The Republic of Maldives
Public Service Media (PSM)

PREPARATORY SURVEY REPORT ON THE PROJECT FOR THE DIGITAL TERRESTRIAL TELEVISION BROADCASTING NETWORK DEVELOPMENT IN THE REPUBLIC OF MALDIVES

OCTOBER 2016

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

YACHIYO ENGINEERING CO., LTD.

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey and entrust the survey to Yachiyo Engineering Co., Ltd.

The survey team held a series of discussions with the officials concerned of the Government of the Republic of Maldives, and conducted a field investigations. As a result of further studies in Japan, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Maldives for their close cooperation extended to the survey team

October, 2016

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Summary

1. Overview of the Republic of Maldives

The Republic of Maldives is an island country, located in the Indian Ocean and has a total population of approximately 340,000. The land is consisted of approximately 1200 islands and 26 atolls and the total area is approximately 300km^2. The land is located between the southern latitude 0 degree, forty minutes and the northern latitude 7 degree, 7 minutes and the east longitude 72 degree and 74 degree and elongated from north to south. It has a subtropical climate with high temperature and humidity. Season comprises the rainy season between May and November and the dry season between December and April. The average temperature throughout the year is between 26 and 33 degree. During the dry season, there are some rainy days while during the rainy season, though it is not the case that the rain continues throughout the period, there are many clouds and sometimes the rain continues for one week. Due to the climate change, there is a case recently that the rain continues for a certain period even during the dry season, while shower continues during the dry season.

The Republic of Maldives has GDP of USD 3.24 billion and a real GDP growth rate of 6.5% and its per capita GNI is USD 6,670 (2015, World Bank). Primary industry is tourism and fishing industry. Tourism accounts for 28% of GDP and becomes 60% of the source of foreign currency revenue. Fishing industry has a history of supporting the whole industry and still vast majority of people are engaged in the industry. Fishing industry comprises 15% of GDP and 30% of the total labor is engaged in the industry. Due to the limited land available and labor skills, agriculture and manufacturing industry is not developing. Due to the tsunami occurred in the Indian ocean in 2004, tourism was damaged and the growth rate of GDP in 2005 dropped down to -8.7%. However, after 2005, the economy recovered due to the recovery of tourism, reconstruction and rehabilitation work of the tsunami and development of resort facilities. The growth rate of GDP exceed 10% between 2006 and 2008, and in 2011 the country graduated from least developing countries.

2. Background and outline of the Project

The Republic of Maldives elongated about 1000km from north to south, consists of approximately 1,190 islands of which about 200 islands are inhabited. Information gap becomes a serious issue. Though television is a major source of information for the population, only Public Service Media provides a nation-wide service and its coverage is 77.3% in terms of population. Private broadcasting station only covers Male, the capital. In order to narrow the information gap between the capital and other outer islands, it is anticipated that the number of channels available with the local language and contents is increased in outer islands. More than 80% of the land in Maldives is less than 1.0m above sea level and plain field. The country is vulnerable to the natural disasters such as sea level rising, tsunami and high tide and needs a system by which disaster information is delivered in a timely and accurate manner.

The Seventh National Development Plan (2006-2010) prescribe the policy that the quality of broadcasting is improved and provide access to the media in all administrative area. In the next development plan which is

under preparation also prescribe the promotion of digital broadcasting by which access to information, dissemination of information, adaptation to climate change is improved. Under this situation, the government of Maldives prepared the roadmap toward the digital broadcasting under the support of International Telecommunication Union and made an announcement in the statement that they adapt the Japanese standard as a digital broadcasting standard when the President visited Japan in April, 2014. The president requested the cooperation to Japan for the smooth digital migration and the prime minister of Japan made a promise that Japan send a survey team to confirm the items to be addressed. Based on this statement, Japan sent a survey team in October, 2014 and confirmed the plans, issues and challenges to be addressed in order to start digital broadcasting and what could be done as a ODA project. After the survey, an official request was submitted from the government of Maldives for a grant aid project, development of digital broadcasting network for the purpose of improving access to information of the national, improvement of information gap and disaster management capacity. This survey was conducted based on this request in order to understand the background, purpose and scope of the Project and confirm the effect, technical and economic feasibility of the Project.

3. Outline of the Study Findings and Contents of the Project

JICA dispatched a survey team to the Republic of Maldives from 4th October to 7th November, 2015 to confirm the contents of the Project and conduct a site survey and conducted a site survey from 29th February to 15th March, 2016 again where the locations of the sites were changed. Based on the field survey conducted above mentioned period, the team analyzed its findings, implemented the rough design, and conducted cost estimation. The team visited the country again to explain the outline design of the Project from 9th to 18th June, 2016. The project is aimed to construct a digital terrestrial broadcasting network by which terrestrial broadcasting services are provided to all nationals of the country in a stable manner and access to information such as news, entertainment, health, education, fishing industry, religious and culture is improved. The outline of equipment procured for the Project is shown in Table-1, and the outline of facility is shown in Table-2.

Table-1 Outline of equipment

No.	Item	Quantity
1	Digital transmission system （Include Network system, UHF receiver, Exciter, Power amplifier, Combiner, Antenna system, UPS, Lighting-proof transformer, Distribution board and Microwave link system）	1 set
2	Network Operation Centre （Include Encoding system, Media converter, TS re-multiplexer, TS routing system, GPS reception system, TS compressor, Network switch, BTS/IP converter for TS output, EPG system, EWBS transmission server, TS monitoring system, TS recorder, TS analyzer, Alarm monitoring system, Monitoring camera system, Console and Rack）	1 set
3	PSM equipment	1 set

No.	Item	Quantity
	（Include Encoding system, Data broadcasting system, EWBS terminal and MMS studio equipment）	
4	Assembly box	3 sets
5	Antenna tower/pole	21 sets
6	Measuring instruments and tools for maintenance	1 set
7	Spare parts	1 set

Table-2 Outline of facility

<table>
<tr><th>Item</th><th colspan="6">Outline</th></tr>
<tr><td>Digital transmitting station and relay station</td><td colspan="4">(1) Floor space： 1st floor 25.00 m^2、2nd floor 28.10 m^2
Architectural area 1,115.10 m^2
(2) Foundation： Spread foundation, pile foundation for antenna tower of some sites
(3) Floor height： 1st floor GL+0.100 m
2nd floor GL＋3.600 m
(4) Eave height： GL+6.800 m
(5) Structure： RC Structure</td><td colspan="2">21 sites</td></tr>
<tr><td rowspan="22">Antenna Tower</td><td>Province</td><td>No.</td><td>Atoll</td><td>Island</td><td>House Type</td><td>Tower (m)</td></tr>
<tr><td rowspan="3">Upper North</td><td>1</td><td>HAA ALIFE</td><td>Dhidhdhoo</td><td>Transmission</td><td>60.0</td></tr>
<tr><td>2</td><td>HAA DHHALL</td><td>Kulhudhufushi</td><td>Transmission</td><td>50.0</td></tr>
<tr><td>3</td><td>SHAVIYANI</td><td>Funadhoo</td><td>Transmission</td><td>70.0</td></tr>
<tr><td rowspan="4">North</td><td>4</td><td>NOONU</td><td>Manadhoo</td><td>Transmission</td><td>70.0</td></tr>
<tr><td>5</td><td>RAA</td><td>Ungoofaaru</td><td>Transmission</td><td>70.0</td></tr>
<tr><td>6</td><td>BAA</td><td>Eydhafushi</td><td>Transmission</td><td>70.0</td></tr>
<tr><td>7</td><td>LHAVYANI</td><td>Naifaru</td><td>Transmission</td><td>80.0</td></tr>
<tr><td rowspan="4">North Central</td><td>8</td><td>KAAFU</td><td>Male(Vilinagili)</td><td>Transmission</td><td>60.0</td></tr>
<tr><td>9</td><td>KAAFU</td><td>Maafushi</td><td>Relay</td><td>90.0</td></tr>
<tr><td>10</td><td>VAAVU</td><td>Felidhoo</td><td>Transmission</td><td>80.0</td></tr>
<tr><td>11</td><td>ALIFU DHAALU</td><td>Dhangethi</td><td>Transmission</td><td>70.0</td></tr>
<tr><td rowspan="4">Central</td><td>12</td><td>FAAFU</td><td>Feeali</td><td>Relay</td><td>80.0</td></tr>
<tr><td>13</td><td>FAAFU</td><td>Nilandhoo</td><td>Transmission</td><td>50.0</td></tr>
<tr><td>14</td><td>LAAMU</td><td>Gan</td><td>Transmission</td><td>80.0</td></tr>
<tr><td>15</td><td>ThAA</td><td>Guraidhoo</td><td>Transmission</td><td>80.0</td></tr>
<tr><td rowspan="2">Upper South</td><td>16</td><td>GAAFU ALIFU</td><td>Viligili</td><td>Transmission</td><td>80.0</td></tr>
<tr><td>17</td><td>GAAFU DHAALU</td><td>Gadhdhoo</td><td>Transmission</td><td>80.0</td></tr>
<tr><td rowspan="2">South Central</td><td>18</td><td>GAAFU DHAALU</td><td>Fiyoari</td><td>Relay</td><td>60.0</td></tr>
<tr><td>19</td><td>GAAFU DHAALU</td><td>Thinadhoo</td><td>Transmission</td><td>50.0</td></tr>
<tr><td rowspan="2">South</td><td>20</td><td>GNAVIYANI</td><td>Foammulah</td><td>Transmission</td><td>20.0</td></tr>
<tr><td>21</td><td>SEENU</td><td>Hithadhoo</td><td>Transmission</td><td>30.0</td></tr>
</table>

The Project responsible agency on the Republic of Maldives side is the Ministry of Home Affairs and implementing agency is Public Service Media. The Project intends to develop a digital terrestrial broadcasting network by a digital terrestrial broadcasting platform by which the coverage is expanded and private broadcasting stations that have limited coverages in the surrounding area of Male can provide their services to all nationals which made it possible for those living in rural atolls to access to various information.

4. Project Schedule and Cost estimation

The Project implementation schedule including implementation design, tender, and installation works will be 22 months based on the Government of Japan's Grant Aid guidelines. The total Project cost on the Maldives side will be approximately 1.15 hundred million yen including removing existing facilities, securing power and space for installation of network operation centre equipment.

5. Evaluation of the Project

(1) Relevance

Relevance of the Project was examined from the point of view of 1) the number of beneficiaries, 2) urgency, 3) contribution to the achievement of the medium to long term development goals of the recipient country and 4) consistency with the assistance policies and strategies of Japan. The relevance of the Project is considered to be high.

1) Beneficiaries of the Project

The number of the beneficiaries of the Project is 311,634 people in the digital terrestrial television broadcasting coverage area. The figure corresponds to approximately 91.32% of the total population. The people living in 172 out of the 201 inhabited islands will be able to watch DTTB programmes when the Project has been completed. This extension of the TV broadcasting network will lead to the improved access to information and correction of the regional disparity in access to information.

2) Urgency

The development of an information communication network in the Maldives is at the stage of preparing the installation of optical fibre cables throughout the country. Broadcasting and mobile phones are the main means of communication to remote islands, while development and use of the landline telephone and the Internet are still limited. Because of its flat terrain, the Maldives is vulnerable to sea level rise caused by climate change and natural disasters such as flood tide caused by strong wind and tsunami. Therefore, the development of a system for quick and accurate dissemination of disaster prevention information is urgently required.

If this project is implemented, the coverage of the broadcasting service in remote islands is expected to increase from 83.23% of the population to 91.32%. It will also become possible to provide meteorological information regularly from MMS through PSM and also to broadcast emergency warnings. Maritime accidents occur frequently near remote atolls in the northern Maldives. If one-seg broadcasting is made available, it will be possible to obtain meteorological information from MMS on boats at sea. For these reasons, the extension of the coverage of the emergency broadcasting and the information dissemination utilizing the value-adding service of DTTB are required.

3) Contribution to the Achievement of Medium to long term development goals of the recipient country

Infrastructure development for the correction of the regional disparities is a priority issue of the national development plan of the Maldives. The government aims at providing public broadcasting service to all households in the country for the improvement of the governance. If this project is implemented, a DTTB network of the platform will be established. This network will not only extend the coverage of PSM but also enable broadcasting of programmes of other private broadcasters and provision of value-added services. The extension of the coverage and provision of these new services are expected to improve the access to information in remote atolls and correct the regional disparity in the access to information. Therefore, this project is consistent with the development plan of the Maldives.

Many households in remote atolls pay monthly viewer fees to watch TV programmes on CATV, at present. The multiplex broadcasting service of DTTB will enable the people in remote atolls to watch terrestrial broadcasting programmes in good quality free of charge and offer them larger choice of programmes. The establishment of the DTTB network will also enable provision of value-added services such as the one-seg broadcasting and data broadcasting. With these services, people will be able to watch TV while they are travelling on boats and obtain local information valuable to them. For these reasons, this project is consistent with the needs of the TV viewers in the Maldives.

4) Assistance policy and strategy of Japan

The Country Assistance Policy for the Maldives of the Government of Japan states the basic infrastructure development and the improvement of basic social services on remote islands for the correction of the regional disparity, food assistance and 'Cool Earth Partnership' as priority areas of its assistance to the Maldives. This project is considered consistent with some of the priority areas because it aims at making it possible for the people in remote atolls to watch TV programmes of PSM and private broadcasters on terrestrial broadcast by establishing information communication infrastructure.

(2) Effectiveness

The output of the Project is the establishment of a DTTB network by DBNO. This output can be verified with clearly defined indicators, i.e. the number of people in the coverage area, the number of programmes available in each Atoll and the record of live broadcast from MMS for the prompt dissemination of weather information. The Government of the Maldives considers PSM as an important medium to provide cultural, educational and entertainment programmes to the people. Once a DTTB network has been established, the people in remote atolls will be able to watch a variety of TV programmes produced by domestic media including PSM and private broadcasters on the terrestrial broadcast free of charge. As a consequence, the implementation of this project will contribute to the improvement of people's access to information and the correction of the regional disparity by ensuring equitable access to information to all the people. Therefore, the project is considered highly effective.

However, many people in the remote atolls watch CATV programmes because of the poor reception of the analogue TV broadcasting signals. The promotion of the viewing of DTTB programmes will require production of attractive programmes, provision of new services including the data broadcasting, a public awareness-creation campaign to viewers and assistance to the purchase and installation of DTTB receivers, in addition to the advantage of the free viewing.

1) Quantitative effect

The table below shows the indicators of the quantitative effects expected from the implementation of this project and their current (reference) figure and target figures (figures after the implementation).

Table-3 Quantitative effect expected from the implementation of the Project

Indicator	Reference figure (2016)	Target figure (2021)
1. Terrestrial broadcasting coverage	83.23 % (Analogue)	91.23 % (Digital)
2. Number of terrestrial broadcasting channels available in regional atolls	1	8

2) Qualitative effect

The implementation of the Project is expected to have the qualitative effects mentioned in the table below.

Table-4 Qualitative effects expected from the implementation of the Project

Current State and issues	Measures to be taken in the cooperation project	Direct effects and the extent of improvement	Qualitative effects
• The coverage of the analogue broadcasting service of PSM is 83.23%. The target of the national development plan of provision of broadcasting service to all the households has not been achieved.	• Establishment of a DTTB network to extend the coverage of the terrestrial broadcasting	• Approx. 8% of improvement in the coverage to 92.32% is expected from the establishment of the DTTB network.	• An environment for the correction of the regional disparity in access to information is established.

• There is regional disparity in the access to information because the analogue TV broadcast of PSM is the only free TV available in remote islands and the people in these islands do not have choices of programmes unless they subscribe to CATV.	• Programme multiplexing at DBNO to broadcast programmes of both PSM and private broadcasters • Use of the data broadcasting service to disseminate regional information	• The programme multiplexing by using the platform enables the people in remote islands to watch eight programmes free of charge. • A data programme can be produced using the regional information and such a programme can be transmitted to the region concerned.	• The provision of choices of a variety of TV programmes to the viewer is expected to improve level of their understanding of culture and education. • People can obtain regional information they need from the data broadcasting service and the availability of such information as weather information is improved.
• There is no established means to disseminate essential information such as disaster information quickly to the people.	• Introduction of the emergency warning broadcasting service (EWBS), data broadcasting and one-seg broadcasting	• Value-added services such as EWBS, data broadcasting and one-seg broadcasting are made available.	• EWBS enables quick information dissemination at the time of disaster. • The one-seg broadcasting service improves the availability of disaster information for the people on the move on a boat, etc.

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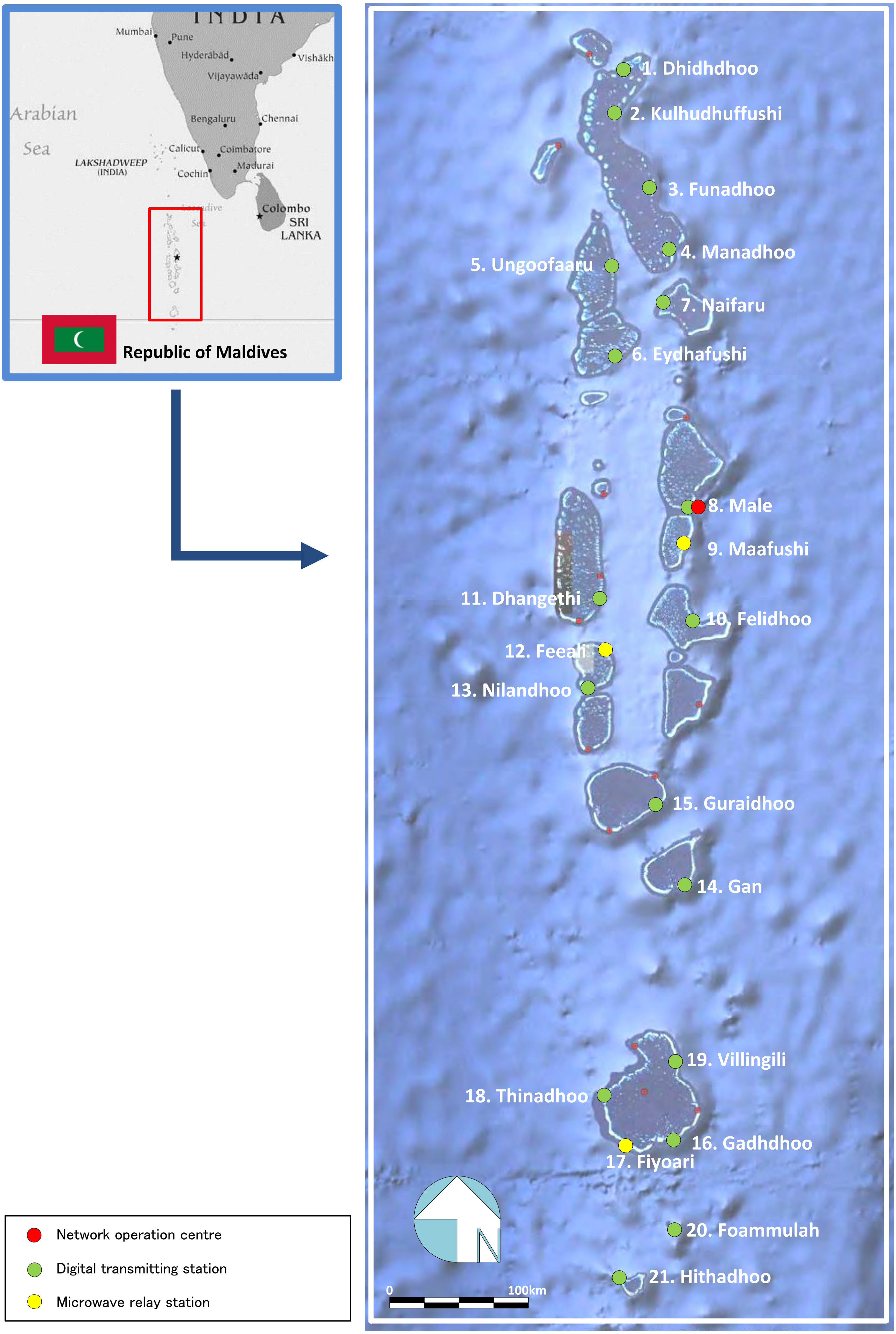

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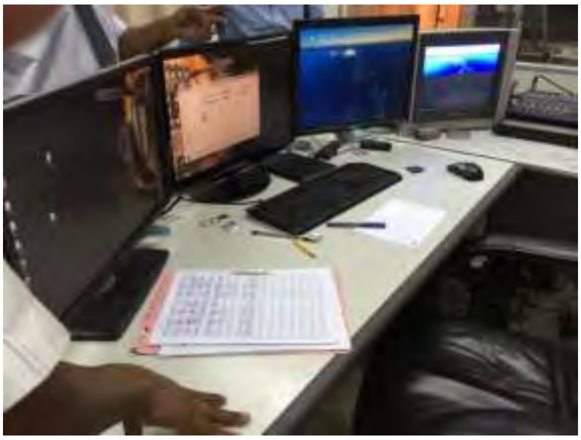
Signature of MD between the Ministry of Home Affairs and JICA Survey Team

Master control room at PSM

Experimental broadcasting equipment for ISDB-T at PSM

Existing antenna tower for analogue broadcasting at PSM



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Existing station building and antenna tower at the site in Kulhudhuffushi

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Outer circumference of the site where antenna tower to be built in Maafushi

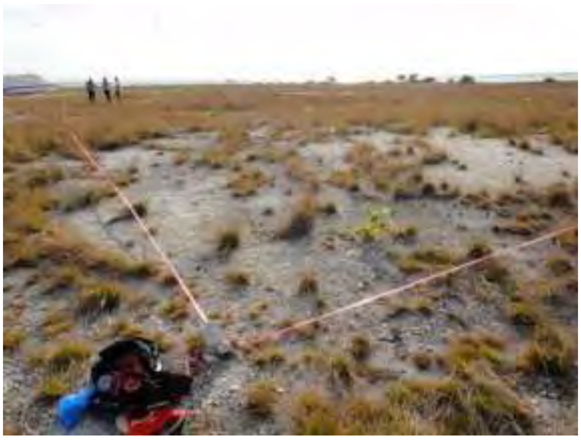

Existing antenna tower at the site in Felidhoo


The site where antenna tower to be built in Felidhoo


Port in Dhangethi


The site where antenna tower to be built in Dhangethi


Port in Feeali


The site where antenna tower to be built in Feeali


The site where antenna tower to be built in Nilandhoo


Outer circumference of the site where antenna tower to be built in Nilandhoo


Outer circumference of the site where antenna tower to be built in Gan


The site where antenna tower to be built in Gan


Outer circumference of the site where antenna tower to be built in Guraidhoo


The site where antenna tower to be built in Guraidhoo


Port in Gadhdhoo


The site where antenna tower to be built in Gadhdhoo


Existing foundation for analogue broadcasting tower and station building at the site in Fiyoari


The site where antenna tower to be built in Fiyoari


The site where antenna tower to be built in Thinadhoo


Existing antenna tower for analogue broadcasting at the site in Thinadhoo

The site where antenna tower to be built in Villingili

Equipment for analogue broadcasting and FM radio at the station in Villingili

The site where antenna tower to be built in Foammulah

Equipment for analogue broadcasting at the station in Foammulah

The site where antenna tower to be built in Hithadhoo

Outer circumference of the site where antenna tower to be built in Hithadhoo

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Abbreviations

A/P	Authorization to Pay
AEP	Acrylic Emulsion Paint
AES/EBU	Audio Engineering Society / European Broadcasting Union
AFD	French Development Agency
APC	Automatic Programme Control
ARIB	Association of Radio Industries and Business
ASO	Analogue Switch Off
B/A	Banking Arrangement
BML	Broadcast Markup Language
BTS	Broadcast Transport Stream
BTS	Base Transceiver Station
CAM	Communications Authority of Maldives
CATV	Cable Television
CG	Computer Graphics
DBNO	Digital Broadcasting Network Operator
DiBEG	Digital Broadcasting Experts Group
DSO	Digital switchover
DTTB	Digital Terrestrial Television Broadcasting
DVB-T	Digital Video Broadcasting Terrestrial
E/N	Exchange of Notes
EDS	Environmental Decision Statment
EIA	Environmental Impact Assessment
EIA	Electronic Industries Alliance
EIAJ	Electronic Industries Association of Japan
EPA	Environmental Protection Area
EPG	Electric Programme Guide
EPZ	Environmental Protection Zone
ERP	Effective Radiation Power
ESA	Environmental Sensitive Area
EWBS	Emergency Warning Broadcast System
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GNI	Gross National Income
GPI	General Purpose Interface
GPS	Global Positioning System
HD	High Definition
ICAO	International Civil Aviation Organization

IEC	International Electrotechnical Commission
IEE	Initial Environmental Evaluation
IIP	ISDB-T Information Packet
ISDB-T	Integrated Services Digital Broadcasting
ISO	International Organization for Standardization
ITU	International Telecommunication Union
ITU-R	ITU Radiocommunication Sector
JCS	Japanese Cable Makers' Association Standard
JEAC	Japan Electric Association Code
JEC	Japanese Electrotechnical Committee
JEM	Standards of the Japan Electrical Manufacturers' Association
JICA	Japan International Cooperation Agency
JIS	Japanese Industrial Standards
KOICA	Korea International Cooperation Agency
LED	Light Emitting Diode
MCR	Master Control Room
MEE	Ministry of Environment, Energy and Water
MFA	Ministry of Fisheries and Agriculture
MFN	Multi Frequency Network
MMS	Maldives Meteorological Service
MNP	Mobile Number Portability
MPEG-TS	Moving Picture Experts Group
NBSAP	National Biodiversity Strategy and Action Plan
NHK	Nippon Hoso Kyokai
NOC	Network Operation Centre
ODA	Official Development Assistance
OFDM	Orthogonal Frequency Division Multiplexing
OJT	On the Job Training
PMT	Programme Map Table
PSI/SI	Programme Specific Information/ Service Information
PSM	Public Service Media
QAM	Quadrature Amplitude Modulation
RC	Reinforced Concrete
RF	Radio Frequency
SD	Standard Definition
SD	Space Diversity
SDH	Synchronous Digital Hierarchy
SDI	Serial Digital Interface

SS	Suspended Solid
SFN	Single Frequency Network
SMPTE	Society of Motion Picture and Television Engineers
STB	Set Top Box
STL	Studio to Transmitter Link
STM-1	Synchronous Transport Module level-1
TMCC	Transmission and Multiplexing Configuration Control Information
TOR	Terms of Reference
TS	Transport Stream
TTL	Transmitter to Transmitter Link
TVRO	TeleVision Receive Only
UHF	Ultra High Frequency
UNICEF	United Nations International Children's Emergency Fund
UPS	Uninterruptible Power Supply
VOM	Voice of Maldives
VSWR	Voltage Standing Wave Ratio
WHO	World Health Organization

Chapter 1   Background of the Project

Chapter 1 Background of the Project

1-1 Current State of and Issues in the Broadcasting Sector

1-1-1 Current State and Issues

The public broadcaster, Public Service Media (hereinafter referred to as PSM), and three major private broadcasters, VTV, DhiTV and Atoll TV, transmit terrestrial TV signals in the Republic of the Maldives (hereinafter referred to as 'the Maldives'). These three private broadcasters are implementing a European system of digital terrestrial television broadcasting (hereinafter referred to as DTTB) around Malé Island and have not implemented analogue terrestrial broadcasting. On the other hand, PSM has installed 27 transmitting stations in the country and has developed a nationwide broadcasting network using the analogue terrestrial television broadcasting system. At the same time, experimental broadcasting using the Japanese system of DTTB (Integrated Services Digital Broadcasting, hereinafter referred to as ISDB-T) is under way around Malé Island by the technological assistance from the Ministry of Internal Affairs and Communications of Japan. Other broadcasters send their programme contents to PSM and Atoll TV, and PSM and Atoll TV provide these contents around Malé Island through the digital broadcasting service using the multiplex operation of transmission signals, which is one of the characteristics of DTTB.

Private broadcasters transmit their TV programmes from the transmitting stations on Malé Island. They also distribute their TV programmes nationwide, covering rural areas, through cable television (CATV) networks or satellite transmission for TV provided by PSM (TeleVision Receive Only, hereinafter referred to as TVRO).

Each broadcaster prioritises producing programmes and does not develop its own terrestrial television broadcasting network. This is because the Maldives is an island country composed of approx. 1,190 islands and this topography makes it difficult both technically and financially for private broadcasters to establish a nationwide broadcasting network of their own. It has become a characteristic of the broadcasting field in the Maldives that private broadcasters depend on CATV or PSM with abundant funds in order to broadcast their programmes nationwide.

Radio broadcasting service and television broadcasting service started independently in the Maldives, in 1962 and 1978, respectively. They were integrated into one national broadcaster in 2008 and it became public as the Maldives Broadcasting Corporation in 2012. As of 2015, it has become an organisation that can provide diversified media services including online and print media as well as conventional services specialised in radio and television, in accordance with the Public Service Media Act enacted in April 2015. The act allows PSM to be engaged in commercial activities.

Television broadcasting has developed rapidly in the Maldives. The household income survey conducted in 2009 by the Ministry of Finance and Treasury of the Maldives revealed that most of the households, 95.6% in Malé Island area and on average 94.9% nationwide in the remote atolls (20 atoll districts consisting of 26 coral reefs), owned TV sets. The Survey Team estimated the percentage of population in the PSM coverage area at 83.23%. TV is a major information source for the people particularly in the remote atolls. Table 1-1-1 shows the coverage of the existing analogue TV service.

Table 1-1-1 Percentage of Population in Coverage Area of Analogue TV Service in a Simulation

Atoll	Population in Atoll (people)	Population in the coverage area (people)	Percentage of people in the coverage area (%)	Number of islands in the coverage area*
Malé Island area	133,019	133,019	100.00	6/6
Haa Alifu	13,175	12,721	96.55	15/15
Haa Dhaalu	18,300	16,384	89.53	13/16
Shaviyani	12,310	5,149	41.83	4/14
Noonu	11,100	10,513	94.71	13/13
Raa	15,120	12,850	84.99	13/15
Baa	9,990	7,220	72.27	9/13
Lhaviyani	8,725	0	0.00	0/5
Kaafu	16,908	9,603	56.80	8/9
Alifu Alifu	6,474	1,780	27.49	2/8
Alifu Dhaalu	10,127	7,824	77.26	9/10
Vaavu	1,635	1,174	71.80	3/5
Meemu	4,814	3,989	82.86	7/8
Faafu	4,089	4,044	98.90	5/5
Dhaalu	5,908	5,356	90.66	7/7
Thaa	9,012	3,745	41.56	5/13
Laamu	12,075	9,571	79.26	8/13
Gaafu Alifu	8,868	3,958	44.63	3/10
Gaafu Dhaalu	11,765	7,346	62.44	4/9
Gnaviyani	8,055	8,055	100.00	1/1
Seenu	19,787	19,712	99.62	6/6
Total	341,256	284,013	83.23%	141/201

Source: JICA Survey Team

However, the quality of the image of the analogue terrestrial TV programmes is inferior, because the quality of the signal transmitted to the satellite link is poor, signal interference at the reception sites is highly likely and most of the households use indoor antennas to receive the signal. In most of the country, PSM's programmes are the only programmes that households can watch on the terrestrial TV broadcast. For these reasons, almost all households subscribe to CATV services and watch TV programmes at an average monthly fee of approx. MVR 200 – 250 (depending on viewing plans, 1,500 to 2,000 yen). Therefore, the number of viewers of the terrestrial TV programmes is small.

Although PSM, which is authorised to produce its programmes independently, produces programmes from fair and diverse viewpoints, the situation in which PSM's programmes are the only domestically-produced TV programmes that the people in remote atolls can watch through terrestrial broadcasting and the fact that the sources of information for citizens are limited are considered problematic. The Seventh National Development Plan 2006 – 2010 also states that the provision of the choices of TV programmes to those people at affordable prices with the renewal of existing equipment and facilities and the installation of new equipment and facilities is an issue to be addressed.

1-1-2 Development Plan

The Government of the Maldives has formulated a national development plan every five years. The government has prepared the draft of the Eighth National Development Plan and currently is collecting and analysing the comments on the draft plan from the ministries and agencies. Because of its topographic characteristics, the population of the Maldives is spread to islands far away from Malé. Basic infrastructure on these islands is underdeveloped because of the large cost required for its development. Therefore, there is inequality in the access to information and provision of public services between Malé and those remote islands. The Seventh National Development Plan, a development plan for the period between 2006 and 2010, proposed this inequality as a problem. The plan acknowledges the importance of the improvement of the contents of broadcasting services and extension of the service area in the media sector and proposes the implementation of the policies mentioned below for the achievement of such improvement and extension.

i. To improve the quality of broadcasting and provide equitable access to media, especially in remote atolls;

ii. To strengthen human resources capacity to enhance the provision of quality media services in the country;

iii. To enhance technical capability to provide broadcasting service to remote atolls with the same quality as in Malé Island;

iv. To develop E-infrastructure; and

v. To improve the efficiency and quality of the media and promote the right to freedom of expression

The Eighth National Development Plan is expected to inherit the policies in the media sector from its predecessor. The draft plan expects that the provision of terrestrial broadcasting services to all the people, which is to be realised by the migration to DTTB, will lead to the correction of the regional disparity in the access to information and the provision of quality information services. The draft plan also describes the contribution of the promotion of the use of the new technologies to disaster management and measures against climate change. The draft is expected to be approved later.

This project does not intend to develop a broadcasting office which produces and broadcasts programmes using transmitting facilities, but aims at establishing a DTTB platform which makes transmitting facilities and many programmes common and providing DTTB services which enable people to watch various programmes. Until now, the people living in remote atolls have only been able to watch analogue programmes of PSM on the terrestrial broadcast. The establishment of the platform will enable multiplex broadcasting of programme contents of all the platform member TV stations, which have been produced and transmitted independently, and the multiplex broadcasting will enable provision of these contents in remote atolls. Ninety-five percent of the households in the Maldives own TV sets. TV is not only the most important medium for the people to obtain information, but also, in remote atolls, a means to acquire knowledge and to learn their culture, a means of education and a rare source of entertainment.

This project aims at the establishment of the foundation for the provision of DTTB to all the people in the country through the DTTB platform. Therefore, it will facilitate the achievement of the above-mentioned expectation of the development plan of the Maldives by ensuring equitable access to information to the citizens, improving the quality of information and providing choices of information sources.

1-1-3 Social and Economic Conditions

(1) Social Conditions

The Maldives is a long and narrow country consisting of islands located along a north-south direction. The 26 natural atolls in the Maldives are divided into seven provinces and 20 Atolls. Malé is the capital of the Maldives.

The current population of the Maldives is approx. 341,000 people. Table 1-1-2 shows the population of each Atoll. Approx. one-third of its people live in the capital, Malé. Malé Island, where the capital Malé is located, is said to have the largest population density in the world. The shortage of houses resulting from the overpopulation is a serious social problem in Malé. The government has built an artificial island, called Hulhumale, adjacent to the Malé International Airport, and urges people in Malé to migrate there. Most of the current residents of Hulhumale are those who lost their houses in the tsunami disaster in 2004.

The population of the Maldives is composed of a single ethnic group, Maldivians. Most of its people are Muslim. Its official language is Dhivehi.

Although the major industries in remote atolls differ from one another, the people of the Maldives earn their living by working in the construction, fisheries, agriculture and tourism industries.

In many Atolls, the Internet coverage is less than 100%. Among them, Vaavu Atoll has the smallest coverage at 50%. Therefore, the people of the Maldives have limited access to information through the Internet. Meanwhile, although the percentages of the households that own TV sets differ from one Atoll to another within the range of 70 – 98%, many people are believed to be obtaining information from TV. Therefore, the migration to DTTB is expected to correct the regional disparity in the access to information.

Table 1-1-2 Population by Atoll

Province	Atoll	Population (people)[*1]	Main industry	Internet coverage (%)[*2]	Percentage of households that own TV set[*3]
Upper North	Haa Alifu	13,175	Fisheries, tourism	81	80
	Haa Dhaalu	18,300	Fisheries, agriculture	77	95
	Shaviyani	12,310	Agriculture	75	80
North	Noonu	11,100	Fisheries, tourism	95	77
	Raa	15,120	Construction, agriculture	78	78
	Baa	9,990	Tourism	73	95
	Lhaviyani	8,725	Tourism	91	93
North Central	Kaafu (including Malé)	149,927	Construction, fisheries, tourism	87	99
	Alifu Alifu	6,474	Tourism	79	87
	Alifu Dhaalu	10,127	Tourism	85	97
	Vaavu	1,635	Tourism	50	70
Central	Meemu	4,814	Agriculture, tourism	64	80
	Faafu	4,089	Agriculture	100	80
	Dhaalu	5,908	Agriculture	70	88
Upper South	Thaa	9,012	Fisheries, agriculture	85	97
	Laamu	12,075	Construction, fisheries	86	80
South Central	Gaafu Alifu	8,868	Fisheries, tourism	93	93
	Gaafu Dhaalu	11,765	Fisheries, tourism	92	89
South	Gnaviyani	8,055	Agriculture	100	98
	Seenu	19,787	Construction, agriculture, tourism	100	90
Total		341,256			

Source: *1 Ministry of Finance & Treasury Malé – POPULATION AND HOUSING CENSUS, 2015
*2 Data source: CAM
*3 Data source: PSM

(2) Economic Conditions

The Maldives used to be classified as a least developed country. However, thanks to the continuous economic growth driven by the tourism, one of the main industries of the country, it is currently classified as an upper middle income country. Fisheries are the main industry in the remote atolls and fishery products account for the largest proportion of the exports from the Maldives. Meanwhile, the scales of agriculture and manufacturing industry are small because of the limited availability of land and labour. The Maldives does not have mineral resources to sustain the mining industry.

In 2008, the tourism industry was hit hard by the decrease in the number of tourists visiting the country due to the worldwide financial crisis which resulted from the bankruptcies of investment banks in the U.S. and happened continuously. The slump of tourism was accompanied by those of other industries. Although there was no obvious change regarding the breakdown of the GDP, the GDP growth rate fell to -5.5% in 2009. Afterwards, while European economy was late to improve, the tourism industry in the Maldives rallied in 2010 and 2011 thanks to the change of the situation including rapid increase in the number of Chinese tourists, followed by the recovery of the GDP growth rate. The tsunami caused by the 2012 Indian Ocean Earthquakes hit hard the tourism and construction industry and the GDP growth rate decreased temporarily in 2012. Since then, the GDP growth rate of the country has recovered steadily and was restored to 6.5% in 2014.

The breakdown of the GDP of the Maldives shows that the service industry, which includes the tourism, has accounted for more than 40% of the GDP every year. Tourism is extremely important for the economy of the Maldives and the largest source of foreign currency income of the country.

Meanwhile, the economy of the Maldives is likely to be affected by the global business trends and it is affected greatly by natural disasters because of its heavy dependence on tourism and fisheries. As mentioned above, the GDP growth rate dropped sharply after the financial crisis in 2008 and the 2012 Indian Ocean Earthquakes.

Table 1-1-3 Major Economic Indicators of the Maldives

Item	2008	2009	2010	2011	2012	2013	2014
Real GDP*1 (in million U.S. dollars)	2,118	2,166	2,332	2,461	2,535	2,705	3,032
GDP growth rate (%)	10.9	-6.0	7.2	10.8	1.5	7.7	7.6
Per capita GNI*2 (in U.S. dollars)	5,430	5,460	5,960	6,640	6,670	6,730	7,170
Breakdown of GDP (%) (Note)							
Agriculture, fisheries and mining	5.4	4.1	4.1	3.9	4.1	3.9	3.5
Manufacturing	5.7	4.5	4.2	5.2	6.0	5.7	4.9
Utilities	1.4	1.4	1.4	1.3	1.3	1.3	1.1
Construction	10.2	8.5	9.3	11.4	9.6	7.5	12.1
Commerce	5.0	3.7	3.8	3.9	4.2	4.4	4.3
Transport and communications	10.7	12.1	13.8	12.5	12.7	12.8	12.4
Administration	12.5	15.7	13.6	13.7	14.8	15.3	16.4
Finance	5.6	5.9	6.1	5.5	5.3	5.2	4.9
Service industry	43.5	44.2	43.8	42.5	42.0	44.0	40.4

*1 GDP which refers to the market price in 2005
*2 *Per capita* GNI (reference: Atlas method)
Source: The World Bank for the real GDP, GDP growth rate and per capita GNI
The breakdown of GDP was calculated from the data in 'Key Indicators for Asia and the Pacific 2014' of ADB.

1-1-4 Topography

The Maldives is an island country in the Indian Ocean located southwest of Sri Lanka. It is composed of approx. 1,190 islands in 26 Atolls in the area between 0°40'S and 7°07'N and between 72°E and

74°E. Single specific functions are assigned to many of the islands: There are approx. 200 inhabited islands and approx. 100 resort islands in the country. In addition, there are airport, manufacturing and agricultural islands. The total area of the country is approx. 300km^2, approximately half the area of the Awaji Island of Japan.

The highest points on 80% of the islands in the Maldives are below 1m above sea level and the highest point in the country is at 2.4m above sea level. The country of such low and flat terrain is under the threat of the loss of its land due to the recent sea level rise and death of coral reefs. Therefore, measures against climate change are an important issue of the government.

1-2 Background and Outline of the Grant Aid Cooperation

1-2-1 Background of the Grant Aid Cooperation

The Maldives is an island country in the Indian Ocean. It is a long and narrow country, approximately 1,000km-long in the north-south direction. It is composed of approx. 1,190 small Atolls, among which approx. 200 are inhabited. The regional disparity in the access to information is a serious problem. While TV broadcasts are a major news source of its people, PSM is the only TV broadcaster providing nationwide service. The coverage of this service is 77.3% of the population. Meanwhile, private TV broadcasters provide services only to Malé and its surrounding area. The improvement of the quality of the broadcasting service, including the increase in the availability of TV programmes in the local language, in the islands other than Malé and the surrounding islands is required for the improvement of the people’s access to information and correction of the regional disparity in the access to information. Because of its low and flat terrain with 80% of its islands below 1.0 m above sea level, the Maldives is vulnerable to sea level rise caused by climate change and natural disasters including flood tide caused by strong wind and tsunami. Therefore, the establishment of a system for rapid and accurate emergency information dissemination is urgently required.

The ‘Seventh National Development Plan (2006 – 2010)’ of the Maldives has included the policies of improving the quality of the broadcast and providing equitable access to media in all remote atolls. The next national development plan in preparation is expected to mention the promotion of the migration to DTTB as a means to correct the regional disparity in the access to information, as a means of disaster management and as a measure against climate change.

Against this background, the Government of the Maldives prepared a road map for the migration to DTTB with assistance from the International Telecommunication Union (ITU). In the joint statement published during the visit to Japan of President Yameen of the Maldives, the president announced that the Government of the Maldives had decided to adopt the Japanese system of digital terrestrial television broadcasting (ISDB-T). The president also requested cooperation to the smooth migration to DTTB from Japan. In response, Prime Minister Abe of Japan announced the dispatch of a survey team to identify a method which could be used in the assistance to the introduction of ISDB-T in the Maldives in the joint statement. In accordance with this announcement, the Government of Japan dispatched a survey team for data collection survey in October 2014. The team conducted a study on the environment required, issues to be solved and a future plan for the migration to DTTB required for the preparation of a plan of Japanese ODA assistance to the smooth migration to DTTB. The team elucidated the current state of TV broadcasting in the Maldives, assessed the contents of the request, identified the issues in the migration to DTTB and formulated a strategy to prepare appropriate measures against the issues in the study.

After the dispatch of the survey team, the Government of the Maldives submitted an official request for grant aid cooperation for the improvement of people's access to information, the correction of the regional disparity in the access to information and the improvement of the capacity in disaster management and mitigation to the Government of Japan. In response, the Government of Japan decided to implement this survey to verify the background, purposes and contents of the requested project and analyse its effects and technical and economic relevance, on condition that the grant aid cooperation scheme was to be used for its implementation.

A study required for the implementation of a cooperation project for the development of a DTTB network in the Maldives for the introduction of ISDB-T was conducted in this survey. The purposes of this survey, which was conducted on condition that the requested project would be implemented as a grant aid cooperation project, were 1) to verify the background, purposes and contents of the project, 2) to analyse its effects and technical and economic relevance, 3) to prepare an outline design of the project with the contents and scale ideal and required for producing the assumed effects and estimate the project cost based on the outline design and 4) to prepare a recommendation on points to be noted, such as the contents of the recipient's obligations, execution schedule and the capacity in the operation and maintenance, required for the achievement of the outputs and purposes of the project.

1-2-2 Contents of the Request

The Communications Authority of Maldives (CAM) under the jurisdiction of the Ministry of Home Affairs submitted the request for grant aid cooperation to the Government of Japan on 18th February 2015. The request describes that 'to migrate to digital broadcasting' is the overall goal of the project. It describes the three purposes of the project as follows:

- To build a nationwide DTTB network and migrate to digital broadcasting
- To get all broadcasters to share a common transmission network (digital terrestrial television transmission platform – DTTB platform)
- To have a system for early warnings and emergency communication for the better mitigation of disasters

Although the Government of the Maldives does not mention the quantity of the equipment required for the achievement of these purposes in the request, when it comes to the policies of the migration to DTTB, the improvement of the population-based coverage and the expansion of the coverage in resort islands are emphasised strongly, the Survey Team confirmed. In order to go ahead with these policies, the Government requests the assistance to the establishment of a DTTB network, such as collecting programmes of 18 transmitting stations, 3 relay stations and broadcasters, provisioning equipment of Network Operation Centre (hereinafter referred to as NOC) which has the function of providing programmes to digital terrestrial platforms, and so on.

At the same time, the Survey Team confirmed that the Government of the Maldives hopes for technology transfer by technical cooperation project scheme of Japan, regarding smooth migration to DTTB and learning characteristic technology to operate the terrestrial digital platforms.

Table 1-2-1 Contents of Request (Comparison with the contents of the original request)

	Original request		Request at the time of the preparatory survey
Implementing agency	CAM		PSM
(1) Overall goal **(2) Project purpose** **(3) Outputs**	(1) To migrate to digital broadcasting (2) The following three i) To build a nationwide DTTB network and migrate to digital broadcasting ii) To get all broadcasters to share a common transmission network (DTTB platform) iii) To have a system for early warnings and emergency communication for the better mitigation of disasters		(1) To be decided (2) To improve people's access to information and to correct the regional disparity in the access to information (3) A DTTB network is established
Locations	20 locations		21 locations
Requested items (Assumed quantity)	Facilities	Antenna towers	Antenna tower – 90m-high (1 set)
			Antenna towers – 80m-high (7 sets)
			Antenna towers – 70m-high (5 sets)
			Antenna towers – 60m-high (3 sets)
			Antenna towers – 50m-high (3 sets)
			Antenna pole – 30m-high (1 set)
			Antenna pole – 20m-high (1 set)
		Transmitting stations - with air-conditioner - and power supply system	Transmitting stations (18)
			Relay station buildings (3)
		Transmission systems - Transmitter - Relay station - Antenna	Digital transmission systems – 200W (6 sets)
			Digital transmission systems – 100W (4 sets)
			Digital transmission systems – 50W (4 sets)
			Digital transmission systems – 20W (2 sets)
	Equipment		Digital transmission systems – 10W (2 sets)
			Renovation of digital transmission systems (2 sets)
			Microwave relay systems (3 sets)
		Equipment of NOC	Equipment of NOC (1 set)
		EWBS server	EWBS server (1 unit)
		Link system (microwave)	Link system (microwave) (1 set)
		Link system (optical fibre)	Link system (optical fibre) (8 sets)
		-	Maintenance equipment/tools (1 set)
		-	Spare parts (1 lot)
		-	Consumables (1 lot)
	Soft component	Human resource development including training of engineers	Implementation of a technical cooperation project under consideration

1-3 Japan's Assistance to the Maldives

The Government of Japan has provided assistance to the Maldives in the broadcasting sector for a long time since 1979 when it provided radio receivers for educational programmes. Japan's assistance to the Maldives in this sector includes the provision of the equipment for educational broadcasting equipment to the Ministry of Information and Broadcasting in 1980 and the provision of equipment to Television Maldives in 1996. CAM's office is currently located in the building constructed in 1986 in a grant aid cooperation project of Japan.

Table 1-3-1 Japan's Assistance to the Maldives in Broadcasting Sector

	Description of assistance	Calendar year	Amount of assistance (in hundred million yen)	Scheme
1.	Provision of radio receivers for educational programmes	1979	0.15	Grant aid cooperation
2.	Provision of educational broadcasting equipment to the Ministry of Information and Broadcasting	1980	0.15	Grant aid cooperation
3.	Provision of TV programme production equipment to Television Maldives	1986	0.43	Grant aid cooperation
4.	Provision of digital exchangers and construction of POSTAL Building (currently Telecom Building)	1985 – 1988	24.43	Grant aid cooperation
5.	Provision of broadcasting equipment to Voice of Maldives	1995	0.48	Grant aid cooperation
6.	Provision of equipment to Television Maldives	1996	0.42	Grant aid cooperation

Source: Voice of Maldives and Ministry of Foreign Affairs of Japan

1-4 Assistance from Other Donors

Table 1-4-1 below shows the assistance in the sector concerned provided by other donor countries and organisations to the Maldives.

Table 1-4-1 List of Assistance from Other Donors

	Description of assistance	Objects of support	Donor	Calendar year
1.	Construction of radio programme production centres on remote islands	Unknown	UNICEF	Unknown
2.	Provision of broadcasting equipment (5kW medium-wave transmitter) to Voice of Maldives	VOM (Voice of Maldives)	Australia	1981
3.	Financial assistance to TETRA Project (for the establishment of an early warning and emergency communication network system)	Maldives Police Service	KOICA (South Korea)	2006
4.	Upgrading of the equipment used in the TETRA Project	Maldives Police Service	AFD (France)	2006

Source: Voice of Maldives, Department of Information, CAM

Chapter 2   Circumstances of the Project

Chapter 2 Circumstances of the Project

2-1 Status of the Migration to DTTB

This chapter describes the status of preparation of the various plans that must be prepared by Maldives for the migration to DTTB.

2-1-1 ITU DTTB Roadmap and Overview of DTTB Migration

ITU provides support for the preparation of a roadmap for DTTB migration to ITU member countries with insufficient technical capability, knowledge, and experience in the migration to DTTB. The Maldives DTTB roadmap was prepared by a digital terrestrial roadmap preparation team formed by specialists in digital terrestrial broadcasting dispatched by ITU and the relevant organisations from Maldives. This roadmap advised that a DTTB platform be constructed and that DTTB be implemented by PSM and private broadcasting stations via this DTTB platform, in order that diverse DTTB programmes can be provided in the whole country.

As a result the Maldives commenced detailed studies for the construction of the DTTB platform, digital migration plan, expected service area of the DTTB platform and its operation and in 2015 it was decided that a Digital Broadcasting Network Operator (DBNO) would be established for operation of the DTTB platform by PSM.

Note that as stated in Chapter 1-2, in response to a request for smooth migration to DTTB in the Maldives, it was decided that the funding and technical capability for the construction of the DTTB platform will be supported in part by Japanese grant aid cooperation.

On the other hand, for migration to DTTB it was necessary that various plans be prepared, and that work be promptly carried out in accordance with these plans. However after preparation of the ITU DTTB roadmap, studies for the preparation of the specific plans tended to be delayed. Therefore specific studies were carried out on the details of the ITU DTTB roadmap through the ‘Data Collection Survey on Digital Terrestrial Television Broadcasting in the Republic of the Maldives’ implemented by the Japan International Cooperation Agency (JICA) in 2014 – 2015 (hereinafter referred to as the ‘Previous Survey’) and this survey ‘Preparatory Survey on the Project for the Digital Terrestrial Television Broadcasting Network Development in the Republic of Maldives’ implemented in 2015 – 2016 (hereinafter referred to as the ‘JICA Preparatory Survey’) and advice was provided on the preparation of various plans. The migration to DTTB is broadly divided into the following five operations, and further sub-divided into individual plans and work, etc. Also the overall schedule for these is shown in Fig. 2-1-1.

i. Preparation of DTTB master plan
ii. Formulation of DTTB migration plan
iii. Development of systems, laws, standards, etc.
iv. Implementation of equipment procurement and installation construction
v. Implementation of organisational and personnel training

It is necessary that work be implemented steadily in accordance with these five items by Analogue Switch Off (ASO), scheduled in 2020, which was decided at the time when the DTTB roadmap was prepared. The status of implementation of the above five items are described from the next item onwards.

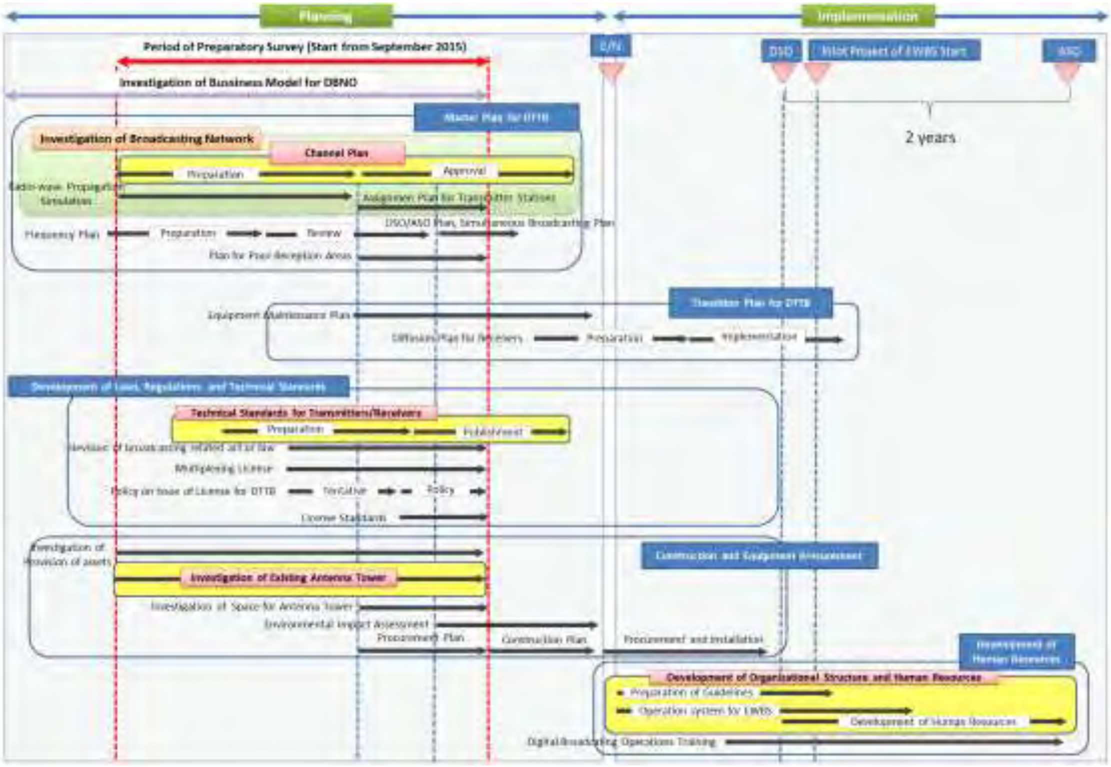


Fig 2-1-1 DTTB Migration Schedule

2-1-2 DTTB Master Plan

The DTTB master plan defines the DTTB migration master schedule, objectives, etc., such as the basic timing of the Digital Switch Over (DSO), whether broadcasting will be in High Definition (HD) or in Standard Definition (SD) when commencing DTTB, whether there will be a mixture of HD and SD, whether multiplexed operation will be implemented to enable programmes to be multiplexed within one frequency for broadcasting several programmes, whether to terminate analogue transmission via simulcast, how many years the simulcast period should be in this case, the target percentage of the population coverage for DTTB migration (hereinafter referred to as the ‘percentage of population-based coverage’, or ‘coverage’), etc.

Also in the Maldives the DTTB platform will be constructed so that basically all terrestrial broadcasting stations will deliver broadcast programmes to the viewers via the DTTB platform. Therefore in addition to measures to support the frequency allocation and channel plan, it is necessary to prepare a plan for areas with poor reception (measures against poor reception).

Table 2-1-1 below shows the content and status of the DTTB master plan.

Table 2-1-1 Maldives DTTB Master Plan

	Item	Implementation method	Notes
1.	Digital switch over (DSO) time	Into areas successively from 2017	DSO will be carried out in each area that can be covered from transmitting stations where installation of digital transmitters is complete.
2.	Image quality	From the start of DSO, there will be mixed HD and SD, and in the future SD will be eliminated	It is not yet determined when broadcasting will be completely HD
3.	Analogue switch off (ASO)	Simulcasts will be implemented, with ASO in 2020	DSO will be carried out separately for each area, and simulcasts will commence according to the area. ASO will be the same for the whole country
4.	Target percentage of population-based coverage for DTTB migration	The same or higher than current analogue broadcasting	Coverage of 97.64% of the country can be achieved with a total of 26 transmitting stations.
5	Establishment of the DTTB platform	Establishment of the DTTB platform which all terrestrial broadcasting stations can join and run by a public organisation.	It enables reducing the initial cost of transmitter installation by the use of the platform. Various programmes produced by different broadcasting stations are broadcast in regional atolls.
6.	Channel plan (including allocation of frequencies)	26 transmitting stations (four frequencies used per station)	CH21 to CH40 to be used for DTTB. In addition to the 26 transmitting stations, in order to construct the platform apart from the 26 transmitting stations, three relay stations will be installed (see the next item for details).
7.	Multiplexing operation	Multiplexing operation with HD/SD, data, one-seg broadcasting	With mixed HD/SD: HD×2, SD×2, data × 1, one-seg × 1 per frequency HD only: HD×3, data × 1, one-seg × 1 per frequency
8.	Assistance for broadcasting stations	Implementation of indirect assistance	The European format transmitters will be transferred to DBNO
9.	Plan for areas with poor reception	Solve by adjusting the height of the receiving antennas	In accordance with the channel plan, the areas with poor reception are resort islands, and it is recommended that receiving antennas are installed on a high location (for details see Chapter 2-1-4).
10.	Assistance for viewers	None scheduled	Almost all households have HD television, so the receivers will mainly be STBs. PSM will promote the spread of STBs. However, there will not be direct assistance for the poverty group, such as free distribution, etc., and it is likely that market publicity measures that increase market distribution will be mainly taken

Source: Created by the Survey Team based on interviews with relevant organisations in Maldives

DSO will be implemented successively in areas when installation of the transmitters has been completed, and ASO is targeted to be by 2020. However, in the event of implementation of a Japanese grant aid cooperation project, most of the DTTB platform equipment will be procured by this grant aid cooperation, so there is a possibility that the simulcast period, which was examined in the Maldives DTTB roadmap will be amended in the future taking into consideration the schedule of implementation of the grant aid cooperation project.

Regarding image quality, currently there are some broadcasting stations that produce programmes in HD and some broadcasting stations that produce programmes in SD. The financial status of private sector broadcasters (hereinafter referred to as ‘private broadcasters’) varies, so initially at DSO there will be mixed HD and SD, and private broadcasters will successively convert to HD. Therefore in the future it will be necessary to clarify the time for complete migration to HD. Also associated with this the Government of the Maldives will multiplex DTTB for efficient use of broadcast waves, but for the meantime multiplexing will be implemented on mixed HD/SD. Thereafter when all stations have converted to HD, the number of multiplexed programmes will be changed as shown in Table 2-1-1 in accordance with the HD image quality.

In the ITU DTTB roadmap, the target value for DTTB migration is equal to or greater than the current analogue broadcasting coverage. As stated in Chapter 1-1, the terrestrial broadcasting stations in the Maldives that have constructed a nationwide terrestrial network are PSM only. The coverage of terrestrial broadcasting by PSM has not been accurately determined, but this Survey Team has calculated that it is 83.23%. In the draft channel plan prepared with assistance from the Survey Team (see Chapter 2-1-3), a DTTB network of 26 transmitting stations is planned in order to correct the information difference between islands, which will result in a coverage of 97.64%. Twenty six transmitting stations is the ultimate target number of installations, and it is planned that there will be 26 transmitting stations within five years of DSO.

With this channel plan all the islands with housing and industry will be covered, but 12 resort islands cannot be covered. It is the policy of the Government of the Maldives that the resort islands should also be covered by the terrestrial broadcasting services, taking into consideration the 1,125,202 tourists per year (2013, Yearbook 2014, Ministry of Tourism). However taking into consideration that geographically the islands are isolated and it is not possible to efficiently install transmitters, and the cost effectiveness for the beneficiary population, it was judged that it was more effective to take separate measures for poor reception. Details of these measures are described in Chapter 2-1-4, and if these measures for poor reception are taken, it will be possible to obtain substantially 100% coverage for the DTTB channel plan, and it will be possible to glimpse the importance attached to DTTB by the Government of the Maldives.

On the other hand, test digital terrestrial broadcasts have been implemented in the Maldives by several broadcasting stations, including PSM, for the past several years. However, at that time it had not been decided that Maldives would adopt ISDB-T for the whole country, so private broadcasting stations purchased transmitters using the European system to implement their test broadcasts. Almost all the broadcasting system must be replaced by the broadcasting stations for the DTTB migration, such as transmission equipment, studio equipment, master control equipment, etc., which will require considerable financial and managerial power. In order to reduce the financial burden of investment in this equipment, construction of the DTTB platform was proposed in the ITU DTTB roadmap. Instead of securing finance for large scale renewal of equipment in a short period of time, construction of the broadcasting network will be carried out by the DBNO, and by levying a usage charge on each broadcaster for the procurement of the equipment, the burden of procurement of finance on each broadcasting station will be reduced. The Government of the Maldives will not provide direct financial assistance to broadcasters, but an indirect measure to reduce the burden will be adopted. In addition, the broadcasting stations that have already procured transmitters with the European system have generally agreed to a policy in which the transmitters in use will be transferred to DBNO, and an adjustment will be made by deducting from the usage charge an amount equivalent to the remaining value of the transmitters. The details regarding the DTTB platform which will operate both PSM and private broadcasts will be worked out in the future.

The DTTB migration is not completed when the broadcasting stations have completed development of their equipment and facilities. It is necessary that the viewers purchase receivers for digital broadcasts before ASO, to create the environment for implementing ASO. Normally the requirements for implementing ASO are studied in order to implement ASO. The digital broadcast coverage and the spread of digital receivers among households are examined. In other words, even if the service area of the digital broadcasts of the broadcasting stations is expanded to the whole national land area, ASO cannot be implemented unless the spread of receivers among households reaches a certain level, and the broadcasting stations must continue simulcasts. With simulcasts both digital and analogue transmitters are operated in parallel, so the operational cost burden on the broadcasting stations is increased. In order to avoid this, it is necessary to set a certain period for simulcasts, and during this period take various measures to enable ASO to be implemented.

The channel plan and the plan for areas with poor reception, which are a part of the DTTB master plan, are described separately in Chapters 2-1-3 and 2-1-4. The channel plan was studied and prepared in the JICA Preparatory Survey together with the Government of the Maldives. Also, by producing the channel plan, it is judged that effective measures with low burden were obtained for the plan for areas with poor reception too.

Each private broadcasting station in the Maldives agreed on the DTTB master plan shown in Table 2-1-1 and expresses their expectation that their service coverage expands with the establishment and operation of the DTTB platform.

2-1-3 Channel Plan

2-1-3-1 Preliminary Study of Candidate Locations for Transmitting Stations

Candidate locations for the transmitting stations must be studied as the first stage of the channel plan. However PSM in the Maldives has already achieved almost complete coverage of the country, so it was decided that the existing locations be adopted in priority as candidate locations. In particular it is considered that it is easy to obtain information regarding the existing locations, and public infrastructure such as electrical power and water, etc., are provided, so the existing locations have great merit as candidate locations.

On the other hand, it is not necessarily the case that efficient locations were selected as locations for transmitting stations in terms of transmission of radio waves in the case of the existing locations for PSM's transmitting stations. This is because when the transmitting stations were installed the infrastructure was not developed, so it was not possible to determine the locations for transmitting stations on the basis of efficiency of radio wave transmission only.

As a result of discussions with PSM, the transmission output of digital terrestrial transmitters was provisionally determined by reference to the transmission output of analogue transmission. Twenty one locations for transmitting stations were selected by a desk study, such as moving to a different island in the case of an existing analogue locations for transmitting station that was considered to be inefficient geographically to cover the islands within an Atoll. Also for Atolls and islands that could not be covered from these 21 locations for transmitting stations, additional candidate locations were selected based on simulations of radio wave transmission.

2-1-3-2 Setting the Percentage of Population-based Coverage

The percentage of population-based coverage of the existing analogue broadcasts in the Maldives was estimated to be 77.3% in the previous survey. However to obtain a more accurate estimate, the transmission output, the ERP, the antenna heights, and the antennas patterns were obtained from PSM, and radio wave transmission simulations were carried out to determine the area where a prescribed electrical field strength could be obtained, and based on this the percentage of population-based coverage was calculated. The result was estimated to be 83.23%.

The policy for DTTB migration in the Maldives is to obtain a percentage of population-based coverage equal to or higher than that of the current analogue broadcasts. In addition in constructing the DTTB platform in the Maldives an objective is to correct the difference in information between islands, and taking into consideration the rapid provision of weather and disaster information for the more than 1.2 million tourists annually and those working in the tourist industry, ultimately the aim was a percentage of population-based coverage of 100%.

2-1-3-3 Preliminary Study of Transmission Links

The method of transmission of programmes to the various transmitting stations from the NOC of DBNO which will form the core of the DTTB platform to be operated by PSM will be by use of optical fibres, microwave links, and broadcast wave relays in priority, based on reduction of operating costs (see Chapter 2-1-7 (3) 'Network Configuration' which is described later). Therefore in the case of islands where optical fibres are laid (in this channel plan this corresponds to nine islands including Malé Island), base stations will be provided in these regions, and from there the programmes will be transmitted to the other transmitting stations by a microwave link or broadcast wave relay. When it is necessary to transmit between transmitting stations over a distance longer than the distance that can be transmitted by microwave, a microwave relay station will be provided.

2-1-3-4 Study for Allocation of Frequency Channels (CH)

2-1-3-4-1 Confirmation of Frequencies that can be Used

In the Maldives, broadcasting frequencies were allocated by the broadcasting commission based on the comprehensive frequency plan created by CAM with technical examination and advice of CAM. The broadcasting commission has all rights to give permission for the broadcasting stations to start their services such as broadcasting licences. In addition, the programme contents are also regulated by the commission. CAM, under the auspices of the Ministry of Home Affairs plays a role as a communication regulatory authority and works closely with the commission to regulate the broadcasting industry. However this system changed in April, 2016. Afterward, CAM directly allocates frequencies to broadcasting stations, while the commission continues to issue broadcasting licences and regulate programme contents.

In the Maldives, UHF frequencies will be used for DTTB, the same as for most countries. The frequencies in the UHF band currently used for TV broadcasts in the Maldives are CH27 to CH32, and as shown in Table 2-1-2 the six frequencies of CH27 to CH32 are already allocated to broadcasting stations by the commission. However, there are frequencies that are allocated but not in use, such as in the European system of broadcasting by DVB-T and DVB-T2, etc., so in reality there are many frequencies that can be used when starting DTTB.

On the other hand, in the Maldives the broadcasting frequencies were allocated by a rule of uniform licencing in the whole country, so if frequency A is allocated to a certain broadcasting station, and broadcasting is carried out around Malé Island with frequency A, it is not possible to allocate frequency A to another broadcaster for a location distant from Malé Island, where the radio waves at frequency A do not arrive (a signal is received at or below the electrical field strength to cause interference).

Table 2-1-2 Plan for Use of Channels in DTTB

CH	Name of broadcasting station allocated	Use	Time when it can be used	
			During DSO	After ASO
21	None	For non-television broadcast use		△
22	None	For non-television broadcast use		△
23	None	For non-television broadcast use		△
24	None	For non-television broadcast use		△
25	None	For non-television broadcast use		△
26	None	For non-television broadcast use		△
27	Sun TV	Not currently used		○
28	DTV	DVB-T		○
29	VTV	DVB-T2		○
30	Atoll TV	Not currently used	○	

CH	Name of broadcasting station allocated	Use	Time when it can be used	
			During DSO	After ASO
31	Atoll TV	DVB-T	○	○
32	PSM	ISDB-T test broadcasts being implemented	○	
33	Not allocated		○	
34	Not allocated		○	
35	Not allocated		○	
36	Not allocated		○	
37	Not allocated		○	
38	None	For non-television broadcast use	○	
39	None	For non-television broadcast use	○	
40	None	For non-television broadcast use		○

Source: CAM

(Notes) The symbol ○ indicates an initial plan channel that can be used in both the DSO and ASO periods. At each transmitting station there will be two channels at DSO, and in addition at ASO an additional two channels will be selected and ultimately digital broadcasting will be carried out at four channels.
The symbol △ indicates a channel that became necessary as a result of a simulation that is described later.

In studying the channel plan, it is necessary to set specific frequencies, and to investigate based on whether or not there is frequency interference. Therefore, first a simulation was carried out using provisional transmission parameters at frequencies for TV broadcasting, to investigate the potential for occurrence of interference. The simulation investigating interference using provisional transmission parameters was carried out for two types of interference: interference due to the same frequency, and interference between adjacent channels, between candidate locations for transmitting stations.

At each transmitting station ultimately four frequencies are necessary. This is based on the policy of the Government of the Maldives for the DTTB migration, to provide a maximum 12 programme system at HD for the seven companies constantly producing TV programmes and broadcasting them by either terrestrial broadcasting services or CATV, and also in anticipation of expansion in the future. In other words, the ultimate target is multiplexing three HD programmes per frequency, so ultimately the DTTB platform will operate with four frequencies (see Chapter 2-1-5 ‘Programme Multiplexing Operation Plan’). Note that at DSO when DTTB commences, SD will also be included, so operation with two frequencies will be possible.

Therefore frequency allocation was studied under the basic concept that the frequencies that can be used from the time of DSO in Table 2-1-2 above will be allocated in priority, and when insufficient, frequencies that can be used after DSO will be additionally allocated.

Table 2-1-3 shows the technical standards of stationary reception used in the simulation. Also the specific details of the same frequency interference and the interference between adjacent channels studied are described in Chapter 2-1-3-4-2 and Chapter 2-1-3-4-3.

Table 2-1-3 Technical Standards for Stationary Reception

Parameter	Value	Notes
1. Received signal parameters 1) Received signal 2) Mode 3) Guard interval length 4) Modulation method 5) Code rate	 Full-seg Mode 3 1/8 64QAM r=3/4	 Proposed (same parameters as Japan recommended)
2. Receiving conditions 1) Receiving antenna height 2) Receiving antenna format 3) Receiving antenna gain 4) Receiving antenna directional characteristics	 10 m Directional antenna 10dB ITU-R BT-417	 In accordance with ITU-R BT.1368
3. Required C/N (dB)	20.1dB	
4. Required electric field strength (dBuV/m)	51dBuV/m	10m height, time percentage 99%

Source: ITU-R

2-1-3-4-2 Investigation of Interference between Channels

The main radio waves transmitted in the Maldives are transmitted over the sea, so both the desired waves and interference waves are transmitted strongly for long distances, and same channel interference and adjacent channel interference are factors. Same channel interference is a phenomenon in which the electric field strength of an interference wave of the desired wave and the same channel is equal to or greater than a certain value with respect to the electric field strength of the desired wave, causing the image to be not displayed on the screen at the receiver. Likewise adjacent channel interference is a phenomenon in which the electric field strength of an interference wave of an adjacent channel is equal to or greater than a certain value with respect to the electric field strength of the desired wave, causing the image to be not displayed on the screen at the receiver. The allowable value of the ratio of the desired wave (D) and the interference wave (U) (allowable D/U ratio) for each type of interference is shown on Table 2-1-4. From this, it can be seen that in the case of same channel interference, when the value of the electric field strength D is 20dB or more greater than the electric field strength of U, there is no problem. Also, in the case of adjacent channel interference, it can be seen that when D is -30dB or more greater than U, there is no problem.

Note that the above technical standards are defined in the ITU Radio communication Sector (hereinafter referred to as 'ITU-R').

Table 2-1-4 Interference Conditions for Stationary Reception

Interference type	Allowable D/U ratio	Notes
1. Same channel interference	20dB	According to ITU-R BT.1368-10
2. Adjacent channel interference	-30dB	According to ITU-R BT.1368-10
Condition	Time percentage of interference wave 1%	(Note)

Source: ITU-R

(Note) In order to make a percentage of a fixed period of time receiving the desired wave 99%, the most severe time percentage of 1% stated in ITU-R P.1546 is used. If a certain level of the desired wave can be received that satisfies a certain D/U ratio against the interference wave, for every one hour (3,600 seconds) of the desired wave, there is a possibility of receiving reception interference by an interference wave for a cumulative 36 seconds.

Next, a specific example is described of determining a channel to be used while preventing same channel interference. First based on the channels that can be allocated from Table 2-1-2, four frequencies for a combination of four channels (hereinafter referred to as 'channel set') was provisionally allocated to each transmitting station, and simulation was carried out to confirm that between transmitting stations provisionally allocated the same channel, at the most distant point within the service area receiving the desired wave (the area where an electric field strength of 51dBμV/m or more can be obtained) an electric field strength difference of 20dB or more can be obtained. Specifically the same channel set was provisionally allocated to two different transmitting stations and detailed simulation was carried out to determine whether or not interference occurred, until the following two conditions were satisfied (see Fig. 2-1-2 Conceptual Diagram of Conditions for Provisional Allocation of Channel Set).

(a) Improvement of reception by changing the directivity of reception antenna cannot be expected if a reception point is on the line that connects A transmitting station radiating interference wave and B radiating desired wave. Therefore the electric field strength of an **interference wave** at the **most distant point** within the service area of the **desired wave** becomes 20 dB lower than the desired wave, **31dBμV/m or less**.
(b) The electric field strength of an **interference wave** at the **closest point** within the service area of the **desired wave** on the line that connects transmitting station A radiating an interference wave and transmitting station B radiating the desired wave is improved in 16dB due to the 180 degree directional difference. Therefore the electric field strength of an interference wave is 4 dB lower than that of desired wave, **47dBμV/m or less**.

However, if it was difficult to find channels that satisfy the above two conditions due to restrictions on channels that can be used, it was assumed that an improvement to D/U = 20dB was likely by adjustment of the transmitting antenna pattern, the transmitting channel, and the effective radiated power (ERP) within the range of a few dB, and provisional allocation was carried out.

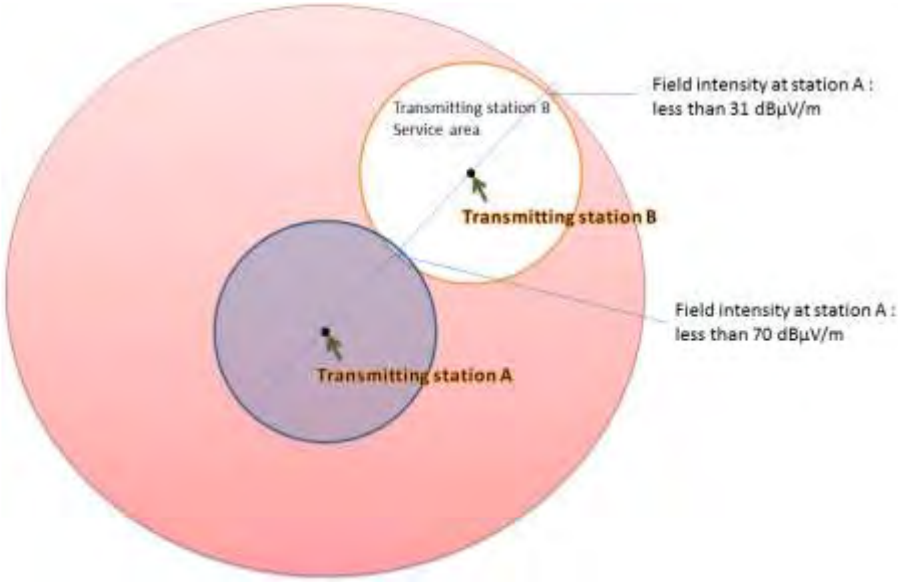
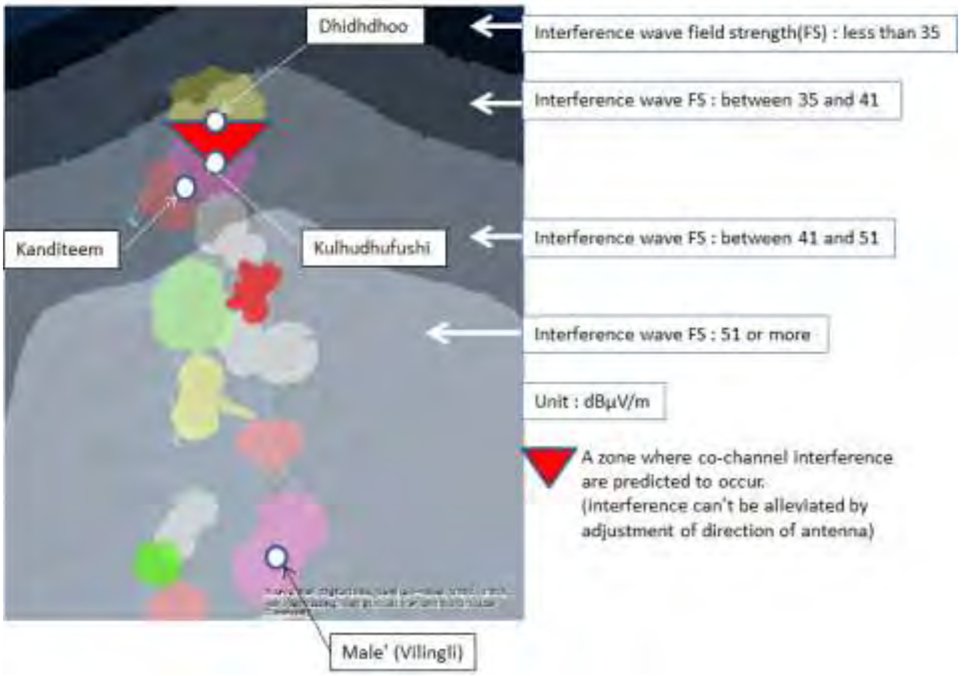


Fig 2-1-2 Conceptual Diagram of Conditions for Provisional Allocation of Channel Set

As an example, reduction of interference waves between the Malé Transmitting Station (installed on Villingili Island adjacent to Malé Island) and Kulhudhfushi, Dhidhdhoo and Kanditeem Transmitting Stations is described.

First, the situation prior to taking measures to reduce the interference is shown in Fig. 2-1-3. Malé Island and Kulhudhfushi, Dhidhdhoo and Kanditeem Islands are located in the centre and north of Maldives respectively. The straight line distance between Malé Island and Kulhudhfushi Island is about 270km, the distance between Malé Island and Dhidhdhoo Island is about 300km, and the distance between Malé Island and Kanditeem Island is about 250km. However, due to the effect of transmission over the sea, there is likely to be an interference wave of electric field strength of 35 to 41dBμV/m at the northern end of the service area of the Kulhudhfushi Transmitting Station. Likewise at the southern end of the Kulhudhfushi Transmitting Station service area, there is likely to be an interference wave of electric field strength of 41 to 51dBμV/m. These cannot satisfy the frequency provisional allocation conditions (a) or (b), but other channels that can be used cannot be found, so it is necessary to examine improvements by adjusting the antenna pattern, ERP, etc.



Source: Created by JICA Survey Team

Fig 2-1-3 Diagram Predicting Occurrence of Same Wave Interference North of Malé Island

In carrying out this study, the following interference states were adjusted. In the simulations prior to adjustment of antenna pattern, ERP, etc., from the electric field strength pattern of the interference wave within the Kulhudhfushi service area in Fig. 2-1-3, interference was predicted as shown in Table 2-1-5.

Table 2-1-5 Prediction of Same Wave Interference within the Kulhudhfushi Transmitting Station Service Area

	Location within service area	Adjustment of reception equipment to reduce interference
1	Near transmitting station	Desired wave was strong so there was no interference
2	South side of transmitting station (excluding near the transmitting station)	No interference by appropriate installation of receiving antenna
3	North side of transmitting station (excluding near the transmitting station)	Interference in most of the area

Source: Created by JICA Survey Team

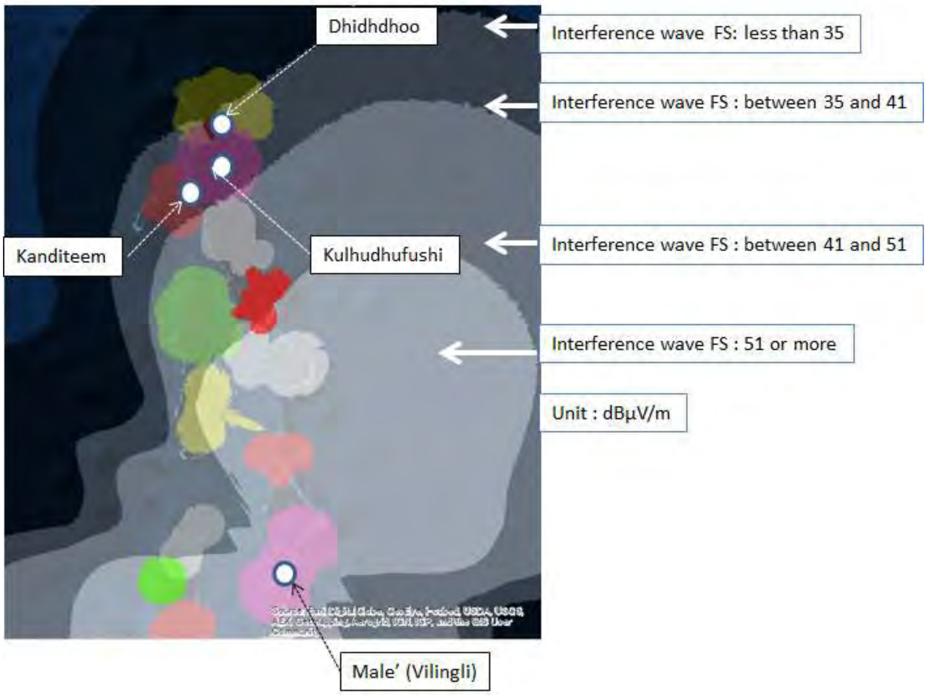
Also, Dhidhdhoo and Kanditeem Transmitting Stations are to be broadcast by broadcast wave relay that receives and re-transmits the radio waves, so if the interference wave is strong it will not be possible to appropriately radiate the radio waves from these transmitting stations. The prediction of interference before adjustment of antenna pattern, ERP, etc., is shown in Table 2-1-6. From this it can be seen that for Dhidhdhoo D/U ≥ 20dB cannot be satisfied, so it is necessary to take some kind of measure.

Table 2-1-6 Prediction of Same Channel Interference to Broadcast Wave Relay Stations with Kulhudhfushi Transmitting Station as Master Station

	Slave station name	Reception electric field strength from master station (dBμV/m)	Electric field strength of interference wave (dBμV/m)	D/U (dB)	Same wave interference within the service area
1	Dhidhdhoo	64.1	45.6	18.5	Reception interference occurs in all areas
2	Kanditeem	74.5	48.6	25.9	Appropriate radio wave reception possible in all areas

Source: Created by JICA Survey Team

From Tables 2-1-5 and 2-1-6, it can be seen that it is necessary to reduce the electric field strength of the interference wave from Malé Island on the north side of the service area of the Kulhudhfushi Transmitting Station and in the service area of the Dhidhdhoo Transmitting Station. For this purpose, the transmission power at Malé Transmitting Station was reduced from the initial value, and the directionality of the transmitting antenna was adjusted a certain amount in the downward direction. Fig. 2-1-4 shows the electric field strength obtained from the simulations. From this it can be seen that the interference that could occur on the north side of the service area of the Kulhudhfushi Transmitting Station and in the service area of the Dhidhdhoo Transmitting Station was reduced, and appropriate radio wave reception can be received in these areas.



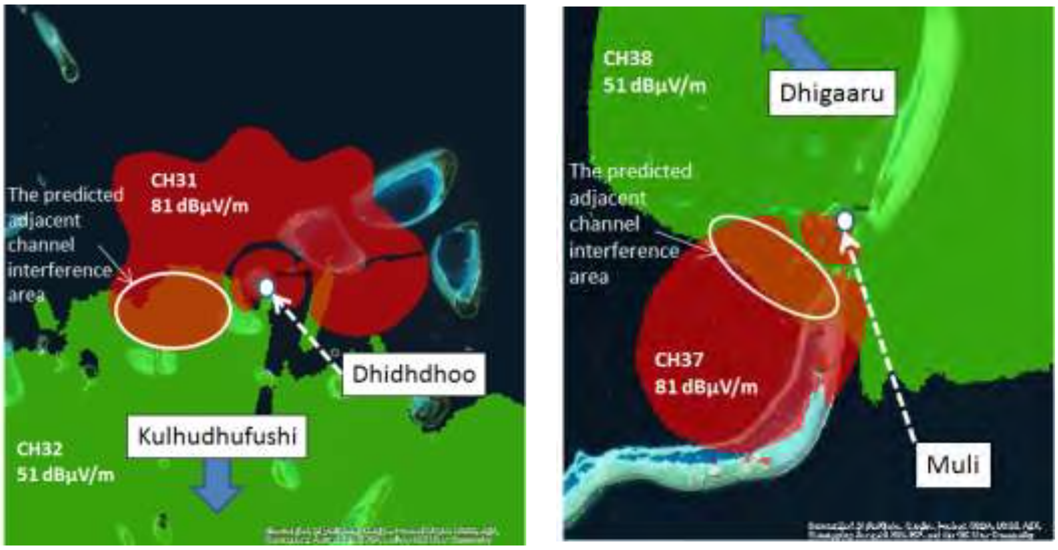
Source: Created by JICA Survey Team

Fig 2-1-4 Prediction of Occurrence of Same Wave Interference to the North Side of Malé Island after Implementing Measures to Reduce this Interference

2-1-3-4-3 Checking the Occurrence of Adjacent Channel Interference

Adjacent channel interference occurs when within an area where an electric field strength of 51dBμV/m or higher, which is the prescribed value in the service area, can be obtained for the desired wave, the electric field strength of an interference wave from a channel adjacent to the desired wave is higher by 30dB or more (D/U < -30dB), or 81dBμV/m, so the weaker desired wave cannot be received (see Table 2-1-4). In Japan, broadcasting is carried out in prefecture units, and when specialised information is provided within that prefecture area, it is necessary to take measures such as installation of additional transmitting stations such as gap fillers, etc., or introduce community reception equipment within the area, etc. However in the case of Maldives, it is not planned to provide individual information on island units or Atoll units, so it is possible to avoid interference by dealing with the reception equipment.

Fig. 2-1-5 shows an example of the simulation results around Dhidhdhoo and Muli, where adjacent channel interference is predicted.



Source: Created by JICA Survey Team

Fig 2-1-5 Prediction of the Occurrence of Adjacent Channel Interference around Dhidhdhoo and Muli

The green part in the figure is the area covered by the broadcast wave relay master station in the direction of the blue arrow, and has an electric field strength of 51dBμV/m. The reddish-brown part is the area with an electric field strength of 81dBμV/m or higher. If the radio waves from the reddish-brown area and the nearby broadcast wave relay master station are received, adjacent channel interference can easily occur. On the other hand, by orienting the direction of the receiving antenna from Kulhudhfushi to Dhidhdhoo, or from Dhiggaru to Muli, the electric field strength of the desired wave becomes 81dBμV/m and that of the interference wave becomes 51dBμV/m, so interference can be prevented.

Therefore, it is necessary to properly convey the information to the residents within the area where interference is predicted in the figure to change the receiving direction of the receiving antennas. It is important to establish an organisation for receiving inquiries, such as a customer centre, etc., as a response measure.

2-1-3-4-4 Determining Frequency Channels

As a result of carrying out the investigation of same channel and adjacent channel interference as described above, it was found that it is necessary to have digital terrestrial channels from CH21 to CH40. Initially in the Maldives 11 channels from CH27 to CH37 are to be used for TV broadcasting as shown in Table 2-1-2, but as the future concept in the Maldives is operation of the platform with four frequencies, it was decided as a result of discussion between CAM and the commission that CH21 to CH40 be used for DTTB.

Table 2-1-7 shows the physical channel set. Also Fig. 2-1-6 is a channel allocation plan diagram showing the channel sets. The channel plan diagram shows the areas with the prescribed value of the reception electric field strength 51dBμV/m.

Note that channels are allocated to each broadcasting TS (broadcasting transport stream: BTS[1]). In the future the official channel allocation in the Maldives will be decided by the Maldives Broadcasting Commission and CAM, in accordance with this plan.

Note that the channels used for the meantime in this grant aid project are the channels indicated as BTS-1 and BTS-2 in Table 2-1-7.

Table 2-1-7 Channel Arrangement Proposal

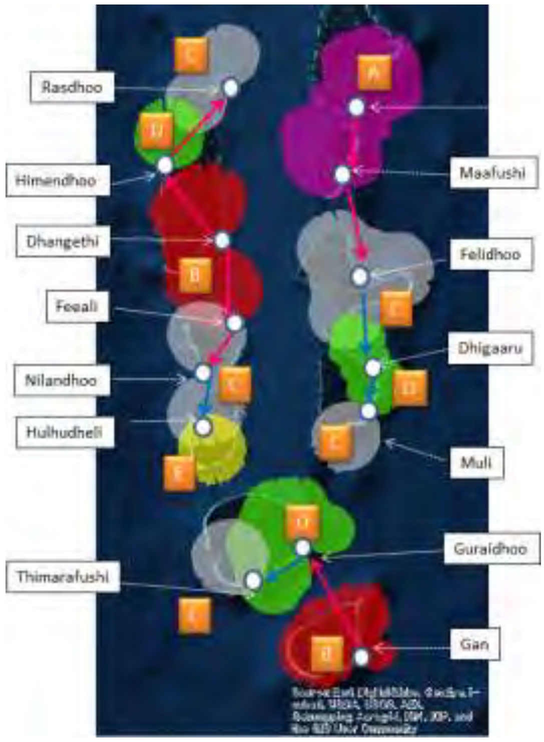
Channel set	BTS-1	BTS-2	BTS-3	BTS-4
A	32	33	21	22
B	34	35	23	24
C	36	37	25	26
D	38	39	27	40
E	30	31	28	29

Source: Created by JICA Survey Team

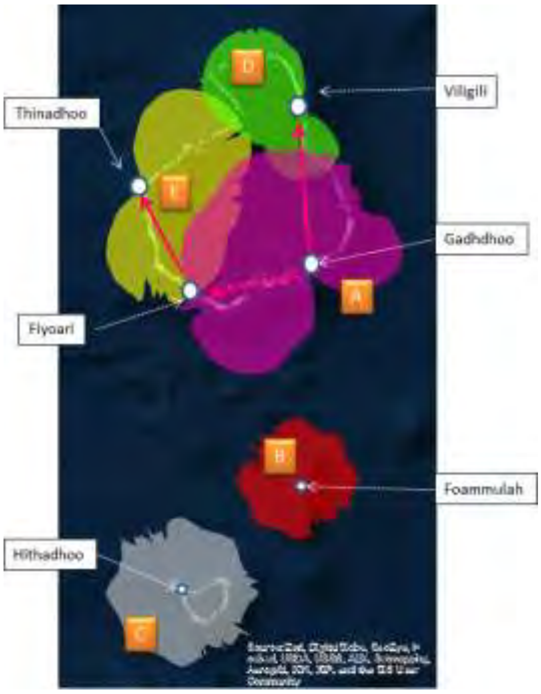
(Note) BTS: A broadcast wave is converted into a TS signal for the broadcast wave, known as BTS. One BTS requires one UHF physical channel wave.

[1] As a result of multiplexing operation at the initial stage of DTTB in the Maldives, HD×2, SD×2, data×1, and one-seg×1 programmes will be multiplexed into BTS.

(a) Northern broadcast coverage area



(b) Central broadcast coverage area



(c) Southern broadcast coverage area

Source: Created by JICA Survey Team

< Legend >

- A, B, C, D, E: Channel sets
- Red solid line arrow: Microwave link, the arrow direction is the transmission direction
- Blue solid line arrow: Broadcast wave relay, the arrow direction is the transmission direction
- Purple, brown, grey, green, and yellow colours: Area with an electric field strength of 51dBμV/m at 10m above the ground (coverage area)

0 50km 100km

Fig 2-1-6 Channel Plan

The percentage of population-based coverage of this draft channel plan is 97.64%, so it can be seen that a value close to the 100% population-based coverage aimed for by the Government of the

Maldives can be expected. For the remaining more than 2%, there is a possibility that receiving digital terrestrial broadcasts can be enabled without the construction of new transmitting stations, by examining reception side measures, etc., so this channel plan is the final draft.

For reference, Table 2-1-8 shows the list of provisional transmitting stations determined from the simulation.

Table 2-1-8 Table of Simulation Results and Parameters

	Atoll	Island name	Position	Channel set	Main parameters - Transmitting antenna height - ERP - Directionality (Note 1)
1	Haa Alifu	Dhidhdhoo	06N5314.037 073E0650.246	E	62m 726W 80,270,350 (2.2.2)
2	Haa Dhaalu	Kulhudhuffushi	06N3658.133 073E0408.976	A	52m 289W 0,90,180,270 (2.2.2.2)
3		Kanditeem	06N2542.886 072E5535.457	B	62m 743W 215,285 (2.2)
4	Shaviyani	Funadhoo	06N0901.325 073E1722.312	C	72m 711W 130,260,300 (1.1.2)
5	Noonu	Manadhoo	05N4554.925 073E2441.630	B	72m 46W 0,220,290 (2.2.2)
6	Raa	Ungoofaaru	05N4004.152 073E0155.247	D	72m 739W 60,150,240,330 (1.2.4.4)
7	Baa	Eydhafushi	05N0608.973 073E0423.056	E	72m 364W 220,340 (2.2),111 (30DGU-12)(Note 2)
8	Lhaviyani	Naifaru	05N2641.370 073E2156.628	C	82m 162W 105,225,315 (2.2.2)
9	Kaafu	Kaashidhoo	04N5713.355 073E2712.565	B	52m 772W 145,215 (2.2)
10		Malé (Villingili)	04N1017.580 073E3037.908	A	62m 313W 30,120,210,300 (8.2.8.2)
11		Maafushi	03N5615.96 073E2919.12	Relay station	—
12	Vaavu	Felidhoo	03N2815.956 073E3252.019	C	82m 170W 80,200,320 (2.2.2)

	Atoll	Island name	Position	Channel set	Main parameters - Transmitting antenna height - ERP - Directionality (Note 1)
13	Alifu Alifu	Himendhoo	03N5539.687 072E4322.554	D	72m 167W 20 (3)
14		Rasdhoo	04N1552.699 072E5930.544	C	72m 106W 0,250 (2.2)
15	Meemu	Dhigaaru	03N0616.401 073E3421.364	D	32m 957W 60,150,240,330 (1.2.1.2)
16		Muli	02N5429.160 073E3500.249	C	42m 889W 230 (3)
17	Alifu Dhaalu	Dhangethi	03N3628.296 072E5719.080	B	72m 853W 180,260,340 (2,1,2)
18		Feeali	03N1614.18 072E5959.10	Relay station	—
19	Faafu	Nilandhoo	03N0324.260 072E5324.205	C	52m 543W 0,90,180 (2.1.2)
20	Dhaalu	Hulhudheli	02N5129.217 072E5043.300	E	32m 889W 140 (3)
21	Laamu	Gan	01N5515.694 073E3238.773	B	82m 341W 0,120,260 (2.1.2)
22	Thaa	Guraidhoo	02N1930.572 073E1905.912	D	82m 205W 50,230,320 (1.2.2)
23		Thimarafushi	02N1221.472 073E0830.987	C	52m 849W 300 (3)
24	Gaafu Dhaalu	Gadhdhoo	00N1721.557 073E2724.574	A	82m 781W 50,230,320 (1.2.2)
25		Fiyoari	00N1316.080 073E0802.810	Relay station	—
26		Thinadhoo	00N3153.252 072E5951.360	E	52m 1153W 50,160 (2.2)
27	Gaafu Alifu	Villingili	00N4502.275 073E2606.216	D	82m 136W 180,300 (1.2)
28	Gnaviyani	Foammulah	00S1742.227 073E2530.209	B	22m 72W

	Atoll	Island name	Position	Channel set	Main parameters - Transmitting antenna height - ERP - Directionality (Note 1)
					360 (1)
29	Seenu	Hithadhoo	00S3657.420 073E0545.312	C	32m 145W 360 (1)

Source: Created by JICA Survey Team

(Note 1) Directionality is expressed by the orientation direction of the antenna element (bearing) and the number of stages in that direction. For example '60, 150, 240, 330 (4.2.4.2)' indicates an antenna with antenna elements oriented in the four directions; 60 degrees, 150 degrees, 240 degrees, and 330 degrees, with 4, 2, 4, and 2 stages respectively.

(Note 2) Regarding 110 (30GU), Eydhafushi is the broadcast wave relay master station for Kaashidhoo, so from Eydhafushi the equivalent of 30DGU (diameter 3m grid parabola antenna) has been added in the direction 110°. 30DGU is cited in 'Common Specification for Digital Terrestrial Broadcasting Transmission Equipment', National Digital Transmission Equipment Study Group, 16th March 2007 version.

2-1-3-5 Study of Mobile Reception

In the Japanese system (ISDB-T), one-seg service is multiplexed for mobile reception. Also, the majority of the total area of Maldives is ocean, so there are many opportunities for boats transporting or fishing between the islands, etc. Particularly in the northern region, many marine accidents have been reported, so providing weather information, etc., to these boats by digital terrestrial broadcasting is expected to have the effect of reducing marine accidents to shipping.

Therefore in addition to the channel plan assuming fixed reception on each of the islands, a study was carried out to determine what service could be provided to boats. First a simulation was carried out for the sea area around Malé to determine the potential for reception by boats of ISDB-T radio waves transmitted from the Malé Transmitting Station.

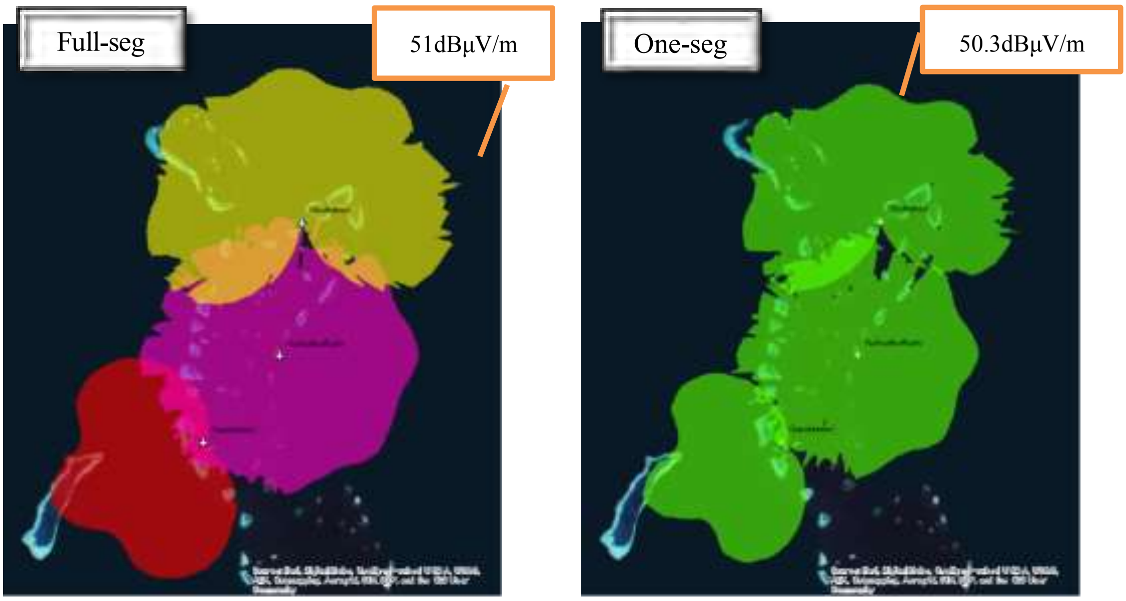
The transmission side parameters for the simulation were set as shown in Table 2-1-8, the reception side conditions were as shown in Table 2-1-9, and values were determined from standard specifications such as ITU-R, etc.

As an example, Fig. 2-1-7 shows the simulation results for three transmitting stations in the north. In this figure, the left side shows the full-seg area, and in contrast the right side green part is the area that satisfies the one-seg required electric field strength of 50.3dBμV/m, and where it is confirmed that one-seg reception service is possible around the islands. A simulation was carried out in the same way for the one-seg broadcasting service area from all transmitting stations. From the results, it was confirmed that because the receiving antenna height was low at 4m, the service area was a bit narrower than the service area that is possible with 10m full-seg, but generally viewing is possible via one-seg in any of the sea areas.

Table 2-1-9 Parameters Used in Simulation of Reception by Boat

Parameter	Value	Notes
1. Received signal parameters 1) Received signal 2) Mode 3) Guard interval length 4) Modulation method 5) Code rate	 One-seg Mode 3 GI=1/8 QPSK r=2/3	The same parameters as Japan are recommended
2. Receiving conditions 1) Receiving antenna height 2) Receiving antenna format 3) Receiving antenna gain 4) Vessel moving speed	 4 m Non-directional monopole -3dBd 60km/h	 Installed on roof of pilothouse, or on mast of fishing boat High speed boats envisaged
3. Required C/N (dB)	13.5dB(Note 1)	
4. Required electric field strength (dBuV/m)	50.3dBμV/m	4m height, time percentage 99%

(Note 1) Value obtained by adding a Doppler loss of 1.5dB and frequency interleaving loss of 0.5dB to the mobile channel 5% ESR[2] value of 11.5dB shown in Table 87 of ITU-R BT.1368-10



Source: Created by JICA Survey Team

Fig 2-1-7 Comparison of One-seg and Full-seg Coverage Area
(around the three northern islands, Kulhudhuffushi, Dhidhdhoo, Kanditeem)

[2] Erroneous Second Ratio: 5% ESR is the state in which during a 20 second period, there is one second containing one or more errors

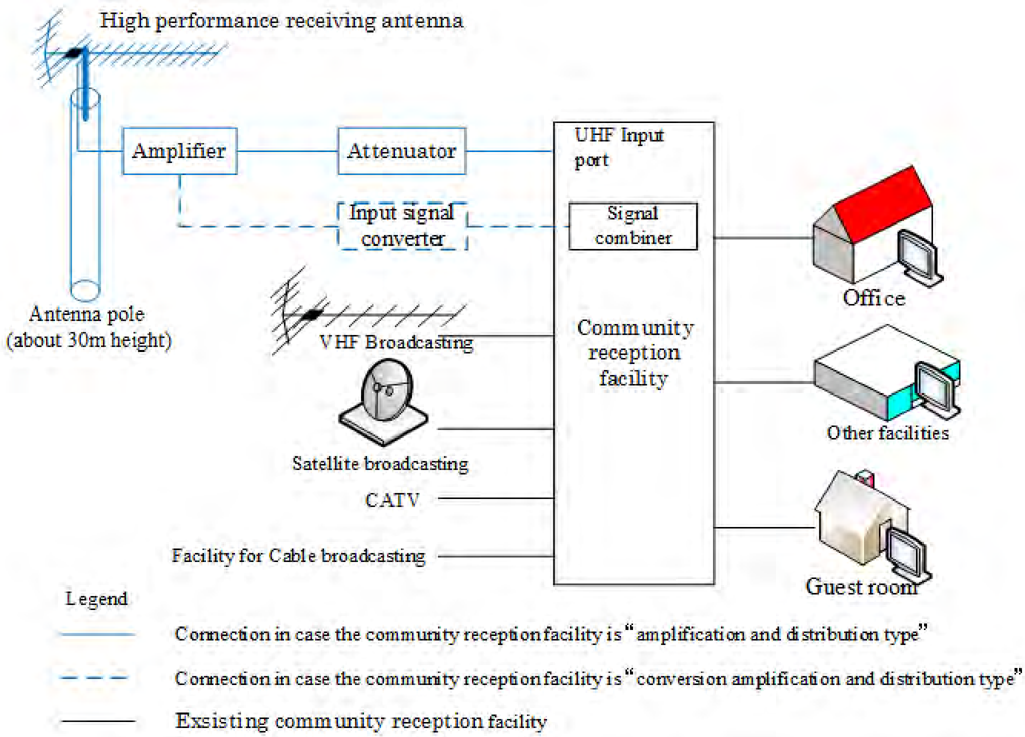
2-1-4 Dealing with Poor Reception Areas

With the channel plan described in the previous Chapter 2-1-3, a population-based coverage of 97.64% is likely to be achieved. This value covers all the inhabited islands and industrial islands, but the remaining more than 2% is only 12 resort islands, which cannot be covered with the necessary prescribed electric field strength. There are various poor reception measures that can be taken for the areas than cannot be covered with the prescribed value, but it is desirable that they be investigated with priority on cost-effectiveness.

On the other hand, with the Maldives channel plan, a certain level of electric field strength can be obtained even on the 12 resort islands that do not satisfy the prescribed value. The electric field strength is affected by the receiving antenna height, so if the electric field strength is low, appropriate reception is possible by further increasing the antenna height. When a simulation was carried out on achieving the prescribed value when the receiving antenna height is raised on the 12 islands, it was found that if a high performance receiving antenna is installed to a height of 20 to 30m on each of the islands, an appropriate electric field strength can be obtained.

Therefore by installing a high performance receiving antenna 20 to 30m high as a poor reception measure on the 12 resort islands, and inputting the received signal to the community reception equipment of the resort hotels, digital terrestrial broadcasts can be viewed. The new equipment that is necessary is indicated by the blue lines in the following Fig. 2-1-8, and the cost per location is about 200,000 to 300,000 yen (excluding the 20 to 30m antenna column installation cost). The community reception equipment is already installed at each of the resort hotels, so if DBNO informs each resort island of the reception electric field strength, it is considered that the resort hotels themselves can deal with the installation sufficiently.

However, this is for the case that the community reception equipment of the resort hotels just amplify and distribute the input signal (amplification and distribution type). In the case where the input signal is amplified and distributed after conversion (conversion amplification and distribution type), it is necessary to separately provide an input signal converter, as shown by the dotted line part in Fig. 2-1-8. Also the outline cost required is shown in Table 2-1-10.



(Note) Equipment for displaying contents such as a description of the facilities of the resort island, introduction to services, etc.

Source: Created by JICA Survey Team

Fig 2-1-8 Reception Equipment on Resort Islands in Poor Reception Areas

Table 2-1-10 Equipment Required and Outline Equipment Costs

	Equipment name	Outline cost (yen)	Notes
1.	High performance receiving antenna	80,000	Product equivalent to a high gain Yagi antenna with 20 elements or more
2.	Amplifier	40,000	Gain 25dB or more
3.	Attenuator (3-9dB)	3,000	For adjustment of the input level to the existing community reception equipment
4.	Antenna column	120,000	About 30m (installation cost not included)
Total		243,000	Construction cost is separate

Source: Created by JICA Survey Team

2-1-5 Programme Multiplexing Operation Plan

As stated in Chapter 2-1-3 'Channel Plan', at the DSO stage it will be necessary to operate on two frequencies. Therefore it is assumed that in the Maldives several programmes will be multiplexed on one frequency (hereinafter referred to as 'multiplexing operation') will be carried out.

ISDB-T is a broadcasting format having 13 OFDM segments, with hierarchy transmission that can be selected, of which 12 segments are for fixed reception, and the remaining one segment is for moving or mobile reception. The bit rates that can be used with the hierarchical transmission of 12 segments and one segment are shown in Table 2-1-11.

Table 2-1-11 Bit Rate that can be Allocated

	No. segments allocated	Modulation parameter	Bit rate
Fixed reception	12	64QAM, r=3/4	22.468Mbps
Mobile reception	1	QPSK, r=2/3	0.55Mbps

(Note) The mode and guard length are common for both 12 segment and one segment, with Mode 3, GI=1/8.

In the case of Maldives there will be multiplexed operation with a mixture of multiple HD and SD at DSO. Six programmes of four types, namely, HD×2, SD×2, data×1, one-seg×1 will be multiplexed on one wave. In this case, the HD, SD, and data are allocated in the 12 segment bit rate. With multiplexed operation allocation can be flexibly carried out taking into consideration the image quality and the response speed of data broadcasts. However each station shares the radio waves through the DTTB platform, so it is necessary that each bit rate be determined in advance, and each broadcaster provides their programmes accordingly. Therefore it is considered that in the Maldives the 12 segments (Layer B) and the one segment (Layer A) should be allocated as shown in Table 2-1-12. It is assumed that in the future all programmes will be in HD, so for SD the bit rate is taken to be 1/2 that necessary for HD, so that bit rates are allocated for easy migration to complete HD operation.

Table 2-1-12 Example of Configuration of Digital Terrestrial Broadcasting Signal at DSO

Layer No. segments	Broadcast programme	Allocated bit rate	Notes
Layer B 12 segment	HD-1	Approx. 6.70Mbps	Allocated to PSM
	HD-2	Approx. 6.70Mbps	
	SD-1	Approx. 3.35Mbps	
	SD-2	Approx. 3.35Mbps	
	Data	Approx. 1.50Mbps	Multiplex to HDTV-1
	PSI/SI, PCR	Approx. 0.80Mbps	6 systems amount (common)
MAX rate ＝about 22.468Mbps	**Layer B total**	**Approx. 22.4Mbps**	
Layer A 1 segment	A/V (1CH amount)	Approx. 0.30Mbps	
	Data	Approx. 0.15Mbps	
	PCR, PI/SI	Approx. 0.05Mbps	
MAX rate ＝0.55Mbps	**Layer A total**	**Approx. 0.50Mbps**	

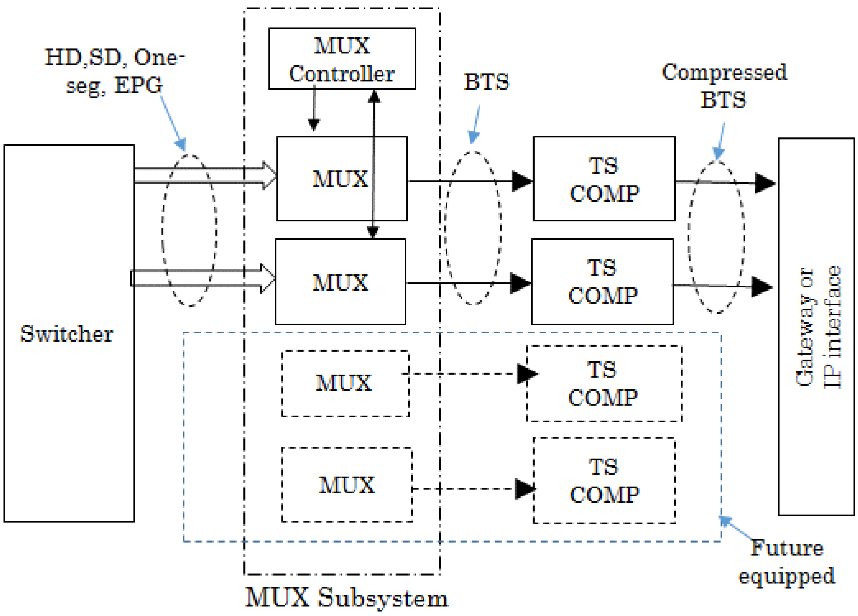
Source: Created by JICA Survey Team

In addition to the total 22.9Mbps bit rate allocation shown in Table 2-1-12, transmission and multiplexing configuration control (TMCC) information, transmission control information, the broadcasting network control information ISDB-T Information Packet (IIP), null packets for aligning synchronisation information and bit rates, etc., will be multiplexed, so the total bit rate of a BTS signal of the 8MHz system will be 43.34Mbps.

However, if it is necessary to reduce the bit rate in order to minimise the outlay on transmission link cost, as in four channel multiplexing for satellite transmission or STM-1, it will be necessary to adopt a method in which a TS compressor is introduced on the NOC side, the null packets are eliminated, the compressed BTS signal is transmitted, and the re-inserted original BTS signal is produced by a TS decompressor provided at each transmitting station. In this case, the bit rate of the compressed BTS signal will be about 26.0Mbps for the modulation parameters shown in Table 2-1-11.

Also, in the operational guidelines of the Association of Radio Industries and Businesses (ARIB), when multiplexed operation is implemented, it is stated that it is necessary for the NOC to edit or change the programme specific information / service information (PSI/SI[3]) generated by the multiplexing organisation (in this plan, DBNO) and descriptors regarding multiplexing operation from among the PSI/SI multiplexed with the TS signals transmitted from each programme provider. Therefore it is necessary that the configuration of the multiplexing equipment be provided with a multiplexing control function.

The following Fig. 2-1-9 shows the flow of the signal at NOC.



Source: Created by JICA Survey Team

Fig 2-1-9 Signal Flow at NOC

The Government of the Maldives is planning for the likelihood that after ASO all SD programmes will be converted to HD, the number of broadcasters participating in the DTTB platform will be increased, and the frequencies allocated to DTTB will be increased. With the increase in the number of

[3] PSI/SI: Programme specific information/service information, the information necessary for programme selection on the receiver side

programmes broadcast, it will be necessary to expand the equipment at the NOC and carry out reconfiguration of each channel. The part within the dotted lines in the above Fig. 2-1-9 indicates the equipment to be expanded after ASO. Also, it will be necessary to change the system between the switcher and the multiplexing device, change the PSI/SI in the multiplexing device, etc. In addition in order to add new frequencies for DTTB and change service IDs, etc., it will be important to thoroughly inform the receivers via a customer centre or similar that can scan the receiver side.

2-1-6 DTTB Migration Plan

The DTTB migration plan includes an equipment development plan that provides an overall view of the equipment necessary for DTTB migration, a receiver promotion plan, a poverty group measures plan, an analogue receiver disposal plan for the equipment in use to date, etc.

The equipment development plan will be prepared based on the channel plan described in Chapter 2-1-6. In the case of the transmission output, antenna configuration and pattern, ERP, and antenna height, the Survey Team also studied the sites, which was outside the scope of the grant aid cooperation, through the preparation of the channel plan. Also, it is necessary that the configuration of the transmission system be basically the same as that of the grant aid cooperation. The other parts were designed so that they could configure a part of the platform by connecting to the equipment and system provided in the grant aid cooperation.

Establishment of a customer centre within DBNO to promote the spread of receivers, telephone response, dispatch of a technician to support installation of external antennas and others are being investigated by PSM. The call centre was only established on Malé Island, but outsourcing local companies to deal with other islands is being examined. The platform usage charge is calculated including maintenance, operation, and management costs of the customer centre as stated in Chapter 2-2-4, so it is considered that it is feasible financially.

The policies have not yet been determined, although studies are in in progress with reference to examples in other countries.

In Japan, the policy was adopted to distribute digital receivers to low income families, so ASO was able to be achieved on the target date. It was confirmed that in the Maldives, this sort of policy that directly supports the viewer is not adopted, while the Government of Maldives is aware that the promotion of digital receivers is an issue to be addressed. When PSM was directed to operate DBNO in the circular notice by the President’s Office issued in November, 2015, DBNO was also directed to play a role to promote digital receivers. Though PSM has examined how to incentivise the market to promote digital receivers, the details are not known yet. Attention must be paid to this.

It is predicted that most of the viewers in the Maldives will purchase a STB, so there will not be a large quantity of waste generated as a result of buying replacement TV receivers. Therefore it is assumed that an analogue receiver disposal plan will not be prepared.

2-1-7 Network Construction Plan

It is necessary to investigate the methods of most economically and reliably distributing the broadcasting signals to each of the transmitting stations. The most common method to be considered is a network, from which the method that is considered to be most suitable can be adopted.

(1) Transmission Medium and Format of Signals to be Transmitted to Transmitting Stations

The signal to be transmitted to each transmitting station from the Network Operation Centre (NOC) of DBNO will be either a BTS signal, or a compressed BTS signal, as explained previously in Chapter 2-1-5 ‘Programme Multiplexing Operation Plan’. One BTS signal requires one frequency. In the Maldives plan, the number of broadcasting signals at DSO will be two, and from ASO onwards there will be a maximum of four.

The signal transmission format varies depending on the service type of telecom carriers, but are generally broadly classified as follows in accordance with the medium forming the network. It is desirable that the formats be selected from these to enable high reliability and low costs.

- Satellite transmission: A link is leased for each BTS unit. The link charge is proportional to the bandwidth, so it is assumed that transmission will be by compressed BTS. Therefore, at DSO links will be provided for both analogue and digital for simultaneous broadcasting, and after ASO there will only be a digital link.
- High speed digital link (optical + microwave): In order to provide for four signals after ASO, it is envisaged that an STM-1 link (155.52Mbps, level that can be used by the user slightly less than 150Mbps) within the Synchronous Digital Hierarchy (SDH) menu will be used. In the case of uncompressed BTS, for four systems more than 170Mbps is required, so two STM-1 links are required. A link one rank higher at 622Mbps is not economical. Therefore by using compressed BTS to reduce the usage charges, 120Mbps is required for four systems, so transmission is possible using one STM-1 link. In this case the signal format is the same with an independent microwave link.
- Broadcast wave relay link: At the network terminal, a broadcast wave relay can be used for links with comparatively short distance between transmitting stations. In this case the frequency will be changed to the RF broadcast wave format, and re-transmitted. The system configuration is simple, so the cost is lowest of the three systems described above.

Note that after ASO when the number of frequencies can be increased using vacant channels, the bit rates can be re-allocated, including improvement of services such as HD, etc.

(2) Image of Network Configuration with Each Medium

1) Satellite Transmission Network

(a) Satellite Transmission Network Configuration

At present PSM uses C-Band for distribution of analogue TV broadcasting contents. A similar link can be established for digital broadcasting signals.

If a satellite transmission network is used, the receiving system at each transmitting station will have a common specification for each site. In order to reduce the link usage charge when using a satellite transmission network, the compressed BTS signal obtained by compressing the BTS signal will be digitally modulated and transmitted on the satellite link. Fig. 2-1-10 shows a satellite transmission network concept diagram.

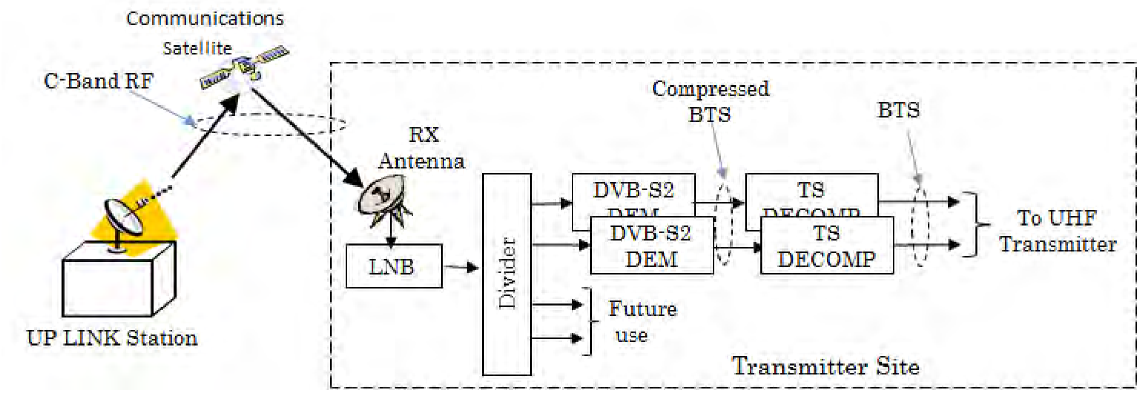


Fig 2-1-10 Satellite Transmission Network Concept Diagram

(b) Network Parameters

Assuming the parameters shown in Table 2-1-13 such as satellite used, link used, bandwidth, receiving antenna diameter, etc., the communication link usage charge was calculated, and a high speed digital link and a high speed IP multicast link were compared. The communication link charges are proportional to the number of channels, so for digital broadcasting it is necessary to assume 2×(charge per channel) at DSO and 4×(charge per channel) after ASO. However the link usage charge is high, so from the long-term perspective it is judged that the cost is higher compared with a terrestrial transmission network as described later.

Table 2-1-13 Main Parameters for Satellite Network System (draft)

Item	Parameter	Notes
Satellite / relay used	APSTAR-7, C-band global beam	It is necessary to check the status of vacancies, EIRP contour of relay used
Bandwidth used (per channel)	11.5MHz(Note)	DVB-S2 transmission format envisaged
No. channels used	At DSO: 2 After ASO: up to 4	Deal with by the number of links and increasing the receiving systems by installing transmitting station
Receiving antenna diameter	3.6mφ or more	Diameter when one relay is used divided into three

(Note) This is the necessary bandwidth for a compressed BTS signal (about 26Mbps)

2) Network Configuration for Terrestrial Transmission

In contrast to satellite transmission, the signal formats for terrestrial transmission means such as optical fibre, independent microwave, broadcast wave relay can be an STM-1 link or IP multicast, but the STM-1 link is ideal due to link reliability, operational experience, etc. With this link configuration, it is judged that in the long term, comparatively low cost digital terrestrial broadcast can be realised, compared with the method of using a satellite.

(3) Network Configuration

As a result of the above studies, the conclusion obtained was that a network that distributes the broadcast programmes to each transmitting station via an existing optical fibre link or microwave link is ideal. Because of the distance, it is considered that a good method to provide links between the NOC on Malé and the North, the South Central, and the South Provinces by microwave link is to use the optical fibre link (undersea cable) of a telecom carrier and to provide a microwave link owned and operated by DBNO from the landing stations of the telecom carrier, as the operating cost can be reduced. Also, for links where the transmission distance is comparatively short and sufficient electric field strength can be obtained, a broadcast wave relay link should be used to reduce the overall equipment procurement cost.

Fig. 2-1-11 on the next page shows the overall broadcasting signal network configuration by terrestrial transmission. The figure shows the sections of optical fibre link, microwave TTL, and broadcast wave relay. For microwave TTL, whether or not there is space diversity (SD) is also shown.

Fig 2-1-11 Network Configuration for Terrestrial Transmission

(4) Network and Link Quality

1) Optical Fibre Link Network

Regarding the link configuration from Malé to the hub stations of the telecom carrier in each area, there is the method of forming a star-type link from the hub station of the telecom carrier in Malé, and a ring-type that connects the local hub stations in each area in a ring shape. With the ring shape the reliability is high as even if one location is cut off communication can be maintained from the opposite direction. Upon checking with a telecom carrier in the Maldives, the reply received was that a ring-type service could be provided, so the network should be constructed assuming a ring type. Also, taking into consideration security and guaranteeing the bit rate required to ensure broadcast quality, dedicated lines should be provided.

Note that it is possible to configure the network different transmission media such as optical and microwave as the individual transmission means. Fig. 2-1-12 shows an image of the network forms.

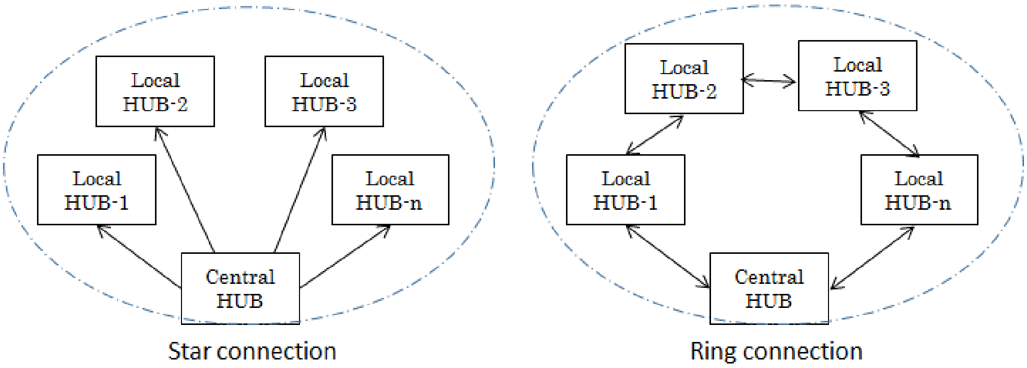


Fig 2-1-12 Image of Network Configuration

2) Independent Microwave Link (TTL)

The signal transmitted from the local hub station of the telecom carrier is converted to a microwave signal at the DBNO transmitting station on the same island, and transmitted to the DBNO transmitting station at subsequent stages by independent microwave link. The independent microwave link is configured as a star-type adopting a studio-transmitting station link (STL) or transmitter to transmitter link (TTL), as in Japan and other countries. In constructing the TTLs particular attention must be paid to transmission over the sea, and the height of the towers must be set taking into consideration the distance to the next-stage transmitting station. Also, for links with a distance of 40km or more, space diversity, with which link maintenance rates of 99.99% have been achieved in Japan, is used to improve the link reliability. Table 2-1-14 shows the TTL distance between each site, the tower height, the antenna height, the antenna diameter, and whether or not there is space diversity.

Table 2-1-14 List of Independent Microwave Links

Site name	Next-stage site	Distance (km)	Parabola antenna height(Note 1) (m)	Antenna diameter (m)	Presence of SD
(North)					
7. (Note 2) Eydhafushi	8. Naifaru	50	68 / 78	3.0 / 3.0	Yes
8. Naifaru	5. Manadhoo	36	78 / 68	2.4 / 2.4	No
8. Naifaru	6. Ugoofaaru	45	78 / 68	2.4 / 2.4	Yes
5. Manadhoo	4. Funadhoo	43	68 / 68	2.4 / 2.4	Yes
(Central)					
10. Malé	11. Maafushi	26	58 / 88	1.8 / 1.8	No
11. Maafushi	12. Felidhoo	52	88 / 78	3.0 / 3.0	Yes
17. Dhangethi	13. Himendhoo	44			
13. Himendhoo	14. Rasdhoo	45			

Site name	Next-stage site	Distance (km)	Parabola antenna height(Note 1) (m)	Antenna diameter (m)	Presence of SD
17. Dhangethi	18. Feeali	38	68 / 78	2.4 / 2.4	No
18. Feeali	19. Nilandhoo	27	78 / 48	1.8 / 1.8	No
(South)					
21. Gan	22. Guraidhoo	50	78 / 78	3.0 / 3.0	Yes
24. Gadhdhoo	25. Fiyoari	37	78 / 58	2.4 / 2.4	No
25. Fiyoari	26. Thinadhoo	37	58 / 48	2.4 / 2.4	No
24. Gadhdhoo	27. Villingili	52	78 / 78	3.0 / 3.0	Yes

(Note 1) In the case of SD, the height above ground of the upper stage antenna is shown.

(Note 2) The number to the side of the site name is the site number shown on Fig. 2-1-11.

Also, Fig. 2-1-13 shows an image of the interface between the microwave TTL and the broadcasting equipment at each transmitting station. As shown in this figure, the interface between the microwave TTL and the transmission system is either STM-1 or IP multicast, the same as the interface between the NOC and the telecom carrier's hub station (in image, the transmission system is directly connected to the NOC).

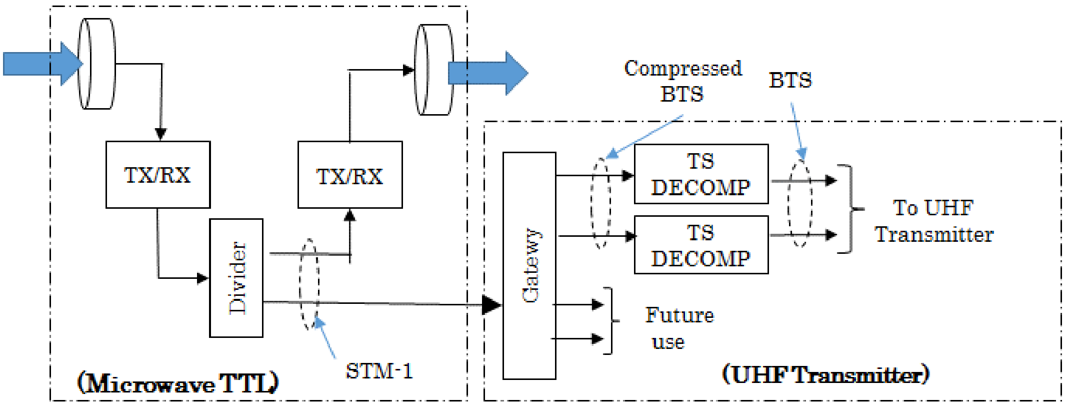


Fig 2-1-13 Microwave TTL and Transmission System Interface

3) Broadcast Wave Relay Link

Broadcast wave relay is an established technology, and is widely used in Japan. As shown in Fig. 2-1-14, in the basic link configuration, frequency conversion and amplification is carried out on the received broadcasting signal, and it is then re-transmitted. In the Maldives broadcasting network it is planned that comparatively short distance links to the terminal will be used. The broadcast wave will be used, so a communication link cost will not arise, so the operating cost can be reduced below that of the normal link configuration. Also, the site to site distance for each site to have a broadcast wave relay, the receiving side antenna height, and the receiving antenna format are shown in Table 2-1-15.

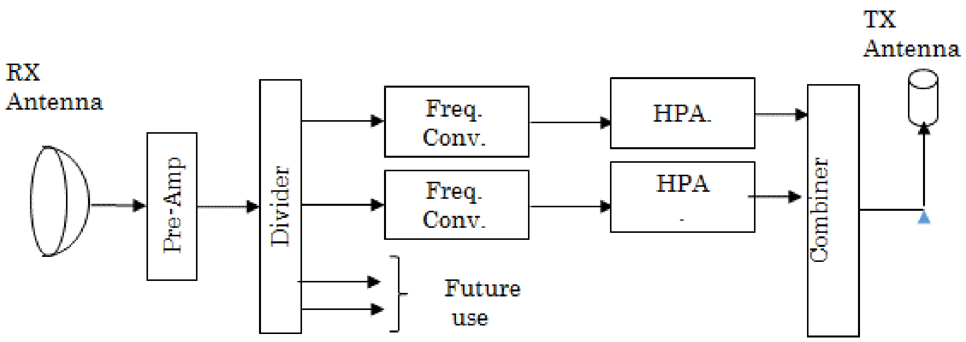


Fig 2-1-14 Example of Configuration of Broadcast Wave Relay Station

Table 2-1-15 List of Broadcast Wave Relay Links

Master station	Receiving station	Distance (km)	Receiving antenna height (m)	Receiving antenna format
2. (Note 1) Kuldhudhufushi	1. Dhidhdhoo	38	58	1.8mφ parabola
2. Kuldhudhufushi	3. Kandhiteem	25	58	1.8mφ parabola
7. Eydhafushi	9. Kaashidhoo	45	48	3.0mφ parabola
12. Feidhoo	15. Dhigaaru	40	28	3.0mφ parabola
15. Dhigaaru	16. Muli	21	38	1.8mφ parabola
19. Nilandhoo	20. Hulhudheli	27	28	1.8mφ parabola
22. Guraidhoo	23. Thimarafushi	42	48	1.8mφ parabola

(Note 1) The number before the site name is the number of the site shown in Fig. 2-1-11.

(5) Interface between the Telecom Carrier Local Hub Station and the DBNO Transmitting Station

The four types of interface between the telecom carrier local hub station and the DBNO transmitting station shown in Fig. 2-1-15 can be considered.

In the case of an optical interface, an optical connection is provided within the station building of one of either the telecom carrier and DBNO. On the other hand, in the case of a microwave, a high speed digital link (STM-1) or an IP link within the station building of one of the two is provided as the connection.

It is necessary to select the ideal interface method for each island with a local hub station taking into consideration the environmental conditions and whether or not existing infrastructure can be used or not, etc., at each island with a local hub station.

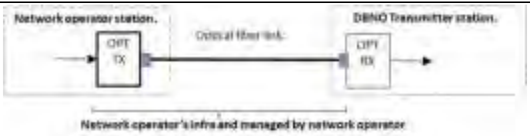
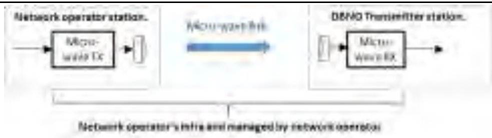
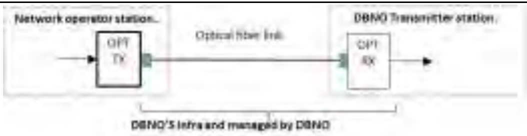
	
(a) Case 1: Optical interface, from telecom carrier	(b) Case 2: Microwave TTL interface, from telecom carrier
	
(c) Case 3: Optical interface, from DBNO	(d) Case 4: Microwave TTL interface, from DBNO

Fig 2-1-15 Interfaces between Telecom Carrier and DBNO Transmitting Station

2-1-8 Transmission System Plan

Transmission systems are broadly classified into single frequency networks (SFN) and multi frequency networks (MFN). The major merit of an SFN is that the same channel can be repeatedly used so the number of channels can be reduced. However there is the restriction that if a fixed period of time known as the guard interval (GI[4]) is not maintained between the arrival times of the desired wave (D=Desired) and the interference wave (U=Undesired) the image will fail. On the other hand with MFN different channels are used for the desired wave and the interference wave so this restriction does not apply. As can be seen from the channel plan diagram in Fig. 2-1-6, the distance between transmitting stations is mostly 40km or more, so because the GI cannot be maintained the MFN configuration is ideal. Regarding the issue of number of channels, as can be seen from Table 2-1-7 the necessary number of channels can be maintained. In the project to be implemented in the Maldives as a whole, transmitting stations will be installed at 26 locations and relay stations at three locations. However for the meantime the priority is to expand the network, so costs can be reduced with a one transmitter system, which is the simplest equipment configuration. However, it is necessary that the DTTB platform have at least a certain level of reliability, so reserve transmitter units will be procured as a countermeasure. In this way the effect of breakdowns can be minimised as much as possible.

Table 2-1-16 shows a channel / transmission system plan including transmitting / relay station positions, transmission output, antenna format and patterns, etc. The transmission output electrical power plan for each transmitting station is a maximum of 200W and a minimum of 10W. Also the transmission and relay systems are in the MFN format, so stabilisation of the frequency is not as necessary as for the SFN format, but it is desirable that the transmission be stabilised as much as possible. In this project, operation and management of the system is not complex, and a reference synchronisation system will be adopted, but the signal will be stabilised with a reference signal from either a crystal oscillator, a 10MHz reference clock signal received by GPS, or a 1PPS signal.

[4] The repetition time when a part of the signal is repeated every one symbol of the broadcast wave, in order to prevent interference in a SFN due to reflection or delayed wave (multi-pass)

Table 2-1-16 Maldives Channel / Transmission System Plan

No.	Item / Station name	Latitude and longitude	Above sea level (m)	Tower height (m)	Installation location of transmitting antenna	Transmitting antenna height (m)	Transmitting antenna type	Transmitting antenna configuration			Transmitting antenna type	Antenna system gain (dBd)	Main feeder size	Length (m)	Broadcasting equipment output (W)
								Direction	**Number of stages**	**Tilt angle**					
1.	Dhidhdhoo	N06° 53'22.7" E73° 6'50.79"	10	60	Top of tower	62	4 dipole	80, 270, 350	(2.2.2)	0	2･4Dx3	8.2	7/8" gap insulation	82	200
2.	Kulhudhuffushi	N6 °36'57.67" E73°4'23.90"	5	50	Top of tower	52	4 dipole	0, 90, 180, 270	(2.2.2.2)	0	2･4Dx4	7.0	7/8" foam insulation	72	100
3.	Funadhoo	N6°08'27.15" E73°17'32.63"	-6	70	Top of tower	72	4 dipole	130, 260, 300	(1.1.2) P=1.1.2	0	2･4Dx1 1･4Dx2	10.0	7/8" foam insulation	92	100
4.	Manadhoo	N5°46'08.76" E73°24'35.65"	3	70	Top of tower	72	4 dipole	0, 220, 290	(2.2.2)	0	2･4Dx3	9.5	7/8" foam insulation	92	10
5.	Ungoofaar	N5°40'04.35" E73°1'55.06"	0	70	Top of tower	73	4 dipole	60, 150, 240, 330	(1.2.4.4)	0	4･4Dx2 2･4D,1･4Dx1	11.6	7/8" foam insulation	92	100
6.	Eydhafushi	N5°06'10.70" E73°04'21.9"	5	70	Top of tower	72	4 dipole	111, 220, 340	1, (2.2) P = 1:9	0	2･4Dx2	11.4	7/8" foam insulation	92	50
7.	Naifaru	N5°26'26.15" E73°21'57.05"	0	80	Top of tower	82	4 dipole	105, 225, 315	(2.2.2) P = 8:1:1	0	2･4Dx3	12.0	7/8" gap insulation	102	200
8.	Malé (Villingili)	N0°35'50.69" E73°05'01.98"	1	60	Top of tower	65	4 dipole	30, 120, 210, 300	(8.2.8.2)	0	8 ・ 4Dx2 2･4Dx2	14.8	7/8" gap insulation	85	200
	Maafushi	N03°56'15.96" E73°29'19.12"		90	—	—	—	—	—	—	—	—	—	—	—
9.	Felidhoo	N3°28'15.13" E73°32'53.15"	10	80	Top of tower	82	4 dipole	80, 200, 320	(2.2.2)	0	2･4Dx3	8.2	7/8" foam insulation	102	50
10.	Dhangethi	N03°36'17.36" E72°57'17.58"	0	70	Top of tower	72	4 dipole	180, 260, 340	(2.1.2)	0	2･4Dx2 1･4Dx1	9.0	7/8" gap insulation	92	200
	Feeali	N03°16'14.18" E72°59'59.10"		80	—	—	—	—	—	—	—	—	—	—	—
11.	Nilandhoo	N03°03'18.47" E72°53'34.31"	9	50	Top of tower	52	4 dipole	0, 90, 180	(2.1.2) P = 2:1:2	0	2･4Dx2 1･4Dx1	9.7	7/8" foam insulation	72	100
12.	Gan	N01°56'03.75" E73°32'44.33"	9	80	Top of tower	82	4 dipole	0, 120, 260	(2.1.2) P = 0.8.0.1:2	0	2･4Dx2 1･4Dx1	11.2	7/8" foam insulation	102	50
13.	Guraidhoo	N02°19'30.46" E73°18'59.24"	8	80	Top of tower	82	4 dipole	50, 230, 320	(1.2.2)	0	2･4Dx2 1･4Dx1	9.0	7/8" foam insulation	102	50
14	Gadhdhoo	N0°17'38.1" E73°27'45.8"	-2	80	Top of tower	82	4 dipole	50, 230, 320	(1.2.2)	0	2･4Dx2 1･4Dx1	9.0	7/8" gap insulation	102	200
	Fiyoari	N00°13'16.08" E73°08'02.81"		60	—	—	—	—	—	—	—	—	—	—	—
15.	Thinadhoo	N0°31'29.07" E72°59'32.4"	2	50	Top of tower	52	4 dipole	50, 160	(2.2)	0	2･4Dx2	10.0	7/8" gap insulation	72	200
16.	Villingili	N0°45'38.04" E73°26'1.92"	-3	80	Top of tower	82	4 dipole	180, 300	(1.2)	0	2･4Dx1 1･4Dx1	11.2	7/8" foam insulation	102	20
17.	Foammulah	S0°17'46.92" E73°25'18.6"	8	20	Steel column on top of building	20	Non-directional	360	1	0	1･STA	11.0	1/2" foam insulation	25	10
18.	Hithadhoo	S00°35.50.69" E73°05'1.9"	4	30	Tower on top of building	30	Non-directional	360	1	0	1･STA	11.0	1/2" foam insulation	35	20
19.	Kanditeem	N/A (location not decided)	N/A	60	Top of tower	62	4 dipole	215 ,285	(2.2)	0	2･4Dx2	11.3	7/8" foam insulation	82	100
20.	Kaashidhoo	N/A (location not decided)	N/A	50	Top of tower	52	4 dipole	145, 215	(2.2)	0	2･4Dx2	11.3	7/8" foam insulation	72	100

No.	Item / Station name	Latitude and longitude	Above sea level (m)	Tower height (m)	Installation location of transmitting antenna	Transmitting antenna height (m)	Transmitting antenna type	Transmitting antenna configuration			Transmitting antenna type	Antenna system gain (dBd)	Main feeder size	Length (m)	Broadcasting equipment output (W)
								Direction	**Number of stages**	**Tilt angle**					
21.	Himendhoo	N/A (location not decided)	N/A	70	Top of tower	72	4 dipole	20	(3)	0	3・4Dx1	14.8	7/8" foam insulation	77	10
22.	Rasdhoo	N/A (location not decided)	N/A	70	Top of tower	72	4 dipole	0, 250	(2.2)	0	2・4Dx2	10.0	7/8" foam insulation	77	20
23.	Dhigaaru	N/A (location not decided)	N/A	30	Top of tower	32	4 dipole	60, 150, 240, 330	(1.2.1.2)	0	2・4Dx2 1・4Dx2	8.2	7/8" foam insulation	52	50
24.	Muli	N/A (location not decided)	N/A	40	Top of tower	42	4 dipole	230	(3)	0	3・4Dx1	14.8	7/8" foam insulation	62	50
25.	Hulhudheli	N/A (location not decided)	N/A	30	Top of tower	32	4 dipole	140	(3)	0	3・4Dx1	14.8	7/8" foam insulation	52	50
26.	Thimarafushi	N/A (location not decided)	N/A	50	Top of tower	52	4 dipole	300	(3)	0	3・4Dx1	14.8	7/8" foam insulation	72	50

Source: Created by JICA Survey Team

2-1-9 Development of Systems, Laws, Standards, etc.

(1) Reform of communication and broadcasting sector

Maldives is currently in the midst of a reorganisation of the regulatory authorities in the communication and broadcast sector. Firstly the communication sector including administration of the radio waves has been supervised and regulated by a Presidential Decree promulgated in 2004. This Decree prescribes the CAM as the regulatory authority in this sector. However in December 2015 the People's Majlis approved the Telecommunication Law and the Communication Authority of Maldives Law, which will come into force from April and March 2016, respectively. The Telecommunication Law adds an overall policy and measures taking into consideration new technologies such as mobile number portability (MNP) and DTTB, and amends the Presidential Decree. Also the CAM Law defines the CAM as an autonomous organisation under certain restrictions, from which political interference is systematically excluded regarding financial and personnel affairs, although it is not a completely independent organisation. Also in the past, allocation of frequencies to broadcasting stations was carried out by the Maldives Broadcasting Commission based on advice from CAM, but this has been changed so that in the future CAM will allocate the frequencies.

In the Maldives, in facing the digital migration of television, laws and regulations regarding the policy of terrestrial television broadcasting, allocation of frequencies for digital broadcasting, technical standards, establishment of DBNO and multiplex operation must be amended. With abovementioned reform, CAM and the commission that regulates programme contents and issues broadcasting licences shall take measures by the time the Exchange of Notes for this grant aid project is signed.

(2) Items to be addressed by CAM

The technical standards for DTTB transmitting / receiving equipment, whose draft was produced during the Previous Survey with the assistance of the Ministry of Internal Affairs and Communications and DiBEG, was soon published in the Official Gazette by CAM after the Telecommunication Law came into force.

CAM will establish telecommunication regulations in the future, and deliver them as Ministry of Home Affairs Decrees within a few months. These regulations will prescribe guidelines regarding digital terrestrial licencing, allocation of frequencies, etc. It must be addressed urgently in order to implement the grant aid project because it is necessary to allocate frequencies to DBNO for terrestrial digital broadcasting. In particular the allocation of frequencies will have a great effect on the procurement of the transmitter system. In the future when the platform operates under four frequencies, DBNO must use CH21 to CH40. Currently in the Maldives frequency licencing is uniform throughout the whole country. One operator is permitted to use one wave. In other words, there is a rule that if CHa is used in a certain location, then the frequency of 'a' cannot be allocated to another company even for another location where the radio waves of ‘a’ do not reach. On the other hand, in the Maldives where same frequency interference can easily occur due to transmission over the sea, it is difficult to effectively use frequencies with a single nationwide frequency. When CH21 to 40 are assigned to DBNO, under the current regulation it will not be possible to grant a frequency to another company. Therefore, in the future it is desirable that measures be implemented to enable frequencies to be granted to parties other than DBNO, so that frequency licences can be granted based on appropriate radio wave control (prediction of radio wave transmission based on ERP, and antenna height, and granting of frequency licences based on this).

Note that under the present legal system there is no obstacle to two frequency operation, and the grant aid cooperation project is not affected.

(3) Items to be addressed by the commission

To date the Maldives Broadcasting Commission has been the regulatory authority for business licencing for broadcasting companies, and rules regarding programmes. However, there is debate ongoing to form a single media regulatory authority by integrating the Maldives Broadcasting Commission with the Media Council, which is responsible for promotion and regulation of newspapers, publications, journalism, and information, and the Information Commissioner’s Office, but the direction is not yet clear. For the meantime the Maldives Broadcasting Commission continues to be the regulatory authority for the broadcasting contents.

It is necessary that the Maldives Broadcasting Commission revises broadcasting regulations concerning 1) the definition of DBNO as the entity that re-transmits terrestrial signals, 2) the differences from satellite/CATV operators, 3) the scope of their work, 4) the points of difference between a broadcaster’s licence and a programme provider’s licence, 5) the competent organisation to operate multiplexing, and 6) the multiplexing operation methods. However, the work on these specific amendments is delayed. The major reason why these amendments are delayed is because the Maldives Broadcasting Commission does not have sufficient understanding of DTTB, and they have not studied the improvement measures.

The guidelines for granting a licence to digital terrestrial broadcasters have not yet been determined, including the method of application for a digital terrestrial licence such as submission of proposal, auctioning or priority rights for existing broadcasting stations, etc. Also, for HD, SD, data, and one-seg, etc., if for example there is a concentration of companies that want to provide a HD service, there has been no investigation into how to resolve this situation. On the other hand, on 5th April 2016 the President of the Maldives appointed six new commissioners in accordance with Article 3 of the Maldives Broadcasting Act (Law No.16/2010). It is necessary for the Maldives Broadcasting Commission to continue and develop the debate that has been carried out to date, and quickly deal with the legal system.

2-1-10 Equipment Procurement and Installation Plan

The investigation into whether or not the existing towers can be used has been completed in this survey. Among the candidate sites within the scope of the grant aid project the existing towers cannot be used, but at two other locations the existing towers of Ooredoo, a telecom carrier, likely can be used. In the future specific investigations will be carried out by PSM and Ooredoo.

For this project a total of 26 transmitting stations and three relay stations are required, of which land acquisition will be necessary at 20 locations. Of the 18 transmitting stations and three relays in locations considered in the cooperation project, land acquisition will be necessary at 13 locations. PSM has already applied to the Ministry of Housing and Infrastructure for the land for these sites.

The study has assisted holding scoping conferences and public consultation, and thereafter PSM will employ a registered consultant if necessary to obtain the EIA/IEE.

In this survey the equipment procurement plan has been generally prepared, and henceforth it will be investigated by PSM on their own outside the scope of the cooperation project.

The construction plan of the grant aid cooperation project is scheduled to be completed in the 2nd quarter of 2018. Assuming that PSM will develop transmitting stations on their own at eight locations, they will be developed over two years after completion of the grant aid cooperation. The DBNO usage charges are likely to accumulate the funds for this. Also, thereafter it is likely that the system will be expanded to three frequencies in two years, and expanded to four frequencies in five years.

2-1-11 Organisational and Personnel Training

PSM intends to implement EWBS as a pilot project at DSO. Currently warnings are received from the Maldives Meteorological Service (MMS) via dedicated line between PSM and MMS, where the warnings are communicated to PSM through the telephone, which are then broadcast. It is important to create an environment where at any time warnings followed by detailed information from MMS can be broadcast live. As an extension of this, the EWBS will be implemented as a pilot project. The system will be constructed and the capabilities of the necessary staff will be improved by periodic training, preparation of guidelines, carrying out EWBS receiving tests in cooperation with specific island committees[5], which produce the development plan of each island and are elected by the residents of the island, etc. However, PSM does not have experience of operating the EWBS, so they wish to receive the knowledge and experience of Japan through a technical cooperation project or similar (see Chapter 3-1-2 ‘Examination of Related Assistance’, described later).

With PSM, it is planned to carry out periodic inspection of all the transmitters at a frequency of once

[5] Based on the Decentralisation Act, 2010, each resident island has a specific island committee or city council. Those members are elected by the local residents, being responsible for the creation of development plan and keep a secure and peaceful environment in cooperation with the police. Sixty-six specific island committees exist in the Maldives and there are 17 city councils on the islands having a population of more than 25 thousand. The minimum administrative district is the atoll council, accounting for 20, which has a role to monitor the activities of specific island committees.

every four months, under the operation of DBNO after the DTTB migration. The 16 transmission engineers and 13 operation engineers currently in PSM will all undertake the work of DBNO. Some employees are close to retirement, so it is desirable that personnel training be carried out from a medium term perspective. In particular it is required that the operation of the platform be highly reliable technically, so it is necessary that in addition to basic skills, specialist knowledge and skills in ISDB-T be provided. In addition, skills in the preparation of programmes in fields that have not been provided in the past, such as data broadcasting, etc., is necessary, so PSM wishes to have personnel training in new technologies via a technical cooperation project or similar (see Chapter 3-1-2 'Examination of Related Assistance', described later).

2-1-12 Investigation of EWBS System Operation

(1) EWBS Equipment Configuration and Operation

This section examines the technical factors necessary for introduction and operation of EWBS.

EWBS is configured from two functions: (1) emergency start-up of receivers in the area relevant to the EWBS, and (2) distribution of emergency warning to the relevant area by superimposition of text. Fig. 2-1-16 shows an image of the operation.

Normally a disaster management organisation has the authority to issue warnings, so in the case of EWBS also warnings will be issued by the organisation having the authority to issue EWBS warnings. The person responsible for operation on the station side will decide the relevant areas, the details of the text superimposition, and whether or not the receiver emergency start-up flag should be ON or OFF, in accordance with the instructions from the disaster management organisation, and generate and transmit the 'text superimposition', and the EWBS related control information (PSI/SI). Regarding the above process (1), emergency information descriptors (including specification of codes for the relevant areas) within the PMT[6] are generated and the emergency start-up flag ON/OFF bit within the transmission and multiplexing configuration control (TMCC) for controlling the demodulation operation of the receivers that receive the PMT is controlled. This BTS signal is received by the transmitting stations in each area, and is broadcast in the relevant areas.

It is necessary to multiplex the PMT with the emergency information descriptors onto all the multiplexed broadcast programmes, so the PMT is changed and multiplexed within the NOC.

[6] PMT (Programme Map Table): One of the information elements from which PSI is configured, and represents the programme contents (configuration) transmitted in the physical channel.

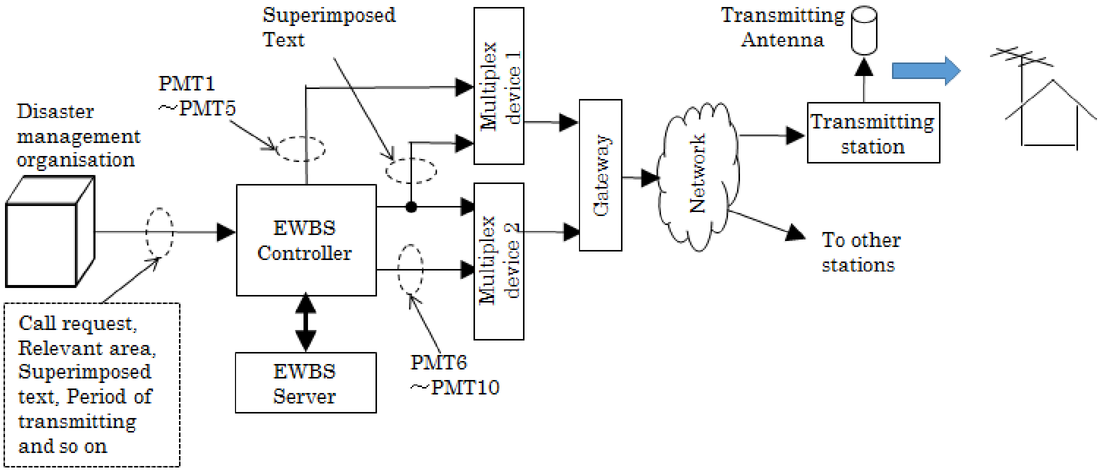


Fig 2-1-16 Flow of EWBS-related Information during MUX Operation

In Fig. 2.1-16, the reason PMT-1 to PMT-5 and PMT-6 to PMT-10 are multiplexed by multiplex device 1 and multiplex device 2 respectively, is because the PMT corresponding to each broadcast programme is different. The text superimposition is common, so one system is branched and that system is multiplexed.

On the other hand, the receivers that receive the signal into which the emergency information descriptors are multiplexed check the descriptors within the PMT multiplexed in the programme signal being watched. If the area code stated therein coincides with the area code where the receiver is installed, the receiver starts up if the TMCC emergency start-up flag (B26) is ON. Fig. 2-1-17 shows an example of the process flow within the receiver.

The area code of EWBS will be fixed by the technical standards publicised by the government gazette. The area will be divided by the atoll and the code will be allocated to each atoll. In case that one transmitting station covers several atolls as a service area, the other atolls which do not have risks of imminent disasters also receive EWBS signal with the intention to send signal to the atoll affected by the disaster.

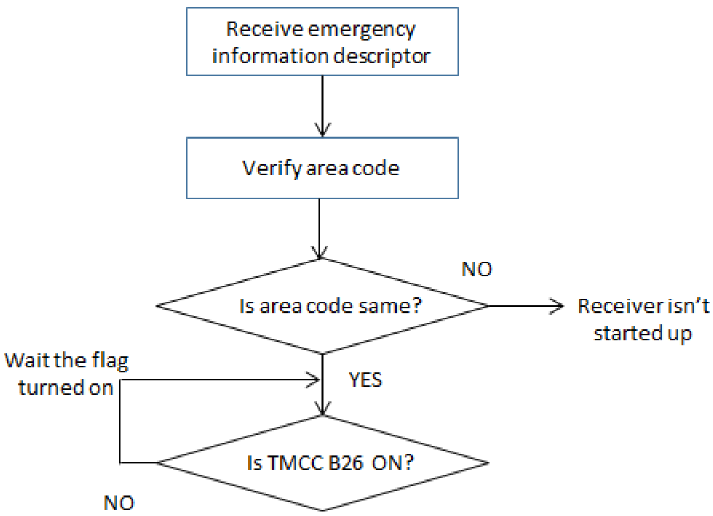


Fig 2-1-17 Receiver Emergency Operation Flow

Note that regarding the distribution of emergency signal by the superimposition of characters, the emergency text superimposition generated by the EWBS server is multiplexed at NOC, and is automatically displayed by the receiver that has been actuated by the emergency signal directed to the area. For a country such as the Maldives where the majority of the national area is sea, the effect of weather changes such as concentrated heavy rain, waves and high tides is great, and this information can be urgently required by people fishing or on ferries, so it is important.

Recently at the ISDB-T international forum, the use of text superimposition for one-seg has been recognised, so there are expectations for the use of emergency text superimposition services for boats.

(2) Issues and Solutions Regarding EWBS Operation

As stated in item (1) above, control of the receiver emergency start-up flag ON/OFF, which is one of the EWBS functions, is a mechanism that is decided on the received side based on the area code. In this case, there is a possibility that the emergency start-up flag ON/OFF control will not be activated;

(a) in cases where the area code is not set or is incorrectly set in the receiver (including cases where a second-hand receiver is purchased, and it is not reset); and

(b) in cases where the area cannot be specified such as for reception by boat.

Having said that, if start-up was implemented without reference to the area code, there is the danger that receivers throughout the whole country would start-up. The method of controlling the TMCC start-up flag ON/OFF in transmitting station units using the PSI rewriting device as described below can be considered as a solution to this issue.

The PSI rewriting device has a function to rewrite the network ID multiplexed in the BTS, which is sent from NOC to each transmitting station, to the network ID allocated to each region. The network ID can be used to as a parameter to relate the region and content that is directed to a particular region if the data broadcasting contents were broadcast to a particular region. In addition, the PSI rewriting device also controls emergency flag for each region and replaces the text superimposition according to the region.

Fig. 2-1-18 shows the process of carrying out TMCC emergency start-up flag control in transmitting station units using the PSI rewriting device.

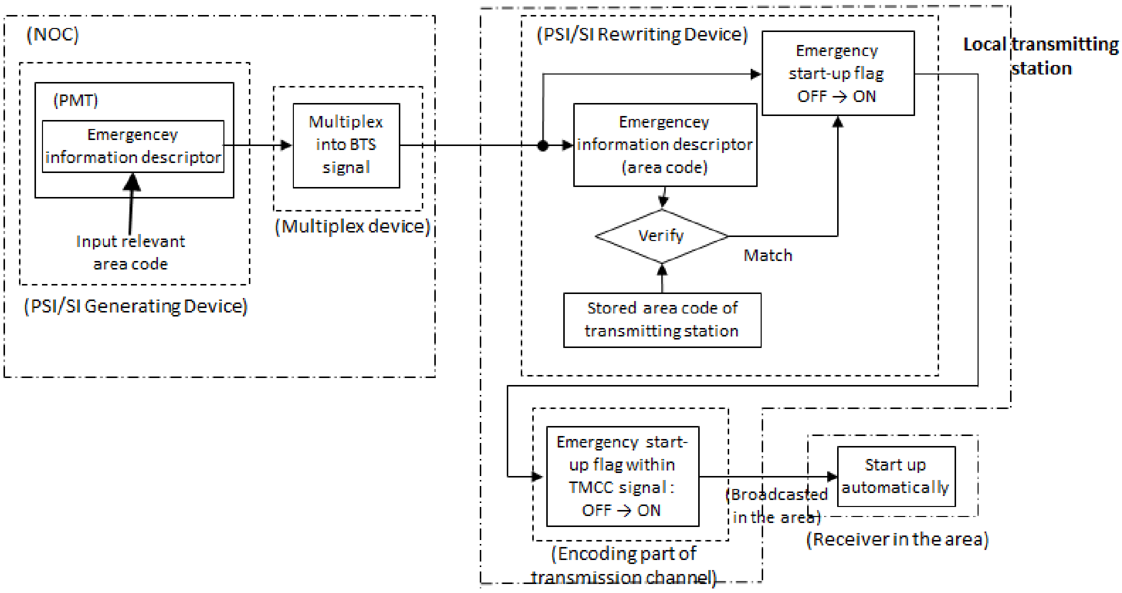


Fig 2-1-18 Process of Controlling the Emergency Start-up Flag for Each Transmitting Station Using the PSI Rewriting Device

As shown in Fig. 2-1-18, in the PSI rewriting device at each local transmitting station, the area code within the PMT is compared with a code allocated to that transmitting station, and if they match the emergency broadcast start-up flag within the TMCC signal is turned ON. If they do not match the flag is turned OFF and the text superimposition is turned off too. The receivers within the area detect the automatic start-up flag and the receivers automatically start up and display text superimposition.

In this way, by using the PSI rewriting device, the emergency start-up flag is turned ON only for transmitting stations in the areas included in the area codes specified in the emergency information descriptors, so the start-up flag is not distributed throughout the whole country. Also, in the case of reception by boat, the emergency start-up flag can be received for their current location, not the area to which they belong, so it is considered that this is an effective means for boats in particular, for which it is necessary to take into consideration emergency disasters due to sudden changes in weather.

MMS has two criteria for issuing the emergency warning: 1) earthquake and tsunami criteria, 2) weather criteria. The earthquake and tsunami criteria have four stages;

1. An earthquake of 7.0 or higher on the Richter scale, occurred in the Indian Ocean ring but with no immediate threat from the event
2. An earthquake of 8.0 or higher on the Richter scale, occurred in the Indian Ocean ring and having the potential to generate an ocean wide destructive tsunami in the Indian Ocean
3. An earthquake of 8.0 or higher on the Richter scale, occurred in the Indian Ocean ring and confirmation of an ocean wide destructive tsunami originated from the epicentre
4. The condition has improved

The weather criteria has three stages;

1. Mean wind speed is expected or prevailing between 20-30 mph, rainfall of more than 50mm is expected to occur within 24 hours, high tidal waves are expected
2. Mean wind speed is expected or prevailing between 30-40 mph, torrential rain is expected and if heavy rain occurs for more than 2 hours, a severe thunderstorm is expected or experienced, tropical cyclone is formed within effective areas of Maldives, significant tidal or swell waves are expected or experienced
3. Flash flood is expected, a tropical cyclone is tracked to move closer or cross Maldives islands, destructive tidal or swell waves or storm surge is expected or observed

Though discussion is necessary among relevant agencies including PSM and MMS regarding in what conditions EWBS be issued, in the case of Japan, in the event of an earthquake with the magnitude of more than 3, the warning is issued if there is a possibility of tsunami.

Regarding the text superimposition, it is possible to send EWBS start up flag information and necessary information by text through text superimposition to a certain region by installation of the PSI rewriting device in each transmitting station and preparing an interface to input text data to the PSI rewriting device. This could be an effective measure in the situation where each area has different level of threats caused by the disaster.

2-2 Organisational Structure for Project Implementation and Finance / Budget of DBNO

2-2-1 Establishment of DBNO and its Duties

The Government of the Maldives decided to establish DBNO within PSM. This is because the private broadcasting stations do not have enough experience to operate a terrestrial television network and PSM has sufficient human resources and know-how through the operation of analogue terrestrial broadcasting network. The government made decision on the establishment of DBNO and its operation by PSM on 1st October 2015 and the President's Office officially notified of the decision on 8th October. DBNO will perform the following duties:

i. Establishment of the DTTB platform
ii. Operation and maintenance of the DTTB platform
iii. Transmission of DTTB signals in accordance with the laws and regulations
iv. Collection and multiplexing of broadcast programmes
v. Implementation of a pilot EWBS project (to be implemented in cooperation with PSM and MMS)
vi. Operation of the Electronic Programme Guide (EPG)
vii. Sales promotion activities to facilitate the purchase of DTTB receivers
viii. Assistance to viewers in preparation for the migration to DTTB (establishment and operation of the support centre)

2-2-2 Personnel Plan

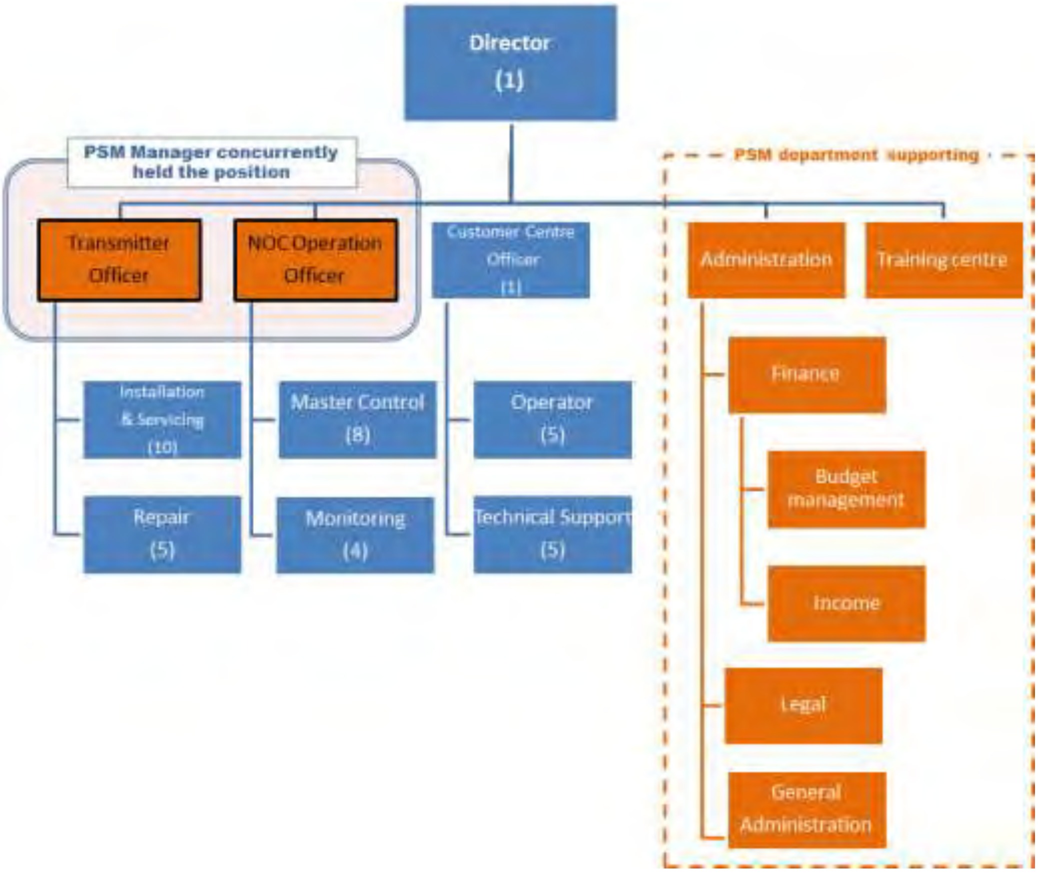
Although DBNO will be established in PSM, its budget will be managed separately from that of PSM. The general affairs including accounting of DBNO and training of its staff members will be managed by the existing relevant departments of PSM for the reduction of the operating cost of PSM including that of DBNO.

Staff members currently working in PSM will be appointed to the managerial positions of the departments responsible for the transmission and the operation of NOC on a part-time basis in addition to their positions in PSM. The other staff members will be assigned to the department as full-time workers. Therefore, all the transmission engineers currently working in PSM will be transferred to DBNO and they will maintain the TV broadcasting network, the DTTB platform, from Malé using a remote monitoring system.

Some viewers may face problems such as being unable to watch programmes on TV and being unable to set up the equipment and antenna, during the migration to DTTB. DBNO is expected to develop a support centre (similar to the organisation called ‘customer centre’ that supported viewers during the migration to DTTB in Japan), as part of the viewer support system. The support centre will provide advisory services to viewers through the telephone. As the support centre will be a new department, a new full-time manager will be assigned to the centre instead of the part-time assignment of a staff member of PSM. The services of the centre will be provided under the supervision of the manager.

Viewers are expected to call the support centre with a wide variety of inquiries, some simple non-technical ones and some technical ones. In order to provide precise answers to all the inquiries, the support centre will be staffed with support centre staff (phone operators) who are to respond all the inquiries from viewers and to provide advice on general simple inquiries and Technical Support Staff who are to provide advice on technical inquiries. In the transitional period, some of these staff members will be outsourced. Staff members shall be assigned to DBNO in the number required for its full-scale operation.

Fig. 2-2-1 shows the (provisional) organisational structure of DBNO. DBNO will have 39 full-time workers and two part-time managers.



Source: Created by the Survey Team based on interviews with PSM

Fig 2-2-1 Organisational Structure of DBNO (provisional)

2-2-3 Technical Capability of the Personnel

For the migration to DTTB, staff members of PSM will be assigned to DBNO on a part-time basis as the managers of the signal transmission and NOC operation and new full-time employees will be assigned to the other positions in DBNO. They will maintain the platform in the areas of the installation, maintenance and repair services on the transmitters and the master control and monitoring of the broadcast. Therefore, engineers with ample experience in radio signal transmission and operation of the transmitters will be required at the establishment of the platform. Such engineers shall have intermediate and higher levels of technical capability in the practical work. They should have technical experience in the analogue TV signal transmission and at least five years of experience in the maintenance and operation, including installation and fault diagnosis, of various equipment in transmitting stations. Alternatively, they should have at least three years of experience in the operation of analogue TV broadcast, including the master control and monitoring. However, since the transmission engineers currently working in PSM are expected to perform the same duties that they are performing in PSM in DBNO, the capacity of the engineers who do not have the sufficient experience will have to be improved by providing them with intensive training.

The migration to DTTB will require not only the replacement of the analogue broadcasting equipment by the digital broadcasting equipment at the broadcasters, but also the preparation of an environment required for the reception of DTTB signals by viewers, including procurement of DTTB receivers and installation of outdoor antennas. Therefore, a system to provide those viewers who are unfamiliar with the new technology with detailed advice will be required. In order to provide them with appropriate advice, a person with sufficient experience in telephone customer relations will be appointed as the manager of the support centre. A person with experience in responding to telephone inquiries and customer relations (handling of claims from customers) will be employed preferentially as a staff member of the support centre, who is expected to respond to phone inquiries under the supervision of the manager. If qualified people have not been found, inexperienced people may be employed. Such employees will be assigned to the position of telephone operator after the training. The technical support staff will respond mainly to technical questions from viewers. Because the support centre is to receive inquiries from ordinary viewers, the number of technical questions on the broadcasting is expected to be small. Therefore, the qualification for the Technical Support Staff will be at least one year of experience as a transmission engineer.

A person working in the support centre must have the capability to respond to inquiries from ordinary viewers who do not have technical knowledge in simple easy-to-understand words without using technical terms.

Table 2-2-1 below shows the technical levels required of the staff of DBNO.

Table 2-2-1 Technical Levels Required of the Staff of DBNO

Job description	Required technical level
Installation and inspection of equipment	At least five years of experience in the installation and maintenance of analogue transmission systems
Repair of equipment	At least five years of experience in the maintenance of analogue transmission systems
Operation monitoring	At least three years of experience in the monitoring of analogue TV broadcasting
Operation of the master control room	At least three years of experience in the management of analogue broadcasting links or equivalent technology
Manager of support centre	At least five years of experience in customer service on the telephone
Support centre Staff	Experience in customer service preferred: Pre-assignment training will be provided to those without experience.
Technical support staff	At least one year of experience as a transmission engineer

Source: Created by JICA Survey Team

2-2-4 Finance and Budget

2-2-4-1 Expenditure – A Study on the Annual Maintenance and Operating Cost of DBNO –

As PSM had not conducted a practical study on the financial planning for the operation of DBNO, the Survey Team provided assistance to PSM in the study. In this study, the budget of DBNO was estimated as follows.

The budget of DBNO consists of expenditure (labour cost, electricity fees, maintenance cost, tower rental fees, user fees of designated links, frequency licence fees and miscellaneous expenses) and revenue. The platform user fees from broadcasters will be the revenue of DBNO.

In this section, the annual maintenance and operating cost, part of the expenditure, of DBNO is estimated. For each expenditure item other than the equipment maintenance cost and miscellaneous expenses, the mean of the actual expenses of PSM in 2013 and 2014 on the item concerned was used as the maintenance cost of the item concerned in the estimation.

The labour cost for the staff of the departments engaged in general affairs including accounting and training was excluded from the expenditure of DBNO because the labour costs of these staff would continue to be covered by the budget of PSM. Likewise, with regard to the costs of transmitting eingineer who are transferred from PSM is owned by PSM and the labour cost of new positions of the director and the member of costomer centre are estimated in the cost of DBNO. Broadcasting equipment is usually maintained by its manufacturer or its agent under a maintenance contract concluded between the owner and the manufacturer or its agent at the cost of 5% – 10% of the purchase price of the equipment. Because no manufacturer of the broadcasting equipment has its service base in the Maldives, the maintenance cost of the equipment of NOC was estimated as follows: The components of the equipment were classified into those of priority levels 1, 2 and 0 in the descending order of the likelihood of breakdown. The level 0 was assigned to components which are expected almost never to break down. The annual maintenance costs of the level 1 and 2 components were estimated at 10% and 3%, respectively, of their market prices. The annual maintenance cost of the level 0 components was estimated at 0.

Because of the characteristics of the grant aid project, a price of equipment used in the estimation is larger than its market price by the amount corresponding to the cost of its handling by a company supervising the project, such as a trading company, and the cost related to warranty. Therefore, the market prices were set at 70% of the prices used in the estimation. This percentage was derived from the prices of equipment directly delivered from its manufacturers to broadcasters of various countries.

The annual operating cost of DBNO was estimated in accordance with the procedures mentioned above and the results of the estimation are shown in Table 2-2-2.

Table 2-2-2 Annual Maintenance and Operating Cost of DBNO (estimate)

in million MVR (1 MVR = JPY 7.95)

	Item		Quantity	Unit price	Annual cost
1	**Labour cost**				**1.61**
		Director	1	0.300	0.30
		Manager of the customer centre	1	0.160	0.16
		Installation/servicing of transmitters	10	0.200	2.00
		Repair of transmitters	5	0.200	1.00
		Master control	8	0.100	0.80
		Monitoring	4	0.100	0.40
		Telephone operators	5	0.100	0.50
		Technical support staff	5	0.130	0.65
	Budget is from PSM				**4.20**
2	**Electricity fee**		**1**	**0.120**	**0.12**
3	**Equipment maintenance cost**				13.09
		Maintenance of towers	29	0.150	4.35
		Cleaning of station buildings	29	0.055	1.60
		Maintenance of station buildings	26	0.050	1.30
		Maintenance of relay stations	3	0.030	0.09
		Maintenance of the equipment of NOC	1	1.860	1.86
		Electricity fee (at transmitting stations)	18	0.200	3.60
		Electricity fee (at relay stations)	3	0.060	0.18
		Communication cost (including the cost of the Internet connection)	21	0.005	0.11
4	**Tower rental fees**		**2**	**0.586**	**1.17**
5	**Cost of the optical fibre installation**		**1**	**2.620**	**2.62**
6	**Frequency licence fees**				**5.75**
		Broadcast wave frequency licence fees	20	0.250	5.00
		Microwave frequency licence fees	3	0.250	0.75
7	**Miscellaneous expenses**				**0.35**
		Communication cost (at NOC)	1	0.35	0.35
	Total				**24.71**

Source: PSM

2-2-4-2 Revenue – A study on the Platform User Fees –

(1) Analysis of the Current Financial Ability

The Survey Team conducted a study on the DTTB platform user fees, the source of the revenue of DBNO, as on the budget planning.

Because advertisements are part of programme contents, advertising revenue is a revenue of broadcasters. Therefore, the revenue of DBNO was estimated on the assumption that the platform user fees were the only revenue source of DBNO. Although DBNO might acquire another source of revenue when its service contents are revised, this possibility was excluded in this analysis of the revenue.

A target was set for the calculation of the platform user fees. The target is a standard obtained as a total of the five items mentioned below, including the monthly frequency licence fees that the private broadcasters pay to CAM and PSM, programme distribution fees and the labour and maintenance costs for the operation of the transmission equipment. In other words, the amount of the expenditure that the private broadcasters currently paid was considered their financial ability in the analysis. The current expenditure is based on the expenditures of four broadcasting stations that answered to the hearing of the Survey Team out of six.

Because the service area of the DTTB platform and that of the re-broadcasters including CATV operators to which the private broadcasters outsource the broadcasting of their programmes are different, it is not certain whether the use of the DTTB platform will increase their coverage area. Nonetheless, the use of the platform will enable the private broadcasters, which have been providing their services in limited areas, to broadcast their programmes through a nationwide broadcasting network. This expansion of the coverage area is expected to be an incentive for them to use the DTTB platform.

(a) Maintenance cost associated with the operation of transmitters (some broadcasters own their own transmitters and the others do not)
   - Broadcasters that own transmitters: VTV, DhiTV and Atoll TV
   - Broadcasters that do not own transmitters: Raajje TV, Sangu TV, Sun TV and CH13

(b) Labour cost associated with the operation of transmitters (salaries of the transmission engineers)

(c) Frequency licence fees

(d) Satellite link user fees

(e) Contents distribution fees to CATV

The interviews at the broadcasters that own the broadcasting licences and actually broadcast programmes regularly revealed the following: VTV and DhiTV broadcast their programmes in and around Malé using their DVB-T2 and DVB-T standard transmitters and in other areas using TVRO satellite link of PSM and re-broadcasters. The other broadcasters distribute their programmes by multiplexing them into the digital broadcasting signals of PSM, VTV and DhiTV and using re-broadcasters such as Medianet.

The satellite link user fee is USD 3,225/MHz/month and PSM is renting 2 MHz bands. Since the distribution fee of Medianet is MVR 80,000/month (1 MVR ≈ JPY 7.8) for the distribution only in the Malé area, many private broadcasters are using the TVRO of PSM at the cost of USD 8,400/month to PSM to broadcast their programmes nationwide. With these fees added up, the private broadcasters reportedly pay between MVR 200,000 and 400,000 per month for the distribution of their programmes, though the actual amounts differ among them.

(2) Calculation of the User Fees

1) Setting Unit Prices by Type of Programme based on Data Capacity Ratio

A method of setting a fee for each type of the programmes to be multiplexed in accordance with the data capacities allocated to it was used as a fair method of calculating user fees. Two HD programmes, two SD programmes, one data broadcasting programme and a One-seg programme will be multiplexed into a single frequency until ASO in the Maldives. Because programmes of different broadcasters might be multiplexed into the same frequency, the unit user prices were set separately for the broadcasting of HD, SD, data and One-seg programmes. The largest data capacity will be allocated to a HD programme, followed by a SD programme, data broadcasting programme and one-seg programmes in the descending order.

At first, the ratio of the data capacity allocated to each type of the programmes to the total data carrying capacity of a single frequency was calculated. Then, a user fee for the broadcasting of each type of the programmes was calculated by multiplying the total expenses by the ratio. Table 2-2-3 shows the data capacity ratios calculated in accordance with the planned multiplex operation in the Maldives.

However, data is an integral part of either HD or SD and data only cannot be broadcast. According to the technical standard prepared by CAM, data is set with HD. One of the broadcasting stations that operates HD will use data too. There is a possibility that A broadcasting station operating HD and data receives HD programmes from B broadcasting station, and A broadcasting station multiplexes data with HD programmes of B broadcasting station. However, as the composition of the equipment is complicated and the cost is heightened, it is unlikely to occur. With regard to one-seg service, a single broadcasting station can operate according to the technical standard. It is desirable that the Government of Maldives make a decision on which broadcasting stations operate what services as early as possible to promote the participation of private broadcasting stations to the platform because it is related to the user fees.

Table 2-2-3 Data Capacity Ratio by Programme Type

Programme type	Data capacity (Mbps/programme)	Estimate of the data capacity ratio
HD	6.70 (x 2 programmes)	0.29 (x 2 programmes)
SD	3.35 (x 2 programmes)	0.145 (x 2 programmes)
Data	1.50 (x 1 programme)	0.065 (x 1 programme)
One-seg	0.45 (x 1 programme)	0.02 (x 1 programme)
Other control signals (PSI/SIEIT)	0.85	0.045
Total	22.90	1.00

Source: Created by JICA Survey Team

After ASO, three HD TV programmes, as well as one data broadcasting programme and a One-seg programme, are expected to be multiplexed into a frequency. Table 2-2-4 shows the data capacity ratios after ASO. However, it is recommended that the timing of the complete transfer to HD broadcasting be determined carefully with the progress of the transfer to HD broadcasting and financial state of the private broadcasters and market trends taken into consideration.

Table 2-2-4 Data Capacity Ratios by Programme Type after ASO

Programme type	Data capacity (Mbps/programme)	Estimate of the data capacity ratio
HD	6.70 (x 3 programmes)	0.29 (x 3 programmes)
Data	1.50 (x 1 programme)	0.065 (x 1 programme)
One-seg	0.45 (x 1 programme)	0.02 (x 1 programme)
Other control signals (PSI/SIEIT)	0.85	0.045
Total	22.90	1.00

Source: Created by JICA Survey Team

2) Calculation of the Operating Cost of DBNO and Capital Expenditure

PSM plans to increase the population coverage of the service of DBNO to 97.64% eventually with the construction of transmitting stations in accordance with the site plan mentioned in 2-1-6. This coverage includes the population in all the inhabited and industrial islands. PSM's plan is to establish 18 transmitting stations in the grant aid project and additional eight stations later by itself. (See Chapter 3.) The establishment of the eight transmitting stations will be financed by facility investment fund to be generated by charging the users extra fees for the establishment in addition to the DBNO user fees and saving the collected extra fees. ASO is currently scheduled for 2020. ASO is to take place after PSM has completed the establishment of the eight stations. The grant aid project is scheduled to be completed in the third quarter of 2018, at present. With these current states taken into consideration, the fund will be raised within the two-year period between 2018 and 2020. If the fund has been raised by the end of 2020, the equipment for the eight stations will be procured in 2021 and ASO is expected after 2021. If the procurement of the transmission equipment for the additional eight transmitting stations to be established by PSM has been delayed, ASO will have to be re-scheduled.

In the two years after ASO, the fund will be raised for increasing the number of the broadcasting frequencies from two to three. Another two-year period will be required until all the programme contents will be produced in the HD quality. The final goal of the migration to DTTB is to operate it on four frequencies. The operating cost and the cost required for the procurement of equipment were estimated on the assumption that the equipment required for the four-frequency DTTB operation would be procured in the 11-year period after the commencement of the DTTB operation. The maintenance cost of DBNO was assumed at MVR 34.53 million/year as estimated in Table 2-2-2.

The equipment and facilities of DBNO will have to be renewed at regular intervals. Because the Maldives does not have a domestic public financing system, it is difficult to plan the renewal of equipment and facilities with loans. Therefore, the method of saving the renewal cost from the user fee revenue was included in the calculation of the user fees. On the assumption that all the equipment in NOC and all the transmitters were to be replaced every 10 and 20 years, respectively, the depreciation periods commonly used for the equipment concerned, the amount obtained by dividing the total amount required for the equipment and facility renewal by their depreciation periods was added to the user fees as a reserve. With this system, the funds required for the renewal of the equipment of NOC and the transmission equipment will be secured within 10- and 20-year periods, respectively.

Meanwhile, if the user fees fluctuate year by year in accordance with the fluctuation of the equipment procurement cost, the operation of the private broadcasters will be destabilised. Therefore, the user fees were to be calculated in such a way that the fees were reduced in every revision, while securing required saving. The saving for the renewal of the transmitters every 20 years and the cost of the renewal of the equipment of NOC every 10 years were estimated as annual capital expenditure and the cost for the procurement of transmitters of the eight new stations and for the increase in the number of the broadcasting frequencies from three to four was estimated as saving in a certain period of time.

Because the eight transmitting stations will have to be established by ASO, the amount of investment required in this period will be large. The amount of investment will have direct impact on the platform user fees. Therefore, the user fees in the five-year period until the initial facility development has been completed will be higher than those of the period that follows. Therefore, it was decided to collect the fund required for the first equipment renewal evenly in the period between the completion of the initial investment and the time of the renewal, in order to reduce this difference.

The fund required for the second and subsequent renewals will be collected evenly over the respective depreciation periods of 10 and 20 years.

The DBNO user fees were calculated by multiplying the sum of the fixed part of the annual expenditure, *i.e.* DBNO maintenance and operating cost and annual capital expenditure, and the variable portion of it by data capacity ratios. Table 2-2-5 shows the annual DBNO user fees (provisional) obtained with the method mentioned above. The table shows that the monthly DBNO user fee for the HD programme is slightly larger than the amount of the user fee that the private broadcasters currently pay, *i.e.* MVR 200,000 – 400,000. However, this fee is considered affordable if the possibility of the increase in advertising revenue expected from the expansion of the service area is taken into consideration. In the interview with the Survey Team, some private broadcasters stated that the slight increase in the user fee for a few years until ASO was acceptable if they were able to broadcast their programmes in the HD quality nationwide, because they could increase their viewership and advertising revenue using the advantage of the HD broadcast.

The user fees calculated in this survey are for the 30 years from the commencement of the service of DBNO, because it is considered appropriate to review the operating plan of DBNO comprehensively and revise the fees based on the new plan after 30 years of its operation. The period of 30 years is selected because all the transmitters on the four frequencies will have been renewed once during this period. Market prices, instead of the prices used in the estimation of the cost of the grant aid project, were used in the estimation of the cost of the equipment renewal.

Table 2-2-5 Annual User Fees of the Services of DBNO (provisional)

Unit: MVR (1 MVR = JPY 7.95)

Programme type	1st to 4th years after the commencement of the service	5th and 6th years	7th to 11th years	12th year on
HD	6,021,661	6,461,947	4,608,154	3,012,744
HD (monthly fee)	501,805	538,496	384,013	251,062
SD	3,010,831	3,230,974	-	-
SD (monthly fee)	250,903	269,248	-	-
Data	1,405,054	1,507,788	1,075,236	702,974
Data (monthly fee)	117,088	125,649	89,603	58,581
One-seg	602,166	646,195	460,815	301,274
One-seg (monthly fee)	50,181	53,850	38,401	25,106

Source: Created by JICA Survey Team

The user fees of the service of DBNO will include the saving to raise the fund for the investment in facilities for the additional transmitting stations and for increasing the number the broadcasting frequencies for the first six years after the commencement of the service. The user fees will be reduced significantly in the seventh year because the amount of the saving for investment to be added to the fees will be reduced significantly as the initial facility investment has been completed. If a broadcaster participates in DBNO in the seventh year or later, the broadcasters who have participated in the platform since DBNO began the DTTB service may feel it unfair that the new member will only have to pay a reduced user fee.

Therefore, it will be necessary to prepare a user fee scheme that offers preferential fees to the long-term members to maintain the fairness of the contribution to DBNO between the long-term and new members. It was revealed that, when the average user fees were calculated from the total of the required operating costs and the discount rate of 5% was applied to the user fees of the long-term members, the difference in the total amounts of the user fees to be paid by the long-term and new members in the period between the seventh year and the time of the renewal of initial equipment generated by the discount rate was approximately the same as the amount obtained by dividing the average amount of the facility investment in the initial stage by the number of the member broadcasters. Therefore, the discount rate of 5% will be applied to the user fees of the long-term members who have participated in the platform since the beginning of its operation. Table 2-2-6 shows the user fees when new broadcasters begin using the service of DBNO and the discount rate of 5% is applied to the long-term users. If the service of DBNO has the expected number of the members, the user fees shown in Table 2-2-6 will be used.

From the 22nd year on, the same fees will apply to all the members because all the initial equipment will have been renewed by then. Because this measure is for the correction of disparity between the members who began using the service at different times, if there is no new member, the discount mentioned above will not be used and the fees in Table 2-2-5 will be used.

Table 2-2-6 Monthly User Fees for the Service of DBNO (with new members and discount for long-term members, provisional)

Unit: MVR (1 MVR = JPY 7.95)

Type of programme	1st – 4th years	5th and 6th years	7th – 11th years	12th – 21st years	22nd year on
HD (for long-term members)	501,805	538,495	364,812	238,508	251,062
HD (for new members)	-	-	480,016	313,827	251,062
SD (for long-term members)	250,902	269,247	N/A	N/A	N/A
SD (for new members)	-	-	N/A	N/A	N/A
Data (for long-term members)	117,087	125,649	85,122	55,652	58,581
Data (for new members)	-	-	112,003	73,226	58,581
One-seg (for long-term members)	50,180	53,849	36,481	23,850	25,106
One-seg (for new members)	-	-	48,001	31,382	25,106

Source: Survey Team

3) Measures to be taken with regard to the DTTB Transmitters of the European Standard DTTB Owned by Private Broadcasters and Their User Fees

Some private broadcasters broadcast digital programmes using their own digital transmitters of the European standards. Because these transmitters are of the DVB-T and DVB-T2 standards, they can be modified into ISDB-T-standard transmitters. Therefore, their use in DBNO as backup transmitters is being considered. If a broadcaster has handed over its European-standard digital transmitter to DBNO, the remaining value of the transmitter will be deducted from the user fee. Three DVB-T and DVB-T2-standard transmitters owned by private broadcasters were identified in this survey. A DVB-T2-standard transmitter of VTV is the only one of which the time of the purchase and purchase price are known.

The depreciation period of transmitters is not defined in the Maldives. NHK of Japan uses the depreciation period of broadcasting facilities of six years (depreciation rate at 33.3%). It is considered appropriate to set the depreciation period of the transmitters at 10 years (depreciation rate at 50.0%) as the life time of broadcasting stations in the Maldives is generally 10 years.

The above-mentioned depreciation period and the date of purchase and the purchase price of the transmitters of VTV mentioned below were used in the estimation of the annual depreciation of the digital transmitters. The estimate of an annual depreciation of MVR 180,000 was obtained in the estimation. Since the transmitter of VTV was purchased in 2011, the user fee of each of the three owners of the digital transmitters will be deducted by MVR 60,000/year until 2020 when their depreciation period expires, if they have handed over their transmitters to DBNO. If this deduction is applied, their user fee payment will be too small to make saving for the investment in the first two years after the commencement of the operation of DBNO. Therefore, it will be necessary to hold negotiations with them to delay the application of the deduction until the third year.

When the purchase prices and the dates of the purchase of the digital transmitters owned by the broadcasters other than VTV are made available, the estimate of the undepreciated balance of the transmitter concerned will have to be revised.

✧ DVB-T2 transmitter owned by VTV (manufactured by Screen Service)
Date of purchase: November 2011
Purchase price: 24,900 GBP (600,877 MVR)
(1 GBP = USD 1.58 and 1 USD = MVR 15.24, as of November 2011)
Annual depreciation: MVR 60,000

2-3 Status of Project Sites and their Surroundings

2-3-1 Status of Equipment of Each Broadcasting Company

The status of the equipment of each of the private sector broadcasters affects the interface with NOC of DBNO. Therefore, it was decided to check the status of the equipment of the private sector broadcasters for the technical items relating to the interface with NOC, and reflect them in the design in the grant aid cooperation project.

The items checked were the studio output signal format, the methods of connecting the signals between the PSM and the private sector broadcasters that were already developed, whether or not there was a data generation function for programme configuration, and whether there was a required equipment installation location when preparing data broadcast programmes, as shown in the following Table 2-3-1.

Note that the participation of private sector broadcasters in DBNO is to be determined in the future, so at the present stage it is not possible to investigate the interface with NOC individually. However, as stated in the design policy, from the results of Table 2-3-1 it was clear that it is possible to adopt a design that can flexibly respond to the interface with other broadcasters that were not checked in this case. In this way also the cost of the grant aid cooperation project cost was not expanded greatly.

Table 2-3-1 Status of the Studio Equipment of PSM and the Main Private Broadcasting Stations

Station name Item	PSM	VTV	Sangu TV	Raajje TV
Studio output signal format	HD-SDI Embedded Audio	Same as on the left	Same as on the left	Same as on the left
Connection to PSM (Note 1)	Optical (SDI)	Optical (SDI) and Ether	Optical (SDI)	Optical (SDI)
Generation of programme configuration data	Operation by master APC (Note 2)	Same as on the left	Same as on the left	Same as on the left
Data broadcast production terminal installation location	Yes (within the master room)	Yes (within the master room)	Data broadcast not planned at present	Data broadcast not planned at present

(Note 1) In PSM programme signals are transferred to PSM in order that the company's programmes can be provided to the PSM satellite distribution network. For DTTB, it is planned that the NOC will be installed within the PSM station, so a survey was carried out of the transmission link between each existing broadcasting station and PSM.

(Note 2) APC (Automatic Programme Control): A system that carries out operation and control of broadcast programmes in a broadcast studio. This operation data forms the basic information of the electronic programme guide (EPG) that is multiplexed with the digital broadcasting signal.

Source: Created by JICA Survey Team

As can be seen from this table, in the PSM and the main private sector broadcasters surveyed by the Survey Team, the programme editing work is almost all carried out in HD-SDI. However, production equipment such as cameras is progressively being converted to HD, so operation will be with a mixture of HD and SD quality. Therefore it is considered that for a while after migration to DTTB, operation in this manner will continue.

Regarding studio output, in most cases an optical fibre link (including independent links) in SDI format has been prepared. However for digital broadcasting, it is necessary to multiplex several programmes as a TS signal with limited allocated bandwidth, and it is necessary to provide a broadcast service together with data broadcast. Therefore it is necessary to install an encoder to convert the image and sound signals to compressed TS signal format at the master output stage of each broadcasting station.

Also, for broadcasting stations that will implement a data broadcasting service from the start of digital broadcasting, it is necessary that they prepare data broadcast production and transmission equipment and multiplexing equipment to multiplex the encoded image and sound signal and the data broadcasting signal.

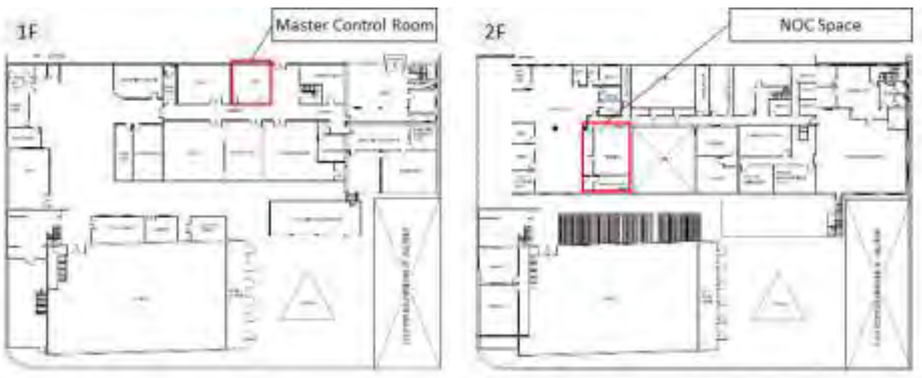
The programme configuration data of each station is multiplexed into the BTS signal at the NOC as the edited electronic programme guide (EPG). Therefore, it is necessary that the programme configuration data of each broadcasting station be sent to the NOC using a link for the NOC.

As explained above, the studio of each broadcasting station that is compatible with digital broadcasting and the link to the NOC is completely different from the link interface operated for analogue broadcasting, so it is necessary to develop the equipment for DTTB.

2-3-2 Status around the Network Operation Centre

The NOC which will collect the programmes of each of the broadcasters, multiplex the programmes into a signal format suitable for DTTB, and transmit the multiplexed programmes to each transmitting station is to be installed within PSM. It is planned that PSM will be refurbished, and the space currently used as the news room, the radio booth for news, and the CG production room will be used as the space for the NOC in the future.

The NOC will receive the TS signals sent from the PSM master control room and each of the broadcasters. The master control room and the NOC will be located on the 1st floor and the 2nd floor respectively, so they will be on separate floors, but the distance will be about 50 m so signal transmission by coaxial cable will be possible.



Source: PSM

Fig 2-3-1 PSM Layout Diagram

The interface between each broadcaster and the NOC will be signal transmission by an optical fibre link as standard. The majority of the private sector broadcasters have already laid their own optical fibre to PSM, and the optical terminal is within the sub-control room of TV studio 1 towards the current master control room of PSM. In the future it will be necessary to move the optical terminal device to NOC after construction of the building in which the NOC is installed. Each broadcaster converts their signals into a TS signal, which is the format that can be transmitted by an optical fibre link, and transmits the signal to the NOC. After multiplexing, the signal is again converted into a TS signal at the NOC. Therefore it is necessary to install a media converter at both the broadcasters' side and the NOC side.

Electrical power will be supplied to the NOC using the vacant capacity of one of the two reserve power supply systems for normal use by PSM. However, if there is insufficient vacant capacity, the responsibility is on the Maldives side to supply it. Also, there will be much equipment in the NOC that is highly necessary for broadcasting, so a backup power supply is essential.

2-3-3 Status of the Maldives Meteorological Service

The Maldives Meteorological Service (MMS) is located on the airport island Hulhulé in Kaafu Atoll. They have a studio and equipment for weather forecasting, and record weather programmes using image synthesis by chroma key. This programme production equipment is SD quality. The recorded programmes are transmitted to the whole country via PSM. However, currently the recorded programmes are sent to PSM by file transfer via the Internet, so live broadcasts and emergency response required during a disaster are issues.

It is important that information with high urgency such as weather information or disaster information be promptly transferred at the appropriate timing, and timely image transmission can be achieved by constructing a system using a microwave link or an optical fibre link from the studio of MMS. The straight line distance between Hulhulé Island and Malé Island is about 3km, so signal transmission by an independent microwave link is low cost, and is desirable. However, there are many tall buildings on Malé Island, and it could be difficult to connect MMS and PSM with a direct microwave link, so the building in which the Ministry of Home Affairs is located and which has a direct view of Hulhulé should be investigated. Optical fibre has already being laid between the building in which the Ministry of Home Affairs is located and PSM, so transmission from that building is easy. Also it is located on the coastline on the Hulhulé side, and is one of the tallest buildings on Malé Island, so it is considered that no blockage of the signal between MMS and the Ministry of Home Affairs will occur.

Note that there is already an antenna pole on the rooftop of MMS building, so this pole can be used for installing the microwave link. Also, solar power generating equipment is installed on the rooftop of the Ministry of Home Affairs, so the microwave link receiving antenna can be installed by installing a pole on the cradle for this equipment, etc.

2-3-4 Status of Existing Links between Project Sites and Telecom Carrier

The broadcasting service in the Maldives is composed of PSM which operates a terrestrial broadcasting network over the whole country, private sector broadcasters who produce programmes broadcast by terrestrial broadcasting in the area around Malé Island, and re-transmission broadcasters that broadcast the programmes of the private sector broadcasters and foreign programmes by CATV. In other words, apart from PSM there is no terrestrial broadcasting network except around Malé Island, so the broadcasting situation differs greatly from that in Japan, where PSM and re-transmission broadcasters distribute programmes to every island.

As stated in Chapter 2-1-8, the nationwide broadcasting network of PSM uses a satellite distribution network to transmit both television and radio to each of the transmitting stations, and programme distribution of some of the private sector broadcasters is also carried out via the broadcasting network of PSM.

The cost burden on the broadcasting stations of satellite transmission is large, and it has been shown that to reduce the DBNO operation charges, the most effect can be obtained by using a transmission link that is cheaper compared with a satellite link, such as an optical fibre link or an independent microwave link, for programme transmission to each transmitting station.

DBNO are planning to transmit eight programmes (excluding data and one-seg) by two frequency operation at the start of operation of the DTTB platform, and 12 programmes all in HD when operating with four frequencies. To transmit these programmes at once will require a large capacity transmission link, but it has been found that the lowest link usage charges are by transmitting from NOC to each area using the optical fibre link of a telecom carrier, and then from each location transmitting the programmes to all the transmitting stations using an independent microwave link.

In the Maldives there are two telecom carriers: Dhiraagu and Ooredoo. Dhiraagu has optical fibre links on 10 islands of the whole country, and Ooredoo is currently enhancing its optical fibre links. Also both have installed microwave links on all the islands where DBNO transmitting stations are to be installed, and are carrying out signal transmission by STM-1 link which DBNO requires.

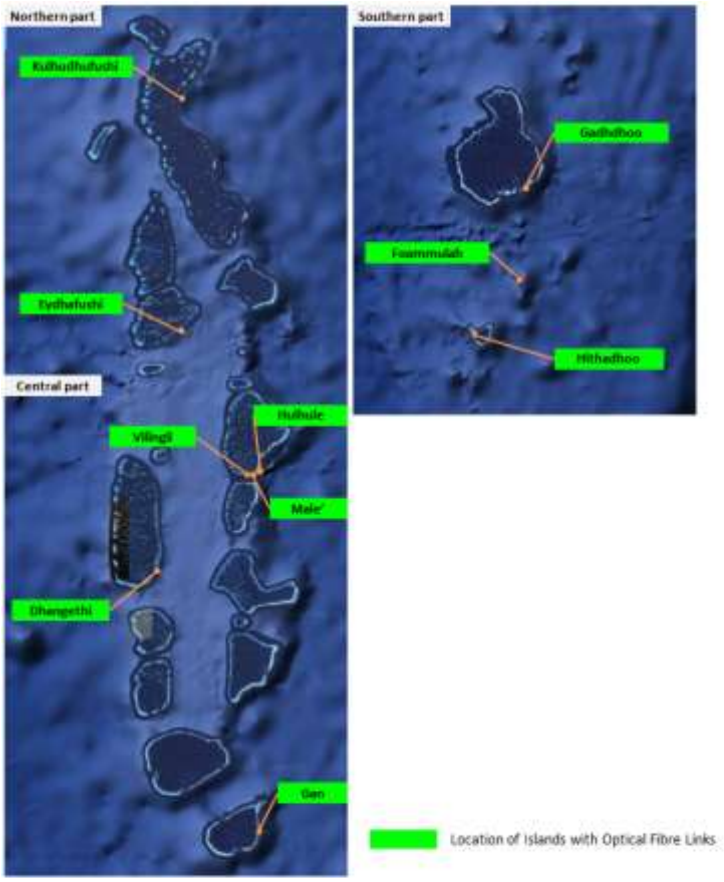
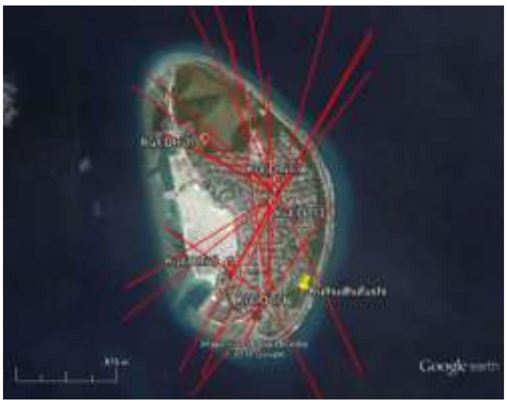


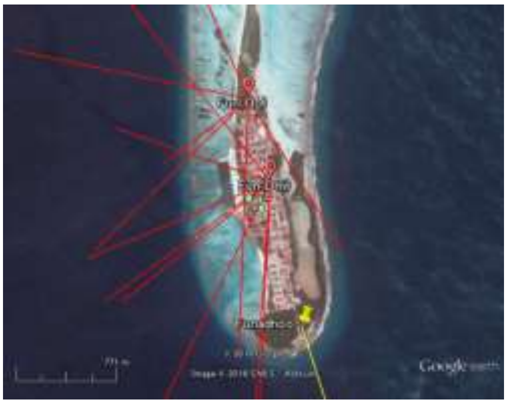
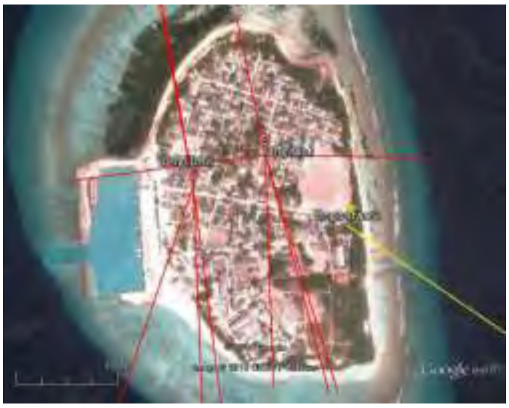
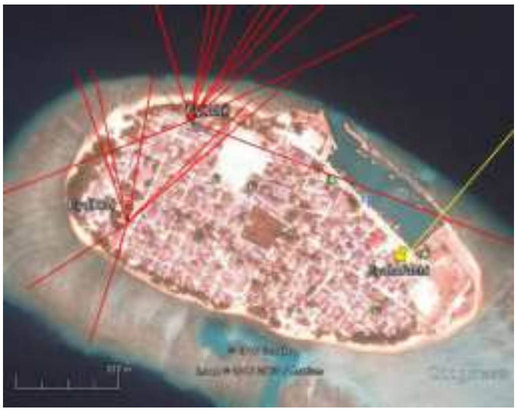
Fig 2-3-2 Location of Islands with Optical Fibre Links

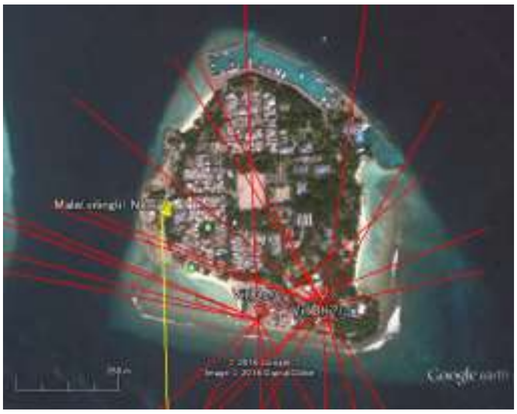
The leasing of links by DBNO from a telecom carrier for transmission of programmes to each transmitting station is a matter to be determined by tender in the future. Therefore it is judged appropriate that the transmitting stations to which the programmes will be transmitted using the links of a telecom carrier will be those on the islands where the optical fibre links are already laid as discussed above, and for the other transmitting stations a transmission network will be constructed by installing independent microwave links by the grant aid cooperation project and PSM.

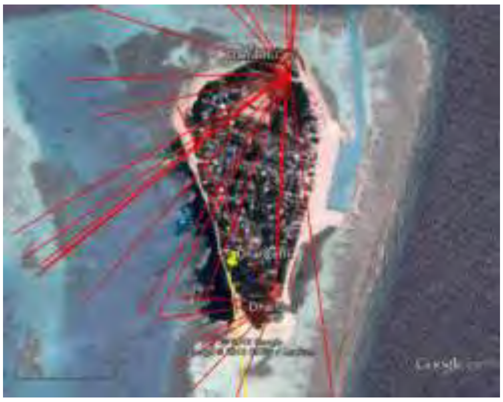
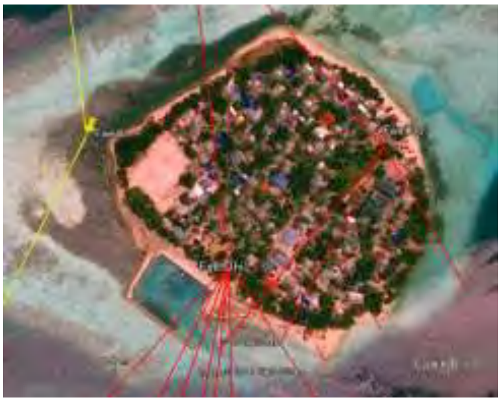
On the other hand, through this survey it was found that towers for microwave links of the two telecom carriers exist at all the DBNO transmitting station sites. If antenna towers for DTTB are to be newly installed, it will be necessary to properly investigate their location to ensure that they do not affect the existing telecom carrier microwave links. The following table shows the existing tower locations and link directions of the telecom carriers at the transmitting station sites that are the subject of the grant aid cooperation project. Based on the field reconnaissance, it was confirmed that the transmitting station sites will not affect the existing telecom carriers, so PSM has formally requested land acquisition at each site (currently awaiting a formal response).

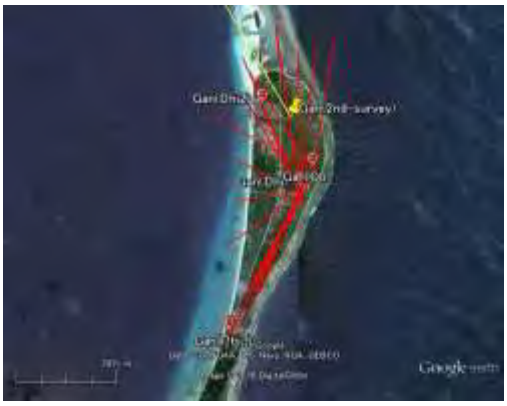
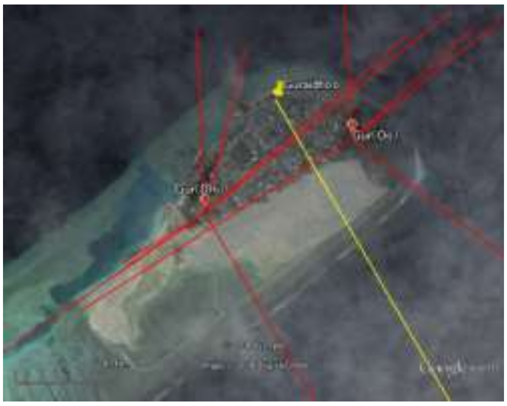
Table 2-3-2 Location of existing tower and link direction at each site

No.	Item / Station name	Location map of DTTB transmitting station/ existing links of telecom carriers	Remarks
1.	Dhidhdhoo		Ooredoo has a tower in the north of the island, with six microwave links. Dhiraagu has a tower in the south of the island, with 14 microwave links. The microwave links from the centre to the south of the island are congested, so it was necessary to take care over the transmitting station location.
2.	Kulhudhuffushi		Ooredoo has two towers, one in the centre and one in the south of the island, with a total of 10 microwave links. Dhiraagu has three towers, one in the centre of the island, one in the northwest, and one in the southwest, with a total of 17 microwave links. There is congestion of microwave links, so it was necessary to take care over the transmitting station location.

No.	Item / Station name	Location map of DTTB transmitting station/ existing links of telecom carriers	Remarks
3.	Funadhoo		Ooredoo has a tower in the north of the island, with six microwave links. Dhiraagu has a tower in the centre of the island, with eight microwave links. The microwave links from the north to the centre of the island are congested, so it was necessary to take care over the transmitting station location.
4.	Manadhoo		Ooredoo has a tower in the centre of the island, with four microwave links. Dhiraagu has a tower in the east of the island, with one microwave link. There are few microwave links, so provisionally determining the location of the transmitting station was easy.
5.	Ungoofaaru		Ooredoo has a tower in the centre of the island, with six microwave links. Dhiraagu has a tower in the west of the island, with five microwave links. There are many microwave links in the south of the island, so it was necessary to take care over the transmitting station location.
6.	Eydhafushi		Ooredoo has a tower in the west of the island, with seven microwave links. Dhiraagu has a tower in the northwest of the island, with 12 microwave links. There are many microwave links in the west of the island, but few in the east, so location of the digital terrestrial transmitting station in the east is ideal.

No.	Item / Station name	Location map of DTTB transmitting station/ existing links of telecom carriers	Remarks
7.	Naifaru		Ooredoo has a tower in the centre of the island, with three microwave links. Dhiraagu has a tower in the centre and slightly to the south of the island, with one microwave link. There are few microwave links, so provisionally determining the transmitting station location was easy.
8.	Villingili (Malé Transmitting Station)		Ooredoo has a tower in the south of the island, with 12 microwave links. Dhiraagu has a tower in the southeast of the island, with 14 microwave links. The microwave links are extremely congested, so it was necessary to take care over the location of the transmitting station. This was decided to be dealt with by moving the initial digital terrestrial tower location to the north.
9.	Maafushi		Ooredoo has a tower in the north of the island, with 12 microwave links. Dhiraagu has a tower in the centre of the island, with six microwave links. The microwave links are extremely congested, so it was necessary to take care over the location of the relay station.
10.	Felidhoo		Ooredoo has a tower in the north of the island, with four microwave links. Dhiraagu has a tower in the centre of the island, with six microwave links. The microwave links are congested on the west side of the island, so it is desirable that the transmitting station be located on the east side.

No.	Item Station name	Location map of DTTB transmitting station/ existing links of telecom carriers	Remarks
11.	Dhangethi		Ooredoo has a tower in the south of the island, with nine microwave links. Dhiraagu has a tower in the north of the island, with 18 microwave links. The microwave links are extremely congested, so it was necessary to take care over the location of the relay station.
12.	Feeali		Ooredoo has a tower in the northeast of the island, with four microwave links. Dhiraagu has a tower in the south of the island, with eight microwave links. The microwave links are congested towards the south side of the island, so it is desirable that the transmitting station be installed on the west side. (In the aerial photograph (taken 2010), the transmitting station is shown as being in the sea, but at present land reclamation construction is complete.)
13.	Nilandhoo		Ooredoo has a tower in the centre of the island, with five microwave links. Dhiraagu has a tower also in the centre of the island, with one microwave link. There are many microwave links on the east side of the island, so it was necessary to take care over the location of the transmitting station.

No.	Item / Station name	Location map of DTTB transmitting station/ existing links of telecom carriers	Remarks
14.	Gan		Ooredoo has a tower in the centre of the island, with five microwave links. Dhiraagu has three towers, one in the northwest of the island, one in the centre, and one in the south, with a total of 13 microwave links. There is congestion of microwave links, so it was necessary to take care over the transmitting station location. This was decided to be dealt with by moving the initial digital terrestrial tower location to the east.
15.	Guraidhoo		Ooredoo has a tower in the east of the island, with five microwave links. Dhiraagu has a tower in the west of the island, with nine microwave links. There are few microwave links on the north side of the island, so the north side is the ideal location for the transmitting station. This was decided to be dealt with by moving the transmitting station location from the initial candidate tower location to the northeast coastline.
16.	Gadhdhoo		Ooredoo has a tower in the centre of the island, with four microwave links. Dhiraagu has a tower in the west of the island, with five microwave links. Towards the north there is no congestion of existing links between the Ooredoo and Dhiraagu microwave links, so this is the ideal location for the transmitting station.

No.	Item / Station name	Location map of DTTB transmitting station/ existing links of telecom carriers	Remarks
17.	Fiyoari		Ooredoo has a tower in the centre of the island, with three microwave links. Dhiraagu has a tower in the west of the island, with one microwave link. There are few microwave links on the south side of the island, so this is the ideal location for the relay station.
18.	Thinadhoo		Ooredoo has a tower in the west of the island, with four microwave links. Dhiraagu has a tower in the east of the island, with seven microwave links. There are few microwave links on the west of the south side of the island, so this is the ideal location for the transmitting station.
19.	Villingili		Ooredoo has a tower in the south of the island, with three microwave links. Dhiraagu has a tower also in the south of the island, with six microwave links. There are few microwave links on the north side of the island, so this is the ideal location for the transmitting station.
20.	Foammulah		Ooredoo has two towers, one in the centre and one in the south of the island, with a total of six microwave links. Dhiraagu has a tower in the centre of the island, with four microwave links. There are no microwave links on the east side of the centre of the island, so this is the ideal location for the transmitting station. At the time of the field survey it was found that there is a Dhiraagu microwave link in the 225.71° direction that passes over the

No.	Item / Station name	Location map of DTTB transmitting station/ existing links of telecom carriers	Remarks
			proposed transmitting station site. However the antenna is more than 100m above ground level, so it is judged that the two links will not affect each other.
21.	Hithadhoo		Ooredoo has two towers, one in the centre and one in the north of the island, with a total of six microwave links. Dhiraagu has three towers in total, in the north and centre of the island, with a total of seven microwave links. The whole island is congested with microwave links, so it was necessary to take care over the location of the transmitting station. The microwave link connecting the Dhiraagu tower on the northernmost side of the island and the Dhiraagu tower in the centre is close to the proposed transmitting station location. However as a result of a second field survey it was found that moving the pole for installing the transmitting antenna a few metres within the PSM site this problem could be dealt with, so there is no problem with the proposed transmitting station location.

Note: White line: Existing microwave line of telecom carrier
Yellow line: Microwave line of digital terrestrial broadcasting network
Source: Created by JICA Survey Team

2-3-5 Natural Conditions

(1) Topography

Maldives is located in the Indian Ocean to the southwest of Sri Lanka, and is an island nation that includes 26 Atolls and about 1,190 islands over an area from latitude 0°40’ south to 7°7’ north, and longitude 72° to 74° east. Many of the islands have specified functions, with about 200 islands as residential islands, and about 100 islands as resort islands. In addition there are airport islands, industry islands, and agriculture islands. The national land is about 300km^2, which is about half the area of Awaji Island.

Eighty percent of the islands of the Maldives are less than 1.0m above sea level, and the highest value of elevation above sea level is 2.4m, so the topography is low, and in recent years it has been affected by the rise in sea level and destruction of coral reefs, and it is in danger of being submerged. Therefore one of the major issues for the government is countermeasures against climate change. Also in the regional Atolls, the development of infrastructure such as transport and communications is delayed due to the topography and the population distribution, so the difference between Malé and regional Atolls is a problem.

The digital transmitting stations that are the subject of this survey are to be installed in the national land of Maldives from Dhidhdhoo in the north to Hithadhoo in the south, but no difference in the climate was seen between north and south, and almost all the islands are Atolls formed from coral.

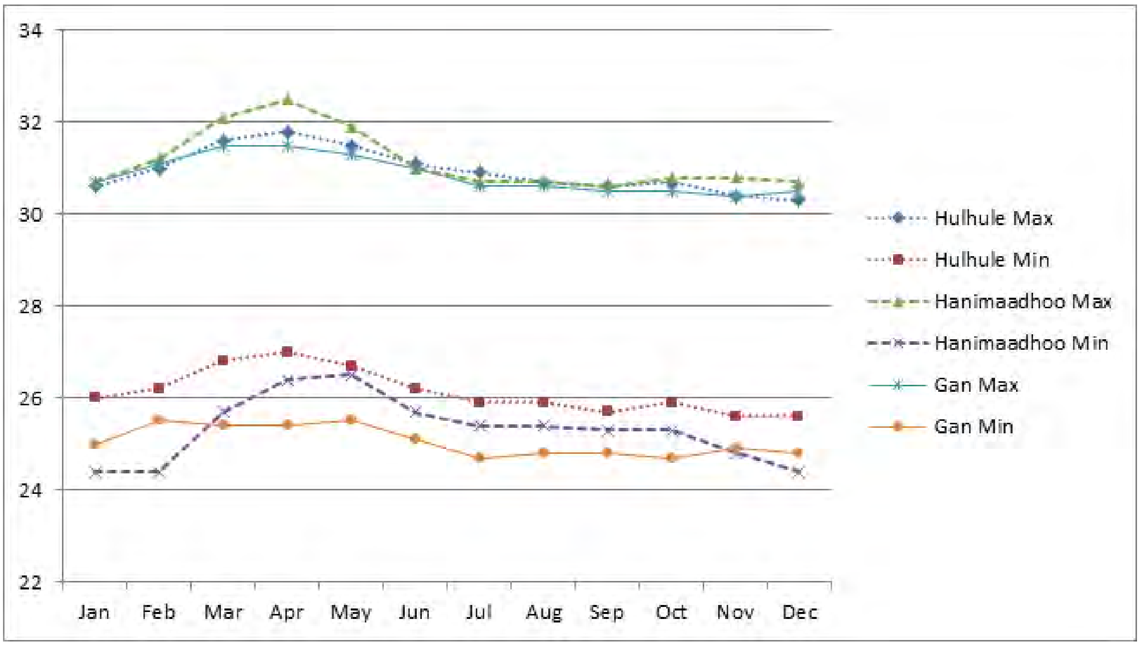
Therefore when implementing the project it is necessary to investigate efficient methods of transportation for the equipment and materials necessary for constructing the transmitting stations. Also it will be difficult for large ships to approach the coast of many of the regional islands for offloading equipment and materials, so this must be considered and factored into calculations.

(2) Weather

The Maldives has a hot and humid sub-tropical climate, and the average air temperature does not vary very much throughout the year. There is a dry season and a rainy season, with the dry season from January to March due to the effect of the dry northeast monsoon, and the rainy season from the middle of May to about November due to the effect of the southwest monsoon which brings much rain. The change from dry season to rainy season from March to May has the highest temperatures of the whole year.

The average air temperatures do not very much throughout the year. During the day the air temperatures reach about 31°C and during the night about 23°C. The highest temperature ever recorded was 36.8°C at Kadhdhoo on 19th May 1991, and the lowest temperature ever recorded was 17.2°C at MMS on 11th April 1978.

The following shows the monthly average air temperatures after 2000. From the figure it can be seen that there is not a large difference in the air temperature from place to place.



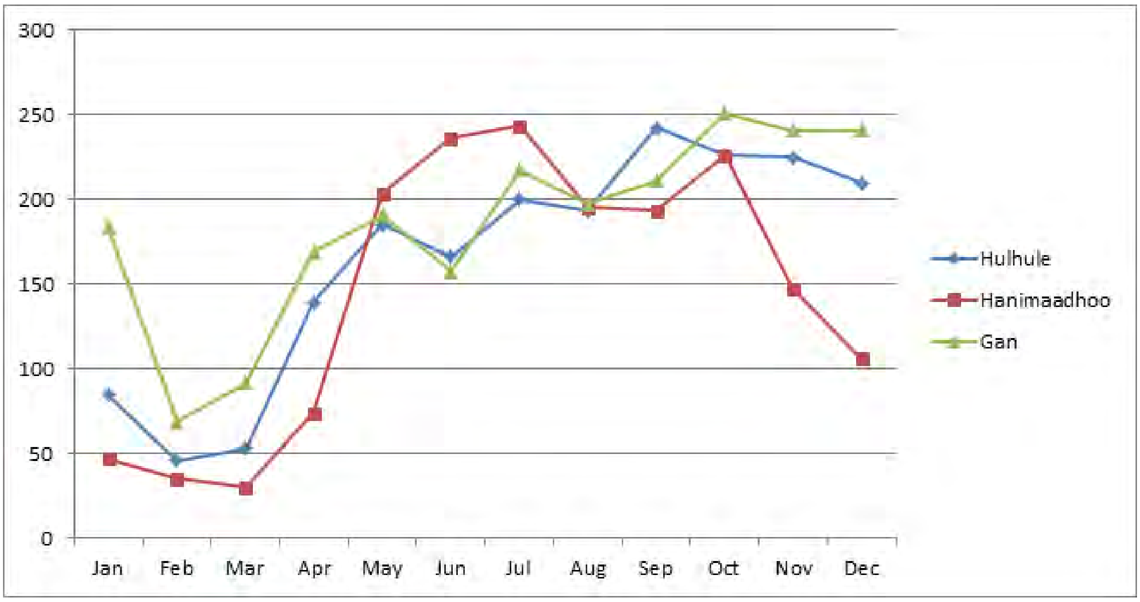
Source: MMS

Fig 2-3-3 Monthly Average Temperatures (average values after 2000)

The dry season and the rainy season are separated, but even in the dry season rain can fall. Also, during the rainy season the rain does not fall continuously, but overall it is cloudy, and once the rain starts to fall it can continue for about a week. However in recent years perhaps due to climate change, there have been continuous squalls during the dry season and continuous fine days during the rainy season. On 9th July 2002 rainfall of 219.8mm was recorded in a 24 hour period at Kaadedhdhoo.

The following shows the average monthly rainfall at three observatories since 2000. From the figure it can be seen that there is no large difference in rainfall from place to place.

From this, it is necessary to prepare a construction schedule that sufficiently takes rainfall into consideration.



Source: MMS

Fig 2-3-4 Average Monthly Rainfall (average rainfall values after 2000)

(3) Natural Disasters

Natural disasters are comparatively few in the Maldives. The Maldives are located on the Indo-Australian Plate where there are few earthquakes, but in the past major damage was caused by the tsunami produced by the Sumatra earthquake. In addition the main natural disasters in the Maldives include storms, tsunamis, high tides, rise in sea level, water shortage, and flooding. In particular the northern part is easily affected by strong winds, tidal surges, and flooding due to the effect of cyclones.

Therefore, it is desirable that the design of the antenna towers sufficiently takes into consideration wind load and oscillation angle, and the construction of the transmitting station buildings takes into consideration tsunamis, tidal surges, etc.

2-3-6 Environmental and Social Considerations

2-3-6-1 Environmental Impact Assessment

This project does not fall within a sector that is easily affected or an area whose characteristics are easily affected in accordance with the ‘JICA Guidelines for Environmental and Social Considerations’ (published April 2010), and it is judged that it does not have a major undesirable effect on the environment, so it is classified as category B based on these guidelines for environmental and social considerations.

2-3-6-1-1 Outline of Project Components that Have an Environmental and Social Impact

An outline of the project components is given in Chapter 3-1. Of these, the items that are considered to have an environmental and social impact are as follows. These are mainly felling of forests and trees, and the environmental impact during the construction period.

(1) Construction of Towers and Buildings

1) Acquisition of the Site

There will be no resettlement of residents, but if it is difficult to construct on an existing site or if there are no existing facilities, it will be necessary to acquire government land (already acquired by PSM), and depending on the location it will be necessary to fell forests and trees or prepare the ground (to be carried out by PSM).

2) Construction

(a) Foundation Construction

During foundation excavation and drainage operations to lower the groundwater levels, it will be necessary to process surplus soil and treat drainage.

(b) Construction of Superstructures

It will be necessary to ensure safety of construction, such as assembly of towers, etc.

(c) Transport of Construction Equipment and Materials, and Temporary Placement

It will be necessary to ensure safety of the nearby residents, homes, existing facilities, etc.

(2) After Entry into Service of the Towers, Buildings

It will be necessary to carry out inspection and maintenance for long-term corrosion and slackness of installed equipment to ensure that accidents do not occur due to objects falling from the towers.

2-3-6-1-2 Baseline Environmental and Social Status

(1) Natural Environment

1) Natural Environment in General

The climate, topography, geology, ground conditions, and natural disasters are described in Chapter 2-3-5.

2) Nature Conservation Areas

(a) Protection Areas

Table 2-3-3 shows the protection areas designated by the EPA. Protection areas are areas where the general public cannot enter, except for the purpose of academic study, and a permit is required for entry.

The target sites are all on residential islands, of which there is a protection area only on Hithadhoo Island, but it is more than 1km from the site.

Table 2-3-3 Protection Areas

Protected area	Protection details
Angafaru	The sea area outside the edge of the coral reef, and the biodiversity in the sea areas
Hanifaru	The sea area outside the edge of the coral reef, the coral reef, and the large sea animals
South Ari Atoll	The sea area on the outside of the shallow sea at the edge of the coral reef, and the locations where the large sea animals congregate
Hithadhoo	Lagoon and surrounding coral reefs, dense growth of lettuce trees (*Pisonia grandis*), nests of genus *Fregata* and other birds, marine invertebrates, the high diversity of fish, the habitats of sea turtles
Olhugiri	Lagoon and surrounding coral reefs, genus *Fregata* birds, red-billed tropicbirds, habitats of sea turtles
Hurasdhoo	Special terrain, environmentally endangered areas, unique species of pineapple plant, biodiversity
Huraa Mangrove Area	Mangrove forest, breeding grounds of protected birds
Filitheyo Kandu	The sea area outside the edge of the coral reef, and the biodiversity in the sea areas
Eidhigali Kilhi Koattery Area	Protected areas of Hithadohoo, coral reefs in all areas, large freshwater ponds, mangrove forests, shallow semi-enclosed lagoons, nests of protected birds, seaweed floor, concentrations of coral and marine life
Fushee Kandu	The strait between Meedhushi Faru and Maavaru Faru, the habitats of the large sea animals

Source: EPA web document, Protected Area Biodiversity and Conservation,
http://epa.gov.mv/index.php?option=com_content&view=category&id=5&Itemid=25

(b) Environmental Sensitive Areas

Two hundred and seventy four locations have been designated as Environmental Sensitive Areas (ESA). Environmental sensitive areas are areas for conservation of specified objects, after protection areas. This applies to special terrain characteristics, the ecosystems of coral reefs, mangroves, wetlands, seaweed beds, places where it is important to maintain the biodiversity over the long term, islands with natural resources such as coastal deposits, soil, water, etc. Table 2-3-4 shows the ESA designated areas on the islands with target sites.

Table 2-3-4 Environmental Sensitive Areas (ESA) in the Target Sites

Atoll	Islands with designated areas	Content
Haa Dhaalu	Kulhudhuffushi	There is a mark on the northern half within the island. The specified objects are mangroves and wetlands.
Shaviyani	Funadhoo	Displayed on the map but not stated on the list. On the east side of the southern 2/3 of the island, judged to be the vegetation of the lagoons and their surroundings.
Gaafu Dhaalu	Gadhdhoo	Sea area in the south-west end (strait)
Seenu	Hithadhoo	One area, Maabendhoo Kulhi, in the centre of the south side of the island (mangroves, wetlands), within the reef on the east side of the southern half of the island (seaweed beds)

Source: EPA Web document, List of Environmentally Sensitive Areas-Version 1, EPA Web document, Environmental Sensitive Area http://epa.gov.mv/index.php?option=com_content&view=article&id=230&Itemid=30

The positional relationships between the target areas and the ESAs are as follows.

a. Kulhudhuffushi of Haa Dhaalu: The target site (using an existing site) is near the southern tip of the island somewhat towards the east, 1.8km from the ESA. The east side of the island is reclaimed, and development is in progress.
b. Funadhoo of Shaviyani: The target site (new site) is more than 200m from the lagoon on the east side of the island.
c. Gaddhoo of Gaafu Dhaalu: The target site is reclaimed land on the north-east tip of the island, and is more than 1.5km from the strait on the south-west of the island.
d. Hithadhoo of Seenu: The target site (using an existing site) is in a residential area, and is 5km from the wetlands and seaweed beds of the ESA.

3) Environmental Protection Zones

The establishment of an environmental protection zone (EPZ) on 20m width of the coast is recommended by the Land Use Plan Guidelines. The area is indicated on the land use plan drawings of the Island Committee, at Villingili of Kaafu (10m to the EPZ) and Gan of Laamu (500m to the EPZ). The protected objects are a disaster prevention forest along the coast and a greenbelt.

Also, a related act to the Environmental Protection and Preservation Act (Law 4/93) states that areas with vegetation 15m or higher along the coast is protected.

4) Protected Flora and Fauna

The species of protected flora and fauna designated by the EPA are shown in Table 2-3-5. The specific names of the designated protected flora and fauna are shown in the **appendix (No.6 Other Relevant References and Information, 6.1 Documents relating to Environmental and Social Considerations (1) List of Designated Protected Flora and Fauna)**.

The target sites are all on residential islands. In the local interviews, it was reported that white and black geese are inhabiting the area around the lagoon in Villingili of Gaafu Alifu. The target site on this island is about 250m from the lagoon. Otherwise it is not known that protected species are inhabiting the areas around the target sites on each island.

Table 2-3-5 Numbers of Protected Flora and Fauna Designated

Protected Flora and Fauna	Classification	No. of Designated Species	Source
Bird species	Capturing, buying and selling, and retention is prohibited	70 species Additional 33 species	EPA document, Protected Bird of Maldives 2010 EPA document, Protected Bird List 2013
Marine species	Fishing, killing, capturing is prohibited	10 species	EPA document, Protected Marine Species in the Maldives
	Buying and selling is prohibited	11 species	Ditto
	Export prohibited	22 species	EPA document, State of the Environment Maldives 2011
Trees		1,831 species	EPA document, Protected Trees of Maldives, list in Divehi language

A list of protected old trees on each island has been prepared by the EPA. Focusing on the target islands, the number of registered old trees is shown on Table 2-3-6.

The number of registered old trees on each Atoll and each island and the list of registered old trees extracted for the target islands only are provided in the appendix (No.6 Other Relevant References and Information, 6.1 Documents relating to Environmental and Social Considerations (2) List of Registered Protected Old Trees). Also, the distance between the old trees and the target sites on the target islands, obtained by interviews during the field surveys are shown on Table 2-3-14.

In addition, a Ministry of Fisheries and Agriculture document introduces 13 species in mangroves that are subject to protection. (Trees and Shrubs of the Maldives, Mangroves trees and shrubs, MFA, FAO Regional Office for Asia and the Pacific)

Also, 30 species of common plants (10 species of trees) including those used for eating in the Maldives are introduced. (Common Plants of the Maldives 2010, Live & Learn Environmental Education)

Table 2-3-6 Numbers of Protected Old Trees within the Islands with the Target Sites

No.	Atoll	Island	Number of Designated Trees
1	Haa Alifu	Dhidhdhoo	6
		12 islands apart from the target islands	121
2	Haa Dhaalu	Kulhudhuffushi	11
		14 islands apart from the target islands	2109
3	Shaviyani	Funadhoo	Not designated
		13 islands apart from the target islands	85
4	Noonu	Manadhoo	7
		13 islands apart from the target islands	1832
5	Raa	Ungoofaaru	2

No.	Atoll	Island	Number of Designated Trees
		10 islands apart from the target islands	127
6	Baa	Eydhafushi	4
		11 islands apart from the target islands	112
7	Lhaviyani	Naifaru	Not designated
		4 islands apart from the target islands	42
8	Kaafu	Villingili	39
		4 islands apart from the target islands	37
9	Kaafu	Maafushi	Not designated
		6 islands apart from the target islands	13
10	Alifu Alifu	All (8 islands, no target islands)	11
11	Alifu Dhaalu	Dhangethi	Not designated
		7 islands apart from the target islands	24
12	Vaavu	Felidhoo	2
		3 islands apart from the target islands	7
13	Meemu	All (4 islands, no target islands)	10
14	Faafu	Feeali	2
		4 islands apart from the target islands	16
15	Dhaalu	All (6 islands, no target islands)	326
16	Thaa	Guraidhoo	1
		8 islands apart from the target islands	37
17	Laamu	Gan (Mathimaradhoo)	2
		Gan (Mukurimagu)	10
		11 islands apart from the target islands	36
18	Gaafu Alifu	Villingili	2
		4 islands apart from the target islands	12
19	Gaafu Dhaalu	Gadhdhoo	Not designated
		Fiyoari	Not designated
		6 islands apart from the target islands	31
20	Gnaviyani	Foammulah	30
21	Seenu	Hithadhoo	4
		2 islands apart from the target islands	24
		Total number of registered trees	5121

Source: Created by the Survey Team by translation of EPA document Protected Trees of Maldives (List)

Table 2-3-7 Distance from Protected Old Trees to Target Sites within Target Islands

Atoll	Island	Tree Species	Distance from Target Site
Kaafu	Villingili	Old wood within EPZ on the east coast	500m
Vaavu	Felidhoo	South-west of the island Nika Gas (Malayan Banyan tree) 3 No.	70m
Alifu Dhaalu	Dhangethi	Within the residential area in the centre of the island, Nika Gas (Malayan Banyan tree) 2 No.	350m

Source: Created by the Survey Team based on local interviews

(2) Social Environment

1) Living Environment for the Residents

(a) Air pollution

There is no air pollution around each of the target sites, and the air is clean.

(b) Noise and vibration

In the target areas, there is virtually no noise and vibration. During the survey, there was some generator noise at Maafushi of Kaafu Atoll.

(c) Water Resources and Water Use

The water resources and water use around each of the target areas are shown in Table 2-3-8. There are some islands where the public water supply has been completed and water is distributed to each house, and some islands where it has not been completed. The water resources for the public water supply are desalinated seawater and in part deep wells.

On the islands where the public water supply is not completed, each house stores rainwater, which is used for daily living. Normally each house has a shallow well, but because it is salty, it is used for toilet water, and in some cases for showers.

Table 2-3-8 Water for Daily Living, Wells around the Sites, Sewage, and Drainage Channels on the Islands with Target Sites

No.	Atoll	Island Name	Water for Daily Living		Wells around the Sites		Sewage	Drainage Channel
			Public water supply	Rainwater storage	Deep well	Shallow well		
1	Haa Alifu	Dhidhdhoo	○	○	×	○	×	×
						T		
2	Haa Dhaalu	Kulhudhuffushi	○	○	×	×	○	×
3	Shaviyani	Funadhoo	○	○	×	×	×	×
4	Noonu	Manadhoo	○	○	×	○	×	×
						T		
5	Raa	Ungoofaaru	○	○	×	○	×	×
						T		
6	Baa	Eydhafushi	○	○	×	○	×	×
						T		
7	Lhaviyani	Naifaru	○	○	×	○	×	×
						T		
8	Kaafu	Villingili	○	○	×	○	○	×
			DSP			T, S		
9	Kaafu	Maafushi	○	○	×	○	○	×
			DW			T, S		
10	Vaavu	Felidhoo	×	○	×	○	×	×
11	Alifu Dhaalu	Dhangethi	×	○	×	○	×	×

No.	Atoll	Island Name	Water for Daily Living		Wells around the Sites		Sewage	Drainage Channel
			Public water supply	Rainwater storage	Deep well	Shallow well		
						T, S		
12	Alifu Dhaalu	Feeali	×	○	×	○	×	×
						T, S		
13	Faafu	Nilandhoo	×	○	×	○	×	×
						T, S		
14	Laamu	Gan	○	○	×	×	×	×
			Not connected			100m		
15	Thaa	Guraidhoo	×	○	×	○	×	×
						T, S		
16	Gaafu Alifu	Villingili	○	○	×	○	×	×
						T		
17	Gaafu Dhaalu	Gadhdhoo	○	○	×	○	×	×
						T		
18	Gaafu Dhaalu	Fiyoari	×	○	×	○	×	×
						T		
19	Gaafu Dhaalu	Thinadhoo	○	○	×	×	×	×
20	Gnaviyani	Foammulah	○	○	×	○	×	×
						T		
21	Seenu	Hithadhoo	○	○	×	×	×	○
								200m

○: Yes, ×: No, DSP: Desalination plant, DW: Deep well, T: Toilet, S: Shower
Numbers are the distance from the site
Source: Created by the Survey Team based on local interviews

2) Historical Heritage

According to the Seventh National Development Plan 2006 – 2013, there is insufficient protection and development of the historical heritage in the Maldives, and it is necessary to develop systems including establishment of policies, implement a nationwide survey, and develop a National Museum. It states that as a result of the tsunami in 2004, damage occurred to the old Mosque in Kolhufushi and Baarah, Maroshi, Huraa, Maabaidhoo, Kinbidhoo, Nilandhoo, etc. where there are ruins of pre-Islam temples and Mosques.

The historical heritage and the distances from the target sites on the islands with these sites are shown on Table 2-3-9.

Table 2-3-9 Historical Heritage and Distances from the Target Sites on the Islands with these Sites

Atoll	Island	Historical Heritage	Distance from Target Site
Alifu Dhaalu	Dhangethi	Old Mosque	300m
Faafu	Nilandhoo	Asary district, an old Mosque at ruins of a pre-Islam temple	200m

Source: Created by the Survey Team based on local interviews

3) Ethnic Minorities and Indigenous People

Based on the local interviews, there are no specially categorised ethnic minorities or indigenous peoples in the sites where the target sites are located.

2-3-6-1-3 Environmental and Social Considerations Systems and Organisations in the Recipient Country

Implementation and approval of environmental impact assessment (EIA) for development projects are carried out by the Environmental Protection Agency (EPA) under the jurisdiction of the Ministry of Environment and Energy (MEE).

The section that deals with EIA is the Environmental Compliance and Assessment Section, within which the Assessment Unit carries out EIA screening, scoping, TOR for EIA, and issues decision documents, and the Compliance Unit carries out inspections to determine that activities are being performed in accordance with each EIA report.

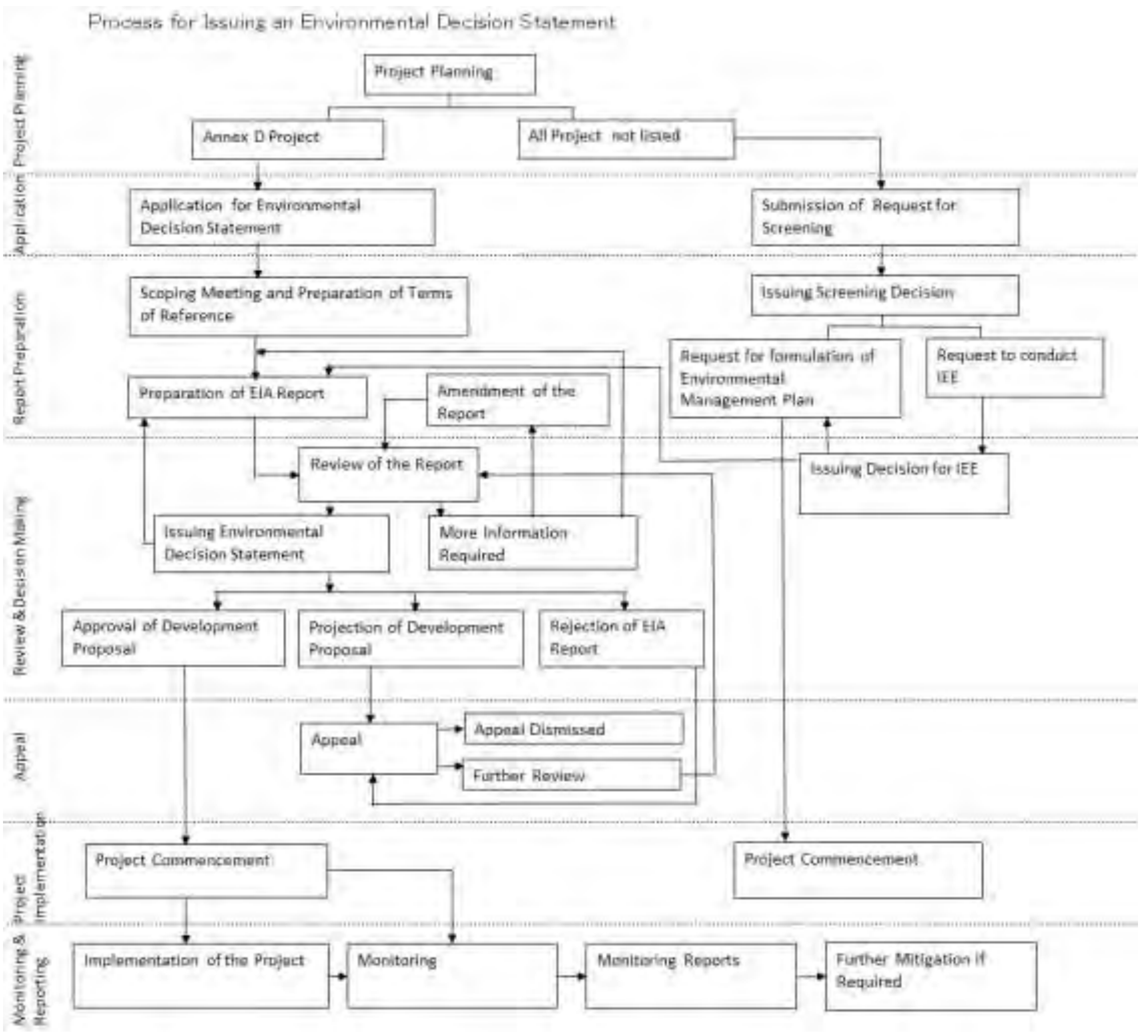
The 2007 EIA Regulations prescribe the responsibilities of the section carrying out the EIA as follows.

(a) Carry out scoping meetings with developers that propose to carry out development activities within Maldives and that have applied for an EIA, and finalise the TOR for these projects
(b) Evaluate EIA reports and issue Environmental Decision Statements (EDS)
(c) Implement monitoring at the development site to ensure strict compliance with the issued EDS
(d) Verify monitoring data submitted by the developer during the construction and operation period of the development project
(e) Examine projects that require an EIA study but are not listed in the EIA Schedule D
(f) Registration of EIA consultants and renewal registration certificates
(g) Implement activities to familiarise the public regarding EIA

In the case of this project, the EIA Regulations (2012 and 2015) do not state that an EIA should be implemented for this type of project, so the project implementation organisation PSM should submit an application for scoping, and at the scoping meeting, the following should be decided, and instructed by the EPA.

(a) Implementation of an EIA
(b) Implementation of an IEE
(c) Formulation and submission of an environmental management plan
(d) The project can be implemented because there is no impact on the environment
(e) The project should proceed in accordance with the Ministry's guidelines, in order to minimise the impact on the environment.

Thereafter the procedure is in accordance with the EIA/IEE application and approval flow shown in Fig. 2-3-5. Also, the laws and regulations associated with the EIA for this project are shown in Table 2-3-10.



Source: EIA Regulation 2012 (Dhivehi)

Fig 2-3-5 EIA/IEE Application and Approval Flow Diagram

Table 2-3-10 Main EIA-related Laws and Regulations Relevant to this Project

Laws and Regulations	Prescripts relevant to EIA
Environmental Protection and Preservation Act (Law 4/93)	Prescribes that for all development projects affecting the environment, an EIA should be carried out before the project is implemented.
Environmental Impact Assessment (EIA) Regulations	Prescribes the method of application and the procedures for approval, the forms for the submission documents, and the contents that should be contained in the report. These were issued in 2007, 2012, and 2015 (amended in part).
Third National Environment Action Plan (2009 – 2013) (NEAP III)	Sets an environmental plan for the period 2009 to 2013 and management issues. The objective is to reliably reduce the environmental impact of projects by strengthening the EIA process, and implementing an EIA before start of a project.

Laws and Regulations	Prescripts relevant to EIA
National Biodiversity Strategy and Action Plan (NBSAP)	The objective of the NBSAP is the conservation of biodiversity and the sustainable use of biological resources in all areas of national planning, development, and management policy. It strengthens the formulation of appropriate development plans, the application of procedures, land use plans, and EIA processes, in order to achieve these objectives. By carrying out an EIA prior to implementing a project, measures can be applied in order to reduce the environmental impact of the project, and to carry out monitoring and management during the project operation period.
Protected areas and sensitive area	Under Article 4 of the Environmental Protection and Preservation Act, the MEE is given the authority to designate and register protected areas and national parks, and to formulate regulations for their protection and conservation.
Guidelines for Land Use Planning – 2005	Environmental Protection Zones (EPZ) of minimum width of 20m formed from vegetation are set along the seashores of islands and along the periphery of islands between the land. EPZ do not include land for harbours or commercial land. When construction work was started in an EPZ before these guidelines were adopted, this work can be completed, but additional construction work cannot be started in the EPZ.
Regulations on Felling, Removing, Uprooting and Relocation Palms and Trees to other Islands	Felling, removing, uprooting, and relocation of palms and trees from one island to another island can only be carried out if there is no alternative. In addition, when felling, removing, uprooting, and relocation of palms and trees from one island to another island is carried out, it is prescribed that two or more trees shall be planted in that island, and allowed to grow. Palms and trees that may not be felled, removed, or uprooted are as follows. Palms and trees 1) within 15m from the boundary line of the coast, 2) within a protected zone designated by the Government, 3) designated by the Government in order to protect biodiversity, or 4) palms and trees having special characteristics. In addition, a) exceptions (mainly matters regarding seed beds), b) approval for felling, removal, uprooting, and relocation to another island, c) special approvals, d) evaluation of growth rates and determining limits on quantities that can be removed, e) conditions for approval of felling, removal, uprooting, and relocation to another island, f) prohibition of waste backfilling after removal, g) penalties for violation, and h) definitions are prescribed.
Regulations on Conservation of Old Trees	1) Introduction, 2) Objectives, 3) Species of protected plants, 4) Protection, 5) Exceptions, 6) Determination of the range over which trees should be protected, 7) Protected plants and conservation of trees, 8) Responsibilities for maintenance of trees, 9) Basic policy of conservation activities, 10) Conservation of trees for protected flora

Laws and Regulations	Prescripts relevant to EIA
	and fauna located close to city buildings and residential areas, 11) Report on protected plants and species, and 12) Compensation are prescribed.
Regulations on Catching and Adopting Migratory Birds as Pets	1) Introduction, 2) Title, 3) Objectives, 4) Formulation of regulations, 5) Implementation of regulations, 6) Protection of seasonal migratory birds, 7) Standards for recognition of migratory birds, 8) Exceptions, 9) Surveys of migratory birds, 10) Penalties, 11) Definitions, and an Appendix on payment of fines are prescribed.
Ministry of Fisheries and Agriculture (MFA) Law on Protected Plants	Prescribes quarantine and insect control for imported plants.
Regulations on Environmental Damage Lability and Fines	The objectives are to ensure that economic and social development are within the standards for environmental conservation and sustainable development, reduction in environmental damage, biodiversity and natural resources, setting criteria and standards for penalties, and guidance for the employees of the Competent Authority, the EPA. 1) Exceptions to the regulations, 2) Measures against environmental damage or the potential therefor, 3) Measures by managing organisations, 4) Authorisation of projects with the potential to cause environmental damage, 5) Measurement of damage, 6) Remediation of damage, 7) Appeals, 8) Authority of managing organisations, 9) Submission of information to managing organisations, 10) Determining penalties, 11) Determining fines, 12) Responsibility for environmental damage, 13) Amendment of regulations, and 14) Definitions are described.
Dewatering Regulations (2013/R-1697) – 31st January 2014	Wastewater is discharged by the construction industry and some other industries, so the Dewatering Regulations were prepared to provide guidance on measures to reduce the effect on the environment and the ecosystem. All developments that require discharge of wastewater as a part of the project can only carry out the wastewater discharge phase after obtaining the necessary permit from the EPA, which is the implementing authority for these regulations. These regulations do not apply to wastewater for installation/ purification of wells for individual use or to the use of groundwater for agricultural purposes. The project applicant must submit to the EPA the necessary documents and the application form as described in detail in the regulations, before discharging the wastewater. If there is a residential area or agricultural land within 100m of the site where the wastewater is to be discharged, the applicant is responsible for notifying the relevant Island Committee. The regulations describe in detail what should be done in terms of

Laws and Regulations	Prescripts relevant to EIA
	water pumping during the wastewater discharge period, and what should be done when the wastewater could affect water resource users within a radius of 30m from the site. The regulations also prescribe the penalties to be applied in the event of non-compliance with the regulations. A proposed project is recognised as being in compliance by submitting an application to discharge wastewater within the project site. In order to obtain the EPA approval, the applicant must take all additional measures necessary to ensure compliance with the regulations.
Waste Management Regulations (R-58/2013)	The objective of the regulations is the implementation of the national policy on waste management. The managing organisation is the EPA. 1) Waste management standards (waste collection, transport, processing, storage, disposal sites, hazardous waste management), 2) Obtaining a waste management permit, 3) Transport of waste (transport to the closest local waste facility), 4) Reporting and information collection, and 5) Legal costs, etc., are prescribed. Appendices deal with (a) waste arising in construction and demolition of buildings, (b) waste incineration standards, and (c) waste combustion. Appendix (a) describes in detail i) Planning and implementing measures to minimise waste production, ii) Reduction of construction waste, iii) Reuse of demolition materials, iv) Designated local waste and storage, v) Prevention of air pollution in the surroundings during demolition.
Maldives National Building Code Handbook (1st Edition – August 2008)	The handbook makes recommendations from the point of view of practicality rather than compliance with regulations for construction work. The handbook covers aspects such as structural stability, fire safety, access, adjustment of humidity, durability, services, equipment, energy efficiency, etc.

Source: Created by the Survey Team by reference to the EPA document 'Summary Report on National Adaptation Plan Process in the Maldives, Environmental Impact Assessment for the Construction of 52 Housing Units in Villingili, Gaafu Alifu Atoll 2015', and other EIA reports, in addition to the content of English translations of relevant laws and regulations in the Dhivehi language.

The types of project requiring an EIA study have been amended in 2012 and 2015 from the 2007 EIA Regulations, and are currently as follows.

1) Aquaculture projects for commercial purposes, 2) Fish processing projects for commercial purposes, 3) Artificial reefs exceeding $100m^2$, 4) Agricultural projects (individual farms exceeding 1ha), 5) Poultry or livestock breeding farms for commercial purposes, 6) Harbour construction and dredging (excluding refurbishment of existing harbours without expansion), 7) Harbour inlet dredging (excluding refurbishment of existing harbour inlets without expansion), 8) Paved roads, roads, bridges,

concrete piers, 9) Land development, 10) Coastal defences, 11) Soil erosion prevention projects, 12) Soil gathering using heavy machinery, 13) Road paving projects, 14) Airport construction and airport runway modification, 15) Heliport construction, 16) Seaplane hub airport construction, 17) Housing projects for more than 150 residents, 18) Buildings higher than 31m, 19) Buildings having foundations for buildings higher than 31m, 20) Buildings having piled foundations, 21) Buildings having a foundation or part thereof more than 6 feet (1.83m) deep, 22) Buildings having an underground level more than 3m below ground and more than 172 square feet (19.6m^2) in plan, 23) Manufacturing and packaging factories (projects exceeding an initial investment of 15 million MVR), 24) Incinerators exceeding 10 tons, 25) Waste and trash landfill, 26) Waste and trash disposal facilities (exceeding a processing capacity of 10 tons per day), 27) Desalinated water production systems, 28) Electricity and electricity distribution systems, 29) Installation of pipes in the sea, 30) Construction of electrical power generation buildings, 31) Modification of the installation location of electrical power generation buildings and installation of generators exceeding 1 megawatt, 32) Gas or petroleum excavation stations in the sea or on land, 33) Establishment of desalination plant and ice production plant with a production capacity exceeding 10 tons (excluding installation of a new discharge outlet or discharge pipe without changing the plant's installation location), 34) Hospitals exceeding 50 beds.

The contents required in the EIA report and the IEE report is prescribed in the EIA regulations (2012).

2-3-6-1-4 Comparison of Alternative Schemes (Including the Zero Option)

Table 2-3-11 shows a comparison of alternative schemes.

An alternative scheme with fewer trees felled, as emphasised by the EPA, and the zero option were studied as alternative schemes to the current scheme. The current scheme is recommended for the following reasons.

(a) With the zero option the population coverage percentage of analogue terrestrial broadcasting is 83.23%, but the terrestrial broadcasts that can be received by each Atoll is PSM only, and on some Atolls the noise is significant, so it is not practical. Also there are transmitters that do not operate, so there are significant differences in the reception of important information (including disaster prevention information).

(b) With the alternative scheme, changes were made in order to reduce the amount of tree felling as much as possible; the site area of sites requiring a lot of tree felling was reduced (sites at nine locations), and as much as possible existing sites were used so that tree felling is not necessary (sites at four locations). Reducing the site to a standard 20×20 m can contribute to a reduction in the extent of tree felling, but the reduction was not significant, and a separate slim type of tower needs to be constructed, so it would be necessary to increase the strength and weight of the members, and separate construction procedures would be necessary, so the cost would be increased and the construction period lengthened.

(c) With the current scheme, the population coverage percentage of the digital terrestrial broadcasting network is 91.32%, and it will be possible to broadcast HD×4 programmes, SD×4 programmes, data broadcast×2 programmes, and one-seg×2 programmes, so the difference in information between Atolls will be corrected, which can contribute to disaster management and climate change countermeasures. Standard sites of 30m×30m will be provided, and a uniform standard of tower and station building with a standard design will be efficiently constructed using uniform procedures. However, among the 21 sites where construction is required, at 10 sites it is necessary to fell forests or trees. As a result of this tree felling the habitat and activity area of the nearby animals will be narrowed, so there is a possibility that this will affect the biodiversity. For this reason the alternative schemes were devised.

Table 2-3-11 Comparison of Alternative Schemes

Item		Alternative Scheme 1	Alternative Scheme 2	Current Scheme
Facility construction	Overview	Digital broadcasting network facility construction with reduced felling of forests (When it is necessary to fell forests, as much as possible existing sites are used and facilities are constructed by designing with a smaller site.)	Zero option	Construction of the digital broadcasting network facilities with a standard design (If construction of the standard design of facility is not possible within an existing site, a new site is secured.)
	Total number of construction sites	21	0	21
	Number of existing sites (that require tree felling)	9		5
	Number of existing sites (that do not require tree felling)	5		5
	Number of new sites (that require tree felling)	0		4
	Number of new sites (that do not require tree felling)	7		7
	Number of sites reduced in size	9		0
Technical aspects	Predicted broadcast reception use	The coverage percentage of the digital terrestrial broadcasting network is 91.32% Broadcast of HD×4 programmes, SD×4 programmes, data broadcasts×2 programmes, and one-seg×2 programmes will be enabled, the information difference between Atolls will be corrected, which can contribute to disaster management and measures against climate change.	Population coverage percentage of the analogue terrestrial broadcasting network is 83.23% The domestic programmes that can be viewed in each Atoll are PSM programmes only, so there is a disparity in the media access in the Atolls.	The coverage percentage of the digital terrestrial broadcasting network is 91.32% Broadcast of HD×4 programmes, SD×4 programmes, data broadcasts×2 programmes, and one-seg×2 programmes will be enabled, the information difference between Atolls will be corrected, which can contribute to disaster management and measures against climate change.
	Technical viewpoints	Construction will be carried out in accordance with individual designs at sites in locations where tree felling is necessary. Because of the reduction in size of the sites, a slim type of tower will be necessary, so it will be necessary to increase the strength and weight of	There is significant noise at present, and there are some PSM transmitters that are not operating. Private sector subscription-based satellite broadcast reception systems are spreading, but due to the economic disparity between the capital and the regional islands, there	As a result of the standard design in accordance with tower height, uniform standard fabrication of members and uniform construction procedures are enabled.

Item		Alternative Scheme 1	Alternative Scheme 2	Current Scheme
		the members, strengthen foundations, and carry out individual construction procedures.	are many households in the regional islands for whom subscription is difficult, so it is not possible to resolve the disparity in important broadcast reception (including disaster prevention information).	
	Project cost amount (tower and station building construction cost only)	Construction cost of current scheme of towers and station buildings 1,181.723 million yen	0 yen	Construction cost of current scheme of towers and station buildings 929.580 million yen
Environmental and Social Considerations	Social environment	Existing sites (expanded in some cases) and new sites are Government land, so no resettlement of residents will occur. In the sites whose size is reduced, it will be necessary to strengthen safety management during construction.	The present status is maintained Reception of PSM is limited in part, and there is a disparity in the reception of important information (including disaster prevention information) depending on location.	Existing sites (expanded in some cases) and new sites are Government land, so no resettlement of residents will occur. Safety management during construction is necessary.
	Natural environment	An average 20×20m site is necessary, and at nine sites felling of a wood or many trees is necessary. This will reduce the habitat and activity area of the wildlife in the surrounding forest.	The present status is maintained	An average 30×30m site is necessary, and at nine sites felling of a wood or many trees is necessary. This will reduce the habitat and activity area of the wildlife in the surrounding forest.
	Measures to mitigate the environmental impact	Transplanting or replanting will be carried out to replace the main trees felled.		Transplanting or replanting will be carried out to replace the main trees felled.
Recommended ideal scheme and basis of the recommendation		Not recommended. The development area with tree felling can be reduced compared with the current scheme, and the mitigation measures to ensure biodiversity are advantageous compared with the current scheme. The construction cost is increased, and the construction period is increased by the complexity of the individual construction, and safety management is more complex.	Nor recommended. Reception of PSM is limited in part, and the disparity in notification and understanding of important information (including disaster prevention information) depending on the location is not improved.	Recommended as the ideal scheme. The extent of the development requiring tree felling is greater compared with Alternative Scheme 1, but biodiversity can be maintained and restored by mitigation measures, etc. The project cost is standard, and by standard design, construction, and management, safety is ensured, and the construction

Item	Alternative Scheme 1	Alternative Scheme 2	Current Scheme
			period can be shortened. As a result of the shortening of the construction period the environmental impact is reduced, and recovery is easier.

Source: Created by JICA Survey Team

2-3-6-1-5 Scoping

The scoping impact items and evaluation reasons for this project are as shown in Table 2-3-12.

Table 2-3-12 Scoping

Category	No.	Environmental Item	Evaluation		Evaluation Reason
			Before/During construction	During service	
Mitigation Measures	1	Air Pollution	B-	D	During construction: A temporary worsening of the air quality due to the operation of construction machinery is envisaged. During service: No worsening in air quality is envisaged due to the towers and buildings.
	2	Water Pollution	B-	D	During construction: It will be necessary to discharge wastewater from the construction locations mainly during construction of the tower foundations, and depending on the processing of the wastewater there is a possibility of contamination of the groundwater or seawater. During service: Water pollution due to the towers and buildings after completion is not envisaged.
	3	Waste	B-	D	During construction: Ground preparation will be carried out by PSM, but there is a possibility that a surplus spoil disposal area will be necessary for the soil excavated from the foundations. Also, if the site is on reclaimed land, there is a possibility that deposited waste will be excavated in the excavation for foundations, and in this case it will be necessary to dispose of the waste. During service: Waste will not be generated from the towers and buildings after completion.
	4	Soil Contamination	B-	D	During construction: There is a possibility of soil contamination due to leakage of oil from construction machinery and vehicles. It is envisaged that this quantity will be small from the scale of the construction and the construction machinery used. During service: There will be no oil leakage from the towers and buildings after completion, so soil contamination will not arise.

Category	No.	Environmental Item	Evaluation		Evaluation Reason
			Before/During construction	During service	
	5	Noise and Vibration	B-	D	During construction: Noise and vibration from construction machinery and vehicles is envisaged. During service: Noise and vibration from the towers and buildings is not envisaged.
	6	Subsidence	D	D	From the results of soil surveys, the foundations will be established on stable ground, so ground subsidence is not envisaged.
	7	Odour	D	D	Odours are not envisaged during construction or after completion of the facilities.
	8	Sediment	D	D	It is envisaged that the construction work and the completed facilities will not affect sediment.
Natural Environment	9	Protected Area	B-	D	During construction / During service The islands where the towers and buildings will be constructed are all residential islands, and are not in protection areas or sensitive areas designated by the EPA. Even in residential islands vegetation within 1m of the coast is protected, and, 20m environmental protection zones are established along the coasts in some cases. Depending on the location of the site there is a possibility of some effect.
	10	Ecosystem	B-	D	During construction / During service The sites have not been established in the habitats of protected flora and fauna, but in locations where woods are felled or trees are felled, the activity areas of normal flora and fauna and the eco-region may be affected.
	11	Hydrology	D	D	No change in the hydrology is envisaged due to the construction of the towers and buildings or the completed facilities.
	12	Topography and Geology	D	D	No change in the topography or geology is envisaged due to the construction of the towers and buildings or the completed facilities.
Social Environment	13	Resettlement	D	D	There are no residents within the sites, so no resettlement of residents is envisaged.
	14	Poverty Group	D	D	The effect on the local residents will be the same, and there will be no particular burden on the poverty group.

Category	No.	Environmental Item	Evaluation		Evaluation Reason
			Before/During construction	During service	
	15	Ethnic Minorities and Indigenous People	D	D	There are no ethnic minorities or indigenous peoples living on the target islands.
	17	Living and Livelihood	C	B+	During construction: No hindrance to the residents' living and livelihood due to the construction of the towers and buildings is envisaged, but it will be necessary to check traffic congestion, etc., locally. During service: As a result of multiplexed broadcasts, it will be possible to view many programmes and obtain disaster prevention information.
	18	Heritage	C	D	There is an old Mosque (old temple) but they are 150m or more from the site, so they are not envisaged to be affected by the construction of the towers and buildings or by the completed buildings. However, survey and designation of national cultural assets has not been carried out, so it is necessary to check locally whether or not there are protected facilities in the area.
	19	Landscape	D	D	Towers of communication providers have been constructed and are in operation in each of the target islands. It is not envisaged that construction of the towers and buildings and the completed facilities will have an adverse effect on the landscape.
	20	Gender	D	D	It is not envisaged that the construction of the towers and buildings and the completed facilities will impose any particular gender burden.
	21	Working Conditions	B-	D	During construction: There is a possibility of the effects of a temporary worsening of air quality and noise and vibration during excavation of the foundations. Also, there is the danger of a worker falling from a high location, or materials or equipment being dropped and injuring a worker. During service: It is not envisaged that there will be any obstacle to maintenance of the working conditions in the completed facilities.
Other	22	Accident	B-	D	During construction: There is a possibility of injury to a resident or a worker due to a falling object during work at an elevated

Category	No.	Environmental Item	Evaluation Before/During construction	Evaluation During service	Evaluation Reason
					location or mistaken operation of a crane, etc. Also, there is a possibility of occurrence of an accident during materials and equipment transport or at a temporary placement area. Safety measures will be necessary. During service: It is not envisaged that accidents will occur to the facility operators or nearby residents in the completed facilities. However, it will be necessary to prohibit entry of residents to the tower, and to carry out inspection and maintenance of the aging tower.

(Note) Evaluation A+/-: Serious positive/negative impacts is expected.
Evaluation B+/-: Some positive/negative impacts is expected.
Evaluation C: Extent of positive/negative impact is unknown (Examination is needed. Impacts may become clear as study progresses.)
Evaluation D: No impact is expected.
Source: Created by JICA Survey Team

2-3-6-1-6 TOR for Environmental and Social Considerations Study

From the above scoping, the TOR for environmental and social considerations study is as summarised in Table 2-3-13.

Table 2-3-13 TOR for Environmental and Social Considerations Study

Environmental Item	Study Item	Study Method
Air Pollution	1) Confirmation of environmental standards (Maldives environmental standards) 2) Effect during construction	1) Survey of existing documents 2) Confirmation of construction content, construction methods, construction period, locations, extent, types, operating positions, operating time periods of construction machinery, number of trips, time periods, and routes of construction vehicles, etc.
Water Pollution	1) Confirmation of environmental standards (Maldives environmental standards) 2) Confirmation of status of use of groundwater, positions of wells, etc. 3) Effect during construction	1) Survey of existing documents 2) Confirmation on site 3) Use of water during the construction period, drainage plan, types, operating positions, operating times, numbers of drainage equipment and machinery, etc., quantity of wastewater discharged
Waste	1) Processing of landfill waste associated with excavation of foundations on reclaimed land, etc. 2) Processing of surplus excavation spoil	1) Survey of existing documents 2) Interviews with relevant organisations, and with the local residents
Soil	1) Processing of oil spills during	1) Confirmation of types, operating locations,

Environmental Item	Study Item	Study Method
Contamination	construction	time periods, etc. of construction machinery, vehicles
Noise and Vibration	1) Confirmation of schools, hospitals, private homes, etc., near the construction sites 2) Effect of noise and vibration during construction	1) Confirmation on site 2) Confirmation of types, operating locations, time periods, etc. of construction machinery, vehicles
Protected Area	1) Confirmation of designated protection areas, sensitive areas 2) Confirmation of other protected areas (vegetation along the coast, environmental protection zones)	1) Survey of existing documents 2) Local interviews
Ecosystem	1) Confirmation of the habitats of protected flora and fauna 2) Effect of felling of woods and trees	1) Survey of existing documents 2) Confirmation on site, local interviews
Living and Livelihood	1) Effect of the construction on the daily lives of the residents (traffic restrictions, etc.)	1) Confirmation on site
Heritage	1) Presence or otherwise of historical heritage, and effect thereupon	1) Survey of existing documents 2) Local interviews
Working Conditions	1) Working safety measures	1) Confirmation of similar examples (confirmation of methods applied on similar projects) 2) Confirmation on site
Accident	1) Measures to prevent accidents during construction (safety measures for the construction site and nearby residents)	1) Survey of similar projects 2) Confirmation on site

Source: Created by JICA Survey Team

2-3-6-1-7 Results of Environmental and Social Considerations Study (Including Prediction of Effects)

Table 2-3-14 shows the results of the study to confirm the status around the target sites carried out by the Survey Team.

Also, the items regarding which response is necessary in terms of environmental and social considerations at each site are extracted in Table 2-3-15.

Table 2-3-14 Results of the Study to Confirm the Status around the Target Sites

No.	Atoll Name	Island Name	Confirmation Item	Existing Site	New Site	Remarks
1	Haa Alifu	Dhidhdhoo	Can be used or not	○	Not necessary	Construction at the existing site is possible
			Site size	1789		
			State of site	Wooded area / Surroundings: residential area		
			Environmental impact	Felling of wood, school 50m, residences nearby		
2	Haa Dhaalu	Kulhudhuffushi	Can be used or not	△	○	
			Site size	750	2200	
			State of site	Grassy ground, trees / Surroundings: residential area	Forest / Surroundings: residential area	
			Environmental impact	The site is narrow, trees to be felled (few), adjacent to residences	Felling of forest, adjacent to residences	
3	Shaviyani	Funadhoo	Can be used or not	△	○	
			Site size	625	2000	
			State of site	Trees / Surroundings: residential area	Forest / Surroundings: forest, water plant	
			Environmental impact	The site is narrow, trees to be felled (few), environmentally sensitive zone (lagoon) 70m	Forest to be felled, environmentally sensitive zone (lagoon) 200m, along the coast	
4	Noonu	Manadhoo	Can be used or not	○	× (No alternative site)	Construction at the existing site is possible
			Site size	2153		
			State of site	Wooded area / Surroundings: wooded area, ground		
			Environmental impact	Felling of wood, adjoining coastal greenbelt		
5	Raa	Ungoofaaru	Can be used or not	○	Not necessary	
			Site size	1321		
			State of site	Trees / Surroundings: residential area, coast		
			Environmental impact	Trees to be felled (few), residences nearby, adjoining coastal greenbelt		
6	Baa	Eydhafushi	Can be used or not	○	Not necessary	Construction at the existing site is possible
			Site size	1462		
			State of site	Vacant lot / Surroundings: residential area, road		
			Environmental impact	Trees to be felled (few), residential area nearby		
7	Lhaviyani	Naifaru	Can be used or not	○	Not necessary	Construction at the existing site is possible

No.	Atoll Name	Island Name	Confirmation Item	Existing Site	New Site	Remarks
			Site size	1470		
			State of site	Prepared ground / Surroundings: vacant lot, park, coast		
			Environmental impact	Trees to be felled (few)		
8	Kaafu	Villingili	Can be used or not	× (No existing site)	○	
			Site size		1200	
			State of site		Reclaimed land / Surroundings: waste facility, greenbelt	
			Environmental impact		Felling trees not necessary, adjacent to environmental protection zone	
9	Kaafu	Maafushi	Can be used or not	× (No existing site)	○	No alternative site
			Site size		500	Station within the tower
			State of site		Vacant lot / Surroundings: residential area, prison, coast	
			Environmental impact		Trees to be felled 1 No., site is narrow, residences nearby	
10	Vaavu	Felidhoo	Can be used or not	○	× (No alternative site)	
			Site size	737		
			State of site	Forest / Surroundings: residences, forest		
			Environmental impact	Felling of forest, protected old trees 70m, adjoining coastal greenbelt, residences nearby		
11	Alifu Dhaalu	Dhangethi	Can be used or not	× (No existing site)	○	
			Site size		825	
			State of site		Forest / forest	
			Environmental impact		Felling of forest, adjoining coastal greenbelt	
12	Alifu Dhaalu	Feeali	Can be used or not	× (No existing site)	○	
			Site size		900	
			State of site		Reclaimed land (grassy ground) / Surroundings: Reclaimed land, coast	
			Environmental impact		Felling trees not necessary	
13	Faafu	Nilandhoo	Can be used or not	○	Not necessary	
			Site size	924		
			State of site	Forest / Surroundings: residential area, forest		

No.	Atoll Name	Island Name	Confirmation Item	Existing Site	New Site	Remarks
			Environmental impact	Felling of forest, close to coastal greenbelt, close to residential area		
14	Laamu	Gan	Can be used or not	× (No existing site)	○	
			Site size		900	
			State of site		Forest / Surroundings: forest, road	
			Environmental impact		Felling of forest	
15	Thaa	Guraidhoo	Can be used or not	△	○	
			Site size	900	900	
			State of site	Palm trees (27 No.) / Surroundings: residential area, school	Vacant lot / Surroundings: residential area, coastal greenbelt	
			Environmental impact	Felling palm trees, adjacent to school	Felling trees not necessary, adjacent to residences, adjacent to coastal greenbelt	
16	Gaafu Alifu	Villingili	Can be used or not	△	○	
			Site size	625	1800	
			State of site	Trees / Surroundings: residential area, close to coastal greenbelt	Prepared ground, materials store / Surroundings: sites for residential construction	Materials need to be cleared
			Environmental impact	The site is narrow, trees to be felled (few), adjacent to residences	Felling trees not necessary, close to residences	
17	Gaafu Dhaalu	Gadhdhoo	Can be used or not	× (No existing site)	○	
			Site size		1800	
			State of site		Prepared ground / Surroundings: sites for residential construction	
			Environmental impact		Tree felling not necessary, close to residences	
18	Gaafu Dhaalu	Fiyoari	Can be used or not	○ Expansion necessary	Not necessary	
			Site size	2800		
			State of site	Forest / Surroundings: residential area, forest		
			Environmental impact	Felling of forest, School < 100m		
19	Gaafu Dhaalu	Thinadhoo	Can be used or not	× (Same site as media centre)	○	
			Site size		2800	
			State of site		Vacant lot / construction materials store, water plant, vacant lot	

No.	Atoll Name	Island Name	Confirmation Item	Existing Site	New Site	Remarks
			Environmental impact		Tree felling unnecessary, piled foundations necessary, close to the coast	
20	Gnaviyani	Foammulah	Can be used or not	○	Not necessary	
			Site size	1505		
			State of site	Grassy ground, trees / Surroundings: vacant lot		
			Environmental impact	Trees to be felled (few), hospital 10m		
21	Seenu	Hithadhoo	Can be used or not	○	Not necessary	
			Site size	5000		
			State of site	Grassy ground, trees 6 No. / Surroundings: residential area, park		
			Environmental impact	Tree felling (few), piled foundations necessary, residences and park nearby		

Source: Created by JICA Survey Team

Table 2-3-15 Points to Note in Terms of Environmental and Social Considerations for each Target Island (excluding common items)

No.	Atoll Name	Island Name	Tower Height (m)	Existing or New site	Tree Felling	Points to Note in Terms of Environmental and Social Considerations
1	Haa Alifu	Dhidhdhoo	60	Existing use	Felling of wood	School (50m), residences nearby
2	Haa Dhaalu	Kulhudhuffushi	50	New	Felling of forest	Residences nearby
3	Shaviyani	Funadhoo	70	New	Felling of forest	Adjacent to greenbelt around lagoon
4	Noonu	Manadhoo	70	Existing use	Felling of forest	Adjacent to coastal greenbelt
5	Raa	Ungoofaaru	70	Existing use	Felling of trees (few)	Adjacent to coastal greenbelt, adjacent to residences
6	Baa	Eydhafushi	70	Existing use	Felling of trees (few)	Residential area
7	Lhaviyani	Naifaru	80	Existing use	Felling of trees (few)	Prepared quiet area, park nearby
8	Kaafu	Villingili	60	New	Not necessary	Environmental protection zone (10m)
9	Kaafu	Maafushi	90	New	Felling of trees (few)	Close to residences
10	Vaavu	Felidhoo	80	Existing use	Felling of forest	Close to old tree (70m), adjacent to coastal green area and residential area
11	Alifu Dhaalu	Dhangethi	70	New	Felling of forest	Adjacent to coastal green area
12	Alifu Dhaalu	Feeali	80	New	Not necessary	Reclaimed ground
13	Faafu	Nilandhoo	50	Existing use	Felling of forest	Close to coastal green belt, close to residential area
14	Laamu	Gan	80	New	Felling of forest	Forest, unpaved road
15	Thaa	Guraidhoo	80	New	Not necessary	Close to residences, close to coast
16	Gaafu Alifu	Villingili	80	New	Not necessary	Close to residences
17	Gaafu Dhaalu	Gadhdhoo	80	New	Not necessary	Close to residences
18	Gaafu Dhaalu	Fiyoari	60	Use existing, expansion required	Felling of forest	Adjacent to forest, residences
19	Gaafu Dhaalu	Thinadhoo	50	New	Not necessary	Close to coastal green area
20	Gnaviyani	Foammulah	20	Existing use	Felling of trees (few)	Close to hospital (10m)
21	Seenu	Hithadhoo	30	Existing use	Felling of trees (few)	Close to residences, park

Source: Created by JICA Survey Team

Table 2-3-16 summarises the results of the environmental and social considerations study based on the scoping from the confirmed results. This will be updated in more detail by an environmental and social considerations study through local sub-contracting.

Table 2-3-16 Results of the Environmental and Social Considerations Study

Environmental Item	Survey Result
Air Pollution	The air is clean within the islands around each of the target sites. There is a possibility of generation of dust associated with foundation excavation. However the groundwater level is about 1m, and excavation below groundwater level will be carried out with drainage, and the amount of dust generated in the wet state is lower compared with excavation in the dry state. Air pollution due to the exhaust gas from construction machinery (described below) will be low because machinery will be selectively operated, not simultaneously, and the exhaust gas discharged into an open space. The maximum excavation at one site will be about 2,000m^3, and the use of construction machinery will be concentrated into the short period of two weeks for excavation, so there will be no significant problem. The Maldives has not established air pollution standards. World Health Organization (WHO) air pollution standards CO (8 hrs: 10,000, 1 hr: 30,000), NO_2 (1 hr: 200, 1 yr: 40), SO_2 (24 hrs: 20), O_2 (8 hrs: 100), Pb (1 yr: 0.5), SPM (not prescribed) Sri Lankan air pollution standards CO (8 hrs: 10,000, 1 hr: 30,000), NO_2 (24 hrs: 100, 8 hrs: 150, 1 hr: 250), SO_2 (24 hrs: 80, 8 hrs: 120, 1 hr: 200), O_2 (1 hr: 200), Pb (1 yr: 0.5, 24 hrs: 2), SPM (1 yr: 100, 24 hrs: 300, 8 hrs: 350, 3 hrs: 450, 1 hr: 500) (Units: μ/m^3, SPM: Suspended particulate matter) The main construction machinery and transport vehicles: trucks (10t), dump truck (10t), crane track (4t), bulldozer (10t), backhoe (0.45m^3), backhoe (0.8m^3), track crane (25t), concrete mixer (0.25m^3), tamper (60kg), road roller, drainage pump (150m^3/hr), generator
Water pollution	On each of the islands with target sites, shallow wells are used at many homes, but most of these produce salty water, so the water is used for flushing toilets and in some cases for showering, but it is not used as drinking water or cooking water. For excavation of foundations and pouring of foundation concrete, etc., the water level will be lowered by sumping, etc. The drainage water will be extracted from the surrounding groundwater, so the quality will be the same as that of the surrounding groundwater. However, there is a possibility that surface soil and excavated muck from the surrounding excavation will be mixed in to form muddy water. If the suspended solids are removed, then water pollution will not be caused by seepage into the underground from a drainage pit or discharge into the sea.
Waste	In the foundation excavation work, depending on the location there is a possibility that roots of trees or landfill waste from reclaimed land that must be treated as waste will be excavated, and it will be necessary to dispose of this waste. Also, it will be necessary to provide a spoil disposal site for spoil arising from surplus excavated soil.
Soil contamination	There is a possibility of occurrence of small scale soil contamination due to oil leakage from construction machinery.
Noise and vibration	Generally each of the islands where there is a target site is quiet. In one the sound of a generator can be heard. In the excavation of the foundations, there is a possibility of occurrence of noise from the operation of the machinery used in the excavation work and vibrations from breakers, etc. There are no standards for noise and vibration in the Maldives. The Sri Lankan standards for noise and vibration are as follows. Noise:

Environmental Item	Survey Result
	In a low noise area (daytime: 55dB, night time: 45dB), in a silent area (daytime: 50dB, night time: 45dB) Construction site (daytime: 75dB, night time: 50dB) Vibration: Construction site (2.0PPV (mm/sec.), quarry (5.0PPV (mm/sec.))
Protected Area	Each of the target sites is more than 1km from protection areas designated by the EPA, so there will be no effect during construction or during service. An environmental sensitive area (ESA) designated by the EPA is within 100m of the target site on Funadhoo (Shaviyani). A residential area has already been developed around the site, so it is considered that there will be almost no effect. However it will be necessary to prepare a drainage plan and carry out operations to reduce the effect on the protected vegetation around the lagoon. 1) For underground seepage of wastewater during excavation of foundations, install a water injection pit between the water pumping pit and the protection area to minimise the effect of groundwater lowering. 2) During the construction period use existing wells for lowering groundwater and checking the water quality, and adjust the operating hours, etc. (Note that the groundwater drainage from excavation of foundations is pumped up free groundwater, and the extent of the effect is generally less than 100m. The EPA Dewatering Regulations require that an area within 30m be dealt with.) The other target sites are all more than 1km from an ESA, so there will be no effect during construction or during service. Regarding environmental protection zones (EPZ) included within the land use plans of Island Committees, in Villingili of Kaafu Atoll the site is adjacent to an EPZ. It will be necessary to prepare a drainage plan and carry out operations so that damage is not caused by groundwater drainage. 1) The above 1) and 2) will be dealt with. 2) Exhaust gas from construction machinery will be fed to the opposite side from the target protection zone, so that it does not directly affect the zone. Also, monitoring will be carried out, and if necessary the operation hours will be adjusted. For the other sites, either there are no designated EPZs or the EPZ is more than 500 m away, so there will be no effect during construction or during service. In addition, although not designated as protected, the following sites are adjacent to coastal greenbelts, so it will be necessary to prepare a drainage plan and carry out operations so that damage is not caused by groundwater drainage. Manadhoo (Noonu Atoll), R, Ungoofaaru, V, Felidhoo, ADh, Dhangethi, F, Feeali, F, Nilandhoo, GDh, Thinadhoo
Ecosystem	Among the target sites, the places where felling of forests will be carried out and ground preparation is necessary are as follows. HA, Dhidhdhoo, HDh, Kulhudhuffushi, Sh, Funadhoo, N, Manadhoo, V, Felidhoo, ADh, Dhangethi, F, Nilandhoo, L, Gan, Th, Guraidhoo, GDh, Fiyoari Also, the places where it is necessary to fell trees within the site are as follows. R, Ungoofaaru, B, Eydhafushi, Lh, Naifaru, K, Maafushi, Gn, Foammulah, S, Hithadhoo The places where there are protected trees within the islands with target sites are as

Environmental Item	Survey Result
	follows. Villingili (Kaafu Atoll) (east coast greenbelt, 500m from site), V, Felidhoo (3 No. Malayan banyan trees, 70m from the site), ADh, Dhangethi (2 No. Malayan banyan trees, 350m from the site) Through inquiry only on site, it was confirmed that protected plants and animals do not inhabit the target sites. Felling of forests and trees will reduce the habitat and activity areas for flora and fauna, so it is necessary to prepare a plan to reduce the area of tree felling as much as possible, and to reduce the effect on the adjacent forests.
Living and Livelihood	The roads in the residential areas on the islands with target sites are narrow, and there is a possibility of occurrence of traffic obstruction due to construction vehicles and temporary placement of materials and equipment. It will be necessary to explain the routes used and materials and equipment stores to the Island Committees, and obtain their approval. As a result of the spread of digital terrestrial broadcasting, enjoyment will be increased by the multiplexed broadcasts, and disaster prevention communications and response will be easier.
Heritage	The historical assets and heritage on the islands with target sites are as follows. Dhangethi (old Mosque, 300m from the target site), Nilandhoo (old Mosque at ruins of a pre-Islam temple, 200m from the site) These old Mosques are protected by the local residents, but they are not used for tourism. At 200m or more from the target site, there is almost no effect of noise and vibration during construction. They are also away from the transport routes for materials and equipment during construction. During service there will be no effect.
Working Conditions	It will be necessary to take safety measures for workers against dust, noise, and vibration during excavation of the foundations, and safety measures for crane operations, and working at elevated heights.
Accident	It will be necessary to take safety measures for transport of materials and equipment and temporary storage places for materials and equipment, safety management of the construction site, preventative measures against falling or dropped objects from heights, and safety measures for the local residents.

2-3-6-1-8 Impact Assessment

Table 2-3-17 'Scoping Scheme and Study Results' shows the results of the evaluated environmental impact, based on the results of the environmental impact assessment study.

Table 2-3-17 Scoping Scheme and Study Results

Category	No.	Environmental Item	Impact Assessment at Time of Scoping		Impact Assessment based on Study Results		Assessment reason
			Before/ During construction	During service	Before/ During construction	During service	
Mitigation Measures	1	Air Pollution	B-	D	B-	D	During construction, air pollution will be generated by excavation dust and exhaust gas as a result of operation of construction machinery and vehicles.
	2	Water Pollution	B-	D	B-	D	As a result of the drainage operation during foundation excavation and foundation pouring, the level of the

Category	No.	Environmental Item	Impact Assessment at Time of Scoping		Impact Assessment based on Study Results		Assessment reason
			Before/ During construction	During service	Before/ During construction	During service	
							surrounding ground water will be lowered, and muddy wastewater will be generated.
	3	Waste	B-	D	B-	D	There is a possibility that tree roots and waste that was deposited in landfill will be excavated during the foundation excavation. It will be necessary to process the waste and process the surplus excavation spoil.
	4	Soil Contamination	B-	D	B-	D	It is envisaged that there would be a small quantity of oil leakage from the construction machinery and vehicles, etc., resulting in soil contamination.
	5	Noise and Vibration	B-	D	B-	D	Noise and vibration will be generated by operation of construction machinery and vehicles during the construction.
	6	Subsidence	D	D	D	D	Generally the bedrock is limestone, and this is not a ground subsidence area. From the results of the site investigations the foundations will be located in places having sufficient bearing capacity, so ground subsidence is not envisaged.
	7	Odour	D	D	D	D	The foundation excavation is mainly in locations where the ground is limestone, and in reclaimed land surplus soil from widening harbours or sea sand has been used. In addition in the ground surveys material that would generate odours has not been found, so the occurrence of odours is not envisaged.
	8	Sediment	D	D	D	D	The work will not affect sediment.
Natural Environment	9	Protected Area	B-	D	B-	D	There are locations close to environmental sensitive areas and environmental protection zones, so there is a possibility of an effect.
	10	Ecosystem	B-	D	B-	D	Some sites are close to protected areas so there is a possibility of an effect. Protected flora and fauna has not been confirmed at each site, but as a result of forest felling there is a possibility that the habitats and activity areas of flora and fauna will be reduced.
	11	Hydrology	D	D	D	D	Alteration of hydrology is not envisaged.
	12	Topography and Geology	D	D	D	D	Alteration of the topography and geology is not envisaged.

Category	No.	Environmental Item	Impact Assessment at Time of Scoping		Impact Assessment based on Study Results		Assessment reason
			Before/ During construction	During service	Before/ During construction	During service	
Social Environment	13	Resettlement	D	D	D	D	Resettlement of residents will not occur.
	14	Poverty Group	D	D	D	D	There will be no particular burden on the poverty group.
	15	Ethnic Minorities and Indigenous People	D	D	D	D	There are no residents from ethnic minorities or indigenous peoples.
	16	Living and Livelihood	C-	B+	C	B+	Movements of the residents will be affected by the transport of materials and equipment, temporary storage of materials and equipment, and the construction. During service there will be the benefits that many programmes can be viewed, and disaster prevention information can be obtained.
	17	Heritage	C-	D	C	D	Historical assets are distant from the site, and will not be affected.
	18	Landscape	D	D	D	D	Worsening of the landscape will not occur.
	19	Gender	D	D	D	D	No particular effect on gender is envisaged.
	20	Working Conditions	B-	D	B-	D	There will be worsening of the working conditions due to worsening of the air quality and noise and vibration caused by operation of construction machinery, etc., during construction.
Other	21	Accident	B-	D	B-	D	There is a possibility of occurrence of traffic congestion and traffic accidents due to traffic restrictions, temporary closures, etc.

2-3-6-1-9 Mitigation Measures and Cost of Implementation of Mitigation Measures

Mitigation measures and their costs for the environmental items envisaged to occur in the environmental impact assessment are shown in Table 2-3-18.

Table 2-3-18 Mitigation Measures and Costs

During construction only, none during service

No.	Environmental Item	Proposed Environmental Management Plan	Implementing agency	Responsible Agency	Amount (in thousand yen)
1	Air Pollution	Sprinkling water periodically or as necessary in order to reduce the dispersion of dust during construction.	Construction contractor	PSM	1,641
2	Water Pollution	For wastewater arising during foundation construction, a drainage plan as prescribed by the Dewatering Regulations must be submitted to the EPA to obtain their approval, and the instructions of the EPA must be carried out. Also the topsoil must be covered by a sheet, etc., in order that the topsoil from the top of the excavation does not enter the water pit. Also, if soil gathers in the pumping pit, it must be dewatered and the water changed. If necessary, a sedimentation pit shall be installed, to separate the water and soil.	Construction contractor	PSM	7,311
3	Waste	Tree roots and deposited waste from reclaimed land must be separated from the excavated soil, and a temporary placement area, receiving and disposal area, and soil disposal area provided.	Construction contractor	PSM	284
4	Soil Contamination	Check for oil leaks of construction machinery and vehicles, and instruct repairs. Collect the leaked oil (soil including oil) and dispose of it in a disposal site.	Construction contractor	PSM	400
5	Noise and Vibration	At sites close to schools, hospitals, or residences, 1) reduce noise by enclosing or covering, 2) restrict the hours of use of construction machinery that generate noise and vibration, 3) manage noise by the construction plan that avoids concentrated operation. Also, formulate and implement a construction plan so that noise associated with construction does not occur at night time.	Construction contractor	PSM	1,751
6	Protected Area	On sites close to environmental sensitive areas and environmental protection zones, arrange the construction machinery and vehicles during foundation construction so that the exhaust gas does not affect these areas and zones. For drainage operations, submit a drainage plan based on the Dewatering Regulations to the EPA, obtain approval, and carry out the instructions of the EPA. If a water injection pit is provided to percolate the wastewater into the	Construction contractor	PSM	4,470

No.	Environmental Item	Proposed Environmental Management Plan	Implementing agency	Responsible Agency	Amount (in thousand yen)
		underground, arrange it so as to reduce the effect on the surroundings, such as lowering of the groundwater level, etc. Also, when discharging wastewater into the sea, feed the wastewater to a position of the drainage outlet which has low impact using a pipe, etc. Also, combine this with the measures to reduce water pollution in No.2. In the case of sites adjacent to or close to a coastal greenbelt also, carry out these countermeasures. In locations where forests are felled, this shall be done in accordance with the Regulations on Felling, Removing, Uprooting, etc., and environmental restoration shall be carried out around the site by alternative planting, and attending and managing these during the service period.			
7	Ecosystem	At locations where felling of a forest is necessary, even though the extent of the development is small inevitably the habitat and activity area of flora and fauna will be reduced, but every effort should be made to ensure that there is no unnecessary felling of trees. Also, consideration shall be given to planting in areas that do not affect the facility, such as corners, etc., after the completion of the facility. During the construction enclosures shall be provided so that the surrounding trees are not damaged, and measures shall be taken to reduce the effect of wastewater (same as the mitigation measures of No.6 Protected Area). This shall apply to sites where tree felling is necessary, and sites surrounded by trees. In locations where forests are felled, alternative planting and cultivation mitigation measures (same as the mitigation measures of No.6 Protected Area) shall be carried out in accordance with the regulations, and efforts shall be made to restore the habitats and activity areas of flora and fauna.	Construction contractor	PSM	4,470
8	Living and Livelihood	It is envisaged that on the islands with a target site, movement of the residents could be obstructed by the transport and temporary storage of construction equipment and materials, etc., because generally	Construction contractor	PSM	285

No.	Environmental Item	Proposed Environmental Management Plan	Implementing agency	Responsible Agency	Amount (in thousand yen)
		the roads are narrow. A detailed plan shall be explained to the Island Committees and residents, their approval shall be obtained, and strict management shall be carried out to comply with the set construction period.			
9	Working Conditions	Measures shall be taken for public health during the construction period. As measures against dust, noise, and vibration, where necessary the site workers will be provided with dustproof masks and equipment to reduce noise, and these measures shall be carried out in combination with the health and safety measures for the site workers in accordance with Nos.1 and 4.	Construction contractor	PSM	894
10	Accident	Within the construction areas, safety management rules shall be set to ensure that accidents causing bodily damage not occur, and safety management shall be carried out for the workers. Also, measures shall be carried out to ensure safety of workers operating at heights, and to prevent dropped objects. The relevant authorities shall be notified of the construction schedule, construction signs and preventative barriers shall be installed in the construction areas, and when necessary an observer shall be deployed to ensure the safety of the local residents.	Construction contractor	PSM	4,648

2-3-6-1-10 Environmental Management Plan and Monitoring Plan

The monitoring plan is shown in Table 2-3-19. During construction and during service it will be confirmed that each item is restored to baseline, and during service the mitigation measures will be continued.

Table 2-3-19 Environmental Management Plan and Monitoring Plan

Environmental Item	Item	Point	Frequency	Responsible Agency
Air Quality	SPM, CO, NO_2, SO_2	Adjacent to each site	5 times per site	Construction contractor PSM
Water Pollution	BOD, COD, SS pH, EC, turbidity	Drainage during construction Shallow wells near each site	5 times per site	Construction contractor PSM
Waste	Status of management of waste temporary placement area	Waste material temporary placement area	5 times per site	Construction contractor PSM

Environmental Item	Item	Point	Frequency	Responsible Agency
	Status of transfer to waste disposal site Status of levelling of excavated soil disposal site	Waste disposal site Soil disposal site		
Soil Contamination	Status of inspection and repair of oil leaks Status of processing of oil leak areas	Construction sites, construction machinery and vehicle storage sites	5 times per site	Construction contractor PSM
Noise and Vibration	Noise and vibration	Adjacent to each site	5 times per site	Construction contractor PSM
Protected Area	Status of implementation of construction management, alternative tree planting and cultivation by monitoring drainage and exhaust operations, water quality, groundwater levels, etc., in accordance with the specific mitigation measures. Status of ESAs, EPZs, and coastal greenbelt close to the sites	ESAs, EPZs, and coastal greenbelt close to the sites	5 times per site Alternative tree planting and cultivation in the case of tree felling once in 3 years	Construction contractor PSM
Ecosystem	Status of implementation of mitigation measures (same as for protected areas) Status of protected trees and surrounding woods close to the sites	Each site, and protected trees, woods, and forest areas close to the sites	5 times per site Alternative tree planting and cultivation in the case of tree felling once in 3 years	Construction contractor PSM
Living and Livelihood	Status of management of traffic obstruction of residents due to the construction	Near each site	5 times per site	Construction contractor PSM
Working Conditions	Status of health and safety guidance Status of use of worker safety equipment	Each site	5 times per site	Construction contractor PSM
Accident	Status of implementation of safety measures Status of implementation of safety measures for the nearby residents	Each site	5 times per site	Construction contractor PSM

ESA: Environmental Sensitive Area
EPZ: Environmental Protection Zone

2-3-6-1-11 Consultations with Stakeholders

At the location of the 21 target sites, consultations with stakeholders were carried out by an environmental and social considerations study through local sub-contracting. Details of the project were explained to the attending Island Committee members and residents by a local environmental consultant, and the opinions of the participants were heard. Table 2-3-20 shows the main opinions that were received. The details can be found in the documents at the end of this report (No.6 Other Documents and Information, Chapter 6.1 Documents Relating to Environmental and Social

Considerations (3) Stakeholder Consultations, Minutes and List of Participants).

Table 2-3-20 Main Opinions from Consultations with Stakeholders

No.	Island Name	Content of Main Opinions
1	Dhidhdhoo	Date held: 8th April 2016, attendees: 10 persons including the Island Committee
		➢ They look forward to viewing sports programmes through the broadcasting network and an internet connection service. ➢ They would like to receive information regarding proper repairs in the event of occurrence of a breakdown of reception. ➢ From past experience there is concerned about the effects on the surroundings of a lightning strike to the towers. ➢ There is concern about the effect on houses in the event of vibrations during the construction period. ➢ There is concern over the effect on nearby children's playgrounds, harbours, and police stations, and the effect on cable television operators. ➢ The community is expecting the provision of a better service by the new broadcasting network.
2	Kulhudhuffushi	Date held: 9th April 2016, Participants: 16 persons including the Island Committee
		➢ The site is close to the coast so maintenance might be difficult. In particular during the monsoon period the effect of wave splash should be considered. ➢ The site is close to the coast, so the need for coastal protection should be considered. ➢ They would like a channel that provides topics regarding the island. ➢ There is an expectation that island administrative information, advertisements, etc., can be provided to the broadcasting network.
3	Funadhoo	Date held: 6th June 2016, Participants: 16 persons including the Island Committee
		➢ The construction of the tower is not preferable because it reduces the area of land available. ➢ The lightining to the tower might affect the lives of people living in the surrounding area ➢ They expect the channel specialised in religious and culture. The island committee also would like to use the network for disemminating information ➢ It is considered to be advantages to be able to broadcast disaster information and increase the number of free channels.
4	Manadhoo	Date held: 30th June 2016, Participants: 18 persons including the Island Committee
		➢ It was requested that the boundary of the site be clear and pay attention to safety during the construction and perform maintenance works and equip a lightning rod. ➢ It was expected that the quality of picture is improved, the disaster information will reach to the people as early as possible and reasonable price of service is achieved. ➢ If the local companies can perform maintenance works, the employment oppitunity is expected.
5	Ungoofaaru	Date held: 27th June 2016, Participants: 26 persons including the Island Committee
		➢ It is expected that the number of channel is increased, the local information is broadcasted ➢ During the consutruction period, it is expected that the employment

No.	Island Name	Content of Main Opinions
		opportunity is provided to the local people ➢ The location of the area identified is most sutable in this island
6	Eydhafushi	Date held: 7th April 2016, Participants: 18 persons including the Island Committee ➢ In Malé many channels can be viewed free of charge, but the service is not available on the island. There is expectation that more free of charge channels can be viewed on the island. ➢ There is an expectation that information transmissions exclusively for the island can be received through the broadcasting network. ➢ There is an expectation of free of charge and good quality service from the new broadcasting network. ➢ There is concern about the effect of electromagnetic waves. ➢ It is considered that there may be difficulties providing the necessary workers for the construction.
7	Naifaru	Date held: 26th June 2016, Participants: 26 persons including the Island Committee ➢ It is requested that the fence be prepared along the boundary and pat enough attention to safety ➢ It is expected that the channel for religious and education are increased and the service will be provided in a reasonable price. ➢ The tower and transmitting station could be shared with other business entities to make use of the limited land avaialbe at most
8	Villingili	Date held: 22th June 2016, Participants: 26 persons including the Island Committee ➢ The Project is considered to be meaningful for the community and the residents are cooperative to the Project ➢ It is requested that the measures be taken so that the local people would not approach to the site ➢ It is suggested that trees are planted near the site. ➢ It is expected that the employment opportunity is increased due to the construction
9	Maafushi	Date held: 26th June 2016, Participants: 20 persons including the Island Committee ➢ It is concerned that the land available is decreased. Enough attention should be paied for safety during the construction because the site is close to the residential area. ➢ The affect of the lightening and strong wind to the tower is concerned ➢ It is expected that educational program is increased and the reasonable price of service is provided and quality of signal is improved.
10	Felidhoo	Date held: 4th July 2016, Participants: 22 persons including the Island Committee ➢ The pland allocated to PSM currently is not well maintained and became the source of mosquites breeding. ➢ The number of free, religious and education channel are increased and disaster information reaches to the people as early as possible. ➢ It is expected that employment opportunity is provided to the local people for the simple works
11	Dhangethi	Date held: 3th July 2016, Participants: 25 persons including the Island Committee ➢ The site sould be managed by building fences arount it. ➢ It is expected that the number of channel for sport, education, religious, health are improved. ➢ It is concerned that the location of current site is close to the

No.	Island Name	Content of Main Opinions
		sightseeing site.
12	Feeali	Date held: 16th June 2016, Participants:16 persons including the Island Committee
		➢ The island committee and community are supportive to the Project ➢ It is expected that the employment opportunity will be provided to the community members ➢ The Project is not harmful to the residents, commercial and community activities. ➢ It is concerned that the site is closer to the sea.
13	Nilandhoo	Date held: 15th June 2016, Participants:16 persons including the Island Committee
		➢ The island committee and residents are supportive to the Project and community members too. ➢ The community experienced the same sort of project and is waiting for the Project. ➢ The community will benefit from the project by connected to PSM. ➢ The community will provide adivices during the construction period.
14	Gan	Date held: 19th June 2016, Participants:10 persons including the Island Committee
		➢ It is expected that the local channel and island committee are able to communicate information ➢ It is expected that the reasonable service is provided. ➢ The boundary should be prepared alongside the site.
15	Guraidhoo	Date held: 24th June 2016, Participants:20 persons including the Island Committee
		➢ The Project is expected so that it was requested that the Project will not be delayed ➢ The fence should be constructed around the site. ➢ It is expected that education and relifious channel are increased ➢ It is concerned that the lighening affects the tower. ➢ It is expected that the local people would be employed by the Project.
16	Villingili	Date held: 25th February 2016, Participants: 18 persons including the Island Committee
		➢ The proposed site has not yet been allocated for the project. It is necessary to receive an official application. However, the proposed site is the most suitable location for the project. ➢ The PSM office should go to the new site, and the land currently possessed by PSM should be returned to the Island Committee. ➢ It is expected that local companies would be given the opportunity of advertising. ➢ Access to the site should be restricted in order to prevent accidents during the construction period. ➢ The existing PSM antenna affects the flight path. The new site does not affect it.
17	Gadhdhoo	Date held: 27th February 2016, Participants: 13 persons including Island Committee
		➢ The new site is not yet allocated for this project. It is necessary that an official application be received. The land is limited, and land has been allocated for various projects to date with not much benefit for the residents of the island. ➢ The project site will be leased land, so there should be some revenue for the Island Committee. ➢ In the past when lightning struck a tower the nearby electrical goods

No.	Island Name	Content of Main Opinions
		were affected. There is concern that the same phenomenon could occur with the new tower. ➢ There is expectation that this will result in opportunities of employment of local residents. ➢ There is expectation that various types of service, television, telephone, and internet can be used through the new broadcasting network.
18	Fiyoari	Date held: 27th February 2016, Participants: 22 persons including the Island Committee
		➢ The number of television services that can be used is small, so there is expectation for early commencement of the new broadcasting network. ➢ In the past there have been similar attempts, but only the transmitter has been brought on the islands, and the service could not be used. There is concern over whether the project will actually be implemented. ➢ There is expectation that educational programmes can be viewed on the new broadcasting network. Also, it should be low cost and viewing of some of the programmes should be restricted. ➢ It is expected that the construction waste will be properly processed.
19	Thinadhoo	Date held: 27th February 2016, Participants: 20 persons including the Island Committee
		➢ The new site has not been allocated to the project yet. It is necessary that an official application be received. At present a road construction contractor has been given a permit to use the site for one year. ➢ There are concerns that the new site will affect the flight path. ➢ There are concerns over the effects of electromagnetic waves on humans. ➢ Competition should be introduced into the services. It is expected that better services would be provided by competition. ➢ There is an expectation for free of charge channels and educational channels. ➢ There is an expectation that opportunities for employment will be provided to island residents. ➢ There is concern that the maintenance costs will be high because the site is close to the sea. ➢ In the past the Island Committee was the leader of a project. Should the Island Committee be given a role in this project also?
20	Foammulah	Date held: 19th June 2016, Participants:14 persons including the Island Committee
		➢ It is expected that the price of service is reduced. ➢ It is requested that the maintenance of the site is well performed ➢ It is expected that the number and quality of educational and disaster information are improved. ➢ It is expected that the employment opportunity is provided to the local residents during the construction period.
21	Hithadhoo	Date held: 28th February 2016, Participants: 17 persons including the Island Committee
		➢ There is concern over safety of the workers during the construction period. ➢ There is concern that the service provided will be expensive. Also, there is concern over the possibility that unsuitable programmes will be distributed. ➢ There is expectation of provision of sports channels in HD quality,

No.	Island Name	Content of Main Opinions
		free of charge channels in the local language, provision of religious programmes, strengthening of news programmes, etc.

Source: Created from a study through local sub-contracting

2-3-6-1-12 EPA Project Approval Procedures and Progress

The environmental impact assessment system in the Maldives has been established in accordance with the Environmental Protection and Preservation Act of the Maldives (Law No.4/93), the Environmental Impact Assessment Regulation (2012)*1, and the amended Environmental Impact Assessment Regulation (2015)*2, and is managed by the Environmental Protection Agency (MPA) of the Ministry of Environment and Energy (MEE). In the system the project promoter (applicant, in the case of this project PSM) prepares the necessary documents in cooperation with registered consultants approved by the EPA (individuals or several environmental specialists), and submits the application.

Note) *1 The Environmental Protection and Preservation Act of the Maldives (Law No.4/93)

*2 Environmental Impact Assessment Regulation (2012)

The progress of the procedures for obtaining a permit from the EPA to implement the project is as follows.

1) The JICA Survey Team prepared explanatory documents for application for screening for the 21 sites, submitted them to PSM, and requested an application be submitted (4th to 12th November 2015, documents for the application prepared by the team). PSM together with the company that was commissioned to carry out the environmental and social considerations study (registered consultants Energy Consultancy Pvt. Ltd.) submitted the screening application documents to the EPA.
2) The scoping decision statements were received from the EPA, and for nine sites it was specified that an EIA be carried out, and for 10 sites it was indicated that an EIA/IEE was unnecessary (the project can be started). The decision results for the EIA screening application are shown on Table 2-3-21.
3) Thereafter it was decided that piled foundations were necessary as a result of the site investigation at Thinadhoo (Gaafu Dhaalu Atoll) and Hithadhoo (Seenu Atoll), so it was necessary to carry out an EIA, and as a result 11 sites are subject to EIA.
4) In addition at Guraidhoo (Thaa Atoll), 27 palm trees are to be felled, and the site is close to a school, so the site will be moved to a new location. When an application is re-submitted, and there is a possibility that it will not be necessary to carry out an EIA.

Table 2-3-21 EPA Screening Decision Results

No.	PSM No.	Atoll	Island (Site)	Decision	Decision Statements Issue Date
1	20	Haa Alifu	Dhidhdhoo	1	16th Nov. 2015
2	18	Haa Dhaalu	Kulhudhuffushi	1	16th Nov. 2015
3	19	Shaviyani	Funadhoo	1	16th Nov. 2015
4	5	Noonu	Manadhoo	1	16th Nov. 2015
5	2	Raa	Ungoofaaru	4	13th Jan. 2016

No.	PSM No.	Atoll	Island (Site)	Decision	Decision Statements Issue Date
6	13	Baa	Eydhafushi	4	16th Nov. 2015
7	12	Lhaviyani	Naifaru	4	16th Nov. 2015
8	17	Kaafu	Villingili	4	16th Nov. 2015
9	14	Kaafu	Maafushi	4	16th Nov. 2015
10	8	Vaavu	Felidhoo	1	16th Nov. 2015
11	4	Alifu Dhaalu	Dhangethi	1	16th Nov. 2015
12	9	Alifu Dhaalu	Feeali	4	16th Nov. 2015
13	15	Faafu	Nilandhoo	4	16th Nov. 2015
14	7	Laamu	Gan	1	16th Nov. 2015
15	3	Thaa	Guraidhoo	1	16th Nov. 2015
16	16	Gaafu Alifu	Villingili	4	16th Nov. 2015
17	11	Gaafu Dhaalu	Gadhdhoo	4	16th Nov. 2015
18	6	Gaafu Dhaalu	Fiyoari	1	16th Nov. 2015
19	10	Gaafu Dhaalu	Thinadhoo	1	16th Nov. 2015
20	21	Gnaviyani	Foammulah	4	16th Nov. 2015
21	1	Seenu	Hithadhoo	1	13th Jan. 2016

(Notes) Decision 1: The effect of this project on the environment is large, so an EIA report must be submitted.
Decision 2: It is necessary to submit an IEE report
Decision 3: It is necessary to submit an environmental management report
Decision 4: This project has no impact on the environment, so the project can proceed as planned
Decision 5: Proceed with this project in accordance with the Ministry's guidelines in order to minimise the effect on the environment

As a result of the site investigations at 19 Thinadhoo and 21 Hithadhoo, a piled foundation is necessary, so an EIA must be carried out.

Source: Created by the Survey Team based on the EPA screening decision statements

5) A local subcontractor will conduct an IEE level field survey using outline design drawings of the tower, building, and foundations for the 21 sites, carry out local hearings of opinions, and prepare a field survey report. After receiving this report, the JICA Survey Team will summarise the study results of the Category B environmental and social considerations study into a draft report.
6) In parallel with 5) above, PSM will conclude a negotiated contract with a subcontractor, to implement the EPA study. PSM agrees to continue with the surveys after the JICA Survey Team, and continue with the approval procedures.
7) From Japan, the Survey Team will be in touch with PSM and the subcontractor, and support the approval procedures in 4). The deliverables of this project such as basic design drawings for the towers, buildings, and foundations, construction plan documents, descriptions of the content of the project, evaluation of alternative schemes including the zero option, impact reduction measures, monitoring plan, etc. will be provided.

2-3-6-2 Land Acquisition, Resettlement of Residents

The new sites are on Government land, and PSM has initiated the acquisition procedures. The current Island Committees have been informed that the sites could be used, and it has been explained that in the case of wooded areas the trees could be felled.

There are residents on none of the sites, so there will be no resettlement of residents.

2-3-6-2-1 Necessity for Land Acquisition and Resettlement of Residents

In this project, the land used will be either an existing site owned by PSM, or if PSM does not have an existing site on a target island or if the existing site is too narrow, the existing site will be extended in part, or a new site will be acquired.

In the cases of extension of a site or acquisition of a new site, PSM will submit an application to the Ministry of Housing and Infrastructure since the land is owned by the Government. The Ministry of Housing and Infrastructure confirms with the Atoll Committees and Island Committees of the target island, obtains their opinion, and issues a permit for use.

In all the cases of extension of a site or acquisition of a new site, there are no residents on the site. Therefore, in this project there will be no resettlement of residents.

Note that according to CAM, if a resident has obtained a permit to plant useful plants or trees in the site, it will be necessary to compensate them. On the new candidate site recommended by the Gan Island Committee (Laamu Atoll), there was a field within a forest, and the field was a part of the target site. However, there was a possibility of obstruction of a communication route of an existing communication facility, so the target site was moved, and the field is not attached to the target site. If necessary, tree felling and site preparation will be carried out by PSM within the land. However, if many trees have to be felled, the EPA will specify that an EIA must be implemented.

2-3-6-2-2 Legal Framework for Land Acquisition and Resettlement of Residents

Table 2-3-22 shows the laws and regulations concerning land acquisition in the Maldives. There are no laws or regulations regarding resettlement of residents.

Table 2-3-22 Laws and Regulations concerning Land Acquisition

Laws and Regulations	Content
Maldivian Land Act 2002	➢ This act deals with the allocation and granting of the national land of the Maldives for various purposes and uses, and management concerning the announcement of national housing for residential purposes, and deals with national housing and private housing for residential purposes, sale, transfer, and rental. ➢ The organisation with jurisdiction is the Ministry of Home Affairs, which carries out allocation and granting of national land, and management and maintenance of land registration. ➢ This act describes the allocation of national housing to residents, and the buying and selling, transfer, and leasing of national housing, its use for non-residential purposes, and other matters.
Maldives Land Law Regulations 2003	➢ Management of registration of national land and buildings ➢ Management of allocation of national land for residential purposes ➢ Management of the acquisition of national land by an inheritor of real estate ➢ Management of joint ownership of buildings ➢ Management of leasing of land and buildings on the land

Laws and Regulations	Content
	The above are described. Applications and registration are carried out by the offices with jurisdiction on Malé and the Atolls.
Maldives Land Law Regulations 2004	➢ Management of buying and selling of land ➢ Management of transfer of land by gift or intention ➢ Management of mortgages on land, buildings, and flats The above are described. Applications and registration are carried out by the offices with jurisdiction on Malé and the Atolls.

Source: Created by the Survey Team from the English versions of the laws and regulations

Regarding land ownership, in Maldives, there is private ownership and national ownership. Private ownership is land ownership purchased from the state by an individual or other entity, and national ownership is land ownership in which the state grants the right of use of the land possessed by an individual or other entity. There are no restrictions on ownership rights, and they can be passed on to an inheritor as in private ownership. There is no official recognition of land leasing rights, but long-term leases of land are commonplace. On residential islands leases are for a maximum of 35 years, and on industrial islands there is no restriction on leases. Under Maldives law, a foreigner (including a foreign business entity) is not permitted to own real estate, but is permitted to lease it for a maximum of 99 years, or 50 years for a tourism lease. (Source: Asia Pacific Property Investment Guide, Hospitality Edition 2014, Jones Lang LaSalle and Ashurst)

2-3-6-3 Others

2-3-6-3-1 Draft Monitoring Form

Table 2-3-23 Monitoring Form

1. Permits and Explanation for Residents

Monitoring Item	Monitoring Results during Report Period
e.g.) Responses/Actions to comments and guidance from Government authorities	

2. Mitigation Measures

– Air Quality (Emission Gas / Ambient Air Quality)

Measurement during construction period and during service (confirmation of recovery)

Item (Unit)	Measured Value (Mean)	Measured Value (Max.)	Country's Standards (Sri Lanka) $\mu g/m^3$	Referred International Standards (WHO)	Remarks (Measurement Point, Frequency, Method, etc.)
CO			30,000 (1 hr)	30,000 (1 hr)	5 times per site
NO_2			250 (1 hr)	200 (1 hr)	5 times per site
SO_2			200 (1 hr)	20 (24 hrs)	5 times per site
SPM (Suspended particulate matter)			500 (1 hr)	50 (24 hrs)	5 times per site

– Water Quality (Effluent / Wastewater / Ambient Water Quality)

Measurement during construction period and during service (confirmation of recovery)

Item (Unit)	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
BOD			Check the water quality of the nearby shallow wells, and adjust mainly the turbidity of the wastewater to that level or lower.		5 times per site
COD					5 times per site
SS (Suspended solids)					5 times per site

Check the water quality (pH, EC, turbidity, BOD, COD, SS) of the nearby shallow wells, and adjust mainly the turbidity of the wastewater to that level or lower.

– Waste **Monitoring during the construction period**

Monitoring Item	Monitoring Results during Report Period
Status of disposal of landfill waste excavated during the foundation excavation	
Status of disposal of surplus excavation spoil	

– Noise and Vibration

Measurement during construction period and during service (confirmation of recovery)

Item (Unit)	Measured Value (Mean)	Measured Value (Max.)	Country's Standards (Sri Lanka)	Referred International Standards (Japan)	Remarks (Measurement Point, Frequency, Method, etc.)
Noise level			Daytime: 75dB Night time: 45dB	Daytime: 60dB Night time: 40dB Construction: 85dB	5 times per site
Vibration level			2.0mm/sec	Daytime: 60dB Night time: 55dB Construction: 75dB	5 times per site

3. Natural Environment

– Protected Area **Monitoring during construction period and during service**

Monitoring Item	Monitoring Results during Report Period
Status of implementation of mitigation measures at the site	
Status of the protection area close to the site	
Status of implementation and cultivation of alternative tree planting	

– Ecosystem **Monitoring during construction period and during service**

Monitoring Item	Monitoring Results during Report Period
Status of implementation of mitigation measures at the site	
Status of protected trees and forests near the site	
Status of implementation and cultivation of alternative tree planting	

4. Social Environment

– Living and Livelihood **Monitoring during construction period**

Monitoring Item	Monitoring Results during Report Period
Status of management of hindrance to residents' passage due to the construction	

– Working Conditions **Monitoring during the construction period**

Monitoring Item	Monitoring Results during Report Period
Status of safety and health guidance on the construction site	
Status of use of worker safety equipment	

– Accident **Monitoring during the construction period**

Monitoring Item	Monitoring Results during Report Period
Status of implementation of safety measures on the construction site	
Status of implementation of safety measures for the nearby residents	

2-3-6-3-2 Environmental Checklist

Table 2-3-24 Environmental Checklist

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons of Yes/No, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) N (b) N (c) N (d) N	(a) (b) (c) (d) PSM has applied for screening from the Environmental Protection Agency (EPA), as a result of which there is an instruction to carry out an EIA at nine sites, and for the other 12 sites a survey is not necessary and the project can proceed. PSM has concluded a contract with an environmental consultant to implement the EIA.
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) Y (b) Y	(a) The explanations and the opinion hearings with the stakeholders and residents are being carried out by PSM and the local registered consultant in accordance with the process of the EIA approval procedures. (b) The comments of stakeholders meeting such as safety during construction, request for communication program, etc. have been reflected to the project design.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) The examination of alternative plans have been conducted.
2 Mitigation Measures	(1) Air Quality	(a) Do air pollutants, (such as sulphur oxides (SOx), nitrogen oxides (NOx), and soot and dust) emitted from the proposed infrastructure facilities and ancillary facilities comply with the country's emission standards and ambient air quality standards? Are any mitigating measures taken? (b) Are electric and heat source at accommodation used fuel which emission factor is low?	(a) Y (b) N/A	(a) There will be no emissions from the completed facilities. Emissions during construction will be controlled by monitoring. (b) Normally the public electricity supply will be used. A low fuel cost generator will be used as the standby electrical power generator. However, in some cases it may be difficult to select the fuel locally.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons of Yes/No, Mitigation Measures)
	(2) Water Quality	(a) Do effluents or leachates from various facilities, such as infrastructure facilities and the ancillary facilities comply with the country's effluent standards and ambient water quality standards?	(a) Y	(a) During service it will not be necessary to discharge wastewater, and it will not be carried out. Rainwater will flow downstream naturally. During excavation of the foundations during construction, drainage will be carried out. Drainage will be carried out by pumping up groundwater and discharging it, so there is a possibility that the turbidity of the nearby groundwater will increase due to excavated soil from the construction site being mixed into it, so the turbidity will be controlled before discharge.
	(3) Waste	(a) Are wastes from the infrastructure facilities and ancillary facilities properly treated and disposed of in accordance with the country's regulations?	(a) Y	(a) Waste will not arise during service. During construction there is a possibility that tree roots or waste deposited in reclaimed land will be excavated. The waste will be separated from the excavated soil, and transported to a waste facility for disposal by a specific disposal method. Also, the excavated soil will be transported to a specified soil disposal site.
	(4) Soil Contamination	(a) Are adequate measures taken to prevent contamination of soil and groundwater by the effluents or leachates from the infrastructure facilities and the ancillary facilities?	(a) Y	(a) Soil contamination will not arise during service. There is a possibility of occurrence of small scale soil contamination as a result of oil leakage from construction machinery and vehicles during construction. Inspection for oil leaks and repair will be carried out on vehicles and machines. If an oil leakage occurs, the polluted soil will be collected, transported to a specified waste disposal site, and disposed of.
	(5) Noise and Vibration	(a) Do noise and vibrations comply with the country's standards?	(a) Y	(a) During service, noise and vibration will not occur. Noise and vibration will occur during construction, mainly associated with foundation excavation. The Maldives does not have a set criterion, but the noise and vibration levels will be maintained below the criteria of the adjacent countries when carrying out construction.
	(6) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	(a) N	(a) The ground is reef limestone with thin topsoil, and this is not a region of wide area ground subsidence. Also, according to the site investigation, direct foundations or piled foundations will be installed in locations having sufficient bearing capacity, so ground subsidence will not occur.
	(7) Odour	(a) Are there any odour sources? Are adequate odour control measures taken?	(a) N	(a) The foundation excavation will be in limestone ground or land reclaimed with beach sand, and the site investigation did not find material that could be the source of odours, so odours will not arise during construction or during service.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons of Yes/No, Mitigation Measures)
3 Natural Environment	(1) Protected Area	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	(a) The sites are not located in protection areas. Some sites are close to or adjacent to Environmental Sensitive Areas, Environmental Protection Zones, or coastal protection forests, so during construction measures will be taken to reduce the effect (reduction of the effect of exhaust gases, reduction of the effect on groundwater quality associated with drainage, as described in Table 2-3-18 Mitigation Measures and Costs). Also, alternative tree planting will be carried out for felled trees in accordance with the regulations, and during service these planted trees will be cultivated and managed, so that the effect on protection areas will be reduced.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (*e.g.*, coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that the amount of water (*e.g.*, surface water, groundwater) used by the project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	(a) Y (b) N (c) Y (d) N	(a) At nine (out of 21) target sites, felling of natural tropical forests or secondary forests will be carried out. During construction measures to reduce the effect on the surroundings will be taken (reduction of the effect of exhaust gas, reduction of the effect of drainage on groundwater level lowering and water quality, alternative tree planting and cultivation associated with deforestation, as shown in Table 2-3-18 Mitigation Measures and Costs). (b) At Felidhoo (Vaavu Atoll), there is a protected old tree 70m from the site, so measures will be taken during construction to reduce the effect (reduction of the effect of exhaust gas, reduction of the effect of drainage on the groundwater level lowering and water quality, as shown in Table 2-3-18 Mitigation Measures and Costs). (c) No protected flora and fauna have been found on the target, but as a result of felling of forests the habitats and activity areas of the flora and fauna will be reduced. Measures will be taken to reduce the effect on the surrounding forest in accordance with (a) above (reduction of the effect of exhaust gas, reduction of the effect of drainage on groundwater level lowering and water quality, alternative tree planting and cultivation associated with deforestation, as shown in Table 2-3-18 Mitigation Measures and Costs). (d) Water will be used during the drainage operations associated with construction of the foundations, but there will be no effect on river environment and on aquatic organisms.
	(3) Hydrology	(a) Is there a possibility that hydrologic changes due to the project will adversely affect surface water and groundwater flows?	(a) N	(a) Drainage operations will be carried out associated with the construction of foundations, as a result of which there will be a temporary drawdown of

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons of Yes/No, Mitigation Measures)
				the groundwater levels in the area surrounding the site, but it will not affect the flow of surface water or groundwater.
	(4) Topography and Geology	(a) Is there a possibility the project will cause large-scale alteration of the topographic features and geologic structures in the project site and surrounding areas?	(a) N	(a) The target sites are flat ground several metres above sea level, and there will be no change to the topography or geological structure.
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimise the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is the compensations going to be paid prior to the resettlement? (e) Is the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous people? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organisational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) N/A (b) N/A (c) N/A (d) N/A (e) N/A (f) N/A (g) N/A (h) N/A (i) N/A (j) N/A	(a) (b) (c) (d) (e) (f) (g) (h) (i) (j) There will be no resettlement of residents. Necessary lands are ensured by the PSM.
	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?	(a) Y	(a) On the islands with target sites some of the roads are narrow, so the movement of the residents may be hindered due to transport of materials and equipment, temporary storage of materials and equipment, and the construction site. The construction plan will be explained to the Island Committees and residents, safety measures, etc., will be discussed, and the residents will be informed.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archaeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) Y	(a) Historical assets have been identified at two locations on the islands with target sites, but they are distant from the sites, and will not be affected.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons of Yes/No, Mitigation Measures)
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken? (b) Is there a possibility that landscape is spoiled by construction of high-rise buildings such as huge hotels?	(a) N (b) N	(a) (b) Several towers of telecom carriers have already being constructed on each of the target islands, so the addition of one tower will not damage the landscape.
	(5) Ethnic Minorities and Indigenous People	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous people? (b) Are all of the rights of ethnic minorities and indigenous people in relation to land and resources respected?	(a) N/A (b) N/A	(a) (b) There are no distinct ethnic minorities or indigenous peoples on the islands with target sites.
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health programme, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a) Y (b) Y (c) Y (d) Y	(a) The compliance will be carried out. (b) Measures to prevent work-related accidents will be implemented. (c) A labour health and safety plan will be formulated, notified to the workers, and implemented. (d) A guard will be deployed to provide guidance.
5 Other	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (*e.g.*, noise, vibrations, turbid water, dust, exhaust gases, and waste)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(a) Y (b) Y (c) Y	(a) Concentration of construction machinery will be avoided, the hours of high noise and vibration operations will be set, labour safety measures and mitigation measures will be implemented. (b) For the foundation excavation which will have the greatest effect on the natural environment during construction, in particular for the drainage operations, a drainage plan will be submitted to the EPA in accordance with the Dewatering Regulations, and a permit obtained. Measures based on the instructions from the EPA and mitigation measures to reduce the impact will be implemented. (c) Mitigation measures will be implemented such as formulation of a plan to mitigate traffic obstruction for the residents due to the construction, notification of the residents, and control.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons of Yes/No, Mitigation Measures)
	(2) Monitoring	(a) Does the proponent develop and implement monitoring programme for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring programme? (c) Does the proponent establish an adequate monitoring framework (organisation, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Y (b) Y (c) Y (d) N	(a) The project promoter PSM will prepare an EIA Management Department by employing staff. (b) The environmental impact will mainly arise during the construction period. Items to reduce the environmental impact of the construction will be set. Construction will be carried out at 21 locations, and the items will be adjusted in accordance with the construction period at each location. (c) This will be implemented by the PSM management. (d) Although not currently prescribed, this will be prescribed in the environmental decision documents of the EPA.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Roads, Railways and Bridges Checklists should also be checked (*e.g.*, projects including access roads to the infrastructure facilities). (b) For projects, such as installation of telecommunication cables, power line towers, and submarine cables, where necessary, pertinent items described in the Power Transmission and Distribution Lines Checklist should also be checked.	(a) N (b) Y	(a) Roads, railways, and bridges are not relevant. (b) A checklist for electrical power transmission, transforming, and distribution has been confirmed.
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (*e.g.*, the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) Y	(a) There is a possibility of an effect from the rise in sea water levels associated with global warming, but the facility design has taken a tsunami into a consideration.

(Note 1) Regarding the term 'Country's Standards' mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made. In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience).

(Note 2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which the project is located.

Source: Created by JICA Survey Team

2-4 Gender Considerations

The United Nations Food and Agriculture Organization document 'FAO Corporate Document Repository Maldives Gender Roles in Bio-resources Management' (http://www.fao.org/docrep/005/ac792e/AC792E03.htm) states the following regarding the role of gender in Maldives.

Due to their small population and widely dispersed islands, the Maldivians have developed a socio-cultural pattern characterised by close-knit homogenous communities. Frequent divorces and remarriages have enlarged the family and diluted its influence on children.

Traditions favouring segregation of women, common in many Islamic countries, are conspicuously absent in the Maldives. There is free mixing between the genders and restrictions on female education or employment are absent. Women work alongside men in a number of occupations. Thus gender roles reflect the unique culture.

Nevertheless, the traditional gender division of labour is well defined and continues to prevail even today. The islands are dependent upon a seafaring economy.

Fishing has provided the main occupation for men on remote atolls. According to tradition, men go to sea to fish for tuna during the day, while women tend to take care of children and produce food and articles for subsistence at home. Women on remote atolls have also traditionally been involved in boiling, drying and salting fish, as well as in various local fibre-based handicrafts, including the production of coir rope and twine, matting, producing palm frond panels and basketry.

In general, two major constraints inhibit the ability of women to participate in economic activities:

1) Obligations to care for the family, more demanding in the Maldives as a result of the large family size (7.2 persons on average);
2) Mobility constraints imposed by the island geography, as well as the fact that women cannot migrate with or follow their husbands at will to the place of their new and more lucrative jobs, such as the Gulf States.

In this project to develop the digital terrestrial broadcasting network, there are no matters that require special consideration of gender. In carrying out the survey, design, and construction at the relevant sites, consideration will be given to women and children, the handicapped, and the socially vulnerable.

Also, in interviews with households near facility construction, the opinions of women engaged in housework and home work will be heard as much as possible, and reflected in the environmental and social considerations during construction and operation. Also at meetings of island committees, the opinions of women employees will be heard.

Chapter 3　Contents of Project

Chapter 3 Contents of Project

3-1 Overview of Project

3-1-1 Objectives of Project

3-1-1-1 Overall Goals and Project Purpose

The Republic of Maldives is a small country with an approximate population of 350,000. About 133,000 persons, some 40% of the total population, live in the capital city Malé where administrative agencies are concentrated and many job opportunities in commerce and tourism are available. On the other hand, the entire land of the Maldives consists of approximately 1,190 small islands and 201 inhabited islands in an area about 900km north-south. With such geographical characteristics, the infrastructures are underdeveloped on remote atolls in view of cost effectiveness and environmental considerations. The disparity in infrastructure development between the metropolitan area and Atolls has resulted in disparity in access to information, *i.e.*, inhabitants of remote atolls cannot acquire necessary information sufficiently. This status constitutes one of the important issues to be addressed by the Maldives.

To address this issue, the Maldives designated infrastructure improvement as a priority issue in the National Development Plan to alleviate the disparity between islands. In particular, the mobile telecommunication network has already reached a 100% coverage of population. In the Maldives, the television penetration rate is as high as approximately 95% on average nationwide. Television broadcasting constitutes an important means for getting information in addition to mobile phones.

The National Development Plan contains statements that PSM is delivering programmes that provide essential information for people's life such as news, entertainment, education, religion, and weather information and that the majority of the Maldivian citizens depend on the programmes of PSM for information required for their daily life. The Government of the Maldives sets the target coverage of television and radio broadcasting to 100% of the population and gives priority to ensuring dispatch of information required by its people to all of them.

On the other hand, the current analogue terrestrial broadcasting network has an approximate coverage of 83.23% of the population but only PSM is conducting nationwide terrestrial broadcasting. The National Development Plan states it as a problem that only limited programmes and channels can be watched on remote atolls. Although pay-television CATV is rapidly spreading on the remote islands, the Government of the Maldives is pursuing expansion of channels and improvement of programmes of terrestrial broadcasting that can be watched free of charge.

This project is aimed at improving the DTTB platform to improve the broadcasting coverage. Furthermore, it also allows private broadcasters, who have been so far providing terrestrial broadcasting only on the Malé Island and an area surrounding it, to air programmes nationwide using terrestrial broadcasting, enabling acquisition of diverse information also on remote atolls and thus contributing to the achievement of the National Development Plan of the Maldives.

Against this background, the project purpose shall be to 'improve people's access to information and to correct the regional disparity in the access to information'. Furthermore, the overall goal shall be consequently to 'provide diverse broadcasting services throughout the Maldives and transmit high-quality information on its national culture and uniqueness' so that each atoll can transmit programmes on indigenous culture and uniqueness of the regions and that an affluent society that can accept diverse culture is created.

(1) Overall goal

To resolve resional disparities on information through development of a digital terrestrial television network, thereby contributing to mitigating vulnerability against natural disasters

(2) Project purpose

To improve access to information of the national

Indicators: Population coverage by the digital broadcasting network
Number of terrestrial programmes that can be watched in regional Atolls

(3) Expected outputs

A DTTB network is developed by DBNO.

3-1-1-2 Overview of the Project

This project is aimed at achieving the above-mentioned goals and outputs by constructing a digital terrestrial broadcasting network using a DTTB platform and improving the programme production equipment that makes the most of ISDB-T technology, which includes 18 DBNO digital transmitting stations, three relay stations, network operation centre equipment, data broadcasting system for PSM, EWBS terminals, and MMS programme production equipment. The Maldivian side will need to secure appropriate technical personnel and construct a managing organisation to operate the DTTB platform. This grant aid project procures and installs the equipment listed in the table below.

So far on the remote islands, only terrestrial programmes broadcasted by PSM can be watched and terrestrial broadcasting is received only on 141 of the 201 inhabited islands. The implementation of this project will improve the population coverage of DTTB to 91.32% and allow eight terrestrial television channels to be watched on 172 of the 201 inhabited islands. As shown in Table 3-1-1, most of remote atolls will have a higher coverage than with the conventional analogue broadcasting by PSM on the majority of remote atolls. Although Alifu Alifu, Meemu, and Dhaalu will have a lower coverage with DTTB than with the analogue broadcasting, PSM plans to provide simulcast of analogue and digital broadcasting until the Analogue Switch-Off (ASO) so that the said three Atolls will not have a lower coverage.

On the other hand, the Government of the Maldives plans to expand in three years the DTTB platform constructed in this project, finally accomplishing a population coverage of 97.64%. When this occurs, all the inhabited and industrial islands will be covered by DTTB, except for 12 resort islands on which some reception improvement measures are required. When such measures are taken, approximately 100% coverage will be accomplished.

Then, the inhabitants of remote islands will be able to select from diverse programmes and the disparity in access to information will be significantly alleviated.

Table 3-1-1 Comparison of Coverage between DTTB and Existing Analogue Broadcasting

Atoll		DTTB (%)	PSM analogue (%)
Population coverage	Haa Alifu	100.00	96.55
	Haa Dhaalu	93.59	89.53
	Shaviyani	94.62	41.83
	Noonu	100.00	94.71
	Raa	100.00	84.99
	Baa	100.00	72.27
	Lhaviyani	100.00	0
	Kaafu	55.58	56.80
	Alifu Alifu	0	27.49
	Alifu Dhaalu	82.15	77.26
	Vaavu	100.00	71.80
	Meemu	0	82.86
	Faafu	100.00	98.90
	Dhaalu	31.64	90.66
	Thaa	65.14	41.56
	Laamu	100.00	79.26
	Gaafu Alifu	100.00	44.63
	Gaafu Dhaalu	100.00	62.44
	Gnaviyani	100.00	100.00
	Seenu	100.00	99.62
	Total	91.32	83.23

Atoll	DTTB (%)	PSM analogue (%)
Inhabited island coverage (out of **201 islands**)	172 islands	141 islands
Resort island coverage (out of 115 islands)	90 islands	82 islands
Industrial island coverage (out of 30 islands)	28 islands	22 islands

Source: Created by JICA Survey Team

Table 3-1-2 describes the cooperation to be provided in this project.

Table 3-1-2 Description of Cooperation

No.	Item	Quantity		Remarks
1	**Digital transmission system**	**1**	**system**	
1.1	Digital transmission system (Dhidhdhoo)	1	system	
(1)	UHF receiver	1	system	
(2)	Exciter	2	units	
(3)	Power amplifier (200W)	2	units	
(4)	Combiner	1	unit	
(5)	Antenna system	1	system	
(6)	UPS	1	unit	
(7)	Lightning-proof transformer	1	unit	
(8)	Distribution board	1	unit	
1.2	Digital transmission system (Kulhudhuffushi)	1	system	
(1)	Network system	1	system	
(2)	TS expander	1	system	
(3)	Exciter	2	units	
(4)	Power amplifier (100W)	2	units	
(5)	Combiner	1	unit	
(6)	Antenna system	1	system	
(7)	UPS	1	unit	
(8)	Lightning-proof transformer	1	unit	
(9)	Distribution board	1	unit	
1.3	Digital transmission system (Funadhoo)	1	system	
(1)	TS expander	1	system	
(2)	Exciter	2	units	
(3)	Power amplifier (100W)	2	units	
(4)	Combiner	1	unit	
(5)	Antenna system	1	system	
(6)	UPS	1	unit	
(7)	Lightning-proof transformer	1	unit	

No.	Item	Quantity	Remarks
(8)	Microwave link system (Manadhoo master station)	1 system	
(9)	Distribution board	1 unit	
1.4	Digital transmission system (Manadhoo)	1 system	
(1)	TS expander	1 system	
(2)	Exciter	2 units	
(3)	Power amplifier (10W)	2 units	
(4)	Combiner	1 unit	
(5)	Antenna system	1 system	
(6)	UPS	1 unit	
(7)	Lightning-proof transformer	1 unit	
(8)	Microwave link system (Naifaru master station)	1 system	
(9)	Microwave link system (Funadhoo slave station)	1 system	
(10)	Distribution board	1 unit	
1.5	Digital transmission system (Ungoofaaru)	1 system	
(1)	TS expander	1 system	
(2)	Exciter	2 units	
(3)	Power amplifier (100W)	2 units	
(4)	Combiner	1 unit	
(5)	Antenna system	1 system	
(6)	UPS	1 unit	
(7)	Lightning-proof transformer	1 unit	
(8)	Microwave link system (Naifaru master station)	1 system	
(9)	Distribution board	1 unit	
1.6	Digital transmission system (Eydhafushi)	1 system	
(1)	Network system	1 system	
(2)	TS expander	1 system	
(3)	Exciter	2 units	
(4)	Power amplifier (50W)	2 units	
(5)	Combiner	1 unit	
(6)	Antenna system	1 system	
(7)	UPS	1 unit	
(8)	Lightning-proof transformer	1 unit	
(9)	Microwave link system (Naifaru slave station)	1 system	
(10)	Distribution board	1 unit	
1.7	Digital transmission system (Naifaru)	1 system	
(1)	TS expander	1 system	
(2)	Exciter	2 units	
(3)	Power amplifier (200W)	2 units	
(4)	Combiner	1 unit	
(5)	Antenna system	1 system	

No.	Item	Quantity	Remarks
(6)	UPS	1 unit	
(7)	Lightning-proof transformer	1 unit	
(8)	Microwave link system (Eydhafushi master station)	1 system	
(9)	Microwave link system (Manadhoo slave station)	1 system	
(10)	Microwave link system (Ungoofaaru slave station)	1 system	
(11)	Distribution board	1 unit	
1.8	Digital transmission system (Malé)	1 system	
(1)	Network system	1 system	
(2)	TS expander	1 system	
(3)	Exciter	2 units	
(4)	Power amplifier (200W)	2 units	
(5)	Combiner	1 unit	
(6)	Antenna system	1 system	
(7)	UPS	1 unit	
(8)	Lightning-proof transformer	1 unit	
(9)	Microwave link system (Maafushi slave station)	1 system	
(10)	Distribution board	1 unit	
1.9	Microwave relay station (Maafushi)	1 system	
(1)	Microwave link system (Malé master station)	1 system	
(2)	Microwave link system (Felidhoo slave station)	1 system	
(3)	UPS	1 unit	
(4)	Lightning-proof transformer	1 unit	
(5)	Distribution board	1 unit	
1.10	Digital transmission system (Felidhoo)	1 system	
(1)	TS expander	1 system	
(2)	Exciter	2 units	
(3)	Power amplifier (50W)	2 units	
(4)	Combiner	1 unit	
(5)	Antenna system	1 system	
(6)	UPS	1 unit	
(7)	Lightning-proof transformer	1 unit	
(8)	Microwave link system (Maafushi master station)	1 system	
(9)	Distribution board	1 unit	
1.11	Digital transmission system (Dhangethi)	1 system	
(1)	Network system	1 system	
(2)	TS expander	1 system	
(3)	Exciter	2 units	
(4)	Power amplifier (200W)	2 units	
(5)	Combiner	1 unit	

No.	Item	Quantity	Remarks
(6)	Antenna system	1 system	
(7)	UPS	1 unit	
(8)	Lightning-proof transformer	1 unit	
(9)	Microwave link system (Feeali slave station)	1 system	
(10)	Distribution board	1 unit	
1.12	Microwave relay station (Feeali)	1 system	
(1)	Microwave link system (Dhangethi master station)	1 system	
(2)	Microwave link system (Nilandhoo slave station)	1 system	
(3)	UPS	1 unit	
(4)	Lightning-proof transformer	1 unit	
(5)	Distribution board	1 unit	
1.13	Digital transmission system (Nilandhoo)	1 system	
(1)	TS expander	1 system	
(2)	Exciter	2 units	
(3)	Power amplifier (100W)	2 units	
(4)	Combiner	1 unit	
(5)	Antenna system	1 system	
(6)	UPS	1 unit	
(7)	Lightning-proof transformer	1 unit	
(8)	Microwave link system (Feeali master station)	1 system	
(9)	Distribution board	1 unit	
1.14	Digital transmission system (Gan)	1 system	
(1)	Network system	1 system	
(2)	TS expander	1 system	
(3)	Exciter	2 units	
(4)	Power amplifier (50W)	2 units	
(5)	Combiner	1 unit	
(6)	Antenna system	1 system	
(7)	UPS	1 unit	
(8)	Lightning-proof transformer	1 unit	
(9)	Microwave link system (Guraidhoo slave station)	1 system	
(10)	Distribution board	1 unit	
1.15	Digital transmission system (Guraidhoo)	1 system	
(1)	TS expander	1 system	
(2)	Exciter	2 units	
(3)	Power amplifier (50W)	2 units	
(4)	Combiner	1 unit	
(5)	Antenna system	1 system	
(6)	UPS	1 unit	
(7)	Lightning-proof transformer	1 unit	
(8)	Microwave link system (Gan master station)	1 system	

No.	Item	Quantity	Remarks
(9)	Distribution board	1 unit	
1.16	Digital transmission system (Gadhdhoo)	1 system	
(1)	Network system	1 system	
(2)	TS expander	1 system	
(3)	Exciter	2 units	
(4)	Power amplifier (200W)	2 units	
(5)	Combiner	1 unit	
(6)	Antenna system	1 system	
(7)	UPS	1 unit	
(8)	Lightning-proof transformer	1 unit	
(9)	Microwave link system (Fiyoari slave station)	1 system	
(10)	Microwave link system (Villingili slave station)	1 system	
(11)	Distribution board	1 unit	
1.17	Digital transmission system (Thinadhoo)	1 system	
(1)	TS expander	1 system	
(2)	Exciter	2 units	
(3)	Power amplifier (200W)	2 units	
(4)	Combiner	1 unit	
(5)	Antenna system	1 system	
(6)	UPS	1 unit	
(7)	Lightning-proof transformer	1 unit	
(8)	Microwave link system (Fiyoari master station)	1 system	
(9)	Distribution board	1 unit	
1.18	Digital transmission system (Villingili)	1 system	
(1)	TS expander	1 system	
(2)	Exciter	2 units	
(3)	Power amplifier (20W)	2 units	
(4)	Combiner	1 unit	
(5)	Antenna system	1 system	
(6)	UPS	1 unit	
(7)	Lightning-proof transformer	1 unit	
(8)	Microwave link system (Gadhdhoo master station)	1 system	
(9)	Distribution board	1 unit	
1.19	Digital transmission system (Foammulah)	1 system	
(1)	Network system	1 system	
(2)	TS expander	1 system	
(3)	Exciter	2 units	
(4)	Power amplifier (10W)	2 units	
(5)	Combiner	1 unit	
(6)	Antenna system	1 system	
(7)	UPS	1 unit	
(8)	Lightning-proof transformer	1 unit	

No.	Item	Quantity	Remarks
(9)	Distribution board	1 unit	
1.20	Digital transmission system (Hithadhoo)	1 system	
(1)	Network system	1 system	
(2)	TS expander	1 system	
(3)	Exciter	2 units	
(4)	Power amplifier (20W)	2 units	
(5)	Combiner	1 unit	
(6)	Antenna system	1 system	
(7)	UPS	1 unit	
(8)	Lightning-proof transformer	1 unit	
(9)	Distribution board	1 unit	
1.21	Microwave relay station (Fiyoari)	1 system	
(1)	Microwave link system (Gadhdhoo master station)	1 system	
(2)	Microwave link system (Thinadhoo slave station)	1 system	
(3)	UPS	1 unit	
(4)	Lightning-proof transformer	1 unit	
(5)	Distribution board	1 unit	
2	**Network Operation Centre**	**1 system**	
2.1	Encoding system (Full-seg/one-seg image)	1 system	
(1)	MPEG-4 encoder for full-seg images	1 set	
(2)	MPEG-4 encoder for one-seg images	1 set	
(3)	Multiplexer	1 set	
(4)	Media converter	1 set	
2.2	Encoding system (Full-seg image)	5 systems	
(1)	MPEG-4 encoder for full-seg images	5 sets	
(2)	Media converter	5 sets	
2.3	Media converter (redundant configuration)	6 sets	
(1)	Media converter (redundant configuration)	6 sets	
2.4	TS re-multiplexing system	2 sets	
(1)	TS re-multiplexing system (redundant configuration)	2 sets	
2.5	TS routing system	1 system	
(1)	32 x 32 matrix switcher (redundant configuration)	1 system	
(2)	Signal distributor (redundant configuration)	1 system	
2.6	GPS reception system	1 system	
(1)	GPS receiver (redundant configuration)	1 set	
2.7	TS compressor	2 sets	
(1)	TS compressor (redundant configuration)	2 sets	
2.8	Network switch	1 system	
(1)	Layer 3 network switch (redundant configuration)	1 system	
(2)	Layer 2 network switch (redundant configuration)	1 system	
2.9	BTS/IP converter for TS output	1 system	

No.	Item	Quantity	Remarks
(1)	BTS/IP converter for TS output (redundant configuration)	1 system	
2.10	EPG system	1 system	
(1)	EPG transmission server	1 set	
(2)	EPG TS generator	2 sets	
(3)	EPG registered terminal	7 sets	
2.11	EWBS transmission server	1 system	
(1)	EWBS transmission server	1 system	
2.12	TS monitoring system	1 system	
(1)	Monitor	3 sets	
(2)	TS decoder	3 sets	
(3)	BTS decoder	10 sets	
(4)	Monitor rack	1 system	
2.13	TS recorder	2 systems	
(1)	TS recorder	2 systems	
2.14	TS analyser	1 system	
(1)	TS analyser	1 system	
2.15	Alarm monitoring system	1 system	
(1)	Alarm monitoring system	1 system	
2.16	Transmitting station – monitoring camera system	1 system	
(1)	Monitoring camera system server	1 system	
(2)	Fixed monitoring camera	21 systems	
2.17	Console	1 system	
(1)	Console	1 system	
2.18	Equipment rack	1 system	
(1)	Rack	5 sets	
(2)	Connector board	1 set	
(3)	NFB board	5 sets	
3	**PSM equipment**	**1 system**	
3.1	Encoding system (Full-seg/one-seg image TS)	1 system	
(1)	MPEG-4 encoder for full-seg images	2 sets	
(2)	MPEG-4 encoder for one-seg images	2 sets	
(3)	Multiplexer	1 set	
3.2	Data broadcasting system	1 system	
(1)	Data broadcasting material production system	1 set	
(2)	Data broadcasting transmission system	2 sets	
3.3	EWBS terminal	1 system	
(1)	EWBS editing terminal	1 set	
(2)	EWBS control terminal	1 set	
(3)	Weather information terminal	1 set	
3.4	MMS studio equipment	1 system	
(1)	HD camera	1 set	

No.	Item	Quantity		Remarks
(2)	Image processing system	1	set	
(3)	SDI/IP converter	1	set	
(4)	Microwave link system	1	set	
(5)	IP/SDI converter	1	set	
(6)	Intercom system	1	set	
4	**Assembly box**	**1**	**system**	
(1)	Assembly box	5	systems	
5	**Antenna tower/pole**	**21**	**systems**	
(1)	Antenna tower – 90m-high	1	system	
(2)	Antenna tower – 80m-high	7	systems	
(3)	Antenna tower – 70m-high	5	systems	
(4)	Antenna tower – 60m-high	3	systems	
(5)	Antenna tower – 50m-high	3	systems	
(6)	Antenna pole – 30m-high	1	system	
(7)	Antenna pole – 20m-high	1	system	
6	**Measuring instruments and tools for maintenance**	**1**	**system**	
(1)	Spectrum analyser	2	systems	
(2)	Spectrum analyser (for microwave links)	2	systems	
(3)	Frequency counter	2	systems	
(4)	Power meter	2	systems	
7	**Spare parts**	**1**	**system**	
(1)	Network system	1	system	
(2)	TS expander	1	system	
(3)	Exciter	1	system	
(4)	Power amplifier (200W)	3	units	
(5)	Power amplifier (50W)	3	units	
8	**Station building**	**1**	**system**	
(1)	Transmitting station building	18	systems	Elevated floor
(2)	Relay station building	3	systems	Elevated floor

3-1-1-3 Contents of Project

Fig. 3-1-1 shows the contents of this project.

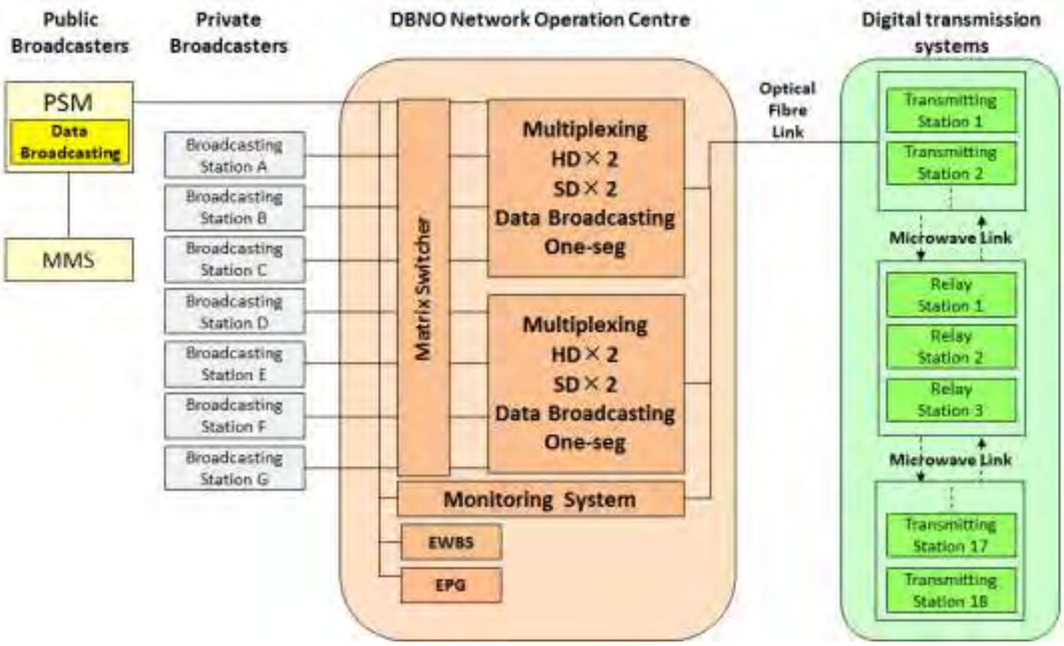


Fig 3-1-1 Contents of Project

(1) Digital transmission system

This project uses the DTTB platform to multiplex two HD programmes, two SD programmes, one data programme, and one one-seg programme in one frequency and, by operating two frequencies in total, enables broadcasting of four HD programmes, four SD programmes, two data programmes, and two one-seg programmes. The digital transmission system includes a transmission link network that delivers broadcasting signals to a transmitting station as well as a transmission system and microwave relay stations to be used for broadcasting. The cooperation to be provided in this project will cover 18 of the 26 transmitting stations and all three of the relay stations planned by the Maldives.

(2) Network Operation Centre (NOC)

The Network Operation Centre (NOC) has functions to receive programmes from broadcasters via optical fibre links, multiplex them, and deliver them to the digital transmission system. The NOC equipment, of which high reliability is expected, has built in redundancy for stable broadcasting operation. Furthermore, equipment regarding the Electric Programme Guide (EPG) and the Emergency Warning Broadcast System (EWBS) will be installed at NOC. EPG information to be received from broadcasters will be converted to EPG signals and multiplexed at NOC. EWBS will be operated by NOC. Since NOC will not edit programmes, the responsibility for the contents of programmes lies with each of the broadcasters.

This project enables broadcasting of four HD programmes, four SD programmes, two data programmes, and two one-seg programmes using two frequencies and supply of free terrestrial broadcasting with choices from multiple programmes on remote islands.

(3) PSM equipment

PSM equipment includes data broadcasting equipment, HD cameras to be installed at MMS, and programme transmission equipment. Data broadcasting, one of the characteristics of ISDB-T, allows viewers to select and see desired information in a similar way to the Internet while watching programmes produced with conventional video and audio. The use of data broadcasting for supply of news, weather information, and important messages from public organisations is hoped for.

Moreover, whereas the current TV network configuration enables only uniform programming throughout the country, data broadcasting can supply different information region by region using a PSI rewriting device which will be installed at each transmitting station. In the Maldives, a long country north-south, supply of region-specific weather information will be convenient for and meet the needs of viewers. In addition, it will be possible to make regional information such as television advertising multiplexed on video and audio.

On the other hand, PSM is actively broadcasting weather forecasts and weather information in collaboration with MMS but it is provided only as pre-recorded programmes. HD cameras and programme transmission equipment to be installed at MMS will enable live broadcasting, which is expected to be useful in emergency.

(4) Antenna tower and poles

The antenna towers of the digital transmission system will be newly constructed in principle because the existing antenna towers of PSM are not sufficiently strong and therefore unfit for installation of transmitting antennas for digital broadcasting. The site plan for the transmitting stations specifies that these towers shall be 90, 80, 70, 60, and 50 metres high. For low heights of 30 and 20 metres, poles will be used instead of towers to reduce the project cost.

(5) Measuring instruments for maintenance

A minimally required number of measuring instruments will be procured for daily maintenance and inspection of the digital transmission systems and NOC equipment to be procured in this project.

(6) Spare parts

In this project, only the NOC equipment is in a redundant configuration. Therefore, important equipment will be procured so that it can be replaced upon the first failure. Due to the characteristics of a DTTB platform, the equipment should be in a redundant configuration wherever possible because a stop of transmission due to a failure of the equipment will require a compensation to private broadcasters for whom television commercials are important sources of revenue. However, the transmission system that will have only a limited range of influence upon an equipment failure will not be in a redundant configuration but spare parts will be used to deal with it (see Chapter 3-2-1, 'Design Policies').

3-1-2 Examination of Related Assistance

3-1-2-1 Verification of Counterpart's Needs

The assistance to be provided in this project was examined to maximise its effects. Since the certainty of the counterpart's needs for DTTB, a new technology, was deemed unclear, related assistance was examined based on the counterpart's needs and in view of potential needs assumed by the Survey Team.

Table 3-1-3 below shows the description of related assistance for which the existence of the counterpart's needs was verified.

Table 3-1-3 Counterpart's Needs for Related Assistance

No.	Item	Counterpart's request	Target
1.	Maintenance of digital transmitters	PSM has been using transmitters for analogue broadcasting and lacks knowledge and experience about digital transmitters except for the use of them in test broadcasting. Technology transfer of the maintenance methods (periodical inspection, replacement of spare parts, emergency responses, etc.) for standard DTTB transmitter systems is needed.	DBNO transmission engineers
2.	Preparation of disaster information broadcasting operation guidelines	One of the reasons for adopting ISDB-T is EWBS. There is a need to sort out procedures to promptly inform islanders of a disaster using EWBS and prepare operation guidelines and manuals about how to collaborate with MMS. However, there is not sufficient knowledge and know-how about them. Technology transfer of these items is required.	● PSM news bureau personnel ● PSM programme operation personnel ● PSM media centre personnel < Collaboration > ● MMS personnel ● Island committees
3.	Data broadcasting programme production techniques	There is no experience of using the Broadcast Markup Language (BML), a description language used to produce data broadcasting programmes. Technology transfer about handling of this language is needed.	Persons in charge of producing PSM data broadcasting programmes

Source: Created by the Survey Team based on interviews with PSM

3-1-2-2 Examination of Potential Assistance Needs

On the other hand, the Survey Team has recognised the necessity of technology transfer also about the following items while verifying the equipment use status and technical level of PSM. These items, which are not included in the counterpart's needs, are not recognised by the counterpart as needs because of overall insufficiency of knowledge and know-how about the actual operation of DTTB equipment.

The items below are deemed important for DBNO in collecting fees from broadcasters and operating the DTTB platform. Furthermore, appropriate use of equipment to be supplied will bring about sufficient effects of cooperation.

Table 3-1-4 Potential Needs for Related Assistance

No.	Item	Potential needs	Target
1.	Management and operation of transmitting stations/relay stations	Since the DTTB platform will be used by many of the terrestrial broadcasters of the Maldives, strict management of the TV broadcasting network is required. With the existing analogue broadcasting, sloppy coverage management is observed in some aspects and, therefore, viewing the appropriate image quality is not available on many of the remote islands. Therefore, the technical capability for 1. DTTB signal measurement and 2. Area management through measurement must be improved.	DBNO transmission engineers
2.	Operation of NOC equipment	The NOC equipment consists of many pieces of equipment specialised for DTTB and multiplexing. Many items of the NOC equipment have complex signal configurations unlike the existing equipment. Therefore, the engineers who operate the NOC equipment must have advanced understanding about signal configurations and equipment. They must also be able to take accurate emergency measures in case of a failure of the NOC equipment because it will influence all the radio waves throughout the Maldives. Furthermore, they must be thoroughly familiar with the operation of equipment that issues EWBS to ensure proper activation of EWBS. Therefore, training on TS/BTS monitoring and analysis, image management, operation and management of multiplexers, transmission of teletext broadcasting, and production of electronic programme guides and subtitled television programmes is needed.	NOC operation engineers of DBNO
3.	Transmission of data broadcasting	Data broadcasting consists of information permanently available regardless of programmes and information supplied in linkage with programmes. Furthermore, PSM plans to produce and transmit different data broadcasting programmes region by region. Therefore, training on ● Examination and decision on broadcasting areas, ● Examination of broadcasting time and programme scheduling, and ● Switching work is needed.	● PSM programme scheduling personnel ● Persons in charge of operation of PSM data broadcasting programmes ● Persons in charge of producing PSM data broadcasting programmes

Source: Created by JICA Survey Team

3-1-2-3 Examination of Assistance Plans

According to Tables 3.1-3 and 3.1-4 above, the content of Table 3-1-5 is expected to be implemented as related assistance.

Table 3-1-5 Overview of Assistance Plans

No.	Item	Contents
1.	Project name	Capacity Development Project for Operation of Digital Terrestrial Television Broadcasting by Utilising the Characteristics of ISDB-T (Technical Cooperation Project)
2.	Project purpose	Broadcasting that makes the most of the characteristics of digital terrestrial television broadcasting will be stably provided.
3.	Overall goal	Digital terrestrial television broadcasting will alleviate the disparity in access to information between islands.
4.	Outputs	1. The technical capability required for maintenance and management of digital broadcasting networks will be improved. 2. The capability of PSM personnel in implementing disaster information broadcasting will be improved. 3. PSM personnel will have data broadcasting production techniques.
5.	Major activities	1-1. Provide OJT on periodical inspection, spare parts replacement, and emergency measures upon equipment failure of transmitter systems. 1-2. Prepare a manual for maintenance and management of transmitter systems. 1-3. Provide OJT on radio wave measurement. 1-4. Prepare a manual for management of coverage. 1-5. Prepare a plan for constructing additional transmitting stations. 1-6. Provide OJT on operation and management of NOC equipment. 1-7. Provide training on taking emergency measures upon failure of NOC equipment. 1-8. Provide OJT on transmission of teletext broadcasting. 1-9. Provide OJT on production of electronic programme guides and subtitled television programmes. 1-10. Prepare a manual for management of coverage. 2-1. Create EBWS operation guidelines. 2-2. Prepare a manual for EBWS operation. 2-3. Provide training on issuing EWBS. 2-4. Provide OJT on operation of EWBS-related equipment. 3-1. Provide training on handling BML. 3-2. Produce templates and contents for region-specific data broadcasting not linked to TV programmes. 3-3. Prepare a scheduling plan for data broadcasting programmes. 3-4. Provide OJT on transmission of data broadcasting programmes. 3-5. Hold workshops on production of data broadcasting programmes. (Allow broadcasters and production staff to attend the workshops as observers to facilitate their understanding on data broadcasting.)
6.	Implementing organisation	PSM (including DBNO)
7.	Input from the Government of	1. Chief consultant/broadcasting business planning 2. Transmission technology maintenance & management planning

No.	Item	Contents
	Japan	3. Channel planning/link design planning 4. NOC equipment operation planning 5. EWBS operation planning 6. Data broadcasting programme production < M/M > ● Approx. 30 to 35 M/M (to be examined) < Equipment to be Supplied > ● One set of radio wave measuring equipment ● One set of templates for data broadcasting (the quantity of them is to be examined in accordance with the project scale.)
8.	Implementation period	Two years

Source: Created by JICA Survey Team

Note that revision of systems and regulations is deemed necessary to enable DTTB via this platform before the start of this project. The major agency in charge of revision is the Maldives Broadcasting Commission. However, the commissioner was changed in April 2016, leaving concern about the continuity of examination about DTTB.

A delay in revision of systems and regulations will slow down the overall migration to DTTB. The Survey Team considers that assistance for revision of systems before the start of this project should be examined if necessary.

3-2 Outline Design of Grant Aid Project

3-2-1 Design Policies

3-2-1-1 Basic Policies

The outline design of the grant aid project shall be made based on the following basic policies:

(1) The transmitting station specifications based on the channel plan in the Maldives shall be used as the basis

The effective radiated power (ERP), transmitter output, antenna, and antenna configuration of each transmitting station shall comply with the transmitting station specifications based on the channel plan in the Maldives as described in Chapter 2-1-3. In the Maldives, transmission over the sea tends to cause interferences between the same channels and adjacent channels. The channel plan can serve as the guidelines to be used by CAM to assign DTTB frequency licences in the future so that the said specifications shall be observed in designing a digital transmission system, etc.

(2) Designs shall be based on the multiplex operation plan of the Maldives

According to the programme multiplex operation plan of the Maldives described in Chapter 2-1-5, the system configuration shall be designed to multiplex two HD programmes, two SD programmes, one data programme, and one one-seg programme and broadcast them. Since the multiplex operation for three HD, one data, and one one-seg programme is planned for the future, the related equipment shall be designed with specifications to comply with the multiplex operations in the future.

(3) The policies on the reliability of design shall also be included

The components of the DTTB platform should have high reliability and stability because the Maldivian broadcasters that provide DTTB shall use the said platform to deliver the television programmes to viewers. Therefore, necessary redundant configurations shall be investigated in consideration of providing stable broadcasting. Furthermore, equipment and systems not to be designed in redundant configuration shall be determined in view of cost-effectiveness after examining the actions to be taken upon equipment failures.

(4) Consideration to programmes with regionality

The broadcasting business in the Maldives is developing mainly on the Malé Island with the capital city. The remote islands are watching domestic and overseas programmes that are transmitted and retransmitted from the Malé Island, respectively. The Government of the Maldives aims at alleviating the disparity in access to information between islands, not only in terms of convenience and access to infrastructures but also in terms of improvement of living standards and culture, by supplying information on daily living as well as information that ensures a relaxed and pleasant style of living without disparity. Since the remote islands are not capable of producing programmes themselves, even the programmes unique to the Maldives tend to be produced with Malé-centred interpretations, viewpoints, and manners. Therefore, the design will be made based on such circumstances of programme production to ensure communication of information required for each of the regions.

(5) Consideration to future plans

The broadcasting market of the Maldives is far from large due to the size of its population. However, the television penetration rate is as high as approximately 95% and people have high expectations for television. Therefore, the plan made by the Maldives aims at starting the DTTB platform operation with eight channels of video/audio programmes but expanding the number of channels to 12 in the future. DBNO’s analysis of finances and budgets concluded that 12 channels are financially possible if there is demand for television programmes. In other words, it is a feasible plan. To realise this project, it is necessary to change the initial DTTB platform operation with two frequencies to that with four frequencies in the future. The value of the platform will increase by using as many common components as possible for all the equipment except towers, transmitting antennas, feeders and the like, transmitters, and exciters. Specifications to be used in the design shall be examined to ensure continued use of the existing common equipment even after an increase from two to four frequencies.

3-2-1-2 Policies about DTTB Migration and Platform Operation

The operation of the platform requires strong collaboration between the private broadcasters and PSM, which is the most important element in bringing this project to a success. The aim of introducing the DTTB platform business is to allow all the broadcasters to accomplish DTTB migration in concert with each other in the same period. The private broadcasters are in different business environments and circumstances. The process of DTTB migration that requires huge equipment investment is a difficult operation even for financially well-off broadcasters. If each broadcaster makes DTTB migration with focus on the finance, the achievement of the objective, Analogue Switch Off (ASO), will depend on the financial circumstances of the broadcasting country.

The Government of the Maldives decided to introduce the DTTB platform because the broadcasting industry of this country is still very young and does not have a solid foundation in comparison with broadcasters in developed countries and therefore the government needs to take the lead to some degree.

In consideration of these circumstances, the design will be made to allow private broadcasters to participate in the platform migration without new investment on equipment at the time of participation. This consideration will allow the private broadcasters to focus their efforts on migration of the studio equipment such as cameras to HD broadcasting in the few years to come and deliver programmes of high-quality images, a characteristic of DTTB, to viewers in the near future.

3-2-1-3 Policies about Natural Conditions

The following four subsections describe policies about natural conditions.

Note that the design policies about survival wind speeds are omitted in this section because they are described in the design policies about towers.

(1) Temperature and humidity conditions

The weather data acquired from MMS shows the highest temperature of 38.3°C and the lowest temperature of 22.1°C in this region and average humidities of 65% to 80% among the regions. Since the major equipment in the digital broadcasting network to be procured in this project will be used basically in air-conditioned rooms, no special measures need to be taken for the outdoor air temperatures and humidities in this country. However, the indoor temperatures shall be designed using a design outside air temperature of 35°C and the maximum allowable temperature for the entire equipment shall be 40°C in consideration of ensuring desired performances and functions of the equipment.

(2) Salt damage

The planned construction sites for digital transmitting station buildings and antenna towers to be constructed in this project are located 50m away from the shorelines at the nearest, where they are exposed to sea wind. The salt concentrations in the air measured in meteorological survey of this project were found to be 1.40 x 10^{-6}g/m^3 at the average wind speed and 1.10 x 10^{-6}g/m^3 at the maximum wind speed. The external walls, openings, towers, outdoor units of air-conditioners, and other equipment to be exposed to the outside air shall be protected against salt damage. Towers shall have hot-dip galvanised aluminium alloy plating.

(3) Seismic conditions

Although no occurrence of large earthquakes has been recorded in the Maldives, PSM shall have a role of communicating warnings and advisories to the islands in the DTTB network to be developed in this project. Since the one-seg broadcasting and the like will have an important role in providing residents with information together with images after a disaster strikes, the buildings, foundations, and facilities to be constructed or improved shall be designed in compliance with the Maldives National Building Code and in consideration of the structural criteria of Japan.

(4) High tides and tsunamis

The DTTB network to be developed in this project is expected to serve as a means to provide information when a disaster strikes. After the Maldives received damage from a tsunami that accompanied the 2004 Indian Ocean Earthquake, the country requires that new public facilities are constructed with an elevated floor. To ensure functionality even during high tides and tsunamis similar to those experienced by the Maldives in the past, the plan shall specify the adoption of an elevated floor for transmitting station buildings that contain transmission equipment and a second-floor height of 3.6m in consideration of the record-high height of 3.4m reached by tsunamis in the past.

3-2-1-4 Policies about Geographic Features and Social Conditions

(1) Policies about equipment transportation in the Maldives

Equipment shall be transported on boats in the Maldives. However, the transportation will be extremely complicated because there are many project sites including 18 digital transmitting stations, three microwave relay stations, and PSM buildings, which are distributed all over the Maldives. Furthermore, the transportation cost is high because basically Dhoni boats or other small or middle-sized boats shall be chartered for the transportation due to the restricted navigation of large ships.

Therefore, efforts shall be made to load on the same boat the equipment to be transported to sites in the same direction in an effort to improve the transportation efficiency and thus reduce the cost. Furthermore, the construction schedule shall be made in consideration of the transportation method.

(2) Policies about securing workers

Although it seems possible to secure workers for construction work in the Maldives, there will be few experts and engineers with special knowledge about processes, quality, safety management, etc. Therefore, it will be necessary to dispatch experts and engineers to the Maldives from Japan. However, the dispatch of all such personnel from Japan will be too costly, and efforts will be made to dispatch personnel from surrounding countries in order to reduce costs. In such a case, recommendations will be made to the implementer to check that the workers have sufficient technical and language levels.

(3) Policies for designing equipment in consideration of regionality

The Maldives is an island nation with 26 Atolls and approximately 1,190 islands, located in the Indian Ocean, southwest of Sri Lanka, scattered between 0º40'S and 7º7'N and between 72ºE and 74ºE. Since each of the islands has regionality, there is a lot of information that cannot be communicated in a uniform programme throughout the country. Therefore, a system shall be examined to broadcast data broadcasting programmes to convey data unique to the region.

Information with strong regionality such as the local municipality information, weather forecast, and emergency disaster information are necessary information usually only for the viewers in the region. PSM hopes to supply services in which only necessary information can be acquired easily and promptly. Since the regional stations are not sufficiently capable of producing conventional video/audio programmes, the broadcasting network is structured to allow broadcasting of only uniform programmes throughout the country that are produced by the headquarters of PSM. In contrast, data broadcasting programmes, which are also produced by the headquarters of PSM, can be multiplexed in linkage with network IDs, each assigned to a different region, to allow broadcasting of region-specific data broadcasting programmes.

(4) Design in consideration of reception by mobile phones and terminals

The design shall enable viewing on mobile phones and terminals. In the Maldives, an island country whose main industries are fishing and tourism such as marine sports, there are many occasions of getting on boats such as transportation between islands and fishing. Supply of weather information to boats via DTTB is expected to be effective in reducing marine accidents during navigation of boats. Therefore, the equipment configuration shall be examined to enable one-seg broadcasting, one of the characteristics of ISDB-T. Regarding radio wave propagation, the specifications of transmitters, transmitting antennas, etc. shall be determined in consideration of the Maldives in the coverage of one-seg broadcasting.

3-2-1-5 Policies about Procurement Conditions Including the Third Country

The equipment to be procured in this project is not manufactured in the Maldives and therefore shall be procured from Japan. For equipment for which competitiveness cannot be ensured if it is procured only from Japan, products of third countries shall also be included in the procurement candidates.

Table 3-2-1 shows the main products to be procured from third countries.

Table 3-2-1 Main Products to be Procured from Third Countries

Equipment	Country for procurement
Power amplifier	Germany
Antenna system	Thailand and Australia
Network system	Sweden
Antenna towers and poles	Thailand and China
NOC equipment (part)	Sweden
MMS studio equipment (part)	Sweden

Source: Created by JICA Survey Team

Each component of the broadcasting equipment, such as transmitters and antennas, does not function by itself. The power supplies, transmitters, transmitting antennas, and other components will fulfil their functions only when they are adjusted comprehensively. Therefore, according to the configuration planned by the Survey Team in this project, the components selected in the implementation phase shall be assembled by the Japanese supplier of procurement equipment into one system in a way that fulfils the required functions and then evaluated and verified for the performance as a system before being loaded into a boat and upon on-site installation to ensure the performance and quality of the overall system.

3-2-1-6 Policies about Equipment Grade Setting

The broadcasting equipment can be roughly classified into the equipment for ‘consumer use’, ‘industrial use’, and ‘broadcaster use’. The equipment for ‘broadcaster use’ is designed in consideration of high reliability and redundancy to withstand continuous operation and reduce the occurrence of failures. Therefore, it is more costly than the equipment for consumer and industrial uses.

The equipment to be used in this project shall be selected from equipment for broadcaster use in principle because the DTTB platform is a broadcasting infrastructure for which the broadcasters demand reliability.

3-2-1-7 Policies about Digital Transmission Systems

This project uses the DTTB platform to multiplex two HD programmes, two SD programmes, one data programme, and one one-seg programme in one frequency and, by operating two frequencies in total, enables broadcasting of four HD programmes, four SD programmes, two data programmes, and two one-seg programmes.

The digital transmission system can be roughly classified into three components:

(a) Transmitter that receives broadcasting signals via optical fibre links and emits broadcast waves to the concerned area,

(b) Transmitter that receives broadcasting signals via microwave links and emits broadcast waves, and

(c) Broadcast wave relay transmitter that receives broadcast waves and re-emits broadcast waves.

The digital transmission system shall be installed at 18 transmitting stations and three relay stations in this project. Therefore, the design policy for the system shall be to design with attention to the items and required actions shown in the Table 3-2-2 below.

Table 3-2-2 Design Policies and Required Actions for the Digital Transmission System

	Design policy	Required action
1.	Pay consideration to the reduction of project costs.	1. Backup configuration with attention to the degree of influence of broadcasting 2. Introduction of broadcast wave relay
2.	Design an equipment configuration in a way that reduces the operation costs of the DTTB platform.	1. Introduction of independent microwave links 2. Introduction of broadcast wave relay 3. Introduction of a remote monitoring system of transmission
3.	Ensure reliability and stability of broadcasting.	1. Setting of link maintenance rate 2. Measure against fading
4.	Pay consideration to future plans.	1. Support of addition of transmitters in the future 2. Broadband support

Source: Created by JICA Survey Team

The digital transmission system shall be designed on the assumption that one transmitter is employed for the system to reduce the project cost. Each transmitter provides broadcasting service in a limited area and therefore will have a smaller scope of influence upon failure than the NOC equipment. Therefore, the transmitter system shall not have a redundant system and shall be replaced with a spare unit upon failure.

As described in Chapter 2-1-3, ‘Channel Plan’, an ITU-R P1546-based simulator is used to execute conditional simulation with a desired wave reception time ratio of 99% and an interference wave reception time ratio of 1% and determine the station site positions throughout the Maldives and the required tower heights, antenna types, antenna patterns, and power requirements.

The transmission and relay networks shall be designed as follows: On an island with optical fibre links of telecom carriers, basically, signals are transmitted via the optical fibre links and, from the terminal station to the transmitting station on the island, the links of the telecom carrier such as the optical fibre links or microwave links shall be used; from there on to subordinate stations, independent microwave links shall be used. This method eliminates the use of satellite links currently used by PSM to transmit signals to the analogue transmitting stations, significantly reducing the link usage fee. Furthermore, in the said network, the broadcast wave relay method shall be used for a link with a relatively short distance between terminal stations in an effort to reduce costs. In this case, the link maintenance rate shall be set to 99.9%, a field-proven setting in Japan. The broadcast wave relay method, which relays signals using actual broadcast waves, eliminates the need for the link usage fee. Furthermore, PSM hopes to reduce personnel cost by introducing unmanned operation of transmitting stations for each of which personnel are currently employed to manage transmission equipment. Therefore, the introduction of a remote monitoring system shall be planned to allow NOC to keep track of the statuses of transmitting stations.

Broadcasting transport stream (BTS) signals generated at NOC of DBNO located on Malé Island are transmitted via a high-speed digital link (STM-1) of a telecom carrier to a local hub of the telecom carrier. At a transmitting station on the destination island, the signals transmitted via the STM-1 link are reconverted to BTS signals and emitted by the transmitter as broadcast waves. If the signals are transmitted further to the next transmitting stations, they are relayed to the transmitting stations via the TTL (Transmitter to Transmitter Link) independent microwave link of DBNO in the same signal format as when transmitted via the STM-1 link, and then re-converted to BTS signals at the next transmitting stations and emitted as broadcast waves in the same way.

Since a loop network cannot be formed with an independent microwave link, the TTL link of the DTTB platform must be constructed as a high-reliability system that does not immediately cause a suspension of broadcasting when the link is cut off due to fading, etc. Therefore, each link shall be set to have a link maintenance rate of 99.9%, a high level of reliability.

The Maldives plans to expand the number of broadcasting channels from two to four in the future. In the implementation phase of the grant aid project, therefore, spaces must be secured in expectation of future equipment expansion. This project shall allow for capacities for four frequencies regarding the station buildings, antenna systems, power facilities, etc. to avoid complication of construction when the broadcast waves are expanded. Furthermore, the combiners that combine broadcast wave outputs and supply them to one antenna shall be broadband combiners for four frequencies.

At present, the DTTB in the Maldives is operated as test broadcasting as shown in Table 3-2-3. It is under consideration that PSM will take over modifiable equipment at a residual value after subtracting the depreciation amount and then deduct the amount of takeover from the usage fee of the DTTB platform. The equipment to be modified to the ISDB-T system is planned to be used as rack-implemented spare transmitters because they do not have a compliant interface with other equipment and cannot be used as active equipment. The modification mainly consists of changing the modulation method of exciters.

It is impossible to use only the power amplifier (PA) as a spare part because there is a connection of control signals with the exciter.

Table 3-2-3 Current Operation Status of DTTB

Channel in use	Broadcaster	Usage status	Transmitter manufacturer
28	DTV	DVB-T	Rohde & Schwarz
29	VTV	DVB-T2	Screen Service
31	Atoll TV	DVB-T	Unknown
32	PSM	ISDB-T test broadcasting in progress	NEC Corporation

Source: Created by JICA Survey Team

Fig 3-2-1 shows the transmission and relay systems to be constructed in this project.

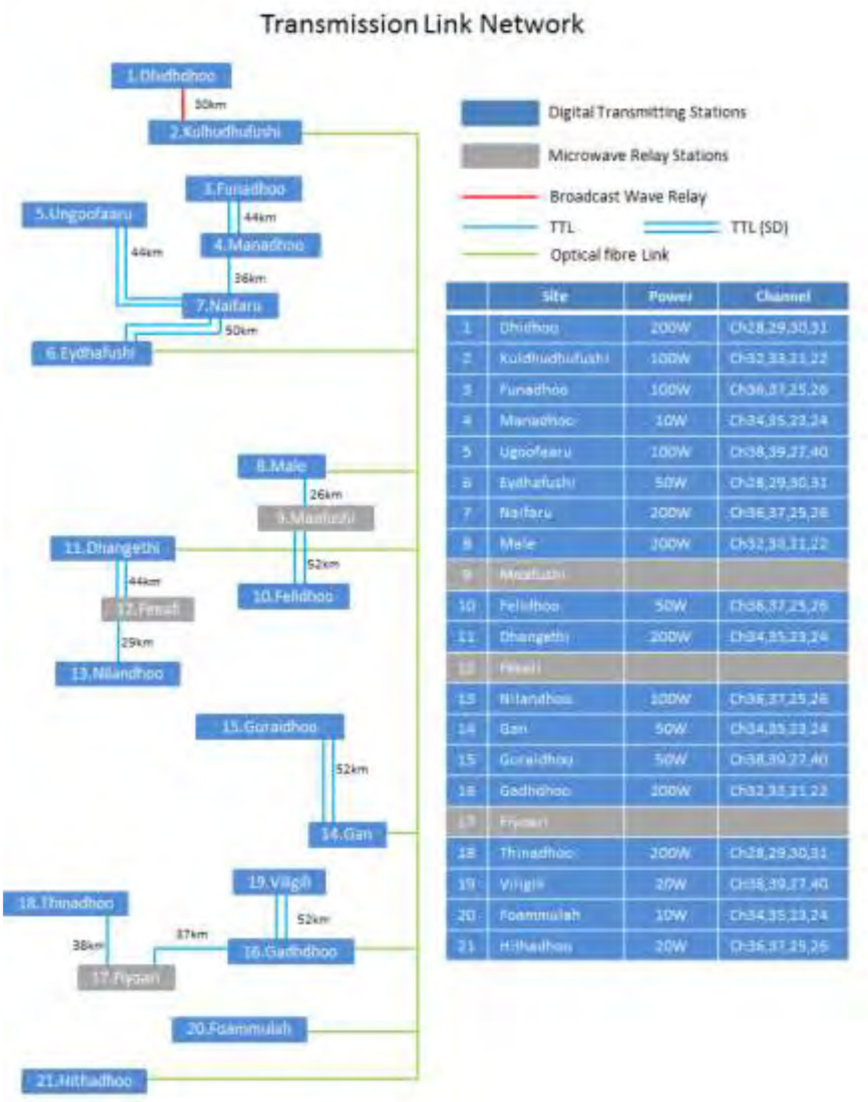


Fig. 3-2-1 Transmission and Relay Systems to be Constructed in this Project

3-2-1-8 Policies about Transmitting Antennas

This section describes the design guidelines for the antenna system and the policies about the transmitting antennas such as the characteristics, directivity, and coaxial feeders of antennas to be used.

(1) Design guidelines

The cover area with the existing analogue transmitting antenna configuration (which refers to a combination of antenna panels to build an overall structural format with which a desired antenna pattern is acquired), using VHF transmitting antennas, is wider than that of UHF transmitting antennas. Since broadcasting via a Multi Frequency Network (MFN) of UHF is used to form areas in this project, optimal antenna directivity must be designed to minimise same-frequency interferences between transmitting station areas due to transmission over the sea and form optimal cover areas.

Furthermore, a broadband antenna system must be designed in consideration of UHF two-channel broadcasting at the start of DTTB service, ASO, and HD three- and four-frequency operations. Therefore, it is desirable to minimise variations of the reception field intensity between channels in a cover area formed by multi-wave antenna systems in which multiple frequencies are emitted from one transmitting antenna.

Since selection of a broadband antenna with small directivity variations is important, four-dipole antennas shall be basically adopted. However, non-directional antennas to be installed on poles in 10W and 20W low-power stations shall be cylindrical non-directional antennas consisting of a super-turnstile element, etc. with a small wind load.

In consideration of use for a long period, it is desirable to adopt products that allow for inspection and maintenance of transmitting antenna system components including antennas. The materials of them shall allow for long-term stable use in consideration of protection against salt damage. The antennas shall consist of stainless steel reflectors, copper or brass elements, and antenna covers made of FRP, fiberglass-reinforced plastic. The antennas shall also be coated for protection against salt damage.

The antennas and main feeder systems shall support an antenna system and a feeder size compatible with a power capacity that allows for future expansion to four frequencies.

(2) Reason for adopting four-dipole antennas

A four-dipole antenna to be adopted as a basic transmitting antenna system as such an antenna:

(a) Is an antenna with four array elements of 1/2 wavelength (a type of directive antenna with numerous antennas mounted on vertical planes), a standard UHF antenna.

(b) Can be used in an ultra-broadband range from 470 to 860MHz.

(c) Can mostly unify the cover area sizes and reception field intensities between channels in an antenna system compatible with multiple frequencies because of small directivity and gain variations in the planned frequency range for use (21 to 40 ch).

(d) Has a structure that allows for removal of the antenna cover and facilitates maintenance inside the cover.

(e) Can alleviate the load on the antenna installation pole (gain tower) and tower because of a small wind receiving area of each antenna.

(3) Reason for adopting UHF non-directional antennas

A super-turnstile antenna to be adopted for the transmitting antenna system of a transmitting station for which a pole will be installed in place of a tower to be constructed as such an antenna:

(a) Is an antenna with four super-turnstile array elements (a type of directive antenna with numerous antennas mounted on vertical planes), which is horizontal-plane non-directive.

(b) Can be used in a broadband range from 470 to 740MHz.

(c) Can mostly unify the cover area sizes and reception field intensities between channels in an antenna system compatible with multiple frequencies because of small directivity and gain variations in the planned frequency range for use (21 to 40 ch).

(d) Has a small wind factor due to a cylindrical structure and can alleviate the load on the pole on which an antenna is to be installed.

(4) Determination of antenna directivity

For broadcasting using the UHF band, it is important to minimise interferences between stations. In particular, interference problems that occur due to long-distance transmission over the sea are expected in this project. Therefore, designs must be made while adjusting the number of antenna planes, directions, and tilt angles to minimise interferences with surrounding stations. To make designs, it is necessary to repeatedly conduct simulations using horizontal and vertical synthetic directivities as parameters to determine optimal conditions.

Since the existing VHF broadcasting stations have towers that are not strong enough to install UHF antennas on them, it was determined to construct new towers at locations near the existing stations. Furthermore, same-channel interferences are expected to occur because transmission over the sea causes radio waves to reach other remote transmitting station areas. Therefore, a simulation to reduce interferences was repeatedly conducted with different conditions of stations such as antenna directivities (antenna directions and tilt angles) and transmission powers. This simulation was conducted in the main survey when a channel plan was prepared.

(5) Determination of main feeder system

For an antenna system compatible with a possible four-frequency operation in the future, coaxial feeders were selected to be used in consideration of a sufficient power capacity for four frequencies. Dehydration-free highly foamed dielectric coaxial feeders were adopted for systems with a transmission output of 100W or less whereas air-insulated coaxial feeders and a dehydrator are used for 200W systems.

Table 3-2-4 shows the transmitter outputs and compatible coaxial feeder sizes.

Table 3-2-4 Broadcasting Equipment Outputs and Coaxial Feeder Sizes

Transmitter output and antenna input	Size of coaxial feeder	Allowable power of coaxial feeder (600MHz, 50°C)
100W (20W×4=80W) or less	1/2" highly foamed dielectric coaxial feeder (less than 50 m) 7/8" highly foamed dielectric coaxial feeder (50 m or more)	1.6kW 3.1kW
400W (100W×4 = 400W) or less	7/8" highly foamed dielectric coaxial feeder	3.1kW
1kW (200W×4 = 800W) or less	7/8" gap-insulated coaxial feeder	2.9kW

Source: Created by JICA Survey Team

3-2-1-9 Policies about Network Operation Centre Equipment

(1) Functions of NOC

NOC shall be managed by DBNO. NOC shall be set up in the PSM building and have the following functions.

- Receiving broadcast programme signals from broadcasters and encoding part of the signals and then multiplexing them with other programmes and generating two frequencies of Broadcasting Transport Stream (BTS) signals to be emitted as broadcast waves
- Editing and unifying EPGs received from broadcasters and multiplexing them on corresponding BTS signals
- Generating and multiplexing PSI/SI signals corresponding to each of BTS signals
- Multiplexing EWBS signals received from the outside
- Compressing BTS signals and transmitting them to link operators (compressed TS signals need only one channel, significantly cutting the communication costs)
- Monitoring signals (NOC input/output and broadcast wave image)
- Live recording of BTS signals: Keeping a record of BTS signals for a certain period of time. This record is used to analyse causes and handle complaints from broadcasters when broadcasting trouble occurs.
- Measuring broadcasting signals for quality check (as needed)
- Monitoring of operation statuses of transmitting stations of DBNO

(2) Equipment system and major equipment configuration of NOC

Figure 3.2-2 shows the equipment system of NOC. NOC has roles of receiving broadcast programme signals from broadcasters, multiplex programmes, and transmitting BTS signals to transmitting stations. NOC is expected to have a high reliability and particularly the main line systems such as the programme encoding and multiplexing units are extremely important. Therefore, the NOC equipment shall have redundancy for stable broadcasting operations.

NOC shall be able to receive signals from six broadcasters except PSM and transmit a total of eight video/audio programmes including two of PSM.

The following describes the functions to be secured on the major equipment of NOC.

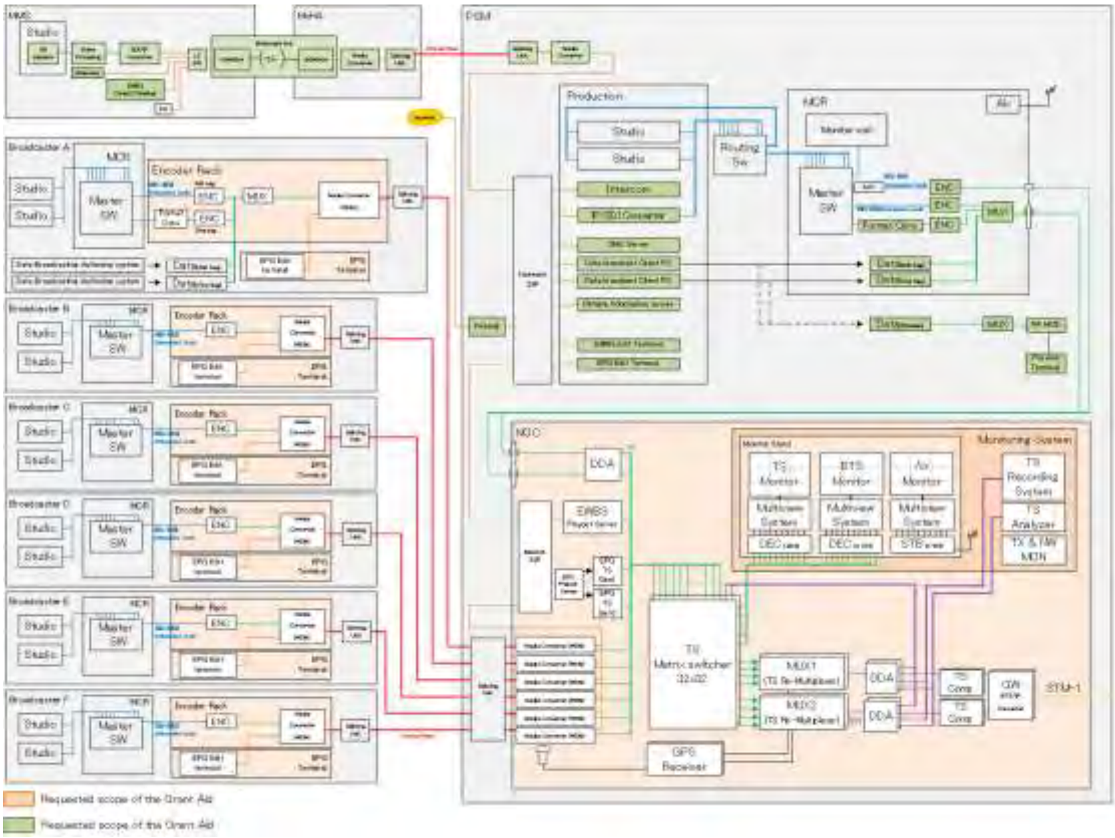


Fig 3-2-2 Schematic Diagram of Equipment Related to NOC

1) Encoder

An encoder encodes video signals to compress the data size and generates TS signals. The encoding by each of the broadcasters alleviates the load on the transmission channel.

2) Matrix switcher

A matrix switcher sorts into two groups the conventional video/audio programmes, data broadcasting programmes, and EPG and EWBS signals received from PSM and other broadcasters. Each of the sorted two groups of programmes is transmitted to the TS re-multiplexing system.

3) TS re-multiplexing system

A TS re-multiplexing system consists of two units. One unit of the TS re-multiplexing system accepts the input of signals for four programmes, data broadcasting, and EPG and EWBS signals that have been sorted by the matrix switcher and generates one stream of BTS signals.

4) TS compressor

A TS compressor compresses the bandwidth of BTS signals generated by the TS re-multiplexer and transmits them to the link of a telecom carrier.

5) EPG system

An EPG system displays a programme guide and programme information on a digital receiver. EPG data received from broadcasters are unified at NOC and multiplexed onto TS signal to include in broadcasting signals.

6) EWBS transmission server

An EWBS transmission server installed in NOC receives ‘disaster warning information’ from MMS and generates EWBS signals.

7) TS monitoring system

A TS monitoring system receives TS signals, BTS signals, and actual broadcast waves to check for abnormalities in broadcasting. It keeps a record of BTS signals for a certain period of time, which is used to analyse causes and handle complaints from broadcasters when broadcasting trouble occurs.

8) Alarm monitoring system

Equipment to be installed at NOC and broadcasting stations has a function of issuing SNMP (abbreviation of Simple Network Management Protocol) or GPI (abbreviation of General Purpose Interface) signals. An alarm monitoring system detects these signals and issues an alarm to enable quick response and prevention of broadcasting troubles.

9) Monitoring camera system

A monitoring camera system collects images of monitoring cameras installed in transmitting stations and keeps image records of trespass of outsiders and occurrence of troubles, which can be utilised in case of emergency.

(3) Interface between NOC and broadcasters

1) Programme contents interface

The interface between broadcasters and NOC shall be designed to avoid heavy financial load on private broadcasters to ensure smooth DTTB migration and participation of broadcasters in the DTTB platform. Therefore, the signals to be passed by private broadcasters to the DTTB platform shall be HD-SDI or SD-SDI and, thereafter, the encoders that convert signals into a format for transmitting them to PSM shall be managed as DBNO assets. Furthermore, the interface configuration shall be designed to be used without change if a broadcasting station that transmits and receives SD-SDI signals shifts to HD programme production in the future. This consideration will allow the private broadcasters to focus their efforts on migration of the studios and master control system to HD broadcasting.

The said interface must also be able to support data broadcasting services provided in linkage with programmes. Therefore, encoded video/audio and data broadcasting programmes must be multiplexed at a studio of each broadcaster. In view of future expandability, the interface signal format between broadcasters and NOC shall be an optical signal format.

Optical fibre links have already been laid between some broadcasters and PSM for digital broadcasting experiments. For them, TS signals shall be converted into an optical signal format and transmitted over the existing optical links.

The following lists private broadcasters who have optical fibre links with PSM.

- VTV
- DhiTV
- Raajje TV
- Sun TV
- Sangu TV
- CH13
- Kaunu TV

2) EPG data transmission link

ISDB-T permits one Electronic Programme Guide (EPG) per broadcast wave. Therefore, EPG data to be created by a broadcaster and multiplexed (virtually operation data in the master) shall be transmitted to NOC in CSV format and unified and multiplexed at NOC into TS signals to be transmitted.

Over the transmission links between broadcasters and NOC, EPG data as well as signals in which the above broadcast programmes are multiplexed shall be converted into optical signals and sent out to the Internet link.

(4) Interface between NOC and telecom carriers

BTS signals generated by NOC (two at DSO and four after ASO) shall be bandwidth-compressed and then transmitted via the gateway to the operation centre of a telecom carrier.

The interface signal format to be used shall comply with the high-speed digital communication service of a telecom carrier. Generally, there are two types of interfaces shown in Table 3-2-5. If the necessary link speed is set to the one that allows for four BTS signals as described in the future plan, the link usage fee for STM-1 is less costly. STM-1 shall be selected also in consideration of the past reliability and stability in transmitting BTS signals and link quality in Japan and elsewhere.

Table 3-2-5 Interface between NOC and Telecom Carriers

	Interface type	
	STM-1	IP multicast
Link speed	155.52Mbps	40Mbps×4
Number of compressed BTS signals	Four BTS signals are multiplexed and converted to STM-1 format	Each BTS signal is converted to IP and transmitted

Source: Created by JICA Survey Team

(5) Action needed when the number of channels is increased after ASO

According to the schedule of migration to DTTB in the Maldives, the broadcasting starts with two frequencies at DSO and the number of channels is increased to four frequencies at the maximum after ASO using the unused frequencies. The facilities of NOC include the equipment to be initially installed in expectation of four frequencies at the start of construction and the equipment that needs to be added when the number of frequencies is increased.

Table 3-2-6 describes the action needed when the number of frequencies is increased.

Table 3-2-6 Action Needed When the Number of Frequencies is Increased

Equipment to be used at NOC	Initial facilities to be installed	Action needed when the number of frequencies is increased
TS re-multiplexing system	2 systems (active/backup)	Addition of two systems and modification of control software (Note)
Signal distributor	2 systems (active/backup)	Addition of two systems
TS compressor	2 systems (active/backup)	Addition of two systems
Gateway (input side)	1 system (active/backup)	Expansion according to the number of programme providers
Gateway (output side)	1 system (active/backup)	Change of channels, expansion of some units
Matrix switcher	1 system (active/backup)	Change of channels, expansion of some units, modification of software (Note)
Monitoring system	1 system	Change of channels, expansion of some units
EPG-related equipment	1 system	Change of channels, expansion of some units, modification of software
EWBS-related equipment	1 system	Change of channels, expansion of some units, modification of software

(Note) Not only the addition of channels but also the modification of control software is needed because it is necessary to change the configurations and parameters of streams to be multiplexed.

(6) Consideration to possible changes of designs

There may be changes in the designs of equipment planned in this project depending on the broadcasters who will participate in the future.

Consensus shall be reached through discussion by the relevant agencies of the Government of the Maldives and the broadcasters who participate in the DTTB platform after establishment of inter-governmental consensus about this project. Therefore, some changes in the designs are expected to be needed depending on the broadcasters who participate while this project is implemented. The part that may be changed is the interface between PSM and other broadcasters. Even if other interface than planned in this project was used, the change of the total project cost would be negligible. Therefore, the quantity calculation of this project shall be based on the design policies described in the above.

3-2-1-10 Policies about PSM Equipment

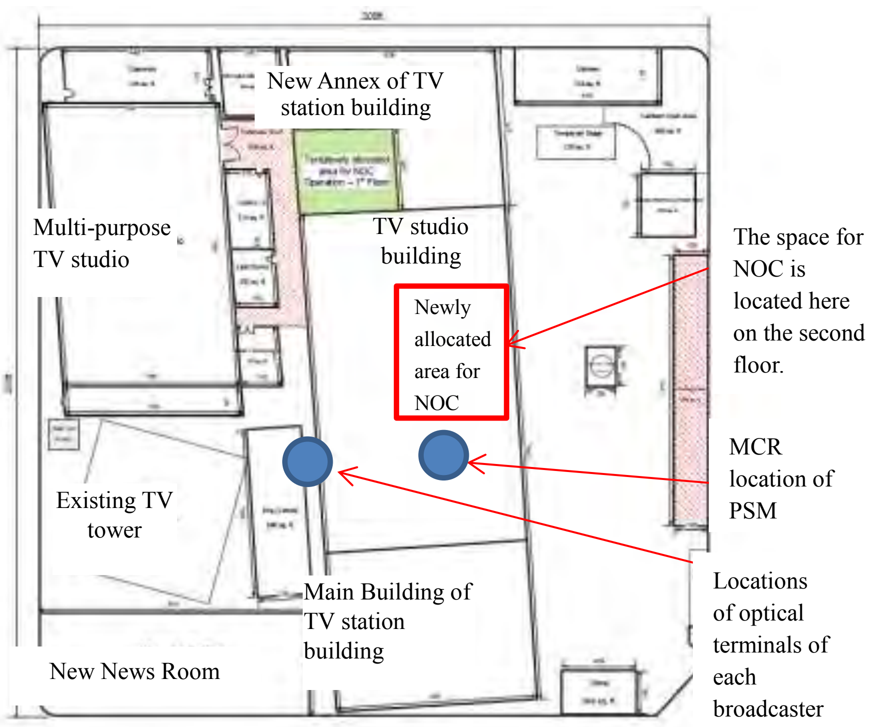
(1) PSM

Since PSM plans to provide HD and SD programmes as well as data and one-seg broadcasting programmes, encoders corresponding to each of them will be required. Encoded signals are unified by the multiplexer into one TS signal and transmitted to NOC. At this time, signals are transmitted via a coaxial cable.

This equipment is assumed to be installed in the Master Room of PSM. However, there may not be sufficient installation space because the master room is small and already contains facilities. If so, some of the equipment shall be installed in other rooms. However, the installation space must be secured within a few tens of metres from NOC in consideration of a distance that allows for signal transmission over coaxial cables.

NOC shall be placed in the second floor of the TV studio building. The reconstruction plan of PSM consists of expanding the Main Building of PSM and constructing a new News Room in the former site of the Information Building that contained the offices of the Maldives Broadcasting Commission and Media Commission and then reconstructing the New Annex of PSM that contains the current News Room and establishing NOC of DBNO in part of the second floor. Currently, a new News Room building is already under construction. After relocation of the News Room to the new building, a building for DBNO will start to be constructed.

Fig. 3-2-3 shows the layout of buildings on the site of PSM. According to this figure, the space secured for NOC is 66.4m^2 (= 9.1m x 7.3m).



Source: PSM

Fig 3-2-3 Layout of Buildings on the Site of PSM

From this figure, a layout plan for NOC shown in Figure 3.2-4 was examined. This figure, in which only equipment supplied in the grant aid cooperation is illustrated, shows that there is sufficient space for possible expansion of equipment from two-frequency to four-frequency operation in the future.

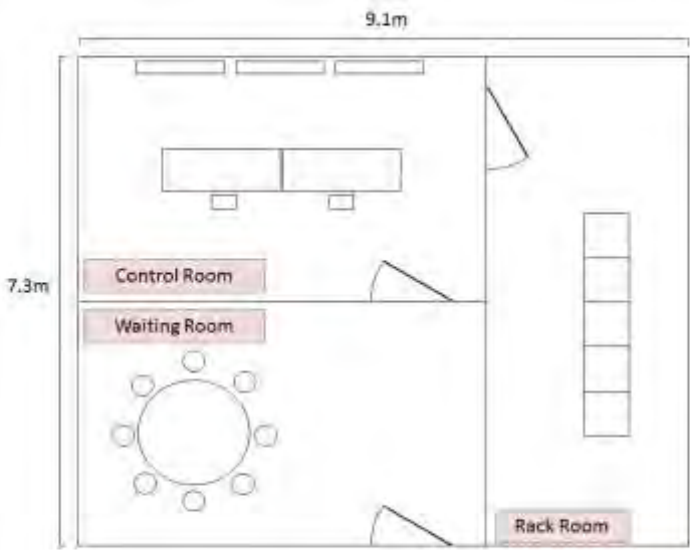


Fig 3-2-4 NOC Layout Plan

(2) Equipment installed at MMS

At MMS, this project shall install PSM equipment to enable live broadcasting and emergency broadcasting upon disasters, such as HD programme production facilities, facilities for acquiring weather information to be utilised in data broadcasting, EWBS control terminals, and transmission equipment that enables real-time information propagation.

MMS has a studio for weather forecast in the office building. Although the broadcasting facilities are for SD quality, weather information programmes using video composition using the chroma key effect can be recorded. MMS uses a system that composes computer graphics (CG) over the image of a weather forecaster who gives weather forecast of various regions. However, recorded programmes must be transmitted over the Internet link to PSM and therefore cannot be broadcast live or just after recording.

MMS has a sufficient line-up of observatories and disaster monitoring facilities and conducts weather forecast through model analysis and around-the-clock observation and monitoring. However, MMS discloses weather information to the general public only on its website so that the information is far from being sufficiently utilised by the islanders, particularly those without Internet access at home.

On the other hand, MMS has been producing weather information programmes for itself as described in the above but the programmes are produced by only one staff member, except for weather forecasters who appear in the programmes.

In view of these circumstances, the PSM equipment to be installed at MMS shall enable one-person operation using a remote control camera and video composition using the existing CG combiner at MMS. Furthermore, the programme production and transmission equipment shall be of a reliable broadcasting quality grade to support live broadcasting. An intercom shall be available to for communications with the master control at PSM.

3-2-1-11 Policies about Antenna Towers

The heights of antenna towers have impacts on the tower construction cost, thereby significantly influencing the total cost of this project. Therefore, the tower construction cost shall be restricted by adopting common tower heights and specifications wherever possible. Basically, the tower heights of 80, 70, 60, and 50m shall be used. A height of 90m shall be adopted only at transmitting stations that need a higher tower. The use of poles shall be examined for heights less than 30m.

According to the International Civil Aviation Organization (ICAO) regulations, towers with a peak height of 60m or less shall be painted in red and white and towers with a peak height of 60 to 90m shall be equipped with a low-intensity aircraft warning light.

The prerequisites for tower designs were examined as described below in accordance with the standards and guidelines listed in Table 3-2-9.

(1) Wind load

Since the design wind speeds for broadcasting antenna towers are not clearly determined in the Maldives, the structures such as towers and antennas to be constructed shall withstand a wind speed of 60m/s, which is a design standard adopted by the broadcasters in Japan, in consideration of the maximum instantaneous wind speed record of a cyclone in the Maldives (206km/h ≈ 57.2m/s). For the sake of prevention of electric field variations in the microwave links and cover areas of transmitting antennas, a transmitting antenna to be installed on a tower shall have a swing angle (angle variation of the transmitting antenna when shaken by wind, etc.) of 0.5 degrees or less at a wind speed of 30m/s.

Note that the wind load shall be calculated by the designer because the tower design itself varies depending on the designer.

(2) Other conditions and design specifications of stations

The configurations and specifications of transmitting antenna systems for which the survey at the stations and the cover area simulation was conducted shall be the ones planned as shown in Table 2-1-16. Regarding the specification settings, the frequency shall be 600MHz and the environmental conditions shall be commonly as follows:

Environmental conditions:

- Ambient temperature: -30 to 50°C
- Relative humidity: Max. 100%

(3) Policies about tower foundation in relation to the ground

- Wind load

The foundation shall be designed based on the tower leg load designed with a design wind speed, V = 60m/s.

- Seismic load

The seismic load shall not be examined because no large earthquake was experienced in the Maldives in the past.

- Liquefaction

Liquefaction shall not be considered because no large earthquake has occurred in the Maldives despite a high groundwater level.

- Materials to be used

Concrete strength: FC 18 (N/mm^2)
Levelling concrete strength: FC 15 (N/mm^2)
Reinforcing bar strength: SD295A
Crushed rock: Crusher run 40 (mm)

- Ground conditions

Since a tower is relatively lightweight as a structure, a direct foundation shall be used if an approximate N-value of 10 can be secured for a few metres from the foundation base. In the case of soft ground that does not allow a direct foundation, a pile foundation shall be used in a bearing layer of the ground in which an N-value of 20 or higher can be secured for a few metres.

- Pile specifications

Piling method: Screw steel pipe pile with toe wing (used because of a low N-value of the supporting layer)
Pile material: SKK400
Blade material: HBL385B
Pile embedded length in the edge ground: Longer than the pile diameter from the supporting layer
Characteristics of piling work: Free of noise, vibration, earth removal, and groundwater contamination

3-2-1-12 Policies about Transmitting Station Buildings

Transmitting station buildings, being highly public facilities required for information propagation and sharing with people, must be planned as safe facilities in case of natural disasters. As the basic policies of this project, therefore, transmitting station buildings shall be protected against storms, tidal waves, tsunamis, etc., be made of reinforced concrete, and have an elevated floor.

The maximum height of a tsunami in the Maldives in the past natural disaster record (2004) was 3.4m at the Hulhulé Airport. Therefore, the second floor on which transmission equipment is to be installed shall have a floor height of 3.6m, *i.e.*, the maximum tsunami height of 3.4m + 0.2m from the ground. The station building shall contain a space for two transmitters as the broadcasting equipment and two more for the future expansion and be provided with a transmitting station alarm and monitor display.

There shall be minimum clearances of 1.2m in front of the broadcasting equipment and 0.6m around it needed for equipment operation and maintenance. The building shall have an approximate space of $25m^2$, 5.0m long by 5.0m wide, to contain an incoming board, lightning resistance board, and other equipment. For ease of carrying in and out equipment during construction and future expansion, the entrance doors to the station building shall be 1.1m (0.8m + 0.3m) wide by 2.1m high (master and slave doors) and 1.1m wide by 1.1m high (double doors) at the handrail of an outdoor passage in front of the doors.

The external wall of a station building shall have openings through which cables of transmission and reception facilities to be installed on a tower are laid, facilitating connection to the facilities in the station building.

3-2-1-13 Policies regarding Power Supply and Air Conditioning

(1) Power supply

It is learned that many of the causes of equipment failures were damage made to the equipment by power failures. On the other hand, the Government of the Maldives is promoting upgrading and expansion of power infrastructures by 2020. Recently, the power supply situation in the Maldives has been improving.

Table 3-2-7 summarises the power failures that occurred on 20 of the 21 sites on which field reconnaissance was conducted, except for Villingili Island next to Malé Island. In this table, power failures continue for twenty minutes at the longest except on No.1, Dhidhdhoo and No.9, Dhangethi. Since these power failures are caused by stoppage of generators, the supply of a UPS eliminates the need for a backup power supply. Dhidhdhoo is under an inferior condition in comparison with other sites: The power failure cause is the same but there are power failures that last for two to four hours on rare occasions. However, it is deemed that this problem can be solved with the supply of a UPS in the upgrade and expansion plan of power infrastructures.

Under such circumstances, the emergency power supply shall be planned as 20-minute backup power using a UPS.

Table 3-2-7 Power Failures at Candidate Sites for Transmitting and Relay Stations

	Island name	Power failure	Frequency	Power failure time	Cause
1	Dhidhdhoo	Seldom occurs	Rare	2 – 4 hours	Generator malfunction
2	Kulhudhuffushi	Seldom occurs	Rare	10 – 20 min.	Generator malfunction
3	Funadhoo	Frequent	Twice or 3 times per week	10 – 20 min.	Generator malfunction
4	Manadhoo	Sometimes	Once or twice per month	10 – 20 min.	Generator malfunction
5	Ungoofaaru	Never			
6	Naifaru	Never			
7	Eydhafushi	Never			
8	Maafushi	Never			
9	Dhangethi	Seldom occurs	Rare	20 – 30 min.	Generator malfunction
10	Felidhoo	Never			
11	Nilandhoo	Sometimes	Once or twice per month	10 – 20 min.	Generator malfunction
12	Feeali	Sometimes	Once or twice per month	10 – 20 min.	Generator malfunction
13	Guraidhoo	Frequent	Once per day	10 – 20 min.	Manual switchover to a standby generator
14	Gan	Seldom occurs	Rare	10 – 20 min.	Generator malfunction

	Island name	Power failure	Frequency	Power failure time	Cause
15	Villingili	Seldom occurs	Rare	10 – 20 min.	Generator malfunction
16	Thinadhoo	Seldom occurs	Rare	10 – 20 min.	Generator malfunction
17	Gadhdhoo	Never			
18	Fiyoari	Sometimes	Once or twice per month	10 – 20 min.	Generator malfunction
19	Foammulah	Frequent	Twice or 3 times per week	10 – 20 min.	Generator malfunction
20	Hithadhoo	Frequent	Twice or 3 times per week	10 – 20 min.	Generator malfunction

Source: PSM

(2) Air conditioning

As described in Chapter 3-2-1-3, 'Policies about Natural Conditions', no special measures need to be taken for the outdoor air temperatures and humidities in this country. However, the indoor temperatures shall be designed using a design outside air temperature of 35°C and the maximum allowable temperature for the entire equipment shall be 40°C in consideration of ensuring desired performances and functions of the equipment. Therefore, air conditioning equipment common and easy-to-maintain in the Maldives shall be considered.

The stable operation of a transmitter system is predicated on the running of an air conditioner. Therefore, a backup system shall be adopted, in which multiple air conditioners are installed to ensure functioning in case one of the air conditioners fails. The cooling thermal capacity shall be a capacity sufficient for the four-frequency active/backup system in consideration of the future plan.

3-2-1-14 Policies regarding Procurement Method and Construction Period

The procured equipment shall be transported mainly by ship from Japan or a third country to the Maldives. Then, domestic transportation on boats shall be required from the Port of Malé to the 18 digital transmitting stations and three microwave relay stations, the target sites of this project. The required transportation time from Japan to the sites of this project is about 60 days. Before the Japanese side starts the construction of digital transmitting stations and tower foundations, the Maldivian side must acquire land for the sites, complete various applications including that for EIA acquisition, removal of obstacles from temporary storages, temporary work places, and sites, and relocation of the existing analogue broadcasting facilities and FM broadcasting facilities.

The overall construction period is estimated at about 16.75 months in consideration of the scales and quantities of facilities construction and the equipment to be installed. The station buildings and antenna tower foundations shall be constructed by seven teams on 21 sites in total and completed in two terms. The antenna towers shall be erected and the antennas shall be installed by five teams and completed in four terms. At two sites in Hithadhoo and Foammulah, an antenna pole shall be installed and consequently the construction period can be short. Therefore, the team that works on the sites including these two shall complete the construction in five terms. Digital transmission systems and microwave link systems can start to be installed only after completion of construction of stations buildings and antenna towers. To eliminate the idle time of equipment installation personnel, therefore, the installation of equipment shall be scheduled after the completion of facility construction.

Since the Maldivian side wants to start digital broadcasting as early as possible with an eye to the 2018 election, digital broadcasting using NOC and some of the transmitting stations shall start promptly after completion of construction. Therefore, transfer shall be conducted in two phases: At first, NOC shall be transferred after completion of construction together with transmitting station sites that have been completed by this time; the second and final transfer shall be conducted upon completion of construction of all the remaining sites.

3-2-1-15 Policies about Other Items Such as Measuring Instruments for Maintenance

(1) Policies about spare parts and consumables

Selection criteria shall be established to procure a minimum required quantity of spare parts. The selection criteria shall be applied to particularly expensive parts, parts with high failure frequencies, and parts that have significant influence on broadcasting and not to parts already designated for redundant configurations. The number of parts to be procured may be reduced if some pieces of equipment are shared in use. For example, the exciters in the digital transmission system can be shared in use and therefore can be procured as common spare parts. Furthermore, the number of power amplifiers to be procured can be reduced because they can be shared in use when the output is reduced. Whereas the transmitters are 200, 100, 50, 20, and 10W, the spare parts for power amplifiers shall be 200 and 50W. Thus, the 200 and 100W transmitters shall be replaced with 200W spare parts and the 50, 20, and 10W transmitters with 50W spare parts.

Note that consumable parts shall be procured with the operating budget of DBNO and shall not be procured in this project.

(2) Policies about measuring instruments for maintenance

A minimum required quantity of measuring instruments for maintenance shall be procured in this project to meet the needs for daily maintenance and inspection of transmitters, antenna systems, NOC, etc.

Since maintenance and inspection are conducted during patrol of islands, measuring instruments are often taken out of the storage area. However, an abnormality may occur at a different location than the patrolled site. Therefore, each of the measuring instruments shall be procured in pairs: One shall be used for patrol and the other for emergency response to ensure broadcasting quality.

3-2-2 Basic Design

3-2-2-1 Design Conditions

For the sake of establishment of the scales and specifications of this project, the conditions such as the design policies described in the previous section were examined to set the following design conditions:

3-2-2-1-1 Locations and Heights of Planned Installation Sites

The sites of this project shall consist of 18 transmitting stations, three relay stations, NOC of DBNO, and MMS. Table 3-2-8 shows a list of planned installation sites.

Table 3-2-8 List of Planned Installation Sites

	Transmission station name/facility name	Equipment installation location	Above sea level (m)	Drawing number/remarks
1	Dhidhdhoo	N06˚ 53'22.7" E73˚ 6'50.79"	10	L-01
2	Kulhudhuffushi	N6 ˚36'57.67" E73˚4'23.90"	5	L-02
3	Funadhoo	N6˚08'27.15" E73˚17'32.63"	3	L-03
4	Manadhoo	N5˚46'08.76" E73˚24'35.65"	3	L-04
5	Ungoofaaru	N5˚40'04.35" E73˚1'55.06"	3	L-05
6	Eydhafushi	N5˚06'10.70" E73˚04'21.9"	5	L-06
7	Naifaru	N5˚26'26.15" E73˚21'57.05"	2	L-07
8	Malé (Villingili)	N0˚35'50.69" E73˚05'01.98"	1	L-08
9	Maafushi	N03˚56'15.96 E73˚29'19.12"	4	L-09
10	Felidhoo	N3˚28'15.13" E73˚32'53.15"	10	L-10
11	Dhangethi	N03˚36'17.36" E72˚57'17.58"	2	L-11
12	Feeali	N03˚16'14.18" E72˚59'59.10"	2	L-12
13	Nilandhoo	N03˚03'18.47" E72˚53'34.31"	9	L-13
14	Gan	N01˚56'03.75" E73˚32'44.33"	9	L-14
15	Guraidhoo	N02˚19'30.46" E73˚18'59.24"	8	L-15
16	Gadhdhoo	N0°17'38.1" E73°27'45.8"	2	L-16
17	Fiyoari	N00˚13'16.08 E73˚08'02.81	4	L-17

	Transmission station name/facility name	Equipment installation location	Above sea level (m)	Drawing number/remarks
18	Thinadhoo	N0°31'29.07" E72°59'32.4"	2	L-18
19	Villingili	N0°45'38.04" E73°26'1.92"	2	L-19
20	Foammulah	S0°17'46.92" E73°25'18.6"	8	L-20
21	Hithadhoo	S00°35.50.69" E73°05'1.9"	4	L-21
22	NOC (Malé Island)	N4°10'17.94" E73°30'37.67"	5	None
23	Meteorological Service (Hulhulé Island)	N4°19" E73°55"	4	Using the pole in the southwestern corner of the rooftop of the MMS building on the Hulhulé Island
24	Rooftop of Ministry of Home Affairs building		Rooftop of 12-storey building	Signals from MMS are received on Malé Island and converted for the optical link at this location.

Source: Created by JICA Survey Team

3-2-2-1-2 Weather and Site Conditions

Weather survey has been conducted. As a resul, the following specifications have been set for the design conditions.

(a) Power supply of transmitting stations:

- 400 VAC (3 phase), 230VAC (single phase), 50Hz

(b) Temperature:

- Low (annual average) Approx. 24°C
- High (annual average) Approx. 31°C

(c) Humidity: Approx. 80% (annual average)

(d) Average wind speed: Approx. 5m (annual average)

(e) Climate:

- Rainy season Mid-May to November
- Dry season January to March

(f) Average rainfall: Approx. 2,000mm (annual average)

3-2-2-2 Applicable Standards

The following standards shall be applied to the outline design.

Table 3-2-9 Standards to be Used in Target Grant Aid Project

	Standard name	Applicable equipment, etc.	Remarks
1.	International Electrotechnical Commission (IEC)	Electric products in general	Basic international standards for electrical products in general
2.	International Organization for Standardization (ISO)	Industrial products in general	Basic international standards for industrial products in general not overlapping with IEC
3.	Japanese Industrial Standards (JIS)	Industrial products in general	Standards for products not specified in IEC or ISO or unique to Japan
4.	Institute of Electrical Engineers of Japan: Standards of the Japanese Electrotechnical Committee (JEC)	Electric products in general	Detailed standards for electrical equipment not specified in JIS
5.	Standards of the Japan Electrical Manufacturers' Association (JEM)	Electric power equipment in general	Detailed standards for electric equipment, particularly electric power equipment, not specified in JIS
6.	Japan Electric Association Code (JEAC)	Power supply facilities in general	Detailed standards for power supply facilities not specified in JIS
7.	Standards of the Japanese Electric Wire & Cable Makers' Association (JCS)	Electric Cables	Detailed standards for electric wires, etc. not specified in JIS
8.	Electronic Industries Association of Japan (EIAJ)	Electronic information equipment in general	Detailed standards for electronic information-related equipment not specified in JIS
9.	International Telecommunication Union (ITU)	Telecommunication system, frequency allocation, etc.	International standards in the telecommunication field
10.	Society of Motion Picture and Television Engineers (SMPTE)	Video equipment in general	Standards in the video technology field such as HD-SDI standard
11.	Audio Engineering Society/European Broadcast Union (AES/EBU)	Digital audio equipment interface	International standards for industrial digital audio equipment interface
12.	International Civil Aviation Organization (ICAO)	Aviation obstruction marking on towers	International treaty about principles and technologies of civil aviation
13.	Electronic Industries Alliance (EIA)	Electronic information equipment in general	U.S.A. electronic information technical standards
14.	Building Standards Act of Japan and enforcement ordinance, announcement, etc.	Building design	Station building and tower standards of Japan
15.	Commentary on Structure-related Standards of Buildings (The Japan Building Disaster Prevention Association/The Building Center of Japan) 2015	Building design	
16.	AIJ Standard for Structural Calculation of Reinforced Concrete Structures (Architectural Institute of Japan)		
17.	Recommendations for Design of Building Foundations (Architectural Institute of Japan)		
18.	Specifications for Highway Bridges and Commentary (Japan Road Association)		

	Standard name	Applicable equipment, etc.	Remarks
19.	Maldives National Building Code (British Standard)	Building design	Station building and tower standards of the Maldives (A site corner connecting to an intersection shall have R = 2.7m)
20.	Maldives aviation related standards	Tower	Compliant with ICAO

Source: Created by JICA Survey Team

3-2-2-3 Equipment Plan

3-2-2-3-1 Digital Transmission System

The equipment plans for the components are as described below.

(1) Transmitter

A transmitter consists of equipment with the following functions: Signals input from an optical or TTL link to the STM-1 link are separated into BTS signals corresponding to each of the physical UHF channels and expanded[7] into specified BTS. In data broadcasting, furthermore, the network ID is changed to enable broadcasting in a specific area and the data is OFDM-modulated to acquire specified ISDB-T signals. As for the Emergency Warning Broadcast Flag (TMCC B26) at the time of OFDM modulation, TMCC control is to be implemented with reference to the area code within the emergency information descriptors, in case of equipping PSI rewriting device. Then, the signals are converted to a rated UHF channel and then amplified.

Note that a transmitting station that relays broadcast waves first separates the received UHF signals into channels and then reconverts them into the specified rated UHF channel and amplifies them. Basically, a transmitter for one frequency shall be installed on one rack whereas combiners and monitor systems shall be installed on one common rack. Therefore, a total of three racks shall be installed as transmission facilities in this project.

(2) Microwave relay (Transmitter to transmitter link: TTL)

Signals shall be transmitted via microwaves to a transmitting station on an island without an optical link of a telecom carrier. Since these signals can transmit BTS signals for four UHF frequencies at the same time, only one TTL unit needs to be installed.

Note that this TTL is transmitted using a two-way handshake protocol for up and down links, requiring a bandwidth of 60MHz in total. However, the Naifaru and other stations with three TTL links including up and down links for branch relay to downstream transmitting stations must be allocated three different frequency bands, a total of 180MHz, to prevent interference between the links. For a link with section-to-section transmission distance more than 40km and

[7] BTS expansion, which undoes BTS compression at NOC to convert signals into STM-1 signals, refers to converting signals back into original BTS signals. Therefore, equipment used for these processes must possess common argorithm for compression and expansion or be products of the same manufacturer.

consequently large fading due to transmission over the sea, a space diversity system with two parabola antennas shall be adopted to improve the link maintenance rates. All the TTL equipment shall be installed on one rack, including the space for future expansion.

(3) Four-frequency combiner

A combiner, part of a transmitter, combines the UHF broadcast waves of transmitter outputs into one and supplies it to a transmitting antenna. Therefore, one combiner shall be installed in the entire system. If channels for four frequencies can be determined, a four-frequency combiner can be manufactured. Since channels for four frequencies have already been determined in the channel plan in this project, four-frequency combiners shall be manufactured and installed even if two-frequency operation is initially conducted. During the two-frequency operation, the unused input terminals shall be sealed with dummy plugs. When transmitters are added in the future, the dummy plugs shall be removed and the output cables of the transmitters shall be plugged in.

(4) Power supply

The power capacity shall be calculated basically for a four-frequency active/backup system with an eye to the future. Therefore, the capacities and quantities of NFBs of the distribution board to be installed shall meet the above requirement.

A lightning-proof transformer shall be installed to protect the equipment from lightning surges. UPS backup shall be provided for transmitters and relays (TTL) as a measure against power failures. UPS shall offer backup time of 20 minutes because power failures mostly last for less than 20 minutes at present. For downsizing of UPS, however, no backup power shall be available for air-conditioning systems and backup systems after shift to two-unit systems in the future.

Although power failures lasting for four hours at the maximum and 30 minutes occurred in Dhidhdhoo and Dhangethi in the past, the longer the backup time, the larger the UPS, the less space in the station buildings. Therefore, backup time of 20 minutes shall apply to all the cases. Since a plan is in progress to eliminate power failures in the Maldives, long-time power failures will no longer occur at the service start of this project.

(5) Air conditioning

For protection of the equipment from salt damage, high temperatures, and high humidities, the transmitter rooms shall be air-tight and equipped with an air conditioner. An air conditioner must be regarded part of the transmitter because a failure of it will make the room hot and cause the transmitter to fail. Therefore, a backup system shall be adopted, in which multiple air conditioners are installed to ensure functioning in case one of the air conditioners fails.

The cooling thermal capacity shall be calculated for a four-frequency active/backup system. Air conditioners shall be a wall-mounted type to make the most of the floor space of the station building.

(6) Equipment mounting rack

The equipment for one frequency shall be mounted on one rack in consideration of the transmitter active/backup system. The microwave relays (TTL) for all the four frequencies including the future backup shall be mounted on one rack. A four-frequency combiner, a remote monitoring system, etc. shall be mounted on a common rack. Therefore, no additional rack will be necessary even if two transmitters are used in the future.

As a result of the above, this project shall install two transmitter racks, one TTL rack, and one common rack and secure floor space for two racks for future expansion. However, three TTL relay stations shall have one TTL rack and one common rack.

(7) Remote monitoring

Since optical and TTL links are based on two-way communications, monitoring from NOC is possible using the same link. UHF broadcast wave reception stations without optical or TTL link shall be monitored from NOC via VPN links of the web. Therefore, the transmitters and relays shall be equipped with an interface that can output the monitoring items for each of them. Table 3-2-10 shows the monitoring items. Furthermore, a camera shall be installed for monitoring of the entrance to a station building to maintain a few days' worth of recording of images and monitor them at NOC as required.

Table 3-2-10 Transmitting Station Monitoring Items

Monitoring item		Monitoring item	
1	CH1 abnormality (suspension of broadcasting)	9	Antenna VSWR abnormality
2	CH2 abnormality (suspension of broadcasting)	10	Air conditioner failure
3	CH3 abnormality (suspension of broadcasting)	11	UPS abnormality
4	CH4 abnormality (suspension of broadcasting)	12	Door open
5	TTL receiver abnormality	13	Reserved
6	TTL transmitter abnormality	14	Reserved
7	Optical reception abnormality	15	Reserved
8	Commercial power abnormality (power failure)	16	Reserved

Source: Created by JICA Survey Team

In view of the above, the digital transmission system to be supplied in this project shall roughly consist of the following components:

- Optical relay transmitter: One-transmitter system x 2 frequencies
- Transmitting antenna for the above
- Microwave relay transmitter: One-transmitter system x 2 frequencies
- Transmitting antenna and reception parabola antenna for the above
- Broadcast wave relay transmitter: One-transmitter system x 2 frequencies

- Transmitting antenna and reception grid parabola antenna for the above
- Optical termination box: Optical link interface and microwave relay (TTL): Programme multiplexing one-transmitter system for two frequencies x One pair
- Parabola antenna for the above

The following describes the remarks for these configurations.

- The same system shall be used wherever possible to enable efficient deployment of common spare units
  (to prevent accidental suspension of broadcasting at minimum cost).
- The long-distance microwave link shall employ a space diversity system
  (to prevent fading due to transmission over the sea).
- Composition with analogue transmission output is not needed (because of the independent antenna system).

3-2-2-3-2 Network Operation Centre

The Network Operation Centre (NOC) of the DTTB platform shall be founded within PSM and operated by DBNO. NOC receives broadcast signals from broadcasters, multiplexes broadcast signals, data broadcasting TS signals, etc. to generate and distribute BTS to the transmitting stations. The systems and equipment used at NOC must have a high reliability because, if any of the NOC equipment fails, none of the images of any broadcasting station in any area can be displayed on the TV monitors. Therefore, the NOC equipment shall be in a redundant configuration except for some of the equipment for monitoring or other purposes that give little influence on broadcasting. The equipment configuration shall allow for four-frequency operation in the future.

Table 3-2-11 shows the equipment to be procured for NOC.

Table 3-2-11 Equipment to be Procured for NOC

No.	Item	Quantity
2	**Network Operation Centre**	
2.1	Encoding system (Full-seg/one-seg image)	
(1)	MPEG-4 encoder for full-seg images	1 set
(2)	MPEG-4 encoder for one-seg images	1 set
(3)	Multiplexer	1 set
(4)	Media converter	1 set
2.2	Encoding system (Full-seg image)	
(1)	MPEG-4 encoder for full-seg images	5 sets
(2)	Media converter	5 sets
2.3	Media converter (redundant configuration)	
(1)	Media converter (redundant configuration)	6 sets
2.4	TS re-multiplexing system	
(1)	TS re-multiplexing system (redundant configuration)	2 sets
2.5	TS routing system	
(1)	32 x 32 matrix switcher (redundant configuration)	1 system
(2)	Signal distributor (redundant configuration)	1 system

No.	Item	Quantity
2.6	GPS reception system (redundant configuration)	
(1)	GPS receiver	1 set
2.7	TS compressor (redundant configuration)	
(1)	TS compressor (redundant configuration)	2 sets
2.8	Network switch (redundant configuration)	
(1)	Layer 3 network switch (redundant configuration)	1 system
(2)	Layer 2 network switch (redundant configuration)	1 system
2.9	BTS/IP converter for TS output (redundant configuration)	
(1)	BTS/IP converter for TS output (redundant configuration)	1 system
2.10	EPG system	
(1)	EPG transmission server	1 set
(2)	EPG TS generator	2 sets
(3)	EPG registered terminal	7 sets
2.11	EWBS transmission server	
(1)	EWBS transmission server	1 system
2.12	TS monitoring system	
(1)	Monitor	3 sets
(2)	TS decoder	10 sets
(3)	BTS decoder	10 sets
(4)	Monitor rack	1 system
2.13	TS recorder	
(1)	TS recorder	2 systems
2.14	TS analyser	
(1)	TS analyser	1 system
2.15	Alarm monitoring system	
(1)	Alarm monitoring system	1 system
2.16	Transmitting station – monitoring camera system	
(1)	Monitoring camera system server	1 system
(2)	Fixed monitoring camera	21 systems
2.17	Console	
(1)	Console	1 system
2.18	Equipment rack	
(1)	Rack	5 sets
(2)	Connector board	1 set
(3)	NFB board	5 sets

3-2-2-3-3 PSM Equipment

(1) PSM

PSM, which plans to provide HD and SD programmes as well as one-seg and data broadcasting programmes, will require encoders corresponding to each of them. Since encoded signals are multiplexed and transmitted to NOC, a multiplexing system shall be installed. The multiplexing system and other equipment shall be installed in the master control room of PSM. Furthermore, the system shall be connected via coaxial cables to NOC, which is to be founded in another building on the premises of PSM.

At present, PSM is not providing HD broadcasting. PSM plans to increase the HD equipment gradually in the future and will install the master control system for HD broadcasting before the start of DTTB via the platform. Whereas the details of the HD master control room will become clear in due time, the constitution of equipment planned in this project shall be usable regardless of the specifications of the HD master control room.

Furthermore, the material production and editing systems and transmission system shall be installed to provide data broadcasting and EWBS.

(2) Meteorological Service

MMS is currently recording weather forecast programmes as SD video and transmits them to PSM in Malé using file transfer via the Internet. This project shall renew the equipment in use to HD-compatible equipment and enable live broadcasting via a microwave link system. Furthermore, emergency broadcasting from MMS upon disasters is also considered. The equipment shall consist of remote-controlled HD cameras, image processing system that combines CG images used by MMS for weather forecast with HD camera images, signal converter that converts signals to transmit programmes to PSM, intercom system for a communication link to be used for communications with PSM during live broadcasting, and microwave link system that is a transmission system based on microwaves. Furthermore, terminals for viewing weather-related information shall also be supplied in order to utilise part of the weather-related information database of MMS as data broadcasting programmes.

These pieces of equipment shall be installed in the weather studio equipment room of MMS. The transmitter of the microwave link system shall be installed on the rooftop of the MMS building on Hulhulé Island. The receiver shall be installed on the rooftop of the Ministry of Home Affairs building on Malé Island. On the rooftop of the Ministry of Home Affairs building, an optical cable laid by PSM is already connected to the PSM building. Programmes shall be transmitted from the microwave link system receiver via the optical termination box to be installed on the rooftop of the Ministry of Home Affairs building to PSM.

Table 3-2-12 shows the equipment to be procured for PSM and MMS.

Table 3-2-12 Equipment to be Procured for PSM and MMS

No.	Item	Quantity
3	**PSM equipment**	
3.1	Encoding system (Full-seg/one-seg image TS)	
(1)	MPEG-4 encoder for full-seg images	2 sets
(2)	MPEG-4 encoder for one-seg images	1 set
(3)	Multiplexer	1 set
3.2	Data broadcasting system	
(1)	Data broadcasting material production system	1 set

No.	Item	Quantity
(2)	Data broadcasting transmission system	2 sets
3.3	EWBS terminal	
(1)	EWBS editing terminal	1 set
(2)	EWBS control terminal	1 set
(3)	Weather information terminal	1 set
3.4	MMS studio equipment	
(1)	HD camera	1 set
(2)	Image processing system	1 set
(3)	SDI/IP converter	1 set
(4)	Microwave link system	1 set
(5)	IP/SDI converter	1 set
(6)	Intercom system	1 set

3-2-2-3-4 Antenna Towers and Poles

As for the basic selection of antenna tower and pole in Hithadhoo, the foundation type is to be classified into direct foundation and pile foundation, and be selected considering N-value and condition of depth of the bearing grounds of the sites. At the sites where the depth from ground is about a few metres and there is a bearing layer in which N-value of 10 or higher can be secured, the direct foundation is to be adopted because antenna tower and pole are relatively lightweight as a structure. At the sites in Thinadhoo and Hithadhoo, there exists the soft ground at the relatively shallow depth at the construction position of antenna tower and pole, so the appropriate depth for bearing is relatively deep. Direct foundation is not selected because the excavating depth will be excessive. Therefore the pile foundation with the ground in which N-value of 20 or higher can be secured over a few metres is to be adopted, considering workability and economy during construction work. The conditions of the bearing grounds of the sites have been summarised and the foundation types have been determined according to the results of soil surveys as shown in Table 3-2-13.

Table 3-2-13 Conditions of Bearing Grounds by Site

No.	Site name	Tower height (m)	Conditions of bearing ground (N-value and depth)		Foundation type
			N-value	Depth	
1	Dhidhdhoo	60	Approx. 10	1m – 15m	Spread foundation
2	Kulhudhuffushi	50	Approx. 10	1m – 15m	Spread foundation
3	Funadhoo	70	Approx. 10	1m – 15m	Spread foundation
4	Manadhoo	70	Approx. 10	1m – 15m	Spread foundation
5	Ungoofaaru	70	Approx. 10	1m – 15m	Spread foundation
6	Eydhafushi	70	Approx. 10	1m – 15m	Spread foundation
7	Naifaru	80	Approx. 10	3m – 15m	Spread foundation
8	Villingili (K)	60	Approx. 10	1m – 15m	Spread foundation
9	Maafushi	90	Approx. 10	1m – 15m	Spread foundation
10	Felidhoo	80	Approx. 10	1m – 15m	Spread foundation
11	Dhangethi	70	Approx. 10	1m – 15m	Spread foundation
12	Feeali	80	Approx. 10	1m – 15m	Spread foundation
13	Nilandhoo	50	Approx. 10	1m – 15m	Spread foundation

No.	Site name	Tower height (m)	Conditions of bearing ground (N-value and depth)		Foundation type
			N-value	Depth	
14	Gan	80	Approx. 10	1m – 15m	Spread foundation
15	Guraidhoo	80	Approx. 10	2m – 15m	Spread foundation
16	Villingili (GA)	80	Approx. 10	1m – 15m	Spread foundation
17	Gadhdhoo	80	Approx. 10	1m – 15m	Spread foundation
18	Fiyoari	60	Approx. 10 Coral Rock/Sand	4m – 15m 2m – 4m	Spread foundation
19	Thinadhoo	50	Approx. 10 Coral Rock/Sand	1m – 3m 9m – 15m 3m – 9m	Pile foundation
20	Foammulah	20 (Pole)	50 < N Coral Rock/Sand	3m – 6m 6m – 15m	Spread foundation
21	Hithadhoo	30 (Pole)	Approx. 10 Coral Rock/Sand	1m – 6m 6m – 9m	Pile foundation

Source: Created by JICA Survey Team

3-2-2-3-5 Measuring Instruments and Tools for Maintenance

A minimum required quantity of measuring instruments for maintenance shall be procured to meet the needs for periodical inspection of transmitting stations, antenna systems, NOC, etc.

Table 3-2-14 shows the maintenance-use measuring instruments to be procured.

Table 3-2-14 Maintenance-use Measuring Instruments to be Procured

No.	Item	Quantity
6	**Measuring instruments and tools for maintenance**	
(1)	Spectrum analyser	2 systems
(2)	Spectrum analyser (for microwave links)	2 systems
(3)	Frequency counter	2 systems
(4)	Power meter	2 systems

3-2-2-3-6 Spare Parts

Spare parts shall be procured only for particularly expensive parts and parts with high failure frequencies. Other necessary equipment must be procured with the budget of DBNO.

Table 3-2-15 Spare Parts to be Procured

No.	Item	Quantity
7	**Spare parts**	**1 system**
(1)	Network system	1 system
(2)	TS expander	1 system
(3)	Exciter	1 system
(4)	Power amplifier (200W)	3 systems
(5)	Power amplifier (50W)	3 systems

3-2-2-3-7 Outline Specifications of Major Equipment

Table 3-2-16 shows the outline specifications of the major equipment.

Table 3-2-16 Outline Specifications of Major Equipment

No.	Item	Quantity	Major specifications
1	**Digital transmission system**	**1 system**	
1.1	Broadcast wave relay link	1 system	
(1)	UHF receiver	1 system	Input level range: -27 to -57 or more
(2)	Exciter	2 units	Band: Designated 8MHz band in a range from 470 to 690MHz
(3)	Power amplifier (200W)	2 units	Input impedance: 50Ω Output impedance: 50Ω Output power: 200, 100, 50, 20 or 10W
(4)	Combiner	1 unit	Function for restricting interferences between adjacent channels and others: 30dB or higher Allowable power: At least four times the output power of the power amplifier
(5)	Antenna system	1 system	Reception: Grid parabola Transmission: 4-dipole antenna Gain: 8.2dB or more Rust-proofing: Salt resistance specification
(6)	UPS	1 unit	Capacity: 15 or 10kVA Backup time: 20 minutes or longer
(7)	Lightning-proof transformer	1 unit	Capacity: 20 or 15kVA
(8)	Distribution board	1 unit	Main circuit breaker: 2 systems Branch: 10 or more
1.2	Digital transmission system (Kulhudhuffushi)	1 system	
(1)	Network system	1 system	Interface: STM-1
(2)	TS expander	1 system	Input: Compressed TS Output: Broadcast TS (including PSI rewriting device)
(3)	Exciter	2 units	Same as 1.1 (2)
(4)	Power amplifier (100W)	2 units	Same as 1.1 (3)
(5)	Combiner	1 unit	Allowable power: At least four times the output power of the power amplifier
(6)	Antenna system	1 system	Transmission: 4-dipole antenna Gain: 7.0dB or more Rust-proofing: Salt resistance specification
(7)	UPS (10KVA)	1 unit	Same as 1.1 (6)
(8)	Lightning-proof transformer	1 unit	Same as 1.1 (7)
(9)	Distribution board	1 unit	Same as 1.1 (8)
1.3	Digital transmission system (Funadhoo)	1 system	
(1)	TS expander	1 system	Same as 1.2 (2)
(2)	Exciter	2 units	Same as 1.1 (2)
(3)	Power amplifier (100W)	2 units	Same as 1.1 (3)
(4)	Combiner	1 unit	Same as 1.2 (3)
(5)	Antenna system	1 system	Transmission: 4-dipole antenna Gain: 10.0dB or more Rust-proofing: Salt resistance specification
(6)	UPS (10KVA)	1 unit	Same as 1.1 (6)
(7)	Lightning-proof transformer	1 unit	Same as 1.1 (7)
(8)	Microwave link system (Manadhoo master station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz) Space diversity: Yes

No.	Item	Quantity	Major specifications
(9)	Distribution board	1 unit	Same as 1.1 (8)
1.4	Digital transmission system (Manadhoo)	1 system	
(1)	TS expander	1 system	Same as 1.2 (2)
(2)	Exciter	2 units	Same as 1.1 (2)
(3)	Power amplifier (10W)	2 units	Same as 1.1 (3)
(4)	Combiner	1 unit	Same as 1.2 (3)
(5)	Antenna system	1 system	Transmission: 4-dipole antenna Gain: 9.5dB or more Rust-proofing: Salt resistance specification
(6)	UPS (5KVA)	1 unit	Same as 1.1 (6)
(7)	Lightning-proof transformer	1 unit	Same as 1.1 (7)
(8)	Microwave link system (Naifaru master station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz)
(9)	Microwave link system (Funadhoo slave station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz) Space diversity: Yes
(10)	Distribution board	1 unit	Same as 1.1 (8)
1.5	Digital transmission system (Ungoofaaru)	1 system	
(1)	TS expander	1 system	Same as 1.2 (2)
(2)	Exciter	2 units	Same as 1.1 (2)
(3)	Power amplifier (100W)	2 units	Same as 1.1 (3)
(4)	Combiner	1 unit	Same as 1.2 (3)
(5)	Antenna system	1 system	Transmission: 4-dipole antenna Gain: 11.6dB or more Rust-proofing: Salt resistance specification
(6)	UPS (10KVA)	1 unit	Same as 1.1 (6)
(7)	Lightning-proof transformer	1 unit	Same as 1.1 (7)
(8)	Microwave link system (Naifaru master station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz) Space diversity: Yes
(9)	Distribution board	1 unit	Same as 1.1 (8)
1.6	Digital transmission system (Eydhafushi)	1 system	
(1)	Network system	1 system	Same as 1.2 (1)
(2)	TS expander	1 system	Same as 1.2 (2)
(3)	Exciter	2 units	Same as 1.1 (2)
(4)	Power amplifier (50W)	2 units	Same as 1.1 (3)
(5)	Combiner	1 unit	Same as 1.2 (3)
(6)	Antenna system	1 system	Transmission: 4-dipole antenna Gain: 11.4dB or more Rust-proofing: Salt resistance specification
(7)	UPS (10KVA)	1 unit	Same as 1.1 (6)
(8)	Lightning-proof transformer	1 unit	Same as 1.1 (7)
(9)	Microwave link system (Naifaru slave station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz) Space diversity: Yes
(10)	Distribution board	1 unit	Same as 1.1 (8)
1.7	Digital transmission system (Naifaru)	1 system	
(1)	TS expander	1 system	Same as 1.2 (2)
(2)	Exciter	2 units	Same as 1.1 (2)
(3)	Power amplifier (200W)	2 units	Same as 1.1 (3)
(4)	Combiner	1 unit	Same as 1.2 (3)
(5)	Antenna system	1 system	Transmission: 4-dipole antenna Gain: 11.4dB or more

No.	Item	Quantity	Major specifications
			Rust-proofing: Salt resistance specification
(6)	UPS (10KVA)	1 unit	Same as 1.1 (6)
(7)	Lightning-proof transformer	1 unit	Same as 1.1 (7)
(8)	Microwave link system (Eydhafushi master station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz) Space diversity: Yes
(9)	Microwave link system (Manadhoo slave station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz)
(10)	Microwave link system (Ungoofaaru slave station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz) Space diversity: Yes
(11)	Distribution board	1 unit	Same as 1.1 (8)
1.8	Digital transmission system (Malé [Villingili])	1 system	
(1)	Network system	1 system	Same as 1.2 (1)
(2)	TS expander	1 system	Same as 1.2 (2)
(3)	Exciter	2 units	Same as 1.1 (2)
(4)	Power amplifier (200W)	2 units	Same as 1.1 (3)
(5)	Combiner	1 unit	Same as 1.2 (3)
(6)	Antenna system	1 system	Transmission: 4-dipole antenna Gain: 14.8dB or more Rust-proofing: Salt resistance specification
(7)	UPS (10KVA)	1 unit	Same as 1.1 (6)
(8)	Lightning-proof transformer	1 unit	Same as 1.1 (7)
(9)	Microwave link system (Maafushi slave station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz)
(10)	Distribution board	1 unit	Same as 1.1 (8)
1.9	Microwave relay station (Maafushi)	1 system	
(1)	Microwave link system (Malé [Villingili] master station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz)
(2)	Microwave link system (Felidhoo slave station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz)
(3)	UPS (5KVA)	1 unit	Same as 1.1 (6)
(4)	Lightning-proof transformer	1 unit	Same as 1.1 (7)
(5)	Distribution board	1 unit	Same as 1.1 (8)
1.10	Digital transmission system (Felidhoo)	1 system	
(1)	TS expander	1 system	Same as 1.2 (2)
(2)	Exciter	2 units	Same as 1.1 (2)
(3)	Power amplifier (50W)	2 units	Same as 1.1 (3)
(4)	Combiner	1 unit	Same as 1.2 (3)
(5)	Antenna system	1 system	Transmission: 4-dipole antenna Gain: 8.2dB or more Rust-proofing: Salt resistance specification
(6)	UPS (10KVA)	1 unit	Same as 1.1 (6)
(7)	Lightning-proof transformer	1 unit	Same as 1.1 (7)
(8)	Microwave link system (Maafushi master station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz) Space diversity: Yes
(9)	Distribution board	1 unit	Same as 1.1 (8)
1.11	Digital transmission system (Dhangethi)	1 system	
(1)	Network system	1 system	Same as 1.2 (1)
(2)	TS expander	1 system	Same as 1.2 (2)
(3)	Exciter	2 units	Same as 1.1 (2)
(4)	Power amplifier (200W)	2 units	Same as 1.1 (3)

No.	Item	Quantity	Major specifications
(5)	Combiner	1 unit	Same as 1.2 (3)
(6)	Antenna system	1 system	Transmission: 4-dipole antenna Gain: 9.0dB or more Rust-proofing: Salt resistance specification
(7)	UPS (10KVA)	1 unit	Same as 1.1 (6)
(8)	Lightning-proof transformer	1 unit	Same as 1.1 (7)
(9)	Microwave link system (Feeali slave station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz)
(10)	Distribution board	1 unit	Same as 1.1 (8)
1.12	Microwave relay station (Feeali)	1 system	
(1)	Microwave link system (Dhangethi master station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz)
(2)	Microwave link system(Nilandhoo slave station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz)
(3)	UPS (5KVA)	1 unit	Same as 1.1 (6)
(4)	Lightning-proof transformer	1 unit	Same as 1.1 (7)
(5)	Distribution board	1 unit	Same as 1.1 (8)
1.13	Digital transmission system (Nilandhoo)	1 system	
(1)	TS expander	1 system	Same as 1.2 (2)
(2)	Exciter	2 units	Same as 1.1 (2)
(3)	Power amplifier (100W)	2 units	Same as 1.1 (3)
(4)	Combiner	1 unit	Same as 1.2 (3)
(5)	Antenna system	1 system	Transmission: 4-dipole antenna Gain: 9.7dB or more Rust-proofing: Salt resistance specification
(6)	UPS (10KVA)	1 unit	Same as 1.1 (6)
(7)	Lightning-proof transformer	1 unit	Same as 1.1 (7)
(8)	Microwave link system (Feeali master station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz)
(9)	Distribution board	1 unit	Same as 1.1 (8)
1.14	Digital transmission system (Gan)	1 system	
(1)	Network system	1 system	Same as 1.2 (1)
(2)	TS expander	1 system	Same as 1.2 (2)
(3)	Exciter	2 units	Same as 1.1 (2)
(4)	Power amplifier (50W)	2 units	Same as 1.1 (3)
(5)	Combiner	1 unit	Same as 1.2 (3)
(6)	Antenna system	1 system	Transmission: 4-dipole antenna Gain: 11.2dB or more Rust-proofing: Salt resistance specification
(7)	UPS (10KVA)	1 unit	Same as 1.1 (6)
(8)	Lightning-proof transformer	1 unit	Same as 1.1 (7)
(9)	Microwave link system (Guraidhoo slave station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz) Space diversity: Yes
(10)	Distribution board	1 unit	Same as 1.1 (8)
1.15	Digital transmission system (Guraidhoo)	1 system	
(1)	TS expander	1 system	Same as 1.2 (2)
(2)	Exciter	2 units	Same as 1.1 (2)
(3)	Power amplifier (50W)	2 units	Same as 1.1 (3)
(4)	Combiner	1 unit	Same as 1.2 (3)
(5)	Antenna system	1 system	Transmission: 4-dipole antenna Gain: 9.0dB or more

No.	Item	Quantity	Major specifications
			Rust-proofing: Salt resistance specification
(6)	UPS (10KVA)	1 unit	Same as 1.1 (6)
(7)	Lightning-proof transformer	1 unit	Same as 1.1 (7)
(8)	Microwave link system (Gan master station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz) Space diversity: Yes
(9)	Distribution board	1 unit	Same as 1.1 (8)
1.16	Digital transmission system (Gadhdhoo)	1 system	
(1)	Network system	1 system	Same as 1.2 (1)
(2)	TS expander	1 system	Same as 1.2 (2)
(3)	Exciter	2 units	Same as 1.1 (2)
(4)	Power amplifier (200W)	2 units	Same as 1.1 (3)
(5)	Combiner	1 unit	Same as 1.2 (3)
(6)	Antenna system	1 system	Transmission: 4-dipole antenna Gain: 9.0dB or more Rust-proofing: Salt resistance specification
(7)	UPS (10KVA)	1 unit	Same as 1.1 (6)
(8)	Lightning-proof transformer	1 unit	Same as 1.1 (7)
(9)	Microwave link system (Fiyoari slave station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz)
(10)	Microwave link system (Villingili slave station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz) Space diversity: Yes
(11)	Distribution board	1 unit	Same as 1.1 (8)
1.17	Digital transmission system (Thinadhoo)	1 system	
(1)	TS expander	1 system	Same as 1.2 (2)
(2)	Exciter	2 units	Same as 1.1 (2)
(3)	Power amplifier (200W)	2 units	Same as 1.1 (3)
(4)	Combiner	1 unit	Same as 1.2 (3)
(5)	Antenna system	1 system	Transmission: 4-dipole antenna Gain: 10.0dB or more Rust-proofing: Salt resistance specification
(6)	UPS (10KVA)	1 unit	Same as 1.1 (6)
(7)	Lightning-proof transformer	1 unit	Same as 1.1 (7)
(8)	Microwave link system (Fiyoari master station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz)
(9)	Distribution board	1 unit	Same as 1.1 (8)
1.18	Digital transmission system (Villingili)	1 system	
(1)	TS expander	1 system	Same as 1.2 (2)
(2)	Exciter	2 units	Same as 1.1 (2)
(3)	Power amplifier (20W)	2 units	Same as 1.1 (3)
(4)	Combiner	1 unit	Same as 1.2 (3)
(5)	Antenna system	1 system	Transmission: 4-dipole antenna Gain: 11.2dB or more Rust-proofing: Salt resistance specification
(6)	UPS (5KVA)	1 unit	Same as 1.1 (6)
(7)	Lightning-proof transformer	1 unit	Same as 1.1 (7)
(8)	Microwave link system (Gadhdhoo master station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz) Space diversity: Yes
(9)	Distribution board	1 unit	Same as 1.1 (8)
1.19	Digital transmission system (Foammulah)	1 system	
(1)	Network system	1 system	Same as 1.2 (1)

No.	Item	Quantity	Major specifications
(2)	TS expander	1 system	Same as 1.2 (2)
(3)	Exciter	2 units	Same as 1.1 (2)
(4)	Power amplifier (10W)	2 units	Same as 1.1 (3)
(5)	Combiner	1 unit	Same as 1.2 (3)
(6)	Antenna system	1 system	Transmission: 4-dipole antenna Gain: 11.0dB or more Rust-proofing: Salt resistance specification
(7)	UPS (5KVA)	1 unit	Same as 1.1 (6)
(8)	Lightning-proof transformer	1 unit	Same as 1.1 (7)
(9)	Distribution board	1 unit	Same as 1.1 (8)
1.20	Digital transmission system (Hithadhoo)	1 system	
(1)	Network system	1 system	Same as 1.2 (1)
(2)	TS expander	1 system	Same as 1.2 (2)
(3)	Exciter	2 units	Same as 1.1 (2)
(4)	Power amplifier (20W)	2 units	Same as 1.1 (3)
(5)	Combiner	1 unit	Same as 1.2 (3)
(6)	Antenna system	1 system	Transmission: 4-dipole antenna Gain: 11.0dB or more Rust-proofing: Salt resistance specification
(7)	UPS (5KVA)	1 unit	Same as 1.1 (6)
(8)	Lightning-proof transformer	1 unit	Same as 1.1 (7)
(9)	Distribution board	1 unit	Same as 1.1 (8)
1.21	Microwave relay station (Fiyoari)	1 system	
(1)	Microwave link system (Gadhdhoo master station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz) Space diversity: Yes
(2)	Microwave link system (Thinadhoo slave station)	1 system	Frequency: L6GHz (5.925 – 6.425GHz) Space diversity: Yes
(3)	UPS (5KVA)	1 unit	Same as 1.1 (6)
(4)	Lightning-proof transformer	1 unit	Same as 1.1 (7)
(5)	Distribution board	1 unit	Same as 1.1 (8)
2	**Network Operation Centre**	**1 system**	
2.1	Encoding system (Full-seg/one-seg image)	1 system	
(1)	MPEG-4 encoder for full-seg images	1 set	Input signal: SD-SDI or HD-SDI (embedded audio) Output signal: TS signal Video coding: H.264 HP@L3.0, H.264@L4.0 Audio coding: MPEG4 HE-ACC
(2)	MPEG-4 encoder for one-seg images	1 set	Input signal: SD-SDI or HD-SDI (embedded audio) Output signal: TS signal Video coding: H.264 MP@L1.3 Audio coding: MPEG4 HE-ACC
(3)	Multiplexer	1 set	Input signal: MPEG-TS
(4)	Media converter	1 set	Input signal: MPEG-TS or BTS signal
2.2	Encoding system (Full-seg image)	5 systems	
(1)	MPEG-4 encoder for full-seg images	5 sets	Same as 2.1 (1)
(2)	Media converter	5 sets	Same as 2.1 (4)
2.3	Media converter (redundant configuration)	6 sets	
(1)	Media converter (redundant configuration)	6 sets	Input signal: Ethernet or Optical

No.	Item	Quantity	Major specifications
2.4	TS re-multiplexing system	2 sets	
(1)	TS re-multiplexing system (redundant configuration)	2 sets	Input signal: MPEG-TS Output signal: BTS signal
2.5	TS routing system	1 system	
(1)	32 x 32 matrix switcher (redundant configuration)	1 system	Matrix configuration: 32 x 32 or more Input signal: HD-SDI, SD-SDI or TS Output signal: HD-SDI, SD-SDI or TS
(2)	Signal distributor (redundant configuration)	1 system	Input signal: HD-SDI, SD-SDI or TS Output signal: HD-SDI, SD-SDI or TS
2.6	GPS reception system	1 system	
(1)	GPS receiver (redundant configuration)	1 set	Accuracy: 3×10^{-11}
2.7	TS compressor	2 sets	
(1)	TS compressor (redundant configuration)	2 sets	Input signal: BTS signal Output signal: Compressed TS signal
2.8	Network switch	1 system	
(1)	Layer 3 network switch (redundant configuration)	1 system	Basic interface: IP network
(2)	Layer 2 network switch (redundant configuration)	1 system	Same as 2.8 (1)
2.9	BTS/IP converter for TS output	1 system	
(1)	BTS/IP converter for TS output (redundant configuration)	1 system	Input signal: TS signal Output signal: STM-1
2.10	EPG system	1 system	
(1)	EPG transmission server	1 system	Function: Generating EPG information from CSV information
(2)	EPG TS generator	2 sets	Function: Issuing EPG-TS
(3)	EPG registered terminal	7 sets	Function: Inputting programme information
2.11	EWBS transmission server	1 system	
(1)	EWBS transmission server	1 system	Function: Setting the EWBS flag of TMCC
2.12	TS monitoring system	1 system	
(1)	Monitor	3 sets	Screen size: 50 inch or larger
(2)	TS decoder	3 sets	Input signal: MPEG-TS or BTS signal
(3)	BTS decoder	10 sets	Input signal: MPEG-TS or BTS signal
(4)	Monitor rack	1 system	Form: Freestanding
2.13	TS recorder	2 systems	
(1)	TS recorder	2 systems	Input signal: DVB-ASI or RF signal Output signal: BTS signal Storage capacity: 8TB
2.14	TS analyser	1 system	
(1)	TS analyser	1 system	Input signal: BTS signal
2.15	Alarm monitoring system	1 system	
(1)	Alarm monitoring system	1 system	Function: Alarm issue, status management
2.16	Transmitting station – monitoring camera system	1 system	
(1)	Monitoring camera system server	1 system	Function: Displaying images of monitoring cameras
(2)	Fixed monitoring camera	21 systems	Function: Checking the inside of a station building
2.17	Console	1 system	
(1)	Console	1 system	Size: 1800W x 1300H x 1300D mm or less
2.18	Equipment rack	1 system	
(1)	Rack	5 sets	Standard: EIA Size: 570W x 2100H x 800D mm or less

No.	Item	Quantity	Major specifications
(2)	Connector board	1 sets	Number of connectors: 32 or more
(3)	NFB board	5 sets	230VAC
3	**PSM equipment**	**1 system**	
3.1	Encoding system (Full-seg/one-seg image TS)	1 system	
(1)	MPEG-4 encoder for full-seg images	2 sets	Same as 2.1 (1)
(2)	MPEG-4 encoder for one-seg images	2 sets	Same as 2.1 (2)
(3)	Multiplexer	1 set	Same as 2.1 (3)
3.2	Data broadcasting system	1 system	
(1)	Data broadcasting material production system	1 set	Function: Producing contents
(2)	Data broadcasting transmission system	2 sets	Function: Issuing TS signal
3.3	EWBS terminal	1 system	
(1)	EWBS editing terminal	1 set	Function: Area code and EWBS signal control
(2)	EWBS control terminal	1 set	Function: Area code and EWBS signal control
(3)	Weather information terminal	1 set	Function: Managing weather information
3.4	MMS studio equipment	1 system	
(1)	HD camera	1 set	Video signal system: 1080/50i Number of effective pixels: 1,920 (H) x 1,080 (V) Reference ISO sensitivity: F1.6 to 4.7
(2)	Image processing system	1 set	Function: Supporting chroma key composition of input images and backgrounds and issuing of live images
(3)	SDI/IP converter	1 set	Input signal: SD-SDI or HD-SDI signal (embedded audio)
(4)	Microwave link system	1 set	Frequency band: L6GHz band
(5)	IP/SDI converter	1 set	Input signal: Ethernet Output signal: SD-SDI or HD-SDI signal (embedded audio)
(6)	Intercom system	1 set	Function: Enabling communications with PSM
4	**Assembly box**	**1 system**	
(1)	Assembly box	3 systems	Size: 2000W x 2200H x 2500D or more
5	**Antenna tower/pole**	**21 systems**	
(1)	Antenna tower – 90m-high	1 system	Wind resistance: 60m/sec Deflection angle: 0.5° Rust-proofing: Hot-dip galvanisation and salt resistance specification Aircraft warning light: Compliant with ICAO
(2)	Antenna tower – 80m-high	7 systems	Same as 5 (1)
(3)	Antenna tower – 70m-high	5 systems	Same as 5 (1)
(4)	Antenna tower – 60m-high	3 systems	Same as 5 (1)
(5)	Antenna tower – 50m-high	3 systems	Same as 5 (1)
(6)	Antenna pole – 30m-high	1 system	Same as 5 (1)
(7)	Antenna pole – 20m-high	1 system	Same as 5 (1)
6	**Measuring instruments and tools for maintenance**	**1 system**	
(1)	Spectrum analyser	2 systems	Frequency range: 6.4GHz or higher Software: Compliant with ISDB-T8MHz
(2)	Spectrum analyser (for microwave links)	2 systems	Frequency range: 9 – 13GHz or higher

No.	Item	Quantity	Major specifications
(3)	Frequency counter	2 systems	Measurement range: DC to 6GHz or higher Measurement time: 1μs to 1000s
(4)	Power meter	2 systems	Frequency range: 10Mhz – 18GHz
7	**Spare parts**	**1 system**	
(1)	Network system	1 system	Same as 1.2 (1)
(2)	TS expander	1 system	Same as 1.2 (2)
(3)	Exciter	1 system	Same as 1.1 (2)
(4)	Power amplifier (200W)	3 units	Same as 1.1 (3)
(5)	Power amplifier (50W)	3 units	Same as 1.1 (3)

3-2-2-4 Construction Plan

(1) Precautions on construction

The access of residents to an area around a construction site shall be denied to ensure safety of them except when the construction site is isolated from the outside with fences or walls. Therefore, construction sites shall be managed with sufficient considerations to safety, including storage of construction machines, construction materials, and other articles such as temporary facilities, by isolating them from the outside using temporary fences that have entrances.

(2) Plot plan

The site environment, shape, and area required for construction vary between construction sites. For creation of an optimal plan for a site in the current status, therefore, the plot plans for a tower and a station building shall be classified into three types, a through c.

Type a: A tower and a station building shall be constructed separately because a sufficient construction site area for them can be secured.

Type b: A station building shall be constructed inside a tower because of a small construction site and a high tower.

Type c: A pole and a station building shall be constructed separately because only a low tower is required.

Fig. 3-2-5 below shows the classification of sites by transmitting/relay station.

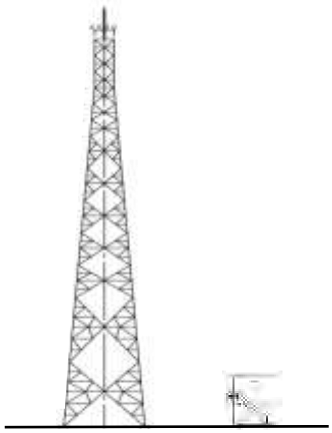
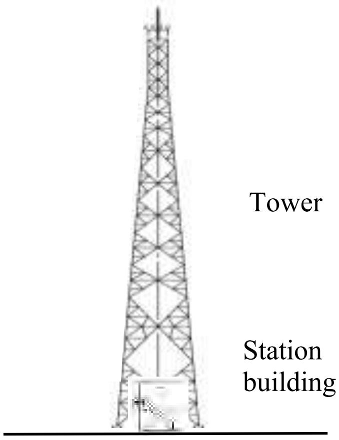
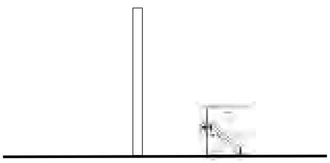
Category	Image of plan	Transmitting/relay station site
a		1 Dhidhdhoo 2 Kulhudhuffushi 3 Funadhoo 4 Manadhoo 5 Ungoofaaru 6 Eydhafushi 7 Naifaru 8 Malé 11 Dhangethi 12 Feeali 13 Nilandhoo 14 Gan 15 Guraidhoo 16 Guraidhoo 17 Thinadhoo 18 Villingili 21 Fiyoari
b		9 Maafushi 10 Felidhoo
c		19 Foammulah 20 Hithadhoo

Fig 3-2-5 Plot Plan by Site

(3) Station building design and facility plans

Based on the results of examining the site plot plan (see Fig. 3-2-5), the construction of a station building shall be planned using a rigid-frame structure for beams and columns and a masonry structure for walls. The design and facility plans are shown in Table 3-2-17, Fig. 3-2-6, 'Floor plan', and Fig. 3-2-7, 'Sectional plan'.

Table 3-2-17 Construction Plan of Station Building

	Building plan	
Building outline	Structure	Reinforced concrete (RC)
	Number of floors	2 floors above ground (elevated floor)
	First floor height	Plan GL + 0.100m
	Second floor height	Plan GL + 3.600m
	Eave height	Plan GL + 6.800m
	Foundation type	Spread foundation
Area	Total floor area	25.00m^2
Outside finish	Rooftop	Metal trowel finish of concrete followed by coating film waterproofing and protection concrete
	Outside wall	Concrete block t=150 mortar finish followed by no-frame multi-layer coating material (spray finish) and face joint (ceiling)
Inside finish	Floor	Metal trowel finish of mortar followed by dustproof coating finish
	Baseboard	Metal trowel finish of mortar H=100
	Wall	Metal trowel finish of concrete followed by AEP coating (acrylic emulsion paint)
	Ceiling	Repair of exposed concrete finish followed by AEP coating (acrylic emulsion paint)
Fittings	Fittings	Steel master and slave doors (1,100 W x 2,100 H) OP coating and aluminium fixed sash window (1,000 W x 500 H)
Machine facilities	Air conditioners	Two units work in alternate shifts.
Electric facilities	Lighting fixtures	Fluorescent light (LED): The required illuminance (at 70 cm above floor) is 200 LX in the transmitter room.
	Wall sockets	Provide three wall sockets in the transmitter room.
Fire-fighting facilities		Not provided
Water supply and drainage facilities		Not provided

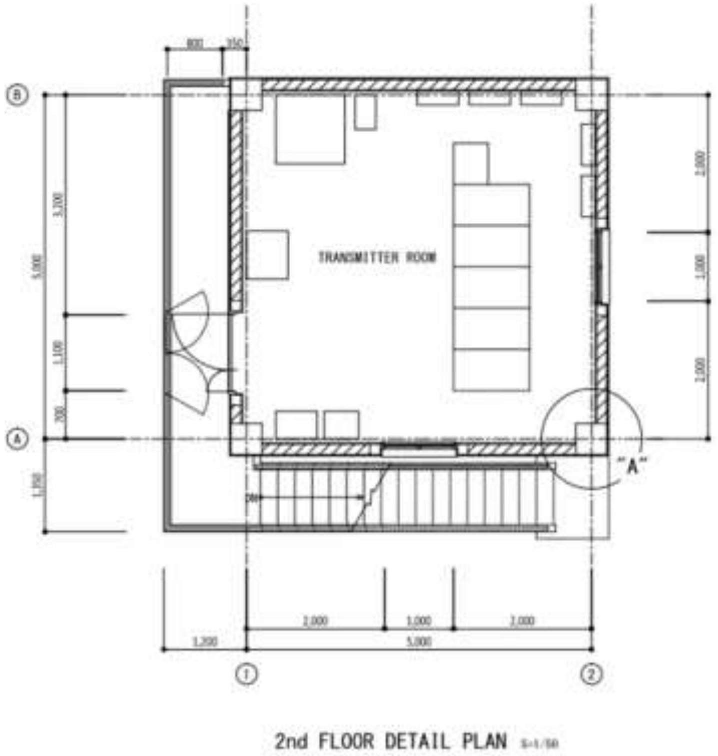


Fig 3-2-6 Floor Plan of Station Building

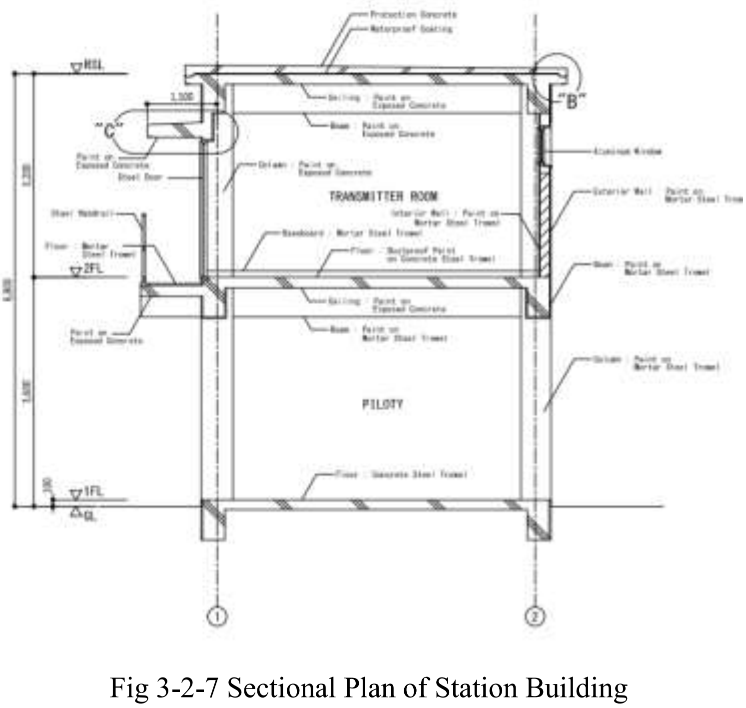


Fig 3-2-7 Sectional Plan of Station Building

(4) Structural design policies and materials used for station building

Structural design policies for station building

- Calculation route X direction (Rigid-frame structure) Route 2-1

Y direction (Rigid-frame structure) Route 2-1

Route 2-1 calculation result

Table 3-2-18 Route 2-1 Calculation Result

	X direction 2-1		Y direction 2-1	
Wall quantity formula (1)/ZWAi ≥ 1.0	0.834	×	0.834	×
Wall quantity formula (1)/ZWAi ≥ 0.75	0.834	○	0.834	○
Wall quantity formula (2)/ZWAi ≥ 1.0	2.146	○	2.146	○
Storey drift ≤ 1/200	1/898	○	1/905	○
Rigidity ≥ 0.6	0.813	○	0.810	○
Eccentricity ≤ 0.15	0.029	○	0.049	○

Source: Created by JICA Survey Team

- Two-storey telecommunication station building made of reinforced concrete with one X-direction span, one Y-direction span, and four columns.
- As for seismic forces for this four-column building, the standard shear coefficient shall be Co=0.25, the locational constant Z=1.0, and the ground classification Type 2. Furthermore, the horizontal seismic coefficient in the underground part shall be k=0.2. The seismic forces in 45 ° directions shall also be examined.
- As for wind pressures, the reference wind speed shall be Vo=34m/s and the roughness coefficient shall be I.
- The live load shall be as shown below. (Unit: N/m^2)

Table 3-2-19 Live Load

Unit: N/m^2

	For design of floors and binders	For design of columns, girders, and foundations	For calculation of seismic forces	Remarks
Roof	1000	0	0	Based on load of transmission equipment
Transmission equipment room	3000	2000	1000	Same as for offices
Passages and stairs	2900	1000	800	

Source: Created by JICA Survey Team

- The foundation shall be a spread-mat foundation.

  Supporting layer GL-1.0m Sandy soil

Design soil bearing capacity 70kN/m^2

- Materials used and use classification

  Plain concrete Fc21

  Deformed bar SD295A D10-D16

  SD345 D19-D25

- Allowable stress of materials

  Rebar Unit: N/mm^2

Table 3-2-20 Allowable Stresses by Material (Rebars)

Unit: N/mm^2

Material type	Rebar diameter	Long-term force			Short-term force		
		Compression	Tension	Shear	Compression	Tension	Shear
SD295A	D10, D14, D16	195	195	195	295	295	295
SD345	D19, D22, D25	215	215	195	345	345	345

Source: Created by JICA Survey Team

・Concrete Unit: N/mm^2

Table 3-2-21 Allowable Stresses by Material (Concrete)

Unit: N/mm^2

Material type	Strength	Long-term force			Short-term force		
		Compression	Tension	Shear	Compression	Tension	Shear
Plain	21	7	-	0.7	14	-	1.05

Source: Created by JICA Survey Team

- Design soil bearing capacity of foundations and grounds

  Spread foundation supporting layer GL-1.0m Sandy soil

Table 3-2-22 Design Soil Bearing Capacities of Foundations and Grounds

Spread foundation	Foundation type	Allowable pile bearing capacity		Allowable soil bearing capacity		Remarks
		Long-term	Short-term	Long-term	Short-term	
○	Independent foundation			70	140	KN/m^2

Source: Created by JICA Survey Team

Table 3-2-23 Fixed Loads

Roof	Holding concrete t=100 (average)	2300 N/m^2
	Waterproof coating	200
Transmission equipment room	Finish	600 N/m^2
	Concrete slab t=150+20	4080
	Total	4680 N/m^2
Passage (cantilever)	Finish	600 N/m^2
	Concrete slab t=150+20	4080
	Total	4680 N/m^2
Stairs	Finish (tread and riser)	800 N/m^2
	Frame (average t=300)	7200
	Total	8000 N/m^2
Wall	Concrete block t=150 + Mortar two sides	3400 N/m^2
	2500+500+400=3400	2nd-floor block wall load shall be entered on computer as 2nd-floor particular load of beams.
		W1=3.4×(3.2-0.5)=9.2 N/m^2

Source: Created by JICA Survey Team

Concrete slab t=150+20 4680

Total 6580 N/m^2

- Design load Unit: N/m^2

Table 3-2-24 Design Load

Unit: N/m^2

		For design of floors and binders	For design of columns, girders, and foundations	For calculation of seismic forces
Roof	Live	1000	0	0
	Fixed	6580	6580	6580
	Total	7580	6580	6580
Transmission equipment room	Live	3000	2000	1000
	Fixed	4680	4680	4680
	Total	7680	6680	5680
Passage	Live	2900	1800	800
	Fixed	4680	4680	4680
	Total	7580	6480	5480
Stairs	Live	2900	1800	800
	Fixed	8000	8000	8000
	Total	10900	9800	8800

Source: Created by JICA Survey Team

3-2-3 Outline Design Drawing

The design drawings, site location maps, etc. listed in Table 3-2-25 are provided at the end of this document.

Table 3-2-25 List of Design Drawings, etc.

No.	Drawing name
A-1	Overall view of digital broadcasting network
B-1	System diagram of transmitting station (Dhidhoo)
B-2	System diagram of transmitting station (Kulhudhuffushi)
B-3	System diagram of transmitting station (Funadhoo)
B-4	System diagram of transmitting station (Manadhoo)
B-5	System diagram of transmitting station (Ungoofaaru)
B-6	System diagram of transmitting station (Eydhafushi)
B-7	System diagram of transmitting station (Naifaru)
B-8	System diagram of transmitting station (Malé [Villingili])
B-9	System diagram of transmitting station (Maafushi)
B-10	System diagram of transmitting station (Felidhoo)
B-11	System diagram of transmitting station (Dhangethi)
B-12	System diagram of transmitting station (Feeali)
B-13	System diagram of transmitting station (Nilandhoo)
B-14	System diagram of transmitting station (Gan)
B-15	System diagram of transmitting station (Guraidhoo)
B-16	System diagram of transmitting station (Gadhdhoo)
B-17	System diagram of transmitting station (Fiyoari)
B-18	System diagram of transmitting station (Thinadhoo)
B-19	System diagram of transmitting station (Villingili)
B-20	System diagram of transmitting station (Foammulah)
B-21	System diagram of transmitting station (Hithadhoo)
C-1	Overall view of NOC

3-2-4 Construction and Procurement Plans

3-2-4-1 Construction and Procurement Policies

This project shall be implemented in the framework of grant aid cooperation of Japan. Therefore, the implementation of this project shall first be authorised by the Government of Japan and then Exchange of Notes shall be had and a Grant Agreement shall be concluded between the Governments of Japan and the Maldives before it is implemented.

(1) Project implementing agency

The implementing agency of this project in the Maldives shall be PSM. The responsible agency shall be the Ministry of Home Affairs. The department in charge of implementation at PSM shall be DBNO, a new department to be founded in PSM. DBNO shall implement this project and be in charge of operation and management of equipment. For smooth promotion of this project, therefore, DBNO shall keep close contact and have discussion with the Japanese consultant and contractor and appoint a responsible person who takes change of this project.

(2) Consultant

To procure and install equipment in this project, the Japanese consultant shall conclude a business agreement for design supervision with the Maldives and make execution designs and supervise works in this project. Furthermore, the consultant shall create tender documents and tender bids on behalf of PSM, the project implementing agency.

(3) Contractor

According to the framework of grant aid cooperation of Japan, a subcontractor that is a Japanese corporation selected by the Maldivian side in an open bid shall construct facilities, procure and install facilities and equipment, and provide technical guidance (OJT) related to instructions on initial setup and operation. Even after completion of this project, the contractor will need to continuously supply spare parts and provide after-sales service such as troubleshooting. Therefore, a liaison mechanism between the Maldivian side and the contractor shall be established after transfer of the relevant facilities, materials, and equipment.

(4) Dispatch of engineers

Equipment to be procured in this project includes precision machines to be used at a broadcasting station, which are inspected after manufacturing at a factory in Japan and shipped as products. Therefore, the installation, adjustment, and test of them require a high level of technology. For these procedures, therefore, engineers dispatched from Japan must conduct quality control upon installation and completion, provide technical guidance (OJT) on initial setup and operation, and conduct process management.

3-2-4-2 Precautions on Construction and Procurement

Although it seems possible to secure workers for construction work in the Maldives, there will be few experts and engineers with special knowledge about processes, quality, safety management, etc. Therefore, the Japanese contractor must dispatch engineers or experts to the Maldives from Japan as required. Alternatively, it will be necessary to seek personnel in the surrounding countries. Additionally, no sufficient concreting materials and construction vehicles (such as trucks, cranes, and mixers) that are indispensable for construction work can be procured on the sites in the Maldives. Depending on the island, consideration must be paid to cases in which construction vehicles cannot be secured.

During excavating and backfilling, some of the grounds of the planned construction sites are landfill sites that are expected to contain waste (woodchips and plastics). Therefore, waste mixed into excavated soil must be separated and properly treated. Furthermore, the groundwater level is expected to be high. Therefore, a supplementary construction method shall be adopted using a sheet pile with a high water cut-off performance. Furthermore, it is important to set the sheet pile deeply and take measures against heaving and boiling. There are expected to be some sites for which construction must be conducted using the groundwater level lowering method while using also the shallow sump method. As for backfill soil, soil excavated on the site shall be basically used. If it is inappropriate, however, backfill shall be conducted using purchased soil.

For use in the construction of a station building or tower, special concrete that needs special considerations must be manufactured because the daily average temperature exceeds 25°C. Therefore, cement with as low a hydration heat as possible shall be selected. Aggregate shall be shielded from direct sunlight and water-sprinkled to lower the temperature. Considerations such as use of as cold water as possible are required. As for construction and curing, concrete must be cast at as low a temperature as possible, at most 35°C. Concrete must also be cast as early as possible within 1.5 hours after mixing. An exposed surface must be kept wet at least for 24 hours. The former concrete ground and foundation must be sufficiently sprinkled with water before the start of concrete casting. Therefore, casting, test, and quality management of concrete must be sufficiently discussed with construction companies as realistic problems from now.

3-2-4-3 Division of Burdens of Construction and Procurement and Installation

The Japanese side shall cover the costs for constructing transmitting station buildings and towers, and procuring/installing transmission and NOC equipment. The Maldivian side shall cover the costs for removing the existing facilities, felling and uprooting trees on the transmitting and relay station sites, and installation of commercial power at NOC (including lead-in panels), etc. Table 3-2-26 shows the proposed division of major burdens.

About optical links, in particular, a telecom carrier who provides links to the DTTB platform shall be determined by tender. Therefore, it should be determined smoothly to avoid impacts on the project implementation. Furthermore, the Maldivian and Japanese sides must have detailed discussion before tendering to avoid causing major changes in the signalling formats, specifications, etc.

Table 3-2-26 Division of Burdens

	Burden item	Division of burden		Remarks
		Japanese side	Maldivian side	
1	Acquisition of IEE/EIA		○	
2	Securing of land required for transmitting and relay stations		○	
3	Removal of existing facilities from transmitting and relay station sites and preparation such as felling of trees		○	
4	Securing of commercial power to transmitting and relay stations		○	
5	Supply of backup power to NOC		○	
6	Fee for using the network of a telecom carrier		○	
7	Equipment procurement	○		
8	Station building construction	○		
9	Tower construction	○		
10	Transportation to the sites of this project	○		
11	Tax exemption and custom clearance procedures at ports of discharge		○	
12	Supply of temporary storage areas near project sites		○	
13	Guidance on initial setup and operation	○		

Source: Created by JICA Survey Team

3-2-4-4 Construction and Procurement Supervision Plans

After conclusion of a business contract between the Client and the Contractor, the Client shall check and approve the equipment and construction specifications proposed by the Contractor and then instruct it to start manufacturing equipment. While the equipment is manufactured, the manufacturing statuses and processes shall be checked as required. After completion, pre-dispatch inspection and pre-shipment equipment collation shall be conducted. Furthermore, Japanese engineers shall be dispatched as on-site supervisors during the site construction period according to the process shown in Table 3-2-27. The personnel plan for procurement supervision is shown below.

Table 3-2-27 Personnel Plan for Procurement Supervision

Person in charge	Rating	Description of work	Japan (M/M)	Maldives (M/M)	Number of visits round-trip
Equipment					
Chief Consultant	2	Safety management		1.09	3
		Total		**1.09**	**3**
Procurement supervising engineer (Transmitting antennas)	3	On-site equipment installation work supervision		1.70	2
		Total		**1.70**	**2**
Procurement supervising engineer (Transmission equipment (1))	3	On-site equipment installation work supervision		2.87	1
		Total		**2.87**	**1**

Person in charge	Rating	Description of work	Japan (M/M)	Maldives (M/M)	Number of visits round-trip
Procurement supervising engineer (NOC equipment)	3	On-site equipment installation work supervision		3.10	2
		Total		**3.10**	**2**
Procurement supervising engineer (Acceptance inspection and transfer)	2	Final inspection check, acceptance inspection, and transfer		1.46	2
		Total		**1.46**	**2**
Inspecting engineer 1 (Equipment: Drawing, collating, and witness inspection)	3	Meeting before start of work by contractor and verification and approval of manufacturing drawings of equipment	0.50		
		Witness of pre-dispatch inspection (First ship)	0.05		
		Procedure of commissioning pre-shipment equipment collation (First ship)	0.05		
		Witness of pre-dispatch inspection (Second ship)	0.05		
		Procedure of commissioning pre-shipment equipment collation (Second ship)	0.05		
		Witness of pre-dispatch inspection (Third ship)	0.05		
		Procedure of commissioning pre-shipment equipment collation (Third ship)	0.05		
		Total	**0.80**		
Clerical workers (employed locally)	-	Miscellaneous duties during on-site work of procurement supervisors		14.50	
		Total		**14.50**	
Construction					
Procurement supervising engineer (Construction)	3	On-site equipment installation work supervision		1.00	2
		Total		**1.00**	**2**
Resident procurement supervising engineer (Construction)	4	On-site work supervision		12.75	2
		Total		**12.75**	**2**
Spot procurement supervising engineer (Construction)-1	4	On-site work supervision		6.00	2
		Total		**6.00**	**2**
Spot procurement supervising engineer (Construction)-2	4	On-site work supervision		6.00	2
		Total		**6.00**	**2**
On-site construction management assistant (Construction)-1	-	Miscellaneous duties during on-site work of procurement supervisors and check/notification of work processes during absence of procurement supervisors (before interruption of work)		12.75	
		Total		**12.75**	
On-site construction management assistant (Construction)-2	-	Miscellaneous duties during on-site work of procurement supervisors and check/notification of work processes during absence of procurement supervisors (before interruption of work)		12.00	
		Total		**12.00**	
On-site construction management assistant (Construction)-3	-	Miscellaneous duties during on-site work of procurement supervisors and check/notification of work processes during absence of procurement supervisors (before interruption of work)		12.00	
		Total		**12.00**	

The following provides major precautions on procurement supervision.

(1) Process supervision

The Consultant shall require the Contractor to meet the project completion date specified in the contract and conduct progress management every week and every month. If a delay in the process is expected, the Consultant shall caution the Contractor against it and require the Contractor to submit and implement a corrective plan. The planned and actual processes shall be compared in terms of the following items:

(a) Check of completed amounts (Completed amounts of manufacturing at the equipment factory and shipment)
(b) Check of completed equipment delivery
(c) Check of planned and actual productivity rates of engineers, skilled workers, labourers, etc.

(2) Quality and work progress control

The Consultant shall control quality and work progress in terms of the items listed below to meet the quality and work progress specified in the contract documents. The Consultant shall immediately require the Contractor to correct, change, or modify the current work status if the quality or work progress is found not likely to be accomplished as a result of check and collation.

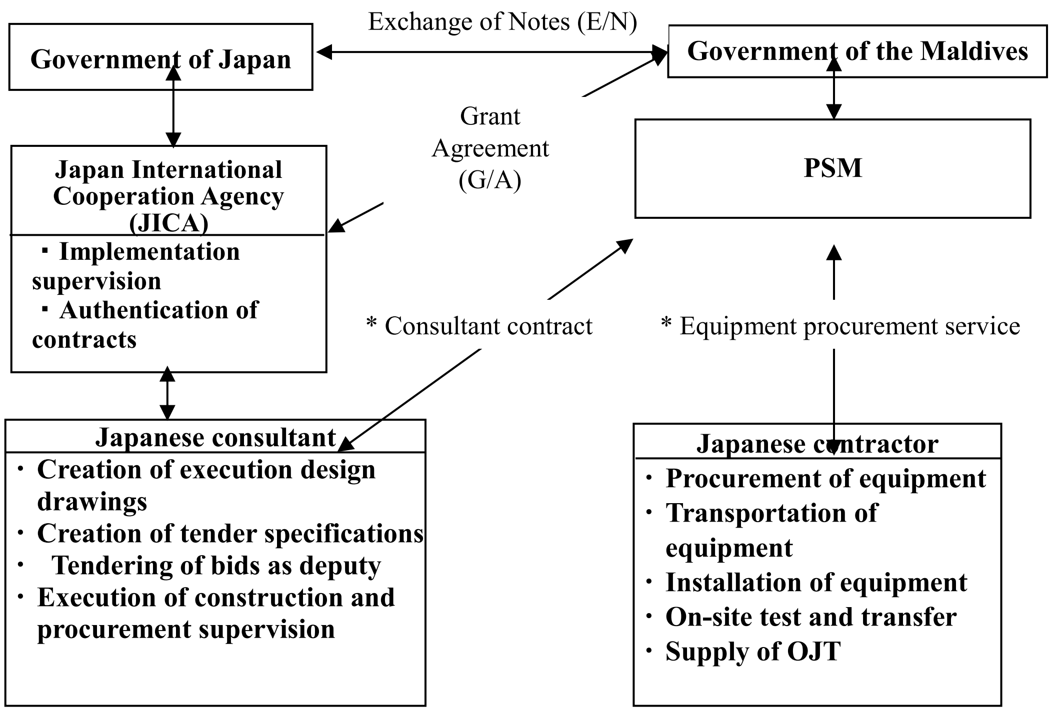
(a) Collation of equipment specifications
(b) Collation of manufacturing drawings, working drawings, and specifications of equipment
(c) Witness of factory inspection or collation of factory inspection results
(d) Collation of installation manuals
(e) Trial run of equipment and collation of adjustment, test, and inspection manuals
(f) Supervision of on-site installation of equipment and witness of trial run, adjustment, test, and inspection

(3) Labour supervision

The Consultant shall discuss sufficiently with the safety manager of the Contractor to prevent an on-site labour disaster and an injury and accident of a third person during the construction period. The precautions on on-site safety supervision shall be as listed below:

(a) Establishment of safety management regulations for work and appointment of managers
(b) Establishment of running routes for construction vehicles, conveying equipment, etc. and assurance of safe driving
(c) Benefit plans for workers and encouragement for taking holidays
(d) Security measures during stay

Fig. 3-2-8 shows interrelations between concerned parties of this project.



* Note: A consultant contract and a contractor contract must be authorised by JICA.

Fig 3-2-8 Interrelations in Project Implementation

(4) Services of Contractor

The Contractor shall procure and supply equipment and conduct installation work. To implement the work, the Contractor shall make sure that the local subcontractors also comply with the work process, quality, work progress, and safety measures specified in the service contract. The Contractor shall dispatch to the Maldives an engineer who has experience in similar operations in a foreign country and have him provide guidance and education to local subcontractors.

1) Factory (product) inspection, pre-dispatch inspection, and pre-shipment collation of equipment

The subcontractor shall submit to the consultant the specifications, drawings, etc. of equipment and work and instruct the manufacturers to manufacture equipment after approval by the Consultant. While the equipment is manufactured, the manufacturing statuses and process progress shall be kept track of. Then, factory (product) inspection and pre-dispatch inspection shall be conducted and pre-shipment equipment collation shall be witnessed.

2) On-site procurement management

During the on-site work period, a Japanese manager shall be dispatched as an on-site procurement manager.

3-2-4-5 Quality Control Plan

The pre-shipment equipment collation shall check whether procured equipment complies with the technical specifications provided in tender documents.

During site construction, quality control shall be conducted according to the construction management criteria specified in the construction manual.

After equipment production by equipment manufacturers, the Contractor shall conduct a factory (product) inspection and then, in the presence of the Consultant, pre-dispatch inspection to inspect the functions and performances of the entire system while also checking each item of equipment for quantities and specifications and obtain approval from the Consultant. After completion of this inspection, the Contractor shall allow an inspection institute commissioned by the Consultant to conduct pre-shipment equipment collation to check the equipment list in the contract against the shipping documents and the pre-shipping documents against equipment.

3-2-4-6 Equipment Procurement Plan

The equipment to be procured in this project is not manufactured in the Maldives and therefore shall be procured from Japan. For equipment for which competitiveness cannot be ensured if it is procured only from Japan, products of third countries shall also be included in the procurement candidates. Table 3-2-28 lists the countries from which equipment shall be procured.

Table 3-2-28 List of Countries for Equipment Procurement

No.	Item	Countries for Procurement	
		Japan	**Third country**
1	**Digital transmission system**		
1.1	Digital transmission system (Dhidhdhoo)		
(1)	UHF receiver	○	
(2)	Exciter	○	
(3)	Power amplifier (200W)	○	Germany
(4)	Combiner	○	Germany
(5)	Antenna system	○	Thailand, Australia, Germany
(6)	UPS	○	
(7)	Lightning-proof transformer	○	
(8)	Distribution board	○	
1.2	Digital transmission system (Kulhudhuffushi)		
(1)	Network system	○	Sweden
(2)	TS expander	○	
(3)	Exciter	○	
(4)	Power amplifier (100W)	○	Germany
(5)	Combiner	○	Germany
(6)	Antenna system	○	Thailand, Australia, Germany
(7)	UPS	○	
(8)	Lightning-proof transformer	○	
(9)	Distribution board	○	
1.3	Digital transmission system (Funadhoo)		
(1)	TS expander	○	

No.	Item	Countries for Procurement	
		Japan	Third country
(2)	Exciter	○	
(3)	Power amplifier (100W)	○	Germany
(4)	Combiner	○	Germany
(5)	Antenna system	○	Thailand, Australia, Germany
(6)	UPS	○	
(7)	Lightning-proof transformer	○	
(8)	Microwave link system (Manadhoo master station)	○	
(9)	Distribution board	○	
1.4	Digital transmission system (Manadhoo)		
(1)	TS expander	○	
(2)	Exciter	○	
(3)	Power amplifier (10W)	○	Germany
(4)	Combiner	○	Germany
(5)	Antenna system	○	Thailand, Australia, Germany
(6)	UPS	○	
(7)	Lightning-proof transformer	○	
(8)	Microwave link system 1 (Naifaru master station)	○	
(9)	Microwave link system 2 (Funadhoo slave station)	○	
(10)	Distribution board	○	
1.5	Digital transmission system (Ungoofaaru)		
(1)	TS expander	○	
(2)	Exciter	○	
(3)	Power amplifier (100W)	○	Germany
(4)	Combiner	○	Germany
(5)	Antenna system	○	Thailand, Australia, Germany
(6)	UPS	○	
(7)	Lightning-proof transformer	○	
(8)	Microwave link system (Naifaru master station)	○	
(9)	Distribution board	○	
1.6	Digital transmission system (Eydhafushi)		
(1)	Network system	○	Sweden
(2)	TS expander	○	
(3)	Exciter	○	
(4)	Power amplifier (50W)	○	Germany
(5)	Combiner	○	Germany
(6)	Antenna system	○	Thailand, Australia, Germany
(7)	UPS	○	
(8)	Lightning-proof transformer	○	
(9)	Microwave link system (Naifaru slave station)	○	
(10)	Distribution board	○	
1.7	Digital transmission system (Naifaru)		
(1)	TS expander	○	
(2)	Exciter	○	
(3)	Power amplifier (200W)	○	Germany
(4)	Combiner	○	Germany
(5)	Antenna system	○	Thailand, Australia, Germany
(6)	UPS	○	
(7)	Lightning-proof transformer	○	
(8)	Microwave link system 1 (Eydhafushi master station)	○	

No.	Item	Countries for Procurement	
		Japan	**Third country**
(9)	Microwave link system 2 (Manadhoo slave station)	○	
(10)	Microwave link system 3 (Ungoofaaru slave station)	○	
(11)	Distribution board	○	
1.8	Digital transmission system (Malé [Villingili])		
(1)	Network system	○	Sweden
(2)	TS expander	○	
(3)	Exciter	○	
(4)	Power amplifier (200W)	○	Germany
(5)	Combiner	○	Germany
(6)	Antenna system	○	Thailand, Australia, Germany
(7)	UPS	○	
(8)	Lightning-proof transformer	○	
(9)	Microwave link system (Maafushi slave station)	○	
(10)	Distribution board	○	
1.9	Microwave relay station (Maafushi)		
(1)	Microwave link system 1 (Malé master station)	○	
(2)	Microwave link system 2 (Felidhoo slave station)	○	
(3)	UPS	○	
(4)	Lightning-proof transformer	○	
(5)	Distribution board	○	
1.10	Digital transmission system (Felidhoo)		
(1)	TS expander	○	
(2)	Exciter	○	
(3)	Power amplifier (50W)	○	Germany
(4)	Combiner	○	Germany
(5)	Antenna system	○	Thailand, Australia, Germany
(6)	UPS	○	
(7)	Lightning-proof transformer	○	
(8)	Microwave link system (Maafushi master station)	○	
(9)	Distribution board	○	
1.11	Digital transmission system (Dhangethi)		
(1)	Network system	○	Sweden
(2)	TS expander	○	
(3)	Exciter	○	
(4)	Power amplifier (200W)	○	Germany
(5)	Combiner	○	Germany
(6)	Antenna system	○	Thailand, Australia, Germany
(7)	UPS	○	
(8)	Lightning-proof transformer	○	
(9)	Microwave link system (Feeali slave station)	○	
(10)	Distribution board	○	
1.12	Microwave relay station (Feeali)		
(1)	Microwave link system (Dhangethi master station)	○	
(2)	Microwave link system (Nilandhoo slave station)	○	
(3)	UPS	○	
(4)	Lightning-proof transformer	○	
(5)	Distribution board	○	
1.13	Digital transmission system (Nilandhoo)		
(1)	TS expander	○	
(2)	Exciter	○	
(3)	Power amplifier (100W)	○	Germany

No.	Item	Countries for Procurement	
		Japan	Third country
(4)	Combiner	○	Germany
(5)	Antenna system	○	Thailand, Australia, Germany
(6)	UPS	○	
(7)	Lightning-proof transformer	○	
(8)	Microwave link system (Feeali master station)	○	
(9)	Distribution board	○	
1.14	Digital transmission system (Gan)		
(1)	Network system	○	Sweden
(2)	TS expander	○	
(3)	Exciter	○	
(4)	Power amplifier (50W)	○	Germany
(5)	Combiner	○	Germany
(6)	Antenna system	○	Thailand, Australia, Germany
(7)	UPS	○	
(8)	Lightning-proof transformer	○	
(9)	Microwave link system (Guraidhoo slave station)	○	
(10)	Distribution board	○	
1.15	Digital transmission system (Guraidhoo)		
(1)	TS expander	○	
(2)	Exciter	○	
(3)	Power amplifier (50W)	○	Germany
(4)	Combiner	○	Germany
(5)	Antenna system	○	Thailand, Australia, Germany
(6)	UPS	○	
(7)	Lightning-proof transformer	○	
(8)	Microwave link system (Gan master station)	○	
(9)	Distribution board	○	
1.16	Digital transmission system (Gadhdhoo)		
(1)	Network system	○	Sweden
(2)	TS expander	○	
(3)	Exciter	○	
(4)	Power amplifier (200W)	○	Germany
(5)	Combiner	○	Germany
(6)	Antenna system	○	Thailand, Australia, Germany
(7)	UPS	○	
(8)	Lightning-proof transformer	○	
(9)	Microwave link system 1 (Fiyoari slave station)	○	
(10)	Microwave link system 2 (Villingili slave station)	○	
(11)	Distribution board	○	
1.17	Digital transmission system (Thinadhoo)		
(1)	TS expander	○	
(2)	Exciter	○	
(3)	Power amplifier (200W)	○	Germany
(4)	Combiner	○	Germany
(5)	Antenna system	○	Thailand, Australia, Germany
(6)	UPS	○	
(7)	Lightning-proof transformer	○	
(8)	Microwave link system (Fiyoari master station)	○	
(9)	Distribution board	○	

No.	Item	Countries for Procurement	
		Japan	Third country
1.18	Digital transmission system (Villingili)		
(1)	TS expander	○	
(2)	Exciter	○	
(3)	Power amplifier (20W)	○	Germany
(4)	Combiner	○	Germany
(5)	Antenna system	○	Thailand, Australia, Germany
(6)	UPS	○	
(7)	Lightning-proof transformer	○	
(8)	Microwave link system (Gadhdhoo master station)	○	
(9)	Distribution board	○	
1.19	Digital transmission system (Foammulah)		
(1)	Network system	○	
(2)	TS expander	○	
(3)	Exciter	○	
(4)	Power amplifier (10W)	○	Germany
(5)	Combiner	○	Germany
(6)	Antenna system	○	Thailand, Australia, Germany
(7)	UPS	○	
(8)	Lightning-proof transformer	○	
(9)	Distribution board	○	
1.20	Digital transmission system (Hithadhoo)		
(1)	Network system	○	Sweden
(2)	TS expander	○	
(3)	Exciter	○	
(4)	Power amplifier (20W)	○	Germany
(5)	Combiner	○	Germany
(6)	Antenna system	○	Thailand, Australia, Germany
(7)	UPS	○	
(8)	Lightning-proof transformer	○	
(9)	Distribution board	○	
1.21	Microwave relay station (Fiyoari)		
(1)	Microwave link system 1 (Gadhdhoo master station)	○	
(2)	Microwave link system 2 (Thinadhoo slave station)	○	
(3)	UPS	○	
(4)	Lightning-proof transformer	○	
(5)	Distribution board	○	
2	**Network Operation Centre**		
2.1	Encoding system (Full-seg/one-seg image)		
(1)	MPEG-4 encoder for full-seg images	○	Germany
(2)	MPEG-4 encoder for one-seg images	○	Germany
(3)	Multiplexer	○	Germany
(4)	Media converter	○	Sweden
2.2	Encoding system (Full-seg image)		
(1)	MPEG-4 encoder for full-seg images	○	Germany
(2)	Media converter	○	Sweden
2.3	Media converter (redundant configuration)		
(1)	Media converter (redundant configuration)	○	Sweden
2.4	TS re-multiplexing system		
(1)	TS re-multiplexing system (redundant configuration)	○	
2.5	TS routing system		
(1)	32 x 32 matrix switcher (redundant configuration)	○	

No.	Item	Countries for Procurement	
		Japan	**Third country**
(2)	Signal distributor (redundant configuration)	○	
2.6	GPS reception system (redundant configuration)		
(1)	GPS reception system	○	
2.7	TS compressor (redundant configuration)		
(1)	TS compressor (redundant configuration)	○	
2.8	Network switch (redundant configuration)		
(1)	Layer 3 network switch (redundant configuration)	○	
(2)	Layer 2 network switch (redundant configuration)	○	
2.9	BTS/IP converter for TS output (redundant configuration)		
(1)	BTS/IP converter for TS output (redundant configuration)	○	
2.10	EPG system		
(1)	EPG transmission server	○	
(2)	EPG TS generator	○	
(3)	EPG registered terminal	○	
2.11	EWBS transmission server		
(1)	EWBS transmission server	○	
2.12	TS monitoring system		
(1)	Monitor	○	
(2)	TS decoder	○	Germany
(3)	BTS decoder	○	Germany
(4)	Monitor rack	○	
2.13	TS recorder		
(1)	TS recorder	○	Germany
2.14	TS analyser		
(1)	TS analyser	○	Germany
2.15	Alarm monitoring system		
(1)	Alarm monitoring system	○	
2.16	Transmitting station – monitoring camera system		
(1)	Monitoring camera system server	○	
(2)	Fixed monitoring camera	○	
2.17	Console		
(1)	Console	○	
2.18	Equipment rack		
(1)	Rack	○	
(2)	Connector board	○	
(3)	NFB board	○	
3	**PSM equipment**		
3.1	Encoding system (Full-seg/one-seg image TS)		
(1)	MPEG-4 encoder for full-seg images	○	
(2)	MPEG-4 encoder for one-seg images	○	
(3)	Multiplexer	○	
3.2	Data broadcasting system		
(1)	Data broadcasting material production system	○	
(2)	Data broadcasting transmission system	○	
3.3	EWBS terminal		
(1)	EWBS editing terminal	○	
(2)	EWBS control terminal	○	
(3)	Weather information terminal	○	
3.4	MMS studio equipment		
(1)	HD camera	○	
(2)	Image processing system	○	
(3)	SDI/IP converter	○	Sweden
(4)	Microwave link system	○	

No.	Item	Countries for Procurement	
		Japan	Third country
(5)	IP/SDI converter	○	Sweden
(6)	Intercom system	○	
4	**Assembly box**		
(1)	Assembly box	○	
5	**Antenna tower/pole**		
(1)	Antenna tower – 90m-high	○	Thailand, China
(2)	Antenna tower – 80m-high	○	Thailand, China
(3)	Antenna tower – 70m-high	○	Thailand, China
(4)	Antenna tower – 60m-high	○	Thailand, China
(5)	Antenna tower – 50m-high	○	Thailand, China
(6)	Antenna pole – 30m-high	○	Thailand, China
(7)	Antenna pole – 20m-high	○	Thailand, China
6	**Measuring instruments and tools for maintenance**		
(1)	Spectrum analyser	○	
(2)	Spectrum analyser (for microwave links)	○	Germany
(3)	Frequency counter	○	
(4)	Power meter	○	Germany
7	**Spare parts**		
(1)	Network system	○	Sweden
(2)	TS expander	○	
(3)	Exciter	○	
(4)	Power amplifier (200W)	○	
(5)	Power amplifier（50W）	○	

Since equipment may be procured from several third countries in this project, pre-shipment equipment collation shall be conducted in each of the source countries, from which equipment shall be transported on ships to the Port of Malé in the Maldives. Equipment shall then be transported on boats from the Port of Malé to each site.

In this project, equipment shall be transported separately on four ships as described below due to circumstances of processes and required time until delivery of equipment to be procured. Since implementation of DSO in some regions by December 2017 is requested, the first ship will transport materials required for antenna towers. When the construction of transmitting station buildings and antenna towers is partially completed and the installation of equipment becomes possible, the second ship shall transport transmission equipment for NOC and the project sites for which DSO is implemented. Those project sites where construction and installation are completed can start digital broadcasting one by one. The third and fourth ships shall transport the remaining antenna tower equipment and transmission equipment.

First ship:
Antenna, Assembly box

Second ship:
NOC equipment and transmission system microwave link equipment (Kulhudhuffushi, Malé (Villingili), Gan, Hithadhoo)

Third ship:

Transmission system microwave link equipmentAntenna tower equipment and microwave link equipment (except avove mentioned sites)

3-2-4-7 Plan on Guidance on Initial Setup and Guidance on Operation, etc.

The supplier of procured equipment shall provide the Client with guidance on initial setup. The persons in charge have been operating and managing the existing broadcasting equipment including analogue broadcasting equipment. However, the PSM personnel do not have experience in operating many of the items of the special equipment for DTTB. Therefore, related assistance proposed in Chapter 3-1-2 is required.

(1) Guidance on initial setup

In view of lack of experience in the operation and maintenance of latest equipment for digital broadcasting to be procured in this project, the supplier of procured equipment shall dispatch Japanese engineers to take a lead in providing the personnel in charge with guidance on the basic operation procedures for the systems and equipment.

These programmes for guidance on initial setup shall be designed to repeat hands-on training to transfer basic know-how required for the running of the new system. The personnel plan for guidance on initial setup is shown below.

Table 3-2-29 Personnel Plan for Guidance on Initial Setup

Person in charge	M/M
< Transmission equipment >	
Outline of microwave links	0.17
Outline of transmission systems	0.17
NOC system	0.13

(2) Guidance on operation

After the guidance on initial setup described above, the supplier of procured equipment shall provide trainees with guidance on the basics required for daily management such as the procedures of periodical inspection of systems and equipment, diagnosis in troubleshooting, repair request to manufacturers, and liaison. Detailed guidance on periodical inspection, emergency measures, and other operations shall be provided separately in relevant assistance.

The personnel plan for guidance on operation is shown below.

Table 3-2-30 Personnel Plan for Guidance on Operation

Person in charge	M/M
< Transmission equipment >	
Outline of microwave links	0.30
Outline of transmission systems	0.30
NOC system	0.53

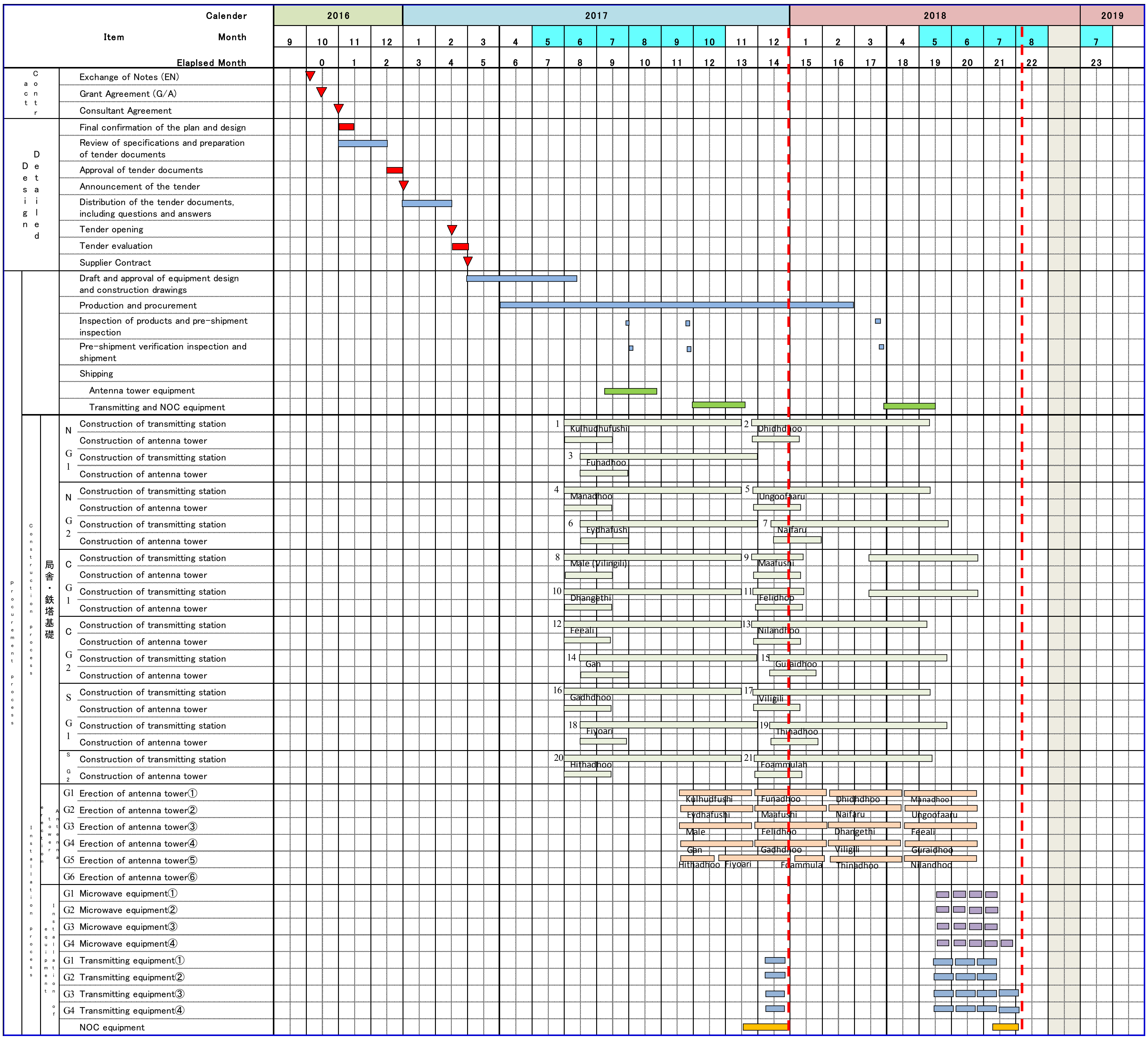
3-2-4-8 Implementation Schedule

The implementation schedule of this project shall be as shown below. After execution design, construction work and installation work shall be conducted in parallel in this project. Therefore, the required time shall be approximately 22 months including the execution design process. While the processes are conducted in parallel, the required time lengths of the processes are as follows:

(1) Execution design and tendering:	4.50 months
(2) Facility construction work:	11.25 months
(3) Equipment procurement and installation work:	17.00 months

Table 3-2-31 shows the project implementation schedule chart.

Table 3-2-31 Project Implementation Schedule Chart



3-3 Obligations of Recipient Country

The Japanese side shall cover the costs for constructing digital transmitting station buildings and antenna towers and procuring and installing broadcasting and NOC equipment. The Maldivian side shall cover the costs for removing the existing facilities when required for carrying out the construction and installation of commercial power at transmitting stations and NOC, etc.

(1) Items that must be completed before Exchange of Notes (E/N)

- Acquisition of IEE/EIA

PSM, the implementing agency, must acquire EIA approval of the Environmental Protection Agency (EPA) of the Maldives. The existence of even one transmitting station with major environmental and social considerations requirements will give serious impact on the entire plan of the DTTB platform. Therefore, it is desirable to acquire an EIA approval before E/N.

- Securing of sites for digital transmitting stations

This project shall construct digital transmitting stations and microwave relay stations on 21 sites in total. Land must be acquired for sites that do not have sufficient space for constructing new station buildings and antenna towers and islands on which new digital transmitting stations will be constructed. Although candidate sites were examined during preparatory survey, PSM must acquire permission from the Island Committees and the Ministry of Housing and Infrastructure. Whereas application for land acquisition is currently in progress, an official approval must be acquired before E/N.

(2) Items that must be completed before tendering

- Securing of optical links to specified transmitting stations

PSM must secure optical links between a broadcasting station and NOC and from NOC to a planned transmitting station. Optical fibre links have already been laid between a major broadcasting station and NOC. However, the broadcasting stations that will participate in the DTTB platform have not yet been determined. Therefore, if any broadcasting station without an optical fibre link decides to participate in it, an optical fibre link must be laid by one or both of PSM and the said broadcasting station by consultation between them before announcement of tender. On the other hand, NOC and a planned transmitting station shall be connected with a leased optical or microwave link network operated by a telecom carrier. The link must be an STM-1 link.

Laying of optical fibre links and securing of links, which will give influence to the tender specifications, must be completed before announcement of tender.

- Payment of costs for opening an account and commissions to be paid

The procedures for paying commissions for issuing and modifying Banking Arrangement (B/A) and Authorisation to Pay (A/P) shall be followed.

(3) Items that must be conducted during project implementation

- Removal of existing facilities from transmission and relay station sites and preparation such as felling of trees

Before the start of construction, PSM must relocate the analogue transmitters and FM transmitters currently in use, remove station buildings and towers, and fell and uproot the trees in the planned construction sites to prepare an environment that ensures smooth start of construction.

- Securing of backup power to NOC

NOC plays an important role in collecting programmes from broadcasting stations and multiplying signals to generate digital broadcasting signals. Any malfunction of NOC makes it impossible to transmit broadcasting signals to transmitting stations. Therefore, NOC must secure a backup power supply.

- Securing of power supply to transmitting stations, relay stations, and equipment installation sites

PSM shall install commercial power at transmitting stations and relay stations before start of construction on each site. Furthermore, it must provide commercial power supply for the equipment to be installed in the weather studio of MMS and on the rooftop of the Ministry of Home Affairs building after consultation with the relevant organisations.

- Securing of land on and around the sites

There is a need to provide material and equipment storage yards and temporary land required for construction and installation work in this project.

- Tax exemption

Materials and equipment required for this project and dispatched Japanese persons shall be given tax exemption and facilities. The procedures for tax exemption for procurement of materials and equipment required for this project and business tax exemption for Japanese companies and persons involved shall be followed.

- Assignment of counterpart personnel

The counterpart shall appoint personnel for operation and maintenance technology transfer in this project, check the work during the construction period, and witness the performance and function inspection of materials and equipment.

(4) Items that must be conducted after project completion

- Payment of operation and maintenance costs

  Costs required for appropriate use and management of facilities and equipment constructed and procured in grant aid cooperation of Japan and procurement of consumables, spare parts, etc. must be paid.

- Implementation of future plan

  It is necessary to construct digital transmitting stations excluded from construction in this project and procure transmitters required to change the multiplexed programme lineup according to the DBNO plan. However, the plan implementation timing must be determined by modifying the plan as required because there are external factors such as private broadcasters' project implementation statuses and change of their intention to participate.

3-4 Project Operation and Maintenance Plan

The equipment to be procured and installed in this project does not contain any moving part nor consumable part that need to be replaced within one year after operation start. Generally, the facilities of a transmitting station contain a lightning-proof transformer and therefore a surge absorber must be replaced. However, this part is to be replaced when the impact of a lightning surge deteriorates it to a certain degree. Therefore, surge absorbers shall be procured as required on the responsibility of the Maldives. Furthermore, the UPS batteries to be used as a backup power supply must be replaced about once every five years. It is desirable to replace the fan units and air filters for transmitters and other daily consumable parts every one to three years. Furthermore, the fuses and LEDs of each item of equipment shall be replaced every time they are consumed or damaged. The parts listed so far shall be procured on the responsibility of the Maldives.

The transmitters, server equipment, etc. shall be entirely renewed in 20 years after the service start according to the plan of the Maldives in consideration of depreciation periods and technical renovations. Furthermore, the NOC equipment shall be entirely renewed in 10 years, earlier than the transmitters, according to the plan because daily operation of it damages it significantly. The replacement cycles of spare parts related to transmitters shown in Table 3-4-1 are provided only as guidelines. The details must be checked for each of the supplied products.

Table 3-4-1 Equipment Maintenance Plan

Replacement cycle	Target part and maintenance work	Remarks
Whenever consumed or damaged	Fuses, surge absorbers, lamps, and LEDs	
Every one or two years	Fans and air filters	Air filters shall be cleaned or replaced.
Every three years	Fans	The replacement cycle depends on the type.
Every five years	Batteries	
Every 10 years	Salt-resistant coating	Need to be painted earlier than the replacement cycle depending on the corrosion status.
Every 15 years	Salt-resistant coating	

Source: JICA Survey Team

Table 3-4-2 shows the periodical inspection items and guidelines for transmission-related equipment among the equipment to be procured in this project.

Table 3-4-2 Equipment Inspection Guidelines

Inspection item	Inspection cycle	Target equipment	Description of inspection, measurement, etc.
Metering and visual inspection	Every six months	Equipment in general, station buildings, and towers	Recording of meter readings, presence of rust and oil leaks, necessity of replacing desiccants of dehydrators, room temperatures and humidities, retightening of screws, cleaning of air filters, presence of foul odours and unusual sounds
Electric characteristics	Every year	Transmitters, relays, and antennas	Output power, frequencies, spectrum masks, and antenna VSWR
Electric intensity measurement	Every year	Transmitters	Check of electric intensities and images at fixed points
UPS operation check	Every six months	UPS	Power failure test and inspection for battery leakage, etc.

Source: JICA Survey Team

3-5 Approximate Project Cost

3-5-1 Approximate Project Cost for Grant Aid Project

According to the Maldives' obligations shown in Chapter 3-3, the Maldives shall cover the cost of 115 million yen. whereas the cost owned by the Japanese side is closed due to confidentiality. The following table shows the costs to be covered by Japan and the Maldives and the calculation conditions.

(1) Costs to be covered by the Japanese side

<u>This section is closed due to confidentiality</u>

(2) Costs to be covered by the Maldivian side

<u>Covered costs: Approx. 115 million yen</u>

Obligation	Estimated amount (MVR)	Remarks
1. Acquisition of IEE/EIA	515,000	For 13 sites. This amount was estimated by the consultant and must be updated in the future.
2. Removal of existing facilities from transmission and relay station sites and preparation such as felling of trees.	2,180,000	Preparation regarding existing facilities and trees
3. Transfer of exsiting facilities in transmission and relay station sites	1,400,000	Ungoofaaru, Eydafushi, Felidhoo, Nilandhoo
4. Exmeption of tax of domestically procured services and goods	6,366,000	
5. Supply of backup power to NOC	1,098,000	Estimated at 20kVA
6. Securing of commercial power to transmitting stations	798,000	Cable: MVR 1,200m Cable laying work: MVR 100 / m Meter installation work: MVR 12,000 per site
7. Cost for securing space for NOC	2,800,000	-
8. Charge of remittance to bank account of the Republic of Maldives according to the banking arrangement	397,000	0.1% of E/N amount
9. Training cost for DBNO staff members	800,000	
Total	**16,389,000**	

(3) Estimation conditions

Estimation made as of: November 2015

Exchange rates: 1 US dollar = 122.20 yen
1 Maldivian rufiyaa = 7.95 yen

3-5-2 Operation and Maintenance Costs of DBNO

The Government of the Maldives maintains that DBNO shall be founded in PSM but financially independent from PSM. Therefore, the operation and maintenance costs were examined in two classifications: Those for the DTTB platform to be covered by DBNO and those for other PSM equipment to be covered by PSM.

The equipment to be procured in this project must be appropriately maintained for the sake of sound operation of the DTTB platform. Since the Government of the Maldives also maintains that no government budget shall be allocated to the operation cost of DBNO, DBNO must secure the equipment renewal cost for itself. Therefore, there must be a maintenance and management plan that allows for not only the maintenance cost for new and existing equipment but also the cost for periodical equipment renewal.

3-5-2-1 Setting Conditions

The conditions for estimating the operation expenditures and revenues are set as follows:

(1) Expenditures

The average expenditures of PSM in the past two years were adopted as the estimated basic expenditures for the operation of DBNO. Although development of human resources is required for the new organisation, no training cost is included in the expenditures because the personnel training is planned to be provided by the training department of PSM. Likewise, the cost for the administration department including accounting is not included in the expenditure because the existing department of PSM is planned to carry out this work for DBNO.

The NOC equipment of DBNO, which is different from the existing facilities, has no past data that can be used as reference. For the NOC equipment maintenance cost to be included in the equipment maintenance item, therefore, a failure frequency of the equipment was estimated to derive an annual maintenance cost.

Note that, for the expenditures of DBNO, the financial and budgetary statuses were analysed while allowing for additional construction of transmitting stations and increase of broadcasting channels to four as described in Chapter 2-2-4-1. Since financial analysis was made based on the usage fees collected from broadcasters, DBNO is supposed to have operation and maintenance capabilities. However, it must be noted that this section calculates the operation and maintenance costs for equipment to be supplied in the grant aid cooperation project as required in this section but only estimates minimally required expenditures for operation and maintenance of the equipment supplied in the grant aid cooperation. It is hoped that, in actuality, the said expansion plan is smoothly promoted by this grant aid cooperation according to the expansion plan of the DTTB platform.

Table 3-5-1 Estimated Annual Expenditures for DBNO Operation

MVR (1MVR = JPY7.8)

	Setting condition	Estimated annual expenditure (MVR)
Labour cost	The unit cost of labour of PSM is adopted as the basic unit cost. The number of personnel required for DBNO operation is assumed to be 39. (See Chapter 2-2-2, 'Personnel Plan')	1,610,000
Electricity cost	The expenditures of PSM in 2014 and 2015 were used as reference for calculation. The electricity costs for relay and transmitting stations are included in the equipment maintenance cost.	120,000
Equipment maintenance cost (including the electricity costs for relay and transmitting stations)	The maintenance costs for towers and transmitting station buildings were calculated based on the expenditures in 2014 and 2015. The maintenance costs for NOC equipment were calculated based on the market prices for the equipment. The equipment was classified into three importance levels based on the estimated failure frequencies for the equipment. The cost for Level 1 was set to 10% of the market price, cost for Level 2 to 3% of the market price, and cost for Level 0 with an exceedingly low failure frequency to no maintenance cost. Note that the equipment maintenance cost refers to cost for maintenance and repair of equipment in use including towers. The equipment renewal cost required due to depreciation, which is collected from platform users and accumulated, shall not be included in the annual expenditures. (See Chapter 2-2-4)	13,080,000
Tower rental fees	For two digital transmitting stations, rental fees are paid to the telecommunication company	1,170,000
Optical fibre usage fee	The optical fibre usage fee was calculated based on the result of interviews about the current status at CAM.	2,620,000
Frequency licence fee	Frequency licence fee currently in effect (CAM)	5,750,000
Other incidental costs	This item is expected to include costs for communications with regional transmitting stations, etc. and costs for supplies such as stationery. This item is set to 10% of estimated expenditures other than this item.	350,000

Source: Created by JICA Survey Team

The equipment renewal cost is estimated as an expenditure other than the DBNO operation cost. Transmitters, which commonly have a depreciation period of 20 years, shall be renewed every 20 years. Towers have a service life of 40 years or longer if the salt-resistant coating is applied every 10 to 15 years and other repair is done whenever required. Therefore, the renewal cost is not included in the plan shown in Table 3-5-2. The NOC equipment shall be renewed every 10 years, a common depreciation period for broadcasting equipment. The equipment renewal costs shall be obtained by dividing the market prices by the depreciation periods and accumulated.

These equipment renewal costs shall be included in the DBNO usage fee and collected from various organisations.

(2) Revenues

The Government of the Maldives maintains that DBNO shall be operated using the usage fee collected from PSM and private broadcasters to provide broadcasting via the DTTB platform and that no government budget shall be allocated to the operation cost of DBNO. The Maldives plans to multiplex two HD programmes, two SD programmes, one data programme, and one one-seg programme per frequency until ASO. As a result of interviews conducted with private broadcasters during the survey period, VTV intends to provide HD and data broadcasting, Sunga TV and Raajje TV to provide HD, data, and one-seg broadcasting, and DTV to provide SD programmes. Although other private broadcasters have not been directly asked about their intention, the PSM's advance check with them found that they seem to have a high incentive because they can migrate to DTTB using the existing equipment and use a broadcasting network that enables nationwide broadcasting. Therefore, the broadcasters are expected to participate in the DTTB platform. In case a few participants are lacking, PSM is willing to fill the vacancies to provide broadcasting.

3-5-2-2 Estimation Results

The table below shows the revenue and expenditure forecast until the renewal due date for transmitting stations under the setting conditions described so far.

As described in the previous section, the NOC equipment shall be renewed every 10 years and transmitters every 20 years in view of depreciation period. Towers can have a service life of 40 years or longer as described earlier if they are maintained appropriately. Since the usage fees from broadcasting stations are expected, the digital transmission system and NOC equipment for the DTTB platform are deemed to be appropriately managed and maintained.

Table 3-5-2 Estimated Revenues and Expenditures of DBNO (2018 to 2038)

Unit: Million MVR (1MVR = JPY7.8)

				2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
			Elapsed years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Revenue		Usage fee of DBNO	HD	15.88	15.88	15.88	15.88	13.12	13.12	29.52	29.52	29.52	29.52	27.24	27.24	27.24	27.24	27.24	27.24	27.24	27.24	27.24	27.24	27.24
			SD	7.92	7.92	7.92	7.92	6.56	6.56															
			Data Broadcasting	1.84	1.84	1.84	1.84	1.52	1.52	2.28	2.28	2.28	2.28	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12
			One-seg	0.78	0.78	0.78	0.78	0.64	0.64	0.96	0.96	0.96	0.96	1.28	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Expenditure	Operating and maintenance cost regarding equipment provided by the Project	Renewal of Equipment of NOC													38.00									38.00
		Operational expenditure of DBNO	Labour cost	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61
			Electricity cost (only at office)	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
			Equipment maintenance cost (18 sites)	13.09	13.09	13.09	13.09	13.09	13.09	13.09	13.09	13.09	13.09	13.09	13.09	13.09	13.09	13.09	13.09	13.09	13.09	13.09	13.09	13.09
			Tower rental fee	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17
			Extension fee of optical fiber cable	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62
			Frequency license fee	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75
			Other expenses	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
			Balance	1.71	1.71	1.71	1.71	-2.87	-2.87	8.05	8.05	8.05	8.05	8.05	-32.47	5.53	5.53	5.53	5.53	5.53	5.53	5.53	5.53	-32.47
			Reserve	1.71	3.42	5.13	6.84	3.97	1.10	9.15	17.20	25.25	33.30	39.23	6.76	12.29	17.82	23.35	28.88	34.41	39.94	45.47	51.00	18.53
		Event					ASO			Operation with 3 frequencies (only HD)				Operation with 4 frequencies	Renewal of equipment of NOC									Renewal of transmitting system

3-5-3 Operation and Maintenance Costs of PSM Equipment

The PSM equipment shall be operated and maintained by PSM. Since accounting will be conducted separately for PSM and DBNO which have different budgets, the operation and maintenance costs for PSM equipment to be supplied in this project must be examined separately from those for DBNO in this project.

PSM is operated on its own revenues which consist of the government budgets, advertising, equipment leasing, etc. The table below shows the data acquired by the study team, which contains revenues and expenditures of PSM in the past three years.

Table 3-5-3 Budgets and Revenues/Expenditures of PSM (from 2013 to October 2015)

MVR (1MVR = JPY7.8)

Item		2013	2014	2015
Revenues	Government budgets	72,000,000*	60,033,318.00	74,100,000**
	Revenues from advertising, etc.		19,593,983.20	
Expenditures	Current expenditures	N/A	19,960,820.32	-
	Capital-investment cost	N/A	4,366,826.62	-
	Labour cost	N/A	637,934.19	-

* Breakdowns are unknown.
** Until October 2015 (at the time of field survey)
Source: PSM

3-5-3-1 Setting Conditions

The conditions for estimating the operation expenditures and revenues are set as follows:

(1) Expenditures

A common maintenance cost for studio equipment in Japan is around 5% to 10% of the equipment purchase price. This amount is paid to the manufacturer as an annual maintenance cost to conclude an equipment maintenance contract. In the Maldives, there is no service office under direct management of a manufacturer. Therefore, a repair request must be made to a distributor or a branch of the manufacturer in a neighbouring country. Therefore, the maintenance cost was set to 10%.

The PSM equipment to be procured in this project shall be as described in Chapter 3-2-2-3-3, ‘PSM Equipment’. Since the estimated total amount of this grant aid cooperation is MVR 10 million (1 MVR ≈ JPY 7.8), the market price is set to 70% of this amount and the operation and maintenance costs are estimated at 10% of this amount, MVR 700 thousand. After the other annual expenditures that amounted to approx. MVR 25 million in FY2014 are added, the total annual expenditure is estimated at approx. MVR 25.7 million.

(2) Revenues

The revenues were set to the actual figures in 2013 to 2015. PSM has its own revenue sources that consist of government budgets, advertising, equipment leasing, etc. As shown in Table 3-5-3, there is no great difference between the revenues in three years. Therefore, the revenues of PSM that consist of both the government budgets and own revenues are estimated at MVR 70 million or more in the future, too.

3-5-3-2 Estimation Results

When the PSM equipment maintenance cost is substituted into the 2014 data as an example, the revenues amount to MVR 79,627,301.20 whereas the expenditures amount to MVR 25,661,439.21. Since the revenues of PSM are a lot more than expenditures, it is expected to be able to appropriately manage and maintain the supplied equipment.

Chapter 4   Project Evaluation

Chapter 4 Project Evaluation

4-1 Preconditions

The fulfilment of the obligations described in Chapter 3.3 'Obligations of Recipient Country' by the Government of the Maldives is a precondition for the implementation of this project. Because DBNO is to operate and maintain the digital broadcasting network to be established in this project, it will have to fund the operation and maintenance of the network and make required savings for projects in future from the user fee revenue from the broadcasters participating in the platform. The participation of private broadcasters in the platform project is a precondition for the sustainability of this project because the operating and maintenance cost and the fund required for the implementation of projects in future will have to be covered by the user fee revenue.

4-2 Necessary Inputs by Recipient Country

The optical fibre and microwave links of telecom carriers will have to be used for the appropriate operation of the digital transmission system and the equipment of NOC to be provided in this project. If these links cannot be used, broadcasters will not be able to transmit broadcast programmes to transmitting stations and, as a consequence, viewers will not able to watch DTTB programmes.

It is absolutely necessary to complete the preparatory work including the land expropriation at the sites of transmitting and relay stations, removal of the existing equipment not required in this project from the sites and extension of the commercial power supply to the transmitting stations and NOC before the installation work begins. Successful implementation of the preparatory work will lead to successful execution of the assumed overall plan of the project.

4-3 Important Assumptions

The achievement of the project purposes will require particular consideration to and specific measures for the important assumptions mentioned below.

(1) The private broadcasters participating in the platform continue to use the platform and pay the set user fees

The DTTB platform to be established in this project will be operated and maintained by DBNO. Because the operating and maintenance cost of DBNO will be paid from the user fees collected from the broadcasters participating in the platform, they will have to pay the set fees without delay.

(2) Improvement of the Technical Capability of the Implementing Agency

Some of the equipment to be provided in this project is equipment specifically for DTTB which has not been used in PSM, the implementing agency of this project. The encoder and multiplexer in the equipment for NOC and the data broadcasting programme production equipment and EWBS-related components among the equipment for PSM are among them. PSM will have to not only employ the required number of staff members but also take measures to improve the technical capability of its staff to the level required for operating DTTB including the provision of sufficient training opportunities. If the assistance recommended in Chapter 3-1-2 is implemented as an associated assistance project, it will ensure the improvement of the technical capability of the implementing agency in the operation of the DTTB-specific equipment.

(3) Maintenance of the Operating System in the Relevant Organisation

The equipment for PSM includes the equipment to be installed in MMS. It is to be installed to improve the quality of the weather information that is in extremely high demand in the Maldives. There is great expectation for the use of the equipment in the emergency broadcasting at the time of disaster. A very limited number of staff members produce daily weather information programmes at the weather studio in MMS. MMS will have to maintain this programme production system and continue providing the weather information to PSM every day.

Appropriate measures will have to be taken on the issue mentioned below for the achievement of the overall goal of this project.

(4) Promotion of the Purchase of the DTTB Receivers

People cannot watch DTTB programmes without a DTTB receiver. ISDB-T model receivers sold in Japan cannot be used in the Maldives. It is necessary to make DTTB receivers that can be used in the Maldives commercially available in the country. The availability of the receivers does not directly affect the achievement of the overall goal. However, if the increase in the number of DTTB receivers in households is slow and the number of the viewers of TV programmes broadcast through the DTTB platform does not increase, the private broadcasters may not produce TV programmes appealing to the local people because they think the production of such programmes does not increase their advertising revenue.

4-4 Project Evaluation

4-4-1 Relevance

A study was conducted on (1) the number of beneficiaries, (2) urgency, (3) contribution to the achievement of the medium- to long-term development goals of the recipient country and (4) consistency with the assistance policies and strategies of Japan of this project to evaluate the relevance of this project. The results of the study have confirmed that this project is highly relevant.

(1) Beneficiaries of the Project

The number of the beneficiaries of this project is 311,634 people in the DTTB coverage area. This figure corresponds to approx. 91.32% of the total population of the country. The people living in 172 out of the 201 inhabited islands will be able to watch DTTB programmes when this project has been completed. This extension of the TV broadcasting network will lead to the improved access to information and correction of the regional disparity in access to information.

The maximum impact of this project will be realised if the Government of the Maldives takes appropriate measures to facilitate purchase of DTTB receivers.

Table 4-4-1 Number of Households in the DTTB Coverage Area

	Atoll	Population	Population in the coverage area	Percentage of people in the coverage area	Number of islands in the coverage area/number of inhabited islands
1	Republic	133,019	133,019	100.0%	6/6
2	Haa Alifu	13,175	13,175	100.0%	15/15
3	Haa Dhaalu	18,300	17,127	93.6%	15/16
4	Shaviyani	12,310	11,823	96.0%	13/14
5	Noonu	11,100	11,100	100.0%	13/13
6	Raa	15,120	15,120	100.0%	15/15
7	Baa	9,990	9,990	100.0%	13/13
8	Lhaviyani	8,725	8,725	100.0%	5/5
9	Kaafu	16,908	9,398	55.6%	7/9
10	Alifu Alifu	6,474	0	0.0%	0/8
11	Alifu Dhaalu	10,127	8,398	82.1%	10/10
12	Vaavu	1,635	1,635	100.0%	5/5
13	Meemu	4,814	0	0.0%	0/8
14	Faafu	4,089	4,089	100.0%	6/6
15	Dhaalu	5,908	1,869	31.6%	3/7
16	Thaa	9,012	5,870	65.1%	8/13
17	Laamu	12,075	12,075	100.0%	13/13
18	Gaafu Alifu	8,868	8,868	100.0%	10/10
19	Gaafu Dhaalu	11,765	11,765	100.0%	9/9
19	Gnaviyani	8,055	8,055	100.0%	1/2
20	Seenu	19,787	19,787	100.0%	6/6
Total		341,256	311,634	91.32%	172/201

Source: Created by JICA Survey Team

(2) Urgency

The development of an information communication network in the Maldives is at the stage of preparing the installation of optical fibre cables throughout the country. Broadcasting and mobile phones are the main means of communication to remote islands, while development and use of the landline telephone and the Internet are still limited. Because of its flat terrain, the Maldives is vulnerable to sea level rise caused by climate change and natural disasters such as flood tide caused by strong wind and tsunami. Therefore, the development of a system for quick and accurate dissemination of disaster prevention information is urgently required.

If this project is implemented, the coverage of the broadcasting service in remote islands is expected to increase from 83.23% of the population to 91.32%. It will also become possible to provide meteorological information regularly from MMS through PSM and also to broadcast emergency warnings. Maritime accidents occur frequently near remote atolls in the northern Maldives. If one-seg broadcasting is made available, it will be possible to obtain meteorological information from MMS on boats at sea. For these reasons, the extension of the coverage of the emergency broadcasting and the information dissemination utilising the value-adding service of DTTB are required.

(3) Contribution to the Achievement of Medium- to Long-term Development Goals of the Recipient Country

Infrastructure development for the correction of the regional disparities is a priority issue of the national development plan of the Maldives. The government aims at providing public broadcasting service to all households in the country for the improvement of the governance. If this project is implemented, a DTTB network of the platform will be established. This network will not only extend the coverage of PSM but also enable broadcasting of programmes of other private broadcasters and provision of value-added services. The extension of the coverage and provision of these new services are expected to improve the access to information in remote atolls and correct the regional disparity in the access to information. Therefore, this project is consistent with the development plan of the Maldives.

Many households in remote atolls pay monthly viewer fees to watch TV programmes on CATV, at present. The multiplex broadcasting service of DTTB will enable the people in remote atolls to watch terrestrial broadcasting programmes in good quality free of charge and offer them larger choice of programmes. The establishment of the DTTB network will also enable provision of value-added services such as the one-seg broadcasting and data broadcasting. With these services, people will be able to watch TV while they are travelling on boats and obtain local information valuable to them. For these reasons, this project is consistent with the needs of the TV viewers in the Maldives.

(4) Assistance Policy and Strategy of Japan

The Country Assistance Policy for the Maldives of the Government of Japan states the basic infrastructure development and the improvement of basic social services on remote islands for the correction of the regional disparity, food assistance and ‘Cool Earth Partnership’ as priority areas of its assistance to the Maldives. This project is considered consistent with some of the priority areas because it aims at making it possible for the people in remote atolls to watch TV programmes of PSM and private broadcasters on terrestrial broadcast by establishing information communication infrastructure.

4-4-2 Effectiveness

The output of this project is the establishment of a DTTB network by DBNO. This output can be verified with clearly defined indicators, *i.e.* the number of people in the coverage area, the number of programmes available in each Atoll and the record of live broadcast from MMS for the prompt dissemination of weather information. The Government of the Maldives considers PSM as an important medium to provide cultural, educational and entertainment programmes to the people. Once a DTTB network has been established, the people in remote atolls will be able to watch a variety of TV programmes produced by domestic media including PSM and private broadcasters on the terrestrial broadcast free of charge. As a consequence, the implementation of this project will contribute to the improvement of people's access to information and the correction of the regional disparity by ensuring equitable access to information to all the people. Therefore, the project is considered highly effective.

However, many people in the remote atolls watch CATV programmes because of the poor reception of the analogue TV broadcasting signals. The promotion of the viewing of DTTB programmes will require production of attractive programmes, provision of new services including the data broadcasting, a public awareness-creation campaign to viewers and assistance to the purchase and installation of DTTB receivers, in addition to the advantage of the free viewing.

4-4-3 Expected Outputs

The outputs mentioned below are expected from the implementation of this project.

- DTTB network is developed by DBNO.

With these outputs, one of the project purposes, 'To improve access to information of the national', will be achieved and people on remote islands will be able to watch various programmes and receive weather information and emergency disaster information through the broadcast.

4-4-4 Quantitative Effect

The table below shows the indicators of the quantitative effects expected from the implementation of this project and their current (reference) figure and target figures (figures after the implementation).

Table 4-4-2 Quantitative Effects Expected from the Implementation of this Project

Indicator	Reference figure (2016)	Target figure (2021)
1. Terrestrial broadcasting coverage	83.23%	91.23%
2. Number of terrestrial broadcast channels available in regional atolls	1	8

4-4-5 Qualitative Effect

The implementation of the project is expected to have the qualitative effects mentioned in the table below.

Table 4-4-3 Qualitative Effects Expected from the Implementation of this Project

Current state and issues	Measures to be taken in the cooperation project	Direct effects and the extent of improvement	Qualitative effects
• The coverage of the analogue broadcasting service of PSM is 83.23%. The target of the national development plan of provision of broadcasting service to all the households has not been achieved.	• Establishment of a DTTB network to extend the coverage of the terrestrial broadcasting	• Approx. 8% of improvement in the coverage to 92.32% is expected from the establishment of the DTTB network.	• An environment for the correction of the regional disparity in access to information is established.
• There is regional disparity in the access to information because the analogue TV broadcast of PSM is the only free TV available in remote islands and the people in these islands do not have choices of programmes unless they subscribe to CATV.	• Programme multiplexing at DBNO to broadcast programmes of both PSM and private broadcasters • Use of the data broadcasting service to disseminate regional information	• The programme multiplexing by using the platform enables the people in remote islands to watch eight programmes free of charge. • A data programme can be produced using the regional information and such a programme can be transmitted to the region concerned.	• The provision of choices of a variety of TV programmes to the viewer is expected to improve level of their understanding of culture and education. • People can obtain regional information they need from the data broadcasting service and the availability of such information as weather information is improved.
• There is no established means to disseminate essential information such as disaster information quickly to the people.	• Introduction of the emergency warning broadcasting service (EWBS), data broadcasting and one-seg broadcasting	• Value-added services such as EWBS, data broadcasting and one-seg broadcasting are made available.	• EWBS enables quick information dissemination at the time of disaster. • The one-seg broadcasting service improves the availability of disaster information for the people on the move on a boat, etc.

Appendices

Appendices 1 Member List of the Study Team

Appendix 1 Names of the Survey Team members

Name	Assignment	Organization
JICA		
Mr. Jotaro TATEYAMA	Leader	Director Transportation and ICT Group Infrastructure and Peacebuilding Department JICA
Consultant		
Mr. Naoaki NAMBU	Chief Consultant Broadcasting Business Plan	Yachiyo Engineering Co., Ltd.
Mr. Katsuya TERABAYASHI	Deputy Chief Consultant Broadcasting Network Design	Yachiyo Engineering Co., Ltd.
Mr. Yasuo TAKAHASHI	Platform Business Plan	Yachiyo Engineering Co., Ltd. (Private)
Mr. Fukuyoshi YAMAMOTO	Transmitting and Relay Station Equipment Design	GHL wave, inc.
Mr. Osamu NITTA	Transmitting Station Facility 1 (Transmitting Antenna)	Yachiyo Engineering Co., Ltd. (Private)
Mr. Katsuhisa OGAWA	Transmitting Station Facility 2 (Tower and Station)	Yachiyo Engineering Co., Ltd. (Private)
Mr. Yoshitaka IKEDA	Equipment Procurement Plan	Yachiyo Engineering Co., Ltd.
Mr. Hisashi OOURA	Environmental and Social Consideration	Yachiyo Engineering Co., Ltd.
Mr. Satoshi HAMANAKA	Radio wave Propagation Simulation	Yachiyo Engineering Co., Ltd. (Japan Digital Broadcasting Engineering Systems Co. Ltd.)
Mr. Keiya FUJIWARA	Studio Equipment Plan (NOC equipment)	Yachiyo Engineering Co., Ltd.
Ms. Keiko UCHIUMI	Financial Analysis	Yachiyo Engineering Co., Ltd.

Appendices 2　Study Schedule

Appendix 2 Survey Schedule

First survey (2015/10/4 ~ 2015/11/7)

No.	Date		JICA survey members	Consultant team											Place of Stay
			Leader Mr. Jotaro Tateyama	Chief Consultant/ Broadcasting Business Plan Mr. Naoaki Nambu	Platform Business Plan Mr. Yasuo Takahashi	Deputy Chief Consultant/ Broadcasting Network Design Mr. Katsuya Terabayashi	Transmitting and Relay Station Equipment Design Mr. Hukuyoshi Yamamoto	Transmitting Station Facility ① (Transmitting Antenna) Mr. Osamu Nitta	Transmitting Station Facility ② (Tower and Station) Mr. Takehisa Ogawa	Equipment Procurement Plan Mr. Yoshitaka Ikeda	Environment and Social Consideration Mr. Hisashi Ooura	Radiowave Propagation Simulation Mr. Satoshi Hamanaka	Studio Equipment Plan (NOC Equipment) Mr. Keiya Fujiwara	Financial Analysis Mr. Keiko Uchiumi	
				35 days	28 days	35 days	27 days	28 days	28 days	35 days	28 days	28 days	17 days	17 days	
1	2015/10/4	Sun	･Trip [Tokyo →Colombo (5/00:05),SQ468]	･Trip [Tokyo (11:10) → Colombo (17:00), UL455]		･Trip [Tokyo (11:10) → Colombo (17:00), UL455]				･Trip [Tokyo (11:10) → Colombo (17:00), UL455]					Colombo
2	2015/10/5	Mon	･Meeting with JICA Sri Lanka office ･Courtesy call to the embassy of Japan in Sri Lanka ･Trip [Colombo (18:50) → Male (19:45), UL103]	･Meeting with JICA Sri Lanka office ･Courtesy call to the embassy of Japan in Sri Lanka ･Trip [Colombo (18:50) → Male (19:45), UL103]		･Meeting with JICA Sri Lanka office ･Courtesy call to the embassy of Japan in Sri Lanka ･Trip [Colombo (18:50) → Male (19:45), UL103]				･Meeting with JICA Sri Lanka office ･Courtesy call to the embassy of Japan in Sri Lanka ･Trip [Colombo (18:50) → Male (19:45), UL103]					Male
3	2015/10/6	Tue	･Meeting with JICA Maldives office ･Ministry of Home Affairs (MOH), Communication Authority of Maldives (CAM), Public Service Media (PSM) joint meeting (Inception)	･Meeting with JICA Maldives office ･Ministry of Home Affairs (MOH), Communication Authority of Maldives (CAM), Public Service Media (PSM) joint meeting (Inception) ･Meeting with consultants for topographical and Soil investigation survey ･Meeting with agencies for Site survey		･Meeting with JICA Maldives office ･Ministry of Home Affairs, Communication Authority of Maldives, Public Service Media joint meeting (Inception) ･Meeting with topographical and Soil investigation survey consultant ･Meeting with Site survey agency				･Meeting with JICA Maldives office ･Ministry of Home Affairs, Communication Authority of Maldives, Public Service Media joint meeting (Inception) ･Meeting with topographical and Soil investigation survey consultant ･Meeting with Site survey agency					Male
4	2015/10/7	Wed	･Meeting with MOH, CAM and PSM for MD	･Meeting with MOH, CAM and PSM for MD ･Meeting with CAM and PSM for Site survey ･Meeting with Maldives Broadcasting Commission (Inception)		･Meeting with MOH, CAM and PSM for MD ･Meeting with CAM and PSM for Site survey ･Meeting with Maldives Broadcasting Commission (Inception) ･Meeting with consultant for topographical and Soil investigation survey ･Meeting with agency for Site survey				･Meeting with MOH, CAM and PSM for MD ･Meeting with CAM and PSM for Site survey ･Meeting with Maldives Broadcasting Commission (Inception) ･Meeting with consultant for topographical and Soil investigation survey ･Meeting with agency for Site survey					Male
5	2015/10/8	Thu	･Meeting with MOH, CAM and PSM for MD approval ･Trip[Male(23:25, SQ451)—]	･Meeting with MOH, CAM and PSM for MD approval ･Meeting for recommissioning surveys		･Meeting with MOH, CAM and PSM for MD approval ･Meeting for recommissioning surveys				･Meeting with MOH, CAM and PSM for MD approval ･Meeting for recommissioning surveys					Male
6	2015/10/9	Fri	･Report to JICA Sri Lnaka Office	･Document arrangement		･Document arrangement				･Document arrangement					Male
7	2015/10/10	Sat		･Document arrangement		･Document arrangement				･Document arrangement					Male
8	2015/10/11	Sun		･Meeting with MOH and CAM for DBNO ･Meeting with CAM for (Frequency assignment, Tower strength, Channel plan, relevant laws and regulations)	･Trip [Tokyo (11:10, SQ637)—Singapore (17:20/20:45, SQ452)—Male (22:10)]	･Meeting with MOH and CAM for DBNO ･Meeting with CAM for (Frequency assignment, Tower strength, Channel plan, relevant laws and regulations)		･Trip [Tokyo (11:10, SQ637)—Singapore (17:20/20:45, SQ452)—Male (22:10)]		･Meeting with MOH and CAM for DBNO ･Meeting with CAM for (Frequency assignment, Tower strength, Channel plan, relevant laws and regulations)	･Trip [Tokyo (11:10, SQ637)—Singapore (17:20/20:45, SQ452)—Male (22:10)]				Male
9	2015/10/12	Mon		･Visit for site survey in PSM ･Meeting with Ministry of Environment Energy (MOEE,Inception) ･Visit for site survey to tower in Viligili island			･Trip[Tokyo (11:10, SQ637)—Singapore (17:20/20:45, SQ452)—Male (22:10)]	･Visit for site survey in PSM ･Meeting with Ministry of Environment Energy (MOEE,Inception) ･Visit for site survey to tower in Viligili island			･Visit for survey in PSM ･Survey for relevant laws and regulations for environment and social consideration ･Meeting with Ministry of Environment Energy (MOEE,Inception)	･Visit for site survey in PSM ･Meeting with Ministry of Environment Energy (MOEE,Inception) ･Visit for site survey to tower in Viligili island		･Visit for site survey in PSM ･Collection of general information ･Visit for site survey to tower in Viligili island	Male
10	2015/10/13	Tue		･Meeting with private broadcasting stations ･Meeting with Meteorological Service		･Meeting with private broadcasting stations ･Design for digital broadcasting network			･Meeting with private broadcasting stations ･design for contraction plan	･Survey for procurement of materials ･Survey for tariff and relevant information for import	･Visit for site survey to tower in Viligili island ･Study for environment and social consideration	･Visit for site survey to tower in Viligili island ･Meeting with private broadcasting stations ･Radiowave propagation simulation for coverage	･Meeting with private broadcasting stations ･Study for NOC equipment ･Meeting with Meteorological Service	･Meeting with private broadcasting stations ･Study for financial status for DBNO	Male
11	2015/10/14	Wed		･Internal Meeting	･Internal Meeting ･Study for Channel plan				･Internal Meeting			･Internal Meeting ･Study for Channel plan	･Internal Meeting	･Internal Meeting	Male
12	2015/10/15	Thr		･Team3 departure from Male 1. Villingili 2. Gadhdhoo	･Team1departure from Male 1. Eydhafushi	･Team1departure from Male 1. Eydhafushi	･Team3 departure from Male 1. Villingili 2. Gadhdhoo	･Team2 departure from Male 1. Guraidhoo	･Team1departure from Male 1. Eydhafushi	･Team2 departure from Male 1. Guraidhoo	･Team2 departure from Male 1. Guraidhoo	･Team3 departure from Male 1. Villingili 2. Gadhdhoo	･Meeting with PSM ･Study for NOC	･Meeting with PSM ･Study for financial status for DBNO	Male and sites
13	2015/10/16	Fri		3. Fiyoare 4. Thinadhoo	2. Naifaru 3. Ungoofaaru	2. Naifaru 3. Ungoofaaru	3. Fiyoare 4. Thinadhoo	2. Gan	2. Naifaru 3. Ungoofaaru	2. Gan	2. Gan	3. Fiyoare 4. Thinadhoo	資料解析		Male and sites
14	2015/10/17	Sat		5. Hithadhoo Arrive in Male	4. Manadhoo 5. Funadhoo	4. Manadhoo 5. Funadhoo	5. Hithadhoo Arrive in Male	3. Maafushi 4. Felidhoo Arrive in Male	4. Manadhoo 5. Funadhoo	3. Maafushi 4. Felidhoo Arrive in Male	3. Maafushi 4. Felidhoo Arrive in Male	5. Hithadhoo Arrive in Male	資料解析		Male and sites
15	2015/10/18	Sun		Arrive in Male	6. Kulhudhufushi 7. Dhidhdhoo	6. Kulhudhufushi 7. Dhidhdhoo	Departure from Male	Departure from Male 5. Dhangethi 6. Feeali Arrive in Male	6. Kulhudhufushi 7. Dhidhdhoo	Departure from Male 5. Dhangethi 6. Feeali Arrive in Male	Departure from Male 5. Dhangethi 6. Feeali Arrive in Male	Departure from Male	･Meeting with PSM ･Study for NOC	･Meeting with PSM ･Study for financial status for DBNO	Male and sites
16	2015/10/19	Mon		･Study for the results of site survey	Arrive in Male	Arrive in Male ･Join the team 1 Foammulah	6. Foammulah	Departure from Male 7. Nilandhoo Arrive in Male	Arrive in Male ･Join the team 1 Foammulah	Departure from Male 7. Nilandhoo Arrive in Male	Departure from Male 7. Nilandhoo Arrive in Male	6. Foammulah	･Market survey ･Social survey		Male and sites
17	2015/10/20	Tue		･Study for the results of site survey ･Internal meeting ･Tender for topographical and Soil investigation survey		Arrive in Male ･Study for the results of site survey ･Internal meeting	Arrive in Male ･Study for the results of site survey ･Internal meeting	･Study for the results of site survey ･Internal meeting ･Visit for site survey to tower in Viligili island		･Study for the results of site survey ･Internal meeting ･Tender for	･Study for the results of site survey ･Internal meeting ･Visit for site survey to	Arrive in Male ･Study for the results of site survey ･Internal meeting	･Market survey ･Social survey ･Tender for topographical and Soil investigation survey		Male
18	2015/10/21	Wed		･Study for the results of site survey ･Internal meeting ･Meeting with private broadcasting station（DhiTV,VTV）			･Study for the results of site survey ･Internal meeting						･Study for the results of site survey ･Internal meeting ･Meeting with private	･Study for the results of site survey ･Internal meeting	Male
19	2015/10/22	Thr		･Internal meeting ･Meeting with MOH, CAM, PSM(Channel plan/Project scope)		･Internal meeting ･Visit for MMS	･Internal meeting ･Meeting with MOH, CAM, PSM(Channel plan/Project scope)		･Internal meeting ･Visit for MMS	･Internal meeting ･Meeting with MOH, CAM, PSM(Channel plan/Project scope)			･Internal meeting ･Visit for MMS	･Internal meeting ･Meeting with MOH, CAM, PSM(Channel plan/Project scope)	Male
20	2015/10/23	Fri		･Document analysis											Male
21	2015/10/24	Sat		･Document analysis											Male
22	2015/10/25	Sun		･Meeting with private broadcasting station（Sun TV） ･Prepare for field report	･Study for Channel plan	･Design for digital broadcasting network	･Design for digital broadcasting network and prepare for proposed component for equipment	･Study for Channel plan ･Study for antenna pattern	･Verification for topographic and soil investigation survey ･Study for towers and stations			･Study for channel plan	･Study for NOC equipment plan	･Meeting with private broadcasting station（Sun TV） ･Prepare report of financial analysis	Male
23	2015/10/26	Mon		･Prepare for field report	･Study for Channel plan	･Design for digital broadcasting network ･Prepare plans		･Study for channel plan	･Verification for topographic and soil investigation survey	･Verification for topographic and soil investigation survey ･Study for component of equipment	･Study for environment and social consideration	･Design for digital broadcasting network ･Prepare plans	･Trip[Male (12:50, SQ461)—Singapore(20:35/→]		Male
24	2015/10/27	Tue		･Prepare for field report	･Study for channel plan	･Design for digital broadcasting network		･Study for channel plan	･Design for digital broadcasting network	･Design for digital broadcasting network ･Study for component of equipment	･Study for environment and social consideration	･Design digital broadcasting network	･Trip→[00:48, SQ5926)—Tokyo [08:51]		Male
25	2015/10/28	Wed		･Prepare for field report	･Study for channel plan	･Study for procurement and transportation procedures for equipment					･Study for environment and social consideration	･Study for procurement and transportation procedures for equipment			Male
26	2015/10/29	Thr		･Prepare for field report											Male
27	2015/10/30	Fri		･Internal meeting ･Document analysis											Male
28	2015/10/31	Sat		･Internal meeting ･Document analysis											Male
29	2015/11/1	Sun		･Prepare for field report	･Prepare for field report ･Study for design conditions ･Prepare plans				･Prepare for field report ･Examination of topographic and soil investigation works		･Prepare for field report ･Examination of environment and social consideration	･Meeting with MOH ･Prepare field report ･Study for design conditions			Male
30	2015/11/2	Mon		･Meeting with CAM and PSM ･Prepare field report	･Meeting with CAM and PSM ･Prepare field report ･Study for design conditions ･Prepare plans				･Meeting with CAM and PSM ･Prepare field report ･Examination of topographic and soil investigation works		･Prepare field report ･Examination of environment and social consideration	･Meeting with CAM and PSM ･Prepare field report ･Study for design conditions			Male
31	2015/11/3	Tue		･Meeting with private broadcasting stations ･Prepare field report	･Meeting with private broadcasting stations ･Prepare field report ･Study for design conditions ･Prepare plans				･Meeting with private broadcasting stations ･Prepare field report		･Prepare field report ･Examination of environment and social consideration	･Meeting with private broadcasting stations ･Prepare field report ･Study for design conditions			Male
32	2015/11/4	Wed		･Meeting with private broadcasting stations ･Approve field report ･Prepare report	･Meeting with CAM and PSM ･Approve field report ･Prepare report ･Study for design conditions ･Prepare plans				･Meeting with CAM and PSM ･Approve field report ･Prepare report		･Prepare report ･Examination of environment and social consideration	･Meeting with CAM and PSM ･Approve field report ･Prepare report ･Study for design conditions			Male
33	2015/11/5	Thr		･Report to JICA Maldives office ･Trip[Male(15,35, UL116)—Colombo(17:30)]	･Report to JICA Maldives office ･Prepare report	･Report to JICA Maldives office ･Trip [Male(15,35, UL116)—Colombo(17:30)]		･Report to JICA Maldives office ･Prepare report		･Report to JICA Maldives office ･Trip[Male(15,35, UL116)—Colombo(17:30)]	･Report to JICA Maldives office ･Prepare report				Colombo and Make
34	2015/11/6	Fri		･Report to JICA Sri Lanka office ･Report to the embassy of Japan in Sri lanka ･Trip[Colombo(19:15, UL454)—Tokyo(7/07:35)]	･Trip[Male(12:50, SQ461)—Singapore(20:35/→]	･Report to JICA Sri Lanka office ･Report to the embassy of Japan in Sri lanka ･Trip[Colombo(19:15, UL454)—Tokyo(7/07:35)]		･Trip[Male(12:50, SQ461)—Singapore(20:35/→]		･Report to JICA Sri Lanka office ･Report to the embassy of Japan in Sri lanka ･Trip[Colombo(19:15, UL454)—Tokyo(7/07:35)]	･Trip[Male(12:50, SQ461)—Singapore(20:35/→]				Over night flight
35	2015/11/7	Sat		･Trip[Colombo(6/19:15, UL454)—Tokyo(7/07:35)]	･Trip→[00:48, SQ5926)—[Tokyo08:51]	･Trip[Colombo(6/19:15, UL454)—Tokyo(7/07:35)]		･Trip→[00:48, SQ5926)—[Tokyo08:51]		･Trip[Colombo(6/19:15, UL454)—Tokyo(7/07:35)]	･Trip→[00:48, SQ5926)—[Tokyo08:51]				

Second survey (2016/2/29 ~ 2016/3/1)

No.	Date		Consultant			Place of Stay
			Chief Consultant/ Broadcasting business plan Mr. Naoaki Nambu	Equipment Procurement Plan Mr. Yoshitaka Ikeda	Radiowave Propagation Simulation Mr. Satoshi Hamanaka	
			16 days	16 days	16 days	
1	2016/2/29	Mon	・Trip[Tokyo(11:05, SQ637)—Singapore(17:45/20:35, SQ452)—Male(22:10)]			Male
2	2016/3/1	Tue	・Meeting with CAM and PSM ・Meeting with ELS & AMIN International Pvt. Ltd			Male
3	2016/3/2	Wed	・Villingili survey ・Meeting with CAM and PSM			Male
4	2016/3/3	Thu	・Meeting with Energy Consultancy Pvt. Ltd ・Departure from Male ・Hithadhoo survey			Site
5	2016/3/4	Fri	Arrive in Male			Male
6	2016/3/5	Sat	・Departure from Male ・Guraidhoo survey			Site
7	2016/3/6	Sun	・Gan survey ・Arrive in Male			Male
8	2016/3/7	Mon	・Meeting with CAM and PSM			Male
9	2016/3/8	Tue	・Meeting with CAM and PSM			Male
10	2016/3/9	Wed	・Meeting with CAM and PSM ・Preparation for DTTB seminar			Male
11	2016/3/10	Thu	・Meeting with CAM and PSM ・Preparation for DTTB seminar			Male
12	2016/3/11	Fri	Internal Meeting			Male
13	2016/3/12	Sat	Internal Meeting			Male
14	2016/3/13	Sun	DTTB seminar			Male
15	2016/3/14	Mon	・Trip[Male(12:55, SQ5481)—Singapore(20:45)]			Over night flight
16	2016/3/15	Tue	・Trip→[23:55, SQ638)—[Tokyo07:30]			

Third survey (2016/6/9 ~ 2016/6/18)

No.	Date		JICA Survey members	Consultant			Place of Stay
			Leader	① Chief Consultant/ Broadcasting business plan Mr. Naoaki Nambu	③ Deputy Chief Consultant/ Broadcasting Network Design Mr. Katsuya Terabayashi	④ Transmitting and Relay Station Equipment Design Mr. Akira Saito	
				10 days	10days	10days	
1	2016/3/17	Thr	・Trip [Tokyo (11:10) →Colombo (17:00), UL455]				Colombo
2	2016/3/18	Fri	・Meeting with JICA Colombo office ・Courtesy call to the embassy of Japan in Sri lanka ・Trip [Colombo (18:50) →Male (19:45), UL103]				Male
3	2016/3/19	Sat	・Preparation for M/D disucssion ・Site visit for NOC				Male
4	2016/3/20	Sun	・Meeting with JICA Maldives office ・Meeting with MOH, CAM for DF/R ・Meeting with PSM or DF/R				Male
5	2016/3/21	Mon	・Meeting with MOH, CAM and PSM or M/D				Male
6	2016/3/22	Tue	・Meeting with MOH, CAM and PSM or M/D				Male
7	2016/3/23	Wed	・Meeting with MOH, CAM and PSM or M/D				Male
8	2016/3/24	Thr	・Meeting with MOH, CAM and PSM or M/D approval ・Report to JICA Maldive office ・Trip [Male (17:00)→Colombo (19:45)、UL103]				Colombo
9	2016/3/25	Fri	・Report to the embassy of Japan in Sri lanka ・Report to JICA Colombo office ・Trip[Colombo(19:15, UL454) →				Over night flight
10	2016/3/26	Sat	・→Tokyo (07:35)]				

Appendices 3 List of Parties Concerned in the Recipient Country

Appendix 3 List of Interviewees

Name	Designation
Embassy of Japan in Maldives	
Kenichi Suganuma	Ambassador Extraordinary
Asako Okai	Minister
Yasuaki Ito	Second Secretary
JICA Sri Lanka Office	
Hiroshi Hidaka	Senior Representative
Toshiyuki Shimano	Representative
JICA Maldives Office	
Hiroshi Saito	Chief Representative
CAM: Communication Authority Development	
Ilas Ahmed	Chief Executive
Abdullah Shiham	Deputy Director General
PSM: Public Service Media	
Hussain Shuhad	Director – Infrastructure Planning & Development
Ibrahim Khaleel	Managing Director
Hassan Amir	Managing Engineer
Ministry of Foreign Affairs	
Aishath Azeema	Joint Secretary
Mohamed Shaffau Iblahim	Senior Desk Officer
Ministry of Home Affairs	
Ahmed Adeem	Deputy Minister
Maldives Broadcasting Commission	
Mohamed Shahyb	President
Ibrahim Ashraf	Commissioner
Noora Ali	Secretary General
Ahmed Arshad Ali	International Relations Officer
MMS: Maldives Meteorological Service	
Ali Shareef	Deputy Director General Meteorology
Abdulla Muaz	Meteorological Engineer
Dhiragu	
Fathmath Shoozee	Assistant Manager Legal & Regulatory
Abdulla Firg	Manager Access Engineering
Oredoo	
Hussain Haleem	Senior Engineer Power System
Mohamed Ibrahim	Manager Radio Network
DhiTV	
Midhath Adam	Chief Executive Officer
VTV	
Ahmed Irshan	Chief Technical Officer
Mohamed Zaheen	Director General(Technical Operation)
Mohamed Asif	Chief Operating Officer V- Media
Ahmed Umar	Director General
Raajje TV	
Ahmed Saleem	Managing Director
Ismail Jinah	Chief Technical Officer
Ibrahim Waheed	Deputy Chief Executive Officer
Sun TV	
Sinaan Ali	Chief Executive Officer
Sungu TV	
Abdulla Yamin Rasheed	Chairman
Ibrahim Waheed	Managing Director
Channel 13	

Name	Designation
Mohamad Saizan	COO
Mohamed Niyaz	Station Manager
MBC	
Mohamed Shahyb	President
Mohamed Aslam	Vice President
Hassan Nabaah	Commissioner
Mohamed Nasih	Secretary General

Appendices 4　Field Report

PREPARATORY SURVEY (FOR OUTLINE DESIGN)
ON
THE PROJECT
FOR
THE DIGITAL TERRESTRIAL TELEVISION BROADCASTING NETWORK DEVELOPMENT PROJECT
IN
THE REPUBLIC OF MALDIVES

FIELD REPORT

4th November, 2015

Prepared and Submitted by:

Naoaki Nambu
Chief Consultant
JICA Study Team
(Yachiyo Engineering Co., Ltd.)

Acknowledged by:

Mr. Ibrahim Khaleel
Managing Director
Public Service Media (PSM)

Mr. Iliyas Ahmed
Chief Exective
Communications Authority of Maldives (CAM)

JICA STUDY TEAM
(Yachiyo Engineering Co., Ltd.)

Table of Contents

1. Introduction

This Field Report is to establish mutual understandings between JICA Study Team (hereinafter referred to as "the Team") for the Project for the Digital Terrestrial Television Broadcasting Network Development(hereinafter referred to as "the Project") and the Maldives such as Public Service Media (hereinafter referred to as "PSM) and Communications Authority of Maldives (hereinafter referred to as "CAM") and relevant organizations of the Government of Maldives on the policies, finance and technical aspects for the Project. This has been also prepared by the Team based on the results of the 1st field survey and discussions with the Maldives side.

It is also noted that all the information as described in this report will be decided after further studies in Japan and consultations with JICA and relevant organizations of the Government of Japan. JICA will submit the draft final report, which describes the final component of the Project, to the Maldives side in July 2016 as stated in the Minutes of Discussions (M/D) signed by both parties on 8th October 2015.

2. Item agreed and confirmed with PSM during the 1st Field Survey

2-1 Policies

(1) Coverage

The service coverage of Digital Terrestrial Television Broadcasting (hereinafter referred to as "DTTB") platform developed by the Project will be entire population in the country not only inhabitant islands but also industry and resort islands. It was discussed with CAM and PSM that the first priority is given to development the service coverage to spread through as much as a wide area in considering the scope of the Grant Aid project. Proposed channel plan is confirmed, thus the Team uses the channel plan for the outline design and estimation of the budget of the Grant Aid project.

(2) ASO and DSO

It was discussed that Analogue switch off (hereinafter referred to as "ASO") is remained to take place in 2020 according to the national digital roadmap. Simultaneous broadcasting services will be conducted ASO criteria will be determined with appropriate indicators such as population coverage and receivers' penetration. Also, the areas which are able to receive current analogue should be considered.

The Maldives side expected that DSO take place from the digital transmitting stations that have completed the installation of the digital transmitter.

(3) Implementation Schedule

The Maldives side desired that the Grant Aid project completes by the end of 2017 and would like ASO to take place in 2020.

Two schedules are prepared. One is based on the request from the Maldives side as it completes by the end of 2017 and the other is prepared by the Team. Those schedules are shown in Chapter 8, "Implementation Schedule of the Project (Tentative). Further studies and discussions are required to finalize the schedule to examine feasibility as well as to incorporate the request by the Maldives side.

(4) Eligible broadcaster on DTTB

Method of selection of applications to DTTB should be determined by Maldives side such as proposal evaluation, auction and priority to the current broadcasters.

(5) Multiplex service

It was agreed that 2 HDs and 2 SDs and 1 data broadcasting and one-seg services are multiplexed into one frequency, and DBNO starts digital broadcasting with two frequencies. Also, the policy that is 3 HDs multiplexing with one data broadcasting and one-seg services are secured in the outline designed for future. The Team incorporates such the policy for outline designs if necessary.

(6) Analogue Frequency Termination

Encouragement to the broadcasters to release the frequencies in operations currently in order to migrate smoothly will be managed by MBC and CAM.

(7) Frequency allocation

20 frequencies (4 frequencies 1 set, 5 sets are needed in 26 sits) are required for operation of DBNO, Maldives side reserve CH 21 to CH 40. Also 3 frequencies in 5 GHz band with 30 MHz band width are assigned for microwave links in case the Project takes land line link between network operation centre of DBNO and transmitting stations for programme transmission. Those frequency fees of microwaves will be considered free of charges to DBNO by Maldives side.

2-2 Regulations

The following amendments to the broadcasting regulations realized Maldives side and it was discussed that those amendments would be preconditions to the formulation of the Grant Aid project. CAM and PSM will further corroborate with the Maldives Broadcasting Commission (hereinafter referred to as "MBC") and the Team will confirm them by the Draft Final Report which is scheduled in the next March, 2016 tentatively.

(1) Definition of DBNO and its scope of work

The current broadcasting regulation says none of the broadcaster are registered as re-broadcaster, however DBNO is obviously re-broadcaster. Thus, definition of DBNO is necessary. Also as scope of the works of DBNO, aggregation of contents, multiplexing of contents, transmission of contents, EPG operation, EWBS operation so on should be indicated. Eligible multiplexing operator of terrestrial should be considered.

(2) Consideration of License to Broadcaster

There are two classifications such as broadcaster and re-broadcaster under Broadcasting Act in Maldives. DBNO might be identified as a new type of re-broadcaster, however broadcasters who are registered as the Broadcaster under the Act are needed to be defined either contents provider or new type of broadcaster.

(3) Frequency License Fee Reform

Regional based license fee will be considered to secure efficient frequency assignments to reform from the current system such as national license.

(4) Suspension of frequency license for DVB-T/DVB-T2 standard

JICA Study team requested that the frequencies given to those broadcasting stations operating DVB-T/DVB-T2 standards be used for DBNO transmitters in order to secure enough frequencies for DBNO as well as to prevent viewers from being confused.

2-3 Techniques

(1) Technical Standards

The draft technical standards supported Japanese side for its preparation should be finalized in accordance with certain timeline and Maldives side make an announcement through the nominal protocol within the government.

(2) Backup power at sites

The Maldives side requested to install the backup generators at transmitters' sites in consideration with local energy situation. However, through the analysis with local information provided by PSM, UPS which has capacity up to 2 hours works on the situation. Thus, the Team considers providing UPSs with appropriate specifications.

(3) ISDB-T test transmitter installed in PSM

The test ISDB-T transmitter installed in PSM is agreed to be used as spear transmitter for DBNO

(4) DVB-T transmitters from private broadcasting stations

Three private broadcasting stations, VTV, DhiTV and Atoll TV, are currently broadcasting with DVB-T/DVB-T2 digital transmitters. Two of them are agreed to join DBNO for their digital broadcasting services. Their digital transmitters, PA parts, are used as spear parts of DBNO broadcasting network. The rest of the broadcaster will be confirmed by Maldives side by the end of 2015 and Maldives side will report to the Team.

(5) Interface of private broadcasting stations with NOC

The signal is received with Transport Stream (hereinafter referred to as "TS") format at NOC from each private broadcasting station. For that, equipment such as encoders and multiplexers are required to be installed in the private broadcasting stations. It is examined whether those sets of equipment are included into the scope of the Japanese Grant project with taking the financial capacity of private broadcasting stations into account. PSM will confirm types of interface between the private broadcasting stations who will join the platform by the end of 2015.

(6) Backup power for NOC

It was discussed with PSM that backup power in a form of UPS or generator for NOC will be provided by PSM.

(7) Conceptual diagram of the system design

The conceptual diagram of the system design for DTTB Network and NOC is as par Annex 1. The diagram will be modified based on the estimation of the budget of the Grant Aid.

3. Result of Site Survey

The site survey has been conducted between 15th and 20th October. In total 21 sites are visited by three teams to investigate the technical feasibility of constructing digital transmitting stations and environmental and social considerations.

The technical, social and environmental issues are investigated to examine the feasibility of establishing digital transmitting stations. It was found that in the following sites land acquisition is required due to the reasons that there is not enough land in the existing site or the site itself is new. The discussion was held with the islands councils during the sites survey and they were agreed that the proposed new lands are available for the Project. PSM is officially confirming the availabilities of lands with the islands councils, the Ministry of Housing and Infrastructure. The official answer will be reported to the Team by the end of this year.

Also the heights of antennas are under examination with the civil aviation authority whether it might disrupt air routes and approaching routes of the airports and complies with regulations.

Table 3. List of site for land acquisition or extension

No	Name of Site	Purpose of Use	Reasons for the Acquisition
1	Kulhudhufushi	Digital Transmitting Stations	There is not enough area within the premise of existing site for the construction of a new tower.
2	Funadhoo	Digital Transmitting Stations	A new school is under construction next to the existing site and there is not enough area within the existing site.
3	Manadhoo	Digital Transmitting Stations	There is not enough area within the existing site to construct 80m tower. The extension of land is required.
4	Naifaru	Digital Transmitting Stations	There is not enough area within the existing site to construct 80m tower. The extension of land is required.
5	Male (Vilingili)	Digital Transmitting Stations	According to the policy of the government, a new tower is not able to be built in Male and moved to surrounding islands. Therefore a new land is proposed in Vilingili island next to Male.
6	Maafushi	Microwave Relay Stations	PSM does not have a land in this island. However microwave link station is required for transmitting signal to Felidhoo.

No	Name of Site	Purpose of Use	Reasons for the Acquisition
7	Dhangethi	Digital Transmitting Stations	PSM does not have a land in this island. However, the optical fiber network from Male is available. By using the optical fiber network, it is possible to build cost-efficient and reliable broadcasting transmission network.
8	Feeali	Microwave Relay Stations	PSM does not have a land. However, microwave relay station is required because distance between Dhangeti and Nilandhoo is 120km.
9	Gan	Digital Transmitting Stations	PSM does not have a land. However, optical fiber network is available and it is possible to cover Laam atoll from the island.
10	Gadhdhoo	Digital Transmitting Stations	PSM does not have a land. However optical fiber network is available and the island has the base for telecommunication company for Gaau Dhaal and Gaafu Alifu atoll so that it is easy to establish a reliable broadcasting transmission network.
11	Fiyoari	Microwave Relay Stations	Microwave relay station is required to transmit signal from Gadhdhoo to Thinadhoo. In order to construct 60m tower, the extension of land is reqried.
12	Thinadhoo	Digital Transmitting Stations	There is a media center with in the existing site so that there is not enough area to construct a new tower. A new land is required.
13	Viligili	Digital Transmitting Stations	Civil aviation authority requested to move the tower from the existing site because it is in the approach surface of the airport.

4. Scope of Project

The application for Grant Aid for the Project was submitted in 18th February 2015 from the CAM/ Ministry of Home and Affairs with the overall goal is to migrate to digital broadcasting and three project purposes below;

1) To build a national-wide digital terrestrial television broadcasting network and migrate to digital broadcasting

2) To get all broadcasters to share a common transmission network

3) To have as system for early warnings and emergency communication for the better mitigation of disasters

Project purpose has been reviewed as "To improve access to information of the national and resolve regional disparities on information through development of a digital terrestrial television network, thereby contributing to migrating vulnerability an further social and economic development" and Output as "To establish digital terrestrial television broadcasting network" as per M/D

Overall goal and indicators for evaluation of the Project are under examination. Those will be reviewed and presented to the Maldives side to agree on before the submission of the draft final report.

There have been some updates from the initial application. The implementing agency was changed from CAM/ Ministry of Home Affairs to PSM for the decision of DBNO placed in PSM. The application was submitted without the quantity information of facilities and equipment however the number of them were decided during this preparatory survey. Soft components were also included in the application. Technical cooperation project are now under consideration instead of soft components requested initially for the capacity building.

The differences between previous scope and present one are shown in table 4.

Table 4. Proposed Scope of the Project by the Recipient Country

	Initial Application (18th Feb 2015)		Now
Implementing Agency	CAM		PSM
Overall Goal	To migrate to digital broadcasting		Addition of three indicators
Locations	20 islands in the Maldives		21 islands
Items (Quantity)	Facilities	Antenna Tower	90m Antenna Tower (1 set)
			80m Antenna Tower (7 set)
			70m Antenna Tower (5 set)
			60m Antenna Tower (3 set)
			50m Antenna Tower (3 set)

	Initial Application (18th Feb 2015)		Now
			30m Antenna Tower (1 set)
			20m Antenna Tower (1 set)
		Transmitting Houses -Air Conditioner -Power Supply	Transmitting Station Building (18 sets)
			Relay Station Building (2 sets)
			Renovation of relay station building (1 set)
	Equipment	Transmitting system -transmitter -Antenna	200W Transmitting System (6 sets)
			100W Transmitting System (4 sets)
			50W Transmitting System (4 sets)
			20W Transmitting System (2 set)
			10W Transmitting System(2 set)
			Repair of the Transmitting System (2 sets)
		NOC Equipment	NOC Equipment (1 set)
		EWBS Server	EWBS Server (1 set)
		Link System (Microwave)	Link System (Microwave) (1 set)
		Link System (Optical Fiber)	Link System (Optical Fiber) (TBD)
		-	Spare parts (1 lot)
		-	Consumable parts (1 lot)
		-	Installation Materials (1 lot)
	Soft Components	Capacity building for the project including training and development of engineers and technicians	Technical Cooperation Project is now under consideration. The following activities will be considered. -EWBS pilot project operation -Data broadcasting production -Call centre operation in consideration with receivers' penetration

5. Result of the Other Studies

5-1 Frequency Allocation

It was discussed with CAM that total 20 channels between Ch 21 and 40 will be secured for digital terrestrial television broadcasting.

5-2 Channel Plan

Channel Plan was proposed for the 26 digital broadcasting stations to cover the whole population including 18 digital transmitting stations and 3 microwave link stations procured by the Japanese Grant project if the scope was decided as same as assumption and 8 digital broadcasting stations procured by PSM. For the future of the operation, the channel plan was made based on the operation with four frequencies. For the Grant aid project of initial operation of DBNO, only 2 frequencies are used for each digital broadcasting station.

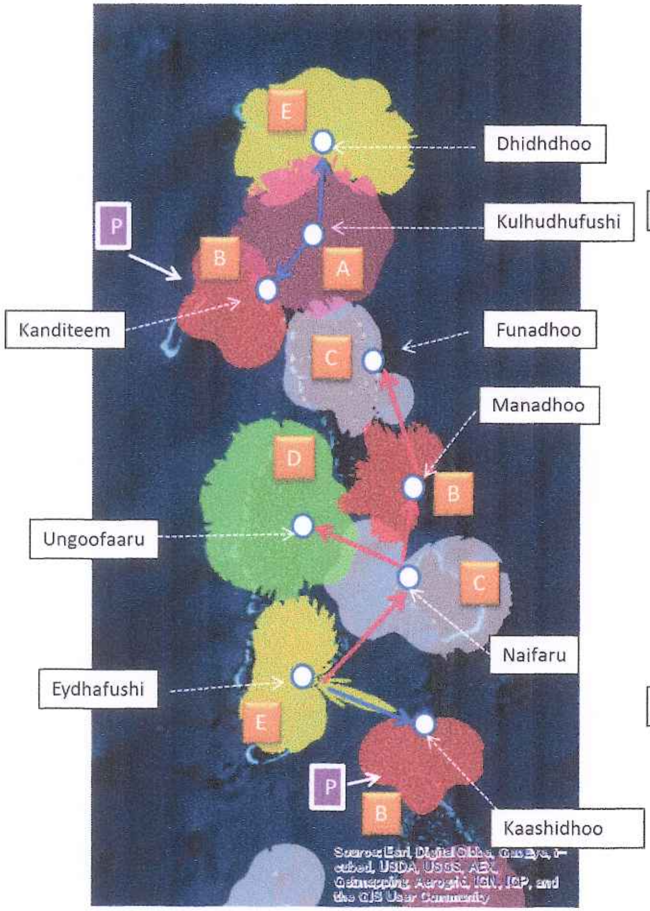
Channel Plan is still under development to be fixed with examining the interference with other stations. It is still subject to change according to the result of interference examination.

Table 5-1 Channel Plan

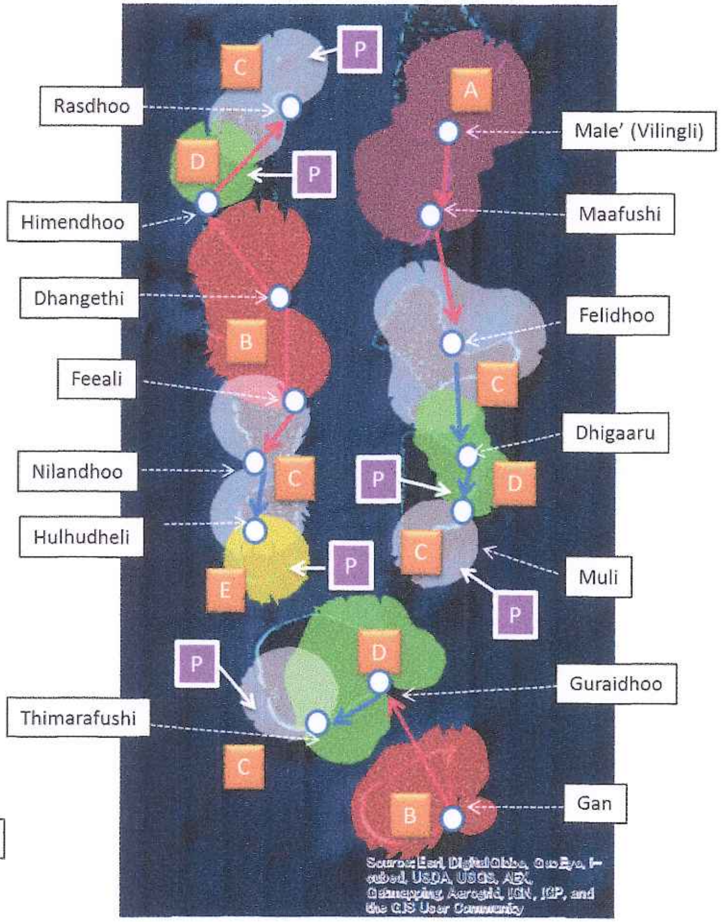
No	Atoll	Islands (Position)	Tower and Antenna				Broadcast Wave	
			Tower Height (m)	Antenna Height (m)	Micro Antenna Height (Upper, m)	Micro Antenna Height (Down, m)	Frequency,Ch (Future use for four BTSs)	TX Power (W)
1	HAA ALIFU	Dhidhdhoo	60	+2	-	-	28,29,(30,31)	200
2	HAA DHHALU	Kulhudhufushi	50	+2	-	-	32,33, (21,22)	100
3		Kanditeem	60	+2	-2	-12	34,35, (23,24)	100
4	SHAVIYANI	Funadhoo	70	+2	-2	-12	36,37, (25,26)	100
5	NOONU	Manadhoo	70	+2	-2	-12	34,35, (23,24)	10
6	RAA	Ungoofaaru	70	+2	-2	-12	38,39, (27,40)	100
7	BAA	Eydhafushi	70	+2	-2	-12	28,29, (30,31)	50
8	LHAVIYANI	Naifaru	80	+2	-2	-12	36,37, (25,26)	200
9	KAAFU	Kaashidhoo	50	+2	-	-	34,35, (23,24)	100
10		Male' (Vilingli)	60	+2	-2	-12	32,33, (21,22)	200
11		Maafushi	90	-	-2	-12	-	R
12	VAAVU	Felidhoo	80	+2	-2	-12	36,37,(25,26)	50

No	Atoll	Islands (Position)	Tower and Antenna				Broadcast Wave	
			Tower Height (m)	Antenna Height (m)	Micro Antenna Height (Upper, m)	Micro Antenna Height (Down, m)	Frequency,Ch (Future use for four BTSs)	TX Power (W)
13	ALIFU ALIFU	Himendhoo	70	+2	-2	-12	38,39,(27,40)	10
14		Rasdhoo	70	+2	-2	-12	36,37,(25,26)	20
15	MEEMU	Dhigaaru	30	+2	-	-	38,39,(27,40)	50
16		Muli	40	+2			36,37,(25,26)	50
17	ALIFU DHAALU	Dhangethi	70	+2	-2	-12	34,35,(23,24)	200
18	FAAFU	Feeali	80	-	-2	-12	-	R
19		Nilandhoo	50	+2	-2	-12	36,37,(25,26)	100
20	DHAALU	Hulhudheli	30	+2	-	-	28,29,(30,31)	50
21	LAAMU	Gan	80	+2	-2	-12	34,35,(23,24)	50
22	THAA	Guraidhoo	80	+2	-2	-12	38,39,(27,40)	50
23		Thimarafushi	50	+2	-	-	36,37,(25,26)	50
24	GAAFU DHAALU	Gadhdhoo	80	+2	-2	-12	32,33,(21,22)	200
25		Fiyoari	60	-	-2	-12	-	R
26		Thinadhoo	50	+2	-2	-12	28,29,(30,31)	200
27	GAAFU ALIFU	Viligili	80	+2	-2	-12	38,39,(27,40)	20
28	GNAVIYANI	Foammulah	20	+2	-	-	34,35,(23,24)	10
29	SEENU	Hithadhoo	30	+2	-	-	36,37,(25,26)	20

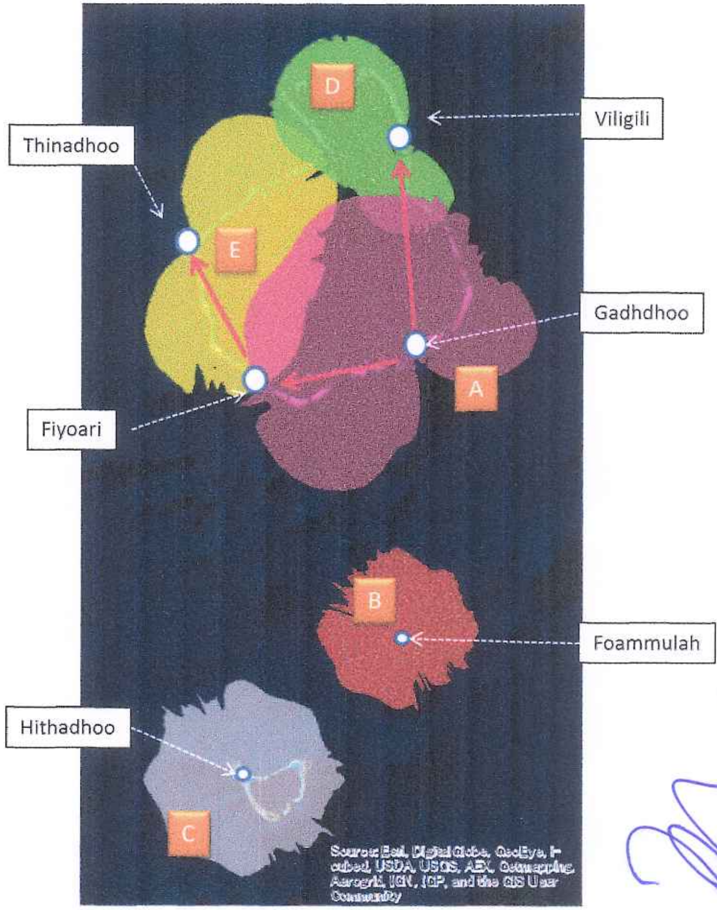
Result of the coverage simulation is shown in Figure 5-1.



North Area Coverage Map



Central Area Coverage Map



South Area Coverage Map

Figure 5-1 Result of Coverage Simulation

5-3 Transmission link design

Transmission link is designed with consideration of operational cost of DBNO and cost for the Japan's Grant Aid project. The broadcasting Transport Stream (hereinafter referred to as "BTS") is transmitted both/either optical fibers and/or microwave links to the islands where regional hubs of a carrier be able to feed the BTSs to each transmitting station. From the island, private microwave links and broadcasting wave relay owned by DBNO are used to reduce the operational cost. The transmission network is shown Figure 5-1.

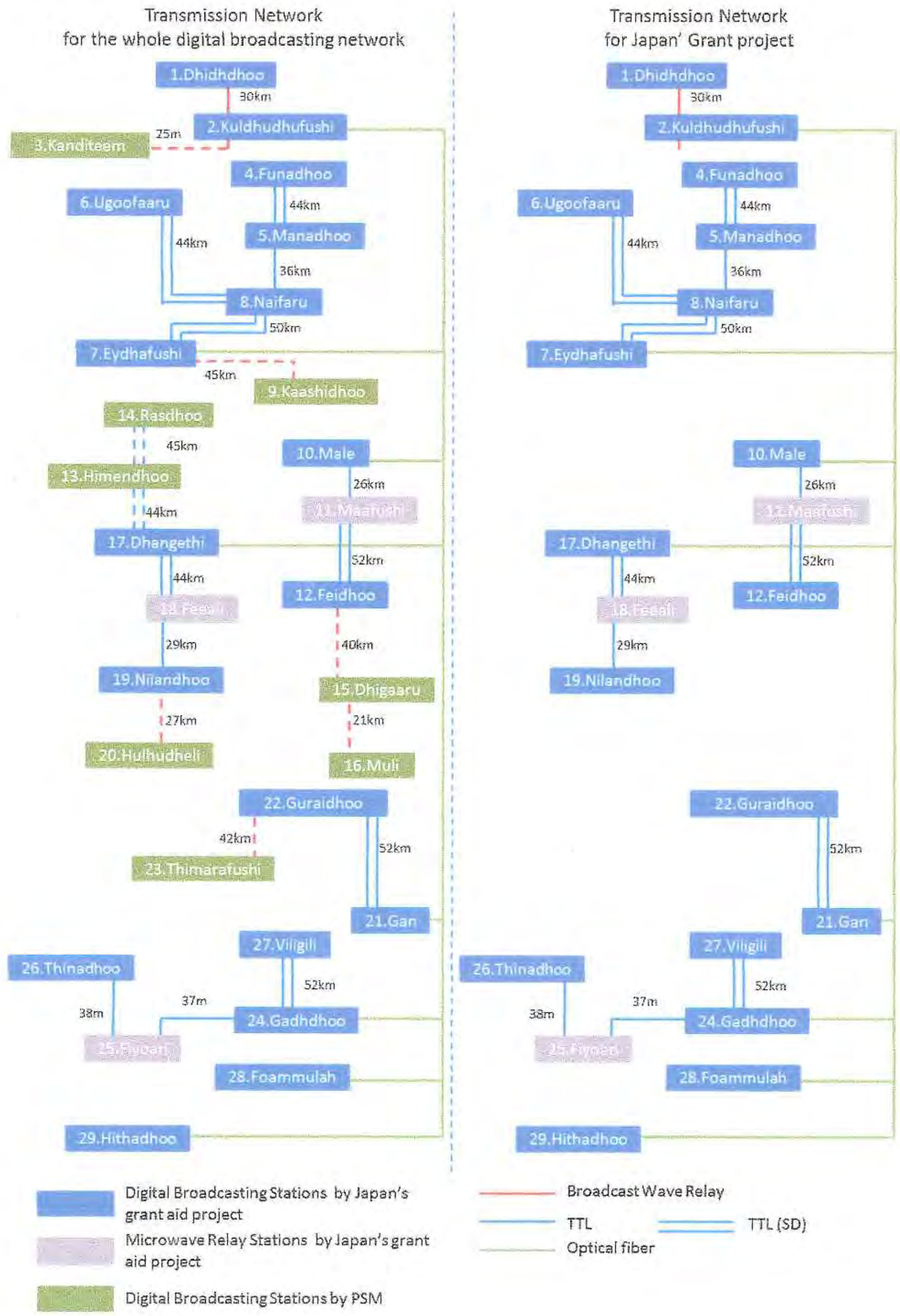


Figure 5-1 Transmission network

5-4 Network Operation Centre Location

PSM plans to provide the space for Network Operation Centre (NOC) for DBNO showed in Figure 5-2. If PSM needs to change the area, PSM will inform the Team as soon as possible with a figure pointed new area.

PSM Television Maldives Building Tentatively allocated area for NOC Operation – 1st Floor

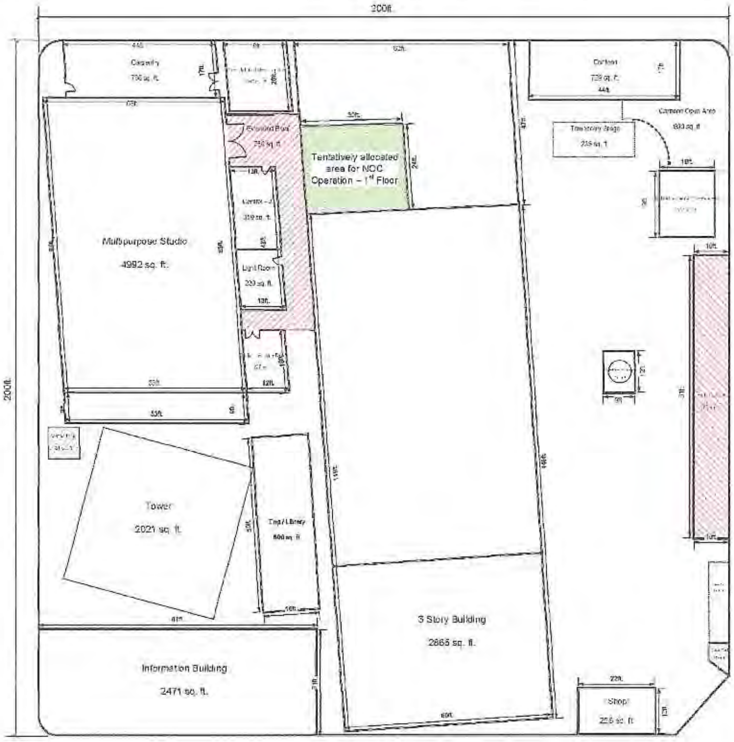


Figure 5-2 NOC Allocated Area

5-5 Component of Equipment

CAM, PSM and the Team have agreed that the following contents of the proposed component of equipment (hereinafter referred to as "the Equipment") in case 18 transmitting stations are in the scope for further studies by the Team, such as outline design, project cost estimation, preparation of the detail equipment specification and the draft final report, etc.

Table Component of equipment

Nr	Description	Q'ty
1	Digital Transmitting system	18 lot (TBD)
1.1	Digital transmitting system (Dhidhdhoo)	1 lot (TBD)
1.2	Digital transmitting system (Kulhudhushi)	1 lot (TBD)
1.3	Digital transmitting system (Funadhoo)	1 lot (TBD)

Nr		Description	Q'ty
	1.4	Digital transmitting system (Manadhoo)	1 lot (TBD)
	1.5	Digital transmitting system (Ungoofaaru)	1 lot (TBD)
	1.6	Digital transmitting system (Eydhafushi)	1 lot (TBD)
	1.7	Digital transmitting system (Naifaru)	1 lot (TBD)
	1.8	Digital transmitting system (Male, (Villingili))	1 lot (TBD)
	1.9	Digital transmitting system (Felidhoo)	1 lot (TBD)
	1.10	Digital transmitting system (Dhangethi)	1 lot (TBD)
	1.11	Digital transmitting system (Nilandhoo)	1 lot (TBD)
	1.12	Digital transmitting system (Gan)	1 lot (TBD)
	1.13	Digital transmitting system (Guraidhoo)	1 lot (TBD)
	1.14	Digital transmitting system (Gadhdhoo)	1 lot (TBD)
	1.15	Digital transmitting system (Thinadhoo)	1 lot (TBD)
	1.16	Digital transmitting system (Viligili)	1 lot (TBD)
	1.17	Digital transmitting system (Foammulah)	1 lot (TBD)
	1.18	Digital transmitting system (Hithadhoo)	1 lot (TBD)
	1.19	Renovation of digital transmitting system	2 set (TBD)
2		Microwave link system	1 lot (TBD)
3		Network Operation Center	1 lot (TBD)
4		PSM Equipment	1 lot (TBD)
	4.1	Equipment installed in PSM	1 lot (TBD)
	4.2	Equipment installed in MET	1 lot (TBD)
5		Antenna Towers	1 lot (TBD)
	5.1	90m antenna tower	5 sets (TBD)
	5.2	80m antenna tower	7 sets (TBD)
	5.3	60m antenna tower	7 sets (TBD)
	5.4	30m antenna tower	1 set (TBD)
	5.5	20m antenna pole	1 set (TBD)
6		Transmitting station building	21 lots (TBD)
	6.1	Digital transmitting station building	18 sets (TBD)
	6.2	Relay station building	2 sets (TBD)
	6.3	Renovation of relay station building	1 set (TBD)
7		Maintenance Equipment and Tools	1 lot (TBD)
8		Spare parts	1 lot (TBD)
9		Consumable parts	1 lot (TBD)
10		Installation Materials	1 lot (TBD)

Power Amplifier (PA) of DVT-T/DVB-T2 digital transmitters procured by VTV and DhiTV and ISDB-T digital transmitters operated by PSM are planned to be used for the spare parts in Naifaru and Dhangethi.

"4.2 Equipment installed in MET" includes the following items described in the Figure 5-3 in order to receive live weather forecast program.

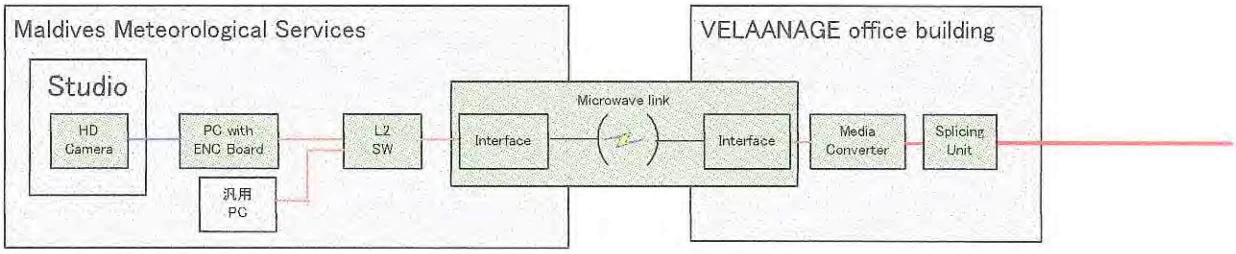


Figure 5-3 Equipment installed in MMS

6. The Work Demarcation of the Project

The undertakings of the Maldives side for smooth implementation of the Grant Aid project, as a condition for the Japanese Grant to be implemented, have been agreed in the Minutes of Discussions (hereinafter referred to as "M/D") signed on 8th October, 2015 between the Team and the Ministry of Home Affairs. During the 1st field survey, the following modifications have been discussed and agreed. The modifications from M/D are highlighted in red characters. The costs will be estimated by the both sides by March, 2016.

I. Major Undertakings to be taken by Recipient Government

1. Before the Tender

NO	Items	Deadline	In charge	Cost	Ref.
1	To open Bank Account (Banking Arrangement (B/A))	within 1 month after G/A	MoFT		
2	To approve IEE/EIA	before conclusion of G/A	EPA		
3	To implement EIA	before conclusion of G/A	~~MoHA~~ PSM		
4	To secure the following lands 1) land for transmission station	before EIA implementation	MoHA/ PSM		
5	To obtain the planning, zoning, building permit	before notice of the tender document	MoHA/ PSM		
6	To clear, level and reclaim the following sites 1)leveling and reclaiming the sites for transmission stations	before notice of the tender document	MoHA/ PSM		
7	Preparation of a DTTB Master Plan				
	1) Establishment of a broadcasting network				
	a) Study on coverage expansion to remote islands by preparation of a transmitting station site plan	before end of the preparatory survey	MoHA/ PSM		
	2) Frequency plan	during the preparatory survey	Commission		
	3) the schedules for DSO/ASO and simulcast	before conclusion of G/A	Commission		
	4) Assistance plan and budgetary measures for TV broadcasters	before end of the preparatory survey	MoHA		
	5) Plan for areas of poor reception	before DSO	MoHA/ PSM		
8	Preparation of DTTB migration plan				
	1) Plans to promote purchase of new TV receivers, assist poor households and dispose of disused analogue TV receivers	before DSO	MoHA		
	2) Promotion of the purchase of TV receivers and import of DTTB-compatible equipment	before DSO	MoHA		
	3) Study on Platform Equipment Plan				
	a) Equipment outside the scope of the Project	before end of the preparatory survey	MoHA/ PSM		
	4) Study on business model of DTTB platform including private broadcasters' participation to the platform	before end of the preparatory survey	MoHA/ PSM		
9	Legal Framework and Guidelines				
	1) Amendment of broadcasting laws and regulations	before conclusion of G/A	Commission		

NO	Items	Deadline	In charge	Cost	Ref.
	2) Amendment of broadcasting-related laws and introduction of multiplexing license	before completion of the Project	Commission		
	a) Decree on establishment of the DBNO	before conclusion of G/A	MoHA		
	b) Guidelines for issuance of DTTB licenses	before end of the preparatory survey	Commission		
	3) Licensing standards	before end of the preparatory survey	Commission/CAM		
10	Equipment procurement and construction work				
	1) Study on use of existing properties	during the preparatory survey	MoHA/PSM		
11	Organisational and Human Resource Development				
	1) Study on Disaster-Prevention Broadcasting and Development of Organisational Structure and Human Resources for the Operation of EWBS	before DSO	MoHA/PSM		

2. During the Project Implementation

NO	Items	Deadline	In charge	Cost	Ref.
1	To bear the following commissions to a bank of Japan for the banking services based upon the B/A				
	1) Advising commission of A/P	within 1 month after the singing of the contract	MoHA/PSM		
	2) Payment commission for A/P	every payment	MoFT		
2	To ensure prompt unloading and customs clearance at the port of disembarkation in recipient country				
	1) Tax exemption and customs clearance of the products at the port of disembarkation	during the Project	MoHA/PSM		
3	To accord Japanese nationals and/or physical persons of third countries whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work	during the Project	MoHA/PSM		
4	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the Products and/or the Services be exempted and/or borne by its designated authority without using the Grant; Such customs duties, internal taxes and other fiscal levies mentioned above include VAT, commercial tax, income tax and corporate tax of Japanese nationals, resident tax, fuel tax, but not limited, which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract	during the Project	MoHA/PSM		
5	To bear all the expenses, other than those to be borne by the Grant Aid, necessary for construction of the facilities as well as for the transportation and installation of the equipment	during the Project	MoHA/PSM		
6	Equipment procurement and construction work				
	1) Providing power supply to all the Transmitting and Relay Stations	before equipment at the sites	PSM		
	2) Providing backup power facility to NOC equipment	before equipment at the sites	PSM		
	3) Providing optical fiber connection to the designated transmitting stations	before equipment at the sites	PSM		

NO	Items	Deadline	In charge	Cost	Ref.
	4) Securing sites for the installation of the equipment, material storing yard, temporary construction yard and waste disposal	before equipment at the sites	PSM		
	5) Securing the space for installation for NOC of DBNO and other site(s) and providing power supply to them	before equipment at the sites	PSM		
	6) Removing designated equipment and obstacles from the Project site	before equipment at the sites	PSM		
	7) Demolishing the existing Antennas, feeders and foundation, and leveling the site	before equipment at the sites	PSM		
	8) Constructing the following facilities and install the equipment				
	a) Temporary roads within the sites for construction of the Transmitting and relay Stations	before equipment at the sites	MoHA		
	b) Roads outside the sites if necessary	before equipment at the sites	MoHA		
	c) Parking lots if necessary	before equipment at the sites	MoHA		
	9) Installation of optical fiber cables for the programme transmission between Carrier's NOC and transmitting stations if necessary. ~~Establishing the programme transmission links for the DTTB network~~	during the Project	~~MoHA/~~ PSM		
7	Organisational and Human Resource Development				
	1) Training of personnel in DTTB	during the Project	PSM		
8	To implement EMP and EMoP	during the construction	MoHA/ PSM		
	1) To submit results of environmental monitoring to JICA, by using the monitoring form, on a quarterly basis as a part of Project Monitoring Report	during the construction	MoHA/ PSM		
	2) To implement RAP (livelihood restoration program, if needed)	for a period based on livelihood restoration program	MoHA/ PSM		
	3) To implement social monitoring, and to submit the monitoring results to JICA, by using the monitoring form, on a quarterly basis as a part of Project Monitoring Report - Period of the monitoring may be extended if affected persons' livelihoods are not sufficiently restored. Extension of the monitoring will be decided based on agreement among MoHA, PSM and JICA.	- until the end of livelihood restoration program (In case that livelihood restoration program is provided) *- for two years after land acquisition and resettlement complete (In case that livelihood restoration program is not provided)*	MoHA/ PSM		

3. After the Project

NO	Items	Deadline	In charge	Cost	Ref.
1	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid 1) Allocation of maintenance cost 2) Operation and maintenance structure 3) Routine check/Periodic inspection	After completion of the construction	PSM		

NO	Items	Deadline	In charge	Cost	Ref.
2	To implement EMP and EMoP	for a period based on EMP and EMoP	PSM		
	To submit results of environmental monitoring to JICA, by using the monitoring form, semiannually - The period of environmental monitoring may be extended if any significant negative impacts on the environment are found. The extension of environmental monitoring will be decided based on the agreement between PSM and JICA.	for three years after the Project	PSM		
3	To secure the budget of programme transmission links managed by carriers	Before actual operation of the platform commencement	PSM		

(B/A: Banking Arrangement, A/P: Authorization to pay, N/A: Not Applicable)

II. Major Undertakings to be Covered by the Japanese Grant

NO	Items	Deadline	Cost Estimated (Million Japanese Yen)*	
1	Preparation of a DTTB Master Plan			
	1) Establishment of a broadcasting network			
	a) Radio wave propagation simulation	before end of the preparatory survey		
	b) Channel planning	before end of the preparatory survey		
2	Preparation of DTTB Migration Plan			
	1) Study on Platform Equipment Plan			
	a) Equipment in the scope of the Project	before end of the preparatory survey		
3	Equipment Procurement and Construction Work			
	1) Study on Availability of Antenna Towers for DTTB	before end of the preparatory survey		
	2) Study on Sites for New Towers and Environmental and Social Considerations	before end of the preparatory survey		
4	To provide equipment			
	1) To ensure prompt unloading and customs clearance at the port of disembarkation in recipient country			
	a) Marine(Air) transportation of the products from Japan to the recipient country	during the Project		
	b) Internal transportation from the port of disembarkation to the project site	during the Project		
	2) Prepare temporary facilities for existing towers and stations for the designated sites.	during the Project		
	3) To install the equipment	during the Project		
	Total			

*; The cost estimates are provisional. This is subject to the approval of the Government of Japan.

7. Tax Exemption Procedure

Tax exemption procedures are handled by the implementation agency for the new project.

The list of equipment and services procured by the Project is prepared by the Supplier approximately two to three months before the arrival of those sets of equipment and services. Then the implementation agency, PSM will submit the list to the President Office with the copy to the Ministry of Finance and Treasury. The President Office assesses the documents and notifies the tax exemption to the Ministry of Finance and Treasury. The procedures are shown in Figure 7-1.

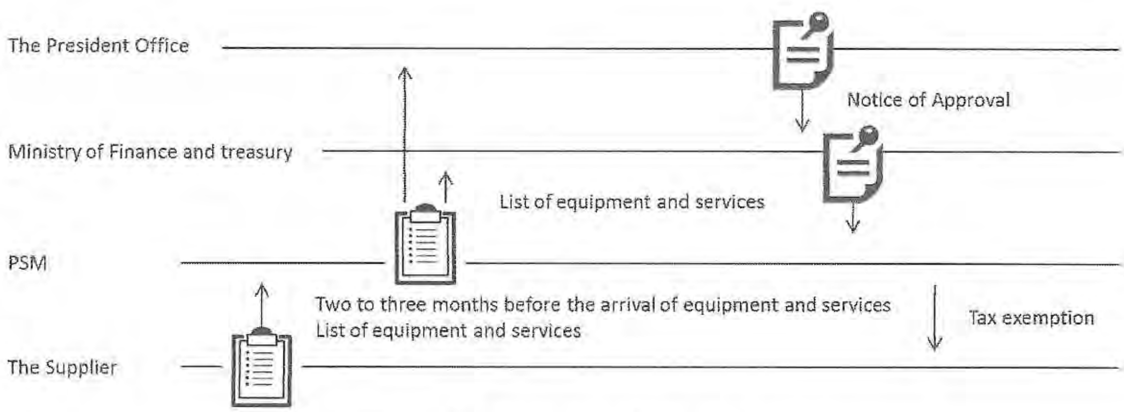
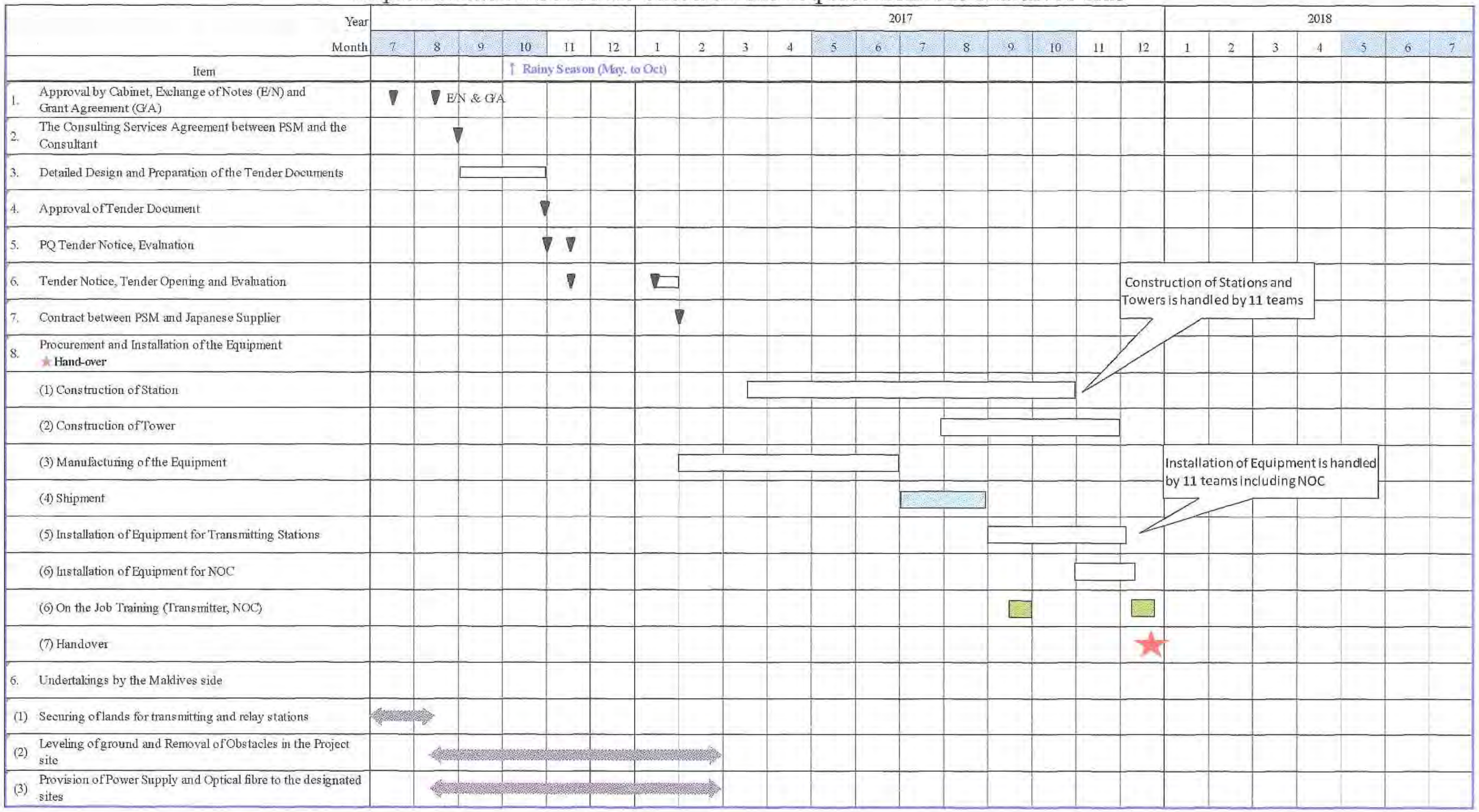


Figure 7-1 Tax exemption procedure

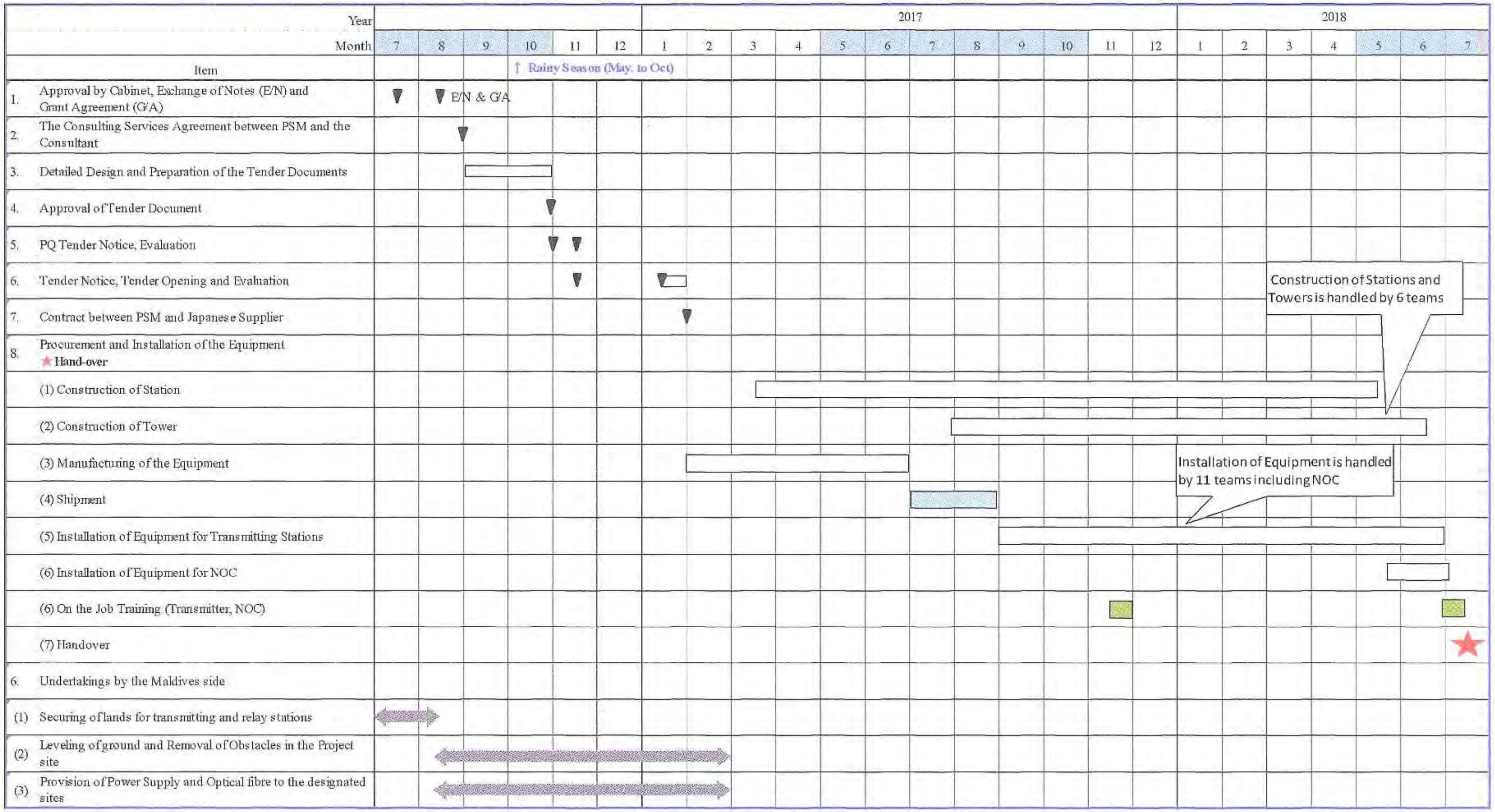
8. Implementation Schedule of the Project (Tentative)

Implementation Schedule based on the request from the Maldives side



Note: <u>Implementation schedule mentioned above must be considered whether such teams could be formulated in the same time or not. If it is impossible Maldives side and the Team will discuss in the solution for the both sides.</u>

Implementation Schedule prepared by the Team



9. Implementation Structure of DBNO

DBNO is established within PSM. However, the budget is allocated independently from PSM. The structure of DBNO is shown in Figure 8-1. With regard to the administration works including training, because of the nature of the works the existing sections in PSM can perform its works for both organizations. With regard to transmitting engineering and network operation centre operation, only the manager positions are held by officers from PSM and the rest of the engineers belong to DBNO.

Viewers support is considered to be necessary works for DBNO. In particular, at the initial stage of digital broadcasting, it is expected that the viewer will face many problems such as installation of receivers and antennas and reception of signal if they live in poor reception area. DBNO plays a role to provide support to the viewer with customer call center. The customer call center consists of one officer and two sections. Customer center staff deals with questions and claims from the viewers by telephone, and technical support provide support and answers to the technical questions. Corroboration with islands councils would be required.

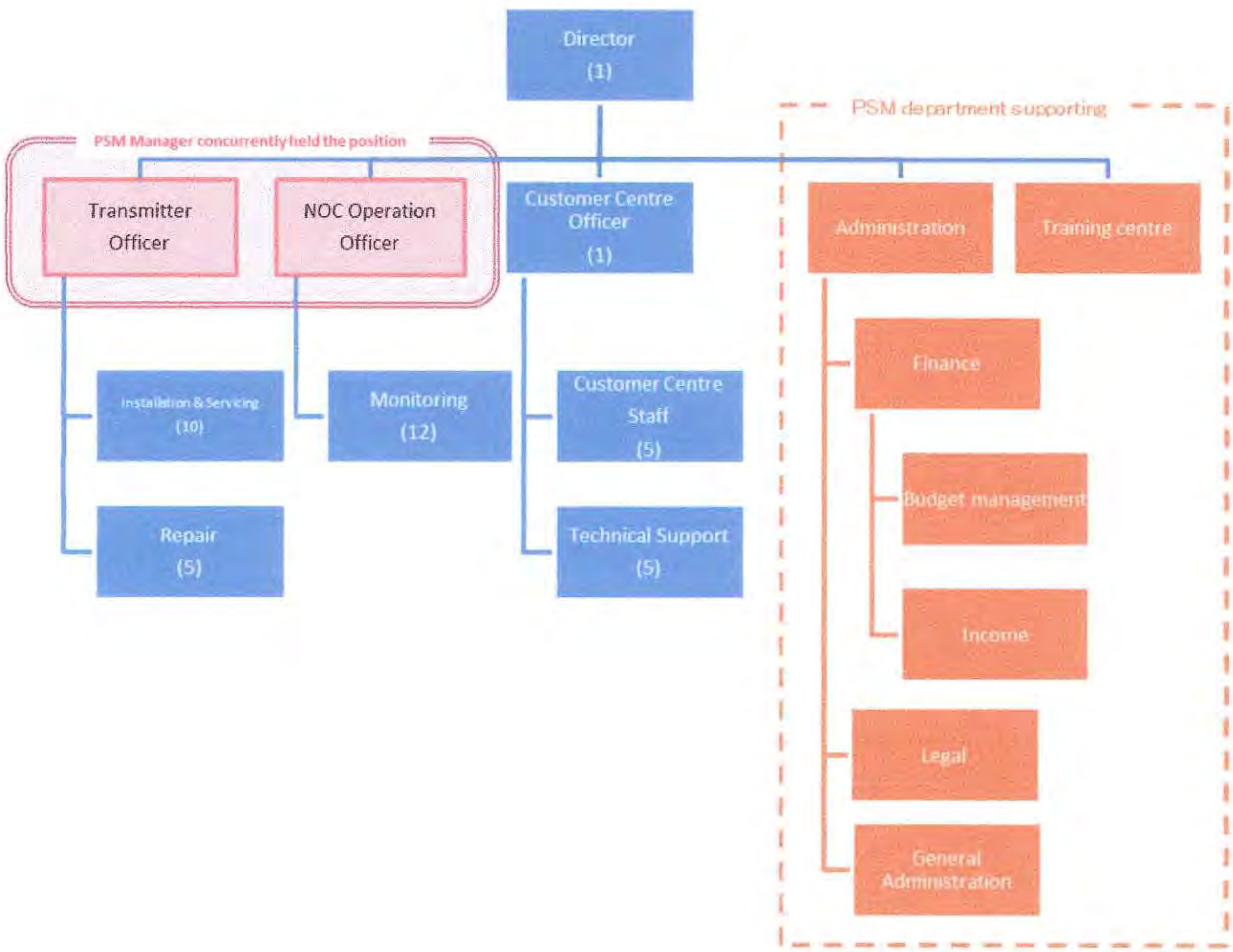


Figure 8-1 Structure of DBNO

The experiences of the DBNO staffs required for each work is shown in Table 8-1

Table 8-1 Experience required for each staff members

No	Professions	Years of Experience
1	Installation and Services	More than 7 years
2	Repair	More than 7 years
3	Monitoring	More than 7 years
4	Customer Center Officer	More than 5 years
5	Customer Centre Staff	Not required
6	Technical Support	More than 1 year as transmitting engineer

The tentative operation and maintenance cost of DBNO is shown in Table 8-2. The ream will further examine on it.

Table 8-2 Annual Operation and Maintenance Cost of DBNO (Tentative)

Unit: MVR

	Item		Qty	Unit	Annual Amount
1	Personnel costs		39		5.81
		Director	1	0.30	0.30
		Customer Centre Officer	1	0.16	0.16
		Transmitter Engineer (Installation and Servicing)	10	0.20	2.00
		Transmitter Engineer (Repair)	5	0.20	1.00
		Operator (Monitoring)	12	0.10	1.20
		Customer Call Centre Operator	5	0.10	0.50
		Customer Calll Centre Technical Support	5	0.13	0.65
2	Electricity costs (NOC)		1	0.12	0.12
3	Repair and maintenance costs				9.18
		Tower Maintenance	21	0.150	3.15
		TX house and site cleaning	21	0.055	1.16
		TX house maintenance	18	0.050	0.90
		Relay station maintenance	3	0.030	0.09
		Electricity (TX)	18	0.200	3.60
		Electricity (Relay station)	3	0.060	0.18
		Communication (including data)	21	0.005	0.11
4	Tower rental fee		0	0.000	0.00

	Item		Qty	Unit	Annual Amount
5	Optical fiber connection fees		1	6.00	6.00
6	Frequency licensing fees		20	0.25	5.00
7	Other expenses				3.78
		Communication fee (NOC)	1	0.60	0.60
		Communication fee (Customer Centre)	1	0.90	0.90
		Incidentals fee (10%of #1-#6)			2.28
	Total				29.89

The tariff for DBNO was calculated based on the rate of bitrate required for each service. One BTS consists of 2 HDs, 2 SDs, 1 Data broadcasting and 1 one-seg services. The bitrate required for each service is approximately 6 Mbps for HD, 3 Mbps for SD, 1.5 Mbps for Data broadcasting and 0.7 Mbps for one-seg service. Therefore the ratio of each service that occupies one frequency is shown in Table 8-3.

Table 8-3 Data ratio of each service in one frequency

No	Content	Ratio
1	HD	0.30
2	SD	0.15
3	Data Broadcasting	0.07
4	One-seg	0.03

The tariff of DBNO was calculated based on the future investment plan including the 8 addition sites procured by PSM apart from digital transmitting stations procured by Japan's grant project and the plan of operation with four frequencies in the future. The tentative tariff is shown in table 8-4. Also, Maldives side will provide further information to the Team, the Team will re-calculate based on them when the Team receives.

Table 8-4 Tariff for DBNO (Tentative)

Unit: MVR

(MVR)	1-2 year	3-4 year	5-9 year	10-20 year	21-24 year	over 25 year
HD (baseline)	4,977,413	4,977,413	3,318,275	2,488,706	2,488,706	2,488,706
F discount (baseline)	4,632,413	4,632,413	3,088,275	2,316,206	2,316,206	2,316,206
Additional service investment reserve	569,184	1,030,260	412,104	0	0	0
HD Total	5,546,597	6,007,673	3,730,379	2,488,706	2,488,706	2,488,706
HD Total/m	462,216	500,639	310,865	207,392	207,392	207,392
HD Total	5,201,597	5,662,673	3,500,379	2,316,206	2,316,206	2,316,206

(MVR)	1-2 year	3-4 year	5-9 year	10-20 year	21-24 year	over 25 year
(F discunt)						
HD Total (F discunt)/m	433,466	471,889	291,698	193,017	193,017	193,017
SD	2,488,706	2,488,706	1,659,138	1,244,353	1,244,353	1,244,353
F discount	2,316,206	2,316,206	1,544,138	1,158,103	1,158,103	1,158,103
Additional service investment reserve	284,592	515,130	206,052	0	0	0
SD Total	2,773,298	3,003,836	1,865,190	1,244,353	1,244,353	1,244,353
SD Total/m	231,108	250,320	155,432	103,696	103,696	103,696
SD Total (F Discount)	2,600,798	2,831,336	1,750,190	1,158,103	1,158,103	1,158,103
SD Total (F Discount)/m	216,733	235,945	145,849	96,509	96,509	96,509
Data	1,161,396	1,161,396	774,264	580,698	580,698	580,698
F discount	1,080,896	1,080,896	720,598	540,448	540,448	540,448
Additional service investment reserve	132,810	240,394	96,158	0	0	0
Data Total	1,294,206	1,401,790	870,422	580,698	580,698	580,698
Data Total/m	107,850	116,816	72,535	48,392	48,392	48,392
Data Total (F discount)	1,213,706	1,321,290	816,755	540,448	540,448	540,448
Data Total (F discount)/m	101,142	110,108	68,063	45,037	45,037	45,037
One-seg	497,741	497,741	331,828	248,871	248,871	248,871
F discount	463,241	463,241	308,828	231,621	231,621	231,621
Additional service investment reserve	56,918	103,026	41,210	0	0	0
One-seg Total	554,660	600,767	373,038	248,871	248,871	248,871
One-seg Total/m	46,222	50,064	31,086	20,739	20,739	20,739
One-seg Total (F discount)	520,160	566,267	350,038	231,621	231,621	231,621
One-seg Total (F discount)/m	43,347	47,189	29,170	19,302	19,302	19,302

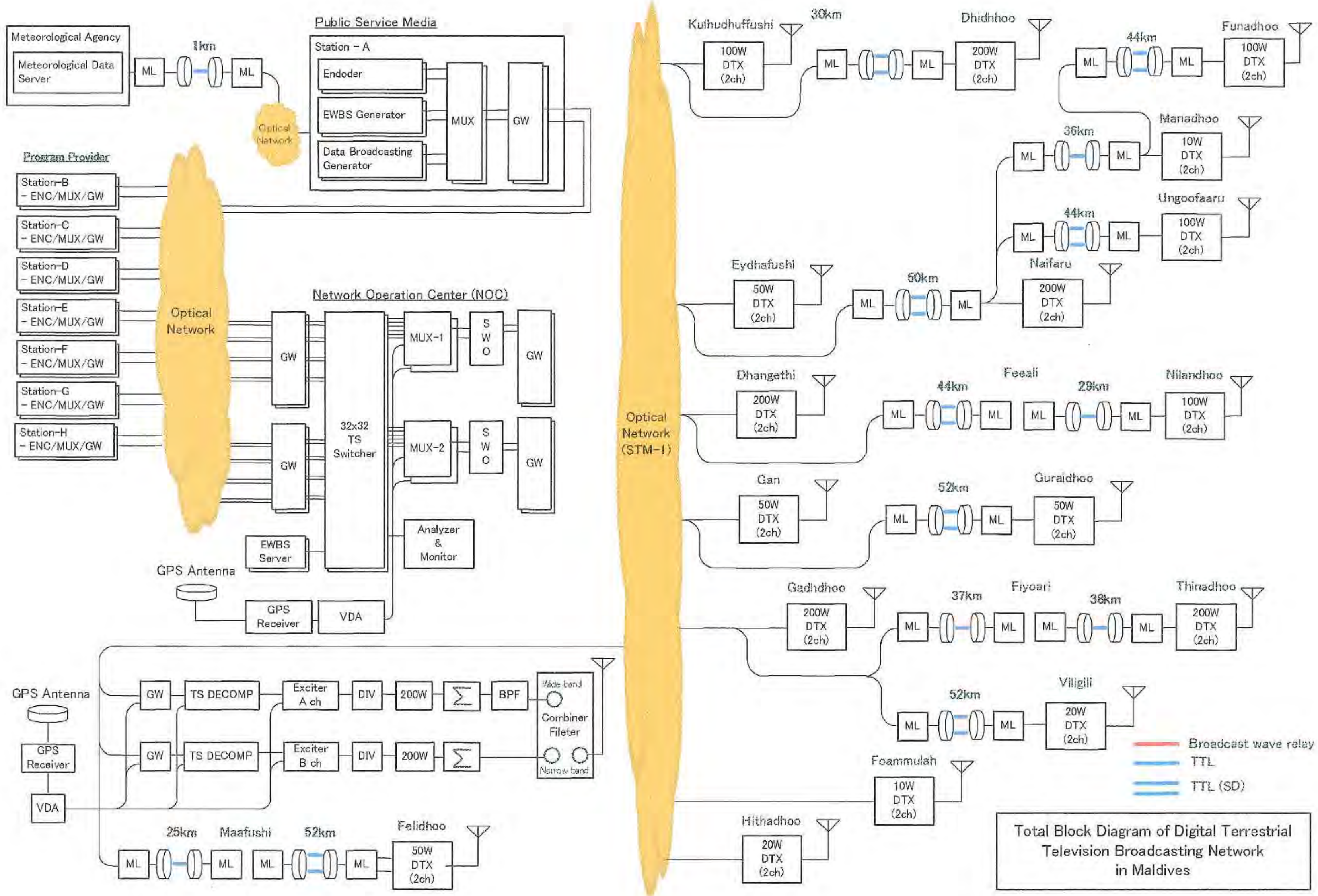
10. Budget Estimation of the Undertakings by PSM (the Maldives side)

For the undertakings to be done by the Maldives side, the Team estimated the budget necessary for conducting undertakings. The estimated budget is shown in Table 9-1

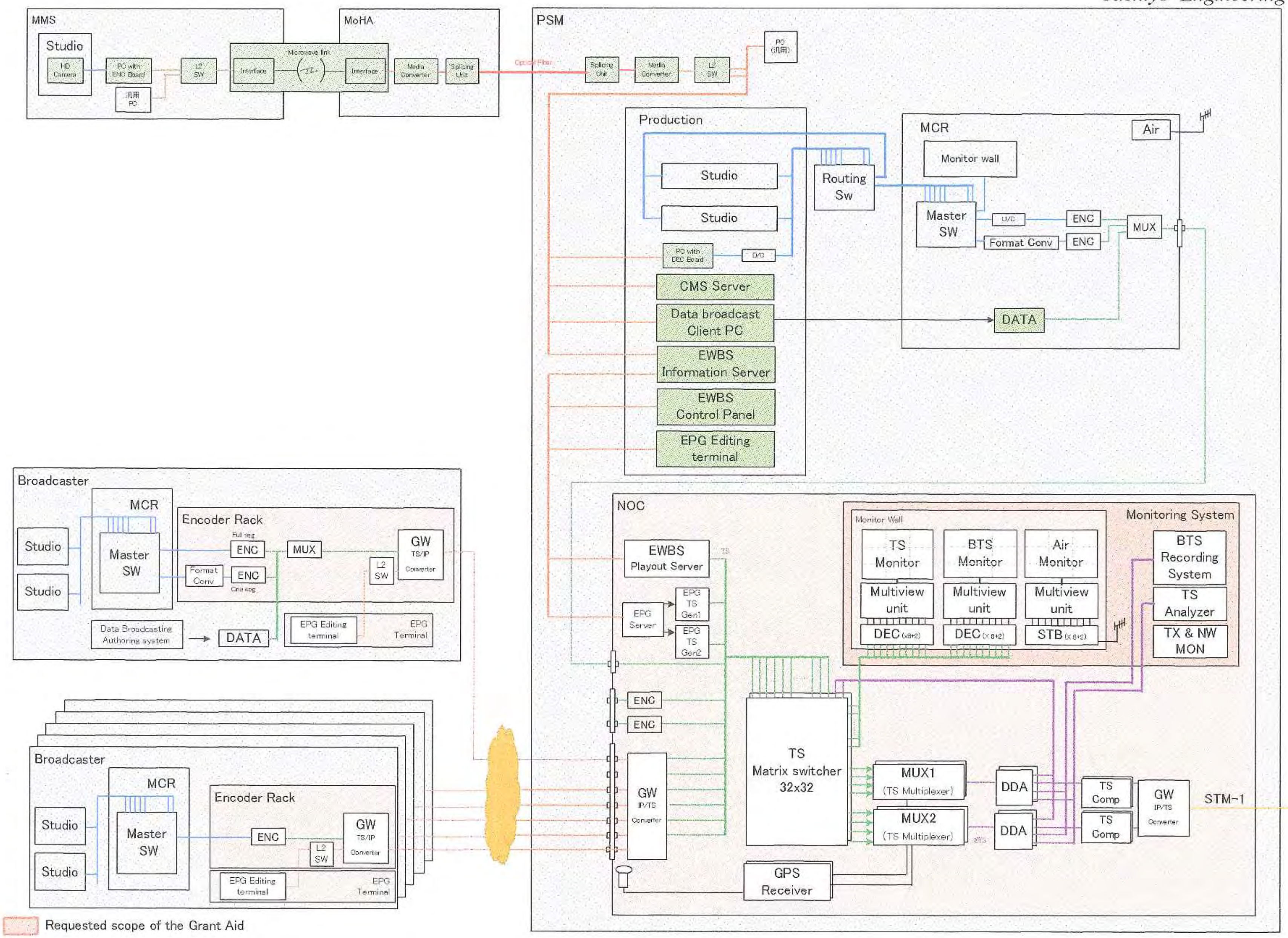
Table 9-1 Budget estimation of the undertakings by the Maldives side

No	Item	Estimated Cost (million MVR)	Remarks
1	Application for EIA or IEE approval	TBD	Calculation provided by PSM
2	Land acquisition	0	Calculation provided by PSM
3	Providing power supply to all the transmitting and relay stations.	TBD	Calculation provided by PSM
4	Providing backup power facility to NOC equipment	TBD	Calculation provided by PSM
5	Providing optical fiber connection to the designated transmitting stations	2.40	Quotation is requested to telecommunication companies. It is under examination whether the optical fiber line owned by telecommunication company is used or PSM prepares their own optical fiber line.
6	Removal of designated equipment and obstacles from the Project site and leveling the ground	1.07	
7	Demolishing the existing antennas and stations from designated sites	0.02	
Total amount:		3.49	

Annex 1



Total Block Diagram of Digital Terrestrial Television Broadcasting Network in Maldives



Requested scope of the Grant Aid

Requested scope of the Grant Aid