of satisfying the demand in Myanmar's telecommunications sector as well as to provide these engineers with follow-up training.

(i) Development and enhancement of practical training facilities where application software for the latest technology is incorporated (IP routing, mobile communications,

interconnection between circuit switching networks and IP routing networks, access technology, shift from IPv4 to IP6, electronic information distribution security) and the establishment of training courses in the latest technologies, where trainees can acquire skills in design, construction, maintenance and operating techniques; also the deployment of instructors;

(ii) Development of telecommunications technology standards and guidelines in Myanmar, drawing on Japan's telecommunications standards and guidelines, and the establishment of a system of qualifications for engineers in an environment where services will be provided by multiple carriers;

(iii) Increase in the number of instructors capable of teaching the latest technology;

(iv) Enhancement of training efficiency and establishment of an online training system to provide follow-up to those who have completed training;

(v) Training in the management of technology (MOT) for the information and communications sector to help in the acquisition of knowledge for the effective use of technology as a management resource;

(vi) Training related to various issues likely to arise from the planned shift from a monopoly, including the move toward privatization, the introduction of competition and the interconnection of multiple networks; and

(vii) Training in the knowledge necessary to create and revise a master plan based on technical justification, as well as the knowledge needed to move the master plan to the practical arena.