The Democratic Socialist Republic of Sri Lanka
Ministry of Mass Media and Information（MMI）

Feasibility Study On Digital Terrestrial Television Broadcasting Network Project in Democratic Socialist Republic of Sri Lanka

Final Report

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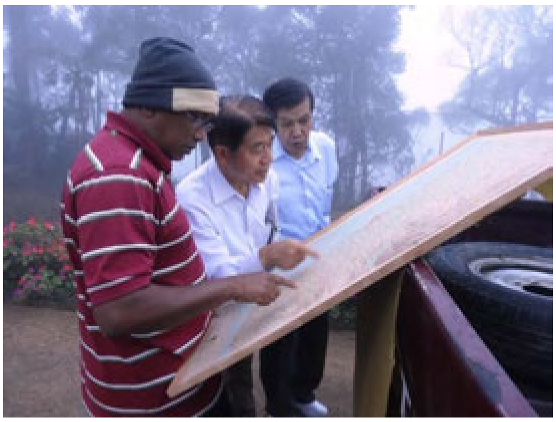

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ABBREVIATIONS

ASI	Asynchronous Serial Interface
ASO	Analogue Switch Off
BML	Broadcast Markup Language
CAA	Civil Aviation Authority
CCIR	Comite Consultatif Internationale des Rediocommunications
CEA	Central Environmental Authority
CEB	Ceylon Electricity Board
CSN	Carlton Sports Network
DBN	Dialog Broadband Networks
DBNO	Digital Broadcast Network Operators
DMC	Disaster Management Center
DSO	Digital Switch Over
DTH	Direct to Home
DTTB	Digital Terrestrial Television Broadcasting
DVB-T	Digital Video Broadcasting - Terrestrial
EIRR	Economic Internal Rate of Return
EPG	Electronic Program Guide
ERP	Effective Radiated Power
EWBS	Emergency Warning Broadcast System
HD	High Definition
IEA	International Energy Agency
ISDB-T	Integrated Services Digital Broadcasting
ISP	Internet Services Provider
ITN	Independent Television Network Ltd
ITU	International Telecommunication Union
LBN	Lanka Broadband Network
MFN	Multi Frequency Network
MMI	Ministry of Mass Media and Information
MPI	Ministry of Plantation Industries
MTV	Maharaja Television Network
NIT	Network Information Table
NEA	National Environmental Act
NOC	Network Operation Center
NPV	Net Present Value
PA	Power Amplifier
PAA	Project Approving Agency

PSI	Program Specific Information
QAM	Quadrature Amplitude Modulation
RDA	Road Development Authority
SD	Standard Density
SDI	Serial Digital Interface
SI	Service Information
SFN	Single Frequency Network
SLRC	Sri Lanka Rupavahini Corporation
SNMP	Simple Network Management Protocol
STB	Set Top Box
SLT	Sri Lanka Telecom
STL	Studio to Transmitter Link
TEC	Technical Evaluation Committee
TIT	Ministry of Telecommunication and Information Technology
TRC	Telecommunications Regulatory Commission of Sri Lanka
TTL	Transmitter to Transmitter Link
TS	Transport Stream

Executive Summary

(1) Background and Objectives of the Study

The government of the Democratic Socialist Republic of Sri Lanka (hereinafter referred to as “Sri Lanka”) approved adoption of the European standard (hereinafter referred to as “DVB-T2”) for Digital Terrestrial Television Broadcasting (hereinafter referred to as “DTTB”) by the Cabinet in 2010 and is promoting digitalization with the aim of switching off analog broadcasting by 2017. In Sri Lanka, two national broadcasting networks, Sri Lanka Rupavahini Corporation (hereinafter referred to as “SLRC”) and Independent Television Network Ltd. (hereinafter referred to as “ITN”), are broadcasting with a TV coverage rate of 95% of the national population according to SLRC. For the introduction of DTTB, the Government of Sri Lanka is considering developing a digital TV broadcasting platform (hereinafter referred to as “DTTB platform”) so that national and private broadcasting stations can switch to DTTB smoothly through the platform.

Meanwhile, since Sri Lanka has often experienced various natural disasters including the 2004 Indian Ocean tsunami caused by the Sumatra-Andaman earthquake in 2004, disaster prevention is recognized as an essential development issue in this country and Japan has also offered strong support in this area. Under such circumstances, the Government of Sri Lanka has reevaluated the Emergency Warning Broadcasting System (hereinafter referred to as “EWBS”) as more suitable than DVB-T2 especially in the area of disaster prevention. Mainly because SLRC has received the support of Japan so far, the Government of Sri Lanka has decided to review the change to ISDB-T from DVB-T2.

Following the visit by President Rajapaksa to Japan in April 2013, the Government of Sri Lanka announced the acceptance of the Study Team and the implementation of a test ISDB-T broadcast in Colombo on the initiative of the Ministry of Internal Affairs and Communications in Japan.

The objectives of the Study are to examine and evaluate the Project, including the validity and necessity, outline, project cost, implementation schedule, implementation method (procurement and installation of equipment), implementation structure, operating and maintaining system, etc., as a ODA loan project by Japan which will be conducted to realize the smooth shift to DTTB by the development of the DTTB platform planned by Sri Lanka.

(2) Situation of the Broadcasting Sector

1. Supervising and Regulatory Agencies and Broadcasting Organizations

The Ministry of Mass Media and Information (hereinafter referred to as “MMI”) is responsible for broadcasting administration in Sri Lanka. MMI announces the national media policy, ensures freedom of speech and promotes the development of knowledgeable citizens. The Telecommunications Regulatory Commission of Sri Lanka (hereinafter referred to as “TRC”) is in charge of licensing frequencies, standard certification of radio wave radiators and radio wave supervision including monitoring.

TV broadcasting in Sri Lanka was launched by a private broadcaster in April 1979 when the ITN Channel operated by Independent Television Network Ltd. started the first terrestrial broadcasting. However, ITN was put under the management of the government in June 1979 and, since then, it has operated as a state-run broadcasting station together with SLRC. On the other hand, the Government of Sri Lanka permitted the establishment of private commercial broadcasting stations in 1992, and since then a number of private companies have participated in the terrestrial broadcasting sector.

2. TV Receiver Ownership

The service coverage of SLRC, one of the state-run broadcasters, is 95 % of the population, according to the broadcaster. (The Study Team calculated the current analog coverage in detail and obtained a population coverage of 67.2% in the electric field over 55 dBμV/m provided by the ITU.)

The four program channels of SLRC are as follows: Rupavahini Channel which airs Sinhalese programs, Channel Eye 1 which airs English and sports programs, Channel Eye 2 which broadcasts in Tamil, and NTV which provides the programs of Channel Eye 1 in English. Channel Eye 1 and NTV form one broadcasting system by switching between two channels. Private broadcasting stations air programs that meet the local conditions and many transmitting stations broadcast only channels in the main language spoken in the area, such as Sinhalese or Tamil.

As of 2012, 23 companies have a license for terrestrial TV broadcasting and 15 of them are in operation. Of the 15 companies, the state-run broadcasters are SLRC and ITN. The reasons for the absence of service by the other eight companies are unknown.

Pay-TV services are also growing rapidly in Sri Lanka in line with the advancement of telecommunications technology. Satellite TV (hereinafter referred to as “DTH”) services had approx. 260,000 subscribers as of the end of December 2012. Although nine cable TV companies are licensed, only two of them were providing a service as of 2012. And Dish TV that can be viewed via the satellite of neighboring India, has gained much popularity in Tamil residential areas.

(3) Transition Plan to DTTB and Adaptability of ISDB-T to Sri Lanka's Situation

1. Transition Plan to DTTB

The International Telecommunication Union (hereinafter referred to as “ITU”) conducted a two-month short-term survey from August to October 2011 together with the national roadmap team from the Sri Lankan Government and compiled the “Roadmap for the Transition from Analogue to Digital Terrestrial Television Broadcasting in Sri Lanka” (hereinafter referred to as the “ITU Roadmap”). The Study Team understands that it is the only comprehensive plan for transition to DTTB in Sri Lanka. The ITU Roadmap examines only the main transmitting stations and makes no detailed investigation. There is concern that dependence on the Roadmap at the preliminary design stage may cause major design changes at the implementation stage.

Examination of the sites selected for viewing DTTB programs is difficult, as described in the ITU Roadmap, and it is based on theoretical simulation with DVB-T2; as such there is a need to verify the validity of the locations of the transmitting stations based on simulation with ISDB-T and field surveys, as a basic design to review the ODA loan project on the assumption that DTTB is provided by ISDB-T.

Table-1 Outline of Contents of ITU Roadmap

Item	Contents and Agenda
DSO/ASO schedule	DSO-SD in Western province in mid-2014, DSO-SD in whole nation at the end of 2015, ASO at the end of 2017 across the country. There is no description of when and how HDTV services will be introduced.
Transmitting stations	8 transmitting stations were proposed by available channels including conditional channels in DVB-T2 in the whole country. However, there are many areas with poor TV signal reception in the coverage area in the simulation map. And the Roadmap does not describe the possibility of using existing transmitting stations as DTTB transmitting stations.
Market scale and future development forecast	Approx. 3,500,000 households had a television set in 2011 and the number is on the rise. There is low viewing growth in poor reception areas, and the number of satellite TV and CATV viewers is on the increase.
Platform	DBNO was introduced and it will be effective for smooth transition to DTTB. However, the Roadmap does not describe the responsibilities of DBNO, the concept of proper usage fees, provision of advice for viewers, compensation for non-operation due to equipment failure, or the criteria for selection of One-seg broadcasting stations.
Legal system	MMI and TRC appropriately share the responsibility for the technical standards for DBNO and tax issues. Multiplexing provisions need to be incorporated into related act(s) urgently.

<Legend>
DSO: Digital Switch Over
ASO: Analog Switch Off
HDTV: high-definition television
DBNO: Digital Broadcast Network Operator

2. Main Features of ISDB-T

- Multifunctional data broadcasting

  ISDB-T data broadcasting provides a general contact to e-government, road traffic information, weather reports, educational and medical information, news and sports, and other contents. TV stations can send local information as necessary.

- Viability and spillover effects of data broadcasting

  Data broadcasting is steadily used in countries that have adopted ISDB-T. However, other DTTB standards do not accommodate data broadcasting in actual broadcasting services, and therefore providing data broadcasting services by ISDB-T is much more feasible.

  Data broadcasting has the potential to create and discover human resources in ICT in Sri Lanka as well as new markets and workforce demand. Data broadcasting can bring socioeconomic spillover effects.

- Usability of mobile TV

  ISDB-T is the only digital terrestrial broadcasting standard in the world that is compatible with mobile TV.

  The standard allows the poor who cannot afford to purchase expensive TV sets to enjoy the benefits of DTTB with the use of Set Top Boxes (hereinafter referred to as "STB") or mobile phones.

- Availability of inexpensive TV sets

  Stable usability of ISDB-T broadcasting has led to stable production of receivers because ISDB-T has been chosen by many counties, and ISDB-T-compatible TV sets, STBs and mobile TV devices are manufactured and sold in large quantities in those counties.

- Economic effects of realization of One-seg broadcasting

  Approx. 3.5 million households own TV receivers in Sri Lanka. If an STB unit costs 2,000 yen on average, it will generate seven billion yen of economic effect. As One-seg broadcasting is highly feasible, sales of ISDB-T receivers will have a major economic impact.

- Usability of EWBS

  EWBS can be a means of providing essential information to citizens. EWBS is highly usable not only for disaster warnings but from a wider perspective.

- Effectiveness in disaster prevention

  EWBS enables the issuance of evacuation information to people in cooperation with disaster monitoring organizations and its redundancy and reliability are generally higher than telecommunications facilities. ISDB-T including EWBS can be an effective means of communication in disaster situations.

3. Adaptability of ISDB-T to Sri Lanka's Situation

(A) Technical Adaptability

One of the features of DTTB is that program multiplexing enables the airing of multiple programs on one frequency. Although ISDB-T can transmit a maximum of 12 programs in one channel, the image quality is sacrificed because the compaction degree is high. Thus the Study Team discussed the appropriate number of multiplexed programs by subjective assessment of picture quality, and realized that 6-multiplexed programs and data and One-seg broadcasting can be accommodated.

The ISDB-T channel plan was studied by the Study Team to ensure expansion of the existing population coverage, promotion of local contents, and effective utilization of ISDB-T features such as data, One-seg broadcasting, EWBS, etc., and it will be a suitable plan with adaptation to the diverse society in Sri Lanka.

(B) Adaptability to Social Background

STBs, which are necessary for data broadcasting, are less expensive than computers and they do not require any usage fees like the Internet as they are used for terrestrial broadcasting. The prevalence of data broadcasting will make it possible to provide information to people who cannot afford to use computers or the Internet for financial reasons and people who live in areas where such services are not available.

Production of educational contents for data broadcasting has major spillover effects in education and ISDB-T is suited to the educational situation in Sri Lanka. Closed-caption broadcasting for persons with hearing difficulties and reading for persons with visual impairment by ISDB-T are highly feasible and effective.

On the other hand, the start of One-seg broadcasting, along with the introduction of DTTB in Sri Lanka, will enable transmission of information to people with no TV set or living in areas where information is not readily available, or people living in areas where electricity has yet to be provided but mobile phones can be used.

In an unelectrified village on an Indonesian island, solar power is used for the transmission system for ISDB-T broadcasting on an experimental basis. Solar power generation is sufficient to provide the transmission power necessary for One-seg broadcasting. Thus, ISDB-T is also adaptable to the situation in Sri Lanka, such as providing broadcasting services to unelectrified areas by installation of a transmitter with solar power generation.

Furthermore, ISDB-T is a broadcasting standard advantageous for mobile devices. The bus is the main means of short- and long-distance travel for Sri Lankans. Establishment of new business in view of the advantages of ISDB-T by utilizing the 30 minutes to one hour of commuting time is meaningful. ISDB-T allows promotion of such revitalization of society.

(4) Environmental and Social Considerations

In Sri Lanka, the National Environmental Act (NEA, Act No.47 of 1980) was enacted under the National Plan “A clean and green environment through service excellence.” Under the NEA, the Central Environmental Authority (hereinafter referred to as “CEA”) was organized on August 12, 1981. The CEA administers environmental considerations in development processes.

According to the Japan International Cooperation Agency (JICA) Guidelines for Environmental and Social Considerations (April 2010), the Project is classified as category C, as negative impacts on the environment by the Project are predicted to be minimal. The prescribed projects which require EIA are listed as follow. However, because the Project does not correspond to the prescriptions, the Project does not require EIA.

- ○ Reclamation of land or wetland areas exceeding 4 hectares
- ○ Removal of timber covering a land area exceeding 5 hectares
- ○ Conversion of forest covering an area exceeding 1 hectare into non-forest uses
- ○ Clearing of land areas exceeding 50 hectares
- ○ Mining and mineral extraction

Compared to without implementation of the Project, the advantages of implementation of the Project are as follows;

- Digital dividend is ensured by digitalization.
- More local contents are provided by digitalization.
- EWBS can contribute to the prevention and mitigation of damage caused by large-scale natural disasters.
- TV programs are viewable on mobile phones and other portable devices through One-seg services.

The environmental impact will be less if transmission antennas are installed on existing towers compared to building new towers. Therefore, the Project has been designed to utilize existing towers and transmitting station buildings as much as possible.

Based on the JICA Guidelines for Environmental and Social Considerations, scoping (A±: Significant positive or negative impact is expected, B±: Some positive or negative impact is expected, C±: Minor positive or negative impact is expected, D: No impact is expected) was conducted. As a result, it was confirmed that the Project will not have irreversible or significant environmental impact. Moreover, migration of the population and involuntary resettlement are not involved.

(5) Basic Design

1. Design Policy

(A) Outline of the Project

This Project consists of the development of a platform for digital terrestrial television broadcasting (hereinafter referred to as “DTTB platform”), the construction of a network center for the DTTB platform, the construction and operation/maintenance (O&M) of transmitting station buildings, antenna towers and a DBNO Building linked to the development of the DTTB platform and the provision of consulting services. Further discussions based on a request by the Government of Sri Lanka will be conducted for technical cooperation projects incidental to this Project. Table-2 shows the outline of the Project.

In addition, the Joint Working Committee, which, with assistance from the Government of Japan, will examine and find solutions to various problems in the transition to DTTB found in countries where the Japanese DTTB standard has been adopted, will need to work in close cooperation with this Project and will be able to provide comprehensive assistance in the transition to DTTB.

Table-2 Project Outline

Category	Outline of the Project
Equipment Procurement	DTTB platform equipment (transmitter, STL/TTL links, etc.), DTTB platform network operation center (NOC) equipment, digital TV center equipment (master control system, HDTV studios, OB vans)
Civil Engineering/ Construction	DBNO administration building, digital TV center building, antenna towers, transmitting station buildings
Training in O&M	Initial operation training, operation training, training in Japan
Consulting Services	Development of employer’s requirements, supervision of procurement and installation/construction, development of a frequency plan with provision of HDTV services, development of technical standards, compatibility test for receivers (including establishment of a test center)
Technical Assistance (to be discussed)	Advice on reception issues for viewers including establishment of a call center, capacity development in production of data broadcasting programs, capacity development in disaster broadcasting

(B) Basic Design Policy

Table-3 summarizes the basic design policies and shows their relation to issues that need to be addressed.

Table-3 Issues Needing to be Addressed and Basic Design Policies for the Transition to DTTB

	Item	Issue to be addressed	Basic design concept
1.	Channel Plan	- The launch of digital terrestrial broadcasting service in stages by area block will begin in 2016. - Signals are impeded in mountainous areas, which account for a large portion of the territory. - There is not enough program diversification.	- Use of the existing transmitting stations - Consideration of topographic features ➢ Installation of gap-fillers ➢ Division of the entire country into area blocks - Promotion of broadcasting of community-based programs ➢ Content of programs at the community, regional and national levels ➢ Use of the broadcasting service to help create mutual understanding between regional cultures
2.	Multiplexing and Frequency Assignment	- Frequency planning for the period of simultaneous broadcasting and subsequent DSO-HD has not been completed.	- Number of programs to be multiplexed and frequency assignment during the period of simultaneous broadcasting ➢ Six-program multiplexing during the period of simultaneous broadcasting - Ideas on future operation ➢ Three-program multiplexing after the transition to HDTV ➢ Design based on DSO-HD
3.	Service diversification	- There is limited access to information.	- Introduction of data broadcasting, One-seg broadcasting, EWBS and EPG
4.	Equipment plan and cost saving	- Stabilization of platform operation is contradictory to cost-efficient operation.	- System redundancy ➢ Duplicated systems ➢ Duplication of equipment and STL/TTL links - Use of remote-control and monitoring - Compatibility with systems to be added in the future

2. Channel Plan

The Study Team conducted a field measurement survey of the existing radio waves in the whole of Sri Lanka and also performed frequency simulations to analyze the propagation of radio waves for DTTB. The channel plan shown in Figure-1 was formulated as a result of the survey and simulations based on the basic design policies. The nation is divided into seven blocks and the estimated population coverage is 84.5 % covered by 16 transmitting stations which are indicated in Figure-1. Compared to the existing analog broadcasting coverage of SLRC which is 67.2 % according to the estimation of the Study Team based on the results of the field measurement survey of the existing radio waves and frequency simulations, DTTB coverage will improve drastically.

No	Site name	Ch	Power
16 transmitting stations			
1	Colombo	Ch41,43,47,55 (48)*	5kW
2	Kokavil	Ch41,43,47,48	3kW
3	Yatiyantota	Ch41,43,47,48	2kW
4	Jaffna	Ch41,43,47,48	500W
5	Pidurutalagala	Ch41,43,47,48	300W
6	Hunnasgiriya	Ch41,43,47,48	1kW
7	Nayabedda	Ch41,43,47,48	3kW
8	Karagahtenna	Ch39,42,44,46	3kW
9	Gongala	Ch35,42,44,46	1kW
10	Trincomalee	Ch39,42,44,46	1kW
11	Vavuniya	Ch39,42,44,46	1kW
12	Suriyakanda	Ch35,42,44,46	1kW
13	Elipitiya	Ch39,42,44,46	300W
14	Primrose	Ch41,43,47,48	10W
15	Hanthana	Ch41,43,47,48	10W
16	Deniyaya	Ch35,42,44,46	10W

Note: Ch55 will be tentatively assigned to the Colombo transmitting station on the DTTB platform, and will be reassigned to another channel below Ch50 after ASO, such as Ch48.

Figure-1 Channel Plan

(Locations of and Frequencies Allocated to the Transmitting Stations and Gap-fillers)

3. DSO and ASO Plan

(A) DSO Plan

Digital Switch Over to SD (hereinafter referred to as "DSO-SD") will commence at the five separate times mentioned below in the DSO-SD Schedule in Table-4 to enable completion of DSO-SD in a short period of time. DSO-SD in Greater Colombo will be the first and will be implemented in the second quarter of 2016. In addition, transmitting stations should be developed in line with the signal flow of the platform for early DSO. Also, there might be the possibility of fine adjustment of the installation schedule through discussions among GOSL, the Consultant(s) and JICA at the stage of development of employer's requirement.

Table-4 DSO-SD Schedule

Time		Transmitting Station
1st step	June 2016	Greater Colombo (by 1 kW transmitter)
2nd step	3rd quarter of 2017	North: Kokavil, Jaffna Greater Colombo: Yatiyantota
3rd step	End of 2017	Central Mountains: Pidurutalagala Central: Hunnasgiriya South-East: Nayabedda

Time		Transmitting Station
4th step	1st quarter of 2018	North: Trincomalee Central: Karagahatenna, Vavuniya South: Gongala
5th step	2nd quarter of 2018	Central Mountains: Primrose, Hanthana South-East: Deniyaya South-West: Elpitiya South: Suriyakanda

(B) ASO Plan

Implementation of ASO while many viewers have not replaced their old sets with DTTB receivers will result in many viewers being unable to watch TV programs. On the other hand, if achievement of 100% of households with DTTB receivers is the condition for implementation of ASO, the progress of the transition to facilitate HDTV equipment at broadcasting stations will be slow and the progress of the overall process of the transition to DTTB will fall far behind schedule. Thus, it has been decided to use the proportion of households with digital receivers and population coverage as the conditions for the smooth implementation of ASO. Also, the proportion of households with TV sets, poverty ratio and electrification rate were used to divide the target area into three and different conditions for the implementation of ASO have been established for each of the three.

Taking advantage of the experience of implementing various measures before ASO in Japan and other countries, a period of five years is allocated up to the implementation of ASO in the schedule.

Table-5 Conditions for the Implementation of ASO

Area	ASO Criteria	
Greater Colombo	Ratio of households with DTTB receiver Population coverage	60 % 85 %
North and East	Ratio of households with DTTB receiver Population coverage	40 % 70 %
Others	Ratio of households with DTTB receiver Population coverage	50 % 70 %

4. Equipment Plan

Figure-2 shows a conceptual diagram of the entire DTTB system including the equipment for the digital TV center, which is in the scope of work of this Project.

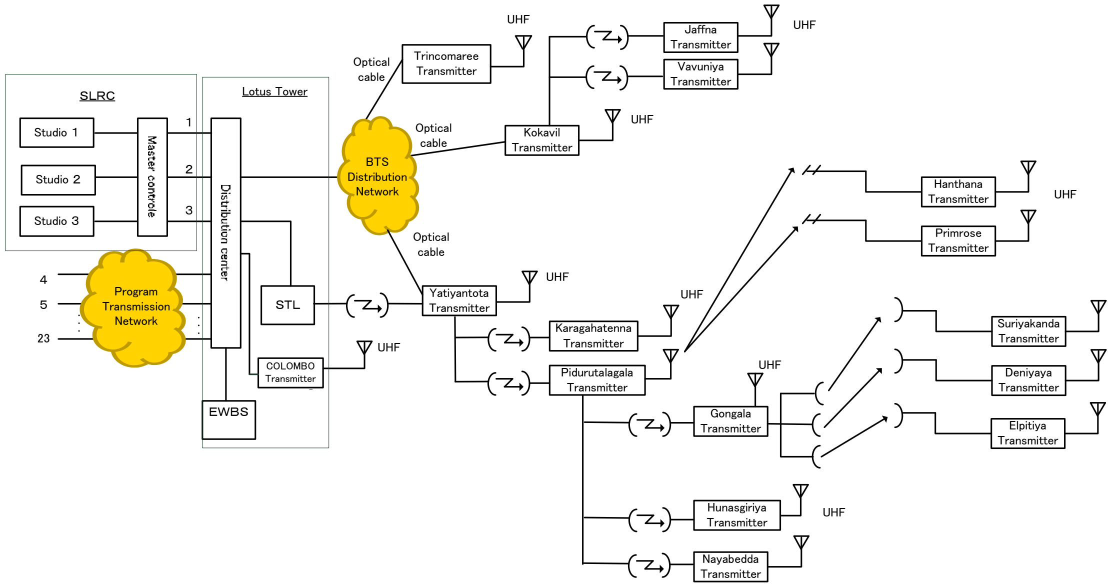


Figure-2 Conceptual Diagram of the Entire DTTB System (Including digital TV center)

The platform is required to be a reliably stable system in view of its characteristics. In order to develop such a system, it has been decided to design a transmitter for each of the transmitting stations that will compose a network covering the entire country with a degree of redundancy appropriate for its importance in the network, as mentioned in the section on design policy.

The redundancy methods are shown in Table-6 as dual exciter/parallel PA, dual transmitter and N+1 transmitter, and one of the three methods is chosen for each of the planned transmitting stations.

Table-6 Redundancy Method of Transmitting System

Redundancy method	Transmission site
Dual exciter/Parallel PA	Jaffna, Vavuniya, Trincomalee, Hunnasgiriya, Yatiyantota, Suriyakanda, Elpitiya
Dual transmitter	Pidurutalagala, Hanthana, Primrose, Deniyaya
N+1 transmitter	Colombo (Lotus Tower), Kokavil, Karagahatenna, Nayabedda, Gongala

A broadband antenna system for the four-channel broadcasting in the UHF band after the launch of DTTB and the eight-channel HD broadcasting after ASO and DSO-HD will have to be designed for this Project. It is desirable to have minimal deviation in reception electric field strength between the channels in the coverage area created by a multi frequency antenna system which radiates waves on multiple frequencies from a single transmitting antenna. It is important to select an antenna with little deviation in directionality in a wide band range. Basically, only the 4L stacked loop antenna which is widely used in Japan can be adopted in the situation described above.

In a broadcasting system that uses the UHF band, inter-station interference must be minimized and the same is true for digital terrestrial broadcasting in the UHF band. Simulation of the synthetic horizontal and vertical directionalities was conducted with simulation software repeatedly with different sets of numbers, directions and tilt angles of antenna panels and the set which gave the best result was identified.

The sizes of the coaxial feeder cables were selected on the basis of the power capacity required for the transmission of eight signals in the future eight frequency antenna system for HDTV services.

The highest recorded maximum instantaneous wind speed in Sri Lanka is 206 km/h (≈ 57.2 m/sec) recorded at the time of a cyclone attack, and the survival wind speed of 60 m/sec used by Japanese broadcasting organizations is used as the design standard. The deflection angle of a transmitting antenna installed on a tower at a wind speed of 30 m/sec should be less than 0.5 degree.

(A) Digital TV Center

With efficient digital signal compression technology, DTTB is able to transmit a greater amount of information within a given transmission band than is possible with conventional analog broadcasting. In addition, in order to make the most of the features of the ISDB-T, the following functions should be incorporated into the master control system and the digital transmitting system that comprise the nucleus of the studio equipment.

- Multi-format compliance with HD signals, SD signals and multiple channels
- Compliance with One-seg broadcasting for the reception of digital broadcasting by mobile or portable TV handsets
- Compliance with EPG for reception of electronic program data by digital broadcasting receivers
- Compliance with data broadcasting for display of data linked to program content
- Compliance with subtitle broadcasting mainly for persons with hearing difficulties

Also, all the facilities such as the master control system, three TV studio systems and two OB vans will accommodate HDTV.

(B) Power-Supply Facility

In order to ensure that DTTB fulfills its public nature and social responsibility, it is necessary to establish a power system that will never allow broadcasting to go off-the-air. The large capacity needed to operate such a system requires a high-quality power supply that will not affect the broadcasting equipment electrically.

5. Construction Plan

The construction of new antenna towers is planned in this Project at nine locations, namely, Jaffna, Trincomalee, Vavuniya, Gongala, Elpitiya, Suriyakanda, Yatiyantota, Nayabedda and Pidurutalagala.

Basically, new transmitting station buildings should be of a two-story concrete structure with a transmitter room and living quarters on the second floor, and UPS and other power supply equipment on the first floor. In addition, since the possibility of a water-cooling system must be considered with regard to transmitters of 2 kW or more, a heat exchanger should be installed outdoors. As digital transmitters, unlike in the past, are basically monitored and controlled with no human involvement, transmitting stations where small and medium power transmission systems are installed should not be provided with accommodation facilities. In addition, the equipment and systems should be so designed that the whole transmitting station can be operated in future via unmanned monitoring. However, it was decided that a nap room should be provided for emergencies.

The Network Operation Center of the DBNO will be established in the Lotus Tower, but the Lotus Tower might not have enough space to accommodate the other DBNO offices. Therefore, the construction of a separate DNBO administration building is planned. It is assumed that the construction site will be next to the TV studio station building within the grounds of SLRC.

The construction costs were estimated by calculating the area required on the assumption that the DBNO personnel will work in the administration building. The cost was estimated on assumptions such as an estimated floor area of 2,000 m^2 and a two-story, reinforced concrete (RC) building.

6. Operation of DBNO

The Study Team estimated that the number of DBNO personnel will be 105 persons, and a Technical Division, Marketing Division and Administration Division will be organized under the Board of Directors.

The costs required for operation and maintenance of the DBNO are divided into the following seven categories for calculation; (1) Personnel costs, (2) Electricity costs, (3) Repair and maintenance costs, (4) Tower rental fees, (5) SLT optical fiber link fees, (6) Frequency license fees, and (7) Other expenses. The results of the calculations are shown in Table-7.

Table-7 O&M Cost of DBNO

Item	Cost (million Rs.)	Remarks
Personnel expenses	90.2	Annual
Annual electricity expenses	149	In 2018
Maintenance work (personnel) and procurement of spare parts	10.8	Annual
Painting of transmission towers	67.5	11 towers will be painted every 10 years
Overhaul	174	In 2024 (see Table 7.6-5)
Replacement of equipment	977 4,822	In 2031 In 2038
Rental fee for transmission towers	9.0	Annual rental fee
Optical fiber line charge	94.1	Annual charge
License fee (frequency/multiplexing)	5	Annual
Other costs	7.5	Annual

7. Technological and Other Advantages of Japanese Products

Japanese products have several advantages for broadcasting equipment compared to other countries' products as follows.

(A) Transmission link system

The compressor used to compress the "broadcasting TS" signals from four program channels and transmit them on the high-speed digital link, and the decompressor to be installed in each transmitting station to expand the "broadcasting TS" signals, were originally developed by Japanese companies, which also hold the intellectual property rights. The multiplexer that is connected to the compressor needs to be manufactured by the Japanese compressor manufacturer, because it has to synchronize with the compressor.

(B) NOC system

The system consists of a multiplexer, input and output monitoring systems, EWBS transmitting system, EPG production system, equipment monitoring system and call center. This system is specific to Japan, and no other country has such a system. Although it is commonly used in Japan, no other countries have such a system.

(C) Master Control System for digital TV center

The expertise of Japanese companies with a wide range of achievements and experience is necessary: no other country has the expertise to accommodate the various necessary functions such as enabling central management of the data, unified control protocol, centralization of the protocol for gathering alarm and other status information and collecting alarm status, etc.

(D) High power transmitter system

The high power transmitter system (1kW or higher) includes an exciter with a distortion compensation function in the pre-stage to compensate for the distortion generated by the power amplifier to the whole transmitter system. Therefore, exciter manufacturers have an advantage when it comes to supplying the system.

8. Examination of Project Evaluation Indicators

Table-8 shows the proposed operation and effectiveness indicators. The target time of the indicators is set at December 2020, three years after completion of the Project.

Table-8 Operation and Effectiveness Indicators (Proposed)

Evaluation indicator	Indicator	Unit	Target value (by 2020)
Operation	(1) PF transmitter equipment downtime ratio *	(Number of downtime days due to failure x 4 systems x 16 locations)/Planned number of operating days (4 systems×16 locations)	8.2%
	(2) Number of DTTB program systems *	Number of DTTB program systems/Total number of program systems x 16 locations	11.1 program systems
	(3) PF usage fee collection rate *	Number of collections/ Number of claims	70%

Evaluation indicator	Indicator	Unit	Target value (by 2020)
	(4) Equipment downtime ratio **	(Number of downtime days due to failure x 5 systems)/Planned number of operating days x 5 systems)	8.2%
	(5) DTTB hours by HD system **	Broadcasting hours/day	10 hours
Benefit	(1) Population coverage*	Population in covered area/Total population	84.5%
	(2) Number of beneficiaries*	Population within province x ASO progress rate x Population coverage x Household diffusion rate of TV sets x value considering rush demand for receiver replacement (Western Province: 5,837,294 x 0.95 x 0.85 x 0.6 x 0.5) (Northern and Eastern Provinces: 2,476,840 x 0.6 x 0.7 x 0.4 x 0.5) (Others : 8,121,321 x 0.6 x 0.7 x 0.5 x 0.5)	2,474,000 persons
	(3) Data broadcasting program broadcasting hours**	Number of data broadcasting program broadcasting hours /month (program-linked and non-program-linked combined)	570 hours

PF: Platform

(6) Execution Plan

1. Project Implementation Plan

(A) Examination of Project Implementation Structure

The executing agency of this Project is the MMI, and the project management unit (hereinafter referred to as "PMU"), which is the supervisory organization for project implementation set up by the executing agency, will be established under the auspices of MMI. The PMU operates under the supervision of the Project Director (hereinafter referred to as the "PD") appointed by the Government of Sri Lanka. To deal with the various components of the Project, a Steering Committee (hereinafter referred to as the "SC") chaired by the secretary of MMI will be established to coordinate the different organizations. DBNO, SLRC, TRC and Ministry of Finance and Planning will be positioned under the PMU to implement each component of the Project. Figure-3 is a diagram of the implementation structure of the Project, showing the relationship between the SC and the PMU.

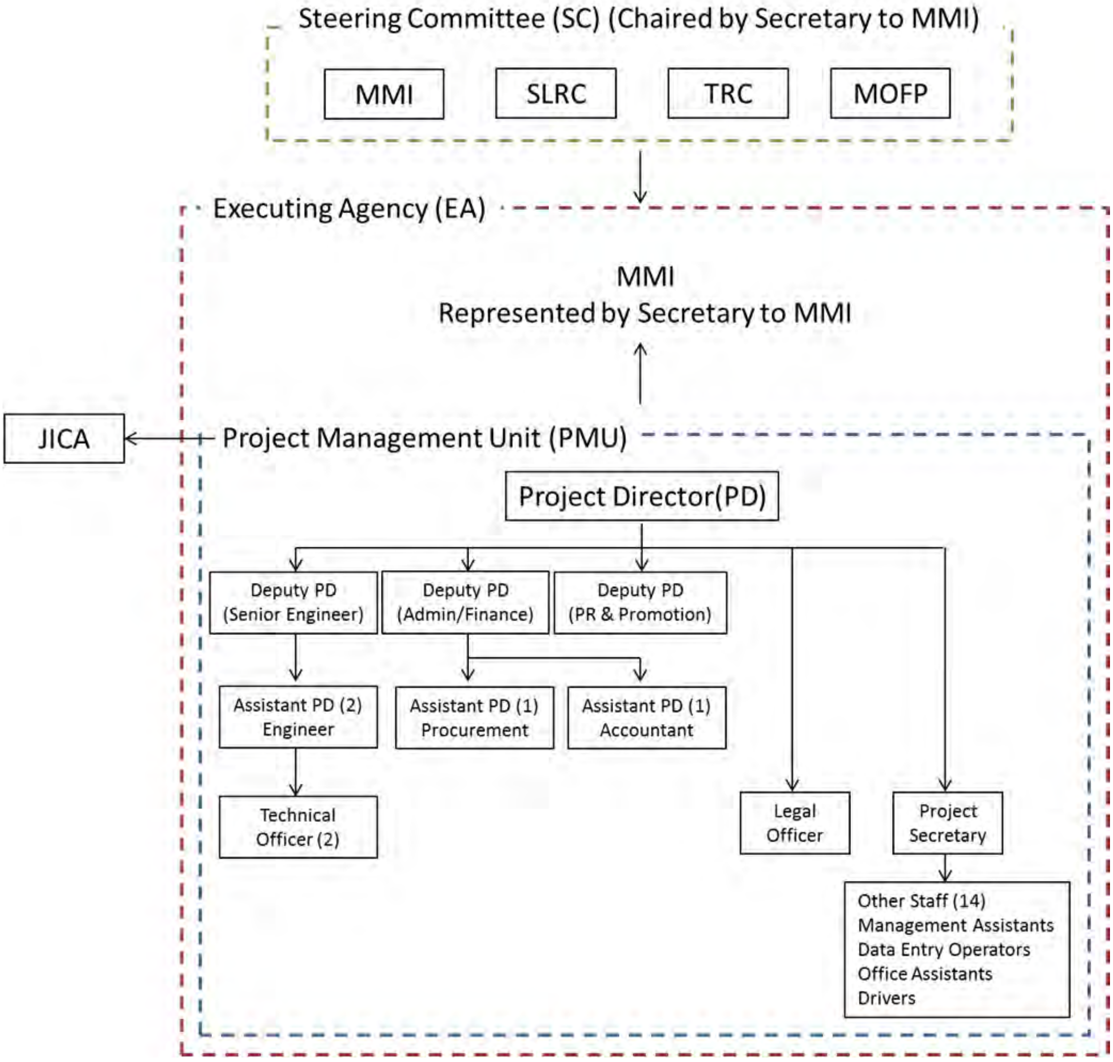


Figure-3 Implementation Structure

(B) Examination of Project Implementation Schedule

The assumed schedule for the selection of consultants and contractor(s) in this Project is examined based on the procedures for public works in Sri Lanka and the project schedule for ODA loans implemented in the past in Sri Lanka.

The plan for development of the employer's requirements considers the problems pointed out during this study to enable prompt DSO-SD in Greater Colombo. In setting the period for each work, in light of the technical skills of the installation and construction subcontractors in Sri Lanka, an appropriate schedule should be established.

It is estimated that the construction and installation will be completed within 46 months of the conclusion of the contract with the consultant after the tender, and that the warranty period will also end within 55 months according to the schedule.

(C) Examination of Division of Work between Lotus Tower Project and the Project

The Lotus Tower is being constructed by the Government of Sri Lanka with funding from China. Most of the equipment for the DTTB platform that the DBNO will operate will be installed in the Lotus Tower. Construction of the Lotus Tower has already started. However, the design of the Lotus Tower is based on the European standard for digital terrestrial broadcasting. It is necessary that MMI and TRC clarify the demarcation of work at the start of the Project.

2. Operation and Maintenance Plan

This operation and maintenance plan covers the transmitters, transmitting antennas, TV studio systems, master control system and NOC equipment of the DBNO. In order to renew the equipment in an appropriate manner, it is necessary to reserve a certain amount of money every year to reduce the financial burden at the time of renewal. Table-9 shows the equipment renewal plan and the overhaul and maintenance periods. The reserve fund for the DBNO equipment should be sourced from the revenues from DBNO operation and advertising, and the advertising revenues of SLRC should be used for the SLRC equipment.

Table-9 Equipment Renewal Plan

Category	Equipment	Renewal	Overhaul & Maintenance
DBNO Equipment	Transmitter	After 21 years	Every 7 years
	Transmitting antenna	After 40 years	Unnecessary
	Equipment for NOC	After 14 years	Every 7 years
Digital TV Center Equipment	TV studio equipment and OB vans	After 14 years	Every 7 years
	Equipment for MCS	After 14 years	Every 7 years

(7) Examination of Technical Assistance

1. Tasks Needed in the Transition to DTTB

A number of tasks will need to be undertaken simultaneously in order to bring about the transition to DTTB. In addition to creating the basic design required for the establishment of the DTTB platform and the building construction and equipment procurement required for the establishment of the digital TV center, this Project also examined the technical assistance by Japan that appears to be essential for the transition to DTTB.

In this examination, therefore, the guidelines prepared by ITU for the creation of the ITU Roadmap for the Transition to DTTB were used as the basis from which to extract the items that generally seem to be required, because the ITU Roadmap serves as part of the master plan for the transition to DTTB in Sri Lanka. The 36 extracted items were classified by category in consideration of progress in the transition to DTTB.

2. Outline of Technical Assistance

Each component/item of technical assistance is categorized into technical support conducted under consulting services or other technical assistance implemented by other projects or activities.

(A) Technical Support

- Frequency Plan for Start of HD Broadcasting Service
  The comprehensive frequency plan was studied in line with the channel plan in the basic design. The next task in the comprehensive frequency plan is the allocation of frequencies to HD broadcasting. Also, it is necessary to consider the comprehensive frequency including the use of the digital dividend after ASO. With regard to the use of the digital dividend, which is the above-mentioned frequency band, the technical information required by the Government of Sri Lanka to determine policy, such as use for mobile phones, will be provided so that a farsighted, comprehensive frequency plan can be drawn up.

- Preparation of Technical Standards
  The technical standards for receivers and transmitters will be examined. The determination of the specifications involves the selection of the necessary parameters from among the many available choices. Receivers, on the other hand, will require specifications unique to Sri Lanka in order to provide language support, such as captions in Sinhalese, Tamil and English. The standards must be announced officially as soon as they have been determined so that viewers can purchase the appropriate imported products.

- Compatibility test for receivers
  The compatibility test for receivers at the test center will test whether products comply with the specifications prepared through preparing the technical standards. The test center will check the hardware, such as the various models of STBs and TV sets, and will conduct device-by-device verification of the data broadcasting programs.

(B) Technical Assistance to be Discussed as JICA Technical Cooperation Project

- Advice on reception issues for viewers

  As for advice on reception for viewers, it is assumed that the call center will basically cover all of the activities aimed at viewers. The call center will be established in DBNO so that inquiries can be handled in cooperation with the engineers. In fact, inquiries from viewers will have to be handled on a case-by-case basis depending on the reception status and individual household circumstances, such as renovation of the reception facilities, replacement of the TV set, or purchase of an STB. The call center will not simply answer inquiries, questions, etc. from viewers, but will also communicate information needed by the viewers and hold explanatory meetings in various areas. It will also share with broadcasting organizations the information required for promotion.

- Capacity Development in Production of Data Broadcasting Programs

  This assistance will be aimed at comprehensive capacity building including the following content.

  - Training in Data Broadcasting Program Production
  - Capacity Development in Data Broadcasting Utilization (Establishment of data broadcasting program production departments, development of educational programs, and development of programs providing public information on health services, etc.)
  - Capacity Development in Disaster Broadcasting Utilizing Data Broadcasting (Preparation of disaster broadcasting criteria/operating manuals, improvement of the emergency broadcasting program production system, and preparation of operating guidelines and manuals for EWBS)
  - Development of Sports Programs Utilizing Data Broadcasting

- Future Assistance to Be Considered (Capacity Development in Disaster Broadcasting)

  The content of the assistance is assumed to be four points: establishment of an EWBS operation plan, preparation of equipment management guidelines, preparation of disaster broadcasting guidelines and preparation of a disaster broadcasting manual, including the preparation of guidelines, training of broadcasting station personnel in providing emergency broadcasting in times of disaster, and EWBS operation training.

(8) Recommended Action Items for DTTB by the Study Team

For smooth transition to DTTB through the execution of this Project, the Study Team identified further action items that it recommends be conducted by the Government of Sri Lanka. The recommended action items are mentioned by category below. The transition to DTTB is related to various sectors and agendas or issues, and therefore, time schedule management of each implementation is an important factor for achievement of digitalization. Hence, prompt execution by the government after determination of the standards is required.

1. Formulation of Plan and Standards

(A) Examination of frequency plan

The transition to DTTB will enable the use of many frequencies for other purposes than TV broadcasting. Thus, it is necessary to consider the efficiency of future frequency assignment so a certain band can be used for HD broadcasting to prevent assignment of random channels. Three issues, (1) digital dividend, (2) number of multiplexed HD programs, and (3) consideration of efficiency of future frequency assignment, need to be considered in frequency planning. The frequency plan should be reviewed before completion of the development of the employer’s requirements in the Project.

(B) Formulation of receiver and transmitter standards

ISDB-T broadcasting has already started on a trial basis and viewers may purchase receivers even in the test period. Thus, receiver and transmitter standards should be formulated soon to define the receivers and transmitters that should be available in Sri Lanka.

(C) Formulation of licensing criteria

The legal requirements for opening a broadcasting station are clearly stated in the existing laws and standards. However, they need to be amended so that they can be applied to DTTB, and standards for dividing into segments including data broadcasting and One-seg broadcasting need to be added. Also, radio waves will be emitted by DBNO and broadcasting contents will be provided by program providers thorough DBNO that are different from the current broadcaster system. It is necessary to determine the necessary criteria and clarify at an early stage the requirements for obtaining a program provider license so that current broadcasters can smoothly make the shift to program providers.

2. Establishment and Revision of Relevant Laws and Regulations

(A) Revision of broadcasting laws and regulations

When the DTTB platform is developed, the two entities, “contents provider” and “facility provider,” need to be defined clearly and their responsibilities need to be clarified in the revised laws. The Government of Sri Lanka is considering the revision of current laws to include the above matters. However, it would be preferable to examine the legal system concerned, including the regulations and standards, as the existing broadcasting-related laws are limited to the Sri Lanka Rupavahini Corporation Act and the Sri Lanka Telecommunications Act. There is also a need to think about the promotion of new entry and careful implementation of license renewal screening for current service providers in order to create a diverse and sound broadcasting culture in consideration of the local characteristics.

(B) Formulation of DBNO Act and Establishment of DBNO

The roles, responsibilities, funding and fund collection methods of the DTTB platform operator, the DBNO, need to be legally defined prior to its establishment.

3. Assistance with Policy Development and Penetration

(A) Promotion of DTTB Penetration

Promotion of DTTB penetration, targeted at viewers, is the key to smooth transition to DTTB. Formulation of comprehensive promotion measures directly affects whether ASO can be carried out as scheduled. In Japan, multilateral dissemination and promotion measures were implemented to enable ASO as planned. If a review of the dissemination and promotion measures in Japan and an examination of whether they can be utilized or not are made by the Sri Lankan government, most of the examination of dissemination and promotion measures will be achieved.

(B) Import of equipment compatible with DTTB

It is likely to be difficult for Sri Lankan manufacturers to produce receivers, STBs and mobile devices compatible with DTTB immediately after the transition to digital broadcasting, so Sri Lanka will have to depend on imported products for the time being. One way to assist the situation will be customs duty exemption for DTTB receivers for a certain period. If a temporary exemption is applied and STBs are imported without tax for purchase by every Sri Lankan household, the Government of Sri Lanka will have 790 million yen less tax revenue, which will be offset by the 13 percent value added tax on the purchase of STBs. When sales of mobile terminals, etc., are included, the tax revenue will increase in total by the economic effect. It will lead to indirect financial assistance for viewers and will bring certain effects.

Meanwhile, broadcasting organizations will need to take measures to make their TV studios and master control systems compatible with HD. Although the Government of Sri Lanka is not planning to provide direct financial assistance to them, facility replacement will require a large amount of investment and tax exemption measures that lead to indirect financial assistance will serve as effective assistance.

(C) Conduct of compatibility test for receivers by test center

Proper receivers need to be available in the retail market so that their prevalence will not be hindered. To this end, a compatibility test for receivers should be conducted by the test center to verify the compatibility before they are launched in the market.

4. Capacity Development in Utilization of Digital Broadcasting

The three working groups (WGs) below are expected to be set up to address capacity development in utilization of digital broadcasting to effectively use the functions unique to digital broadcasting. It is important to include personnel from private broadcasting organizations in the WGs.

(A) Technical standard WG

Establishment of technical standards for transmission and reception is essential. The specifications of the equipment and receivers to be purchased need to be controlled in accordance with the standards. Without technical standards, the situation may arise in which the procured items are not compatible with the interface.

(B) Contents WG

It will be effective to set up a WG to carefully examine the program contents in order to provide advanced and quality services unique to ISDB-T such as data broadcasting, mobile TV, EPG, closed-caption broadcasting, and EWBS. From a proactive point of view, there is room for discussion of establishing the WG in the form of an association or the like organized by broadcasting companies. In such a case, it will be possible to provide technical assistance as Japanese ODA projects for employees of private broadcasting companies through the association.

(C) HR development WG

Digital technology requires equipment operation and management and production approaches that are different from the current ones. It is necessary to develop human resources, targeting not only government employees but also private broadcasting company employees to realize reliable broadcasting with the DTTB platform. It will be possible to provide technical training programs as Japanese ODA projects if the broadcasting organizations operate the WG in the form of an association. In which field and on what scale HR training is needed and whether it is possible to conduct HR development training in Sri Lanka should be carefully examined, and the WG should formulate guidelines for HR development.

5. Lotus Tower Demarcation and Adopted Design for HDTV

It has become foreseeable through due discussions between the Study Team and concerned parties that the Lotus Tower will be usable as the Colombo transmitting station, that is, the prominent transmitting station on the DTTB platform, and as the NOC of the platform. This is because TRC and the Lotus Tower Project conducted a review necessary for applying the basic design policy of the Study Team to the Lotus Tower. However, the demarcation of work between the Lotus Tower project and this Project has not yet been determined, and therefore the Government of Sri Lanka needs to decide the division of work promptly.

6. Land Acquisition

(A) Land for transmitting stations

Although most of the existing transmitting stations will be used, five new stations are to be constructed according to the basic design. Attention needs to be paid to completing the land acquisition before the development of the employer's requirements so that it will not affect the requirements.

(B) Land for DBNO administration building

Because there is no space for the DBNO administration in the Lotus Tower, the basic design involves building an administration building separately from the Lotus Tower. However, because remote monitoring equipment will also be brought into the building, it is preferable that the land is acquired before the development of the employer's requirements.

7. PMU Launch

A project management unit (PMU) will be set up during the implementation period of the yen loan project. The PMU needs to build a structure for proper implementation of procurement, operation and management in the Project. The participation in the PMU of human resources capable of working cross-organizationally needs to be considered.

8. Launch of Trial Broadcasting

ISDB-T test broadcasting is currently carried out in Sri Lanka with assistance from the Japanese government. The test broadcasting will be followed by experimental broadcasting and then by full-scale broadcasting. DSO-SD is proposed by the Study Team in the second quarter of 2016. There is a need to decide whether to shift from the current test broadcasting to experimental broadcasting seamlessly or to conduct the experimental broadcasting just in a short period during installation work when the test wave is transmitted during project execution.

Chapter 1 Introduction

Chapter 1 Introduction

1.1 Background to the Study

The government of Democratic Socialist Republic of Sri Lanka (hereinafter referred to as “Sri Lanka”) in 2010 approved in a Cabinet decision the adoption of the European standard (hereinafter referred to as DVB-T2) for Digital Terrestrial Television Broadcasting (hereinafter referred to as “DTTB”), and has been promoting digitalization with the aim of discontinuing analog broadcasting by 2017. In Sri Lanka there are two national broadcasting networks; Sri Lanka Rupavahini Corporation (hereinafter referred to as “SLRC”) and Independent Television Network Ltd. (hereinafter referred to as “ITN”). TV coverage reaches as much as 95% of the national population. For the introduction of DTTB, the government of Sri Lanka is considering the development of a DTTB platform (see Clause 2-1 Recognition of Issues regarding “Platform Development” to be Solved and Examined in the Study) so that national and private broadcasting stations can switch to DTTB smoothly via the platform.
Meanwhile, since Sri Lanka has in the past frequently experienced all kinds of natural disasters, including the Indian Ocean Tsunami generated by the Great Sumatra-Andaman earthquake of 2004, disaster prevention is recognized as an essential development issue in this country; and Japan has also been offering strong support in this area. Under such circumstances, in view of the fact that the Emergency Warning Broadcasting System (hereinafter referred to as “EWBS”), a distinctive function of the Japanese Integrated Services Digital Broadcasting (hereinafter referred to as “ISDB-T”) is better suited than the DVB-T2 with respect to disaster prevention, and considering that SLRC has received support from Japan in the past (2010 general cultural grant aid "The Project for the Improvement of TV Production Equipment of Sri Lanka Rupavahini Corporation", etc.), the government of Sri Lanka decided to reconsider and change from DVB-T2 to ISDB-T.

Following the visit to Japan by President Rajapaksa in April 2013, the government of Sri Lanka announced that a Study Team would be welcomed and that a test broadcast of ISDB-T would be carried out in Colombo under the initiative of the Ministry of Internal Affairs and Communications.

1.2 Objectives of the Study

The objectives of the Study are to examine and evaluate the project, including its validity and necessity, abstract, project cost, implementation schedule, implementation method (procurement and installation of equipment), implementation structure, operating and maintaining system, etc., in order to bring about the switchover to DTTB through the development of the DTTB platform planned by Sri Lanka. A further objective is to examine those matters required for screening to implement the project as an international ODA loan project of Japan.

1.3 Schedule of the Study

The study was carried out in five phases. The work schedule for each phase was as follows.

Table 1.3-1 Schedule of 1st Work in Sri Lanka

No	Date	Schedule
1	26 – May	Transfer to Sri Lanka, Internal Meeting
2	27 – May	Meeting on Radio Wave Measurement, Internal Meeting
3	28 – May	Courtesy call to JICA Sri Lanka Office
4	29 – May	Courtesy call to EOJ, MMI, JICA Sri Lanka Office
5	30 – May	Meeting with SLRC, ITN, Ministry of Finance and Planning
6	31 - May	Meeting with EOJ, TRC, MMI
7	1 - Jun	Site visit to a transmitting station
8	2 – Jun	Internal Meeting
9	3 – June	Signing of the Minutes of Discussions with MMI
10	4 – Jun	Discussions with SLRC
11	5 – Jun	Collection of basic information, Internal Meeting
12	6 – Jun	Meeting with MMI, ITN
13	7 – Jun	Discussions with SLRC
14	8 – Jun	Analysis of the collected information
15	9 – Jun	Internal Meeting
16	10- Jun	Survey of antenna market in Colombo suburb (Maharagama, Homagama)
17	11- Jun	Survey of existing transmitting stations (South area)
18	12 – Jun	Survey of existing transmitting stations (Suriyakanda)
19	13 – Jun	Discussions with SLRC
20	14 – Jun	Reporting to TRC, JICA Sri Lanka Office
21	15 – Jun	Return to Tokyo

Table 1.3-2 Schedule of 2nd Work in Sri Lanka

No	Date	Schedule
1	27 – Jul	Transfer to Sri Lanka
2	28 – Jul	Internal Meeting
3	29 – Jul	Picture Quality Evaluation Meeting, Meeting with SLRC
4	30 – Jul	Meeting with JICA Sri Lanka Office
5	31 – Jul	Meeting with MMI
6	1 – Aug	Meeting with Secretary to MMI
7	2 – Aug	Presentation of Channel Plan to concerned parties, Meeting with EOJ
8	3 – Aug	Preparation for site survey, Internal Meeting
9	4 – Aug	Preparation for site survey, Internal Meeting
10	5 – Aug	Site Survey A Group (Kandy Area)
11	6 – Aug	Site Survey A Group (Kandy Area)
12	7 – Aug	Site Survey A Group (Kandy Area)

No	Date	Schedule
13	8 – Aug	Site Survey A Group (Kandy Area)
14	9 – Aug	Site Survey A Group (Kandy Area)
15	10 – Aug	Preparation for site survey, Internal Meeting
16	11 - Aug	Preparation for site survey, Internal Meeting
17	12- Aug	Site Survey B, C, D Group (North, South, Central Area)
18	13 –Aug	Site Survey B, C, D Group (North, South, Central Area)
19	14 –Aug	Site Survey B, C, D Group (North, South, Central Area)
20	15 – Aug	Site Survey B, C, D Group (North, South, Central Area)
21	16 – Aug	Site Survey B, C, D Group (North, South, Central Area)
22	17 – Aug	Data Analyzing
23	18 – Aug	Data Analyzing
24	19 - Aug	Meeting with JICA Sri Lanka Office, SLRC, TRC
25	20- Aug	Intermediate Report, Internal Meeting
26	21 –Aug	Meeting with Central Environmental Authority (CEA)
27	22 –Aug	Meeting with SLRC
28	23 – Aug	Meeting with MMI, Ministry of Plantation Industries
29	24 – Aug	Data Analyzing
30	25 – Aug	Data Analyzing
31	26 – Aug	Meeting with ITN
32	27 – Aug	Meeting with Disaster Management Center and MMI
33	28 – Aug	Site Survey (Karagahtenna)
34	29– Aug	Site Survey (Nayabedda)
35	30 –Aug	Meeting with SLT, Meteorological Department
36	31 –Aug	Data Analyzing
37	1 – Sep	Data Analyzing
38	2 – Sep	Internal Meeting
39	3 – Sep	Preparation of the Progress Report
40	4 – Sep	Site Survey (Trincomalee)
41	5 – Sep	Preparation of the Progress Report
42	6 – Sep	Preparation of the Progress Report
43	7 –Sep	Cost Estimation, filing of documents, Site Survey (Yatiyantota)
44	8- Sep	Cost Estimation, filing of documents
45	9 –Sep	Meeting with MMI, EOJ
46	10 –Sep	Preparation of the Progress Report
47	11 –Sep	Presentation to the Minister to MMI, Meeting with JICA Sri Lanka Office
48	12 –Sep	Site Survey (South Area)
49	13 –Sep	Meeting with Moratuwa University, Report to JICA Sri Lanka Office

No	Date	Schedule
50	14 –Sep	Return to Tokyo

Table 1.3-3 Schedule of 3rd Work in Sri Lanka

No	Date	Schedule
1	3 – Nov	Transfer to Sri Lanka
2	4 – Nov	Internal Meeting, Courtesy call to JICA Sri Lanka Office
3	5 – Nov	Preparation of report
4	6 – Nov	Meeting with ITN
5	7 – Nov	Meeting with TRC
6	8 – Nov	Meeting with SLRC
7	9 – Nov	Data Analyzing
8	10 – Nov	Data Analyzing
9	11 – Nov	Meeting with SLRC, Shin Nippon Lanka
10	12 – Nov	Meeting with TRC
11	13 – Nov	Meeting with TRC
12	14 – Nov	Meeting with MFP, Mitsubishi Corp.
13	15 – Nov	Preparation of report
14	16 – Nov	Data Analyzing
15	17 – Nov	Data Analyzing
16	18 – Nov	Site survey (Suriyakanda)
17	19 – Nov	Site survey (Nayabedda, Pidurutalagala)
18	20 – Nov	Site survey (Karagahatenna), TV conference with MIC, Meeting with SLRC
19	21 – Nov	Site survey (Yatiyantota)
20	22 – Nov	Meeting with MMI, JICA, SLRC
21	23 – Nov	Data Analyzing
22	24 – Nov	Data Analyzing
23	25 – Nov	Meeting with EOJ
24	26 – Nov	Meeting with Maspro
25	27 – Nov	Meeting with MMI
26	28 – Nov	Digital Terrestrial Broadcasting Seminar, Meeting with JICA contact mission team
27	29 – Nov	Digital Terrestrial Broadcasting Seminar
28	30 – Nov	Site survey
29	1 – Dec	Data Analyzing
30	2 – Dec	Meeting with JICA contact mission team
31	3 – Dec	Meeting with JICA contact mission team, Lotus Tower project
32	4 – Dec	Meeting with TRC, MMI

No	Date	Schedule
33	5 – Dec	Preparation of report
34	6 – Dec	Wrap-up meeting with JICA contact mission team, EOJ, JICA Sri Lanka Office
35	7 – Dec	Data Analyzing
36	8 – Dec	Data Analyzing
37	9 – Dec	Preparation of report
38	10 – Dec	Preparation of report
39	11 – Dec	Preparation of report
40	12 – Dec	Video conference with MIC
41	13 – Dec	Meeting for Lotus Tower project
42	14 – Dec	Data Analyzing
43	15 – Dec	Data Analyzing
44	16 – Dec	Preparation of report
45	17 – Dec	Preparation of report
46	18 – Dec	Meeting with Maspro Lanka
47	19 – Dec	Meeting for Lotus Tower project
48	20 – Dec	Preparation of report
49	21 – Dec	Data Analyzing
50	22 – Dec	Data Analyzing
51	23 – Dec	Preparation of report
52	24 – Dec	Meeting for Lotus Tower project
53	25 – Dec	Data Analyzing
54	26 – Dec	Meeting for Lotus Tower project
55	27 – Dec	Meeting with EOJ, JICA Sri Lanka Office for Lotus Tower project
56	28 – Dec	Return to Tokyo

Table 1.3-4 Schedule of 4th Work in Sri Lanka

No	Date	Schedule
1	8 – Jan	Transfer to Sri Lanka
2	9 – Jan	Meeting for Lotus Tower project
3	10 – Jan	Meeting for Lotus Tower project
4	11 – Jan	Data Analyzing
5	12 – Jan	Data Analyzing
6	13 – Jan	Meeting for Lotus Tower project
7	14 – Jan	Preparation of report
8	15 – Jan	Preparation of report
9	16 – Jan	Preparation of report

No	Date	Schedule
10	17 – Jan	Return to Tokyo
11	18 – Jan	
12	19 – Jan	
13	20 – Jan	
14	21 – Jan	
15	22 – Jan	
16	23 – Jan	
17	24 – Jan	
18	25 – Jan	
19	26 – Jan	
20	27 – Jan	
21	28 – Jan	
22	29 – Jan	
23	30 – Jan	Transfer to Sri Lanka
24	31 – Jan	Preparation of report
25	1 – Feb	Preparation of report
26	2 – Feb	Preparation of report
27	3 – Feb	Meeting with JICA Sri Lanka Office, EOJ
28	4 – Feb	Preparation of report
29	5 – Feb	Preparation of report
30	6 – Feb	Preparation of report
31	7 – Feb	Meeting with MMI
32	8 – Feb	Preparation of report
33	9 – Feb	Preparation of report
34	10 – Feb	Meeting for Lotus Tower project
35	11 – Feb	Preparation of report
36	12 – Feb	Preparation of report
37	13 – Feb	Meeting for Lotus Tower project
38	14 – Feb	Preparation of report
39	15 – Feb	Preparation of report
40	16 – Feb	Preparation of report
41	17 – Feb	Preparation of report
42	18 – Feb	Preparation of report
43	19 – Feb	Meeting with MMI
44	20 – Feb	Meeting with JICA, meeting for Lotus Tower project
45	21 – Feb	Preparation of report
46	22 – Feb	Preparation of report

No	Date	Schedule
47	23 – Feb	Preparation of report
48	24 – Feb	Meeting with JICA contact mission team, MMI, TRC, SLRC
49	25 – Feb	Meeting with JICA contact mission team, TRC
50	26 – Feb	Meeting with JICA contact mission team, MMI, TRC, SLRC, ITN
51	27 – Feb	Site visits (SLRC, Lotus Tower)
52	28 – Feb	Return to Tokyo

Table 1.3-5 Schedule of 5th Work in Sri Lanka

No	Date	Schedule
1	1 - June	Transfer to Sri Lanka
2	2 – June	Meeting for Lotus Tower project
3	3 – June	JICA Sri Lanka Office
4	4 – June	Meeting for Lotus Tower project
5	5 – June	Meeting for Lotus Tower project
6	6 – June	Meeting for Lotus Tower project
7	7 – June	Examination of layout of Lotus Tower
8	8 – June	Examination of layout of Lotus Tower
9	9 – June	Meeting for Lotus Tower project, Meeting with JICA for Appraisal mission
10	10- June	Pre-meeting for Appraisal
11	11- June	Pre-meeting for Appraisal
12	12 – June	Preparation of report
13	13 – June	Preparation of report
14	14 – June	Preparation of report
15	15 – June	Return to Tokyo

1.4 Contents of the Study

1.4.1 1st Work in Japan (from the end of October to the end of November, 2012 and from the beginning of May to the middle of May, 2013)

(1) Data collection and examination of related materials

(2) Preparation of a study plan

(3) Preparation of the Inception Report

1.4.2 1st Work in Sri Lanka (from the middle of May to the middle of June, 2013)

(1) Presentation to the concerned parties

(2) Confirmation of the need for and relevance of the Project

(3) Local office launch

1.4.3 2nd Work in Japan (from the middle of June to the end of July, 2013)

(1) Examination of the project overview – 2nd stage

(2) Simulation for development of channel plan

1.4.4 2nd Work in Sri Lanka (from the end of July to the middle of September, 2013)

(1) Discussions with the government of Sri Lanka

(2) Meeting with JICA Sri Lanka Office and JICA Headquarters

(3) Site visit to a transmitting station

(4) Examination of financial affairs

(5) Examination of procurements

(6) Examination of related parties

(7) Progress briefing

1.4.5 3rd Work in Japan (from the middle of September to the end of October, 2013)

(1) Preparation of Interim Report

1.4.6 3rd Work in Sri Lanka (from the end of October to the end of December, 2013)

(1) Preparation of Interim Report

(2) Preliminary design

(3) Confirmation of the project implementation schedule

(4) Confirmation of a platform management system

(5) Confirmation of estimated project cost

(6) Discussion of points of concern

(7) Confirmation of evaluation indicators

1.4.7 4th Work in Japan (from the middle of January to the end of January, 2014)

(1) Preparation of the Draft Final Report

1.4.8 4th Work in Sri Lanka (from the middle of January to the end of February, 2014)

(1) Discussion of the Draft Final Report

1.4.9 5th Work in Japan (from the beginning of March to the beginning of August, 2014)

(1) Briefing session in Japan

(2) Review of preliminary design

(3) Review of estimated project cost

(4) Preparation of the Final Report

1.4.10 5th Work in Sri Lanka (from the beginning of June to the middle of June, 2014)

(1) Cooperation in Appraisal

(2) Meeting with for Lotus Tower project

1.5 Work Outsourced in Japan

1.5.1 Electric Field Strength Measurement Survey

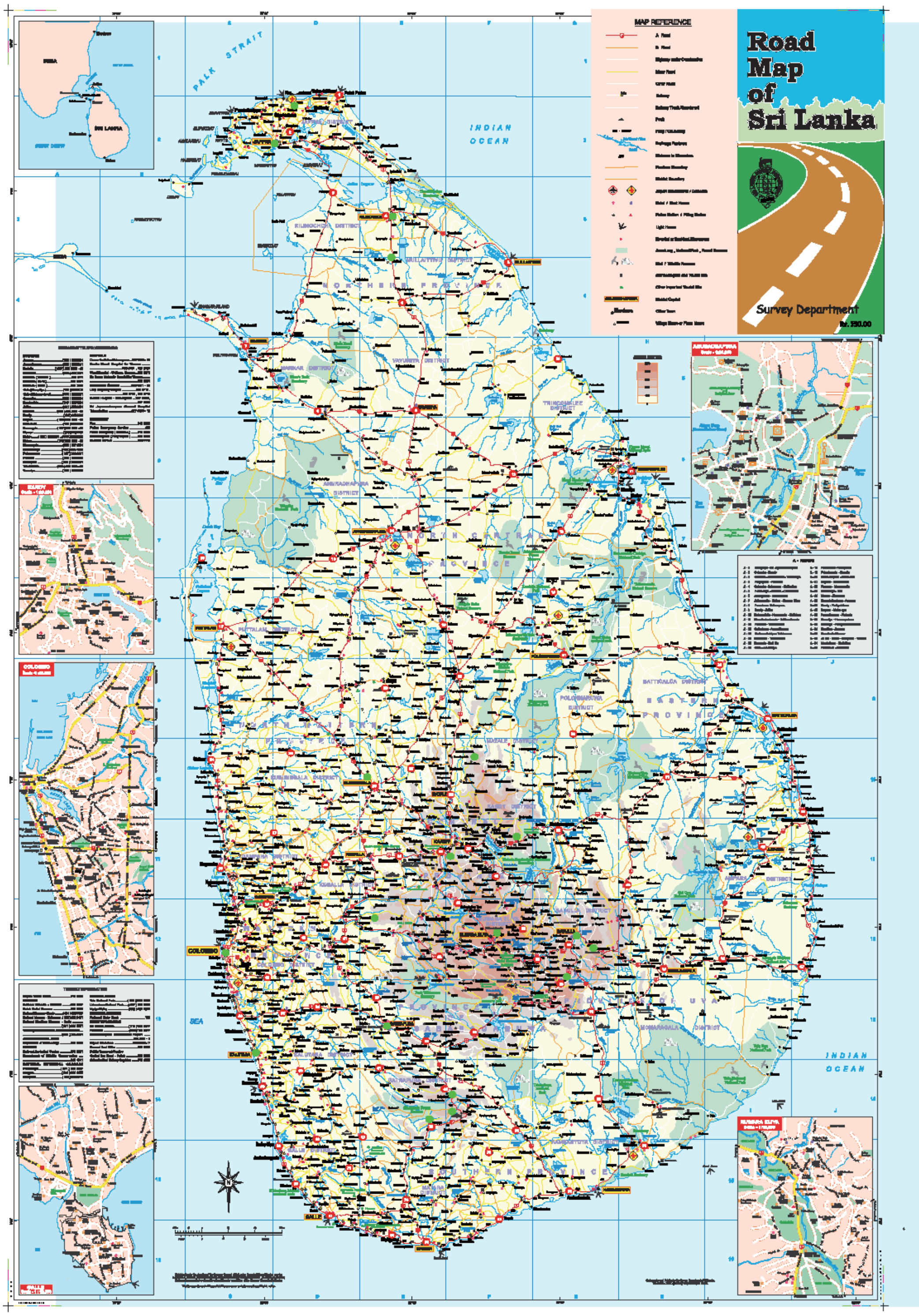
In the Study, the Electric Field Strength Measurement work and the Frequency Simulation survey were outsourced in Japan. The work was outsourced in order to implement precise measurement of radio waves, as in Sri Lanka there is no, organization in possession of a radio-wave vehicle able to carry out automatic measurement.

In switching to DTTB, it is extremely important to prepare a channel plan determining the broadcast coverage areas. The first step to achieving the DTTB target coverage is an understanding of the coverage rate of the current analog broadcasts.

In the Study, the electric field strength was measured and an understanding gained of the various characteristics of radio wave propagation, including the levels of reflective waves and interfering waves and also fading. Since the propagation characteristics of radio waves depend considerably on frequency, topography, etc., it would have been advantageous to measure them at the frequency to be used for DTTB and in the areas in which DTTB was actually planned; but it was possible from our understanding of the propagation characteristics of radio waves from the current analog signal to gain sufficient understanding of how the digital signal will be propagated.

The measurement points were determined using a 1/50,000 map of Japan on which contour lines are shown and a similar map of Sri Lanka, and with reference to a frequency simulation; measurements were made with particular care in areas in the shade of mountains, areas of poor reception and areas of weak electric field intensity located far from transmitting antennas.

The measurement points are shown in Figure 1.5-1, and Table 1.5-1 shows the measurement points and the population of Sri Lanka.



Source: JICA Study Team

Figure 1.5-1 Measurement Points

Table 1.5-1 Measurement Points and Population

No	Province	District	Divisional Secretariat	Population	Population (%)
1	Northern	Jaffna	Vadamaradchi North (Point Pedro)	47,389	0.23
2	Northern	Jaffna	Valikamam East (Kopay)	73,298	0.36
3	Northern	Kilinochchi	Poonakary	20,225	0.10
4	Northern	Kilinochchi	Kandavalai	23,003	0.11
5	Northern	Mullaittivu	Puthukudiyiruppu	23,770	0.12
6	Northern	Vavuniya	Vavuniya North	11,518	0.06
7	Northern	Mannar	Mannar Town	50,937	0.25
8	Northern	Mannar	Madhu	7,631	0.04
9	Northern	Vavuniya	Vavuniya	117,153	0.58
10	Eastern	Trincomalee	Padavi Sri Pura	11,858	0.06
11	Eastern	Trincomalee	Trincomalee Town and Gravets	97,234	0.48
12	Eastern	Trincomalee	Kantalai	46,641	0.23
13	North Central	Anuradhapura	Horowpothana	36,714	0.18
14	North Central	Anuradhapura	Nuwaragam Palatha Central (Anuradhapura)	60,828	0.30
15	North Central	Anuradhapura	Nochchiyagama	49,730	0.25
16	North Western	Puttalam	Kalpitiya	86,019	0.42
17	North Western	Puttalam	Puttalam	82,041	0.40
18	North Central	Anuradhapura	Kekirawa	58,879	0.29
19	North Central	Polonnaruwa	Medirigiriya	64,926	0.32
20	Eastern	Batticaloa	Eravur Pattu	75,136	0.37
21	North Central	Polonnaruwa	Thamankaduwa (Polonnaruwa)	82,138	0.41
22	Central	Matale	Dambulla	72,082	0.36
23	North Western	Kurunegala	Polpithigama	75,119	0.37
24	North Western	Puttalam	Chilaw	62,475	0.31
25	North Western	Kurunegala	Panduwasnuwara	63,492	0.31
26	North Western	Kurunegala	Kurunegala	80,395	0.40
27	North Western	Kurunegala	Rideegama	88,076	0.43
28	Central	Matale	Matale	74,529	0.37
29	Eastern	Ampara	Dehiattakandiya	59,628	0.29
30	Eastern	Batticaloa	Manmunai North	86,028	0.42
31	Eastern	Ampara	Mahaoya	20,715	0.10
32	Uva	Badulla	Mahiyanganaya	75,327	0.37
33	Central	Kandy	Kundasale	127,278	0.63
34	Central	Kandy	Udunuwara	110,232	0.54
35	Sabaragamuwa	Kegalle	Mawanella	111,307	0.55
36	Sabaragamuwa	Kegalle	Warakapola	112,583	0.56
37	North Western	Kurunegala	Pannala	123,551	0.61
38	Western	Gampaha	Negombo	141,676	0.70
39	Western	Gampaha	Gampaha	196,445	0.97
40	Western	Gampaha	Dompe	153,137	0.76
41	Sabaragamuwa	Kegalle	Dehiovita	81,441	0.40
42	Central	Kandy	Udapalatha	91,230	0.45
43	Central	Nuwara Eliya	Hanguranketha	88,055	0.43
44	Uva	Monaragala	Bibile	40,132	0.20
45	Eastern	Ampara	Ampara	43,720	0.22
46	Eastern	Ampara	Kalmunai Tamil Division	29,713	0.15
47	Eastern	Ampara	Pothuvil	34,749	0.17
48	Uva	Monaragala	Siyambalanduwa	53,059	0.26
49	Uva	Monaragala	Moneragala	49,631	0.24
50	Uva	Badulla	Hali-Ela	90,179	0.45
51	Central	Nuwara Eliya	Walapane	103,152	0.51
52	Uva	Badulla	Welimada	100,434	0.50
53	Uva	Badulla	Bandarawela	65,111	0.32
54	Central	Nuwara Eliya	Ambagamuwa	203,976	1.01
55	Sabaragamuwa	Ratnapura	Kuruvita	95,280	0.47
56	Western	Kalutara	Ingiriya	53,645	0.26
57	Western	Kalutara	Horana	112,441	0.55
58	Western	Kalutara	Panadura	181,724	0.90
59	Western	Kalutara	Beruwala	164,507	0.81
60	Western	Kalutara	Mathugama	81,064	0.40
61	Sabaragamuwa	Ratnapura	Nivithigala	59,973	0.30
62	Sabaragamuwa	Ratnapura	Pelmadulla	89,411	0.44
63	Sabaragamuwa	Ratnapura	Balangoda	81,105	0.40
64	Uva	Monaragala	Wellawaya	59,770	0.29
65	Uva	Monaragala	Thanamalvila	26,608	0.13
66	Sabaragamuwa	Ratnapura	Godakawela	75,885	0.37
67	Southern	Galle	Neluwa	28,541	0.14
68	Southern	Galle	Elpitiya	64,418	0.32
69	Southern	Galle	Balapitiya	67,207	0.33
70	Southern	Galle	Hikkaduwa	101,382	0.50
71	Southern	Galle	Nagoda	53,467	0.26
72	Southern	Matara	Kotapola	63,072	0.31
73	Southern	Matara	Pasgoda	58,869	0.29
74	Sabaragamuwa	Ratnapura	Embilipitiya	133,600	0.66
75	Southern	Hambantota	Thissamaharama	67,805	0.33
76	Southern	Hambantota	Ambalantota	72,664	0.36
77	Southern	Hambantota	Tangalle	71,920	0.35
78	Southern	Matara	Matara Four Gravets	114,970	0.57
79	Southern	Matara	Akuressa	52,676	0.26
80	Southern	Matara	Weligama	72,511	0.36
81	Southern	Galle	Galle Four Gravets	101,159	0.50
82	Western	Colombo	Homagama	236,179	1.17
			Total Population of Measurement Points	6,477,578	31.97
			Sri Lanka Total population	20,264,173	

Source: JICA Study Team

A broadcasting service area map was prepared on the basis of the data measured at the measurement points, over which a population distribution map was superposed to determine the appropriate locations for transmitting stations.

Table 1.5-2 Schedule of the Work Outsourced to a Domestic Survey Firm

Process	July	August	September	October	November	Note
Measurement at 70 points in Sri Lanka						Two teams with radio wave measurement vehicle
Compilation of preliminary report of measurement results						
Creation of radio wave measurement report						
Survey and intensity measurement of GF candidate sites						Use of radio wave measurement vehicle
Supplementary survey / intensity measurement						Use of radio wave measurement vehicle
Additional Survey (North Colombo)						
Additional Survey (Jaffna)						

Source: JICA Study Team

1.5.2 Frequency Simulation

Frequency simulation not only makes it possible to carry out an efficient theoretical investigation; displaying the intensity levels of the radio waves graphically on the map facilitates comparison and makes it possible to draw up a very reliable channel plan. This is a task that must be carried out at the channel planning stage; the same kind of simulation is carried out in the mobile phone industry.

In this instance, the survey work was outsourced in Japan. As there is no organization in Sri Lanka with the ability to carry out an ISDB-T frequency simulation, the work was re-commissioned in Japan.

As the results of this simulation can be used at the project implementation stage for recalculations should there be any change in the modulation parameters or transmission parameters, it is also possible to carry out a review efficiently and with less effort when there are changes in the locations of antennas, or when comparing systems. The simulation was carried out in the following steps.

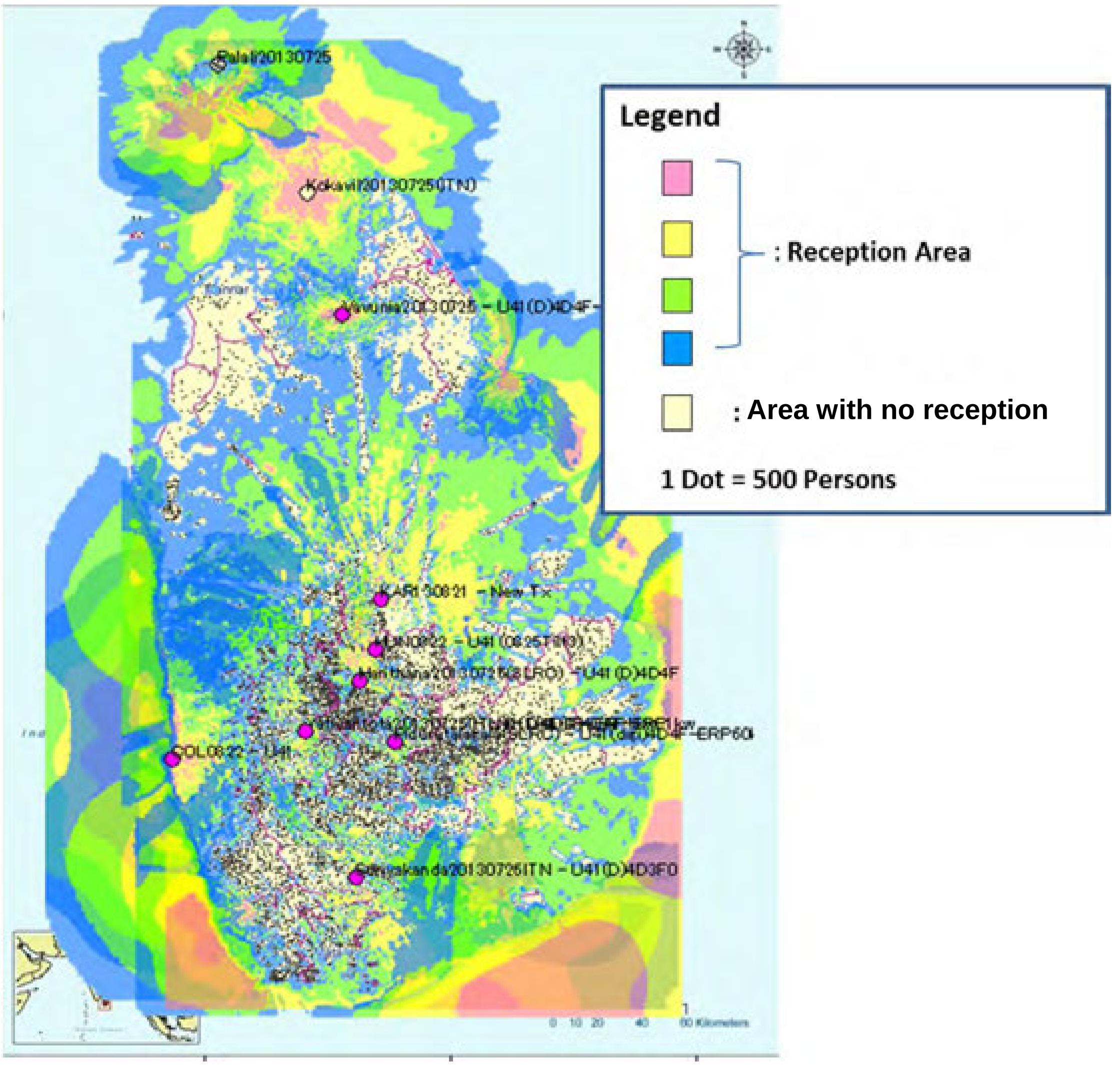
(1) Identification of areas of poor reception

1) Input transmitting station parameters (Latitude & longitude, height of antenna above sea level, effective radiated power (ERP), frequency)
2) Input transmitting antenna directivity pattern
3) Output contours of received electric field strength on the map and check service area
4) Repeat the above three procedures for every transmitting station
5) Identify on the map areas where the received field intensity is below the specified value

(2) Study of SFN

1) Set modulation and transmission parameters
2) Input transmitting station parameters (Latitude & longitude, height of antenna above sea level, effective radiated power (ERP), frequency)
3) Output SFN coverage rate on the map and check the service area
4) Repeat the above three procedures for every transmitting station
5) Identify on the map areas where SFN is not possible
6) Repeat the simulation, changing the parameters as necessary

The above simulations were repeated, making changes to the transmission output, frequency, transmitting antenna location, etc., and the most appropriate channel plan was drawn up. Figure 1.5-2 is a map of the whole country showing the results of the frequency simulation implemented through outsourcing in Japan. In the simulation it was assumed that existing transmitting stations would continue to be used, but in order to improve the coverage rate the outsourced work also included consideration of new transmitting stations and gap fillers.



Source: JICA Study Team

Figure 1.5-2 Frequency Simulation

1.6 Results of the Survey and Reports

The results of the survey are shown in Table 1.6-1 and the submission of reports in Table 1.6-2.

Table 1.6-1 Study Team Members and their Duties

No	Survey	Period	Participant
1	1st Work in Sri Lanka	26th May – 15th June	1: Naoaki Nambu: 26th May - 4th June 2: Akira Saito: 26th May – 15th June 3: Keiko Uchiumi: 26th May – 15th June 4: Akane Nagahiro 26th May – 15th June
2	2nd Work in Sri Lanka	27th July – 15th September	1: Naoaki Nambu: 28th July – 2nd August, 9th – 14th September 2: Kazushi Hashimoto: 30th July – 28th August 3: Yasuo Takahashi: 29th July – 14th September 4: Izumi Takai: 1st – 10th August 5: Katsuya Terabayashi: 27th July – 20th August, 6th – 14th September 6: Akira Saito: 27th July – 15th September

No	Survey	Period	Participant
			7: Hiroyuki Yamaguchi: 30th July – 14th September 8: Osamu Nitta: 29th July – 14th September 9: Yoshiki Maruyama: 3rd August – 14th September 10: Hitoshi Kadowaki: 30th July – 28th August 11: Noboru Osakabe: 2nd – 31st August 12: Michiaki Takeda: 29th July – 14th September 13: Hitoshi Takasaki: 30th July – 14th September 14: Kazuhiro Ishiura: 5th August – 14th September 15: Keiko Uchiumi: 27th July- 2nd August, 3rd -14th September 16: Akane Nagahiro: 12th August – 14th September
3	3rd Work in Sri Lanka	3rd November – 28th December	1: Naoaki Nambu: 4th November – 28th December 2: Yasuo Takahashi: 3rd November – 2nd December 3: Katsuya Terabayashi: 4th November – 5th December, 9th December – 21st December 4: Akira Saito: 3rd November – 1st December 5: Osamu Nitta: 3rd November – 30th November 6: Hitoshi Kadowaki: 4th November – 23rd November 7: Noboru Osakabe: 7th November – 6th December 8: Michiaki Takeda: 3rd November – 7th December 9: Kazuhiro Ishiura: 9th November – 18th November 10: Keiko Uchiumi: 24th November – 28th December 11: Akane Nagahiro: 17th November – 2nd December
4	4th Work in Sri Lanka	8th January – 17th January, 30th January – 28th February	1: Naoaki Nambu: 30th January – 28th February 2: Yasuo Takahashi: 19th – 28th February 3: Akira Saito: 8th – 17th January, 23rd – 28th February 4: Tadashi Takamiya: 9th – 28th February 5: Keiko Uchiumi: 19th – 28th February
5	5th Work in Sri Lanka	1st June – 15th June	1: Naoaki Nambu: 1st June – 13th June 2: Akira Saito: 1st June – 15th June

Table 1.6-2 Submission of Reports

Report	Date	Language	No. of copies
Inception Report	May 2013	Japanese	8
		English	10
Interim Report	October 2013	Japanese	8
		English	10
Feasibility Study report (Draft Final Report)	February 2014	Japanese	8
		English	10
Feasibility Study report (Final Report)	August 2014	Japanese	10
		English	20
		CD-R	3

1.7 Structure of Support by the Sri Lanka Government, and the Study Team

1.7.1 Structure of Support by the Sri Lanka Government

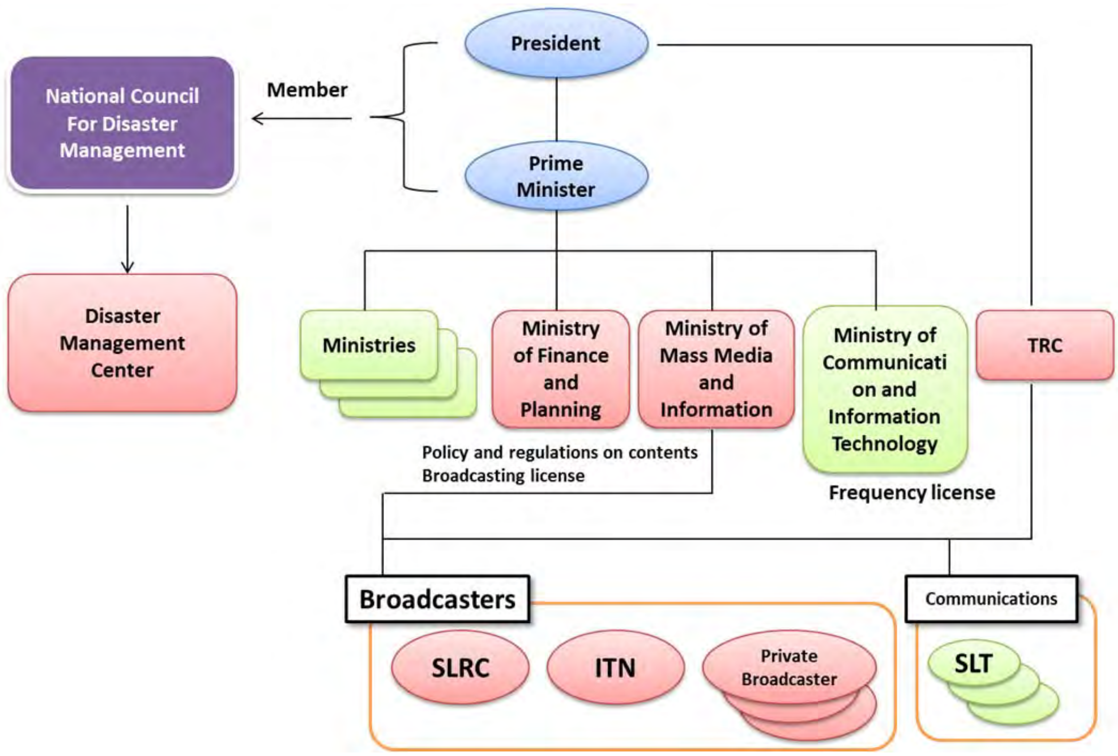
The organization with whom most discussions were held in this Study was MMI. We also requested that MMI coordinate with other related organizations so that the Study might be carried out smoothly and effectively. At the Inception Meeting, MMI appointed counterparts from MMI, SLRC and ITN for the Study. Thanks to this decision and the close cooperation of those counterparts, the Study was carried out smoothly.

With the support given by MMI, the study was carried out in cooperation with other related organizations and stakeholders including the Telecommunications Regulatory Commission of Sri Lanka (TRCSL), the owners of the existing transmitting stations and relay transmitting stations to be reused for the platform (SLRC and ITN), private broadcasters who will be users of the platform, the Ministry of Finance and Planning as the ministry borrowing the ODA loan and the Disaster Management Center (hereinafter referred to as DMC) which is in charge of disaster management.

Table 1.7-1 List of Major Related Organizations of Sri Lanka

Organization	Description
Ministry of Mass Media and Information: MMI	Ministry with jurisdiction in policy planning for broadcasting and information. The implementing organization in charge of the project. (The Communications sector is under the jurisdiction of the Information and Communication Technology Agency of Sri Lanka)
Telecommunications Regulatory Commission of Sri Lanka: TRCSL	Regulatory agency for communications and broadcasting. This will be the regulatory agency of the DTTB platform. It is under the direct supervision of the President.
Ministry of Finance and Planning	Borrowing organization on implementation of the project
Sri Lanka Rupavahini Corporation: SLRC	Launched in 1982 with the support of the Japanese government. It broadcasts in three languages, Sinhala, Tamil and English, and covers almost the whole of Sri Lanka by UHF.
Independent Television Network Ltd: ITN	1st TV station in Sri Lanka, established in 1979. It was initially established as a private broadcaster but the business was soon transferred to the government and in 1992 was nationalized, all stock going to the Ministry of Finance and Planning. It covers almost the whole of Sri Lanka by VHF and UHF.
Disaster Management Center: DMC	In charge of disaster management throughout Sri Lanka. Coordinates with local and community disaster prevention organizations. Prepares and implements the national disaster management plan and implementation plan in time of disaster, and carries out disaster educational activities.

Source: JICA Study Team



Source: JICA Study Team

Figure 1.7-1   Major Parties Involved in the Project

1.7.2   JICA Study Team

The Study Team members are listed in Table 1.7-2.

Table 1.7-2   Study Team Members

No	Name	Area of Responsibility
1	Naoaki Nambu	Team Leader/Broadcasting Business Plan/ Digital Terrestrial Broadcasting Plan
2	Kazushi Hashimoto	Sub Team Leader/Platform Business Plan 1
3	Yasuo Takahashi	Platform Business Plan 2/ Digital Terrestrial Broadcasting Plan 2/Transmission Plan 1
4	Izumi Takai	Broadcasting Policy and System 1
5	Katsuya Terabayashi	Broadcasting Policy and System 2
6	Akira Saito	Transmitters, Repeaters/Relay Stations 1
7	Hiroyuki Yamaguchi	Transmitters, Repeaters/Relay Stations 1
8	Osamu Nitta	TV Station, Tower and Antenna Plan (Construction and Equipment Plan)
9	Tadashi Takamiya	TV Station, Tower and Antenna Plan 2 (Construction and Equipment Plan)
10	Yoshiki Maruyama	TV Transmission/Antenna Plan 2 (Transmission structure/Interference, Propagation)
11	Hitoshi Kadowaki	Studio Equipment and Facility Plan
12	Noboru Osakabe	Economic and Financial Analysis
13	Michiaki Takeda	Equipment Procurement Plan (Japan and Cost Estimation)
14	Hitoshi Takasaki	Equipment Procurement Plan (Local Procurement /

No	Name	Area of Responsibility
		Construction Plan)
15	Kazuhiro Ishiura	Environmental and Social Analysis
16	Keiko Uchiumi	Coordination/Training Planning/Promotion of Digital Terrestrial Broadcasting 1
17	Akane Nagahiro	Social Analysis/Promotion of Digital Terrestrial Broadcasting 2

Chapter 2　Overview of the Country

Chapter 2 Overview of the Country

2.1 Geography

Sri Lanka is an inland nation in the Indian Ocean, covering an area of 65,610 km^2 stretching 445 km from north to south and 225 km from west to east (5°55' - 9°51' N, 79°42' - 81°53' E). Its topography divides the nation into three areas in terms of elevation: the Central Highlands, the plains, and the coastal belt. The south-central part is mountainous, dominated by the nation's highest mountain, Mt. Pidurutalagala (2,524 meters) and includes other 2,000-meter-high mountains such as Adams Peak (2,243 meters) in the west and Mt. Namunukula (2,036 meters) in the east. Because of the high altitude, the area bristles with the antennas of state-run and private broadcasting stations.

Plains at an altitude of between 30 meters and 200 meters above sea level cover most of the land. Although there are several steep hills in the eastern and northern areas, most of the land is relatively flat.

The north-eastern and south-western regions form a coastal belt between zero and 30 meters above sea level, and the island is surrounded by the sea.

These topographic features affect rainfall, temperature and wind throughout the year, in particular the occurrence of the monsoons.

2.2 Climate

Sri Lanka has a tropical climate. While the temperature is lower at higher elevations, it is stable throughout the year at an annual average of 27.5 °C. It is at its coolest in January and hottest between April and August. While the northern and south-eastern regions are arid with an annual rainfall of less than 900 millimeters, the south-western region that includes the Central Highlands is humid with annual rainfall in excess of 5,000 millimeters.

The topographical features and the south-western and north-western monsoons divide the nation into four seasons. During the first inter-monsoon period, from March to April, there are frequent rainstorms and thunderstorms in the afternoons and at night, mainly in the south-western region. During the south-western monsoon period from May to September, it rains all day long, with precipitation of between 100 millimeters and 3,000 millimeters depending on the area. The heaviest precipitation is in the Central Highlands, which receive over 3,000 millimeters. Rainfall in the south-western coastal region varies between 1,000 millimeters and 1,600 millimeters over these five months. During the second inter-monsoon period in October and November, the low-pressure systems and cyclones that are generated in the Bay of Bengal send torrential rain and strong winds across the island, sometimes causing landslides and flooding. During these two months rainfall on the island exceeds 400 millimeters. The south-western region receives the most rain, around 750 millimeters to 1,200 millimeters. During the north-western monsoon season, from December to February, cool dry winds blow from the Indian subcontinent and the weather is sunny. The heaviest rainfall recorded during this season was 1,281 millimeters in Kobonella, and the lowest recorded was 177 millimeters in Chilaw on the western coast.

2.3 Government

Sri Lanka is a republic with a President serving as head of state. The President is elected by popular vote for a term of six years. As the head of state and of the government, the President appoints the Cabinet in consultation with the prime minister. The state assembly has a single legislative chamber, with 225 seats.

As shown in Table 2.3-1, as of February 2014 there are 58 government ministries and agencies.

The governmental authorities involved in the Project are the Ministry of Mass Media and Information ("MMI") and the Ministry of Finance and Planning, together with the Telecommunications Regulatory Commission of Sri Lanka (TRC), Sri Lanka Rupavahini Corporation (SLRC) and the Independent Television Network Ltd (ITN).

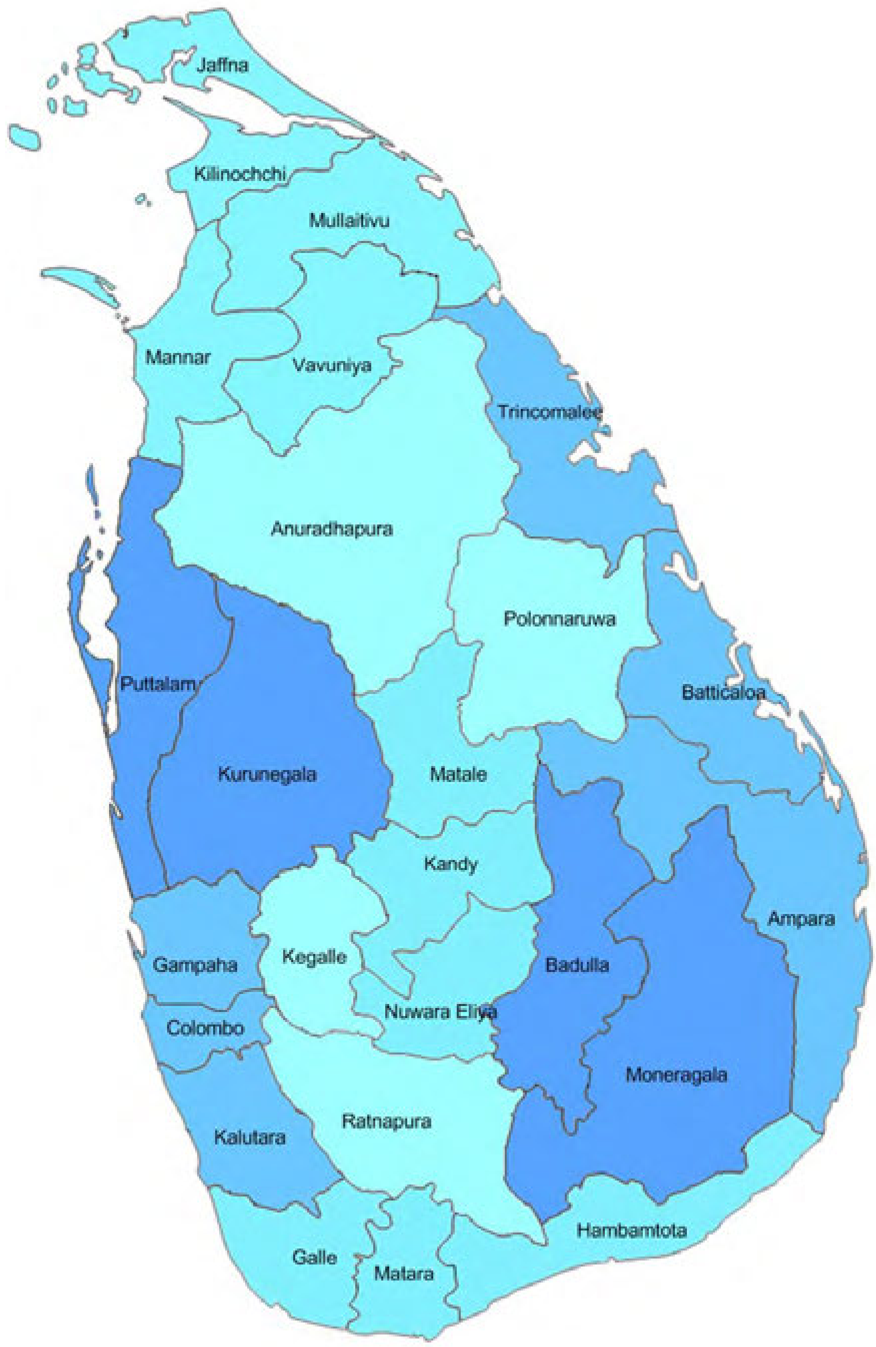
Table 2.3-1 Sri Lankan Ministries and Agencies

Ministry			
1	Agriculture	30	Local Government & Provincial Councils
2	Botanical Gardens and Public Recreation	31	Mass Media and Information
3	Buddha Sasana and Religious Affairs	32	Minor Export Crop Promotion
4	Child Development & Women's Affairs	33	National Heritage
5	Civil Aviation	34	National Languages & Social Integration
6	Co-operatives & Internal Trade	35	Parliamentary Affairs
7	Coconut Development and Janatha Estate Development	36	Petroleum Industries
8	Construction, Engineering Services, Housing and Common Amenities	37	Plantation Industries
9	Culture and the Arts	38	Ports and Highways
10	Defence & Urban Development	39	Power & Energy
11	Disaster Management	40	Postal Services
12	Education	41	Private Transport Services
13	Education Services	42	Productivity Promotion
14	Environment and Renewable Energy	43	Public Administration & Home Affairs
15	External Affairs	44	Public Management & Reforms
16	Finance & Planning Economic Development	45	Public Relations and Public Affairs
17	Fisheries & Aquatic Resources Development	46	Resettlement
18	Foreign Employment Promotion and Welfare	47	Rehabilitation & Prison Reforms
19	Health	48	Social Services
20	Higher Education	49	Sports
21	Indigenous Medicine	50	State Resources & Enterprise Development
22	Industries & Commerce	51	Sugar Industry Development
23	Investment Promotion	52	Technology, Research and Atomic Energy
24	Irrigation & Water Resources Management	53	Telecommunication and Information Technology
25	Justice	54	Traditional Industries & Small Enterprise Development
26	Law and Order	55	Transport

Ministry			
27	Labour and Labour Relations	56	Water Supply & Drainage
28	Land & Land Development	57	Wildlife Resources Conservation
29	Livestock and Rural Community Development	58	Youth Affairs and Skills Development

Source: Presidential Office (website)

In terms of administrative areas, the country is divided into nine provinces and 25 districts. Figure 2.3-1 shows the administrative areas.



Source: Department of Census and Statistics (Population of Sri Lanka by District, 2012)

Figure 2.3-1 Administrative Divisions of Sri Lanka

2.4 Population

2.4.1 Census Population

The population of Sri Lanka according to the 2012 survey by the Department of Census and Statistics is shown in Table 2.4-1. Population density is high on the west coast, and particularly high in Greater Colombo.

Table 2.4-1 Composition of the Population of Sri Lanka

Total Population	20,263,723		
Male / Female ratio	Male		Female
	9,832,402		10,431,322
	48.5%		51.5%
Age	Below 15	Between 15 and 59	Over 60
	5,228,927	12,566,467	2,468,329
	25.8%	62.0%	12.2%

Source: Department of Census and Statistics

2.4.2 Labor Force

As of 2012 the labor force of Sri Lanka numbers 8,464,706 of which approx. 70 per cent is male. The unemployment rate was 8.8% in 2002 but had dropped to 4.0% by 2012, showing an improvement of 4.8 percentage points in the last decade. Table 2.4-2 shows the size of the workforce and numbers in employment.

Table 2.4-2 Working Population and Employment

Year	Workforce	Number in Employment	Employment Rate	Unemployment Rate	Non-working Population
2002	7,145,382	6,519,415	91.2	8.8	7,056,014
2003	7,653,716	7,012,755	91.6	8.4	7,997,763
2004	8,061,354	7,394,029	91.7	8.3	8,532,077
2005	8,141,347	7,518,007	92.3	7.7	8,729,628
2006	7,598,762	7,105,322	93.5	6.5	7,235,040
2007	7,488,896	7,041,874	94.0	6.0	7,558,986
2008	8,081,702	7,174,706	94.8	5.2	7,509,301
2009	8,073,668	7,139,537	94.6	5.4	8,237,363
2010	8,107,739	7,706,593	95.1	4.9	8,753,787
2011	8,554,730	8,196,927	95.8	4.2	9,355,013
2012	8,464,706	8,128,704	96.0	4.0	9,450,677

Source: Department of Census and Statistics (Sri Lanka Labour Force Survey Annual Report 2012)

By sector, in 2012 agriculture, industry and the service sector account for 31%, 26.1% and 42.9% respectively, compared with 34.5%, 22.4% and 43.1% respectively, in 2002. This shows a gradual transition from agriculture to industry over the 10 years, with little change in the service sector. Table 2.4-3 shows the workforce in each sector.

Table 2.4-3 Workforce by Sector

Year	Workforce	Agriculture	Industry	Service
2002	7,145,382	34.5	22.4	43.1
2003	7,653,716	33.6	23.3	43.1
2004	8,061,354	33.0	24.8	42.1
2005	8,141,347	30.3	26.3	43.3
2006	7,598,762	32.2	26.6	41.2
2007	7,488,896	31.3	26.6	42.1
2008	8,081,702	32.6	26.2	41.2
2009	8,073,668	32.6	25.1	42.3
2010	8,107,739	32.5	24.2	43.1
2011	8,554,730	33.0	24.1	42.8
2012	8,464,706	31.0	26.1	42.9

Source: Department of Census and Statistics (Sri Lanka Labour Force Survey Annual Report 2012)

2.4.3 Race, Language and Religion

The major ethnic groups in Sri Lanka are the Sinhalese, the Tamils and the Sri Lankan Moors. There are also such minority groups as the mixed-race Burghers and Eurasians as well as the aboriginal Veddahs.

The national census of 2012 reveals that the three major ethnic groups comprise more than 99% of the nation’s population. Ethnic groups are distinguished by religion and language. Of these three groups, the Sinhalese account for approx. 75 per cent. They form the majority in southern, western, central and north-central regions, and account for more than 95% of the population in the low wetland area. The Tamils comprise two groups, Sri Lankan Tamils and Indian Tamils, and account for 15% of the nation’s population. The Tamils reside mainly in the Jaffna Peninsula, the Central Highlands, Colombo and the northern low wetland areas. The Moors account for 9% of the population and reside mainly in the eastern low wetland area.

With regard to religion, Buddhists account for 77% of the population, followed by Hindus and Muslims at 8% each and Catholics at 6%.

The Sinhala language spoken by the Sinhalese and the Tamil language spoken by the Tamils are both official languages of the country, and English serves as a link between the two.

Table 2.4-4 shows the composition of ethnic groups by region.

Table 2.4-4 Composition of Ethnic Groups by Region (percentage)

Region	Total Population (1,000)	Sinhalese	Sri Lankan Tamils	Indian Tamils	Moors	Others
Sri Lanka	20,263.7	74.9	11.2	4.2	9.2	0.5
Colombo	2,309.8	76.7	10.0	1.2	10.5	1.6
Gampaha	2,294.6	90.6	3.5	0.5	4.2	1.2
Kalutara	1,217.3	86.7	2.0	1.9	9.2	0.1
Kandy	1,369.9	74.3	5.2	6.1	14.0	0.5
Matale	482.2	80.7	5.1	4.9	9.1	0.2
Nuwara Eliya	706.6	39.6	4.5	53.2	2.5	0.3
Galle	1,058.8	94.3	1.4	0.5	3.6	0.0
Matara	809.3	94.3	1.1	1.5	3.1	0.0
Hambantota	596.6	97.1	0.4	0.0	1.1	1.5
Jaffna	583.4	0.6	98.9	0.1	0.4	0.0
Mannar	99.1	2.0	81.3	0.4	16.2	0.0
Vavuniya	171.5	10.0	82.4	0.8	6.8	0.0
Mullativu	91.9	9.6	96.0	2.4	1.9	0.0
Killinochchi	112.9	0.9	97.0	1.5	0.6	0.0
Batticaloa	525.1	1.2	72.6	0.2	25.5	0.5
Ampara	648.1	38.7	17.4	0.0	43.6	0.2
Trincomalee	378.2	27.0	30.6	1.7	40.4	0.3
Kurunegala	1,610.3	91.4	1.2	0.2	7.1	0.2
Puttalam	759.8	73.6	6.3	0.3	19.3	0.5
Anuradhapura	856.2	90.9	0.6	0.1	8.2	0.2
Polonnaruwa	403.3	90.6	1.8	0.3	7.2	0.0
Baddulla	811.8	73.1	2.5	18.4	5.7	0.4
Monaragala	448.1	94.6	2.2	1.0	2.1	0.0
Ratnapura	1,082.3	87.1	5.1	5.8	2.0	0.1
Kegalle	836.6	85.6	2.4	5.0	6.9	0.2

Source: Central Bank of Sri Lanka (Economic and Social Statistics of Sri Lanka 2013)

2.5 Economy

2.5.1 National Economy

Sri Lanka has made efforts in economic structural reform to respond to the market economy. It has worked on regional economic stimulation, the development of a market economy, the eradication of poverty, and fiscal reform. The nation's economy used to depend on such agricultural products as rice and the three major plantation crops, namely tea, rubber and coconuts. However, it has industrialized its textile production and diversified its industry. As a result, during the 1990s the nation maintained an annual average economic growth rate of approx. five per cent. After the damage from the tsunami, investment mainly in the construction sector reached record levels, driven by the demand for reconstruction. In 2010 the real GDP growth rate was eight per cent, partly due to the demand for restoration of the country after the end of the civil war in May 2009.

The tables below show foreign trade and the balance of payments, state finances, foreign debt, the price index and exchange rates.

- **Foreign trade and balance of payments (BOP)**

Export value – Sri Lankan rupee (unit: million)	**1,245,531**
Import value - Dollar (unit: million)	9,774
Current account (based on BOP)- Sri Lankan rupee (unit: million)	-495,853
Current account (based on BOP) - Dollar (unit: million)	-3,915
Trade balance (based on BOP)- Sri Lankan rupee (unit: million)	-1,195,368
Trade balance (based on BOP) - Dollar (unit: million)	-9,409

Source: Central Bank of Sri Lanka 2012

- **State finances**

Revenues (unit: million)	**1,277,544**
Expenditures (unit: million)	1,784,944
Balance (unit: million)	-507,400

Source: Central Bank of Sri Lanka 2012

- **Foreign debt**

Foreign debt - Sri Lankan rupee (unit: million)	**4,419,356**
Foreign debt - Dollar (unit: million)	33,674

Source: Central Bank of Sri Lanka 2012

- **Price index and exchange rates**

Exchange rate (interim average value, to the dollar)	**127.6190**
Exchange rate (term-end value, to the dollar)	127.0800
Rate of increase in consumer price index (%)	7.6
Unemployment rate (%) (North-eastern region excluded)	4.0

Source: Central Bank of Sri Lanka 2012

2.5.2 Transportation

The road network in the Greater Colombo area forms the basis of the Sri Lankan transportation system. Although there are some railways, the main mode of transportation is the bus, and almost all major cities are accessible by bus. The railway system, covering 1,420 kilometers of track, is operated exclusively by the government and, like the road network, is centered on Colombo.

2.6 Electricity

The first electricity to be generated in Sri Lanka was hydroelectric power, developed as a power source for the tea plantations in the 1940s and 50s. As energy demand increased, diesel and other thermal power sources came to be used in addition to hydroelectric power. According to the Ceylon Electricity Board (CEB), the total power generation in Sri Lanka in 2010 was made up of 5,720 GWh of hydroelectric power and 4,995 GWh of thermal power.

Electricity charges in Sri Lanka are among the highest in South Asia and the highest for agricultural use and household use over 91 KWh. The average rate is RS. 13.15 per kWh. The charges were revised in 2006, 2007 and 2008, resulting in a huge increase in electricity rates.

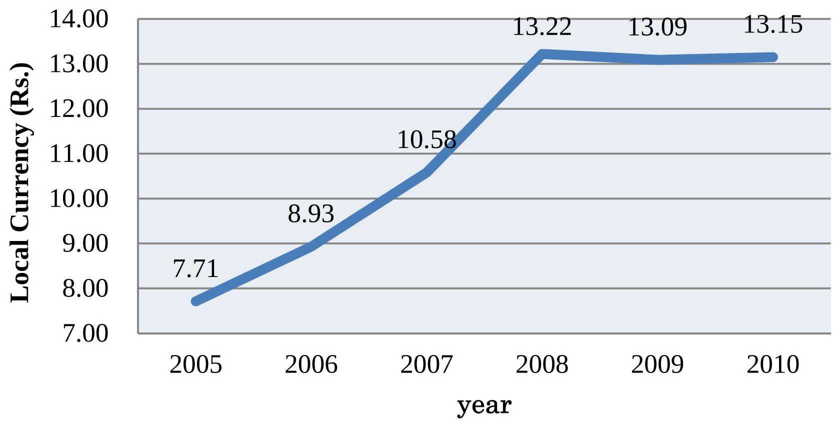
Table 2.6-1 compares electricity charges in South Asian countries, and Figure 2.6-1 shows changes in the average charge per kWh in Sri Lanka.

Table 2.6-1 Electricity Charges in South Asia

(US Cents per KWh)

Consumer Category	India	Pakistan	Bangladesh	Nepal	Sri Lanka
Household	0-200KWh: 5.5	0-5-KWh: 2.2	0-100KWh: 3.3	0-20KWh: 5.6	0-30KWh: 2.7
	201-400KWh :8.8	0-100KWh: 5.1	101-400: 4.2	21-250KWh: 10.3	31-60KWh: 4.3
	>400KWh: 10.4	101-300KWh: 7.6	>400KWh: 7.0	>250KWh: 13.9	61-90KWh: 6.8
		201-700KWh: 12.4			91-120KWh: 19.1
		>700KWh: 15.4			121-180KWh: 21.8
					>180KWh: 32.8
Industry	11.3	10.3	5.4	9.3	9.1
Agriculture	3.5	6.2	2.6	5.0	13.6
Commerce	—	15.1	7.1	10.8	13.6

Source: Sri Lanka Energy Forum Report



Source: CEB Annual Report 2010

Figure 2.6-1 Average Electricity Charge per kWh

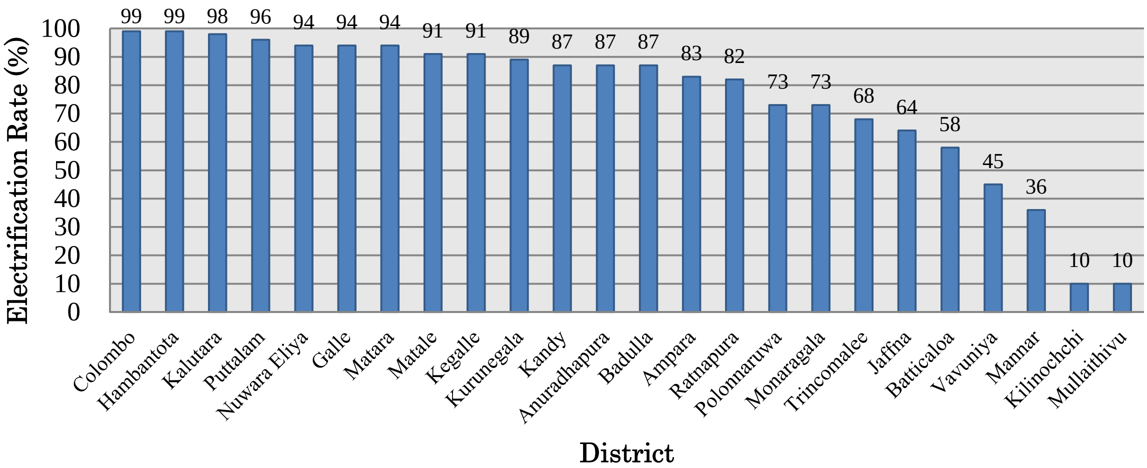
According to CEB, as of 2010 the household electrification rate in Sri Lanka is 88%; according to the International Energy Agency (IEA) it has the highest household electrification rate in South Asia.

However, there are huge regional gaps, and the rate of household electrification is particularly low in the northern region. Table 2.6-2 shows electrification rates in South Asia, and Figure 2.6-2 shows regional electrification rates in Sri Lanka.

Table 2.6-2 Electrification Rates in South Asia

	India	Pakistan	Bangladesh	Nepal	Sri Lanka
Electrification Rate	75.0%	62.4%	41.0%	43.6%	76.6%
Rank	2	3	5	4	1

Source: IEA (World Energy Outlook 2011)



Source: CEB Annual Report 2010

Figure 2.6-2 Regional Electrification Rate

2.7 Telecommunications

The telecommunications infrastructure in Sri Lanka is relatively well developed compared to other countries in South Asia. It introduced a 3G (third-generation mobile telecommunications system) service in 2009, ahead of neighboring nations. High-capacity submarine optical fiber cables, SEA-ME-WE III and SEA-ME-WE IV, have been laid in the sea around Sri Lanka and this provides an advantageous environment for the development of the telecommunications infrastructure.

TRC announced a Ten-Year Development Plan for the Telecommunications Sector that contains a plan to use optical fiber, microwaves and satellites in the development of the national telecommunications infrastructure between 2006 and 2016, with the following numerical targets:

1. Increase the penetration rate of landline phones to 30% by 2016
2. Increase the number of mobile phone subscribers to 16 million by 2016
3. Increase accessibility to data telecommunications (Internet and email) to five million by 2016

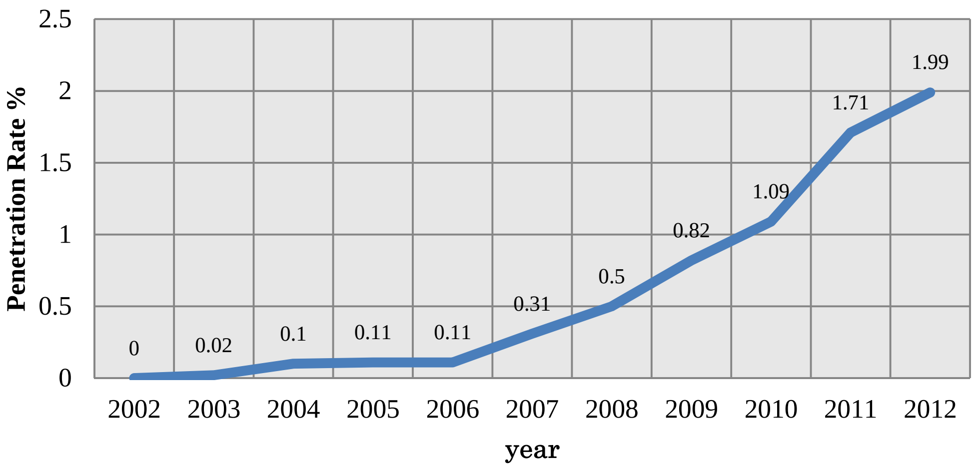
The landline phone market players are Sri Lanka Telecom (SLT), Lanka Bell and Dialog Broadband Network (DBN). The number of penetration rate of landline phones and mobile phones are shown in Figure 2.7-1 below. The rate is 16.25 per cent as of 2012, and the rate of growth is sluggish due to the growing number of mobile phone users.

Source: World Bank (Data for Sri Lanka)

Figure 2.7-1 Penetration Rates of Landline and Mobile Phones

There are five mobile phone service operators (Bharti Airtel, Dialog Axiata, Mobitel, Etisalat and Hutchison Telecom). According to TRC, the number of mobile phone subscribers is 19.53 million as of June 2013, with a penetration rate of 95.76%.

As for Internet broadband, according to TRC at the end of March 2012 there were six licensed data telecommunications service operators with facility ownership and a total of nine other operators and ISPs who did not own facilities. Figure 2.7-2 below shows the number of broadband service subscribers in Sri Lanka. The penetration rate is 1.99% as of 2012.

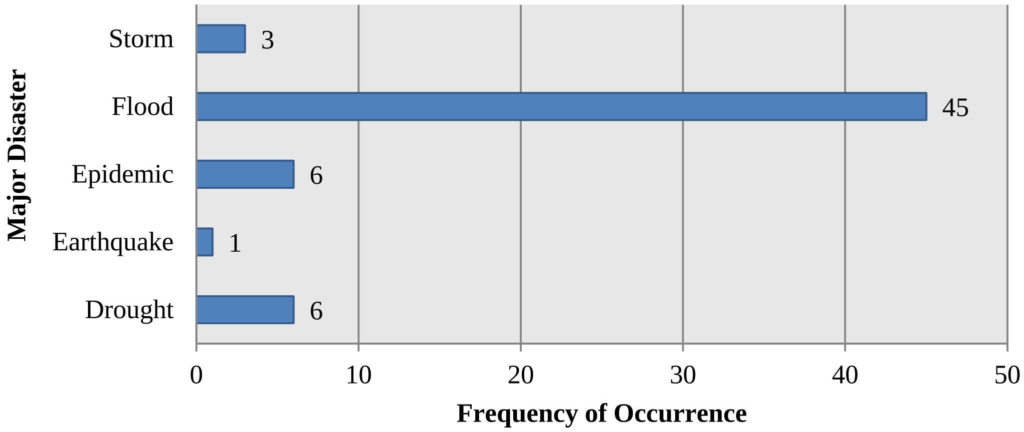


Source: TRC (website)

Figure 2.7-2 Broadband Penetration Rate

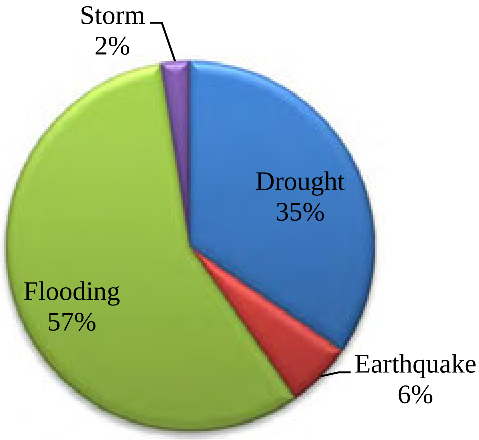
2.8 Natural Disasters

Sri Lanka has a tropical rainforest climate, and it is prone to natural disasters caused almost every year by torrential rains in the monsoon season from May to October. Major types of natural disaster include flooding, cyclone, drought, landslide and coastal erosion. The Disaster Management Act (2005) defines 18 types of disaster including human-generated disasters. Flooding is the type of disaster that occurred most frequently in the 30-year period from 1980 to 2010, with occurrence averaging 1.45 times a year. Figure 2.8-1 shows the occurrence of natural disasters, and Figure 2.8-2 the proportion of the population affected by each type of disaster.



Source: EM-DAT International Disaster Database

Figure 2.8-1 Occurrence of Natural Disasters

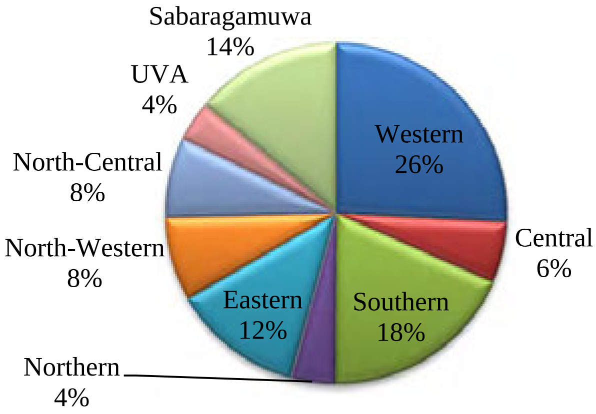


Source: EM-DAT International Disaster Database

Figure 2.8-2 Proportion of Population Affected by Disaster

A major recent disaster was the Indian Ocean tsunami generated by the massive M 9.1 earthquake that occurred off the coast of Sumatra in 2004, which in Sri Lanka caused 35,339 deaths, injured 23,176 and affected more than one million people. The torrential rain of 2007 also caused flooding and landslides in Nuwara Eliya, taking 12 lives, completely destroying 1,102 houses and affecting approx.

87,000 people. The torrential rain of 2008 also flooded an extensive area including Colombo and Kalutara, causing 23 deaths and affecting 418,354 people.



Source: Disaster Information Management System in Sri Lanka

Figure 2.8-3 Flood Occurrence by Region

Sri Lanka announced "Toward a Safer Sri Lanka, Road Map for Disaster Risk Management, 2005", a program of action for disasters one of the mainstays of which is the development of an early warning system for a variety of disasters. Linkage with digital terrestrial broadcasting is also expected.

2.9 Japanese Assistance to Sri Lanka

Japan began providing assistance for Sri Lanka based on the Colombo Plan. Economic assistance began in yen-loans worth five million USD in the form of commodity loans under the technical cooperation scheme of 1965. By 2010 assistance from Japan had reached a total of 4.68216 billion USD, making Japan the biggest provider of assistance to the country. Japan also dispatched emergency rescue teams ahead of other countries at the time of the massive Indian Ocean tsunami in 2004. In response to the disaster Japan extended 8 billion yen of grant aid as emergency and recovery assistance, and approx. 10 billion yen in loans as mid- to long-term assistance.

Tables 2.9-1 shows the economic assistance extended to Sri Lanka by Japan and Table 2.9-2 lists that extended by other countries.

Table 2.9-1 Economic Assistance from Japan to Sri Lanka

(Unit: 100 million JPY)

Year	Government Loan	Grant Aid	Technical Cooperation	Total
2006	161.06	11.30	30.26	202.63
2007	-5.15	21.61	27.71	44.16
2008	27.44	48.53	20.72	96.69
2009	36.23	31.94	23.46	91.62
2010	91.88	32.87	30.68	155.43
Total	2,626.64	1,378.69	676.84	4,682.16

Source: Ministry of Foreign Affairs (2011 Data Book of Governmental Development Assistance by Country)

Table 2.9-2 Ranking of Economic Assistance from Other Countries to Sri Lanka

(Unit: 1 million USD)

Year/Ranking	1	2	3	4	5	Total
2005	Japan 312.91	Germany 75.23	Norway 66.41	USA 59.14	Netherlands 56.16	858.56
2006	Japan 202.63	Germany 63.94	Denmark 38.18	Norway 37.29	USA 29.18	507.81
2007	Japan 44.16	Norway 44.04	USA 33.48	Korea 33.26	Canada 30.73	311.15
2008	Japan 96.69	USA 51.79	Canada 42.05	Norway 30.56	Spain 26.03	406.02
2009	Japan 91.62	Australia 42.58	Denmark 36.30	Norway 35.26	USA 32.31	373.94

Source: Ministry of Foreign Affairs (2011 Data Book of Governmental Development Assistance by Country)

The Country Assistance Strategy released in 2012 states that in terms of assistance to Sri Lanka, Japan plans to provide assistance mainly for the development of infrastructure to promote economic growth based on Sri Lanka's basic development policy, in order to promote the further growth and stabilization of the country, the economy of which is growing steadily. The strategy notes that, based on the country's history of conflict and its current state of development, Japan needs to take into account the nation's characteristic vulnerability to disasters at the same time as we strive to provide assistance fairly and impartially with an awareness of the least developed countries and regions.

Areas of focus

(1) Promotion of economic growth

(2) Development assistance to least developed countries and regions

(3) Reduction of vulnerability

Points to consider

(1) Assistance taking into account regional and ethnic balance

(2) Assistance taking into account trends by other donors

(3) Consideration of environmental conservation and consideration of assistance in human resources development/science and technology

(4) Focus on PP partnerships and collaboration with NGOs and international organizations

Table 2.9-3 below provides a summary of the main areas of recent assistance from Japan.

Table 2.9-3 Main Areas of Assistance Recently Provided by Japan

Type of Assistance	Year of Implementation	Project Title/Others	Summary
Grant Aid	2007	Meteorological and disaster management network improvement project	Provision of equipment for automated weather observation systems and satellite communication systems to the meteorological agency for the automatic collection and editing of observation data.
Technical Cooperation Project	Sep. 2005 to Oct. 2009	Training program for IT engineers via distance education	Training of IT engineers capable of developing ITC human resources through distance learning, in line with Sri Lanka's ITC policy vision.

Type of Assistance	Year of Implementation	Project Title/Others	Summary
Technical Cooperation Project	March 2010 to March 2013	Project for disaster management capacity building to respond to climate change	Establishment of a disaster management model ranging from local disaster monitoring and forecasting to disaster preparedness and evacuation of local residents, mainly in the basins of four major rivers in the south-western region.

Source: Ministry of Foreign Affairs (2011 Data Book of Governmental Development Assistance by Country)

2.10 Aid from Other Donors

With respect to assistance in the telecommunications and broadcasting sectors, the Chinese government provided a loan of USD 88.66 million for the Lotus Tower Project led by TRC (External Resources Department, Ministry of Finance and Planning, Global Partnership Towards Development, 2012). The 350-meter-tall Lotus Tower that it is expected will be completed in 2015 will have the capacity to broadcast 50 TV programs and 35 radio programs. ITU also dispatched experts in 2011 to assist in the formulation of the road map for the transition to digital broadcasting in Sri Lanka.

Table 2.10-1 Aid from Other Donors

Assistance by	Year	Implementation	Assistance Amount (million)	Details
China	2012 to 2015	TRC	US$ 88.66	Lotus Tower Project
ITU	2011	National Road Map Team	N/A	Road map for the transition to digital terrestrial broadcasting in Sri Lanka

Source: JICA Study Team

Chapter 3 Current State of the Broadcasting Sector

Chapter 3 Current State of the Broadcasting Sector

3.1 Key Players in the Broadcasting Sector

3.1.1 Supervising and Regulatory Agencies

The Ministry of Mass Media and Information (hereinafter referred to as “MMI”) is responsible for the administration of broadcasting in Sri Lanka. MMI announces the national media policy, ensures freedom of speech and works to develop discernment in the citizens. The Telecommunications Regulatory Commission of Sri Lanka (hereinafter referred to as “TRC”) is in charge of licensing frequencies, standard certification of radio wave transmitters and radio wave supervision, including monitoring of the same.

3.1.2 State-Run Broadcasters

TV broadcasting in Sri Lanka was launched by a private broadcaster in April 1979 when the ITN Channel, operated by Independent Television Network Ltd. (hereinafter referred to as “ITN”), started the first terrestrial broadcasts. However, ITN was put under the management of the government in June 1979 and, since then, it has operated as a state-run broadcasting station together with Sri Lanka Rupavahini Corporation (hereinafter referred to as “SLRC”) under the Sri Lanka Rupavahini Act 6 (1982).

3.1.3 Private Broadcasters in Sri Lanka

The Government of Sri Lanka permitted the establishment of private commercial broadcasting stations in 1992, and the Maharaja Television Network (hereinafter referred to as “MTV”) was established shortly after. Following that a number of private companies began to participate in the terrestrial broadcasting sector.

Table 3.1-1 is a list of the licensed terrestrial analog broadcasting stations in Sri Lanka.

Table 3.1-1 Licensed Terrestrial Broadcasting Stations in Sri Lanka

No	Organization operating the broadcasting station	License type	Date of license
1	Sri Lanka Rupavahini Corporation	Analog TV broadcasting	By law
2	Independent Television Network (Pvt.) Ltd.		By law
3	EAP Network (Pvt) Ltd.		28.07.1993
4	Maharaja Organization (Pvt) Ltd. (MTV Channel)		12.05.1992
5	Telshan Network (Pvt) Ltd.		8.10.1992
6	IWS Holding (Pvt) Ltd.		11.01.1995
7	Asia Broadcasting Corporation Radio (Pvt) Ltd.		16.05.2008
8	Television and Radio Network		30.05.1996
9	Power House Ltd.		29.02.2004
10	MGMR Networks (Pvt) Ltd.		14.09.2005
11	Dumee International (Pvt) Ltd.		18.01.2006
12	Voice of Asia Network (Pvt) Ltd.		16.02.2006

No	Organization operating the broadcasting station	License type	Date of license
13	People`s Media Network (Pvt) Ltd.		31.05.2006
14	Rangiri Sri Lanka Media Network (Pvt) Ltd.		16.08.2011
15	Lak View Broadcasting (Pvt) Ltd.		25.05.2007
16	Sat Net (Pvt) Ltd		19.07.2007
17	Yellow Win Media (Pvt) Ltd.		18.03.2008
18	Future Sat Com Holdings (Pvt) Ltd.		13.05.2008
19	VIS Broadcasting Network (Pvt) Ltd.		16.05.2008
20	Sri Global Television Company (Pvt) Ltd.		27.11.2008
21	Ask Media (Pvt) Ltd.		22.06.2010
22	Carlton Sports Network (Pvt) Ltd.		03.03.2011
23	Ritz Asia (Pvt) Ltd.		03.03.2011

Source: Website of MMI

In Sri Lanka, satellite broadcasting stations and pay-per-view-style television stations have also been established. In 2008 the state-run telecommunications company, Sri Lanka Telecom (hereinafter referred to as “SLT”), launched an IPTV service that uses Internet protocol. Table 3.1-2 shows the non-terrestrial broadcasting stations. They redistribute mainly overseas satellite TV programs, as well as Sri Lankan terrestrial programs. Mobile phone carriers are also entering the mobile TV business and this shows a potential demand for mobile TV services including One-seg broadcasting following the transition to digital terrestrial broadcasting (hereinafter referred to as “DTTB).

Table 3.1-2 Licensed Non-Terrestrial Broadcasting Stations in Sri Lanka

No	Broadcasting station	License type	Date of license
1	Television and Radio Network	CATV	30.05.1996
2	Grant Communication (Pvt) Ltd.		15.07.1996
3	The Southern Development Authority (Pvt) Ltd.		24.10.1996
4	Dialogue Television (Pvt) Ltd.		09.02.2004
5	Voice of Asia Network (Pvt) Ltd.		16.02.2006
6	Sky TV and Radio Network (Pvt) Ltd.		23.02.2007
7	Lanka Broadband Network (Pvt) Ltd.		29.03.2007
8	City Cable Links (Pvt) Ltd.		19.01.2009
9	Lanka Cable and Satellite Network		24.02.2011
10	Messers Dynavision (Pvt) Ltd.	Satellite TV	
11	Dialogue Television (Pvt) Ltd.		
12	Voice of Asia Network (Pvt) Ltd.		
13	Sky TV and Radio Network (Pvt) Ltd.		
14	The Buddhist Broadcasting Service		
15	Sri Lanka Telecom (Pvt) Ltd.	IPTV	
16	Mobitel (Pvt) Ltd.	Mobile TV	

Source: Website of MMI

3.2 Broadcasting-related Laws and Regulations

3.2.1 Existing Laws

There is no comprehensive broadcasting law covering both state-run and private broadcasters. The government enacted the Sri Lanka Telecommunications Act (25 of 1991), later revised (27 of 1996) for the fair and efficient use of frequencies; the Sri Lanka Rupavahini Corporation Act (1982) covering the state-run broadcasting stations SLRC and ITN with respect to TV broadcasting; and the Sri Lanka Broadcasting Cooperation Act (1967) with respect to radio broadcasting. The Government of Sri Lanka promulgated the Private Television Broadcasting Station Regulations of 2007 in October 2008 to provide detailed regulations on the classification of transmitting stations, service categories and licenses, etc. However, the Private Television Broadcasting Station Regulations of 2010 stipulate only the classification of broadcasting stations and the technical, financial and expertise conditions for the issuing of licenses, and the enactment of these regulations nullified the 2007 regulations.

According to the MMI, the Sri Lanka Broadcasting Corporation Act is applied to private broadcasting stations with respect to basic issues, and the Private Television Broadcasting Station Regulations are concomitant to the Act to cover private broadcasters.

Table 3.2-1 Existing Broadcasting Laws and Regulations

No	Policy/law	Issues related to the Project	Outline
1	National Media Policy		• It supports the right of the media to express their views explicitly, provide guidelines and advice for the public and take a critical stance as needed. • It supports the right of citizens to obtain information and knowledge as enlightened citizenry in a free and democratic society.
2	Sri Lanka Telecommunications Act	Frequency usage fees, etc.	• Grounds for establishment of TRC, its objectives, rights and responsibilities • Frequency licensing
3	Sri Lanka Broadcasting Corporation Act		• Grounds for establishment of SLBC, its objectives, rights and responsibilities
4	Sri Lanka Rupavahini Corporation Act	TV broadcasting law	• Establishment and structure of Rupavahini Corporation • Responsibilities, staffing and finances of Rupavahini Corporation • Definition of TV broadcasting and private broadcasting
5	Private Television Broadcasting Station Regulations of 2007	Detailed regulations for broadcasting license categories, license fees, etc.	• Nullified upon enactment of Private Television Broadcasting Regulations 2010

No	Policy/law	Issues related to the Project	Outline
6	Private Television Broadcasting Station Regulations of 2010	Regulations concerning application for broadcasting license, etc.	Rules on broadcasting license application, etc.

Source: JICA Study Team

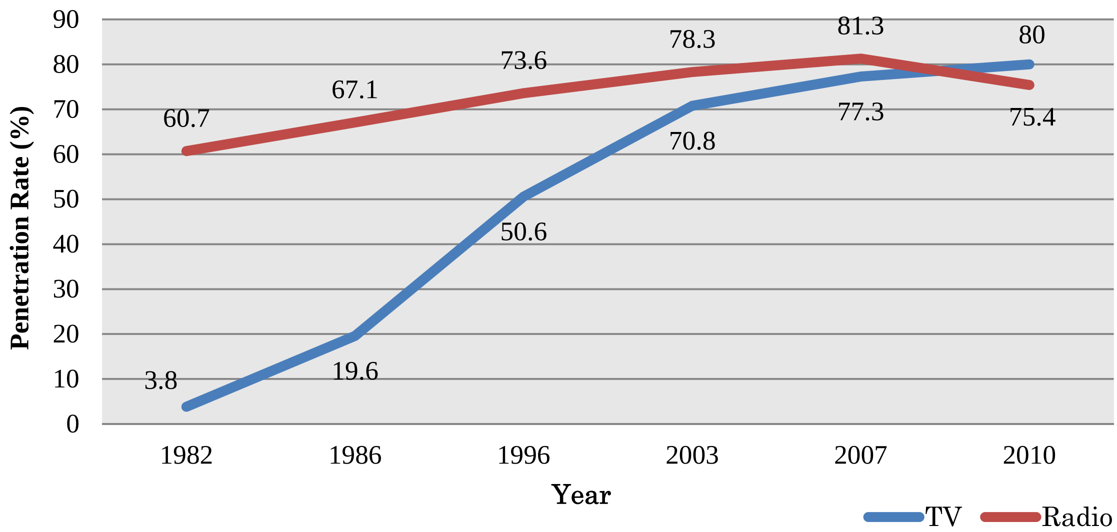
3.3 Penetration of TV Broadcasting in Sri Lanka

3.3.1 TV Set Ownership

In Sri Lanka, 80% of households had a TV set as of 2010, according to a study by the Department of Census and Statistics. The penetration rate exceeded that of radio in 2008, showing that TV has become the most popular source of information for the people of Sri Lanka. (See Figure 3.3-1)

The service coverage of one of the state-run broadcasters, SLRC, is 95 percent of the population, according to the broadcaster. (Because the reception environment for viewers is not as good as the announced figures, the study team calculated the current analog coverage in detail and obtained a population coverage of 67.2% with a field intensity of 55 dBμV/m or more as stipulated by the ITU.) The TV broadcasting network developed with Japanese grant aid serves as the foundation of national broadcasting over four channels in three systems.

The four channels of SLRC are as follows: Rupavahini Channel airs Sinhalese-language programs, Channel Eye and NTV air English-language and sports programs, and Nethra broadcasts in the Tamil language. Channel Eye and Nethra form a single broadcasting system by switching between the two channels. Private broadcasting stations air programs that meet local conditions and many transmitting stations broadcast only in the main language, such as Sinhalese or Tamil, spoken in the local area.



Source: Central Bank of Sri Lanka (Economic and Social Statistics of Sri Lanka 2013)

Figure 3.3-1 Changes in TV and Radio Penetration Rates

3.3.2 Satellite TV and Cable TV Subscription Rates and Fee Structure

In addition to terrestrial broadcasting, nine cable TV licenses, five satellite (direct-to-home, DTH) TV licenses, one IPTV license and one mobile TV license have been issued.

Currently, cable TV operators actually providing services are Lanka Broadband Network (Pvt) Ltd. (hereinafter referred to as LBN) and City Cable Links (Pvt) Ltd. LBN has four fee levels depending on the channels available and image quality. The monthly fees vary from Rs. 1,599.00 to Rs. 699.00 and the registration fee is Rs 6000.00. In addition a 20% telecommunications tax is levied. The number of LBN cable TV subscribers is estimated to be 50,000 households.

The most popular of the DTH satellite TV services is Dialog TV (Pvt) Ltd. It offers three prepaid fee levels. Daily charges are between Rs 3.00 and Rs 9.00 depending on the channels available. There are also five levels of charges for post-payment. The monthly charges are between Rs 699.00 and Rs 1,949.00. The company is estimated to have 264,000 household subscribers as of December 2012.

Table 3.3-1 Pay TV and Fees

Operator	Initial Cost	Monthly Fees (number of viewable channels)
Cable TV (LBN)	Rs 6,000	Rs 699.00 (36 Ch) to Rs 1599.00 (Over 100 Ch)
Satellite TV (Dialog)	Rs 5,999	Rs 699.00 (42 Ch) to Rs 1,949.00 (74 Ch)

Source: JICA Study Team

3.4 An Overview of Broadcasting Service Operation

As of 2012, 23 companies have a license for terrestrial broadcasting and of these 15 are in operation. Of the 15 companies, the state-run broadcasters are SLRC and ITN. The reason why eight of the companies are not operating is unknown, as the Study Team were not able to conduct direct interviews with them. In addition digital broadcasting trials are permitted, and there are some broadcasting stations, such as Dialog TV, that are conducting digital broadcasting trials without a digital terrestrial broadcasting license.

Pay-TV services are also growing rapidly in Sri Lanka with the advances in telecommunications technology. Satellite TV (DTH) services provided by a subsidiary of a major mobile communications service provider, Dialog Axiata, had approx. 230,000 subscribers as of the end of March 2013. Although nine cable TV companies are licensed, as of 2012 only two of them were providing a service, and the market is smaller than the market for satellite TV.

Dish TV, viewed directly by satellite from neighboring India has gained a great deal of popularity in Tamil residential areas.

The following is an overview of the broadcasting stations licensed for digital terrestrial broadcasting.

3.4.1 State-run Broadcasting Stations

(1) SLRC (Sri Lanka Rupavahini Corporation)

The broadcasting station launched its services in February 1982 with grant aid from Japan. The Government of Japan continued to provide technical cooperation in such areas as broadcasting techniques, program production and camera techniques until 2005. The broadcaster has the largest service area in the country.

Channels

- Rupavahini (Sinhalese)
- Channel Eye (English)/ Nethra TV (Tamil)
- NTV (English)

(2) ITN (Independent Television Network Ltd.)

ITN began operation on April 13, 1979, as the nation's first TV broadcasting station. It was put under government control in the same year.

Channels

- ITN Channel (Sinhalese)
- Vasatham TV (Tamil)
- Prime TV* (English)

  *Although the radio wave measurements carried out by the JICA Study Team in June 2013 could not verify the radio waves, ITN intends to broadcast Prime TV in line with the language policy to promote equal treatment of the three languages.

3.4.2 Private Broadcasting Stations

(1) EAP Network (Pvt) Ltd.

EAP Network was started in 1997 and operates two broadcasting stations: ETV broadcasting mainly English-language programs and Swarnavahini, airing local news and entertainment programs. The parent company, EAP Holdings Ltd., is a conglomerate that also handles jewelry, finance, hotel and real estate businesses.

Channels

- Swarnavahini
- ETV

(2) MTV Channel (Pvt) Ltd.

MTV was established in 1992 as a joint venture by Sri Lanka's biggest conglomerate, the Capital Maharaja Organisation Limited, and Singapore Telecommunications Limited. The coverage rate of MTV is 85%. It has three channels: MTV Sports in English, Shakthi TV in Tamil and Sirasa TV in Sinhalese.

Channels

- Sirasa TV (Sinhalese)
- Shakthi TV (Tamil)
- MTV Sports (English)

(3) Telshan Network (Pvt) Ltd.

Telshan Networks (TNL) is a sister station of Isira Radio and is operated by Telshan Network (Pvt) Ltd. It can also be viewed via Dialog satellite broadcasting.

Channel

- TNL

(4) ART Television Broadcasting Company (Pvt) Ltd.

A Sri Lankan conglomerate, IWS Holdings (Pvt) Ltd., is the parent company of ART Broadcasting Company. It provides services in the Greater Colombo area and the Kandy area. It broadcasts around the clock: 15 hours are broadcast by CNN International, and the remaining nine hours are set aside for the broadcast of the latest movies, dramas, music, sports and local business news.

Channel

- ART Television

(5) Asia Broadcasting Corporation (Pvt) Ltd.

Asia Broadcasting Corporation has the biggest radio network in Sri Lanka, owning Hiru FM, Gold FM, Sun FM, Sooriyan FM and Shaa FM. Hiru TV which it also owns began broadcasting in 2012. It is the first broadcasting station in Sri Lanka to cover the entire nation from its launch.

Channel

- Hiru TV

(6) Television and Radio Network

TV Lanka broadcasts for Sri Lankan communities throughout the world. It has acquired a CATV license. TV Lanka is conducting digital broadcasting trials using the European standard on a channel licensed for analog broadcasting, with regard to which it is currently in dispute with TRC.

Channel

- TV Lanka

(7) Power House Ltd.

Derana TV launched its broadcasting service in 2005. Programs are in Sinhalese and the channel airs mainly dramas, music and entertainment programs.

Channel

- TV Derana (Sinhalese)

(8) MGM Network (Pvt) Ltd.

Max TV is a TV station owned by MGM Network Ltd., which also operates a radio station, Max Radio.

Channel

- Max TV (Sinhalese and Tamil)

(9) Dumee International

Details unknown.

(10) Voice of Asia Network (Pvt) Ltd.

Voice of Asia Network operates Siyatha TV in Sinhalese and Vettri TV in Tamil. Siyatha TV began broadcasting in 2009 and the company also operates a radio station named Siyatha. It acquired CATV license.

Channels

- Siyatha TV
- Vettri TV

(11) People's Media Network (Pvt) Ltd.

Operated by a non-profit organization, the cost of operation is funded by donations from individuals and from the public and private sectors. Programs are mainly limited to promotion of the teachings of Buddhism.

Channel

- Buddhist TV

(12) Rangiri Sri Lanka Media Network (Pvt) Ltd.

Rangiri Sri Lanka Media Network broadcasts Buddhist programs only and it also operates a radio station. In 2007 it was the first broadcasting company in Sri Lanka to begin broadcasting Buddhism-specific radio programs.

Channel

- Rangiri Sri Lanka Television

(13) Lak View Broadcasting (Pvt) Ltd.

Details unknown.

(14) Sat Net (Pvt) Ltd.

Details unknown.

(15) Yellow Win Media (Pvt) Ltd.

Details unknown.

(16) Future Sat Com Holdings (Pvt) Ltd.

Details unknown.

(17) VIS Broadcasting Network (Pvt) Ltd.

VIS Broadcasting (Pvt) Ltd. concluded an agreement with CCTV NEWS and began broadcasting in October 2010.

Channel
- CCTV News (English)

(18) Sri Global Television Company (Pvt) Ltd.

Though frequencies have been assigned in Colombo, Kandy, Nayabedda, Karagahatenna, Jaffna and Gongala, the company is not broadcasting. Details are not known.

(19) Ask Media (Pvt) Ltd.

Details unknown.

(20) Carlton Sports Network (Pvt) Ltd.

Carlton Sports Network (Pvt) Ltd. was set up in March 2011. CEO Nishantha Ranatunga is the secretary of Sri Lanka Cricket (SLC). The company acquired its broadcasting license in March 2011. CSN broadcasts sports, lifestyle and business programs.

Channel
- CSN

(21) Ritz Asia (Pvt) Ltd.

Details unknown.

(22) Dialog Television (Pvt) Ltd.

Dialog Television (Pvt) Ltd. bought Asset Radio Broadcasting (Pvt) Ltd. and on June 18, 2007, acquired radio DTH and cable TV licenses as Dialog Television. Dialog Television (Pvt) Ltd. is a member of the Dialog Axiata PLC group, whose business extends widely in broadcasting and communications including the mobile phone business and Internet business.

Although Dialog Television (Pvt) Ltd. holds licenses only in DTH and Cable TV, they have been granted frequencies for 50ch each in Colombo, Gongala and Magalkanda and 54 ch in Madolsima and have started broadcasting trials in some areas, preparing for the commencement of digital terrestrial television broadcasting services. MMI permission is for broadcasting trials only: an official digital terrestrial broadcasting license has not yet been issued.

Table 3.4-1 is a list of all the broadcasting stations and their channels currently available in Sri Lanka. The table shows that there are in total 23 channels not including those channels that are not operational but counting Channel Eye and Nethra TV as two channels.

Table 3.4-1 List of TV Broadcasting Stations in Sri Lanka

	Name of broadcaster	Channel Name	Service area	Transmitting stations	Remarks
1.	Sri Lanka Rupavahini Corporation	Rupavahini (Sinhalese)	Nationwide	Colombo, Palaly, Badulla, Kandy, Deniyaya, Suriyakanda, Spring Valley, Padhagala, Nuwara Eliya	
2.		Channel Eye / Nethra TV (English/Tamil)	Nationwide	Colombo, Palaly, Kokavil, Kandy, Suriyakanda, Nuwara Eliya	
3.		NTV (English)	Colombo city	Colombo	
4.	Independent Television Network (Pvt) Ltd.	ITN (Sinhalese)	Nationwide	Hunnasgiriya, Madulsima, Suriyakanda, Nayabedda, Yatiyantota	
5.		Vasantham TV (Tamil)	Greater Colombo area, Northern, Central Provinces	Colombo, Jaffna, Karagahatenna	
6.		Prime TV (English)	Unknown	Unknown	Not in service. The radio wave measurement conducted by the JICA Study Team in June 2013 could not detect any radio waves.
7.	EAP Network (Pvt) Ltd.	Swarnavahini	Greater Colombo area,	Colombo, Kandy, Ratnapura, Nuwara	

	Name of broadcaster	Channel Name	Service area	Transmitting stations	Remarks
			Central, Southern Provinces	Eliya, Badulla, Gongala, Gammaduwa, Magalkanda, Nayabedda, Hunnasgiriya	
8.		ETV (English)	Greater Colombo area	Colombo	
9.	MTV Channel Maharaja Organization (Pvt) Ltd.	Sirasa TV (Sinhalese)	Greater Colombo area, Central, Southern Provinces	Colombo, Gongala, Gammaduwa, Hunnasgiriya, Kandy, Nuwara Eliya, Ratnapura	
10.		Shakthi TV (Tamil)	Nationwide	Colombo, Gongala, Gammaduwa, Hunnasgiriya, Kandy, Kilinochchi, Nuwara Eliya, Ratnapura	
11.		MTV Sports (English)	Greater Colombo area	Colombo	
12.	Telshan Network (Pvt) Ltd.	TNL	Greater Colombo area, Central, Southern Provinces	Colombo, Badulla, Gongala, Kandy, Ratnapura, Karagahatenna, Nuwara Eliya	
13.	ART Television Broadcasting Company (Pvt) Ltd.	ART TV CNN (English)	Greater Colombo area, Jaffna area, Kandy area	Colombo, Jaffna, Kandy	
14.	Asia Broadcasting Corporation Radio (Pvt) Ltd.	Hiru TV	Greater Colombo area, Central, Southern Provinces	Colombo, Ratnapura, Kandy, Kurunegara, Nayabedda, Badulla, Hunnasgiriya, Gammaduwa, Jaffna, Nuwara Eliya, Kokavil, Gongala, Kalutara, Magalkanda	
15.	Television and Radio Network	TV Lanka	unknown	Colombo, Gammaduwa, Gongala, Nayabedda	Not in service however digital broadcasting trials

	Name of broadcaster	Channel Name	Service area	Transmitting stations	Remarks
					using the European standard are being conducted on the analog channel
16.	Power House Ltd.	TV Derana	Greater Colombo area, Central, Southern Provinces	Colombo, Gammaduwa, Gongala, Nayabedda, Kandy, Nuwara Eliya, Kalutara	
17.	MGMR Networks (Pvt) Ltd.	Max TV	Greater Colombo area	Colombo, Kandy	
18.	Dumee International (Pvt) Ltd.	Unknown	Unknown	Unknown	Not in service
19.	Voice of Asia Network (Pvt) Ltd.	Siyatha TV	Greater Colombo area, Matale area, Kandy area	Colombo, Gammaduwa, Gongala, Kandy, Nuwara Eliya	
20.		Vamam	Greater Colombo area, Matale area	Colombo, Gammaduwa, Nuwara Eliya	
21.	People’s Media Network (Pvt) Ltd.	Buddhist TV	Greater Colombo area, Matale area	Colombo, Karagahatenna	
22.	Rangiri Sri Lanka Media Network (Pvt) Ltd.	Rangiri Sri Lanka TV	Matale area	Gammaduwa	
23.	Lak View Broadcasting (Pvt) Ltd.	Unknown	Unknown	Unknown	Not in service
24.	Sat Net (Pvt) Ltd.	Unknown	Unknown	Unknown	Not in service
25.	Yellow Win media (Pvt) Ltd.	Unknown	Unknown	Unknown	Not in service
26.	Future Sat Com Holdings (Pvt) Ltd.	Unknown	Unknown	Unknown	Not in service
27.	VIS Broadcasting Network (Pvt) Ltd.	CCTV News	Colombo city	Colombo	
28.	Sri Global Television Company (Pvt) Ltd.	Unknown	Unknown	Colombo, Karagahatenna, Nayabedda, Jaffna, Kandy, Gongala	Not in service
29.	Ask Media (Pvt) Ltd.	Unknown	Unknown	Unknown	Not in service

	Name of broadcaster	Channel Name	Service area	Transmitting stations	Remarks
30.	Carlton Sports Network (Pvt) Ltd.	CSN (Sinhalese / English)	Nationwide	Colombo, Gongala, Nayabedda, Jaffna, Karagahatenna, Nuwara Eliya, Badulla, Ratnapura, Hantana	
31.	Ritz Asia (Pvt) Ltd.	Unknown	Unknown	Unknown	Not in service
32.	Dialog Television (Pvt) Ltd.	Unknown	Unknown	Colombo, Gongala, Magalkanda, Madulsima	Digital broadcasting trials using the European standard are being conducted. The status of analog broadcasting is unknown

Note: Unknown: the JICA Study Team was not able to conduct interviews and acquire information

Source: Website (MMI, TRC), ITU roadmap, Interviews with SLRC, ITN, and JICA Study Team

Chapter 4　Transition Plan to DTTB

Chapter 4 Transition Plan to DTTB

4.1 Review of ITU Roadmap for the Transition to DTTB

The International Telecommunication Union (hereinafter referred to as “ITU”) conducted a two-month short-term survey from August to October 2011 together with the national roadmap formulation team from the Sri Lankan Government and compiled the Roadmap for the Transition from Analogue to DTTB in Sri Lanka (hereinafter referred to as the “ITU Roadmap”). The Study Team understands that it is the only comprehensive plan for transition to DTTB in Sri Lanka. The ITU Roadmap examines only the main transmitting stations with no detailed investigation. There is concern that dependence on the roadmap in the preliminary design stage may cause major design changes in the implementation stage.

The examination of the sites selected as sites where viewing DTTB programs is difficult, described in the ITU Roadmap, is based on theoretical simulation with DVB-T2, so there is a need to verify the relevance of the location of the transmitting stations based on simulation with the ISDB-T standard and field surveys, as the preliminary design to review the ODA loan project on the assumption that DTTB is provided by the ISDB-T standard.

Table 4.1-1 shows the frequency assignment for each transmitting station of the broadcasting stations in Sri Lanka based on the JICA Study Team survey in August 2013 and the data which was collected from related organizations. As mentioned in Clause 3.4, 23 companies have a license for terrestrial broadcasting and 15 of them are actually broadcasting. Sri Globaal Television has licenses for five places nationwide and Lanka Broadcasting which operates a Television and Radio Network has licenses in Jaffna. They are not operated. Table 4.1-2 shows the assumed number of DTTB channels, followed by an overview of the contents of the ITU Roadmap.

The JICA Study Team measured the radio waves and conducted a simulation of the radio propagation frequency based on the above-mentioned assumption and examined the specific location plans. (Details are discussed in Clause 7.2.)

Table 4.1-1 Site Allocation and Channels of All Broadcasting Stations

	Broadcasting Station / Site	SLRC	ITN	MTV	EAP	Carlton Sports Network	Voice of Asia	Telshan Network	ART TV	Asia Broadcasting	Power House	TV & Radio Network	Sri Global TV	Others ·MGM Networks, ·Peoples Media Network, ·VIS Broadcasting, ·Rangiri Sri Lanka ·Lanka Broadcasting Net	DTTB (Reference)
1	**Colombo (Rajagiriya)**		24												
2	**Colombo (Battaramulla)**														
3	**Colombo (Bambalapitiya)**	52,57													
4	**Colombo**	39		23,(25), 58	31,35	22	32, (46)	21	28	45	37	48,51	<54>	29, 30, 53	41,43,44,50
5	**Deniyaya**	39	9												
6	**Matale (Karagahatenna)**		9			32		11					<39>	57	
7	**Matale (Gammaduwa)**			23, (25)	37		(21), 31			26	28	48		60	
8	**Gongala**			(25), 29	37	28	23	26		45	31	48	<62>		50
9	**Hunnasgiriya**		(24)	51,58	40					23					
10	**Spring Valley**	52													
11	**Padhagala**	52													
12	**Jaffna**					30			36	<38>			<47>	<53>	
13	**Jaffna (Palaly)**	21, 23	(25)												
14	**Magalkanda**				40					<61>					50
15	**Kalutara**									60	56				
16	**Kandy (Hantana)**	10, 39		29, 51	22	57	35	26	52	<21>	32		<54>	56	
17	**Kandy (Primrose)**	39													

Broadcasting Station / Site		SLRC	ITN	MTV	EAP	Carlton Sports Network	Voice of Asia	Telshan Network	ART TV	Asia Broadcasting	Power House	TV & Radio Network	Sri Global TV	Others ・MGM Networks, ・Peoples Media Network, ・VIS Broadcasting, ・Rangiri Sri Lanka ・Lanka Broadcasting Net	DTTB (Reference)
18	Kilinochchi			(46)											
19	Kokavil									<45>					
20	Badulla (Madulsima)		24												54
21	Badulla (Namunukula)	10				51									
22	Badulla				35			21		23					
23	Bandarawela (Nayabedda)		12		40	30				22	32	53	<46>		
24	Nuwara Eliya (Pidurutalagala)	5,7		27, (34)	33	47	42,49	4		38	36				
25	Kurunegara									22					
26	Ratnapura			(51), 58	22	56		26		21					
27	Suriyakanda	11, 52	24												
28	Yatiyantota		12												
29	Piliyandala							3							
30	Polgahawela							3							

( ): Tamile, Green: VHF, <>:Reserved

Recommended by ITU

Source: Compiled based on TRCSL website and interviews with concerned parties in the field survey conducted by JICA in August 2013.

Table 4.1-2 Number of Program Channels in Digital Broadcasting

Number	Name of broadcasting company	Number of program channels	Remarks
1	SLRC	3	In Sinhalese, Tamil and English
2	ITN	2	In Sinhalese and Tamil
3	EAP	2	In Sinhalese and English
4	MTV	3	In Sinhalese, Tamil and English
5	Telshan Network	1	
6	IWS Holdings	1	
7	Asia Broadcasting Corporation	1	
8	Power House	1	
9	MGM Networks	1	
10	Voice of Asia	2	In Sinhalese and Tamil
11	Peoples Media	1	
12	Rangiri Sri Lanka Media Network	1	
13	VIS Broadcasting	1	
14	Carlton Sports Network	2	In Sinhalese and English
15	TV & Radio Network	1	
	Total	**23**	

Note: The table shows only operating companies.
Source: JICA Study Team

(1) Digital switch over / Analog switch off (DSO/ASO) schedule

According to the ITU Roadmap, the procurement of digital broadcasting devices begins in mid-2012 and digital broadcasting starts (Digital Switch Over to SD, hereinafter referred to as “DSO-SD”) with standard definition quality in mid-2014. Analog broadcasting is planned to terminate (Analog Switch Off, hereinafter referred to as “ASO”) in the 1st quarter of 2016 in the western region where Greater Colombo is situated and at the end of 2017 across the country. However, it is targeted at SDTV which provides standard definition images and there is no mention of when and how HDTV that provides high definition images will be introduced.

(2) Transmitting station site

The ITU Roadmap assumes, based on the broadcasting license issuance that the available channels that are usable across Sri Lanka are channels 41 and 43 and that channels 38, 45, 57, 59 and 61 are usable under certain conditions.

Separately, it also assumes the coverage area when radio waves are emitted from eight transmitting stations in the DVB-T2 standard, based on radio propagation simulation. However, there are many areas where radio waves are less likely to reach scattered in the coverage areas in the simulation map.

(3) Market scale and future development forecast

According to the ITU Roadmap, the total population was 20,680,000 with 4,054,000 households in 2011. Approx. 3,500,000 households had a television set in 2011 and the number is on the rise. Together with the two state-run TV stations, many private stations provide analog terrestrial broadcasting in the VHF and UFH frequency bands. There is also CATV, satellite TV, IPTV and mobile TV. Although the number of viewers in poor TV signal reception areas is not growing as expected, satellite TV and CATV viewers are on the rise not only due to measures against poor reception but also because of the diversity of programs.

(4) Platform

The ITU Roadmap introduces digital broadcast network operator (hereinafter referred to as "DBNO") as a new type of broadcasting service provider. DBNO was discussed at the roadmap formulation stage and are considered to be the most suitable digital broadcasting operation style in Sri Lanka. Specifically, conventional broadcasting companies solely engage in program production, serving as program providers, and the DBNO manages the programs, transmitting and wiring them across the nation.

(5) Legal system

According to the ITU Roadmap, the Ministry of Mass Media and Information (hereinafter referred to as "MMI") is in charge of national broadcasting and media policy, and SLRC programs and broadcasting rights are regulated under the Sri Lanka Rupavahini Corporation Act (hereinafter referred to as the "SLRC Act"). The TRC is responsible for issuance and management of radio wave use licenses under the Telecommunications Act. The MMI and TRC appropriately share the responsibility for the technical standards of the DBNO and tax issues.

There is no Act that comprehensively covers broadcasting business in Sri Lanka. The SLRC Act applies to private broadcasting stations. However, given the emergence of new actors such as DBNO and the introduction of multiplexing of the programs, the preparation of a new Act and regulations is urgently required.

(6) Challenges of Roadmap

The ITU Roadmap presents a realistic proposal of the basic digitalization processes including simultaneous digital and analog broadcasting and procedures for analog termination and an overview of the channel plan for the major transmitting stations. Although it shows a standard checklist of whether the existing transmitting station buildings can be repurposed or not, it does not include specific discussions necessary for creating a platform, with no examination of whether each transmitting station building can be repurposed or not. Furthermore, because the frequency simulation used for the examination of the transmitting stations is based on the DVB-T2 standard, the decision to use the ISDB-T standard requires a review of such matters as the adjacent channel interference protection ratio, co-channel interference protection ratio and other criteria. Thus, detailed investigation of the coverage rate of the national land and adjacent channel and co-channel interference is needed.

Thus, service coverage as a percentage of population (hereinafter referred to as "population coverage") and adjacent and co-channel interference need to be examined in detail. The ITU Roadmap does not discuss co-channel interference or measures to deal with the mountainous and other remote areas where radio wave reception is difficult. The challenges are listed below and they need to be examined and solved.

- Examination of the locations of transmission antennas and broadcasting by proper output power to achieve the target population coverage
- Examination of the number of channels necessary for broadcasting
- Examination of a single frequency network (hereinafter referred to as "SFN") to broadcast the same programs in one channel
- Examination of co-channel interference in SFN
- Examination of a multi-frequency network (hereinafter referred to as "MFN") to broadcast the same programs in multiple channels when there are areas where SFN cannot be used
- Examination of adjacent channel interference between existing analog and digital channels and between digital channels as well as co-channel interference

A broadcasting service coverage map should be produced and the population distribution map should be overlaid on it to decide a plan for appropriate transmitting station locations based on the results of the examination listed above. Although the existing transmitting stations should be used in principle, it is possible that new transmitting stations and gap fillers (to fill the gaps between coverage areas at low power) need to be established.

The results of the wave measurement, frequency propagation simulation and field survey conducted by the Study Team reveal that it is impossible to cover the entire nation with the eight transmitting stations recommended by ITU. (See Claude 7.2)

There is also a plan to build a 350-tall steel transmitter tower (hereinafter referred to as the "Lotus Tower"), higher than Tokyo Tower, in Colombo for DTTB, funded by Chinese aid, to air broadcasters' programs from the tower in Greater Colombo. Because conventional analog broadcasting is aired from the transmitting stations of individual broadcasters, the reception conditions differ from channel to channel. Although a joint antenna would likely greatly improve the reception environment for citizens, it is also necessary to examine the changes in the environment and whether citizens would need to make new investment, for example, purchase a reception antenna, and inform them of such matters.

As of February 2014, the ASO plan is yet to be completed and broadcasters except trial broadcasting stations have not procured transmitting devices in accordance with the transition plan. Thus, there is an urgent need to decide the type of digital broadcasting system, establish laws and promote the ASO plan.

4.2 Matters to be Carried Out for Transition to DTTB

4.2.1 Establishment of New Laws

In Sri Lanka, the existing laws and regulations related to broadcasting are only the Telecommunications Act (25 of 1991, 27 of 1996) and Sri Lanka Rupavahini Corporation Act (1982, SLRC Act). Accompanying the transition to DTTB, the MMI planned to amend the SLRC Act at the beginning of the discussions. However, in the course of the discussions with the Study Team, a consensus has been built on the necessity to establish new laws and regulations including a law on setting up DBNO. The plans, policies, laws and regulations that are regarded as necessary are listed below. (See Chapter 11)

(1) Detailed frequency plan

(2) Establishment or amendment of related laws and regulations

- Law on establishment of DBNO
- Broadcasting license regulations
    1) Frequency license (to serve as grounds for collective license issuance to DBNO)
    2) Multiplexing license (a new license to be issued collectively to DBNO)
    3) License for broadcasting program providers (a new license is needed to produce programs because DBNO will be in charge of transmitting and multiplexing broadcasting radio waves.)

(3) Policy and guidelines for digitalization of satellite TV and cable TV broadcasting

(4) Establishment of standards for transmitters and receivers for digital broadcasting

(5) Policy on the promotion of digital broadcasting

4.2.2 DTTB Platform

(1) Definition of Platform Services

In regard to the definition and style of DTTB platform business, the MMI has the following understanding:

A platform is defined as a “broadcasting network shared by broadcasting stations, and spontaneous and shared use of the facilities and equipment composing the network” in order to air various programs produced by independent broadcasters (public and private). The main advantages of the introduction of a platform are as follows:

- Transition to DTTB requires a large amount of investment if each broadcasting station builds a broadcasting network independently. The introduction of a platform yields the maximum effect (sufficient coverage rate) with the least investment cost (cost minimization) by jointly using the transmitting facilities of the PF and the steel tower facilities of the existing air zones possessed by each broadcasting station.

- It is an effective way of launching DTTB in a short period of time in Sri Lanka where there are few unused frequencies that can be used for the new type of broadcasting.

One of the major points of the transition to DTTB is that it requires the replacement of facilities and equipment for digitalization. The replacement in the time until DSO-SD or ASO places a very heavy burden on the broadcasting stations. Analog and digital simultaneous broadcasting needs to be provided after DSO-SD until ASO. This raises another difficulty of securing space for installing the facilities and equipment.

Transmitting stations are usually built at high altitudes because they are more suitable to increase radio propagation and reduce blockages. Transmitting stations also require electricity and a telecommunications network. Know-how and knowledge are needed to build them to cover the entire country since proper locations need to be selected and ease of installation and electricity and telecommunications network needs to be taken into consideration. Coordination with other broadcasters through TRC is also needed to prevent radio wave interference.

Because the work described above is also a burden, broadcasting through a platform will help alleviate such a burden by means of investment.

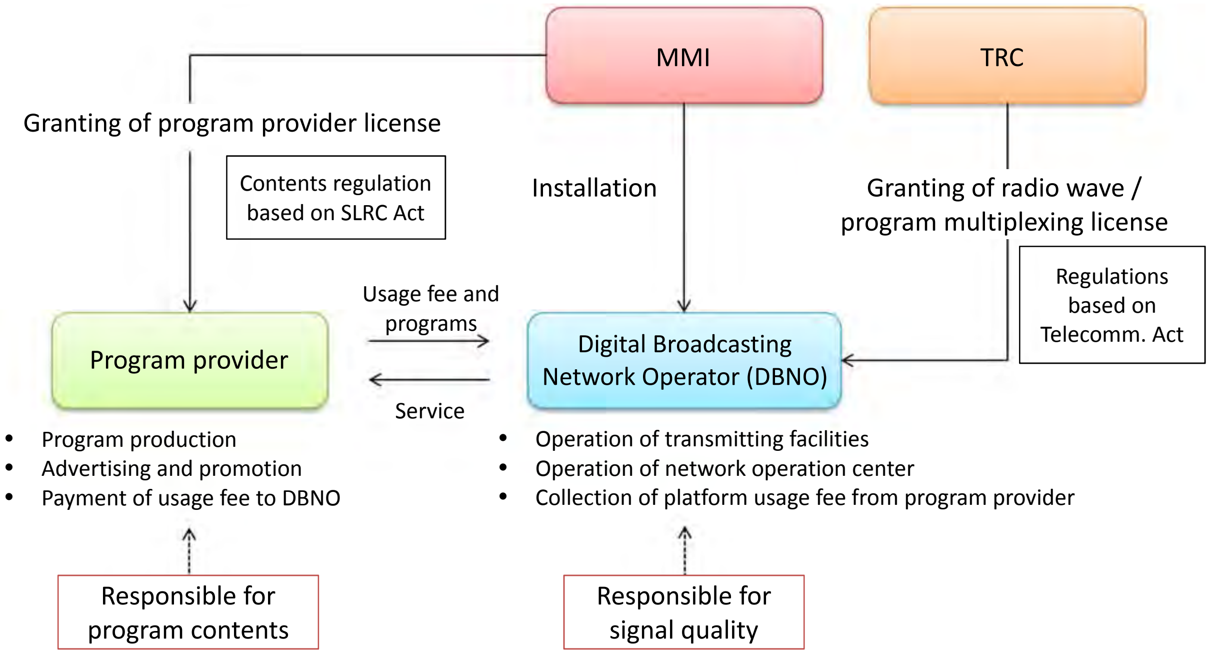
At the same time, as integration of the location of the transmission antennas of each broadcaster leads to the fixed direction of the receiving antennas and eliminates receipt of an electric field gap for viewers, the reception is improved significantly.

However, it is also necessary to clarify such issues as division of responsibilities between the DBNO and the broadcasting stations, the proper subscription fees, contact points for viewers, and compensation for impacts on TV programs in case of malfunctioning of the DBNO equipment. Because One-seg sends one program on one wave, there is a need to disclose the selection criteria of the One-seg providers if the DTTB service is provided via multiple frequencies based on multiplexing.

(2) Establishment of Digital Broadcast Network Operator (DBNO)

The PF structure the MMI intends to create is shown in Figure 4.2-1 below. A DBNO is set up by the MMI and supervised and regulated by the TRC under the Telecommunications Act. It is likely that the MMI will no longer grant broadcasting stations a frequency license, but will issue new licenses as program providers instead. The MMI will revise the SLRC Act and improve the legal system to define the program providers and grant the licenses.

Broadcasters have been responsible for broadcasting appropriate programs and maintaining the broadcasting equipment. As they will be the program providers, they will no longer be responsible for the management of broadcasting and the DBNO will become responsible for it instead. However, because the program providers also possess the facilities to transmit programs to the DBNO as well as shooting and recording equipment, they will likely be responsible for equipment maintenance within a certain scope. The MMI intends to formulate a specific SLRC revision proposal on such matters as qualifications for program providers (screening conditions to grant licenses) and platform usage fees to be collected by the DBNO from providers. Although the TRC will collect radio wave and program multiplexing license fees from the DBNO, the digital terrestrial wave fees have yet to be discussed. Because most of the income of the DBNO is likely to be regulated by laws, the TRC needs to decide the radio wave fees and program multiplexing fees carefully in cooperation with the MMI.



Source: JICA Study Team

Figure 4.2-1 Conceptual Diagram of Platform Business

Also, the MMI plans to examine the following points in relation to DBNO:

- The DBNO to be set up is a service provider completely independent of the government.
- The state government will provide more than 50 percent of the total investment and the remainder will be funded solely by program providers or by program providers together with general corporations.
- If the DBNO is owned by the government, it will be a digital broadcast network operating board or committee. It will be a corporation if the private sector also has joint ownership.
- The organization and manpower are left vacant. (As for the organization, a proposal by the survey team is shown in Section 7.6.1.)
- The platform facilities and equipment will be owned by the government and the DBNO will rent them from the government and be responsible only for their operation. Thus, the government shall be responsible for acquiring the necessary investment funds for the facilities and equipment.

The future course is yet to be decided on the above five issues and attention should be paid to the operation type.

(3) Facilities of DBNO

The DBNO needs to have the following equipment configuration (including leased or rented equipment) to fulfill its functions described in (2):

(i) Function of TV program collection
This is the function of transmitting the digital broadcasting signals supplied by the program providers to the DBNO Network Operation Center (hereinafter referred to as "NOC"). The transmission link is leased from a telecommunications carrier.

(ii) Function of multiplexing TV programs and converting them into signals that can be broadcast
The digital broadcast signals from the program providers of a specific number of programs are multiplexed into one signal wave and the control signals necessary for digital broadcasting are added. The multiplexed signals are converted into TS signals that can be broadcast in the UHF band and sent to the transmitting stations.

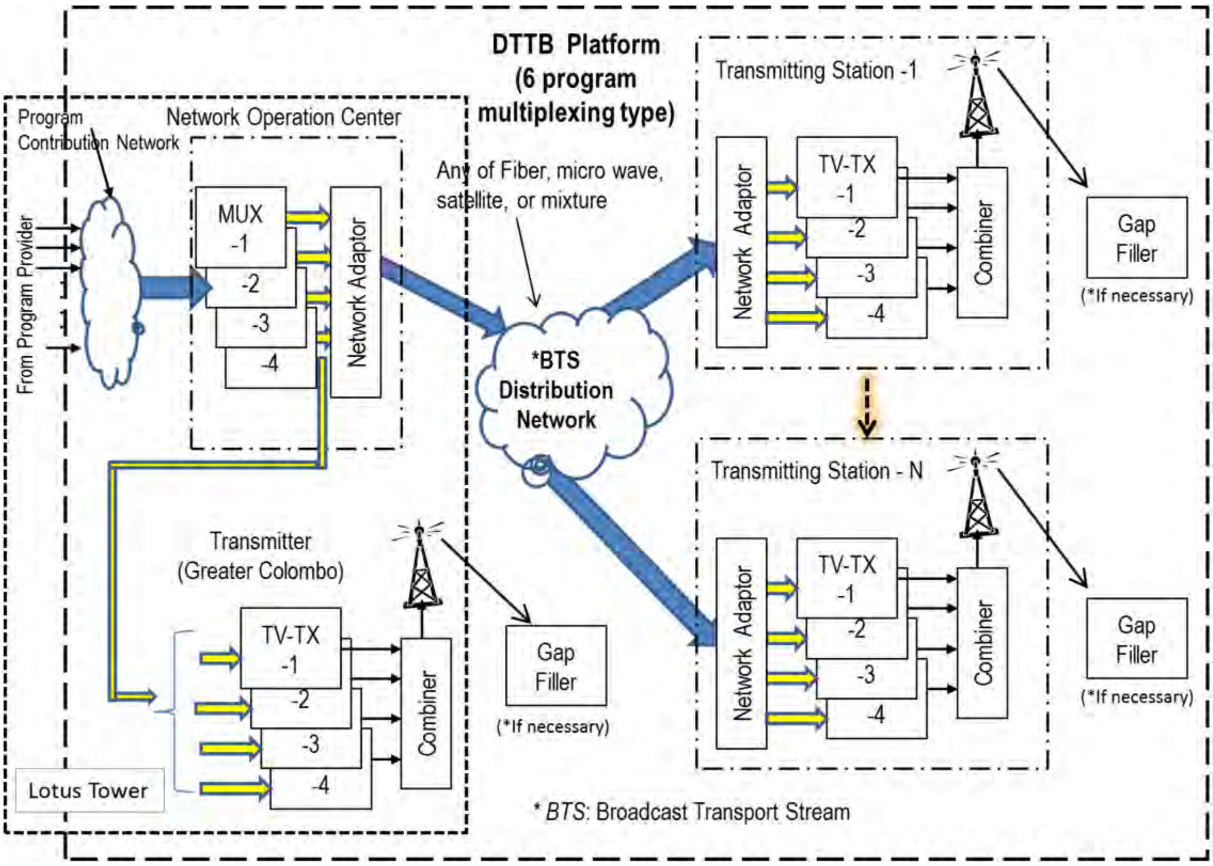
(iii) Function of sending signals to transmitting stations
The TS signals described above are multiplexed and sent to the transmitting stations via the high-speed transmission network. Possible network types are optic fiber, micro-wave STL and satellite, or a combination of them. Feasibility and operation ease and cost (including running cost) will be examined and the network composition will be decided based on trade-off. (See Section 7.4.4 for details.)

(iv) Function of transmitting multiplexed signals in designated areas
The digital signals that are sent to the transmitting stations via the high-speed transmission network are supplied to the TV transmitters after being separated into broadcast TS signals. The digital broadcasting signals are amplified to a predefined power level in the transmitters and combined before being sent to viewers from the transmission antenna. When gap filler stations are also used, the signals sent from the transmitting stations are received and amplified there and then re-transmitted.

Figure 4.2-2 shows the entire structure of the DBNO facilities. The IP network provided by telecommunications carriers is considered appropriate as the program contribution network. The details of the equipment are described in Section 7.4.5: Equipment Plan for NOC.

NOC which multiplexes multiple programs and sends them to the transmitting stations that cover each area has the function of supplying the collected TV programs to the distribution network in the following steps after converting them into a broadcast transport stream (hereinafter referred to as "BTS") signal system which is a multiplexed signal system that can be aired as DTTB. As described later in Section 5.2.1, the number of TV programs multiplexed in one radio frequency (channel) is closely linked with image quality. Figure 4.2-2 shows an example of multiplexing six programs from the maximum of 23 programs in each radio frequency. BTS signals produced by NOC are sent to the transmitting stations that cover each area via the transmission network and they are then broadcast in each area.

The Government of Sri Lanka has announced the target figures for DSO-SD and ASO as the schedule for transition to digital broadcasting. However, no specific preparations for establishment of DBNO are being made and they should be accelerated.



Source: JICA Study Team

Figure 4.2-2 Entire Structure of DBNO Facility

Chapter 5 Adaptability of ISDB-T Sri Lanka's Situation

Chapter 5 Adaptability of ISDB-T Sri Lanka's Situation

5.1 Main Features of ISDB-T

(1) Multifunctional data broadcasting

ISDB-T allows data broadcasting as a standard feature to enable transmission of a variety of information to all viewers simultaneously. Data broadcasting provides a general contact to e-government, road traffic information, weather reports, educational and medical information, news and sports, and other contents. TV stations can freely produce contents for data broadcasting, so they can send local information as necessary.

(2) Viability and spillover effects of data broadcasting

In countries where ISDB-T is used, data broadcasting is steadily used as a means of business and public telecommunications and much know-how has been accumulated. As other DTTB standards do not support data broadcasting, a high amount of development cost is assumed for operating data broadcasting based on a standard other than ISDB-T.

The data for data broadcasting is described in BML, which is equally easily understandable as HTML used on the Internet. Thus, although engineers involved in data broadcasting needs to learn BML, it can be acquired in a relatively short time period.

Data broadcasting not only provides latest information to viewers or citizens at low cost, but also has the potential of creating new markets and workforce demand. For example, data broadcasting production requires programmers, designers and data administrators. Creation and discovery of human resources in ICT in Sri Lanka will activate the market. Activation of the ICT market will likely help improve capacities of engineers. Data broadcasting not only provides information for viewers but also can cause socioeconomic spillover effects.

(3) Usability of mobile TV

ISDB-T is the only DTTB standard compatible with mobile TV in the world.

ISDB-T is the only DTTB standard that supports reception from stationary antennas fixed on building roof or the like, and movable antennas for mobile phones or other movable devices. ISDB-T also allows One-seg broadcasting and can provide mobile TV service in combination with mobile phones. In other words, mobile TV is highly usable in ISDB-T systems. As described in Chapter 2, mobile phone prevalence rate is high in Sri Lanka. The system allows the poor who cannot afford to purchase expensive TV sets to enjoy the benefit of DTTB with the use of STBs or mobile phones.

(4) Availability of inexpensive TV sets

ISDB-T is used in many counties including Brazil and Peru as well as Japan. TV sets, STBs and mobile TV devices are manufactured and sold in large quantities. Mobile ISDB-T TVs has been the best-selling in global mobile TV market. As they are in mass production, the market price has dropped to a low level.

Japan shipped out 130 million DTTB receivers (including TV sets with built-in DTTB tuner, STBs, digital recorders and computers) from 2007 to 2011. The accumulative shipment volume of mobile phones compatible with One-seg broadcasting is 140 million. This shows that a total of 270 million ISDB-T-compatible receivers have been developed and manufactured only in Japan. A large volume of such units are also manufactured and sold in such Latin American countries as Brazil and Peru and thus they can be purchased at reasonable prices. This shows that stable usability of ISDB-T broadcasting has led to stable production of receivers.

(5) Economic effects of realization of One-seg broadcasting

Approx. 3.5 million households own TV receivers in Sri Lanka. If an STB unit costs 2,000 yen on average, it will generate seven billion yen of economic effects. The economic effect is expected to last for five years from the launch of digital broadcasting to termination of ASO, as described in Chapter 7.3: DSO and ASO Plan. When the Japanese case introduced in (3) above is applied, the economic effect will amount to 35 billion yen, on an assumption that the shipment volume is same as that of the fixed receivers and the mobile terminal is priced at 10,000 yen per unit. The economic effects of the mobile terminals will continue also after ASO and the 35 billion yen is not generated only in the five years; however, 30 billion yen of economic effects is still expected in Sri Lanka from the sales of mobile and fixed receivers at a moderate estimate considering the poverty group in the country accounting for 25 percent of the population. In any case, as the One-seg broadcasting is highly feasible, the sales of ISDB-T receivers have big economic impacts.

(6) Usability of Emergency Warning Broadcast System (EWBS)

TV is an effective means for the government to providing information for citizens in such emergency situations as occurrences of earthquake, tsunami, flood and other natural disasters, contagious disease, and riot. EWBS can be the means of communicating such essential information to citizens. EWBS is used for warnings on natural disaster in Japan and highly usable in case of emergency situations to inform citizens of threatening information. Such information can be provided locally via EWBS only for a certain area by dividing the nation into several areas. EWBS is highly usable not only for disaster warning but from a wider perspective.

(7) Effectiveness in disaster prevention

The early warning system is very effective to protect human lives from natural disasters. Construction of such a system requires development of telecommunications routes, creation of warning network, and installation and maintenance of many siren systems.

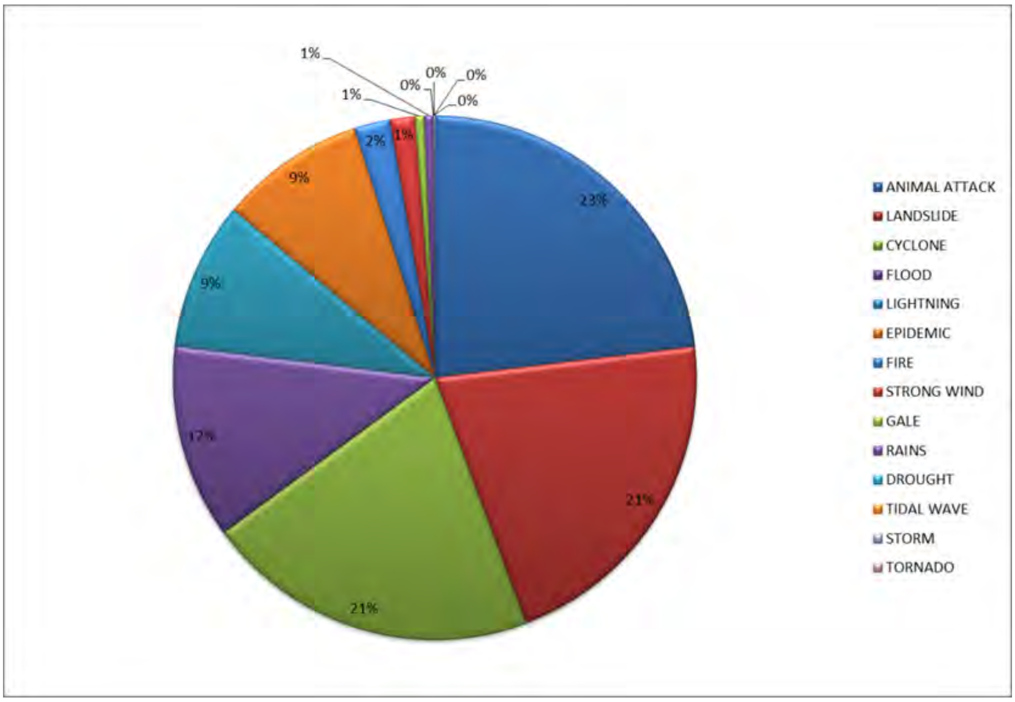
The Ministry of Disaster Management and the Disaster Management Center (hereinafter referred to as “DMC”) are responsible for policy activities concerning disaster prevention. Items shown in Table 5.1-1 are listed in the national disaster prevention plan of Sri Lanka as natural disasters that may cause damage.

Table 5.1-1 Disasters that May Cause Damage in Sri Lanka

No	Type of disaster	Phenomena/examples
1	Meteorological disaster	• Flood, mudslide, landslide • Tropical cyclone, rain, storm, lightning • Drought, desertification, fire due to spontaneous ignition, warming temperature, sandstorm
2	Geological hazard	• Earthquake, tsunami • Volcanic activity • Landslide, liquefaction • Shallow landslide, active fault
3	Biohazard	• Epidemic, infectious disease from animal

Source: DMC

One of major disasters in the past is the massive tsunami in the Indian Ocean in 2004. It caused 35,332 deaths, 16,637 injured people and 5,637 missing people. Approx. 830,000 people lost their house. Figure 5.1-1 below shows the types of disasters that hit Sri Lanka and the percentage of fatal victims.



Source: Desinventar 1974-2012

Figure 5.1-1 Types of Disaster and Fatal Victims in Sri Lanka

The disaster management roadmap produced by the Ministry of Disaster Management in 2005, titled “Roadmap for Disaster Risk Management: Toward a Safer Sri Lanka”, places development of early warning system for a variety of disasters as one of the main themes. Although the development of the system was proposed in response to the tsunami damage caused in 2004, the country aims to develop such a system that will issue warnings for the people in cases of a variety of disasters including flood, landslide, cyclone, drought and high tide that occur frequently in the country in addition to tsunami.

EWBS enables the issuance of evacuation information to people in cooperation with disaster monitoring organizations. EWBS signals can be sent to any types of receiver terminal including fixed and mobile devices. Because its redundancy and reliability is generally higher than broadcasting and telecommunications facilities and information can be sent without depending on the traffic condition of the telecommunication lines, EWBS is capable of transmitting information in a very stable manner.

In the Great East Japan Earthquake in 2011, base stations for mobile phones caused incapability to send information. In contrast, the damage to broadcasting facilities were relatively small, and data and One-seg broadcasting were effectively used as a source of information after the disaster occurrence. Various surveys have revealed that the congestion of mobile phone network after a disaster occurrence is caused by users' attempts to confirm the safety of their relatives, acquaintances and others. Because data broadcasting can air the safety information constantly, such congestion unique to disaster situations can be eased. ISDB-T including its EWBS can be an effective means of communication in disaster situations.

5.2 Technical Adaptability

Technical issues that need to be examined toward the transition to digital broadcasting and how to adapt ISDB-T in the system are described here in Chapter 5.2. The discussions herein show that ISDB-T is adaptable in Sri Lanka.

In addition, according to the registered standard as ITU standard, frequency bandwidth will be selected from 6, 7 or 8 MHz by the country. The video compression system of ISDB-T also should be chosen either MPEG-2 or MPEG-4. Therefore, the Government of Sri Lanka needs to select appropriate bandwidth and video compression system from the above mentioned. However, the Study Team recommends choosing 8 MHz bandwidth and MPG-4 video compression system under consideration of the situation in Sri Lanka.

5.2.1 Program Multiplexing and Frequency Assignment

(1) Relationship between program multiplexing and frequency assignment

Frequency assignment needs to be examined first toward the introduction of DTTB. It needs to be studied how many frequencies (physical UHF channels) are needed to broadcast the planned 23 programs of DTTB (currently, 23 programs are aired analog with 23 channels) and which channels should be used for smooth and proper simulcast. As for the frequency assignment, the number of channels required differs depending on the number of programs to be multiplexed on one frequency. If six programs are broadcast on one channel, four frequencies are needed. This means that one transmitting station of DTTB platform needs to be equipped with four transmitters. Although ISDB-T can transmit the maximum of 12 programs in one channel, the image quality is sacrificed because the compaction degree becomes high. There is inverse relationship between the image quality and the number of channels.

The study team examined the technical issues regarding how to adapt ISDB-T under the current circumstances in Sri Lanka. One of the issues is the program multiplexing. Because most of the channels are occupied by the current analog broadcasting in the western Sri Lanka where the Greater Colombo is situated, it has been believed that there are insufficient frequencies for simulcasting for transition to digital broadcasting. One of the features of DTTB is that program multiplexing enables airing of multiple programs on one frequency. However, as described above, the more programs are multiplexed, the more image quality is sacrificed. Thus, we decided to examine the number of programs to be multiplexed based on subjective evaluation on image quality (viewers watch programs and subjectively evaluate the image quality and difficulty in understanding program contents).

(2) Examination of program multiplexing

The conditions below are established in the examination of program multiplexing.

① The broadcast quality evaluation criteria are standard TV (SDTV) quality.

② A band is also allocated to One-seg service and data broadcasting services that are unique to DTTB.

③ The transmission parameters[1] of DTTB are in accordance with those used in broadcasting service in Japan.

We used the following transmission parameters in the broadcasting quality evaluation based on the preconditions listed above:

① One-seg broadcasting service can be provided (allocate one segment)

② Certain bit rate is allocated to data broadcasting.[2]

Modulation parameters:

a) For stationary reception (B bracket):

- Allocated number of segments: 12
- Modulation system: 64QAM, r [Encoding rate] = 3/4
- Guard interval length = 1/8 of symbol length

b) For mobile reception (One-seg) (A bracket)

- Modulation system: QPSK, r [Encoding rate] = 2.3
- Guard interval length = 1/8 of symbol length

The bit rate of image signals that can be allocated to each program was calculated based on the transmission parameters listed above and the image quality was subjectively evaluated with the bit rate. The evaluation results are shown in Table 5.2-1. SD quality images are broadcast in simulcasting in Sri Lanka. The evaluation results show that multiplexing of six programs in SD image quality will not cause any specific problem. Thus, six standard image-quality programs can be

[1] Parameters with past experience of actual broadcasting were chosen, not the transmission parameters with which the maximum bit rate can be obtained, in consideration of stability of TV reception.

[2] The bit rates assigned to data broadcasting is included in that for mobile reception (A bracket) and for stationary reception (B bracket).

multiplexed into one channel in data and One-seg broadcasting.

Table 5.2-1 Relationship between the Number of Multiplexing Programs and Image Quality and Required Frequencies

Item	Option 1	Option 2	Option 3
No. of multiplexing programs	6	8	12
Video quality by program (A: News, B: Documentary, C: Sports)	A: Excellent	A: Excellent	A: Good
	B: Excellent	B: Good	B: Poor
	C: Excellent	C: Good	C: Poor
No. of RF channels allocated	4	3	2
Video bit rate /program	Around 3.5 Mbps	Around 2.6 Mbps	Around 1.2 Mbps

<Legend>
Excellent = Image quality deterioration is not recognized in SD image viewing.
Good = Very little (sometimes) image quality deterioration is recognized in SD image viewing.
Poor = Image quality deterioration is recognized in most situations in SD image viewing.
Source: JICA Study Team

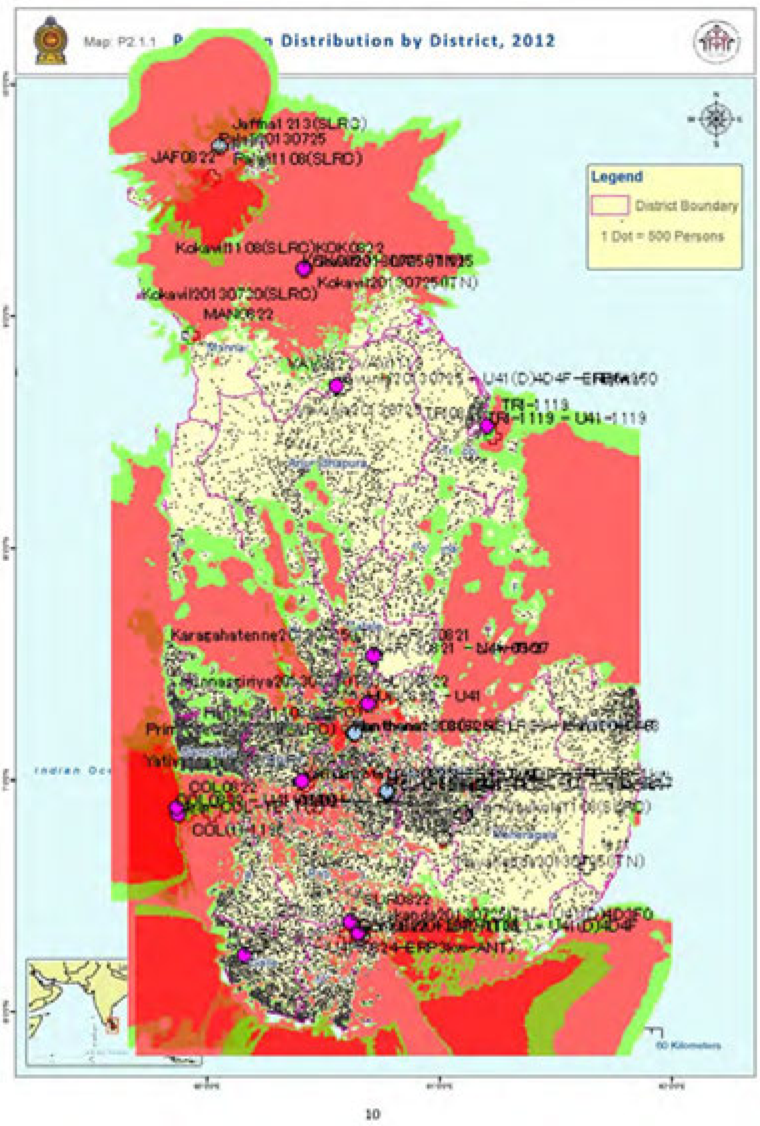
5.2.2 Channel Plan

The radio wave measurement survey result was analyzed and frequency simulation was conducted to select proper sites in the channel plan. (See Section 7.2 for details of the study.)

Because of fewer transmitting stations in northeastern, northwestern and southeastern regions for current analog broadcasting, there are poor reception areas. There are also poor reception areas in villages in the valleys of the Central Highlands as surrounding mountains interrupt radio waves. The channel plan needs to be formulated in consideration of using small and mid-sized transmission systems called gap fillers in order to eliminate areas having difficulty in receiving airwaves.

Figure 5.2-1 shows the simulation result of existing SLRC analog broadcasting conducted by the study team. It was carried out to understand the current transmission situation in detail. It shows that most parts of northeastern, northwestern and southeastern regions are receiving airwaves at a field strength of less than 55 dBμV/m, which is deemed as an area with no TV service coverage according to the provisions of the Comité Consultatif Internationale des Radiocommunications (hereinafter referred to as “CCIR”), the predecessor of ITU's radio communication division (hereinafter referred to as “ITU-R”). Radio waves cannot be properly received also in the Central Highlands and areas around the southern foot of Pidurutalagala. In analog broadcasting, images can be displayed on the screen even at a strength of less than 55 dBμV/m that is the level at which viewing is difficult because of much noise and image quality. Viewers often watch TV patiently even when the image quality is bad if the sound can be understandable while the sound contains much noise. In DTTB, however, images cannot be shown at all on the screen when the radio wave is below a receiving level while very clear images are displayed if the electric field strength reaches to the level required for visual display.

The channel plan with the preposition of ISDB-T broadcasting was studied to improve the local broadcasting to expand the current population coverage rate of analog broadcasting so it will contribute to future development of broadcasting culture as shown in Chapter 7.2. The channel plan will be formulated to construct ISDB-T to effectively use such additional services as data and One-seg broadcasting and EWBS and suitable to the country with a variety of culture.



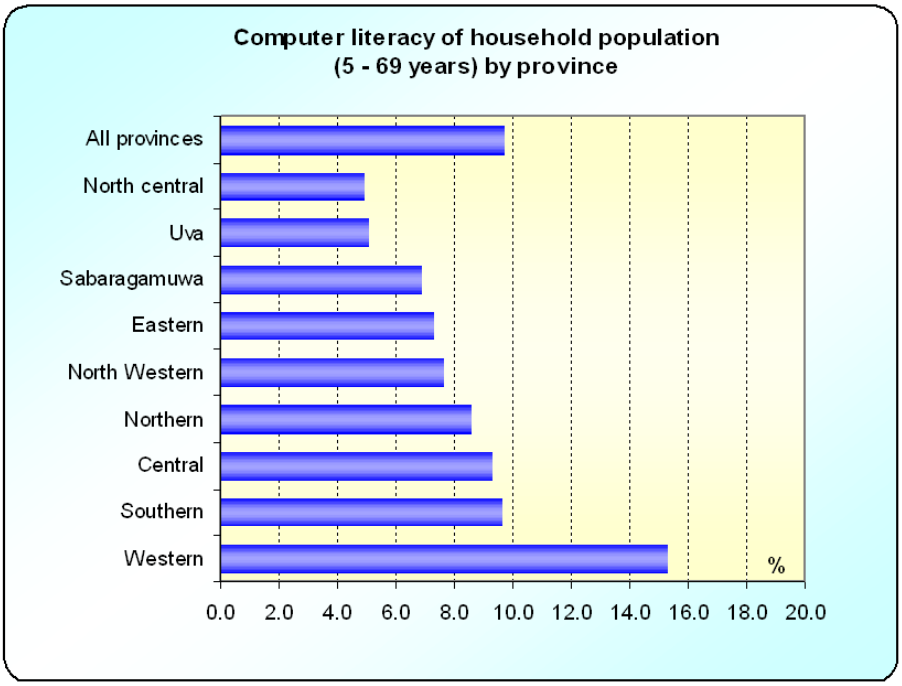
Source: JICA Study Team

Figure 5.2-1 Simulation Results of Existing SLRC Analog Broadcasting

5.3 Adaptability with Social Background

5.3.1 Suitability for Correction of Digital Divide

In studying the adaptability of ISDB-T with the society, we need to examine how to correct the digital divide. As shown in Figure 5.3-1, the results of a computer literacy survey, conducted by the Department of Census and Statistics of Sri Lanka in 2004, show that the gap between the western region including Colombo and the lowest region of north central region is threefold.



Source: Department of Census and Statistics website

Figure 5.3-1 Computer Literacy Survey

Sri Lanka sees that IT is essential for empowerment of the youth and claims that it will provide them with opportunities to acquire IT knowledge and skills in the "Sri Lanka the Emerging Wonder of Asia Vision for the Future, The development policy framework government of Sri Lanka." The government also takes the correction of regional gap of IT infrastructure and service as one of key policies and promotes the people to use e-mails, broadband, satellite TV and overseas telephone through awareness raising programs.

One cause of the informational gap is that telecommunication network is developed in more populated urban areas first. Also, network installation lags behind in certain areas even though there is a certain level of population because of the difficulty in installation and other geographical conditions. The regional gap between the western region and areas where computer literacy is low in Figure 5.3-1 is likely to be caused by the facts that the latter has relatively low population and electrification rate and located in mountains or rural areas. Computers do not become popular in areas with no network or electricity.

STBs, which are necessary for data broadcasting, are less expensive than computers and they do not require any usage fees like the Internet as they are used for terrestrial broadcasting. Prevalence of data broadcasting makes it possible to provide information for those who cannot afford to use the computer or Internet for financial reasons and people who live in areas where such service is not available.

DTTB is capable of providing the service seamlessly with the Internet and the channel plan discussed in Chapter 7.2 enables people in many areas (designed to ensure population coverage rate of 84.5%) to watch data broadcasting via One-seg broadcasting. A variety of information will be offered to viewers constantly through data broadcasting. Combination of 3G Internet service for the mobile phone enables Internet use via digital terrestrial mobile terminals in areas with no internet connection. Both One-seg and full-segment systems allow data broadcasting viewing and direct access from data broadcasting program to the Internet. ISDB-T that can provide broadcasting and Internet service without a computer can contribute to correction of regional gap and thus suitable to the current social condition of Sri Lanka.

5.3.2 Adaptability in Education

We have discussed data broadcasting as one of the features of ISDB-T system. Highly functional data broadcasting that enables access to information whenever wanted can have social impacts when used in various ways.

Audiovisual education approaches have been used for distance learning and TV programs have been recognized to be effective to a certain level. India, where demand for construction of schools overwhelms supply due to the growing population, has long used TV programs for distance learning. In advanced countries, there is also much demand for distance learning that allows learners to take lessons when they hope in accordance with their own lifestyle. This tendency is more noticeable in lifelong learning.

TV programs in distance learning enable instructors to use images in addition to their voice to teach in an easier-to-understand way. It is said that audio and visual information generates modality effects and increases learning efficiency. However, just viewing TV programs ends up with one-way instruction and instructors cannot check what learners do not understand.

Data broadcasting allows instructors to confirm to a certain degree learners' difficulties in learning by giving interactive tests and checking for what they failed to hear or did not understand, in accordance with the comprehension of the learners. It also enables learners to view the programs with their parents at home, which helps maintain their motivation to learn. Use of data broadcasting at home learning will be also very effective in Sri Lanka. Because of the trilingual policy, all citizens are required to learn Sinhalese, Tamil and English. Data broadcasting is believed to be effective to increase adults' literacy. Seventy percent of local residents can understand only the local languages of Sinhalese or Tamil. The low English literacy hinders the improvement in computer literacy. Letters need to be read and pronunciation checked in language learning, and data broadcasting enables both. People can learn languages by watching favorite TV dramas.

Production of educational contents for data broadcasting has major spillover effects in education and ISDB-T is suitable to the educational situation in Sri Lanka.

Figure 5.3-2 shows a sample image of data broadcasting.

Source: NHK data broadcasting

Figure 5.3-2 Sample Image of Data Broadcasting

5.3.3 Adaptability for persons with physical disabilities and the socially vulnerable

Sri Lanka has worked on the use of ICT for persons with physical disabilities and the socially vulnerable in addition to correction of regional gap of ICT. The eNABLE project that the Sri Lanka Telecommunications Regulatory Commission (hereinafter referred to as "TRC") has carried out since 2005 is to provide information and telecommunications facility and technology for such people. Through the project, information and telecommunications facility and technology have been provided for 98 schools, 38 occupational training facilities, three universities and 40 communities of sick and wounded soldiers.

Subtitled broadcasting for persons with hearing difficulties and reading for persons with visual impairment in DTTB are highly feasible and effective. Subtitled broadcasting can be viewed just by pressing the display bottom in ISDB-T systems, which has the advantage of enabling viewers to choose freely. The key operation for using data broadcasting programs is not as complicated as that of the computer, allowing the users to easily access Internet-like services. These tools are friendly to persons with physical disabilities and the socially vulnerable, and ISDB-T provides an ideal system adaptable to these circumstances.

5.3.4 Adaptability of One-seg Broadcasting

One feature of ISDB-T is One-seg broadcasting. Many mobile phone models in Japan are equipped with a One-seg TV receiver. Car navigation monitors and in-vehicle televisions can also receive One-seg broadcasting. One-seg broadcasting serves in various occasions including during traveling and in leisure activities in mountains and ocean where voluminous TV screens cannot be brought. Broadcasting stations also exert efforts to improve One-seg TV programs and viewers watch a variety of programs including news, information and weather programs. Powered by battery, One-seg receivers have served as a valuable information source in such emergencies as earthquake and tsunami.

Start of One-seg broadcasting, along with the introduction of DTTB in Sri Lanka, will enable transmission of information to people not having a TV set or living in areas where information has not reached enough, or those living in areas where electricity is yet to be provided but mobile phone can be used.

In comparison with fixed receivers, One-seg TV receivers also have financial advantages—they do not require a rooftop antenna and the price is relatively low. Many households in Japan have a One-seg tuner as the second television to be put in the bedroom or study room. Taking advantage of the low price, it can be effective to promote spread of TV among households with no analog receiver. Because USB devices mounted with tuners have been also commercialized as One-seg tuners, promotion of One-seg broadcasting is also effective for familiarization of DTTB among young generations who use computers more than watching TV.

5.3.5 Use of Mobile Telecommunications for Vitalizing the Society

ISDB-T is a broadcasting system advantageous for mobile devices. Thus, One-seg tuners have been mounted on car navigation systems since the early stage of introduction of DTTB. In Sri Lanka, the main means of public transport is bus. Although commuters spend their commuting time as they wish on the bus, it is also used as an information source as in the case of Japan where advertisements have been posted since so many years ago. In Brazil, they took the advantage of DTTB suitable to mobile communication, broadcasting stations and bus service operators have worked in cooperation to air TV broadcasting on the bus since the transition to DTTB. Recognizing the fact that people are more aware of media information and advertisement when using transportation facilities than when watching TV; private broadcasters expect to acquire new advertisement clients. Bus companies also expect that TV service helps improve customer satisfaction. Bus TV is already provided in many areas by various broadcasters and has proven to be effective.

The bus is the main means of short- and long-distance traveling for Sri Lankan people. Establishment of new business in consideration of advantages of ISDB-T to utilize the 30 minutes to one hour of commuting time is meaningful. ISDB-T allows promotion of such vitalization of the society.

5.3.6 Adaptability in Villages with No Electricity

The electrification rate of Sri Lanka is 85.3% on national average and it is below 80% in six out of the nine provinces, as shown in Table 7.2-7 in 7.2.8. Although the national electrification plan is in progress, electrification does not guarantee instant stable power supply. According to the channel plan in Chapter 7.2, the population coverage rate is 84.5%. The means to develop broadcasting network in villages with no electricity needs to be studied if the Sri Lankan government intends to spread DTTB with the goal of 100% coverage.

In an unelectrified village on an Indonesian island, solar power is used for the transmission system of ISDB-T broadcasting on an experiment basis. Solar power generation is sufficient to afford the transmission power necessary for One-seg broadcasting. If electricity is supplied to the transmission system from city power source in the future, the system can be revised to provide both full-segment and One-seg broadcasting services. In other words, there is no need to make any investment that may become waste when electrification is achieved in the future. This example shows that ISDB-T is also adaptable to the situation in Sri Lanka described above.

Chapter 6 Environmental and Social Considerations

Chapter 6 Environmental and Social Considerations

6.1 The National Plan and Legal Frameworks Relating to the Environment in Sri Lanka

The National Environmental Act (hereinafter referred to as “NEA,” Act No.47 of 1980) was enacted in Sri Lanka under the National Policy for “A clean and green environment through service excellence.”

The Central Environmental Authority (hereinafter referred to as “CEA”) was organized on Aug 12, 1981 based on the NEA.

The CEA presides over environmental considerations in development activity.

6.1.1 The Level of Environmental and Social Considerations Applied

Under the Japan International Cooperation Agency (hereinafter referred to as “JICA”) Guidelines for Environmental and Social Considerations (April 2010), the Project is classified as category C, as the negative impact of the project on the environment is predicted to be minimum.

* Source: Summary of Project (JICA South Asia Department, South Asia Division III)

6.1.2 EIA Procedure

Projects which require EIA in Sri Lanka are listed in Table 6.1-1.

As the Project does not correspond to any of these, the Project does not require EIA.

Table 6.1-1 Projects Requiring EIA

○Reclamation of land/wetland exceeding 4 hectares in area
○Tree felling on land exceeding 5 hectares in area
○Conversion of forest to non-forest use on land exceeding 1 hectare in area
○Land formation exceeding 50 hectares in area
○Mining and mineral extraction etc.

For reference, the flowchart of the EIA procedure is shown in Figure 6.1-1.

1. Submission of preliminary information
Project proponent is required to submit the preliminary information to the CEA

2. Submission of Project information (when EIA is to be implemented)
When the project is judged to require EIA, the project proponent is required to submit project information to the Project Approving Agency (PAA).

3. Preparation of EIA/IEE report
- The PAA commences preparation of the ToR (Terms of Reference).
  Depending on the content of the project, the implementation of an Initial Environmental Examination (IEE) instead of EIA may be approved.
- The project proponent is required to prepare the EIA/IEE report and submit it to the PAA. This report will be open for public inspection/comments for 30 days.

4. Evaluation of the EIA report
- The EIA report is examined by a Technical Evaluation Committee (TEC) appointed by the PAA. On the basis of this evaluation, the PAA determines the advisability of approval, and the CEA guarantees the effectiveness of this approval.

5. Project implementation
The EIA report and its approval are valid for one year from the date of approval.
If the project proponent does not start work on the project within one year, a re-application must be made to the PAA.

6. Compliance monitoring
- The CEA or the PAA monitor adherence to conditions and the implementation of measures to reduce the environmental impact.
- Approval may be withdrawn should it be judged that the conditions are not being adhered to.

Source: Compiled from The National Environmental Act, No. 47 of 1980

Figure 6.1-1 EIA Procedure Flowchart

However, a "Simple kind of evaluation" is required. In this process, the CEA issues a questionnaire form to the project proponent. The project proponent is required to fill in the questionnaire and submit it to the CEA for examination.

In the case of a Project for which the project proponent has not been determined, it is recommended that the MMI consult with CEA concerning the evaluation process.

A "Simple kind of evaluation" questionnaire form obtained from the CEA is included in Attachment 1.

6.1.3 Outline of Organizations Involved in the Project

- Central Environmental Authority (hereinafter referred to as “CEA”)
  The CEA is responsible for environmental considerations regarding development activities in Sri Lanka.
- Ministry of Mass Media and Information (hereinafter referred to as “MMI”)
  The MMI is in charge of policies and regulations relating to the media, commercial broadcasting licenses and supervision of Sri Lanka Rupavahini Corporation (hereinafter referred to as “SLRC”).
- The MMI does not have a department dedicated to environmental issues. (From an interview with the MMI)

6.2 JICA Guidelines for Environmental and Social Considerations

The impacts to be assessed with regard to environmental and social considerations under the JICA Guidelines for Environmental and Social Considerations are as follows.

“Impacts on human health and safety, as well as on the natural environment, that are transmitted through air, water, soil, waste, accidents, water usage, climate change, ecosystems, fauna and flora, including trans-boundary or global scale impacts. These also include social impacts, including migration of population and involuntary resettlement, local economy such as employment and livelihood, utilization of land and local resources, social institutions such as social capital and local decision-making institutions, existing social infrastructures and services, vulnerable social groups such as poor and indigenous peoples, equality of benefits and losses and equality in the development process, gender, children’s rights, cultural heritage, local conflicts of interest, infectious diseases such as HIV/AIDS, and working conditions including occupational safety.”

The items to be addressed in individual projects are narrowed down to those that are necessary by means of the scoping process.

6.3 Environmental and Social Considerations Survey at the Comparison of Alternatives Stage

6.3.1 Comparison of Alternatives

The aim of this Project is to support the organizational and functional enhancement of the public broadcasting service in Sri Lanka and to develop a DTTB network.

The benefits of implementation of the Project compared to non-implementation are as follows;

- The switch to digital terrestrial broadcasting will enable more effective use of frequency bands, as the frequency band that was being used for analog broadcasting can be assigned as a mobile phone frequency band, of which there is a shortage.

- The introduction of data broadcasting will enable information for a specific area, such as local news and weather forecast, to be received at the same time as a TV program.
- The adoption of EWBS would enable the emergency warning signal to be utilized to help prevent or lessen the damage incurred in a large-scale disaster. In the Great Sumatra-Andaman earthquake of December 26, 2004 Sri Lanka suffered 31,229 fatalities and 4,100 missing (source: UN Office for Coordination of Humanitarian Affairs June 16, 2005), and it may be thought that the people of Sri Lanka have a raised awareness of the need for disaster prevention.
- The introduction of the one-segment broadcasting standard, which is one of the features of the ISDB-T system, will enable TV programs to be viewed on mobile phones and other portable devices.

Installing transmitters on existing towers will have less of an environmental impact than the building of new towers. Therefore, the Project has been designed to make use of existing towers as far as possible.

The results of a site comparison based on field surveys, the gathering of reference materials and received field strength simulation are shown in Table 6.3-1.

Table 6.3-1 Site Comparison Results

No.	Site	Owner of existing facility	Transmitting station	Tower construction	Station construction	Land expropriation	Remarks
1	Jaffna	SLT	Use existing tower	○	○	×	Expropriation of land will be necessary if a future survey shows SLT land cannot be used.
2	Kokavil	TRC	Share existing tower	×	△	×	Laying of antenna feed lines needs to be considered Installation of micro transmitting and receiving antenna needs to be considered Interior ducts, ladders, walls etc., need repair.
3	Vavuniya	TRC	Use existing tower	○	○	×	Expropriation of land will be necessary if a future survey shows TRC land cannot be used
4	Trincomalee	—	New construction	○	○	○	Requires the expropriation of temple land
5	Colombo (Lotus Tower)	—	(New construction)	—	—	—	Under construction (another project)
6	Yatiyantota	ITN	Use existing tower	○	○	×	-
7	Elpitiya	—	New construction	○	○	○	Requires the expropriation of Estate-managed land
8	Suriyakanda	—	New construction	○	○	○	Requires the expropriation of nationally owned land
9	Deniyaya	SLRC	Share existing tower	×	×	×	Installation of micro transmitting and receiving antenna needs to be considered
10	Gongala	—	New construction	○	○	○	Requires the expropriation of Meteorological Agency land
11	Primrose	SLRC	Share existing tower	×	×	×	Requires separate consideration of reception point

No.	Site	Owner of existing facility	Transmitting station	Tower construction	Station construction	Land expropriation	Remarks
12	Karagahatenna	ITN	Use existing tower	∆	○	×	Requires construction of pillars for antenna installation. If calculation of tower strength shows the use of the existing tower to be impossible, it will be necessary to build on the neighboring nationally owned land; for this reason the cost of building a new tower is included in the estimate.
13	Hunnasgiriya	ITN	Use existing tower	×	○	×	Antenna needs to be replaced with a dual-purpose digital / analog antenna. If the antenna installation pillars are corroded, they will need to be replaced.
14	Pidurutalagala	SLRC	Use existing tower	○	○	×	The station will be built inside the tower because there isn't enough space in the grounds
15	Nayabedda	—	New construction	○	○	○	Requires expropriation of neighboring plantation land
16	Hantana	SLRC	Share existing tower	×	×	×	Requires separate consideration of reception point
Number of newly-built transmitting stations / Number of new constructions / Number of land expropriations			5	9*	11	5	*Cost of the construction of 10 towers is included in the estimate.
Number of repaired sites			—	1	1	—	

○: Requires new construction / Requires expropriation of land
∆: Requires partial repair
×: No new construction required / No expropriation of land required

6.3.2 Scoping

Scoping was carried out based on the JICA Guidelines for Environmental and Social Considerations (A±: Significant impact, positive or negative, is expected, B±: Some impact, positive or negative, is expected, C±: Little impact, positive or negative, is expected, D: No impact is expected). As a result, it was confirmed that the Project will not have an irreversible or significant environmental impact. It was also confirmed that there would be no non-voluntary resettlement of residents.

On the other hand, it was confirmed that the Project does require consideration to be given to air pollution, water pollution, waste, noise, vibration, the ecosystem, the existing social infrastructure and services, the landscape, infectious diseases such as HIV/AIDS, the working environment and accidents. Details will be considered in future surveys and the results will be reflected in the plans for construction and operation.

Table 6.3-2 Scoping Results

Item	No.	Impact	Evaluation		Reason for Evaluation
			Construction	Operation	
Pollution	1	Air pollution	C-	D	**Construction:** The operation of construction machinery is expected to cause a temporary deterioration in air quality. **Operation:** Electric power for the stations is to be supplied via underground cable. The use of a generator as an emergency power source will cause temporary air pollution, but the impact will be very small.
	2	Water pollution	C-	D	**Construction:** Underground excavation causing turbid water is a cause for concern. **Operation:** Operation of the facilities will generate no wastewater.
	3	Waste	C-	D	**Construction:** Underground excavation will generate waste soil, which will need to be dealt with appropriately. **Operation:** Operation of the facilities will generate no waste
	4	Soil contamination	D	D	No project components are expected to cause soil contamination.
	5	Noise and Vibration	C-	D	**Construction:** The operation of construction machinery is expected to cause temporary noise and vibration. **Operation:** Electric power for the stations is to be supplied via underground cable. The use of a generator as an emergency power source will cause temporary noise and vibration, but the impact will be very small.
	6	Land subsidence	D	D	No project components are expected to cause subsidence. A geological survey will be conducted to examine the bearing capacity of the ground.
	7	Odor	D	D	No project components are expected to produce odors.

Item	No.	Impact	Evaluation		Reason for Evaluation
			Construction	Operation	
Pollution (continued)	8	Substratum	D	D	No project components are expected to have an adverse impact on the substratum.
Natural environment	9	Protected Areas	D	D	There is an environmental conservation area as shown in Figure 6.3-1. However the project sites are not within the environmental conservation area.
	10	Ecosystem	C-	D	**Construction:** Although there are no rare animals or plants within the project sites, the impact on the flora and fauna of neighboring forests is a cause for concern. **Operation:** The project components are not expected to have any impact on the ecosystem.
	11	Hydrology	D	D	There are no rivers or lakes around the project sites and the project components are not expected to impact on the hydrology.
	12	Topography and Geology	D	D	Since large-scale groundwork is not planned, no impact on the topography or geology is expected.
Social environment	13	Resettlement of residents	D	D	**Construction:** There are no residents within the project sites. **Operation:** There will be no resettlement due to operation of the facilities.
	14	The poor	D	C+	**Construction:** Construction activity will not impact on the poor. **Operation:** The Project will contribute to the expansion of social services to the whole nation, including the poor.
	15	Ethnic minorities	D	D	**Construction:** No ethnic minorities or indigenous peoples live in or near the project areas. **Operation:** No impact on ethnic minorities or indigenous peoples is expected as broadcasting in Sinhalese and Tamil is planned.
	16	Employment	C+	C+	**Construction:** It is expected that the construction works will provide employment for local residents. **Operation:** A positive impact on employment and the economy are expected as the expansion of markets is anticipated.
	17	Land Use	D	D	No change of land use caused by implementation of the Project is expected.
	18	Water Rights	D	D	No project components are expected to impact on water rights.
	19	Existing Social Infrastructure	C-	D	**Construction:** Use of existing roads for transportation of construction materials will lead to a temporary increase in traffic. **Operation:** The introduction of DTTB will enable a more stable supply of social services to medical and educational facilities.

Item	No.	Impact	Evaluation		Reason for Evaluation
			Construction	Operation	
Social environment (continued)	20	Social Capital, Social Structure	D	D	No project components are expected to have an impact on social capital or the social structure.
	21	Uneven distribution of benefit	D	D	Because the DTTB will be introduced as a public service, there will be no unfair distribution of benefit or loss.
	22	Regional Interests	D	D	Because the DTTB will be introduced as a public service, there will be no conflict of interest in surrounding areas.
	23	Cultural heritage	D	D	Although places of cultural heritage, such as the holy site Anuradhapura and the ancient city of Sigiriya exist in Sri Lanka, the project will not have any impact on cultural heritage sites.
	24	Landscape	D	C-	The construction of new towers will change the landscape and may cause changes in the scenery.
	25	Gender	D	D	No project components will have any impact on gender issues.
	26	Rights of Children	D	D	No project components will have any impact on the rights of children.
	27	HIV/AIDS, etc.	C-	D	Although the Project does not involve any large-scale construction, appropriate health education is required as the inflow of construction workers may lead to an increase in transmittable diseases.
	28	Working environment	C-	D	**Construction:** Consideration of working conditions is required. **Operation:** No project components are expected to have a negative impact on workers.
Others	29	Accidents	C-	C-	**Construction:** Care with regard to accidents is required.
	30	Climate change	D	C-	The Project will not have any impact on climate change.

A±: Significant impact, positive or negative, is expected
B±: Some impact, positive or negative, is expected
C±: Little impact, positive or negative, is expected
D: No impact is expected

6.3.3 Environmental and Social Considerations Survey Results

(1) Air Quality

No air pollution will be generated during operation. However, emissions from construction machinery during the construction phase are expected to cause temporary air pollution.

Environmental standards for air quality in Sri Lanka are shown Table 6.3-3. The environmental standards of Japan are also listed for reference.

Table 6.3-3 Environmental Standards for Air Quality

Pollutant	Time period (average)	Environmental standards in Sri Lanka		Reference: Environmental standards in Japan	
		μg/m³	ppm	μg/m³	ppm
PM_{10}	Average yearly value	50	-	-	-
	24 hour value	100	-	100	-
$PM_{2.5}$	Average yearly value	25	-	15	-
	24 hour value	50	-	35	-
Nitrogen dioxide (NO_2)	24 hour value	100	0.05	-	0.06
	8 hour value	150	0.08	-	-
	1 hour value	250	0.13	-	-
Sulfur dioxide (SO_2)	24 hour value	80	0.03	-	0.10
	8 hour value	120	0.05	-	-
	1 hour value	200	0.08	-	0.04
Ozone (O_3)	1 hour value	200	0.10	-	0.06
Carbon monoxide (CO)	8 hour value	10,000	9.00	-	20.00
	1 hour value	30,000	26.00	-	-
	At any time	58,000	50.00	-	-

【During Construction】

Air pollution, albeit temporary, due to the operation of construction machinery is expected. In order to reduce the impact, the following mitigation measures will be applied.

- Avoid intensive operation of construction machinery by spreading out the construction process.
- Encourage the switching off of construction machinery when not in active use.
- Use low-emissions type construction machinery where possible.
- Sprinkle water on the ground as appropriate to keep dust down. Install dustproof nets where necessary.

With the adoption of the measures listed, the impact on air pollution caused by operation of construction machinery is expected to be insignificant.

(2) Water Pollution

No water pollution will be generated by the Project during operation. However, temporary water pollution is expected due the operation of construction machinery. The permitted emission standards for water quality are shown Table 6.3-4. The permitted emission standards of Japan are also listed for reference.

Table 6.3-4 Permitted Emission Standards for Water Quality

Item	unit	Permitted emission standards in Sri Lanka	Reference: Permitted emission standards in Japan
Hydrogen ion concentration (pH)	-	6.0-8.5	5.8-8.6
Biochemical oxygen demand (BOD)	mg/l	30	160
Chemical oxygen demand (COD)	mg/l	250	160
Total suspended solids (SS)	mg/l	50	200
Phenolic compounds	mg/l	1	5
Copper content	mg/l	3.0	3.0
Zinc content	mg/l	2.0	2.0
Soluble Iron content	mg/l	3.0	10
Chromium content	mg/l	0.5	2.0
Fecal Coliform	Sri Lanka: MPN/100ml Japan: organisms/cm^3	40	3,000
Nitrogen content	mg/l	150	120
Phosphate content	mg/l	5	16

In Sri Lanka, water quality (pH, COD, BOD) is measured regularly at the Kelani River. The latest results (measurement date is unknown) are shown in Table 6.3-5. The standards given in Table 6.3-4 are satisfied at all the measurement points.

Table 6.3-5 Kelani River Water Quality Survey Results

Point name	pH	COD(mg/l)	BOD(mg/l)
Thalduwa Bridge	7.3	3	1
Seethawaka Ferry	7.2	9	4
Pugoda Ferry	7.3	3	1
Hanwella Bridge	7.1	9	<1
Weliwita Bridge	7.4	12	1
Kaduwela Bridge	7.1	11	<1
Japanese Friendship Bridge	7.2	8	<1
Pugoda Ela	7.3	3	1
Wak Oya	7.2	9	4
Pusseli Oya	7.3	3	1
Maha Ela	7.1	9	<1
Raggahawatte Canal	7.4	12	1

Source: CEA home page

【During Construction】

During the construction phase, small-scale excavation works are planned. Therefore there is a possibility of the discharge of turbid water and sediment from the construction sites. The following mitigation measures should be adopted to reduce the impact.

- Erect silt fences and settling basins in the construction areas.

- In Sri Lanka, the rainy season is from May to July in the western, southern and central areas, and from December to January in the northern and eastern areas. Excavation work during these periods should be avoided in order to minimize sediment discharge.

In addition, there are no rivers used by local residents near the construction sites. Therefore, the impact on water quality due to the operation of construction machinery is expected to be insignificant.

(3) Waste

【During Construction】

As excavation will take place during the construction process, the appropriate management of waste (gravel, soil and stones) will be required. In Sri Lanka, excavated soil is disposed of at allocated sites designated by the CEA in order to avoid any impact on the environment. Therefore the impact from waste disposal during the construction phase is expected to be insignificant. (From an interview with the Road Development Authority (RDA))

(4) Noise and Vibration

Environmental standards for noise in Sri Lanka are shown in Table 6.3-6.

Table 6.3-6 Environmental Standards for Noise

Unit: dB

Area	Day time	Night time
Silent Area	50	45
Low Noise Area	55	45
Medium Noise Area	63	50
High Noise Area	70	60

Day time: 6:00 -18:00, Night time: 18:00 – 6:00
Silent Area: the area within 100 meters of the boundary of a courthouse, hospital, public library, school, zoo, sacred area or area set apart for recreation or environmental purposes.
Low noise area: the area within the Pradeshiya Sabha
Medium noise area: the area within a Municipal Council or Urban Council
High noise area: the area within an exports processing zone established by the Board of Investment or industrial area approved under Part IV C of NEA

The standards for Medium Noise Areas apply to Jaffna, Vavuniya and Colombo, and standards for Low Noise Areas apply to other areas (from an interview with CEA).

There are no regulatory standards for vibration in Sri Lanka.

【During Construction】

During the construction phase, temporary noise and vibration are expected due to the operation of construction machinery. The following mitigation measures should be adopted.

- Use low-noise and low-vibration type construction machinery where possible.
- Consider the adoption of construction methods that generate less noise/vibration.

- Encourage the switching off of construction machinery when not in active use.

In addition to the mitigation measures listed above, there are no residential areas close to the construction sites. Therefore the impact of noise and vibration due to the operation of construction machinery is expected to be insignificant.

(5) Ecosystem

【During Construction】

In the Project, some of the transmitters will be installed on new TV towers (in Jaffna, Vavuniya, Trincomalee, Yatiyantota, Elpitiya, Suriyakanda, Gongala, Pidurutalagala, and Nayabedda) planned close to the existing towers and the rest installed on existing towers. Gap fillers will be installed in urban areas. There are no rare animals or plants in the construction sites. However, there is expected to be some impact on ecosystems near the construction sites.

The following mitigation measures will be adopted. Additional measures will also be considered so as to minimize the impact as much as possible.

- Erect silt fences and settling basins in the construction areas.
- In Sri Lanka, the rainy season is from May to July in the western, southern and central areas, and from December to January in the northern and eastern areas. Excavation work during these periods should be avoided in order to minimize sediment discharge.

The national policy of Sri Lanka for the conservation of ecosystems is given below.

- Promote study of biological diversity through research and testing of biological resources.
- Use monitoring to gather information and knowledge on the current status of and trends in biological resources.
- Carry out impact assessment of development projects on biological resources.
- Introduce effective laws and regulations for the sustainable use of biological resources.
- Raise awareness among students and the general public of the importance of the conservation of biological resources .

(Source: Colombo National Museum)

From the above, the impact on the ecosystem due to the operation of construction machinery is expected to be insignificant.

(6) Protected areas

The environmental protection area designated by the CEA is located in the hilly area near Monaragala, as shown in Figure 6.3-1.

In addition to this there are also National Heritage Wilderness Areas, Conservation Forests and Reserved Forests designated by the Forest Department under the National Heritage Wilderness

Areas Act, but none of the project sites are located within those areas.

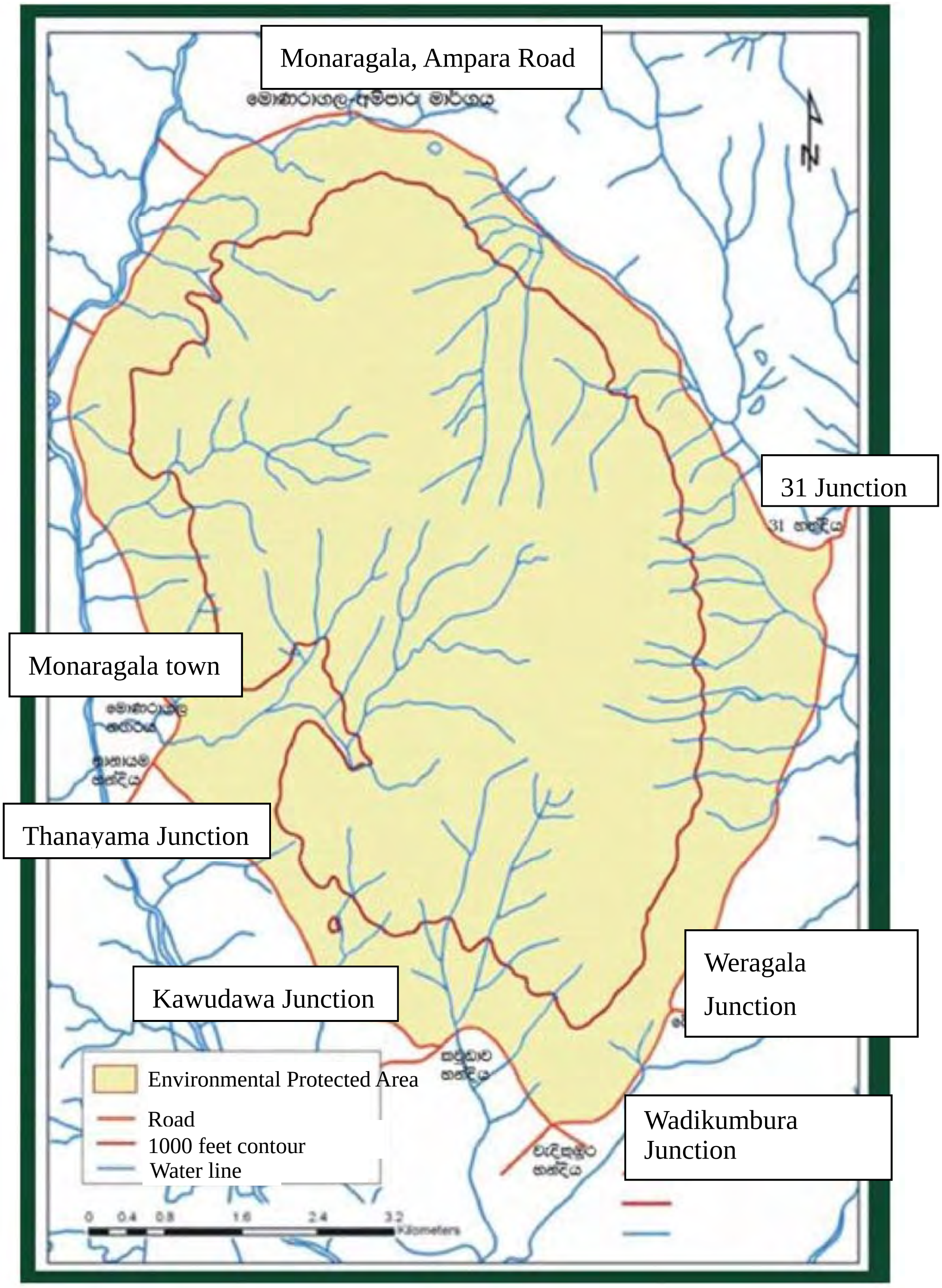


Figure 6.3-1 Protected Area Designated by the CEA

(7) Resettlement

Since there are no residents living in the project sites, the Project will not involve any resettlement. However, the construction of new TV towers and the installation of gap fillers will require coordination with relevant organizations.

Interviews with the relevant organizations have been held, and the results are shown below.

○ Ministry of Plantation Industries (MPI)

(Assuming the construction of new TV towers on what is currently plantation land)

Under the Land Expropriation Law enacted in 1975, all plantations were nationalized and the MPI has leased them for a period of 53 years to a private-sector management company. The MPI is one of the stockholders of the management company and the stocks held by the MPI are golden shares (stocks providing veto rights).

Since the MPI has the right of veto, the permission of MPI is required for the private-sector management company to re-lease the land. The project proponent may apply directly to the MPI. The procedure is same for both national and privately-owned land.

(From the interview with the MPI)

○ Ministry of Defense and Urban Development (MDUD)

(Regarding necessary procedures for the construction of new TV towers)

- Application together with the necessary information (e.g. coordinates of the station site, height of the tower) should be made to the TRC for screening.
- Consultations with the CEA and the Civil Aviation Authority (hereinafter referred to as "CAA") need to be held in advance.
- Consultations with the public office in charge of the area in which the construction site is located need to be held in advance.
- A tower exceeding 80m in height is subject to special consideration including structural calculations.
- The construction of a new tower in Kaltara requires the design to be inspected, as Kaltara is a historical district.

(From the interview with MDUD)

○ Civil Aviation Authority: CAA

(Regarding necessary procedures for the construction of new TV towers)

- The authority responsible for granting permission for broadcasting towers is the TRC.
- Coordination with and application to the TRC is required.
- The TRC will consult with the relevant agencies for the necessary clearances.
- At a request from the TRC, the CAA will examine the height clearance for broadcasting towers.
- The CAA will determine the height of the tower taking into consideration the elevation of the closest land-based/floating airport.
- Mr. S.E. Wakista, Assistant Director for Infrastructure Development, should be contacted.

(From the interview with CAA)

○ Road Development Authority: RDA
(For installing gap fillers on roads)

The installation of gap fillers will be permitted on land held by the RDA where a walkway at least 1.5m wide can be secured, if a license fee is paid and an estimate made of construction costs.

(From the interview with RDA)

○ Colombo Divisional Secretariat
(For installing gap fillers on land under the jurisdiction of the Divisional Secretariat)

The following procedure is required.

1. Write to the Land Commissioner requesting approval for the lease of the land and providing the following information.
   - Details of the location
   - Reason for wishing to lease the land
   - Land use plan

2. The Land Commissioner will forward the request to the Divisional Secretariat, who will submit a report on the land in question to the Land Commissioner.

3. This report will be examined and the Land Commissioner will issue a permit for the lease.

(From the interview with the Colombo Divisional Secretariat)

(8) Existing Social Infrastructure and Services

【During Construction】

Although detailed plans have not yet been made, a temporary increase in traffic is expected due to the use of existing roads by construction-related vehicles.

The following measures will be adopted.

- Spread out construction processes to avoid traffic being concentrated to a specific day or time period.
- Avoid construction work at night as far as possible.

From the above, it is expected that the impact on the existing social infrastructure and services during the construction phase will be insignificant.

(9) Landscape

【Operation】

The construction of a new TV tower is expected to alter the scenery of the surrounding area.

This impact was studied by overlaying the image of a new TV tower on a photograph of one of the sites. The result is shown in Figure 6.3-2.

Although the scenery is altered by the emergence of the new TV tower, the new tower is close to already-existing TV towers.

In addition, the height of the new tower will be matched to that of the existing towers and its appearance, color and finish will be designed so as to minimize the environmental impact, and thus the impact on the landscape is expected to be insignificant.

Figure 6.3-2 Change in Scenery Caused by the Construction of a New Tower (e.g. Elpitiya)

(10) HIV/AIDS and Other Infectious Diseases

【During Construction】

Without appropriate health education, there is a possibility that the inflow of construction workers will lead to an increase in infectious diseases.

The United Nations General Assembly Special Session on HIV and AIDS 2010-2011 Country Progress Report (UNGASS) reported that as of the end of 2009 Sri Lanka had approximately 3,000 people infected with HIV.

The government provides free medical treatment for HIV with support from the Global Fund to Fight AIDS, Tuberculosis and Malaria. Taking this national policy into account, the construction contractor will be required to provide appropriate health education to workers brought in from outside the area.

Such mitigation measures are expected to keep the impact from the inflow of construction workers to a minimum.

(11) Working Environment

【During Construction】

Although the construction work will be relatively small in scale, consideration must be given to the working environment. Mitigation measures, such as the appointment of a safety supervisor, worker education on safety and health, regular meetings on safety issues and consideration of safety issues in the planning of the construction schedule, will be adopted.

From the above, the impact on the working environment during the construction phase is expected to be insignificant.

(12) Accidents

【During Construction】

Although the construction work will be relatively small in scale, consideration must be given to the prevention of accidents. In Sri Lanka, the Department of Labour oversees the safety of factories and construction workers in accordance with the Factory Law (1942 Act No. 45).

In addition, the following measures will be adopted.

- Formulation of a safety management plan and appointment of a health and safety supervisor.
- Provision of worker education on health and safety and regular meetings on safety issues.
- Consideration of safety in the planning of the construction schedule.

Thus, it is expected that the risk of accidents during the construction phase will be kept to a minimum.

6.3.4 Environmental Checklist

The environmental checklist is shown in Table 6.3-7.

Table 6.3-7 Environmental Checklist

Category	Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons for Y/N, Mitigation Measures)
1 Permits and Explanations	(1) EIA and Environmental Permits	(a) Have EIA reports been completed? (b) Have the EIA reports been approved by the host country's government? (c) Have the EIA reports been approved unconditionally? If conditions are imposed on approval of the EIA reports, have the conditions been 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) Interviews with the CEA confirm that this project is not subject to EIA.
	(2) Explanation to the Public	(a) Have the contents of the project and the potential impacts been adequately explained to the public in accordance with appropriate procedures, including information disclosure? Has the understanding of the public been obtained? (b) Have proper responses been made to comments from the public and regulatory authorities?	(a) N (b) N	(a) (b) Although EIA procedures require public comment, this project is not subject to EIA. It is hoped that an explanation of the project details and environmental impact will be provided to the public voluntarily.
	(3) Examination of Alternatives	(a) Have alternative plans for the project been examined with consideration given to the social and environmental issues?	(a) Y	(a) The adoption of the plan to install transmitters on existing towers as far as possible satisfies environmental and social considerations.

Category	Environmental item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons for Y/N, Mitigation Measures)
2 Pollution Control	(1) Air quality	(a) Do air pollutants, such as sulfur oxides (SOx), nitrogen oxides (NOx), and dust emitted from the facilities comply with national emissions standards? Are any mitigating measures being taken? (b) Do the electric power and heat sources at accommodation facilities use fuel with a low emissions factor?	(a) Y	(a) Because there are no emissions from the facilities, the impact on the air quality is expected to be insignificant. (b) Fuel with a low emissions factor will be used as far as possible. Furthermore, as there are no dwellings close to the accommodation facilities, the impact on air quality is expected to be insignificant.
	(2) Water Quality	(a) Do effluents from the facilities comply with national effluent and environmental standards?	(a) Y	(a) Because there is no water discharge from the facilities, the impact on water quality is expected to be insignificant.
	(3) Waste	(a) Will the waste generated from the facilities be properly treated and disposed of in accordance with national regulations?	(a) Y	(a) No waste will be generated from the facilities.
	(4) Soil Pollution	(a) Are measures in place to prevent pollution of the soil and groundwater by effluent from the facilities?	(a) Y	(a) No project components will cause soil pollution.
	(5) Noise and Vibration	(a) Do noise and vibration levels comply with national standards?	(a) Y	(a) The facilities will not produce noise/vibration.
	(6) Land Subsidence	(a) Is there a possibility that the extraction of large volumes of groundwater will cause land subsidence?	(a) N	(a) No project components involve the extraction of groundwater.
	(7) Odor	(a) Are there any odor sources? Will adequate odor control measures taken?	(a) N	(a) No project components will produce odor.
3 Natural Environment	(1) Protected Areas	(a) Is the project site located in a protected area designated by national laws or international treaties and conventions? Is there a possibility that the project will affect a protected area?	(a) N	(a) There is a protected area designated by the CEA in the hilly area near Monaragala. There are also other areas such as National Heritage Wilderness Areas, Conservation Forests and Reserved Forests designated by the Forest Department under the National Heritage Wilderness Areas Act. However the project sites are not within these areas.

Category	Environmental item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons for Y/N, Mitigation Measures)
3 Natural Environment	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests or ecologically valuable habitats (e.g., coral reefs, mangroves, tidal flats, etc.)? (b) Does the project site encompass the protected habitats of endangered species designated by national laws or international treaties? (c) If a significant ecological impact is anticipated, will adequate protection measures be taken to reduce the impact on the ecosystem? (d) Is there any possibility that the project will adversely affect aquatic organisms? Will adequate measures be taken to reduce any negative impact on aquatic organisms?	(a) N (b) N (c) N (d) N	(a)(b)(c) There is a protected area designated by the CEA in the hilly area near Monaragala. There are also other areas such as National Heritage Wilderness Areas, Conservation Forests and Reserved Forests designated by the Forest Department under the National Heritage Wilderness Areas Act. However the project sites are not within these areas. (d) There will be no water discharge from the facilities.
	(3) Hydrology	(a) Will the project facilities have an adverse effect on the flow of surface water or ground water?	(a) N	(a) There will be no water discharge from the facilities.
	(4) Topography and Geology	(a) Will the project require any large scale changes in topographic/geographic features or cause the disappearance of the natural seashore?	(a) N	(a) Large-scale groundwork is not planned in the Project.
4 Social Environment	(1) Resettlement	(a) Will non-voluntary resettlement be caused by project implementation? If so, will efforts be made to minimize the impact of resettlement?	(a) N	(a) No resettlement is involved as there are no residents living on or near the sites. Most of the transmitters will be installed on existing TV towers, and new TV towers (Jaffna, Vavuniya, Trincomalee, Yatiyantota, Elpitiya, Suriyakanda, Gongala, Pidurutalagala, and Nayabedda) are to be constructed close to existing towers.

Category	Environmental item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons for Y/N, Mitigation Measures)
4 Social Environment	(2) Living and Livelihoods	(a) Is there any possibility that the project will have an adverse effect on the lives of local residents? If so, have adequate measures to reduce the impact been considered?	(a) N	(a) The project is expected to contribute to the promotion of "modernization of the administration" and "human resources development" as the establishment of a public broadcaster and introduction of a DTTB network will lead to the expansion of educational broadcasting.
	(3) Cultural Heritage	(a) Is there any possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Have adequate measures been considered to protect these sites in accordance with national laws?	(a) N	(a) Although cultural heritage sites, such as the holy site of Anuradhapura and the ancient city of Sigiriya exist in Sri Lanka, the Project will have no impact on those cultural heritage sites.
	(4) Landscape	(a) Is there any possibility that the project will have an adverse effect on the local landscape? If so, will necessary measures be taken? (b) Is there any possibility that the landscape may be spoiled by the construction of large-scale accommodation facilities and tall buildings ?	(a) N (b) N	(a)(b) The impact will be minimized by the adoption of measures such as matching the height of new towers with that of the existing towers and taking the impact on the scenery into account in the design of their appearance, color and finish .
	(5) Ethnic Minorities and Indigenous Peoples	(a) Has consideration been given to reducing the impact on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Does the project comply with national laws relating to the rights of ethnic minorities and indigenous peoples?	(a) Y (b) Y	(a)(b) The broadcasting is planned to be in Sinhalese and Tamil.

Category	Environmental item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons for Y/N, Mitigation Measures)
4 Social Environment	(6) Working Environment	(a) Does the project abide by those laws and ordinances associated with the working environment of the country that should be observed? (b) Are tangible safety measures in place to protect individuals involved in the project, such as the installation of safety equipment to prevent industrial accidents, and the management of hazardous materials? (c) Will intangible measures aimed at individuals involved in the project, such as the establishment of a health and safety program, and safety training (including traffic safety and public health) for workers etc., be planned and implemented? (d) Are appropriate measures being taken to ensure that security guards involved in the project do not infringe on the safety of other individuals involved, or of local residents?	(a) Y (b) Y (c) Y (d) Y	(a)(b)(c)(d) In Sri Lanka, the Department of Labour oversees the safety of factories and construction workers in accordance with the Factory Law. In addition, measures will be adopted to ensure an appropriate working environment, such as the appointment of a health and safety supervisor and the holding of regular meetings on safety issues.
5 Others	(1) Impact during construction	(a) Have adequate measures been considered to reduce impact during construction? (b) Will construction activities have an adverse effect on the natural environment? Are adequate measures in place to reduce any impact? (c) Will construction activities have an adverse effect on the social environment? Are adequate measures in place to reduce any impact?	(a) Y (b) N (c) N	(a)(b)(c) A temporary impact on air pollution, water pollution, noise and vibration is expected during the construction phase of the project. However, impact will be mitigated through the adoption of appropriate measures.

Category	Environmental item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons for Y/N, Mitigation Measures)
5 Others	(2)Monitoring	(a) Has the proponent developed and implemented a program to monitor environmental items that may have a potential impact? (b) How are the items, methods and frequency of the monitoring program determined? (c) Has the proponent established an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Have any regulatory requirements pertaining to the method and frequency of reports from the proponent to the regulatory authorities been identified?	(a) Y (b) Y (c) Y (d) Y	(a)(b)(c)(d) The Project does not require monitoring. (From the interview with the CEA)
6 Notes	Reference to Checklists of Other Sectors	(a) Where necessary, pertinent items on the Roads, Railways and Forestry Project checklists should also be checked. (b) Where necessary, pertinent items on the Power Transmission and Distribution Lines checklist should also be checked.	(a) N (b) N	(a)(b) The project does not involve any large-scale land reclamation, development or land clearing.
	Note on Use of the Environmental Checklist	(a) Where necessary, the impact on cross-border or global issues should be confirmed (e.g., when the project includes factors that may cause problems with regard to cross-border waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) N	(a) No project component has any impact on global environment issues.

NB: The items for environmental and social consideration were selected by reference to the Check List Table (Other infrastructure facilities)" from the JICA Environmental and Social Guidelines.

Chapter 7 Basic Design

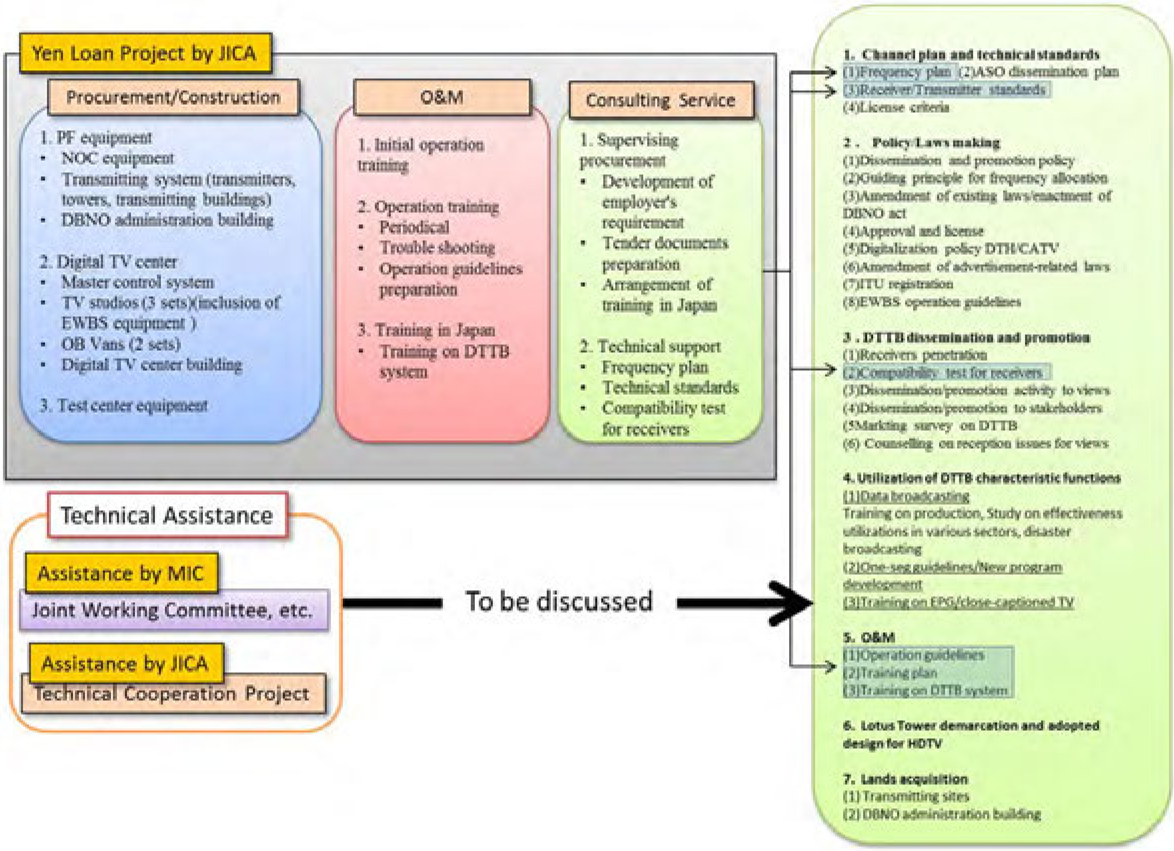
Chapter 7　Basic Design

7.1　Design Policy

7.1.1　Outline of the Project

This project consists of the development of a DTTB Platform, the construction of a network center for the DTTB Platform, the construction and operation/maintenance (O&M) of transmitting station buildings, antenna towers and a DBNO Building linked to the development of the DTTB Platform and consulting service.　A separate study will be conducted for a technical support related to this project. The Joint Working Committee, which will examine and find solutions to various problems in the transition to DTTB found in the countries where the Japanese DTTB system has been adopted with assistance from the Government of Japan, will need to work in close cooperation with this project and be able to provide comprehensive assistance in the transition to DTTB.　As the first step in explaining the planned project, an outline of the entire project is given below.

Figure 7.1-1 below shows the relationship between all the activities to be carried out in this project and the recommended measures to be taken by the Government of Sri Lanka.　The Joint Working Committee mentioned in the figure will be established independently from the studies covering this project.



Source: JICA Study Team

Figure 7.1-1　Overview of the ODA Loan Project

(1) Equipment for the DTTB Platform

All the DTTB will be provided through the DTTB Platform to be established in this project and which is to be operated by DBNO. The equipment to be procured for the DTTB Platform will be the equipment for the DBNO Network Operation Center (hereinafter referred to as “NOC”), 16 transmitting stations and STL/TTL. The equipment for the NOC of DBNO will include signal distributors, multiplexers, matrix switches, backup equipment for a monitoring system and spare parts. (For details see Sections 7.4.2, 7.4.3, 7.4.4, 7.4.5 and 7.4.6.)

(2) Establishment of the DBNO NOC and the Transmitting station for Greater Colombo and Construction of the DBNO Administration Building

The DBNO NOC will be established within the Lotus Tower, which is under construction in Colombo. The transmitting station for Greater Colombo will also be established within the Lotus Tower. A provisional decision has been made in this basic design to construct the DBNO Administration Building in the grounds of SLRC. The Government of Sri Lanka will have to decide on the site for the construction of the DBNO Administration Building before the development of employer's requirement stage in this project begins. (For details see Sections 7.4.2, 7.4.5, 7.5.1 and 7.5.2.)

(3) Equipment for Digital TV Center

The equipment currently in use in the SLRC TV studios and master control system needs to be replaced. Therefore, procurement of the equipment for three TV studios and the master control system for digital broadcasting will be included in this project. Procurement of the equipment for production and provision of data broadcasting programs (one of the characteristic services/functions of DTTB) and for the production and provision of EWBS will also be included in the project. All the equipment to be procured for digital TV center should be suited for use in HDTV broadcasting, and the equipment installed in the center will be regarded as the benchmark for the transition to DTTB in Sri Lanka. (For details see Sections 7.4.7 and 7.4.8.) The digital TV center building will also be constructed in this project.

(4) Initial Operating Training

Initial operating training will be provided for each system that is procured. This training will be provided by the companies that install the equipment in question and supervised by the consultant.

(5) Operational Training

The provision of stable and reliable broadcasting services will require training in system operation. Training in troubleshooting will also have to be provided to the organization that will operate the DTTB Platform so that it can provide stable services to all broadcasting stations. As the necessary backup systems and spare equipment are included in the equipment and systems to be procured in the project, an appropriate plan for maintenance and inspection will be prepared and the capacity of engineers to deal with regular maintenance/inspection and troubleshooting will be upgraded in the training. This operational training will be implemented as part of the consulting service.

(6) Training in Japan

It is desirable that the engineers who are expected to operate the equipment to be procured in this project need to understand actual services of data broadcasting programs, One-seg broadcasting programs and electronic program guide (EPG) and the purposes of these broadcast services in Japan. The engineers should also consider how and for what purposes those systems should be used and operated in Sri Lanka. Therefore, some ten engineers will be invited to Japan to attend a two-week training course to be implemented in three parts, each part covering a different subject.

(7) Frequency Planning for the Commencement of HDTV Broadcasting Service

The Government of Sri Lanka is planning to begin HD broadcasting service after ASO. It will be necessary to prepare a frequency plan after DSO-HD on the assumption that all the broadcasting stations will provide HDTV service. Although the shortage of frequencies will be a problem during the period of simultaneous broadcasting, particularly in Greater Colombo, a sufficient number of frequencies will be available for all the broadcasters to provide HDTV programs after the analogue TV services switched off (ASO). In the preparation of a frequency plan for HDTV broadcasting, studies will have to be conducted on the number of programs to be multiplexed on a single channel and the release of upper UHF bands for another services, such as, mobile phone services, which is called "digital dividend" after ASO Since all signals are to be transmitted from a single transmitting antenna regardless of their frequencies, the specifications of the equipment, especially transmitting antennas, are to be determined in the equipment design, which is to be prepared ahead of the HDTV frequency planning. Therefore, those specifications will have an impact on the HDTV frequency planning. In order for the tender to go ahead appropriately without tender conditions, including equipment specifications, being exposed, the frequency planning will be implemented as part of the consulting service. The frequency simulation and radio wave measurement will have to be implemented at intervals as part of the consulting service, and the simulation and measurement data will have to be used in the frequency planning. These factors, which will impact the efficiency of the work, justify the inclusion of the frequency planning in the consulting service.

(8) Establishment of Technical Standards

The establishment of technical standards means the establishment of specifications for signal transmission and reception that are appropriate for Sri Lanka. These technical standards will be adhered to in the receiver compatibility test mentioned in (9) below. Manufacturers of the transmitters and receivers will be allowed to export to Sri Lanka only those of their products that conform to the relevant technical standards of Sri Lanka. What is most necessary in the preparation of technical standards is the selection of the required parameters from the large number of parameters. It is efficient and practical to take the ARIB Standards of Japan as reference when establishing the technical standards. In addition, technical standards will have to be established for the display on TV screens of captions in Sinhalese, Tamil and English. The ISDB-T system used in Japan was developed in Japan. Therefore, the experience of Japan in the development of this system will be useful in the transition to DTTB in Sri Lanka, although the 8MHz band, a different frequency band from that used for the same purpose in Japan, will be used for DTTB in Sri Lanka. Since the development of the DTTB Platform is an urgent matter, it will need to be implemented simultaneously with the establishment of the technical standards. Since the technical standards are to be established simultaneously with a study on the specifications of the equipment to be procured in this project mentioned in (1) above, the establishment of the technical standards will be included in the consulting service, to prevent exposure of the tender conditions.

(9) Establishment of Test Center

The responsibility of the Test Center with regard to receivers will be to conduct a receiver compatibility test to ensure that only those receivers that satisfy the specifications stipulated in the technical standards mentioned in (8) above are distributed in the domestic market. The work of the Test Center will be important for the provision of DTTB service as it has characteristic features, such as on-screen display of data broadcasting service, that are not available in conventional analog broadcasting. The work of the Test Center will eliminate troubles of reception attributable to the specifications of broadcasting signals (excluding that caused by weak electronic field strength and interference). The Test Center will be operated by TRC, which supervises the enforcement of specifications and technical standards. Crucial equipment required in the Test Center consists of a radio measurement vehicle and measuring equipment, which are to be procured in this project. As mentioned in (7) and (8) above, assistance in the operation of the Test Center will be included in the consulting service in order to prevent the exposure of the conditions of the tender for the DTTB Platform which is to be held at the same time as the assistance is provided.

(10) Establishment of Call Center

One of the important measures to be taken by the government in the transition to DTTB is the promotion of DTTB to viewers, to broadcasting stations and to home appliance manufacturers, importers, distributers and retailers. Activities for the promotion of DTTB to viewers will be implemented under the technical cooperation (ODA Loan-related technical cooperation project) part of this project. In practice, various measures which may have to be taken by the viewer, including the renewal of reception facilities, purchase of a new receiver and purchase of STB, will have to be examined individually depending on signal reception and household circumstances. It is considered that many viewers do not have the technical knowledge required for the purchase of DTTB receiving equipment. Therefore, a call center will need to be established to provide around-the-clock answers to viewer questions on the matter. In addition to responding to questions from viewers, the call center will also disseminate the information needed by viewers and hold explanatory meetings throughout the country.

(11) Capacity development in the Production and Provision of Data Broadcasting Programs

The production of data broadcasting programs requires technologies, expertise and knowledge that differs greatly from those required for the production of conventional TV programs, including expertise in the programming and design of user interfaces for data broadcasting programs (procedures enabling viewers to switch on/off, watch a data broadcasting program or use the two-way communication function using the program displayed on screen). It also requires the operation of a data search engine enabling the acquisition of data held by various public organizations and their provision as data content for data broadcasting when the producer wishes to acquire public interest data, including meteorological and traffic information, for distribution via data broadcasting. In addition, producers of data-broadcasting programs will need to take appropriate measures regarding the conditions of display on a browser of BML (Broadcast Markup Language), which is based on XML and customized to broadcasting data service for the creation of data broadcasting content. Technical support in overall capacity development in the production and provision of data-broadcasting programs will be provided in the technical support related to this project. Also in the technical support, advice will be provided on the development of an appropriate organizational structure for the provision of data broadcasting services. Although the direct beneficiary of this technical support will be SLRC, some Japanese experts will hold frequent workshops for the purpose of providing basic information and expertise to the producers and engineers of private broadcasting stations.

(12) Capacity development in Emergency Broadcasting Operation

As in Japan, in Sri Lanka flooding causes damage many times each year. In Japan, mechanisms and guidelines for emergency broadcasting have long been available and there has long been cooperation between broadcasting stations and disaster-monitoring organizations such as the Japan Meteorological Agency in the prompt provision of precautionary information and disaster warnings. Broadcasting personnel continuously take measures required of them, such as training in emergency broadcasting during times of disaster. At present, one of the characteristics of ISBD-T, the emergency warning broadcasting system (EWBS), is also being used in times of disaster. Capacity development in disaster broadcasting will be provided to the national broadcaster of Sri Lanka in the form of a future technical support. Once SLRC is able to provide a stable DTTB service and cooperation has been established between the disaster management center and SLRC, another technical support will be formulated in which the experience of Japan can be put to good use. The following four activities are being considered at present for future capacity development in disaster broadcasting.

- EWBS operation planning

  Japan is the only country in the world to operate EWBS. It is expected that SLRC and DBNO will have to make their own arrangements for the operation of EWBS in Sri Lanka. An operation plan for EWBS, including the sharing of responsibilities between the two organizations, will be prepared.

- Preparation of equipment operating guidelines

  The operation of EWBS will require equipment-operating guidelines to ensure that warnings are issued without delay. Guidelines aimed mainly at DBNO and mainly at SLRC will be prepared.

- Preparation of Guidelines for Disaster Broadcasting

  Disaster broadcasting, including the provision of precautionary information and the announcement of the grounds for the issuing of a warning, will be provided in line with the rules on the interruption of regular programs and on the basis of clearly-defined evaluation criteria such as the amount of precipitation within a certain short period of time and the rise in river water levels. The preparation of guidelines and the establishment of the evaluation criteria will enable rapid responses. SLRC will be given assistance in the preparation of the guidelines.

- Preparation of Disaster Broadcasting Manual

  The manual for disaster broadcasting, together with the disaster broadcasting guidelines, sets out how SLRC staff members should behave and communicate in times of disaster. This manual will be used in the regular practical disaster broadcasting training, and the capacity of all production and announcing staff will be enhanced to enable them to produce and provide appropriate disaster broadcasting. SLRC will be given assistance in the preparation of the manual.

7.1.2 Basic Design Policies

Table 7.1-1 summarizes the basic design policies and shows their relation to issues needing to be addressed. The policies are explained following Table 7.1-1. Issues requiring detailed explanation are described in Section 7.2 and following.

Table 7.1-1 Issues Needing to be Addressed and Basic Design Policies for the Transition to DTTB in Sri Lanka

	Subject	Issue to be addressed	Design policy	Notes
1.	Channel plan	・ The launch of DTTB service in stages by area block will begin in the 1st quarter of 2016. ・ Signals are shadowed in mountainous areas, which account for a large portion of the territory. ・ Diversification of broadcast contents is not enough	・ Use of the existing transmitting stations ・ Consideration of topographic features → Installation of gap-fillers → Division of the entire country into area blocks ・ Promotion of broadcasting of community-based programs → Content of programs at the community, regional and national levels → Use of broadcasting service to help create mutual understanding between regional cultures	See Section 7.2
2.	Number of programs to be multiplexed, frequency assignment	・ Frequency planning for the period of simultaneous broadcasting and following DSO-HD has not been completed.	・ Number of programs to be multiplexed, frequency assignment during the period of simultaneous broadcasting → Six-program multiplexing during the period of simultaneous broadcasting ・ Ideas on future operation → Three-program multiplexing after the transition to HDTV → Design based on DSO-HD	See Sections 7.3 and 7.4
3.	Service diversification	・ limited access to information.	・ Introduction of data broadcasting, One-seg broadcasting, EWBS and EPG	See Sections 5.2.1, 5.2.2 and 5.2.3
4.	Equipment procurement plan and cost reduction	・ stable management of the DTTB Platform is contradictory to cost-efficient operation.	・ System redundancy → Duplicated systems → Duplication of equipment and STL/TTL links ・ Use of remote-monitoring ・ Compatibility with systems to be added in the future	See Sections 5.2.1 and 7.4.4

Source: JICA Study Team

(1) Channel Plan

One of the most important components of the preparation for the launch of the digital broadcasting is channel planning. In the master plan for digitization in Sri Lanka, DSO in Greater Colombo area is scheduled in 2016, to be followed by digitization in other regions. The UHF frequency band will be assigned for DTTB service, based on ITU Guideline. At present, VHF frequencies are used for analog TV broadcasting. The fact that VHF signals propagate better than UHF signals should be remembered when channel planning is carried out. Therefore, it is necessary to consider this fact for the channel planning of digital broadcasting. The policies for channel planning taking the timing of DSO in Sri Lanka into consideration are described in paragraphs 1) – 3) following.

1) Use of Existing Transmitting Stations

The construction of a new transmitting station requires land acquisition, the access to power lines and waterworks, the construction of an access road for the transportation of equipment and materials for the construction of the transmitting station building and the installation of equipment. Implementation of these works requires a huge amount of time and money. The use of existing transmitting facilities is a very cost-effective way to establish a DTTB transmitting station. It also allows a digital broadcasting network to be established in a short period of time.

2) Consideration of Topographic Features

As radio waves travel in a straight line, topographic features such as mountains and hills can obstruct their path. Therefore, topographic features will have to be taken into consideration in the frequency planning. The radio wave from a transmitting station may not reach certain areas behind mountains because of the obstruction by the mountains of the path of the radio wave. This kind of poor reception area can be improved by the installation of gap-fillers, consisting of low power transmitters and small transmitting antennas. In other words, taking into consideration the topographic features of Sri Lanka, it is difficult to cover the entire country with one or two large-output transmitting stations. It will be necessary to develop an efficient digital broadcasting network by dividing the country into area blocks.

3) Promotion of local broadcasting service

In the digital era, with access to a highly-developed Internet and mobile phone networks, diversification in TV programming is necessary for the acquisition of information, and meets the needs of TV viewers. In fact, the number of subscribers to satellite broadcasting and Cable TV services providing multichannel services is on the increase. People satisfy their interests and needs through the acquisition of all kinds of information from a variety of information sources. Diversity in programming can be attained by providing not only many different types of programs but also programs aimed at different target areas, *e.g.* the community level and the national level. In general, national news broadcasts and programs targeting a wide viewer base provide general news of interest to all the people and information on important events and topics that have a large social impact. Meanwhile, broadcasts targeting individual municipalities and communities should provide topics and programs that are closely linked to their target areas. As such broadcasts can provide more detailed information, viewers will be able to acquire the information they need and that is useful and valuable to them in their living environments. Cases have been observed in developing countries in Africa in which the provision of community-based programs has been used as means of creating employment and stimulating economic activities in the community, and in which the provision in such programs of information regarding the actual living conditions in different regions has facilitated mutual understanding between people of regional different cultures. It is even reported that mutual understanding created between different populations through the viewing of such programs has helped prevent conflict. Multi-ethnic Sri Lanka, with its regionally diverse natural and social (industrial and economic) conditions, will need channel planning that incorporates special measures to promote the provision of community-based programs in the near future.

(2) Program Multiplexing and Frequency Assignment

The transition to DTTB involves a number of steps, including Digital Switch Over to SD (DSO-SD), Analog Switch Off (ASO), Digital Switch Over to HD (DSO-HD) and SD Digital Switch Off (SDSO). In general, a certain period of time separates DSO-SD and ASO. In other words, analog broadcasting cannot be switched off immediately when digital broadcasting begins. The period between DSO-SD and ASO is referred to as the period of simultaneous broadcasting and is necessary to allow viewers a transition period in which to purchase new digital TV sets.

Meanwhile, program multiplexing, which allows simultaneous transmission of multiple programs on a single frequency, is a distinctive characteristic of digital broadcasting. Program multiplexing enables the effective use of frequencies. However, as the number of programs multiplexed on a single frequency increases, the bit rate allocated to each program decreases. Therefore, image quality deteriorates in inverse proportion to the increase in the number of multiplexed programs.

At present, as a large number of frequencies are allocated to analog broadcasting, there are only a small number of vacant channels available in Greater Colombo area. Therefore, program multiplexing is a very effective technique for the efficient use of frequencies during the period of simultaneous broadcasting when a large number of frequencies are required for the analog and digital broadcasting.

The number of licenses for DTTB will be determined from the actual number of frequencies available for new broadcasting services and the number of programs multiplexed on a single channel. Therefore, the policies for program multiplexing and frequency assignment described below will be used in the basic design.

1) Frequency Assignment during the Period of Simultaneous Broadcasting

On the basis of the results of the subjective picture quality evaluation conducted by the Study Team as described in Chapter 5.1.3, the six-program multiplexing system will be used in the basic design. Transition of all 23 licensed TV channels to digital broadcasting will require four frequencies during the period of simultaneous broadcasting.

2) Concept for Future System Operation

Although HD broadcasting is scheduled to begin after DSO-HD, a frequency plan to follow DSO-HD has not yet been developed. DSO-HD will be the final stage in the transition to digital broadcasting. After the termination of analog broadcasting, HDTV broadcasting will begin. The composition and specifications of all equipment, including studio equipment, cameras, switchers, recorders/players and monitors, will be designed on the assumption that the equipment will be used for HD quality programs. HD video can be broadcast in clear quality on a display screen with a large-aspect ratio (width/height ratio). Almost all TV programs produced outside Sri Lanka, including those broadcast via satellite, are produced with HD picture quality. Since it is hoped that HD quality broadcasting will begin as soon as possible after the termination of analog broadcasting in Sri Lanka, the basic design will assume that programs will be provided in HD quality. In general, two to three HDTV programs can be multiplexed and broadcast without compromising their picture quality. The final decision on the number of programs to be multiplexed on a single frequency will be made at the stage at which the frequency plan for HD broadcasting is prepared. At present, it has been decided that the designing and a survey of the quantity of equipment required will be carried out on the assumption that three programs can be multiplexed on a single frequency.

(3) Service Diversification

Service diversification is one of the characteristics of the ISDB-T System. Data broadcasting, One-seg broadcasting which enables TV programs to be viewed on Mobile TV / Portable TV handsets, EWBS and EPG are among the services that the system can provide. Although the Government of Sri Lanka has not decided whether or not all these services should be made available at the time of the launch of DTTB, the basic design shall be prepared on the assumption that a variety of services will be available to viewers at the time of the launch. The availability of data broadcasting and One-seg broadcasting will provide viewers in Sri Lanka, where the Internet service is not so popular, with more opportunities to access the information that they require at any time and in any place. EWBS may be able to contribute to the reduction of damage caused by natural disasters if the TV stations and public organizations involved in disaster management cooperate in its use. The basic design should provide the system to be developed in the project with the capacity to provide viewers with the various services available in the ISDB-T system immediately after the establishment of an environment enabling provision of such services.

(4) Equipment Plan and Cost Reduction

The DTTB Platform project is to be operated with the income from the fees charged to broadcasting program providers (The production and provision of programs has been a major component of broadcasting organizations’ business. However, after the adoption of the system of broadcasting through the DTTB Platform, while the broadcasting organizations will continue to produce programs, which will be broadcast by DBNO). Therefore, it is essential that a cost-effective equipment plan be prepared that includes cost reduction measures to reduce the financial burden on the program providers, which is expected to increase after the transition to DTTB. Meanwhile, the operating and transmission systems will require an extremely high level of stability because of the nature of the DTTB Platform. The basic policies for the preparation of an equipment plan that incorporates both of the requirements mentioned above and cost reduction is described below.

1) System Redundancy

The policy of the Government of Sri Lanka advocates the broadcasting of digital programs through the DTTB Platform to be operated by DBNO. After the establishment of the broadcasting facility DTTB Platform, broadcasting stations will not be obliged to have their own transmitting facilities. DBNO will receive and broadcast the programs of all TV stations. In other words, a serious risk, occurred in DBNO Platform, that causes a disruption of all broadcast service throughout the country or in a specific region should causes a significant problem. To achieve a stable broadcasting service and prevent such a serious disruption, DBNO, which will be the only organization with the function to transmit TV programs, will need to have a reliable transmission system. Therefore, DBNO should have redundant systems. However, since cost reduction and the establishment of a reliable system are conflicting issues simultaneously, full duplexed system may not always be a best solution. It is preferable to select a better redundant system considering the importance of the transmitting station and the stability of the actual transmitters. In NOC, equipment the duplex system design should be done considering the affectless to On-Air service and the stability of equipment operation... Although the STL and TTL systems will also be made duplexed, the details of duplexed system of micro wave transmission and optical fiber transmission will be designed to consider a tradeoff of cost performance.

2) Remote Monitoring

Remote monitoring of transmitter stations in NOC is an effective system to reduce personnel cost, which account for a large proportion of operating costs. The use of remote monitoring system will enable a reduction in the number of operators at the transmitting stations and a reduction in the cost of training for monitoring operation in a transmitting station. Even no staff member is assigned at transmitter stations, the backup system will begin to work automatically and immediately when a failure occurs on the main system. The remote monitoring equipment has the function to search for the cause(s) of system breakdown. This function will enable stable operation of the stations by non-skill person such as janitors. However, taking the current conditions in Sri Lanka into consideration, the basic design will be prepared on the assumption that only the low power transmitting stations will operate unmanned for the time being, rather than all the transmitting sites operating unmanned.

3) Compatibility with Future Systems

As mentioned above, the transition to digital broadcasting involves a number of steps, including DSO-SD, ASO, DSO-HD and SDSO. It is expected to take several years to complete all the steps. The scope of basic design is the design of equipment which will be required until the launch of DSO-HD. Additional transmitters will need to be installed for the launch of DSO-HD. However, exciters, transmitting antennas and other types of equipment will be procured on the assumption that HDTV broadcasting will begin. When DSO-HD begins, there will be no need to procure such equipment. It will be possible to prepare an overall plan by deciding on the overall specifications and quantities of equipment required after DSO-HD after a decision has been made regarding the number of HD broadcasting channels and a study on the digitization of the broadcasting networks has been conducted. In the preparation of this overall plan, care should be taken to ensure that the total amount of investment needed is not extravagant.

7.2 Channel Plan

7.2.1 Study Procedures

The channel plan for DTTB service in Sri Lanka has been proposed in the following procedures

(1) Since a UHF band will be used for DTTB, the difference in the coverage areas between analog broadcasting on a VHF band and digital broadcasting on the UHF band was confirmed through simulation ahead of the channel planning. (See Section 7.2.2 below)

(2) As a result of the coverage area simulation, it has been found that it is difficult to cover the whole of Sri Lanka country by one station in UHF band, while in case of VHF band, SLRC covered main part of country by one staion. Therefore the method has been adopted to cover each area blocks by existing transmitting sites. In order to divide into the blocks, referring the result of the "Survey of field strength in Sri-Lanka" (See Section 7.2.3 below)

(3) Next, the survey on the existing sites has been carried out to examine whether the existing transmitting sites are available for DTTB transmitting site. In addition, the candidate location of gap filler has been investigated to cover the areas which cannot be covered by existing transmitter sites(See Section 7.2.4 below)

(4) Simulation was used to estimate the coverage areas of transmitting stations on the assumption of their construction on the sites considered usable in the above-mentioned study process. (See Section 7.2.5 below)

(5) In next step, a study to make transmission network (STL and TTL) to distribute broadcast contents to transmitting stations. (See Section 7.2.6 below)

(6) In final procedure, a study was made of the channels to be assigned to each transmitting station

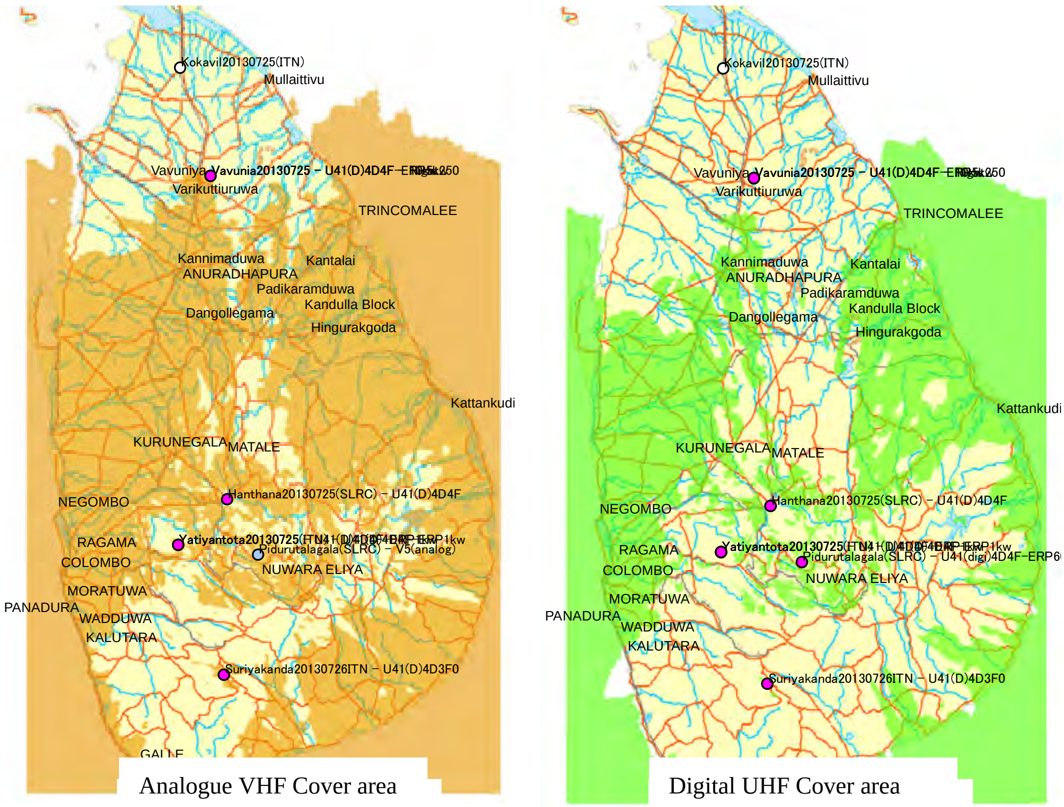
sites assuming the entire country to be divided into seven area blocks.

7.2.2 Analysis of Propagation Status of Existing Analog Broadcasting

In the case of the existing analog broadcasting service of the national broadcaster SLRC, a high-power VHF transmitting station, Pidurutalagala Transmitting Station, was first constructed on the highest point in the Central Mountain Area to cover the entire country, following which transmitting stations were constructed at various sites in the country to cover those areas where the RF signal from Pidurutalagala Transmitting Station was not strong enough.

However, since plans call for the UHF frequency band to be used for DTTB, it will be difficult to use the same method as VHF due to the fact that the coverage range with UHF is smaller compared to VHF.

As for reference, sample simulations of the coverage area based on simulation when an analog VHF transmitting station is located at the Pidurutalagala Transmitting Station and when a digital UHF Transmitting station is located at same position are shown in Figure 7.2-1.



Note: The following transmission ERP was used to compensate for differences between analog and digital
Analog VHF: 200kW ERP, Digital UHF: 60kW ERP

Figure 7.2-1 Comparison of Coverage Area with Analog Radio Waves and Digital Radio Waves

As shown by the diagram, UHF radio waves have a stronger tendency to take a straight line compared to VHF radio waves, therefore, there will be many poor reception areas in the shadows of mountains that will not have adequate service. Therefore, in consideration of the fact that there will be a transition from VHF band to the UHF band for all channels in order to facilitate digital broadcasting, a method was adopted where the country of Sri Lanka is divided into multiple areas with transmitting stations installed in each area to provide coverage (Refer to the next section).

When transitioning to a plan to cover the entire country of Sri Lanka with multiple transmitting stations to facilitate digital broadcasting, there are cases that the transition to digital broadcasting is misinterpreted as the cause for the reduction in coverage area, but as stated above, it is necessary that the change from the VHF band to the UHF band is recognized as the main cause for this.

7.2.3 Division of the Broadcasting Service Area into Blocks

(1) Preliminary Study

The preliminary study described below was conducted before the entire territory of Sri Lanka was divided into a number of area blocks in accordance with the basic design policies mentioned in Section 7.1.2.

1) To examine whether or not the sites of the existing analog transmitting stations could be used as sites for digital transmitting stations, first of all the positional data of the existing stations and current used frequencies were checked. Table 7.2-1 shows the transmitting station data used in the analysis.

Table 7.2-1 Existing Analog Transmitting Stations

Location of transmitting station	Channel name	Channel number	Video carrier frequency (MHz)
Jaffna	CSN	E30	543.25
Palali	Rupavahini	E21	471.25
	Nethra TV	E23	487.25
	Vasantham	E25	503.25
Kilinochchi	Shakthi TV	E46	671.25
Kokavil	Nethra TV	E8	196.25
	Vasanthan	E10	210.25
	CSN	E29[1]	535.25
Matale (Karagahatenna)	ITN	E9	203.25
	TNL	E11	217.25
	Buddhist TV	E57	759.25
Matale (Gammaduwa)	Varnam	E21	471.25
	Sirasa TV	E23	487.25
	Shakthi TV	E25	503.25
	Hiru TV	E26	511.25
	Derana TV	E28	527.25
	Siyatha TV	E31	551.25
	CSN	E32	559.25
	Swarnavahini	E37	559.25
	Rangiri	E60	783.25

[1] The channel has switched off at June 2014.

Location of transmitting station	Channel name	Channel number	Video carrier frequency (MHz)
Kurunegala	Hiru TV	E22	479.25
Hunnasgiriya	Hiru TV	E23	487.25
	Vasantham	E24	495.25
	Swarnavahini	E40	623.25
Kandy	Rupawahini	E10	210.25
	Swabavahini	E22	479.25
	TNL	E26	511.25
	Sirasa TV	E29	535.25
	Derana TV	E32	559.25
	Siyatha TV	E35	583.25
	Nethra TV	E39	615.25
	CSN	E41[2]	631.25
	MTV	E51	711.25
	ART TV	E52	719.25
Yatiyantota	ITN	E12	224.25
Colombo (Battaramulla)	Vasantham	E10	210.25
Colombo	TNL	E21	471.25
	CSN	E22	479.25
	Sirasa TV	E23	487.25
	ITN	E24	495.25
	Shakthi TV	E25	503.25
	ART TV	E28	527.25
	CCTV	E29	535.25
	MaxTV	E30	543.25
	Swarnavahini	E31	551.25
	Siyatha TV	E32	559.25
	ETV	E35	583.25
	Derana TV	E37	599.25
	Rupahavini	E39	615.25
	Hiru TV	E45	663.25
	Varnam	E46	671.25
	Rupavahini	E52	719.25
	Buddhist TV	E53	727.25
	MTV	E58	767.25
Nuwara Eliya	Rupavahini	E5	175.25
	Nethra TV	E7	189.25
	Sirasa TV	E27	519.25
	Swarnavahini	E33	567.25
	Shakthi TV	E34	575.25
	Derana TV	E36	591.25
	Hiru TV	E38	607.25
	CSN	E47	679.25
Badulla	TNL	E21	471.25
	Hiru TV	E23	487.25
	Swarunavahini	E35	583.25

[2] The channel has moved to 57ch at June 2014.

Location of transmitting station	Channel name	Channel number	Video carrier frequency (MHz)
Namunukula (Badulla)	Rupavahini	E10	210.25
	CSN	E51	711.25
Nayabedda (Bandarawella)	ITN	E12	224.25
	Hiru TV	E22	479.25
	CSN	E30	543.25
	Derana TV	E32	559.25
	Swarnavahini	E40	623.25
Ratnapura	Hiru TV	E21	471.25
	Swarnavahini	E22	479.25
	TNL	E26	511.25
	Shakthi TV	E51	711.25
	CSN	E56	751.25
	Sirasa TV	E58	767.25
Kalutara	Derana TV	E56	751.25
Sooriyakanda	Rupavahini	E11	217.25
	ITN	E24	497.25
	Nethra TV	E52	719.25
Gongala	Shakthi TV	E25	503.25
	TNL	E26	511.25
	CSN	E28	527.25
	Sirasa TV	E29	535.25
	Derana TV	E31	551.25
	Swarnavahini	E37	599.25
	Hiru TV	E45	663.25
Deniyaya	ITN	E9	203.25
	Nethra TV	E39	615.25
	Rupavahini	E41[3]	631.25

Source: Data created by JICA Study Team on the basis of Survey (June 2013)

2) In order to verify the reception by viewers of signals transmitted from the above-listed transmitting stations, the field strength measurement study described in Section 1.5.1 was carried out at 82 points throughout the country. The study revealed the status of the existing analog broadcasting services at these receiving positions. In the study, at each point and for each UHF channel, the field strength of received channels, the direction of received signal and the location of the transmitting station were measured and recorded.

3) Measurement results were recorded in the table as the locations of the transmitting stations of received signals at each measurement point. Table 7.2-2 shows the list of channels on which signals were received at each measurement point and the locations of the transmitting stations of received signals

[3] The channel has switched off at June 2014.

Table 7.2-2 Measurement Points and Frequencies of Signals Received and the Transmitting Stations from Which the Signals were Transmitted

Area	No.	Reception point	E21	E22	E23	E24	E25	E26	E27	E28	E29	E30	E31	E32	E33	E34
N	1	Point pedro	Jaffna		Jaffna		Jaffna					Jaffna				
N	2	Kopai	Jaffna		Jaffna		Jaffna				Jaffna	Kokavil				
N	3	Poonai	Jaffna		Jaffna		Kokavil				Kokavil	Jaffna				
N	4	Kilinochchi									Kokavil					
N	5	Mulathiv									Kokavil					
N	6	Munkulam									Kokavil					
N	7	Mannar									Kokavil					
N	8	Madhu road									Kokavil					
N	9	Vavuniya	Matale		×Matale		×Matale						Matale	Matale		
N	10	Pulmudai														
NE	11	Trincomalee											×Matale	×Matale		
NE	12	Kantale	Matale	Nuwara	Matale	Matale	Matale	Matale	Nuwara	Matale			Matale	Matale		
NE	13	Horoupotana	Matale		Matale								Matale	Matale		
NW	14	Anuradhapura	×Matale		×Matale				Nuwara				Matale	Matale		
NW	15	Nochchiyagama	×Matale		Matale		Matale	Matale	Nuwara	Matale	×Kandy		Matale	Matale	Nuwara	Nuwara
NW	16	Kalpitiya	Matale		Matale		Matale	Matale	Nuwara	Matale			Matale	Matale	Nuwara	Nuwara
NW	17	Puttalam	×Matale		×Matale		×Matale	×Matale	Nuwara	×Matale			Matale	Matale	Nuwara	Nuwara
NE	18	Kekirawa	×Matale		Matale		Matale	Matale	Nuwara	Matale	Kandy		Matale	Matale		
NE	19	Medirigiriya	×Matale	Kurune	Matale		Matale	Matale		Matale		×Jaffna	Matale	Matale		
NE	20	Valachchebai	Matale	Nayabedda	Matale	Hunna	Matale	Matale	×Nuwara	Matale			Matale	Matale		
NE	21	Polonnaruwa	Matale	Nayabedda	Matale	×Hunna	Matale	Matale		Matale			Matale	Matale		
NW	22	Dambulla	Matale		?Matale	?Matale	Matale	Matale	?Nuwara	Matale		?Kokavil	Matale	Matale		
NW	23	Politigama	Matale				×Matale	Matale	Nuwara	Matale			Matale	Matale	×Nuwara	×Nuwara
NW	24	Chilaw							Nuwara				×Colombo	×Matale	Nuwara	Nuwara
NW	25	Hettipola	Matale			Colombo	Matale	Matale	Nuwara	Matale	×Gongala		Matale	Matale	Nuwara	Nuwara
NW	26	Kurunegala		Nayabedda				Matale	Nuwara	Matale			Matale	Matale		
NW	27	Ridigama	Matale		Matale		Matale	Matale		Matale			Matale	Matale		
NW, MO	28	Matale	Matale					×Matale		×Matale			Matale			
E	29	Dehiattakandia	Matale		Matale		Matale			Matale			Matale	Matale		
E	30	Batticola	Matale	Nayabedda	Matale	Hunna	Matale	Matale		Matale		Nayabedda	Matale	Matale		
E	31	Mahaoya	Matale	Nayabedda	Matale	Hunna	Matale	Matale		Matale			Matale	Matale		
MO, E	32	Mahiyanganaya	Badulla	Nuwara												
MO	33	Kundasale		Kandy	Hunna						Kandy			Kandy		
MO	34	Peradeniya		Kandy				Kandy	Nuwara		Kandy			Kandy	Nuwara	Nuwara
CO	35	Mawanella							Nuwara					Kandy		
CO	36	Warakapola							Nuwara							
CO	37	Pannala							Nuwara						×Nuwara	Nuwara
CO	38	Negombo	Colombo		Colombo		Colombo	×Nuwara	Nuwara	Nawara	Kandy	Colombo	Colombo	Colombo	Nuwara	Nuwara
CO	39	Gampaha							Nuwara						Nuwara	Nuwara
CO	40	Pugoda							Nuwara				Colombo	Colombo		Nuwara

Area	No.	Reception point	E21	E22	E23	E24	E25	E26	E27	E28	E29	E30	E31	E32	E33	E34
CO, MO	41	Dehiovita														
MO	42	Pussellawa														
MO	43	Hangurantetha			Hunna						Kandy			Kandy		
MO, E	44	Bibile				Hunna										
E	45	Ampara	Badulla	Nayabedda		Hunna		Matale				Nayabedda		Nayabedda		
E	46	Kalmunai	×Badulla	Nayabedda		Hunna		Matale				Nayabedda		Nayabedda		
SE	47	Potuvil	Badulla	Nayabedda		Hunna						Nayabedda		Nayabedda		
SE	48	Siyamblanduwa	Badulla	Nayabedda		Hunna			×Nuwara			Nayabedda				
SE	49	Monaragala	Badulla	Nayabedda		Hunna			Nuwara			Nayabedda		Nayabedda		
MO	50	Hali-Ela		Nayabedda	Badulla	×Hunna						Nayabedda				
MO	51	Ragala		Nayabedda		×Hunna										
MO	52	Welimada	×Badulla	Nayabedda		×Hunna			Nuwara			Nayabedda		Nayabedda	Nuwara	
MO	53	Bandarawela	×Badulla	Nayabedda					×Nuwara			Nayabedda		Nayabedda	×Nuwara	
MO	54	Hatton							Nuwara						Nuwara	Nuwara
CO, MO	55	Kuruvita				Sooriya										
CO	56	Ingiriya		Colombo										×Colombo		
CO	57	Horana		Colombo					×Nuwara				×Colombo			
CO	58	Panadura		Colombo	Colombo	Colombo	Colombo		Nuwara	Colombo	Colombo	Colombo	Colombo	Colombo	Nuwara	Nuwara
CO	59	Beruwala		Colombo	Colombo	×Colombo	Colombo			×Colombo			Colombo	×Colombo		
CO	60	Matugana		×Nayabedda												
MO	61	Nikagola														
MO	62	Pelmadulla	Ratnapura	Ratnapura		Sooriya	×Gongala	Gongala			×Gongala		×Gongala			
MO	63	Balangoda		Nayabedda			×Gongala	×Gongala			Gongala	Nayabedda				
MO, SE	64	Wellawaya		Nayabedda								×Nayabedda		Nayabedda		
SE	65	Tanamalvila		Nayabedda			Gongala	Gongala			Gongala	Nayabedda	Gongala	Nayabedda		
MO	66	Rakwana		Nayabedda		Sooriya						Nayabedda		Nayabedda	×Nuwara	
SW	67	Hiniduma								×Gongala						
SW	68	Elpitiya						Ratnapura								
SW	69	Balapitiya					Gongala	Ratnapura	Nuwara	Gongala	Gongala		Gongala		×Nuwara	
SW	70	Hikkaduwa				×Sooriya	Gongala		×Nuwara	Gongala	Gongala		Gongala			
SW	71	Nagoda					Gongala				Gongala		Gongala			
SW	72	Deniyana					Gongala	Gongala		Gongala	Gongala		Gongala			
SW	73	Middeniya		Nayabedda			Gongala	Gongala		Gongala	Gongala	Nayabedda	Gongala			
SW	74	Embilipitiya		Nayabedda		Sooriya	Gongala	Gongala		×Gongala	Gongala	Nayabedda	Gongala	Nayabedda		
SW, SE	75	Tissamaharama		Nayabedda			Gongala	Gongala			Gongala	Nayabedda	Gongala	Nayabedda		
SW, SE	76	Ambalantota		Nayabedda		×Sooriya	Gongala	Gongala		Gongala	Gongala	Nayabedda	Gongala			
SW, SE	77	Tangalla		Nayabedda		Sooriya	Gongala	Gongala		Gongala	Gongala	Nayabedda	Gongala	Nayabedda		
SW, SE	78	Matara		Nayabedda						Gongala	Gongala					
SW	79	Akuressa					Gongala	Gongala		×Gongala	Gongala		Gongala			
SW	80	Weligama				Sooriya	Gongala	Gongala		Gongala	Gongala		Gongala			
SW	81	Galle				×Sooriya	Gongala	Gongala	Nuwara	Gongala	Gongala		Gongala		×Nuwara	

Source: JICA Study Team

4) The measurement points were classified according to the location of the transmitting stations of received signals, and those points at which signals were received from transmitter sites which are located in approximate same area were provisionally grouped into the same block. The block classification of each measurement point is shown in the leftmost column in Table 7.2-3.

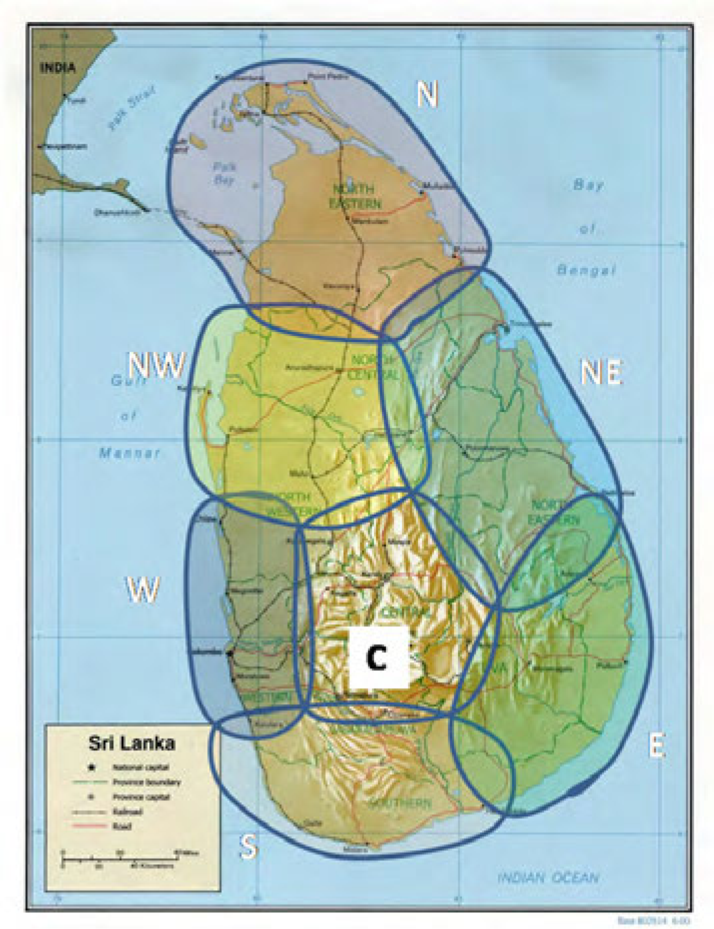
5) Next, the coverage area simulation of DTTB is examined for the same transmitter sites location. And compare to the coverage area of existing analog transmitter site.

6) As the actual coverage area analog broadcasting and the results of the digital broadcasting simulation were almost identical. Based on this result, a channel plan and an equipment installation plan are investigated for each of a total of seven area blocks, and a transmission network for DTTB from the DBNO Network Operation Center is also investigated.

7) As the terrain in the Central Mountain Area is complicated, current analog broadcasting service is done by plural transmitting stations located at a number of different sites. Therefore, a measure to cover by plural transmitter stations and gap-filler stations is adopted for the channel plan of DTTB.

(2) Block Division

Figure 7.2-2 shows the area block division of Sri Lanka in its entirety, determined on the basis of the results of the studies described in (1) above. The area block names listed below are the same as those used in the figure.



Legend
N: North Block
NE: North East Block
NW: North West Block
W: West Block
C: Central Block
E: East Block
S: South Block

Source: JICA Study Team

Figure 7.2-2 Block Division of Coverage Areas in Sri Lanka

Table 7.2-3 shows the major cities in each block.

The installation of digital broadcasting facilities at the sites of the existing analog broadcasting transmitting stations alone may not provide sufficient coverage. A reduction in the size of the coverage areas will have to be considered, particularly in areas where analog broadcasting services which have been provided on the VHF band will be replaced with broadcasting on the UHF band. The simulation predicted that some areas would not be covered. Therefore, coverage areas will have to be extended to those uncovered areas through the installation of new, low-power gap-fillers. The locations at which such gap-fillers are to be installed will be determined after accurate practical data on the propagation of the signals transmitted from the major transmitting stations has been obtained.

Table 7.2-3 Major Cities and the Existing Transmitting Stations in Each Area Block

Block	Major cities	Existing transmitting station(s) for the major analog TV broadcasting services
North (N)	Jaffna, Kilinochchi, Vavuniya	Palali, Kokavil
North East (NE)	Trincomalee, Batticaloa	Karagahatenna
North West (NW)	Anuradhapura, Puttalam, Mannar	Karagahatenna
West (W)	Colombo, Moratuwa, Negombo, Gampaha, Homagama	Colombo, Yatiyantota
Central (C)	Kandy, Nuwara Eliya, Dambulla, Badulla	Hunnasgiriya, Suriyakanda, Nayabedda
East (E)	Kalmunai, Ampara	Madulsima, Nayabedda
South (S)	Galle, Matara	Gongala

Source: JICA Study Team

7.2.4 Evaluation of the Current State of the Existing Sites/ Survey of Candidate New Sites

In the channel planning, a field survey to study whether or not the sites of the existing analog transmitting stations could be used as the sites of digital transmitting stations was carried out, as mentioned in Section 7.2.1, "Study Procedures". Surveys of the candidate sites for the installation of gap-fillers were implemented in areas outside the coverage areas of the major transmitting stations. (There are two types of gap-filler; one has a relatively large transmission output, (100W to 1kW) and the other has a low power output (approx. 10W). In this report, unless "low-power" is specified, "gap-filler" refers either to those with a relatively large output, or to both types.)

The field survey was carried out at the sites of the major existing transmitting stations and at the candidate sites for the construction of new stations. The main purpose of this field survey was to decide whether or not the existing facilities at the sites could be used for the establishment of the main transmitting stations and gap-filler transmitting stations (including retransmitting stations) of the digital broadcasting network. Table 7.2-4 gives a summary of the results of the field reconnaissance. The decision on the feasibility of a studied site as a site for the transmission of digital broadcasting is indicated in the column "Overall evaluation".

Table 7.2-4 Details of the Existing Transmitting Stations

Site	Coverage area	Tower				Station building			Shielding object nearby	Comments. etc.	Environmental and social considerations	Overall evaluation
		Existing/to be constructed (Note 1)	Antenna installation space	Strength/ level of degradation	Availability of land (for new construction)	Existing/to be constructed (Note 2)	Equipment installation space	Need for extension/re novation				
Palali (SLRC/ITN)	Jaffna City, located 10 km from the city	Existing	No	Old	-	Existing	Yes	Interior renovation required	No	Located far (20 km) from the center of Jaffna City; installation in Jaffna City preferred. Need for construction of a 2m x 5m access road (No environmental impact)	-	×
Jaffna (SLT)	Located in Jaffna city, efficient coverage of the city	Existing	Yes	Insufficient strength at the top; significant pattern ripples in the mid-section	-	To be constructed	-	-	No	In the center of Jaffna City; a replacement retransmitting station for Palali Need for a candidate site nearby	-	○
Kokavil (TRC)	Central part of North Block	Existing	Yes	Constructed in 2011	-	Existing	Yes	No	No	Best site for the main transmitting station in North Block, trial transmission from 5kW T2 transmitter in progress	-	◎
Vavuniya (SLT)	Southern part of North Block	Existing	Yes (installation of a multi- panel antenna array in the mid-section under consideration)	Constructed in 1998	No	Existing	Yes	No	No	Excluded on the basis of the results of an examination of the strength of the tower A new tower to be constructed on nearby land	C	○
Vavuniya (TRC)	Southern part of North Block	Existing	Yes	Constructed in 2006 or later	-	To be constructed (land available)	-	-	No	Preference given to the nearby SLT site	-	×
Trincomalee (SLT)	Trincomalee City and the surrounding area	The existing tower is considered unusable because of insufficient strength of its steel members	No	Old; holes in the lower part of the tower	No	-	No	-	Dialog tower to the south and military radar facilities to the north	Excluded as a candidate site for the installation of a gap-filler for Northeast Block because of insufficient strength of the tower: a new site to be sought	C	×

Site	Coverage area	Tower				Station building			Shielding object nearby	Comments. etc.	Environmental and social considerations	Overall evaluation
		Existing/to be constructed (Note 1)	Antenna installation space	Strength/ level of degradation	Availability of land (for new construction)	Existing/to be constructed (Note 2)	Equipment installation space	Need for extension/renovation				
Trincomalee (premises of a temple)	Trincomalee City and the surrounding area	To be constructed	-	-	A 20m x 20m space available in the grounds of the temple	To be constructed (land available)	-	-	A Lanka Bell tower approx. 25m high nearby will not cause obstruction	An appropriate site for a retransmitting station to cover Trincomalee City and the surrounding area; The temple seems inclined to approve the construction of a tower.	C	○
Colombo	Essential station	To be constructed	-	-	-	-		-	-	The Lotus Tower (the main station, progress of the construction project needs to be monitored) is currently under construction There needs to be an alternative plan in case the construction work should be delayed	Under construction	Under study
Yatiyantota (ITN)	Eastern Colombo, also usable as a site for a relay base station supplementary to the station in Colombo	Use of the existing facilities to be considered; if unusable, a new tower to be constructed	An FM antenna at the top, the possibility of relocating it lower down needs to be studied	Strength calculation needed (need to verify strength of antenna steel materials)	Radio broadcasting and mobile phone base station in the direction to be covered by a new antenna	To be constructed (land available)	No	-	Yes (Use of a vacant plot adjacent to the tower is recommended, possible interference from objects on both sides in the direction to be covered)	An important site as a relay station for a microwave link to the Central Mountain Area, with a 55m-high tower; little space on the tower for new antenna installations A new tower to be constructed in such a way as to minimize interference	-	○
Yatiyantota (SLBC)	Usable as a site for a relay base station	Use of the existing tower under consideration	An SLTC antenna at the top, Installation of an FM antenna possible lower down			To be constructed (land available)	-	-		A candidate site should the ITN site not be usable	-	△
Kalutara	Within the coverage area of the Colombo Station, usable as a site for a relay base to Elpitiya	To be constructed	-	-	Yes	-	-	-	-	Use of either site will be needed in the event it is not possible to establish a fiber-optic link between Colombo and Elpitiya (Land available for construction of a retransmitting station, a station building and a tower)	C	○
Matugama/EAP (Kalutara)	Usable as a site for a relay base to Elpitiya	Existing (land available)	No	Rusted	Yes	Existing (land available)	No	-	New construction site is surrounded by forest		C	○

Site	Coverage area	Tower				Station building			Shielding object nearby	Comments. etc.	Environmental and social considerations	Overall evaluation
		Existing/to be constructed (Note 1)	Antenna installation space	Strength/ level of degradation	Availability of land (for new construction)	Existing/to be constructed (Note 2)	Equipment installation space	Need for extension/re novation				
Elpitiya	Inland part of the southwest, a candidate GF site	To be constructed	-	-	Yes	To be constructed	-	-	-	A large space on the summit of a mountain dotted with several telecommunications towers; importance of the site depends on how much of the poor reception area the installation of a GF at the site will be able to eliminate Need for construction of a 2m x 100m access road (no environmental impact)	C	○
Suriyakanda (SLRC)	Central part in the South Block	Existing	No (existence of VHF and UHF antennas)	In good condition	No	Existing	Yes	No	No	Need to study the adjacent ITN site (a retransmitting station)	-	×
Suriyakanda (ITN)	Central part in the South Block	Existing	Yes (below a UHF antenna)	Constructed in 2009: insufficient strength	Yes	Existing	No	Yes	No	Need for extension/construction of a station building needs to be considered A strategic point in the south, like Gongala; New building to be constructed on government- owned land midway between SLT and SLRC	-	○
Deniyaya (SLRC)	Coverage area overlapping those of Gongala and Suriyakanda	Existing	Yes	In good condition	-	Existing	Yes	No	No	Need for installation of a small ring antenna only, if used to install a mini GF with output of 10W or below; in such a case, no need for installation space on the tower; a study is needed to determine whether or not the site can be used as a GF site	-	◎
Deniyaya (ITN)	Coverage area overlapping those of Gongala and Suriyakanda	Existing	No	-	-	Existing	Yes	No	None	Excluded because of the advantages of the SLRC site	-	×
Gongala (EAP)	Wide coverage in the South Block	Existing	No	-	Yes	Existing	No	No	Need to remove former military facilities	Excluded because of unavailability of space	-	×

Site	Coverage area	Tower				Station building			Shielding object nearby	Comments. etc.	Environmental and social considerations	Overall evaluation
		Existing/to be constructed (Note 1)	Antenna installation space	Strength/ level of degradation	Availability of land (for new construction)	Existing/to be constructed (Note 2)	Equipment installation space	Need for extension/re novation				
Gongala/a lot adjacent to the Meteorological Agency		To be constructed	-	-	Yes	-	-	-	No	Land available for a new tower along a mountain ridge; certain measures required to prevent interference from the 23m-high meteorological radar Need for construction of a 2m x 10m access road (No environmental impact)	C	○
Primrose (SLRC)	Limited area near Kandy (a candidate GF site)	Existing	Yes	In good condition	-	Existing	Yes	No	Trees may interfere with radio propagation from an antenna installed at a certain height	Study needed to decide whether it can be used as a mini-GF site; need to establish an optical fiber link	-	◎
Madulsima (ITN)	Used for Tamil Service of ITN, coverage in the East overlapping with that of Gongala and Karagahatenna	Existing	No	Unusable (possible insufficient strength)	No	Existing	No	Yes	Yes	A mobile phone tower adjacent 20m away in the direction of the coverage; significant radio propagation interference (alternative candidate site - Nayabedda)	-	×
Karagahatenna (ITN)	Wide coverage to the northeast, north and northwest, an ideal site for relay transmission	Existing	Yes (at the top of the tower)	Constructed in 2000, testing needed	Yes	Existing (land available)	No	No	SLBT tower 150m to the east; causes no problem in the direction of the coverage	Within the grounds of a military facility; space available on the tower, strength of the tower needs to be examined, construction of a new station building possible in a parking lot	-	○
Hunnasgiriya (ITN)	Located in the north of Kandy City, coverage in the Mountain Area to the southwest	Existing	Yes (Replacement and shared use of the existing antenna)	Constructed in 1998, in good condition	Yes	Existing (land available)	No	No	No	Shared use of the tower possible	-	○
Pidurutalagala (SLRC)	Coverage over the central part of the Mountain Area with appropriate output, as signals transmitted from this site may cause interference nationwide, Use as a relay site also under consideration	Existing	Yes (on the side of the tower)	Constructed in 1981, dilapidated	Yes	Existing (land available)	No	No	Yes	Construction of a station building and a tower within the SLRC grounds, interference between the new and existing towers needs to be estimated	-	○

Site	Coverage area	Tower				Station building			Shielding object nearby	Comments. etc.	Environmental and social considerations	Overall evaluation
		Existing/to be constructed (Note 1)	Antenna installation space	Strength/ level of degradation	Availability of land (for new construction)	Existing/to be constructed (Note 2)	Equipment installation space	Need for extension/renovation				
Nayabedda (ITN)	The southeast	Existing	Yes	Constructed in 2000; insufficient strength	Yes	Existing (land available)	No	-	No	Tea plantation 200m distant from the site, construction of new structures possible	-	○
Namunukula	Service area smaller than expected	Existing	No	In good condition	No	Existing	No	Yes	Yes	No space to construct either a tower or a station building	-	×
Wellawaya	Coverage from other transmission points expected	To be constructed	-	-	-	To be constructed	-	-		Excluded as a GF candidate site as the assumed coverage area can be covered by other stations	-	×

<Legend>

◎: Construction of both tower and station building possible, ○: Usable as a new site (for construction of a tower and/or station building), △: Shared use of the tower currently under study, ×: Not usable

(Note 1) Existing/to be constructed: “Existing” means the use of the tower, which is being used for analog TV broadcasting, in an existing analog transmitting station.

(Note 2) Existing/to be constructed: “Existing” means the use of the station building, which is being used for the analog TV broadcasting, in an existing analog transmitting station.

Source: JICA Study Team

7.2.5 Envisioned DTTB Stations and Frequency Simulation Results

Simulation software was used to study digital broadcasting coverage areas. The simulation software uses the geographic data provided by Google Earth and a propagation model[4] to estimate the attenuation between a transmitting antenna of a given height and a receiving antenna of a given height. The software can calculate field strength at a reception point for given reception parameters, *e.g.* the height of a transmitting antenna and effective radiation power[5] (ERP), and display it on a map. With the input of a radiation pattern, it can also display on a map the area over which field strength is at or above a certain given value.

(1) Transmitting Stations and Parameters Used for Simulation

Table 7.2-5 shows the transmitting stations and parameters used in the simulation. The directions and sizes of the coverage areas were used to set the directional characteristics of the antennas and ERP shown in the table. The parameters shown in the table were used in the design of the transmitters and antennas mentioned in Sections 7.4.2 and 7.4.3.

The simulation was conducted many times using different sets of the major parameters. The set of parameters providing the best coverage area at each station is shown in the table.

Table 7.2-5 Transmitting stations and Parameters Used for Simulation

Transmitting station	Location	Main Parameters	Main Coverage Area
Jaffna	N: 09˚39'56" E: 80˚00'21"	ERP: 3.08kW Directionality: 60, 150, 240, 330 (4.2.4.2)	Area around Jaffna in North
Kokavil	N: 09˚16'11" E: 80˚24'29"	ERP: 27.4kW Directionality: 60, 150, 240, 330 (8.8.8.8)	Central area in North
Vavuniya (GF)	N: 08˚46'02 E: 80˚33'60"	ERP: 6.93kW Directionality: 0, 90, 180, 270 (2.4.2.4)	Area around Vavuniya in North
Trincomalee (GF)	N: 08˚32'55" E: 81˚13'44"	ERP: 14.3kW Directionality: 0, 90, 180, 270 (2.4.2.4)	Area around Trincomalee in Northeast
Karagahatenna	N: 07˚35'28.47" E: 80˚42'49.02"	ERP: 33.9kW Directionality: 20, 100, 300 (5.5.5)	Wide coverage in northeastern, northern and northwestern directions. Suitable as central relay transmitting station.
Hunnasgiriya	N: 07˚23'12.99" E: 80˚41'25.86"	ERP: 12.5kW Directionality: 155, 245, 335 (8.8.8)	Located to north of the city of Kandy, provides coverage in mountainous area in southwestern direction.

4 For the propagation model, see CRC-Predict in Report ITU-R-BT.2137 (2008)

5 ERP: A value obtained by multiplying the antenna input power (the value obtained by deducting the feeder insertion loss, etc. from the transmitter output) by the antenna gain: It shows the strength of power radiated from the antenna.

Transmitting station	Location	Main Parameters	Main Coverage Area
Yatiyantota	N: 07˚02'44.63" E: 80˚24'08.73"	ERP: 25.9kW Directionality: 100, 190, 340 (2.5.5)	Covers eastern portion of Colombo, can also be used as relay base station supplementing coverage in Colombo.
Elpitiya (GF)	N: 06˚17'26" E: 80˚09'26"	ERP: 1.75kW Directionality: (4.4.4.4)	GF candidate to cover inland portion of southwestern area
Suriyakanda (GF)	N: 06˚26'25" E: 80˚36'54"	ERP: 12.7kW Directionality: 50, 320 (4.4)	Covers central portion of southern area
Gongala	N: 06˚23'09" E: 80˚39'02	ERP: 10.1kW Directionality: 60, 150, 240 (2.4.4)	Wide coverage of southern area
Pidurutalagala	N: 07˚00'01" E: 80˚46'26"	ERP: 2.18 Directionality: 130, 220, 310 (4.4.4)	Due to possibility of interference with reception nationwide, will be used to cover center of mountains with suitable power
Nayabedda	N: 06˚48'15" E: 81˚01'02"	ERP: 60.4kW Directionality: 60, 150 (6.6)	Covers southeastern area
Colombo	N: 06˚55'45" E: 79˚51'27"	ERP: 77.5kW Directionality: 0, 90, 180, 270 (8.8.8.4)	Lotus Tower
Primrose	N: 07˚16'38" E: 80˚36'35"	ERP: 0.1kW Directionality to be determined in the detailed design	A small gap-filler station to cover the areas near Kandy which cannot be covered by the station at Hunnasgiriya, together with the station at Hanthana mentioned below
Hanthana	N: 07˚15'31" E: 80˚37'46"	ERP: 0.1kW Directionality to be determined in the detailed design	A small gap-filler station to cover the areas near Kandy which cannot be covered by the station at Hunnasgiriya, together with the station at Primrose mentioned above
Deniyaya	N: 06˚22'56" E: 80˚39'38"	ERP: 0.1kW Directionality to be determined in the detailed design	A small gap-filler station to cover the southern area which cannot be covered by the station at Gongala

Source: JICA Study Team

(Note 1) In addition to the main transmitting stations that are to cover most of the area blocks, transmitting stations will be that cover areas not covered by the main stations, called gap-fillers (gap-filler stations). At present, the installation of gap-fillers with a relatively large output (100W to 1kW) only is under consideration in the planning. Low-power gap-fillers will have to be installed in three places, Primrose, Hanthana and Deniyaya. The exact locations of the installations will be specified after the characteristics of the radio propagation from the transmitting stations listed in Table 7.2-5 have been revealed during the project period.

(Note 2) The directionality of an antenna is represented by the arrangement of antenna elements (represented in azimuth) and the number of stages in each direction. For example, “60, 150, 140, 330 (4.2.4.2)” refers to an antenna array with four, two, four and two stages of antenna elements in the directions of 60, 150, 240 and 330 degrees, respectively.

(2) Simulation Results

Coverage of the signal radiated from the site of each transmitting station shown in Table 7.2-5 was simulated. The coverage over the whole of Sri Lanka was obtained by combining the simulated coverage areas of the individual transmitting stations. Figure 7.2-3 shows the coverage area map thus created.

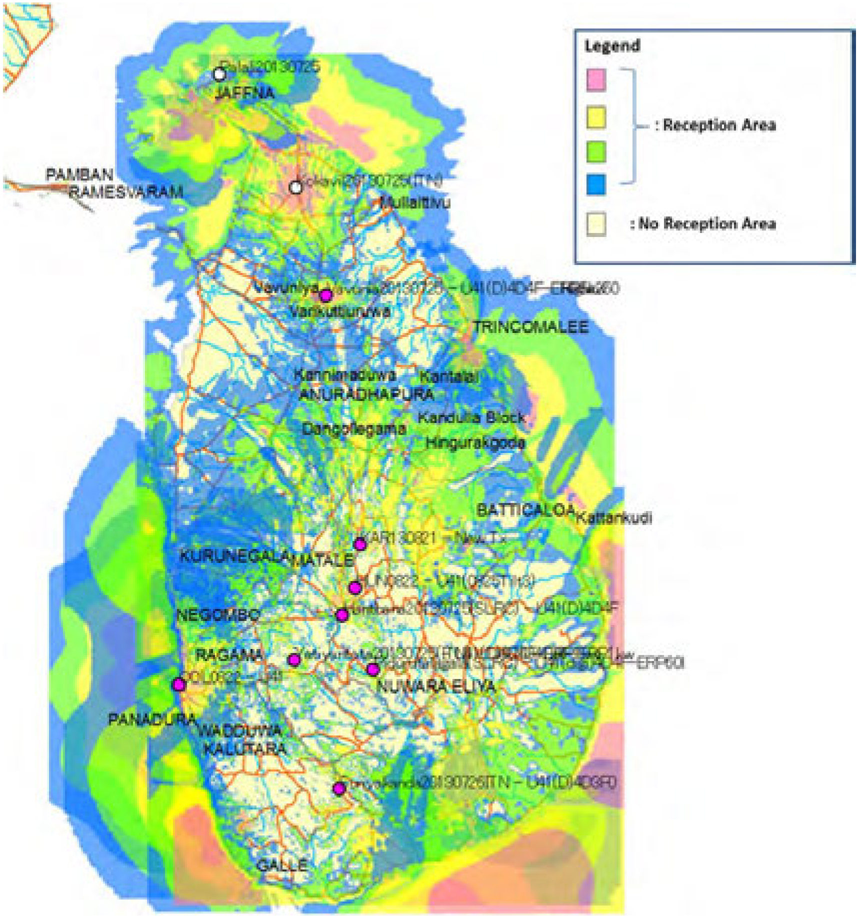


Figure 7.2-3 Sri Lanka Coverage Area (Simulation Results)

The figure shows that the DTTB signals cover almost all populated areas of Sri Lanka, excluding the forested areas in the northeast and northwest and the hilly area north of Galle in the south. Since these results suggest no problems in providing DTTB service throughout the country, the transmitting stations of the DTTB Platform to be operated by DBNO will be located at the locations listed in Table 7.2-5.

Low-power gap-fillers will have to be installed at three places, Primrose, Hanthana and Deniyaya. The exact locations of these stations will be specified during the project period.

7.2.6 Development of Broadcasting Network

(1) Design Procedures

The basic design of the broadcasting network connecting the DTTB transmitting stations and the DBNO NOC to be located in Colombo was prepared following the procedures described below. The results of the studies for the basic design are described following this.

1) Understanding of the current state of the existing analog broadcasting networks: As a

reference for the development of the DTTB network, the current state of the existing analog broadcasting networks of SLRC and ITN was examined.

2) A study of network composition: A study was made of the suitability for the transmission of digital broadcasting signals, for several measures, such as optical fiber communications networks, microwave links, etc. In the study, the location characteristics of the transmitting station sites shown in Table 7.2-6, including the distance from Colombo and difficulties in the last-mile installation, were taken into consideration in determining the composition of the network. The details and results of the study of each site are given in Section (3) below.

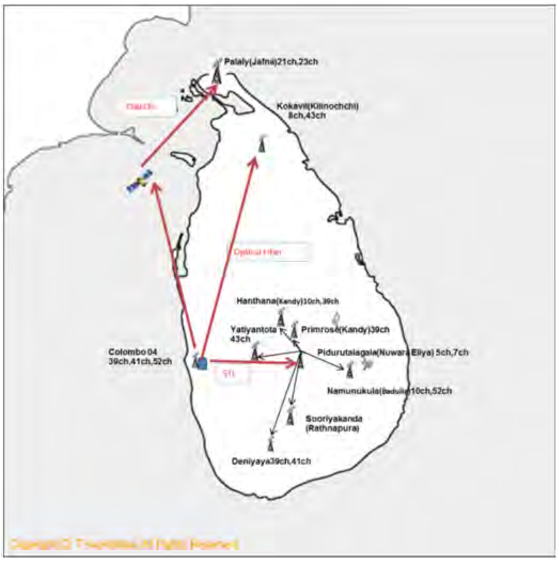
3) A study of transmission methods: A study was made of methods of transmitting multiple digital broadcasting signals for cost-efficient network operation.

(2) Understanding of the Current State of the Existing Analog Broadcasting Networks

There is a mountainous area in the south-central part of Sri Lanka. Therefore, the existing analog broadcasting networks consist of a VHF band transmitting station on the highest peak in Sri Lanka, Mt. Pidurutalagala, which covers nationwide in Sri Lanka, and plural UHF transmitting stations located on mountains in the periphery of the mountainous area. The microwave STLs are used for the transmission links between Colombo studio center and these transmitting stations. From the Pidurutalagala Transmitting Station, signals in the VHF band are transmitted to every part of the country, while signals transmitted from the UHF stations cover those areas where the field strength of the signals from the Pidurutalagala Transmitting Station is not strong enough, *e.g.* areas on or below mountain slopes facing away from Mt. Pidurutalagala. The STLs are used for the transmission of broadcasting program signals from Colombo to the transmitting stations.

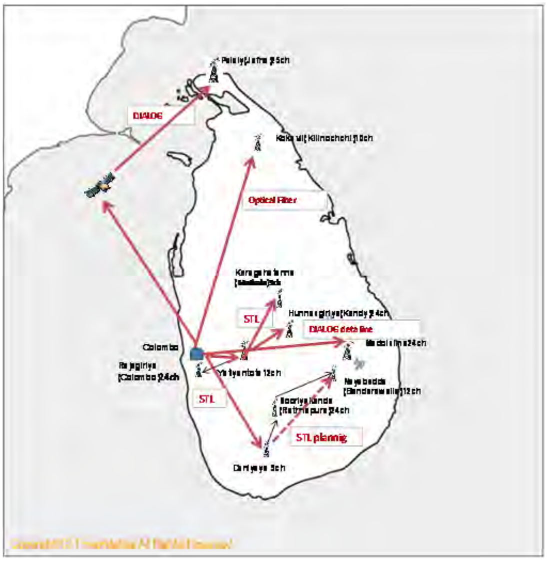
On the other hand, since the VHF radio waves from the Pidurutalagala Transmitting Station cannot provide coverage to the northern area north of Vavuniya. The coverage of northern area is provided by the Palali Transmitting Station (located in an army base, transmits broadcast programs using satellite link of DIALOG company), which is positioned in the northern part of Jaffna, the major city in the northern part of the country. And, southern part of north area is covered by Vavuniya relay station (the broadcast-wave relay link) which uses a tower of Sri Lanka Telecom (SLT) near Vavuniya city. By making use of TRC multipurpose communication site in Kokavil (located between Vavuniya and Jaffna), which was installed in 2011, SLRC and ITN, national broadcaster, started a broadcast service, to increase the coverage area in the northern part of the country.

Examples of the existing analog broadcast transmission link system in Sri Lanka are shown in Figure 7.2-4 and Figure 7.2-5.



Source: SLRC

Figure 7.2-4 Existing analog broadcasting network of SLRC



Source: ITN

Figure 7.2-5 Existing analog broadcasting network of ITN

In the SLRC network, a broadcasting signal is transmitted directly from a studio in Colombo to Pidurutalagala Transmitting Station via a microwave link and then the signal is transmitted from Pidurutalagala Transmitting Station to the transmitting stations on the outskirts of the mountainous area, via microwave links.

Meanwhile, in the ITN network, a broadcasting signal is transmitted from a studio in Colombo to Yatiyantota Transmitting Station, which covers western part of Greater Colombo, via a microwave link and then the signal is distributed from Yatiyantota Transmitting Station to stations in the north and east of the mountainous area. The signal is transmitted from the studio in Colombo to Deniyaya Transmitting Station in the south via a direct microwave link.

The same methods of transmitting broadcasting signals to the north are used in both SLRC and ITN networks. Optical fiber links are used for signal transmission to Kokavil Transmitting Station, while the DIALOG satellite link is used for transmission to Jaffna Transmitting Station.

(3) Composition of the Digital Broadcasting Network

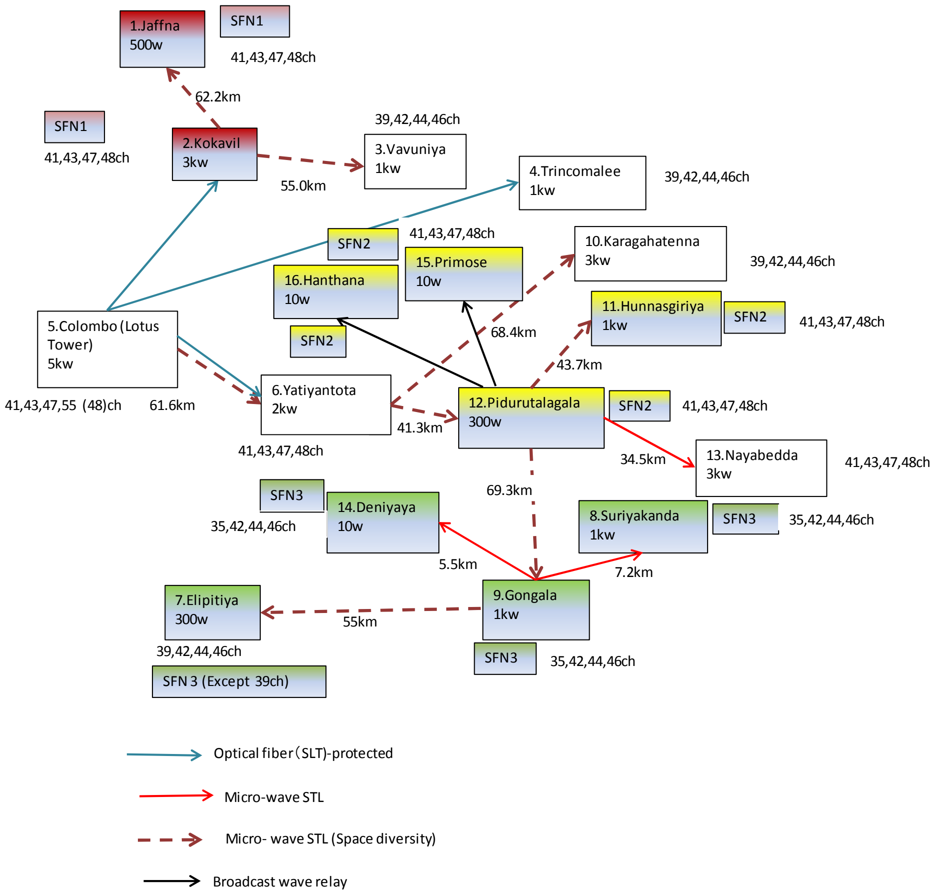
In designing the composition of the digital broadcasting network of Sri Lanka, the three options listed below need to be considered as means of transmission network for DTTB signals:

- Optical fiber link;
- Self-operated microwave link; and
- Satellite communication link.

It is desirable to select the transmission measures to each DTTB transmitter stations, with a comparative study of the distances from Colombo NOC and the ease of the transmission link installation using optical fiber links and microwave links. Since the routes from Colombo to

Kokavil in the north and Trincomalee in the northeast are long and flat, the installation of broadcaster's microwave links on these routes would require higher cost. Therefore, it is recommended that the SLT optical fiber backbone link be used. For transmission measures from Kokavil to Jaffna and Vavuniya, micro-wave links will be better from a viewpoint of cost-efficiency.

Meanwhile, in many cases, transmitting stations in and around the mountainous area are located near the summits of mountain. If optical fiber links are to be installed between Colombo and these stations, the cost of the last-mile installation between the branch points of backbone network and the destination stations will be high. On the other hand, the distances from Colombo to these stations are shorter than the distances from Colombo to Kokavil and Trincomalee. Therefore, broadcaster's microwave links will be advantageous from a viewpoint of cost-efficiency.



Source: JICA Study Team

Figure 7.2-6 Planned Composition of the Digital Broadcasting Signal Network

The broadcast-wave relay link will be used for the signal transmission measure to low-power gap-filler stations, which are located relatively close to their main stations (transmitting stations from which signals are transmitted directly to the gap-filler stations in the network) in order to reduce the cost of installation of transmission link. However, if the same frequency has been allocated to a low-power gap-filler station and its main station for effective use of frequency resource, loop-back interference between the receiving antenna that receives signals from the main station and the transmitting antenna may cause signal degradation in the gap-filler station. In such a case, the broadcast-wave relay link may have to be replaced by a microwave link. For above reason, it is necessary to investigate that a broadcast wave link is available or not to consider several conditions by site survey, such as, enough distance between the receiving antenna and transmitting antenna within transmitting station site is available.

A technique called space-diversity will be adopted for the rather long-range microwave links between receiving and transmitting antennas. In this system, a pair of receiving antennas are installed at locations physically separated by an appropriate distance, and either a "selection diversity system" (select any of better-quality signal from two antennas), or a "combining diversity system" (combine both signal from two antennas)

The composition of the digital broadcasting network depicted in Figure 7.2-6 is based on the assumption that microwave frequencies are allocated for broadcaster's microwave links.

Since for some of the sites, transmission frequencies, exact locations of transmitting stations and specifications of towers have not yet been specified, at the detailed design stage there may be some revision of the composition of the digital broadcasting signal transmission network shown above.

(4) Method of Transmission of Digital Broadcasting Programs

In the designing of a digital broadcasting network, a study for the signal format of the digital broadcasting programs to be transmitted has to be made, in addition to the development of the trunk network mentioned in the previous section.

In the analog broadcasting system, each broadcaster develops its own broadcasting network and transmits analog TV signals, each of which carries one TV program. In the digital broadcasting system, however, broadcasting program providers will transmit broadcasting programs to the NOC of DBNO. At NOC, six programs will be multiplexed into a single channel and the multiplexed signals will be transmitted to each transmitting station as Broadcast TS signals.

The transmission bit rate of 8MHz bandwidth ISDB-T Broadcast TS (transport stream) signal is approx. 43.34Mbps. A single channel-52 Mbps digital hierarchy (in STM/ATM, high speed data network is composed of hierarchical structure, 52Mbps- 155Mbps- 622Mbps) called STM-0 can be used to transmit Broadcast TS signal via a digital link. The use of STM-0 in this project will not be economically feasible because if this project is to be implemented as planned, the transmission of 23 programs will require four STM-0 links. Instead, an economically more feasible system, in which the four Broadcast TS signals are multiplexed and the multiplexed signal is transmitted using STM-1 (155Mbps), the standard that is one level higher than STM-0 in the hierarchy, will be used. However, when the four channels are multiplexed as is, the total bit rate will be 173.36Mbps (43.34Mbps x 4 channels), which is above the allowable transmission capacity of STM-1. By compressing and then multiplexing the four broadcasting TS signals, the total transmission capacity will be reduced to less than 156Mbps. When the four Broadcast TS signals are compressed and multiplexed, the bit rate required for transmitting the multiplexed signal will be approx. 130Mbps. In this way, it will be possible to transmit 23 programs over a single STM-1 link and thus reduce the cost of using links. Since the compression and multiplexing of signals does not affect the quality of images of broadcasting contents, in this project the digital broadcasting network will be designed with single-channel STM-1 links.

The compression of broadcasting TS signals involves extra costs because of the need for a compression/decompression system. However, the use of STM-1 links in preference to other links will lower the connection fee. Therefore, the use of STM-1 will be cost-efficient when all costs are taken into consideration. Table 7.2-6 shows the transmission standards. For details of the equipment composition, see Section 7.4.4.

The above discussion deals with optical fiber links. It is desirable that a transmission system using the same signal format is used in the broadcaster's microwave links, because the same signal interface and equipment can be used for both systems and the use of the same signal format ensures complementarity between the two systems, exemplified by the fact that a signal transmitted via an optical fiber link and a signal transmitted via a microwave link in a duplicated last mile can be treated as the same signal.

Table 7.2-6 Transmission Standards for Digital Broadcasting Signals in the Broadcasting Transmission Network

No.	Item	Standard	Remarks
1.	Transmission signal	Broadcast TS (BTS) signal	
2.	Transmission bit rate	43.34Mbps / 1 BTS signal (Note 1)	Standards for the 8MHz RF bandwidth
3.	Standards for the interface used in the distribution network	Multiple BTS signals will be multiplexed and the multiplexed signal will be connected to a high-speed digital link. (Note 2)	(Note 1)
4.	Usable communication network	STM-1 (155.2Mbps), or IP networks	When a high-speed digital link is used
5.	Standards for signals	DVB-ASI	
6	PSI/SI function	Rewriting of NIT and relevant data	(Note 3)

Source: JICA Study Team

(Note 1) Sample clock of 8MHz bandwidth ISDB-T signal (= 10.836 MHz x 4)

(Note 2) BTS signals can be compressed (to approx. 29 Mbps in the 8MHz system) when they are multiplexed and transmitted. Therefore, the use of a compression/decompression system enables a maximum of four BTS signals (corresponding to four RF channels) to be transmitted via an STM-1 link.

(Note 3) As control information on broadcasting physical channels (frequencies) is included in the PSI/SI signal in a BTS signal, the information has to be replaced with information applicable to the broadcasting frequencies of the individual transmitting station.

7.2.7 Channel Planning

In the simulation analysis for the channel planning, the entire country was divided into seven blocks as mentioned in Section 7.2.3 and frequencies for DTTB were allocated to the transmitting stations including gap-filler stations in each block, which were to be established to cover the entire block.

Broadcasting frequencies have to be allocated to each block in such a way that a radio wave transmitted from a block does not interfere with that transmitted from an adjacent block. As the first step in the channel planning, four frequencies, as a set, were allocated to West Block, as the first digital TV broadcasting was scheduled to begin in the Greater Colombo in the 1st quarter of 2016 (See Section 7.3 for the schedule). Then, frequency assignment for other blocks should be done not to cause interference. The results of the radio wave measurement were used for the identification of frequencies which could be used for DTTB in each block. Four frequencies in a narrow frequency range on which radio waves can be transmitted efficiently from a single transmitting antenna were selected from the identified frequencies. Then, the frequency simulation was conducted to confirm the absence of frequency interference between the radio waves transmitted from adjacent blocks. The parameters in Table 7.2-5 were used in the simulation.

Figure 7.2-7 shows the channel plan for the allocation of frequencies to the nine transmitting stations and seven gap-filler transmitting stations prepared in accordance with the principle mentioned above.

No	Site name	Ch	Power
16 transmitting stations			
1	Colombo	Ch41,43,47,55 (48)*	5kW
2	Kokavil	Ch41,43,47,48	3kW
3	Yatiyantota	Ch41,43,47,48	2kW
4	Jaffna	Ch41,43,47,48	500W
5	Pidurutalagala	Ch41,43,47,48	300W
6	Hunnasgiriya	Ch41,43,47,48	1kW
7	Nayabedda	Ch41,43,47,48	3kW
8	Karagahtenna	Ch39,42,44,46	3kW
9	Gongala	Ch35,42,44,46	1kW
10	Trincomalee	Ch39,42,44,46	1kW
11	Vavuniya	Ch39,42,44,46	1kW
12	Suriyakanda	Ch35,42,44,46	1kW
13	Elipitiya	Ch39,42,44,46	300W
14	Primrose	Ch41,43,47,48	10W
15	Hanthana	Ch41,43,47,48	10W
16	Deniyaya	Ch35,42,44,46	10W

Note: Ch55 will be tentatively assigned for the Colombo transmitting station of DTTB platform, and will be reassigned to other channel below Ch50 after ASO.

Source: JICA Study Team

Figure 7.2-7 Locations of and Frequencies Allocated to the Transmitting Stations and Gap-fillers

As shown in Figure 7.2-7, a set of four frequencies will be allocated to each block, in principle. Channel 55 instead of 48 will be tentatively allocated to Greater Colombo because of the lack of frequencies in the area. TRC has already decided the frequency plan in which channel numbers over 50 are not used for TV broadcasting. Channel 48 will be allocated to the Greater Colombo area after ASO and the final frequency set in the West Block (Colombo and Yatiyantota) will be Channels 41, 43, 47 and 48. A frequency set identical to the one allocated to the West Block, in which Greater Colombo is located, will be allocated to the Central (Hunnasgiriya, Hanthana, Primrose and Pidurutalagala), North (Jaffna and Kokavil) and East (Nayabedda) Blocks. Different sets will be allocated to the Northwest (Karagahatenna), South (Elpitiya, Suriyakanda, Gongala and Deniyaya) and Northeast (Vavuniya and Trincomalee) Blocks.

Since the coverage area of Karagahatenna Transmitting Station includes not only major part of Northeast Block but also Northwest Block, identical frequencies will be allocated to both Northwest Block and the majority of the area in Northeast Block, though Northeast Block is not adjacent to West Block. However, a set of frequencies identical to the set to be allocated to West Block will be allocated to the gap-filler in Trincomalee, despite it being located in Northeast Block, in order to prevent interference between the radio waves transmitted from the Trincomalee gap-filler and Karagahatenna Transmitting Station. The radio waves transmitted on the same frequencies from West Block and Trincomalee will not interfere with each other because of the long distance between them.

Candidate frequencies to be allocated to Colombo Transmitting Station were selected from the frequencies not being used for the current analog broadcasting. More specifically, a set of four frequencies, channel number 41, 43, 47 and 48, were selected as the first option and, if it is difficult to allocate those to the station, a second option of a set of channel number 39, 41, 43 and 47 will be used. The same frequencies will also be allocated to stations whose coverage areas do not overlap with West Block, the coverage area of Colombo Transmitting station. Two sets of four frequencies will be allocated to stations and gap-fillers in the blocks adjacent to West Block. Another set of frequencies, channel number 39, 42, 44 and 46, will be allocated to Kalagahatenna Transmitting Station which will cover the northwest, Elpitiya Transmitting Station which will cover the south and Vavuniya Transmitting Station and Trincomalee Gap-filler Station which will cover the northeast. The other set of frequencies, channel number 35, 42, 44 and 46, will be allocated to the stations at Gongala, Suriyakanda and Deniyaya.

While final approval by the Government of Sri Lanka will be required for the allocation of frequencies to each transmitting station, decision on the frequencies to be allocated should be made to consider the interference between the digital and analog signals in the period of simultaneous broadcasting, in which the analog programs will continue to be broadcast, being confirmed during the implementation period of this project. For the frequencies which will be allocated to Jaffna and Kokavil transmitting station, it is necessary to consider that some interference may be occurred with India, if same frequencies have already been used or will be assigned. TRC will have to have consultation with its

Indian counterpart on this issue. Since signal from India was detected only on VHF 10 ch. in the radio wave measurement conducted by Study Team. However the UHF band will be used for the digital broadcasting, there may be a few cases that some interference caused by a radio wave transmitted from India. Meanwhile, because of the possibility of interference (a situation in which a radio wave transmitted from Sri Lanka causes radio wave interference in India), either frequencies or ERP may have to be changed as a consequence of the consultation. In such a case, additional low-power gap-filler stations will probably be established in the north and northeast area.

Figure 7.2-8 below shows the result of a simulation conducted by Study Team for the assessment of interference with radio waves transmitted from Sri Lanka to India.

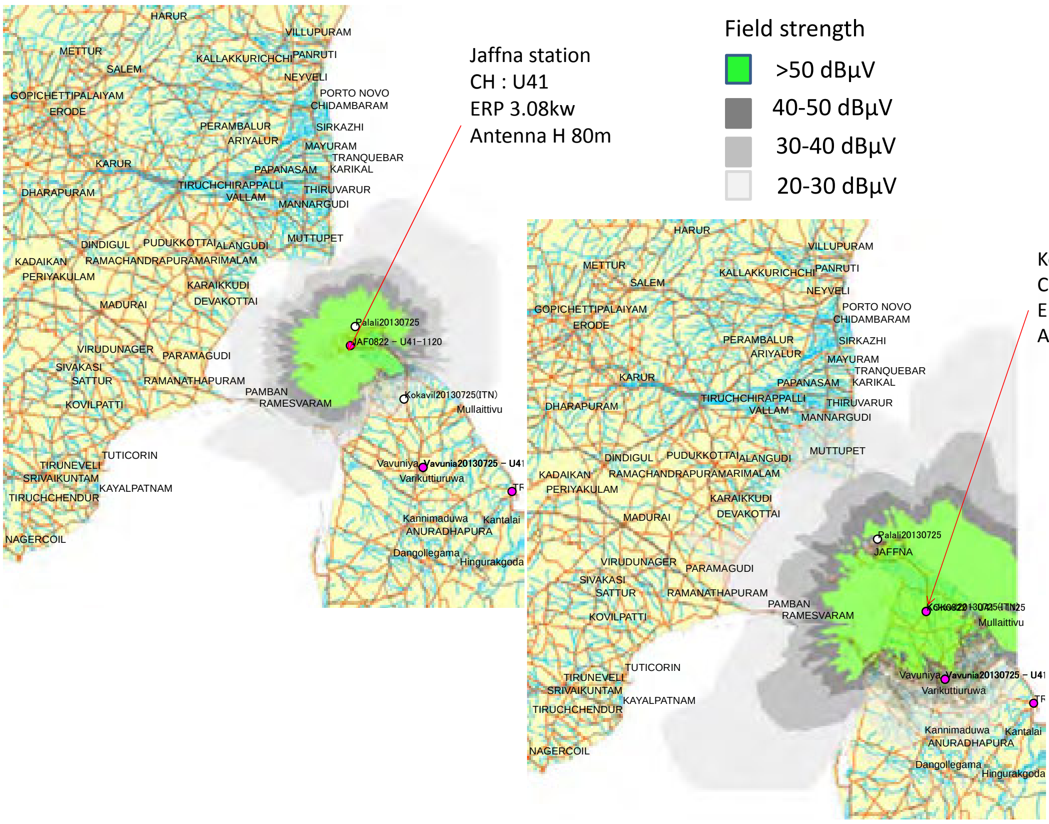


Figure 7.2-8 Simulation for the Assessment of Frequency Interference with Radio Waves Transmitted from Sri Lanka to India (Left: Jaffna, Right: Kokavil)

7.2.8 Study on Broadcasting Service Area

A study was conducted on the proportion of population in the areas of the broadcasting service (population coverage) provided in accordance with the channel plan mentioned in Section 7.2.7. In the study, the coverage areas obtained from the frequency simulation, a population distribution map and demographic software were used for the calculation of population in the coverage area. Population sizes of coverage areas in some of sparsely populated areas were calculate manually from the population distribution map.

Table 7.2-7 shows the population coverages of the DTTB expected from the channel plan mentioned in Section 7.2.7, and proportions of households with TV sets, electrified households, people who do not have either mobile or fixed telephone and people in poverty. The population coverages of the existing analog broadcasting are also shown in the table for reference. Figure 7.2-9 shows the locations of provinces of Sri Lanka.

Table 7.2-7 Relationship between the DTTB Population Coverage and the Proportions of Households with TV Sets, Electrified Households, People Who Do Not Have a Mobile Phone and People in Poverty

Province	Population coverage			Proportion of households with TV sets (%)	Proportion of electrified households (%)	Proportion of people who do not have either mobile or fixed telephone (%)	Proportion of people in poverty (%)
	DTTB (People)	DTTB (%)	Existing analog broadcasting (%)				
Total	17,134,456	84.5	67.2	80.0	85.3	22.9	8.9
Western	5,837,294	84.8	85.1	88.4	95.0	14.0	4.2
Central	1,800,649	70.4	54.2	81.7	87.3	23.8	9.7
Southern	2,161,926	87.7	72.8	79.8	91.1	23.4	9.8
Northern	1,020,165	96.2	80.4	54.3	69.6	34.9	12.8
Eastern	1,456,675	94.1	44.6	63.2	76.3	36.5	14.8
Northwestern	2,213,145	93.3	74.5	78.5	77.0	25.0	11.3
North Central	1,168,381	92.8	41.7	79.2	77.2	21.7	5.7
Uva	777,220	61.7	48.8	78.0	78.9	28.3	13.7
Sabaragamuwa	1,584,029	82.5	65.7	77.5	79.1	27.9	10.6

Sources: Population coverages of the DTTB and the existing analog broadcasting: calculation by the Study Team, proportion of people in poverty: "Household Income and Expenditure Survey – 2009/10; others: "Economic and Social Statistics of Sri Lanka 2013, Central Bank of Sri Lanka"

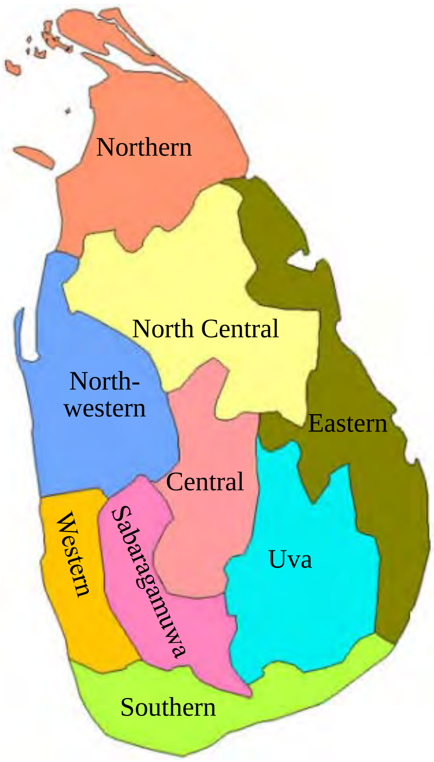


Figure 7.2-9 Map of Provinces in Sri Lanka

The analysis of the figures in Table 7.2-7 for the channel plan revealed the following. They are matters which should be used as reference in future in the stages of the development of employer's requirement and implementation or in a study for the promotion of the use of the DTTB service. Four scenarios are found among the matters which should be used as reference. A new study on the channel plan after the propagation of radio waves from the 16 transmitting stations to be installed in this project have been thoroughly analyzed will be required, instead of its review at present.

The proportion of households with TV sets is larger than the population coverage of the existing analog broadcasting in the all provinces except Northern Province. This observation suggests that some people are watching TV programs with poor quality images with signals whose strengths are at or below 55dBμV/m, the minimum standard of receiving signal strength defined by ITU Radio Communication Sector (ITU-R). In other words, the observation suggests that many people are watching TV programs in areas with under standard field strength technically considered as areas outside service areas. While viewers can watch TV programs with noisy picture in an analog TV broadcasting system, in case of digital broadcasting system, TV programs may not be displayed on a TV screen by noise. Installation of gap-fillers will be an effective way to extend standard coverage areas.

<Scenario 1: a matter requiring extension of coverage areas in future>

- The expected population coverages of DTTB are low in Central and Uva Provinces. Since the levels of the use of mobile phones and electrification in these provinces are not significantly below those of the other provinces, extension of coverage with measures such as installation of gap-fillers will be required in those provinces. The effective way to achieve the extension will be to conduct a study on locations of gap-filler installation after the radio propagation from the currently-planned 16 transmitting stations has been thoroughly analyzed.

<Scenario 2: a matter requiring a measure to support extension of use in future>

- There is strong correlation between the proportions of electrified households and households with TV sets, in general. Therefore, the low proportion of electrified households is considered as a reason for the low proportion of households with TV sets in Northern and Eastern Provinces. The proportion of people in poverty also seems to have an influence on the proportion of households with TV sets. Use of mobile phones is also limited in Northern and Eastern Provinces as they are the only provinces which have the proportion of people who do not have mobile or fixed phones above 30%. With the implementation of the channel plan described in this report, the two provinces will have sufficient population coverage. Therefore, distribution of STBs and receivers free of charge is considered as the most effective **measure to extend the use of DTTB service**.

<Scenario 3: a matter requiring both measures to support extension of use and extension of coverage areas in future>

- While the transition to DTTB to be implemented in this project is expected to increase the strength of TV signals in most of Northern, Northwestern, Northwestern and Eastern Provinces, it will degrade the coverage in Western, Central and Uva Provinces slightly. Implementation of **a policy of making it mandatory for satellite and cable TV providers to re-transmit the terrestrial broadcasting programs** is an effective short-term measure in Western Province where the proportion of people in poverty is small. **Extension of the coverage with installation of gap-fillers** after the thorough analysis of the radio propagation from the 16 transmitting stations in the original plan is recommended as a long-term measure. Implementation of a study on the possibility of implementing **a policy of free provision of satellite and cable TV services** seems necessary as a measure in Uva Province where the proportion of people in poverty is above 13% until the installation of gap-fillers has been completed. Implementation of this policy will require provision of facilities required for reception of satellite and cable signals.

<Scenario 4: a matter requiring either measure to support extension of use or extension of coverage areas in future>

- A simple calculation from the figures of the population coverage and proportion of households with TV sets has revealed the possibility that members of 20% of a total of approx. 330,000 households in Uva Province who have been able to watch TV programs may no longer able to do so after the transition to DTTB. The simple calculation was carried out as follows: The Economic and Social Statistics of Sri Lanka 2013 (Central Bank of Sri Lanka) gives the figure of 3.84 as the average number of people per household. This figure gives the number of households with TV sets at 250,000. The population coverage of the DTTB service is estimated at 61.7 %, which corresponds to 200,000 households. If **fully-subsidized STBs for satellite broadcasting are to be provided** to all households with TV sets in the coverage area on the assumption that all the 200,000 households in the coverage area have TV sets, the amount of the subsidy for the provision of the STBs at the price of 2,000 JPY per unit will be approx. 100 million JPY. The propagation of radio waves from the 16 transmitting stations in the channel plan prepared in this study will be analyzed after the DTTB service has begun. Then, **the costs of providing the subsidy and installation of low-power gap-filler station(s) will be compared and the less expensive measure will be implemented**. The estimated cost of the installation of a 100mW gap-filler is less than 10 million JPY.

7.3 DSO and ASO Plan

7.3.1 DSO and ASO Overall Schedule

(1) DSO and ASO Overall Schedule Outline

In this Section 7.3, procedures, schedule and measures required for the transition to DTTB are described.

1) DSO-SD

By multiplexing existing analog broadcasting programs into DTTB broadcast waves, usable channels can be created. At this stage, the picture quality of DTTB is limited in standard definition due to the limitation of usable bitrate of each programs.

DSO-SD is a digital broadcasting system which will be used in the first stage of the transition to DTTB in Sri Lanka. Although only images of the standard definition can be transmitted in this system, various services which can be possible in digital system become available. This system is very useful in a nation like Sri Lanka where the number of channels available for the launch of digital broadcasting is few because many frequencies are being used for analog broadcasting, because this measure allows a creation of vacant channels by temporarily relocating analog programs. Broadcasting signals will be used for simultaneous broadcasting of both analog programs and digital programs with standard definition. A period in which this type of broadcasting is carried out is called a simultaneous broadcasting period. This period will last until ASO mentioned in the next paragraph has been completed.

2) ASO

The analog broadcasting which has long been enjoyed by many viewers will be terminated. ASO will create many vacant channels. Viewers will no longer be able to use their receivers for analog broadcasting that they have long used for viewing TV programs. They will have to purchase receivers for DTTB (TV sets, STBs, etc.).

3) DSO-HD

DSO-HD will realize authentic DTTB, *i.e.* broadcasting of high-definition images. The implementation of ASO will create vacant channels and availability of those channels will enable implementation of DSO-HD. Broadcasting contents of high-definition and standard definition will coexist between the period between DSO-HD and Digital (SD) Switch-Off mentioned below.

4) Digital (SD) Switch-Off

Digital (SD) Switch-Off will be the final stage in the transition to DTTB in Sri Lanka. The broadcasting of TV programs with the standard definition will be terminated and all programs will be broadcast with the high definition. While viewers will be able to continue to use their receivers for DTTB during and after this stage, broadcasting stations will have to replace all their equipment with that for production and transmission of high-definition TV programs during this stage.

(2) Overall Schedule of the Transition to DTTB

Transition to DTTB in Sri Lanka will be accomplished with appropriate implementation of the four stages mentioned above. Figure 7.3-1 shows the overall schedule of the transition to

DTTB. The work required for achieving DSO-HD will be implemented in the six main steps mentioned below. In each step, various types of work will have to be implemented. Details of the work are mentioned below.

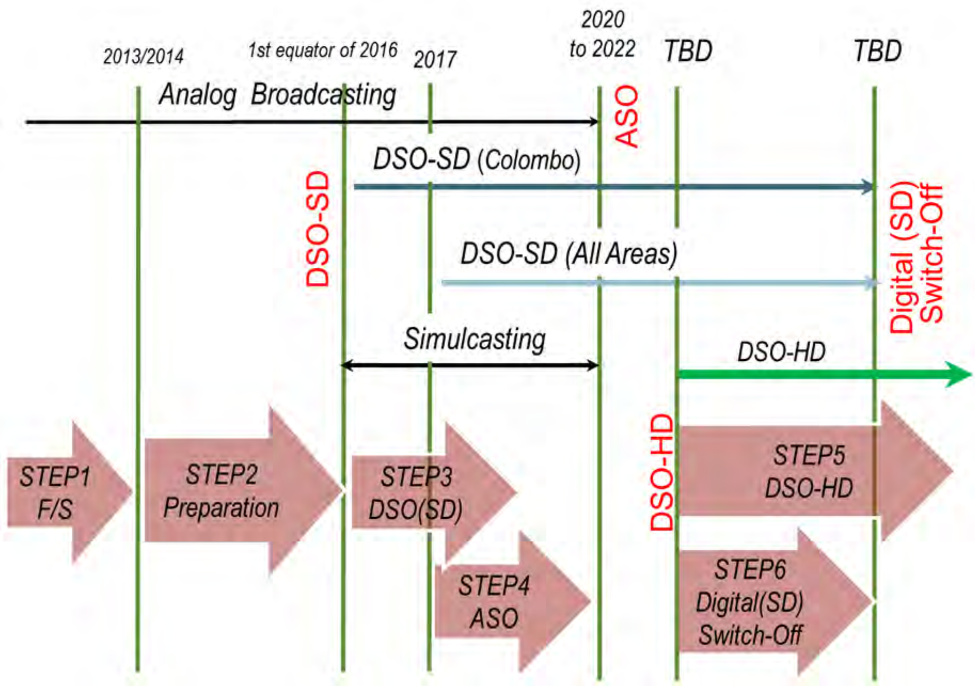


Figure 7.3-1 Overall Schedule of the Transition to DTTB

(3) Step 1: Study on Feasibility of the Transition to DTTB

This is the step to conduct a study for the selection of the DTTB system to be adopted in Sri Lanka. It is the step to study each of the available DTTB systems from various viewpoints including feasibility and impact of the transition to DTTB.

ITU submitted a roadmap report on the transition to DTTB. This report is a comprehensive implementation plan to persuade the Government of Sri Lanka to adopt the European system of DTTB (DVB-T2) submitted by ITU in February 2012. The Government of Sri Lanka is to study the feasibility of adopting the Japanese DTTB system using this study report as reference. The main components of this study are the two points mentioned below:

- Study on impact expected from the adoption of the Japanese system
- Study on the frequency allocation plan for DTTB

(4) Step 2: Preparation Activities

1) Finalization of the DSO-SD Frequency Allocation

As mentioned in Section 7.2.7, "Channel Planning", a detailed study on the use of frequencies by the existing analog TV broadcasting with radio wave measurement revealed existence of the multiple frequencies available in nationwide for DTTB. The study also revealed that a more number of frequencies could be usable for DTTB within each block.

2) Establishment of Sri Lanka DTTB Frequency Allocation Plan Working Group

The Government of Sri Lanka has to establish a frequency allocation plan for digital broadcasting urgently in order to eliminate the possibility of dispute over frequency usage in future. While this report presents a channel plan up to DSO-SD, it does not include the frequency allocation after DSO-HD.

The Study Team recommends that the Government of Sri Lanka should establish the DTTB Frequency Allocation Plan Working Group and prepare an allocation plan for the period including that after DSO-HD in the group immediately after the final decision has been made on the DTTB system to be adopted.

Participation of academics as neutral members, in addition to broadcasting program providers and TRC in the working group is recommended. The working group is to prepare a frequency allocation plan of Sri Lanka and submit it to the government. This process is expected to facilitate implementation of DSO-SD, ASO and even DSO-HD.

3) Support to the Establishment of the Technical Standards for the DTTB System in Sri Lanka

The bandwidth allocated to the conventional TV broadcasting is 6MHz in Japan, North America and South America. Meanwhile, the bandwidth of 8MHz is allocated in Sri Lanka, Europe and Africa. The same bandwidths are to be used in the respective regions after the transition to DTTB. Therefore, the bandwidth of the DTTB in Japan, North America and South America is 6MHz. Since most of the countries which have adopted the ISDB-T system are countries using the 6MHz bandwidth including Japan and countries in South America, serious effort has not be made for the development of TV sets for the 8MHz bandwidth ISDB-T system. Because the Government of Botswana in Southern Africa decided to adopt the ISDB-T system recently, a technical study for the production of 8MHz TV sets was conducted under the leadership of the Ministry of Internal Affairs and Communications of Japan and the Association of Radio Industries and Businesses, a Japanese organization for standardization. As a result, digital TV sets for the 8MHz bandwidth ISDB-T system manufactured by Japanese companies have begun to appear on the market.

Establishment of technical standards for the DTTB system of Sri Lanka will be required for manufacturing of digital transmitters and TV sets appropriate for the use in Sri Lanka. The establishment of the technical standards will require selection of the transmission and reception parameters appropriate for Sri Lanka. Since Article 4 of the Constitution of Sri Lanka describes both Sinhala and Tamil as official languages and English as a link language, TV sets have to have a function to display captions in the three languages, *i.e.* Sinhala, Tamil and English. Therefore, the specifications of the TV sets for the ISDB-T system should include a built-in character generator which enables display of captions in Sinhala and Tamil.

As the population of Sri Lanka is approx. 20 million, the scale of the market for TV sets is relatively small. Large-scale Japanese home appliance manufacturers may not enter such a small market. Since stable supply of TV sets for the ISDB-T system to the Sri Lankan market will be essential once the Government of Sri Lanka decides to adopt the ISDB-T system, a study on measures to ensure the stable supply should be implemented.

4) Establishment of Test Center

Once the new technical standards for the DTTB system have been established, manufacturers of receivers will begin the manufacturing of Sri Lanka Standard DTTB receivers. Then, the manufactured receivers will be supplied to the market in Sri Lanka. Those new receivers will have to be examined for the conformity to the technical standards of Sri Lanka and appropriate operation. Therefore, installation/construction of a new organization/framework is recommended for the implementation of the examination. The Test Center will be the supervisor of the examination with this new organization or framework. Academics, broadcasting program providers and the national government will have to operate the center jointly.

5) Activities for Awareness Creation and Extension of DTTB

Smooth transition to DTTB will require awareness creation and extension activities for the people, including provision of detailed and deliberate explanation and dissemination of information of DTTB. The use of mass media including newspapers, TV and radio programs and journals for creation of awareness to the transition to DTTB among the people, sales promotion activities in cooperation with associations of retailers such as home appliance dealers, public explanation meeting in areas where viewers live and free digital signal reception survey in residential areas are among the activities that the government can take as awareness creation and extension activities. In principle, since all viewers will have to purchase DTTB receivers, they will have to bear the burden of the purchase. It is important for the government to implement the activities mentioned above repeatedly in order not to make viewers oppose to the transition to DTTB.

6) Establishment of Call Center

Understanding of viewers is the most important factor in the transition to DTTB in Sri Lanka. A call center is a facility where operators respond to viewers’ inquiries and comments over the phone. During the transition to DTTB in Japan, the call center responded the inquiries from viewers free of charge. Establishment of a call center which provides response to viewers’ calls free of charge is recommended also in Sri Lanka. It is important to establish a system which can provide answers to viewers’ questions directly before DSO-SD with opening of a DTTB call center. As the call center is part of the awareness creation and extension activities mentioned above, a study will have to be conducted on how to coordinate responses to be provided at the center and overall activities in the transition to DTTB.

7) Establishment of DBNO

The Digital Broadcast Network Operator (DBNO) will be established as an operator of the DTTB Platform for the provision of DTTB services in Sri Lanka.

(i) Purpose of the establishment of the DTTB Platform

Separation of the program production function and the program transmission function that broadcasting organizations have had and complete transfer of the latter to a DTTB Platform which is independent from broadcasting organizations, will eliminate the need for broadcasting organizations to invest on new transmitting facilities. DBNO, which is responsible for the DTTB Platform operation, will be established as a public and neutral organization and will operate the DTTB Platform not only during the transitional period, but also in future.

(ii) Function of the DTTB Platform operated by DBNO

Figure 7.3-2 shows the conceptual diagram of the DTTB Platform to be operated by DBNO. DBNO will receive TV programs from individual TV program providers through links, multiplex them and transmit multiplexed programs to the transmitting stations at various locations through dedicated links. A series of work mentioned above is carried out in the NOC. The programs transmitted from NOC to each transmitting station will be broadcast to the coverage area of the transmitting station. DBNO will operate and maintain the entire system with the revenue from the operation fees collected from broadcasting stations. Since DBNO will not edit programs at NOC, the TV program providers will take all responsibility concerning program contents.

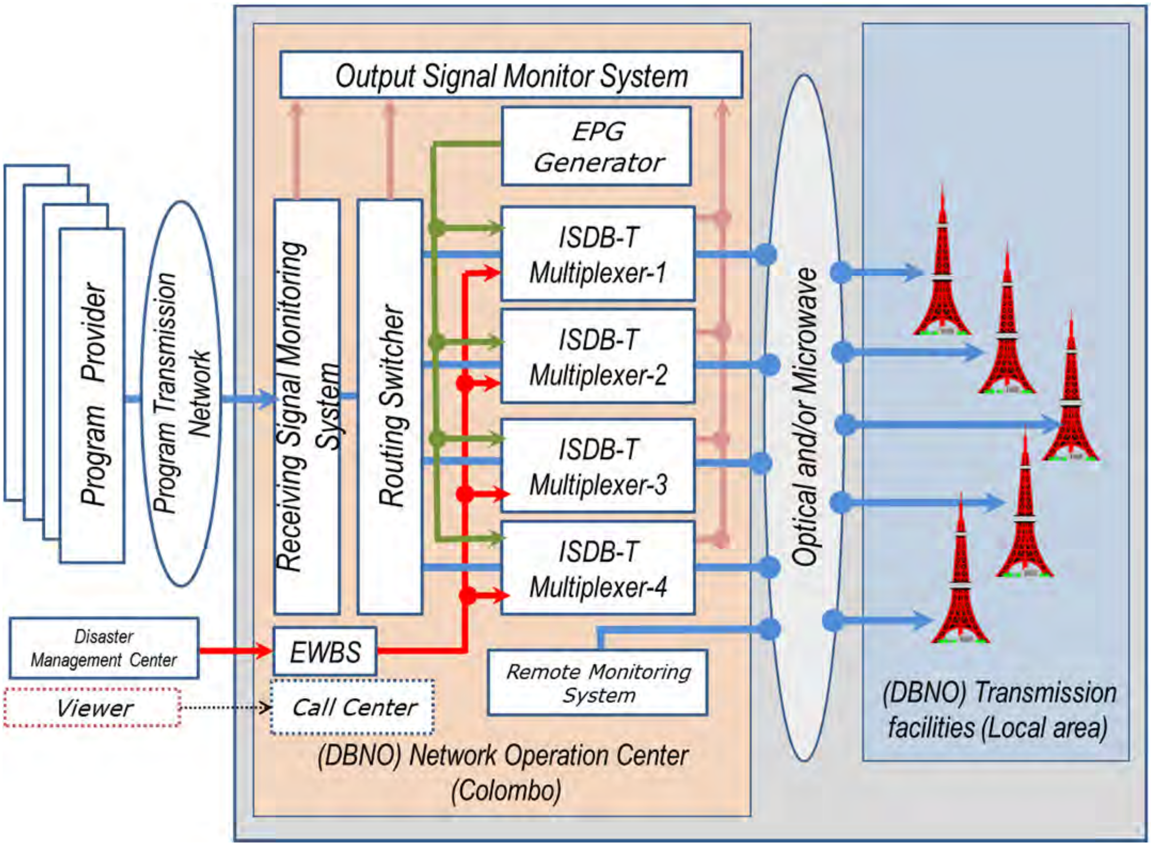


Figure 7.3-2 Conceptual Diagram of the DTTB Platform

(5) Step 3: DSO-SD

The work items and details required in Step 3, DSO-SD, are described in the following.

1) Issuance of Radio Wave Usage License

TRC will issue Radio Wave Usage and Multiplexing Licenses to newly-established DBNO promptly. DBNO will be responsible for multiplexing and transmission of broadcasting signals. Former broadcasting organizations will become broadcasting program providers. They will have to maintain their operator's licenses for production of broadcasting programs. Anyone who does not have this license will not be allowed to provide programs through DBNO to viewers. Therefore, it will be necessary to amend clauses concerning this issue in the relevant laws and ordinances of the Government of Sri Lanka currently in force.

2) Stepwise Implementation of DSO-SD

The DTTB Roadmap Report prepared with assistance from ITU recommends use of the UHF band for DTTB. In principle, the SLRC are transmitting their programs to the entire country using single radio waves in the VHF band. However, it is difficult to do the same using single UHF radio waves because the propagation distance of UHF radio waves is shorter than that of VHF waves. Therefore, division of the country into blocks, as mentioned in Section 7.2, "Channel Planning", and construction of transmitting stations in each block will be required for the transmission of digital TV programs in the UHF band to the entire country. The use of this block system will also bring some advantages. Table 7.3-1 shows the advantages of the block system over the single transmission system revealed in the comparison of the two systems.

Table 7.3-1 Comparison between the Work Coordination for the National Coverage by the Single Transmission System and That by the Block System

	Single transmission system	Block system
Procurement of human resource and equipment	Establishment of the system requires procurement of a large quantity of resources worth a large amount of money in bulk. It is difficult to carry out such procurement	Since resources can be procured in a stepwise fashion for the establishment of a block system, procurement can be carried out easily.
Chanel planning	It is difficult to make precise adjustment for interference avoidance, because complex interference calculation is required for the avoidance.	Since interference calculation is carried out by block, adjustment for interference avoidance can be made relatively easily.
Coordination of progress of work	Delay in the work at a transmitting station has national impact.	Since equipment can be installed at transmitting stations in a stepwise fashion, it is possible to prevent delay in the work at a station affecting the work elsewhere.

Source: JICA Study Team

The planned broadcasting coverage area will be divided into blocks and the blocks will be prioritized. The digital broadcasting will commence in a stepwise fashion in accordance with the priority ranks of the blocks. DSO-SD will commence in the five separate times mentioned below to enable completion of DSO-SD in a short period of time. It will be most efficient to give the highest priority to the Greater Colombo. Then, as required by the composition of the DTTB Platform network, DSO-SD will be carried out serially from main stations. The Government of Sri Lanka plans to implement DSO-SD in the Greater Colombo in the first half of 2016.

The transmitting stations are listed in accordance with the stages in which DSO-SD is to be implemented in the following.

(i) First stage (scheduled for June of 2016)

(a) Greater Colombo Area

The construction of the Lotus Tower is in an advanced stage. The construction is expected to be completed in the first half of 2015. It will be possible to begin DSO-SD, with 1kW transmitters in the beginning, in June of 2016. The 1kW transmitters will eventually be replaced by 5kW transmitters by the third quarter of 2016.

(ii) Second stage (DSO-SD to begin in the third quarter of 2017)

(a) Kokavil (Northern Area)

(b) Yatiyantota (Greater Colombo Area)
(c) Jaffna (Northern Area)

(iii) Third stage (DSO-SD to begin in the end of 2017)
(a) Pidurutalagala (Central Mountain Area)
(b) Hunnasgiriya (Central Area)
(c) Nayabedda (Southeastern Area)

(iv) Fourth stage (DSO-SD to begin in the first quarter of 2018)
(a) Karagahatenna (Central Area)
(b) Gongala (Southern Area)
(c) Trincomalee (Northern Area)
(d) Vavuniya (Central Area)

(v) Fifth stage (DSO-SD to begin in the second quarter of 2018)
(a) Suriyakanda (Southern Area)
(b) Elpitiya (Southwestern Area)
(c) Deniyaya (Southeastern Area)
(d) Primrose (Central Mountain Area)
(e) Hanthana (Central Mountain Area)

3) DSO-SD Test Broadcasting

When the frequency usage license and multiplexing license for DSO-SD have been approved, the start date of the test broadcasting will be set. The test broadcasting is preparation for the launch of official broadcasting. For a period between two to three months and half a year before the official start of a broadcasting service, test patterns of images such as color bars are transmitted on the frequency designated in the license and used for adjustment of transmitting equipment. At a recent period of official service start, the test broadcasting similar to actual programs will be carried out.

Table 7.3-2 shows the procedures of test broadcasting.

Table 7.3-2 Test Broadcasting Procedures

	Activity	Measured to be taken
1	Test broadcasting license (including multiplexing license)	Application for the license
2	Radio wave emission	To begin with small power and then increase the power gradually
3	Avoidance of interference to the existing analog broadcasting stations	To always monitor analog TV programs and stop transmission when interference is observed.
4	Radio wave measurement	Compliance with the laws and ordinances concerning radio waves to be confirmed with the measurement

4) Start of DSO-SD

When all problems have been solved while test broadcasting is being conducted, the official broadcasting will begin. DSO-SD limited in the Greater Colombo will be launched first. After successful implementation of DSO-SD in the Greater Colombo has been confirmed, implementation of DSO-SD will be extended to other areas in a stepwise fashion. DSO-SD in areas other than the Greater Colombo will be implemented in such a way that it will have no influence on DTTB or analog broadcasting in the Greater Colombo where DSO-SO has already been implemented. Although the DTTB Frequency Allocation Plan Working Group has prepared a frequency allocation plan which would not cause interference, it will be necessary to thoroughly examine whether the radio wave transmitted in DSO-SD does not interfere with the existing broadcasting services or not when the radio wave is transmitted at the first time of DSO-SD stage. Close coordination between DBNO and relevant authorities will be required for the implementation of DSO-SD.

(6) Step 4: ASO

The nationwide extension of DSO-SD in Step 3 will enable viewing of DTTB programs everywhere in Sri Lanka and implementation of the next step, step of implementation of ASO.

Since ASO is a process in which the analog broadcasting services which have long been enjoyed by viewers will be terminated, it will have significant impact on viewers. Activities for awareness creation and extension of DTTB mentioned in the preparatory activities in the Step 2 will play an extremely important role in alleviating the influence on viewers. The success of the alleviation will depend on the extent of spread of the activities in the period up to Step 4.

1) Conditions for the Implementation of ASO

Output of the activities for awareness creation and extension of DTTB can be measured with the proportion of households with digital receivers. Implementation of ASO where many viewers have not replaced their old sets with DTTB receivers will results in many viewers unable to watch TV programs. Meanwhile if achievement of the proportion to households with DTTB receivers of 100% is the condition for the implementation of ASO, the progress of the transition to the high-definition program production at broadcasting stations will become slow and the progress of overall process of the transition to DTTB will become far behind the schedule. Therefore, it will be necessary to establish conditions for the implementation of ASO and make it a rule to implement ASO when those conditions have been met. When it is expected that a certain number of people will not be able to watch TV programs temporarily, measures to minimize social impact of the situation with combination of assistance from different political points of view will have to be taken. Implementation of these measures will prevent extreme delay in the progress of the transition to DTTB.

In this project, it has been decided to use the proportion of households with digital receivers and population coverage as the conditions for the smooth implementation of ASO.

The proportions of households with TV sets, people in poverty and electrified households were used to divide the target area into three and different conditions for the implementation of ASO have been established for each of the three.

In order to take advantage of the experience of taking various measures before ASO in Japan and other countries, a period of five years is allocated up to the implementation of ASO in the schedule.

<Conditions for the implementation of ASO>

- The Greater Colombo : Proportion of households with digital TV sets 60%
  : Population Coverage 85%
- All the areas excluding the Greater Colombo, Northern and Eastern Areas
  : Proportion of households with digital TV sets 50%
  : Population Coverage 70%
- Northern and Eastern Areas
  : Proportion of households with digital TV sets 40%
  : Population Coverage 70%

2) Announcement of ASO Implementation Date in Mass Media

The date of the implementation of ASO will be announced to viewers. The announcement will be part of the awareness creation and extension activities. It is important to inform viewers of the date in advance using various mass media.

3) Implementation of ASO

ASO will be implemented on the announced ASO implementation date.

4) Cancellation of Analog Licenses

The analog broadcasting will be terminated. The analog licenses owned by broadcasting stations will be annulled.

(7) Step 5: Starting of DSO-HD

1) Acceptance of Application for Digital License

Application for the DSO-HD licenses will be received after the implementation of ASO. The expected components of the DSO-HD license are license for radio wave transmission on frequencies for HD transmission and multiplexing license to be issued to DBNO and the HD Broadcasting Program Provider License acquired by broadcasting stations after the implementation of ASO.

2) **Issuance of DSO-HD Transmission License**

The DTTB Frequency Allocation Plan Working Group is preparing the DTTB HD TV Broadcasting Frequency Usage Plan. Broadcasting frequencies will be allocated for the DSO-HD in accordance with the plan. Immediately after the completion of ASO, the DSO-HD license will be issued in order to facilitate the transition to DSO-HD.

3) **Starting of DSO-HD Transmission**

When construction of the DSO-HD transmitting facilities is completed, digital broadcasting will be started promptly.

(8) Step 6: Digital (SD) Switch-Off

After the transition of all DSO-SD programs to DSO-HD have been confirmed, transmission of SD broadcasting signals will be terminated. Although this process does not have the same impact as ASO, it will be necessary to inform the people of the termination in advance.

1) **Termination of DSO-SD Transmission**

The SD service will be terminated on the date which has been announced to viewers. Since the SD transmitters operated by DBNO can be used for the transmission of DSO-HD without making adjustment, programs to be transmitted from the said transmitters will be selected before the date of SD termination. After the programs to be transmitted from the SD transmitters have been selected, use of the transmitters will be resumed as DSO-HD transmitters.

2) **Nullification of License**

All licenses concerning SD will be nullified.

7.4 Equipment Plan

7.4.1 Outline of the Entire DTTB System

As shown in Figure 7.3-2, “Conceptual Diagram of the DTTB Platform”, programs produced by program providers, will be transmitted to DBNO and multiplexed on four channels of ISDB-T broadcasting signals. The four channels of broadcasting signal will be transmitted throughout the country through optical fiber links, microwave links and with UHF broadcasting signals. Each transmitting station transmits UHF broadcasting signals with predetermined transmission power to each household after receiving these signals. Figure 7.4-1 shows a conceptual diagram of the entire DTTB system including the equipment for the digital TV center, which is in the scope of work of this project.

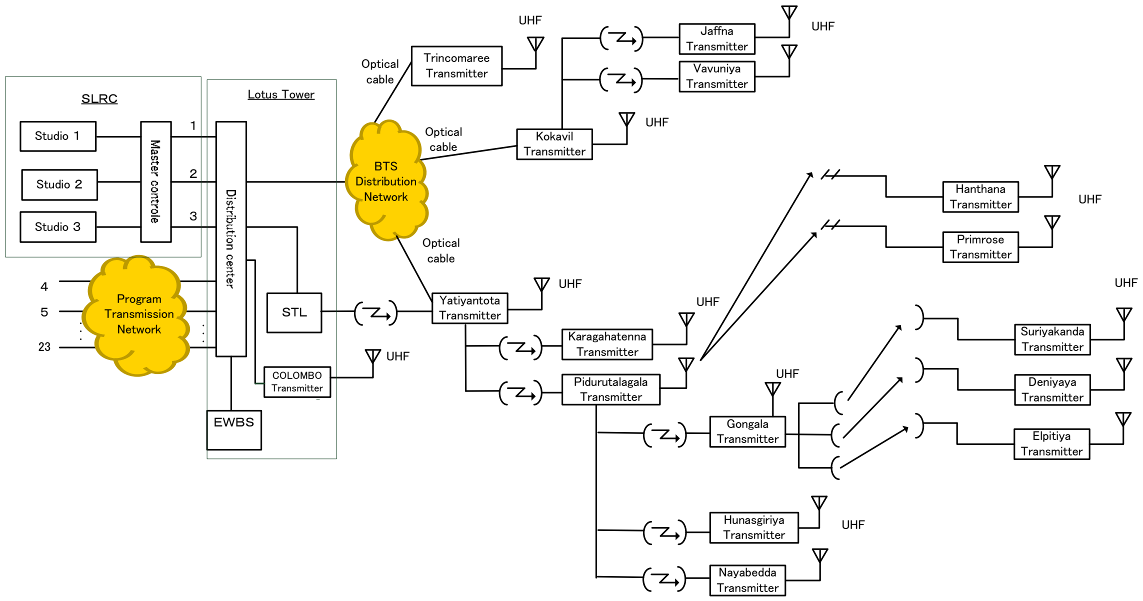


Figure 7.4-1 Conceptual Diagram of the Entire DTTB System

7.4.2 Transmitting Equipment System

Distribution of broadcasting programs to households in the entire territory of Sri Lanka will require a broadcasting signal relay network (Figure 7.4-1) and construction of such a broadcast network will require transmission links and transmitters to emit radio waves everywhere in the country. There are three major type of transmission links; one using optical fiber communication network and the other using microwaves and broadcast signals. The system using broadcast signals is called broadcast-wave relay. At a transmitting station, signals received through those transmission links are processed, amplified and transmitted as broadcasting signals in the UHF band from transmitting antennas to households in the coverage area. There are two types of transmitters: main transmitters which serve the metropolitan area and wide coverage areas which fill local gaps within the coverage areas of the main transmitters and gap-filler. Table 7.4-1 shows the names of all the transmitting stations, types of transmitters to be installed, transmission outputs and types of program reception/transmission links to the stations.

Table 7.4-1 List of Transmitting Stations

No.	Type of transmitting station	Station	Transmission Output (kW)	Type of the program distribution link
1	Main transmitting station	Jaffna	0.5	Microwave link
2		Kokavil	3	Optical fiber link
3		Colombo	5	-
4		Yatiyantota	2	Optical fiber and microwave links
5		Pidurutalagala	0.3	Microwave link
6		Nayabedda	3	Microwave link
7		Gongala	1	Microwave link
8		Karagahatenna	3	Microwave link

No.	Type of transmitting station	Station	Transmission Output (kW)	Type of the program distribution link
9		Hunnasgiriya	1	Microwave link
10		Vavuniya	1	Microwave link
11		Trincomalee	1	Optical fiber link
12		Elpitiya	0.3	Microwave link
13		Suriyakanda	1	Microwave link
14	Gap-filler station	Hanthana	0.01	UHF broadcasting radio wave link
15		Primrose	0.01	UHF broadcasting radio wave link
16		Deniyaya	0.01	Microwave link

Source: JICA Study Team

While an optical fiber link is suitable for long-distance transmission, it cannot be used in mountainous areas and other areas where optical fiber cables have not been installed because of the difficulty in the installation. While a microwave link can be established with relative ease in case that the propagation is line-of -sight, it is not suitable for long-distance transmission. While a link with a UHF broadcasting radio wave is the simplest way, it also has limitations in case of long distance transmission and the case that a propagation path is not line-of –sight, like a microwave link. If the same frequency is used as both reception and transmission frequencies, or so-called SFN network, the interference between receiving signal and transmitted signal will generate oscillation. To prevent this oscillation, an echo canceller, etc. will have to be taken. “Type of the reception/transmission link”, in Table 7.4-1shows the most fittable solution which is selected by investigating these conditions

(1) Main Specifications

The main specifications which are common for all transmitter systems are as follows:

Input signals:	Optical fiber or microwave signals or UHF broadcasting waves
Output Signals:	4 channels in UHF bandwidth
Output Power:	Specified output power (Refer to Table 7.4-1)
Primary Power Input:	AC 3 phase 400V or single phase 200V
Electrical Characteristics:	To comply with ISDB-T standard
Mechanical Characteristics:	To be separately specified
Remote monitoring:	Output monitoring/control signals from each transmitter will be transmitted through the Internet link to the PC designated for remote monitoring in the Monitoring Room of DBNO.

The transmitter systems are classified in two types by the type of the reception link. In one of them, signals transmitted through an optical fiber or microwave link are received by the network gateway. In the other, signals transmitted on a broadcasting radio wave from a pre-stage transmitting station are received. A type of system appropriate for each station site will have to be selected on the basis of a study on site conditions, radio propagation environment and conditions of infrastructure including optical fiber cable network.

Figures 7.4-2, -3 and -4 show the transmission system diagrams for the three types of signal input links, respectively.

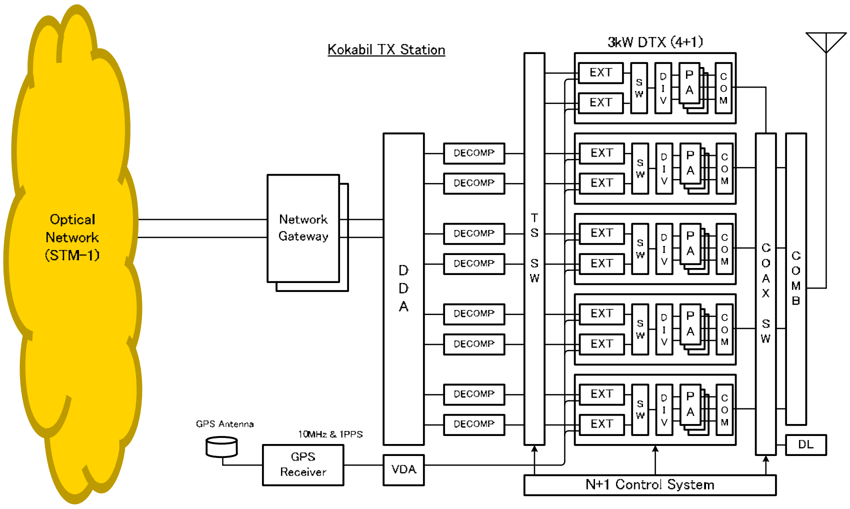


Figure 7.4-2 Transmission System (optical fiber link-type)

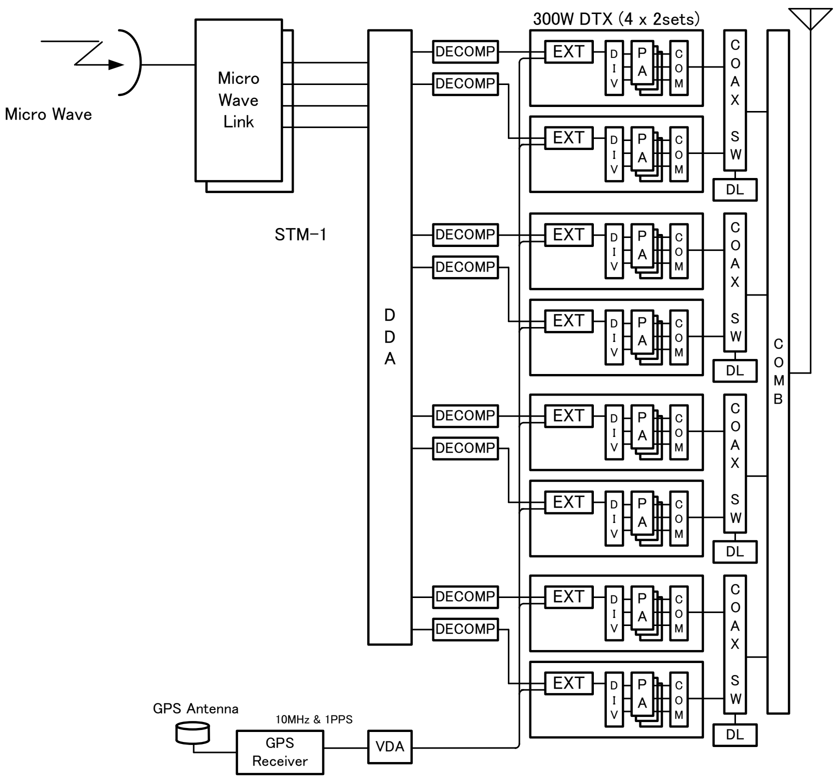


Figure 7.4-3 Transmitter System (signal reception through microwave link)

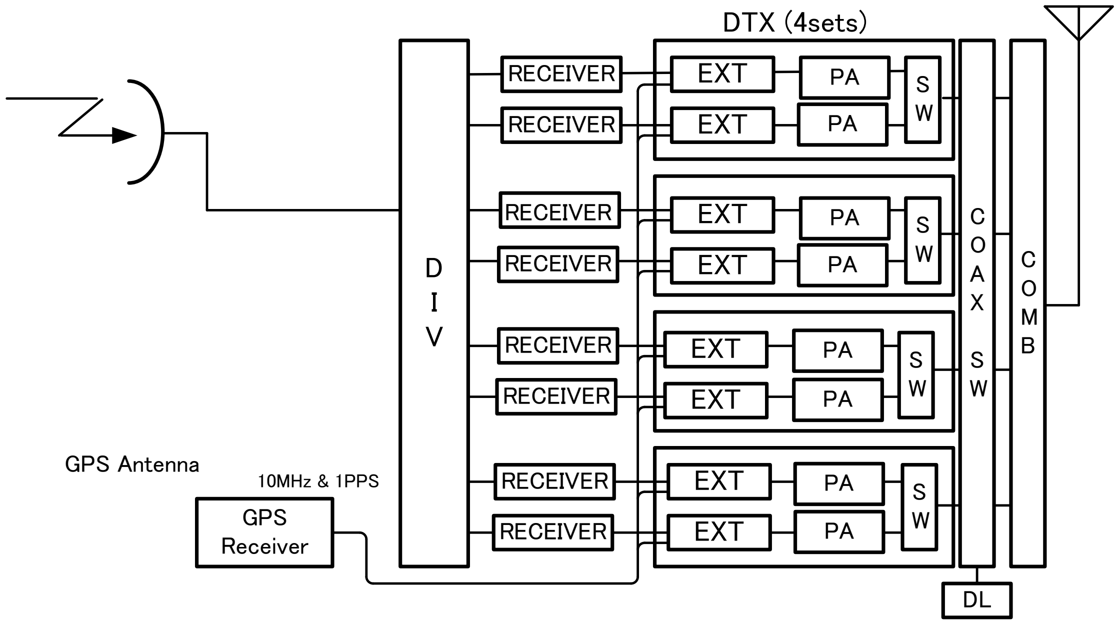


Figure 7.4-4 Transmitter System (signal reception on a UHF radio wave)

(2) Redundancy in the Transmission Systems

The DTTB Platform is required to be a high reliable system because of the characteristics that the DTTB Platform should have. The stability of the system includes capacity to continue broadcasting even if a piece of equipment has broken down. Such a capacity can be ensured with system redundancy. However, a redundant system has its own disadvantages, *e.g.* complication of a system and the increase in system maintenance cost. As the system maintenance cost is a major factor in deciding the DTTB Platform user fees levied on broadcasting program providers, development of a cost-efficient and highly-stable system is recommended.

In order to develop such a system, it has been decided to design a transmitter of each of the transmitting stations composing a network covering the entire country with a degree of redundancy appropriate for its importance in the network as mentioned in the section of design policy.

At first, examples of widely-used backup systems are described in the following:

1) System with Parallel PAs with Duplicate Exciters (front sides)

A system of this type has completely-duplicated front side between the part receiving signals from an optical fiber or microwave link and the input terminals of power amplifiers (PAs), or exciters, and parallel-combined multiple PA units (See Figure 7.4-5). The economic advantage of using a set of PAs, which account for a significant proportion of the cost, instead of two sets as in the complete redundancy system mentioned below, of this system is significant. However, when the number of parallel combined PAs is small, each PA unit has to generate large output. (When a 100W output is to be generated by a system with two parallel PA units, one unit has to generate a 50W output. When the same output is to be generated with a system with four PA units, each unit has to generate only a 25W output.) Although a system with a small number of PAs costs less in installation and maintenance than a system with a large number of PAs, it has disadvantage that the decrease in output is large when one of PA units has broken down. (If one PA unit has broken down in a system generating a 100W output with two PAs, the output will be reduced to 50W, while, if one PA units has broken down in a system generating a 100W output with four PAs, output of 75W can be maintained.) Therefore, when this type of system is to be used, a deliberate study will have to be conducted on the number of parallel-combined PA units.

A measure to make loss of output at the time of breakdown of a PA unit in a PA system small by reducing output per PA units and increasing its quantity is taken for a transmitter with a relatively small rated output.

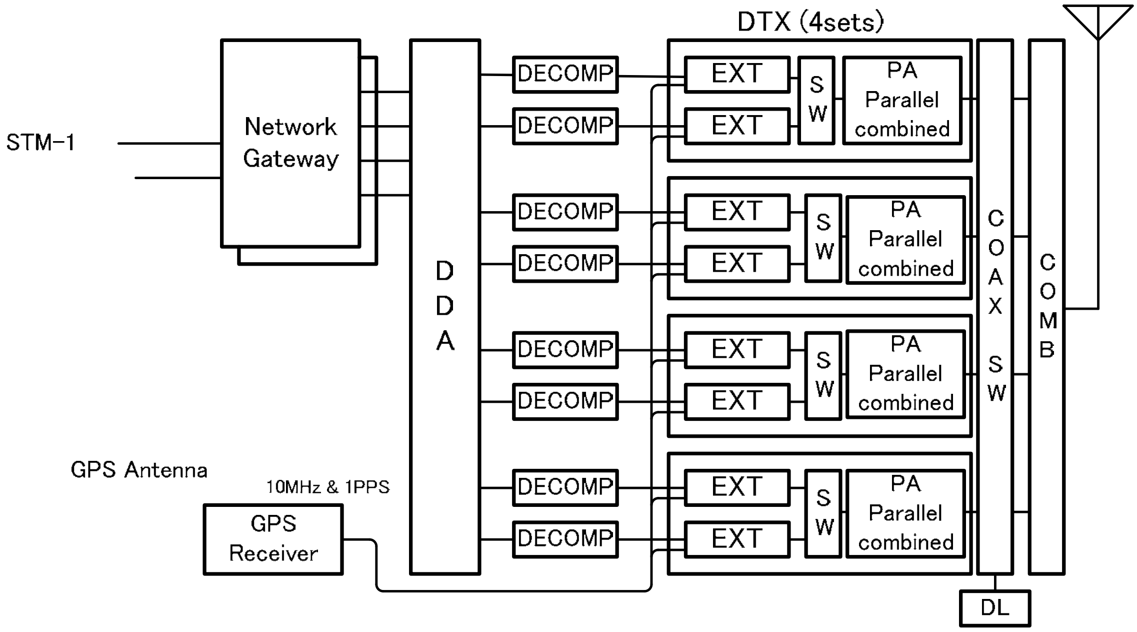


Figure 7.4-5 Diagram of the System with Parallel PAs with Duplicate Exciters (front sides)

2) Complete Redundancy System

This system literally has duplicated sets of equipment from the input terminal to the output terminal. It is the best in terms of redundancy. However, if it is to be used in a high-power transmitter, requirement of two sets of PAs which are expensive and require a large installation space makes its use very expensive. For the installation of transmitters for transmission of four channels as is the case with this DTTB Platform, in particular, a fairly large station building will be required.

Meanwhile, most of low-power gap-filler transmitters with an output of 10W or less have built-in PA units in their exciter units. Therefore, duplication of such exciters inevitably result in a complete redundancy system.

3) N (= the number of transmitters) +1 system

This is a useful backup system where a large number of high-power transmitters are to be installed. (N for the DTTB Platform in this report is 4.) In this system, in addition to transmitters required for transmitting radio waves required for broadcasting programs, an additional unit of transmitters identical to the others is installed as a backup unit. When PA or both of the two exciters of one of the transmitters have broken down, the affected signal will be automatically diverted from the broken-down transmitter to the backup transmitter.

In a rare case of simultaneous breakdown of two or more units of transmitters, only one of them will be replaced by the backup unit and the rest of the broken-down units will be operated at reduced outputs.

(3) Transmitter Backup Systems for each Transmitting Station

Table 7.4-2 shows the backup system to be installed in each transmitting station.

In response to a strong demand for system reliability, the N + 1 system will be used in stations requiring installation of expensive transmitter systems. If a station has a large population coverage and a function to relay signals to multiple transmitting stations (slave stations) as a (“Hub”) relay station, the station concerned is considered as a station for which high reliability is strongly demanded. The complete duplication system will be adopted for the transmitting stations which have sufficient space to install equipment. The same system will be used in low-power transmitting station with no slave station. The parallel PAs with duplicate exciters system will be used in medium-output transmitting station with no slave station.

Provision of a spare unit for replacement to the local transmitting station buildings is recommended.

Table 7.4-2 Backup System for Each Transmitting Station

Station	Characteristics of the station	Backup system	Remarks
Colombo Kokavil	High-power base stations with slave stations and large population coverage	N + 1 system	If a PA unit breaks down while a spare transmitter is being operated, the output of the system will reduced.
Karagahatenna Nayabedda	High-power stations with wide coverage areas Large population coverage No slave station		
Gongala	High-power station with many slave stations		
Pidurutalagala	Medium-power station with many slave stations	Complete redundancy system	If the system output is less than 1kW, low cost system operation and space saving can be achieved even with installation of duplicate PAs.

Station	Characteristics of the station	Backup system	Remarks
Jaffna Vavuniya Trincomalee Hunnasgiriya Yatiyantota Suriyakanda Elpitiya	No slave station	System with Parallel PAs with duplicate exciters	A slave station in Yatiyantota will receive signals through microwave link.
Hanthana Primrose Deniyaya	Low-power station	Complete redundancy system	

Source: JICA Study Team

7.4.3 Antenna System

(1) Design Policy

The existing antenna configuration (*i.e.* assembly of structural forms created with combination of antenna elements to achieve an intended antenna pattern) of the VHF transmitting antennas for the analog transmission has enabled creation of the wide coverage area of the analog TV broadcasting. Meanwhile, establishment of the antenna configuration for the UHF digital broadcasting to be established requires optimal designs of antenna directivity for the creation of an optimal coverage area for each transmitting station for the minimization of the co-channel interference between stations in areas where the SFN broadcasting is carried out and for the prevention of interference caused by existence of different signals on the same frequency in the same area.

A broadband antenna system for the four-channel broadcasting in the UHF Band after the launch of DTTB (broadcasting of multiplexed 23 SD programs on four frequencies) and the eight-channel HD broadcasting after ASO and DSO-HD (broadcasting of multiplexed 23 HD programs on eight frequencies – in this basic design, multiplexing of three HD programs on a single frequency is assumed as mentioned in the design policy) will have to be designed for this project. It is desirable to have small deviation in reception field strength between channels in the coverage area created by a multi frequency antenna system which radiates radio waves on multiple frequencies from a single transmitting antenna. It is important to select an antenna with small deviation in directivity in a wide band range. Therefore, a 4L stacked loop antenna which is widely used in Japan will be adopted as the basic antenna.

Use of products which allow inspection and maintenance of component parts which composes a transmitting antenna system including an antenna is recommended for their long-term use. In this aspect, use of 4L stacked loop antennas is recommended because they have been used in Japan stably for a long period of time with regular basis internal inspection and repainting.

The antenna and main feeder system will be configured with the high power rating antenna system and enough size feeder cables appropriate for the extended eight-channel operation in future. Coaxial switches to be installed in the station buildings will be composed of enough size coaxial cable which enable the eight-channel operation.

(2) Features of 4L Stacked Loop Antenna

The features of 4L stacked loop antenna to be adopted in the transmitting antenna system are as follows:

(i) 4 loop antenna has four stacked loop elements (a type of directional antenna with vertical arrayed elements), and gain is high.

(ii) Deviation of the radiation pattern of antenna unit and the composed some antenna units are small in the frequency range between 548MHz and 770MHz.

(iii) Deviation of the gain is small in the above-mentioned frequency band.

(iv) Because of its small deviation of radiation pattern and gain, the use of this type antennas in multiple channels use makes it possible have an identical coverage area

(v) Because an antenna cover is easily removable, the maintenance of the inside part of cover is easy.

(vi) The wind pressure area is small; therefore, it is possible to reduce the wind load of an antenna mounting post and tower.

(3) Decision on Antenna radiation pattern

In a broadcasting system using the UHF band, the interference between transmitter stations has to be minimized, even for DTTB which will use UHF band. To satisfy this request, Simulation on the synthetic horizontal and vertical directivity with simulation software was conducted repeatedly with different conditions, such as, number of faces, directions and tilt angles of antenna panels and finally most appropriate condition was identified.

The channel planning began with the policy of using existing towers of broadcasting stations. In many cases, new transmitting facilities will be installed near existing transmitting sites which are located in mountain area. As a result, the transmitting signals are emitted from mountains to low land. In these cases, some interferences between transmitter stations caused by long distance propagation from higher point to lower point may be estimated Therefore, simulation on the directivity of antennas installed at transmitting stations in the mountains aiming at reduction of interference was conducted repeatedly with different sets of conditions, including direction, tilt angle and power, of individual stations and the set of conditions which gave the best result was identified.

(4) Decision on the Main Feeder Line System

The sizes of coaxial feeder cables were selected on the basis of the power capacity required for the transmission of eight signals in the future eight frequency antenna system.

Table 7.4-3 shows sizes of coaxial feeder cables appropriate for transmitters of different outputs.

Table 7.4-3 Transmitter Outputs and Sizes of Coaxial Feeder Cables

Transmitter output	Size of coaxial feeder cable
At or below 0.5kW (0.5kWx8=4kW)	1-5/8”
1kW (1kWx8=8kW)	3”
2kW (2kWx8=16kW)	3-1/8”
3kW (3kWx8=24kW)	4-1/8” (3”x2) Note*)
5kW (5kWx8=40kW)	5”

Note*) Because of the difficulty in transporting 4-1/8” feeder cables in the mountains due to their large size, the power will be distributed through two lines of 3” feeder cables.
Source: JICA Study Team

(5) Decision on Survival Wind Speed

Because the design wind speed for antenna towers for broadcasting antennas have not been defined clearly in Sri Lanka and the highest recorded maximum instantaneous wind speed in Sri Lanka is 206 km/h (≈ 57.2 m/sec) recorded at the time of a cyclone attack, the survival wind speed of 60 m/sec used by Japanese broadcasting organizations will be used as the design standard. The deflection angle (an angle of the change in direction of an antenna caused by wind) of a transmitting antenna installed on a tower at the wind speed of 30 m/sec should be less than 0.5 degree, in order not to cause fluctuation of field strength in the coverage area.

(6) Tasks in Future

Table 7.4-4 shows the tasks to be addressed in future at each transmitting station. It is necessary to confirm or complete them before the detailed design. Table 7.4-5 shows whether each transmitting station uses existing tower, station or not.

Table 7.4-4 Future Tasks

Transmitting stations	Task	Deadline
Jaffna	Study and identification of the construction site of a tower and a station building	Before the development of employer's requirement
Vavuniya	Study and identification of the construction site of a tower and a station building	Before the development of employer's requirement
Trincomalee	Surveying and identification of the candidate construction site of a tower and a station building Lease agreement with the landowner	Before the development of employer's requirement
Karagahatenna	Confirmation with strength calculation; Surveying and identification of the candidate construction site of a station building	Before the development of employer's requirement

Hunnasgiriya	Identification of the construction site of a station building within the premises	Before the development of employer's requirement
Yatiyantota	Surveying and identification of the candidate construction site of a tower and a station building	Before the development of employer's requirement
Nayabedda	Surveying and identification of the candidate construction site of a tower and a station building	Before the development of employer's requirement
Pidurutalagala	Surveying and identification of the candidate construction site of a tower and a station building; A study on Candelabra Effect	Before the development of employer's requirement
Gongala	Study and identification of the construction site of a tower and a station building	Before the development of employer's requirement
Suriyakanda	Surveying and identification of the candidate construction site of a tower and a station building	Before the development of employer's requirement
Elpitiya	Study and identification of the construction site of a tower and a station building	Before the development of employer's requirement
Colombo	On-site verification of the details of the change in the design of the antenna mounting part of the Lotus Tower change	Before the development of employer's requirement

Source: JICA Study Team

Table 7.4-5 Existing Tower and Station Use List

No.	Site	Transmitting station	Owner of existing facility	Tower construction	Station construction	Land expropriation	Remarks
1	Jaffna	Use existing tower	SLT	○	○	×	Expropriation of land will be necessary if a future survey shows SLT land cannot be used.
2	Kokavil	Share existing tower	TRC	×	△	×	Laying of antenna feed lines needs to be considered Installation of micro transmitting and receiving antenna needs to be considered Interior ducts, ladders, walls etc., need repair.
3	Vavuniya	Use existing tower	TRC	○	○	×	Expropriation of land will be necessary if a future survey shows TRC land cannot be used
4	Trincomalee	New construction	—	○	○	○	Requires the expropriation of temple land
5	Colombo (Lotus Tower)	(New construction)	—	—	—	—	Under construction (another project)
6	Yatiyantota	Use existing tower	ITN	○	○	×	-

No.	Site	Transmitting station	Owner of existing facility	Tower construction	Station construction	Land expropriation	Remarks
7	Elpitiya	New construction	—	○	○	○	Requires the expropriation of estate-managed land
8	Suriyakanda	New construction	—	○	○	○	Requires the expropriation of nationally owned land
9	Deniyaya	Share existing tower	SLRC	×	×	×	Installation of micro transmitting and receiving antenna needs to be considered
10	Gongala	New construction	—	○	○	○	Requires the expropriation of Meteorological Agency land
11	Primrose	Share existing tower	SLRC	×	×	×	Requires separate consideration of reception point
12	Karagahatenna	Use existing tower	ITN	△	○	×	Requires construction of pillars for antenna installation. If calculation of tower strength shows the use of the existing tower to be impossible, it will be necessary to build on the neighboring nationally owned land; for this reason the cost of building a new tower is included in the estimate.
13	Hunnasgiriya	Use existing tower	ITN	×	○	×	Antenna needs to be replaced with a dual-purpose digital / analog antenna. If the antenna installation pillars are corroded, they will need to be replaced.
14	Pidurutalagala	Use existing tower	SLRC	○	○	×	The station will be built inside the tower because there isn't enough space in the grounds
15	Nayabedda	New construction	—	○	○	○	Requires expropriation of neighboring plantation land
16	Hantana	Share existing tower	SLRC	×	×	×	Requires separate consideration of reception point
Number of newly-built transmitting stations / Number of new constructions / Number of land expropriations		5		9*	11	5	
Number of repaired sites		-		1	1	—	

○: Requires new construction / requires expropriation of land
△: Requires partial repair
×: No new construction required / No expropriation of land required
*: Cost of the construction of 10 towers is included in the estimate.
Source: JICA Study Team

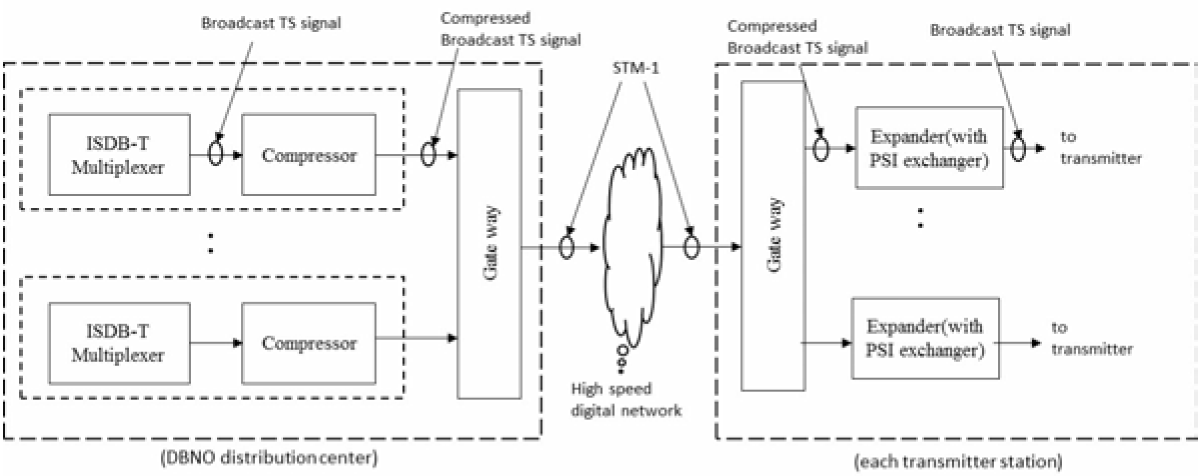
7.4.4 Transmission Link System

(1) Basic Configuration of Transmission Link System

At the DBNO NOC, broadcast programs collected from each program provider are multiplexed into groups of six programs and sent to each transmitting station via high-speed digital link as a broadcasting TS signal. For distribution of the TS signal, as described in Section 7.2.6, in order to maintain consistency with the high-speed digital hierarchy, a system was adopted whereby four Broadcast TS signals are multiplexed for transmission via a single high-speed digital link (STM-1). The signal transmitted by this system should be called a compressed Broadcast TS signal.

The transmitting station, on the other hand, separates the multiplexed compressed Broadcast TS signal into the individual Broadcast TS signals, which it then relays to the transmitters of each channel.

The basic configuration of the transmission link system is shown in Figure 7.4-6.



Source: JICA Study Team

Figure 7.4-6 Conceptual Diagram of Transmission Link System

(2) Equipment Configuration of Transmission Link System

The DTTB transmission link system has the link configuration shown in Table 7.4-6 below.

Table 7.4-6 Configuration of Transmission Network

Link number	Transmission point	Reception point	Type of link used (Note 1)	Last-mile configuration
1	Colombo (Lotus Tower)	Kokavil	Optical fiber (with backup)	Optical fiber/ Microwave
2	Colombo (Lotus Tower)	Trincomalee	Optical fiber (with backup)	Optical fiber/ Microwave
3	Kokavil	Jaffna	Microwave STL/TTL with diversity reception	
4	Kokavil	Vavuniya	Microwave STL/TTL with diversity reception	

Link number	Transmission point	Reception point	Type of link used (Note 1)	Last-mile configuration
5	Colombo (Lotus Tower)	Yatiyantota	Microwave STL/TTL with diversity reception / Optical fiber (with backup)	Optical fiber is used as backup
6	Yatiyantota	Pidurutalagala	Microwave STL/TTL with diversity reception	
7	Yatiyantota	Karagahatenna	Microwave STL/TTL with diversity reception	
8	Pidurutalagala	Hunnasgiriya	Microwave STL/TTL with diversity reception	
9	Pidurutalagala	Gongala	Microwave STL/TTL with diversity reception	
10	Pidurutalagala	Nayabedda	Microwave STL/TTL without diversity reception	
11	Pidurutalagala	Primrose	Broadcast-wave relay	
12	Pidurutalagala	Hanthana	Broadcast-wave relay	
13	Gongala	Elpitiya	Microwave STL/TTL with diversity reception	
14	Gongala	Suriyakanda	Microwave STL/TTL without diversity reception	
15	Gongala	Deniyaya	Microwave STL/TTL without diversity reception	

Source: JICA Study Team

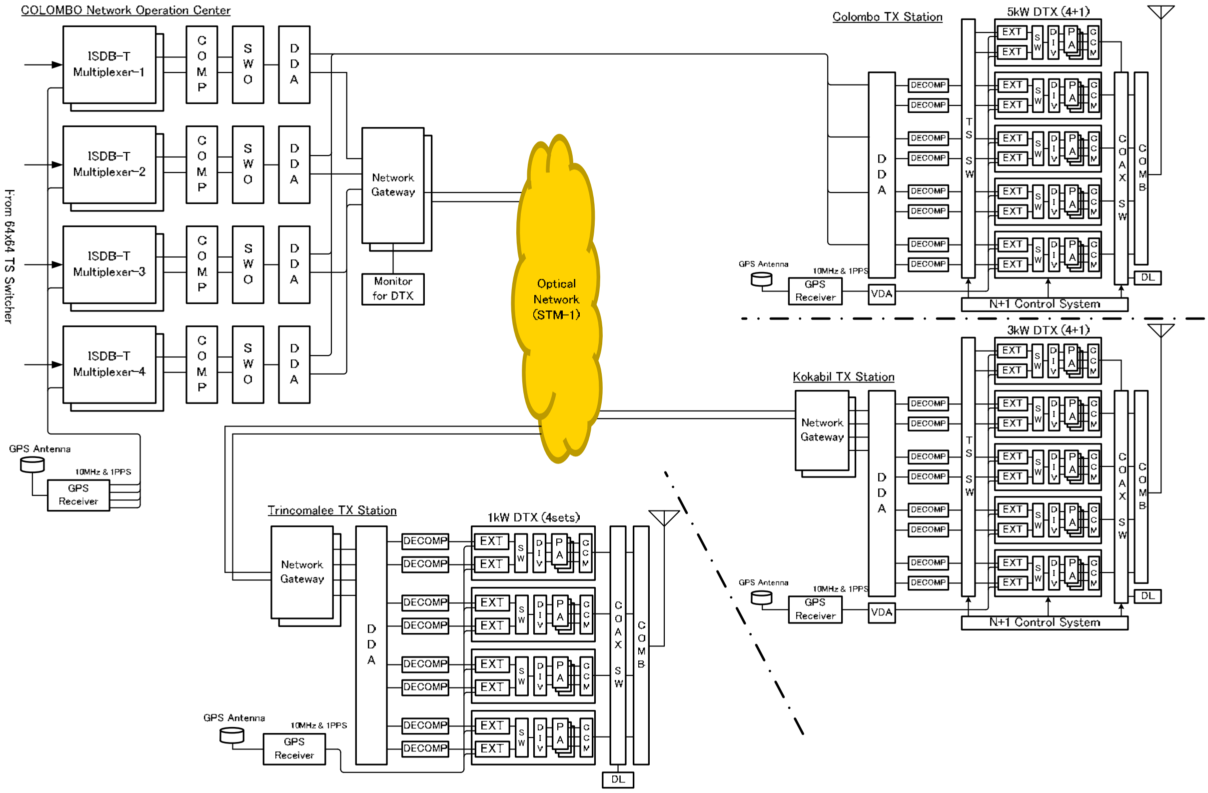
A description of the equipment and operating system for each type of link is given below.

The equipment comprising the transmission link system is installed in the DBNO NOC (described below, in Section 7.4.5) and in each individual transmitting station (described above, in Section 7.4.2) and a description of each is given in the relevant equipment configuration table. Therefore, a description of the equipment configuration of the transmission system is not given in this section.

1) Optical Fiber

A last-mile link is added to the backbone optical fiber link of the SLT (with backup). If it is difficult for an optical fiber link to be laid as an alternative for the last mile backup link, a short-distance microwave link is prepared as a backup. For the link between Colombo and Yatiyantota, an optical link was prepared as a backup to the microwave link. Since this link is a backup, the last mile is not duplexed. However, as this link is an important link that all links pass through, a separate backup of the macro link should be provided.

The transmission system that uses an optical network is shown in Figure 7.4-7.



Source: JICA Study Team

Figure 7.4-7 Sample Transmission System Using Optical Network

With respect to the output of the ISDB-T multiplexers installed in the DBNO NOC to be built within Lotus Tower in Colombo shown in the left of the figure, as the output from the four program channels will be transmitted over one STM-1[6] link, after the bit rate has been reduced through the deletion at the compressor[7] of dummy packet signals, which are added to transmission data to adjust the transition bitrate, the output will be multiplexed at the network gateway and converted to the STM-1 transmission format. After that, it will be transmitted to Kokavil Transmitting Station and Trincomalee Transmitting Station.

After the STM-1 transmission signals are received by the Network Gateway at each transmitting station, they are demultiplexed into compressed Broadcast TS signals. The dummy packets that were deleted on the transmission side are reinserted into the respective demultiplexed compressed TS signals in the De-compressor in order to regenerate the original Broadcast TS signals.

It should be noted that the Broadcast TS signal also includes NIT[8] (Network Information Table)

6 STM-1: One of the transmission units of SDH (Synchronous Digital Hierarchy), which is an optical fiber-based high-speed information transmission system. It has a transmission speed of 155.52Mbps.

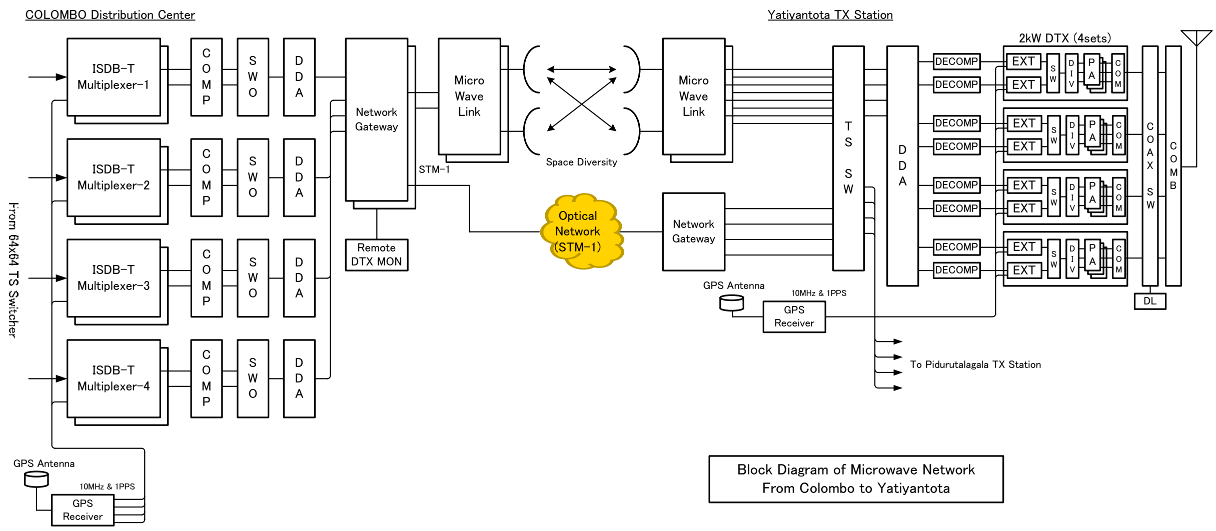
7 Compressor: An apparatus to lower the bit rate by removing dummy packets from the Broadcast TS signal (of which the bit rate is 43.34Mb/s). A decompressor is installed on the reception side to regenerate the original Broadcast TS signal by re-inserting the deleted dummy packets.

8 NIT information: One of the information tables of PSI (Program Specific Information). Mainly includes information concerning TV program selection by receiver, such as the physical channel (frequency).

information and other PSI[9] (Program Specific Information) in which the transmitting frequency is described. As described in Section 7.2.6 above, with respect to the channel plan for the entire area of Sri Lanka, it is proposed that different transmitting frequencies be assigned to different regional blocks for broadcasting. This system would require the rewriting of NIT and would thus make it necessary for the PSI exchanger function to be incorporated into the decompressor. This function would enable the selection of the most appropriate frequency for each block and transmitting station. The regenerated Broadcast TS signal is supplied to the expander of the transmitting equipment (indicated as EXT in Figure 7.4-7).

2) Microwave Link

A microwave link is used for transmission link which is relatively short distance and line-of-sight. In the DTTB network, it is used for transmission between Colombo and Yatiyantota and from Yatiyantota to the individual transmitting stations, which are regarded as slave stations. Taking into account the fading margin, which is the loss of the transmission link, the microwave link for transmission over distances of 40km or more was configured with diversity reception, and that for transmission f less than 40km was configured without diversity reception. Figure 7.4-8 shows the equipment configuration of the microwave link with diversity reception.



Source: JICA Study Team

Figure 7.4-8 Sample Transmission System Using Microwave STL Network (1)

As can be seen from the figure, apart from the means of transmitting STM-1 being microwave instead of optical fiber, the configuration of the rest of the equipment is the same as that for the optical link network. Major specifications of the microwave link are shown in Table 7.4-7.

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9 PSI: Stands for Program Specific Information. Information needed by receiver in channel and program selection is multiplexed into a broadcasting signal and sent to receiver.

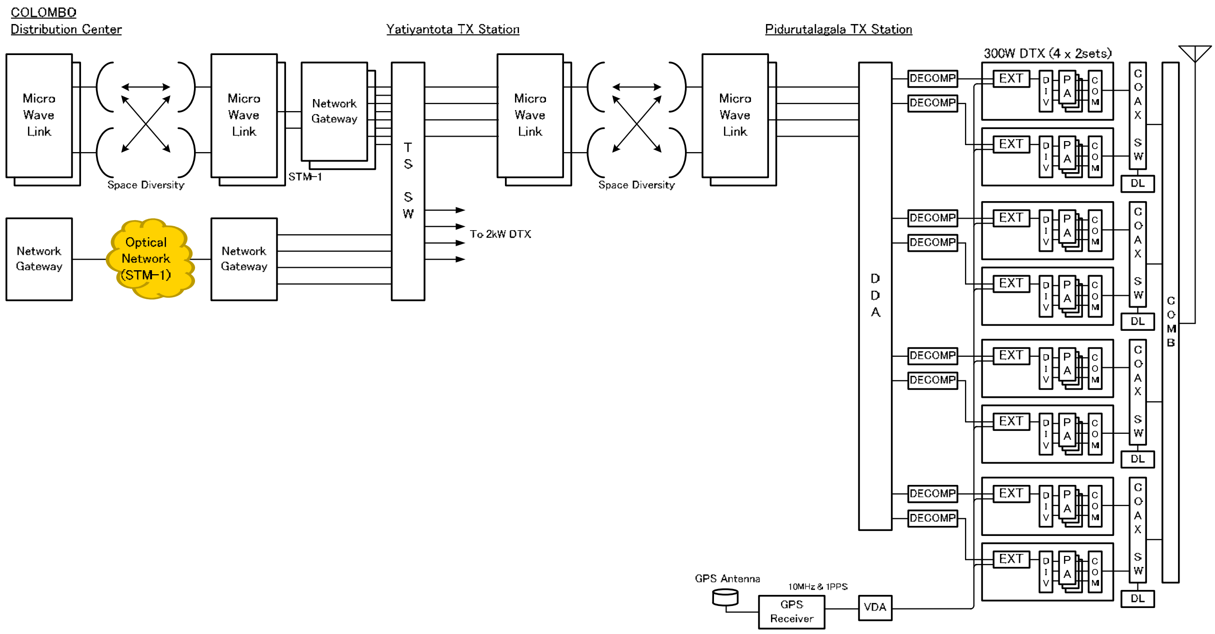
Table 7.4-7 Major Specifications of Microwave Link

No.	Item	Specification	Remarks
1	Frequency band	7 GHz band	
2	Bandwidth	28MHz X 2	Bidirectional link
3	Maximum transmitter power	+33dBm (equivalent to 2W)	Depends on link condition
4	Modulation	64QAM	
5	Threshold level	C/N level @BER=10^{-3}:-76.5dBm, 10^{-6}: -75.8dBm	
6	Maximum antenna diameter	2m	Depends on link condition
7	Space diversity composition	Possible	Depends on link condition

Source: JICA Study Team

Furthermore, for the links of which distance is comparatively long, two transmitting/receiving antennas are required for space diversity method. On the other hand, when the distance of links are comparatively short, only one antenna is needed since diversity reception is not required.

Figure 7.4-9 shows a system in which the digital broadcasting signal is divided at Yatiyantota Transmitting Station and relayed to another transmitting station via microwave STL. As shown in the figure, the STM-1 signal is supplied again to the micro link on the receiving side without being separated into each Broadcast TS signals before being sent to the transmitting station in the next stage.



Source: JICA Study Team

Figure 7.4-9 Sample Transmission System Using Microwave STL Network (2)

3) Broadcast-wave Relay

Broadcast-wave relay is one of TV program transmission method used for TV program network. It is a method whereby the broadcast wave received from the main transmitting station is re-broadcast after frequency conversion and power amplification. This method is used for links where the distance between transmitting stations is relatively short and the received signal strength via relay is enough strength. In the DTTB network, links of this type are used for the two slave transmitting stations of Pidurutalagala (Primrose and Hanthana) and the three slave stations of Gongala Transmitting Station (Elpitiya, Suriyakanda and Deniyaya).

One important point in adopting broadcast-wave relay is that a sufficient isolation distance needs to be ensured between transmitting and receiving antennas so as to avoid loop-back interference[10] between the transmitted signal and the signal received at the slave station when a single-frequency network (SFN) is formed in which the main station and the slave stations broadcast at the same frequency.

If there is not sufficient isolation distance, the use of another type of network must be considered.

7.4.5 Equipment Plan for DBNO NOC

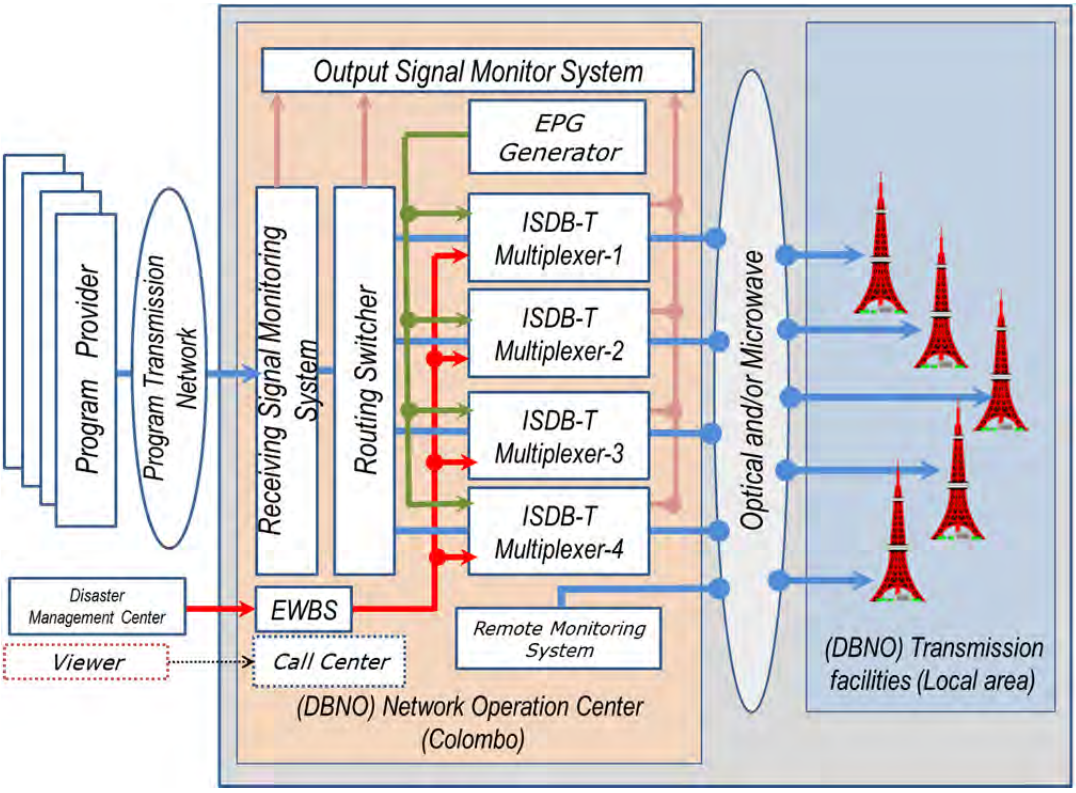
(1) Functions of DBNO NOC

The NOC that provides part of the function of the DTTB Platform has the important role of multiplexing the programs sent by each program provider and transmitting the multiplexed programs to the transmitting facility, which is another function of the DTTB Platform.

The NOC equipment complies with both the SD and HD formats, and it should be so planned that it will be also compliant with the DSO-HD after ASO with no modification. Also, to ensure stable operation of broadcasting services, all the NOC equipment and apparatus is duplexed.

Figure 7.4-10 below shows the conceptual diagram of the overall functions of the DTTB Platform operated by the DBNO. A description of the NOC functions follows.

[10] Loop-back interference: In broadcast-wave relay, if the transmitting and receiving frequencies are the same, part of the transmitted signal is picked up by the receiving antenna and amplified, resulting in the deterioration of the transmitted signal. Measures to avoid this interference include ensuring that there is enough distance between the transmitting and receiving antennas, improving the antenna directivity, etc. If the transmitting and receiving frequencies are different, no such interference occurs because the transmitting component is removed by the input filter at the stage prior to the receiving part of the relay station.



Source: JICA Study Team

Figure 7.4-10 Conceptual Diagram of Overall Functions of DTTB Platform Operated by DBNO

1) Input Monitoring System

Twenty-three programs provided by broadcasters including TV stations in Colombo are sent to the matrix switch through the input monitoring system. The input system is equipped with a monitoring system comprising a multi-division monitor, audio speaker, TS analyzer and waveform monitor. It also has a mechanism that issues an alarm when the input signal is interrupted. A hotline to each broadcasting station master is available for emergency communication with the broadcasting stations.

2) Matrix Switch

After being received, the 23 programs are sorted into four groups by the matrix switch. The four sorted groups of programs are each sent to one of four multiplexers.

One group consists of six programs.

3) Multiplexer

There are four multiplexers. The signals of six programs are input to one multiplexer. These six programs are multiplexed by the multiplexer to generate one Broadcast TS signal. A total of four Broadcast TS signals are generated from the four multiplexers. The electronic program guide (EPG) produced by the DBNO is generated into SI signals, which are added to the four multiplexers and multiplexed to the Broadcast TS signal.

The EWBS (Early Warning Broadcast System) signals generated by the EWBS generating system are added to the four multiplexers and multiplexed into the Broadcast TS signal. These Broadcast TS signals are sent to the transmission link system.

4) Output Monitoring System

The Broadcast TS signals are demodulated to baseband by the demodulator so that output signals from the multiplexers can be monitored by the output monitoring system.

5) Nationwide Transmitting Equipment Monitoring System

In order to watch the operating status of transmitting equipment located around the country, a transmission monitoring system is set up within the NOC.

The monitoring system automatically monitors the signals one by one. Should any trouble/accident occur, a warning system is activated to make an alarm.

6) EWBS Generating System

In the event of a disaster, the Sri Lanka Disaster Management Center sends out "disaster warning information". Based on this information, the EWBS generating system installed in the NOC generates the EWBS signals.

The generated EWBS signals are added to each of the four multiplexers, multiplexed to the Broadcast TS signals and delivered to homes together with the programs. In the event of a disaster, a "warning" can be sent the home digital receiver.

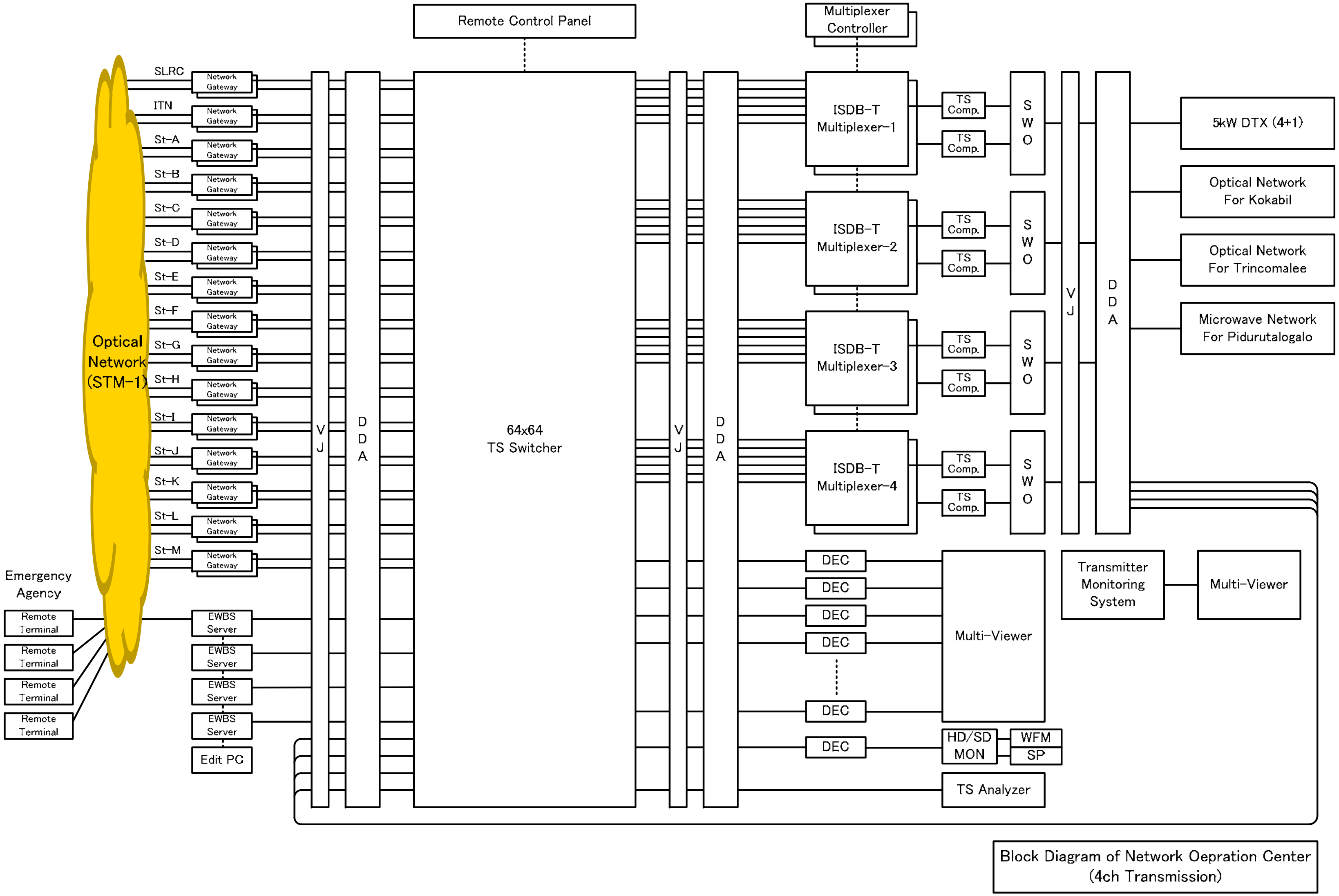
7) EPG Production Office

Displaying a program guide on the digital receiver enables broadcast programs to be checked and allows for easy presetting of programs for recording. The EPG production office is set up within the NOC to digitize the program information sent by each broadcasting station and save the edited data files in the EPG server. The EPG can be broadcast by adding the data output to the multiplexer.

8) Call Center

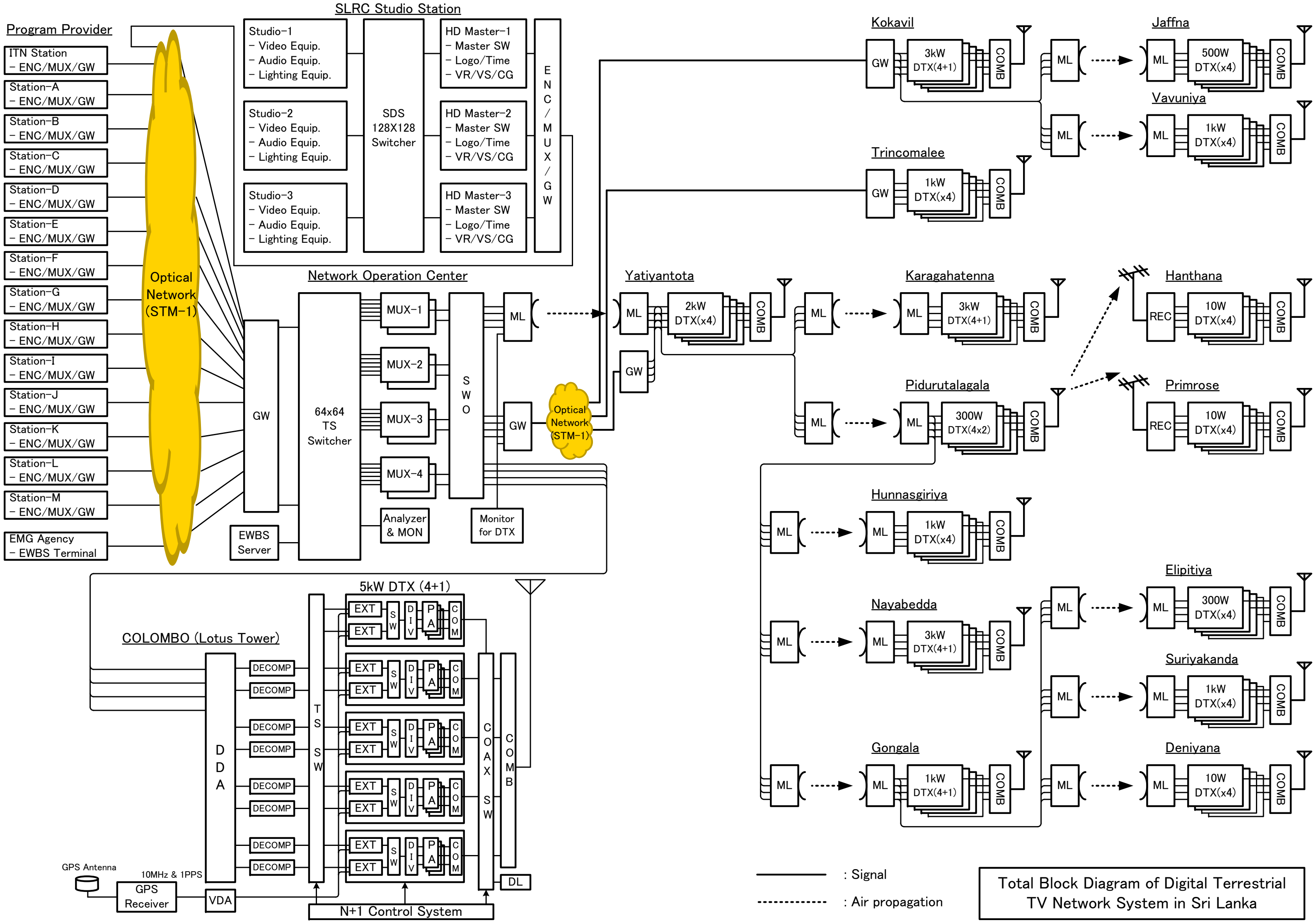
The call center responds to viewer telephone inquiries. It is assumed that there will be more telephone inquiries at the start of DSO-SD and at ASO in Sri Lanka, but this will be a temporary phenomenon. Therefore, it is planned that a call center should be installed within the NOC to respond to normal inquiries, and in order to respond to the increased volume of inquires at the start of DSO-SD and at ASO, the call center function should be outsourced.

A call-center telephone response system should be installed at the NOC so as to enable large numbers of viewer inquiries to be handled with a minimal number of personnel.



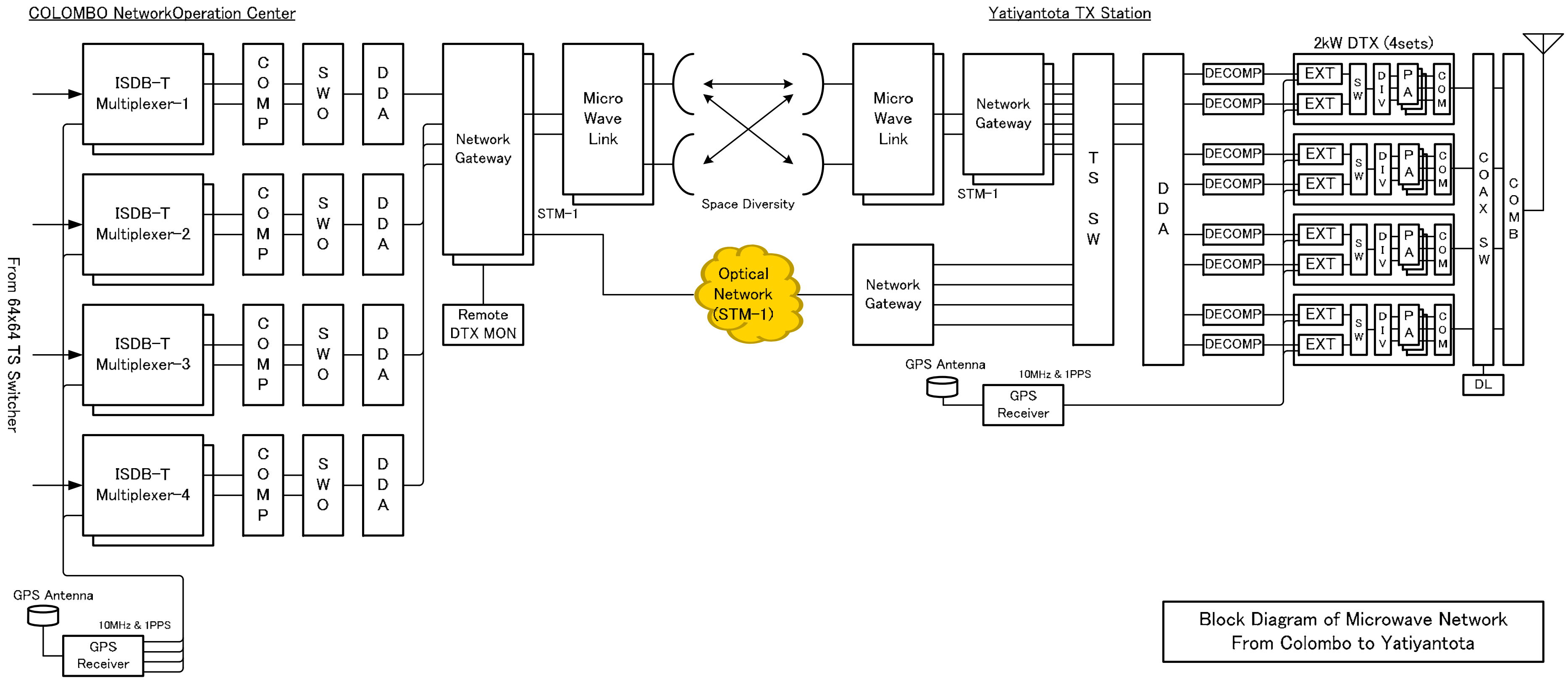
Source: JICA Study Team

Figure 7.4-11 DBNO NOC Block Diagram



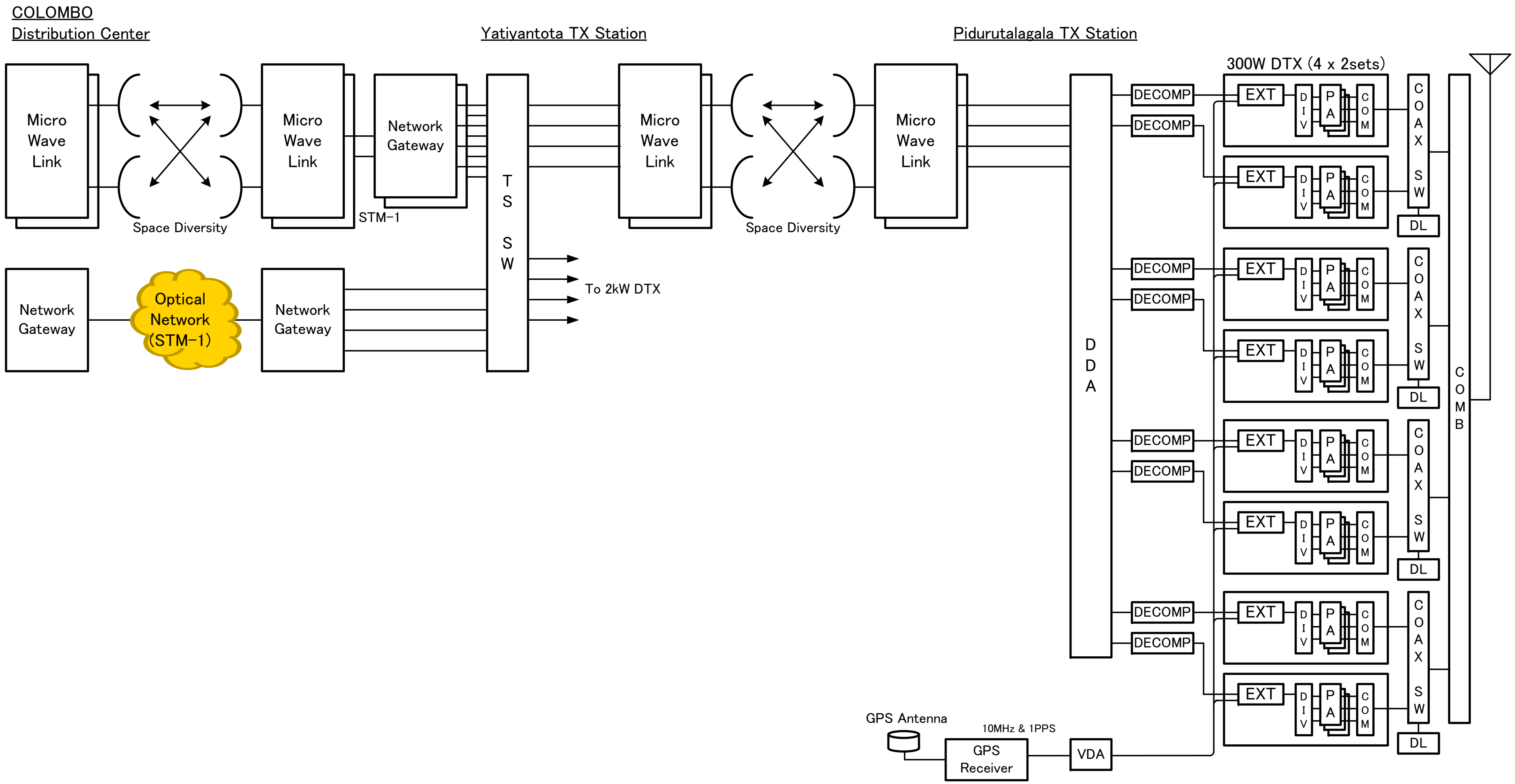
Source: JICA Study Team

Figure 7.4-12 DBNO DTTB Platform Overall Block Diagram



Source: JICA Study Team

Figure 7.4-13 Connection Diagram for NOC-Yatiyantota Transmitting Station



Source: JICA Study Team

Figure 7.4-14 Connection Diagram for Yatiyantota- Pidurutalagala Transmitting Station

(2) Equipment installation plan in Lotus Tower

The Lotus Tower is now under construction. The architectural drawings for the Lotus Tower were made on the premise of DVB-T2. To prevent the situation where the equipment for this Project cannot be installed in the Lotus Tower, consideration of equipment layout, power supply plan and calorie calculation for the air conditioning system is necessary.

1) Equipment layout

NOC, transmitter rooms and electric power room for DBNO will be situated on the second floor of Tower House in the Lotus Tower. The layout is considered as described below.

a. The transmitter room is divided into two rooms. One is for SD and the other is for HD.
b. The electric power room has two isolation transformers and UPS for SD and HD.
c. NOC is divided into three rooms: a master rack room, control room and office.
d. A napping room is provided on the second floor of Tower House.

Detailed layout drawings for the second floor of Tower House in the Lotus Tower will be made in this Project and the Lotus Tower project after the consultants for this Project are hired.

2) Outdoor units of air conditioning system

The outdoor units of the air conditioning system will be placed on the upper microwave platform which will be situated 20m below the second floor of Tower House because there is too little space to install the outdoor units on the second floor of Tower House.

3) Calorie calculation for air conditioning system

The calories emitted from the equipment on the second floor of Tower House are calculated for each room. It has not yet been decided whether the transmitters will be cooled by an air cooling system or a water cooling system, so the calculation was made for each cooling system. The total calories are shown in Table 7.4-8.

A central air conditioning system is adopted in the Lotus Tower. If the system lacks the ability to deal with the heat shown in Table 7.4-8, additional air conditioners will be provided for the necessary rooms in this Project.

Table 7.4-8 Exhaust Heat List

	Air Cooling System	Liquid Cooling System
Transmitter Room-1	120,000 kcal/h	52,000 kcal/h
Transmitter Room-2	120,000 kcal/h	52,000 kcal/h
NOC Master-rack Room	52,000kcal/h	52,000kcal/h
NOC Control Room with Office (for DBNO)	13,000 kcal/h	13,000 kcal/h
Electric Power Room	17,000kcal/h	17,000kcal/h

Source: JICA Study Team

7.4.6 Network System between Broadcast Program Provider and NOC

(1) Basic Design

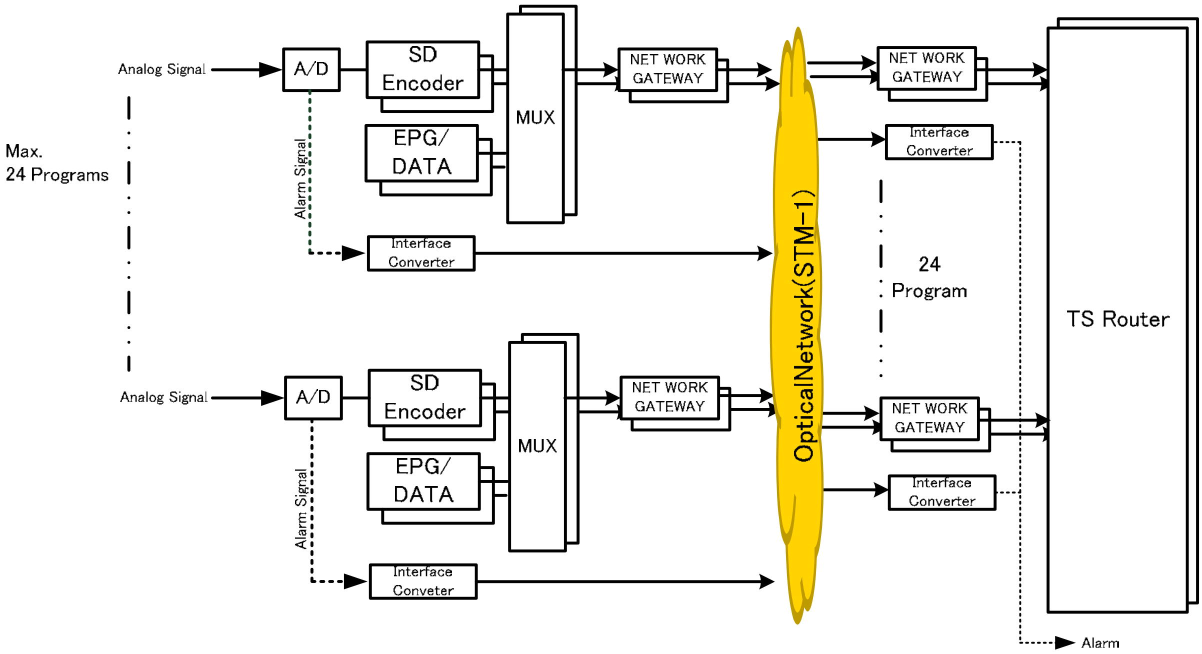
If the broadcast program of an individual broadcast program provider is an analog signal format, the signal is converted to a digital signal format by A/D converter, compressed and encoded to a TS signal compatible to for the digital signal transmission link. In addition, Service Information (SI) other than the broadcast program, EPG information and data-cast information are multiplexed with the broadcast program and sent to the digital link network via the network gateway. At the NOC, the broadcast programs of each program provider are put together and multiplexed by TS multiplexer for each transmitter compliant with the four UHF transmitting frequencies.

As the broadcast programs of the program providers are put together in this way, accountability for the quality of the transmitted signals needs to be clarified and to be necessary to equip some means to be made known to viewers as required. Therefore, equipment to be installed at the broadcast program providers should have the function of detecting any trouble/failure at the point in which an analog signal is converted to a digital signal and sending the alarm to the NOC via the network.

(2) Connection System

Assuming that the current broadcast program suppliers in Sri Lanka are not equipped with digital equipment, a transmission system of the digital broadcast programs to the NOC should be installed on the broadcast program provider side as a prerequisite for digitization. The transmission system should be treated as the property of the DBNO.

Figure 7.4-15 shows the link connection system between the broadcast program providers and the NOC.



Source: JICA Study Team

Figure 7.4-15 Program Network between Broadcast Program Providers and DBNO NOC

(3) Equipment Configuration

The equipment configuration between the broadcast program suppliers and the DBNO network center is shown below.

1) A/D converter (with input signal alarm detection function)
2) SD encoder
3) EPG data encoder
4) Multiplexer
5) Network gateway
6) Network converter

7.4.7 Concept for Design of Equipment for Digital TV Center

The concept for the design of the studio equipment to be installed in the digital TV center is described below.

With efficient digital signal compression technology, DTTB is able to transmit a greater amount of information within a given transmission band than is possible with conventional analog broadcasting. In addition, in order to make the most of the features of the ISDB-T system, the following functions should be incorporated into the master control system and the digital transmitting equipment that comprise the nucleus of digital TV center equipment.

- Multi-format compliance for HD signal, SD signal and multiple channels
- Compliance with One-seg broadcasting for the reception of digital broadcasting by mobile or portable TV handsets

- Compliance with EPG for reception of electronic program data by digital broadcasting receivers
- Compliance with data broadcasting for display of data linked to program content
- Compliance with subtitle broadcasting mainly for persons with hearing difficulties

7.4.8 Digital TV Center Equipment

(1) Basic Policy Concerning Digital Broadcasting Center Equipment of SLRC Station

An important point about the digital broadcasting center equipment to be installed at SLRC in this project is that it should consist of equipment capable of making the maximum use of the functions of the ISDB-T system with an eye to the future introduction of digital high-definition broadcasting, thereby delivering program content different from conventional program content. If this can be achieved, when digital high-definition broadcasting (DSO-HD) starts, it will be implemented in a smooth and prompt manner without the need to procure new equipment. For this purpose, a system must be adopted that is capable of organic combination, integration and management of the master control system, digital signal transmitting equipment and TV studio equipment for program production.

The current analog studio equipment of SLRC consists of a master control system, transmitting equipment centered on a master switcher and studio equipment including TV studios No. 1 – 3 for program production, each of which is independent. The equipment has served its purpose by transmitting programs according to the broadcast schedule.

In order to define SLRC as a point of reference for digital broadcasting in Sri Lanka and to fully equip the station with new digital equipment, the Government of Sri Lanka has decided to construct a new station building within the premises of SLRC and to install digital TV center equipment including a master control system, etc. in this building.

In consideration of operating costs, the lighting equipment used in the studios should be LED lighting.

(2) Current Status of Existing Studio Equipment of SLRC Station

SLRC offers the following four services. In Colombo, two of these four services alternate according to the time and analog programs are broadcast over three channels.

- Rupavahini channel
- Channel Eye-1 channel
- Channel Eye-2 channel (The content is the same as Rupavahini.)
- NTV channel

For the signal transmitting equipment of the Rupavahini and NTV channels, an analog switcher installed in 1998 with the grant aid from the Government of Japan is used and programs are delivered manually. For Channel Eye, an analog master switcher installed by SLRC is used alone, the control system is made by Play Box Technology and delivery is done automatically by a TV automation system.

The studio equipment for the production of TV programs is described below.

1) TV Studio No.1

The studio floor has an area of 200m^2 and the studio lighting equipment was installed in 1982 with grant aid from the Government of Japan. The baton control for raising and lowering the lighting equipment is operated manually.

In the past a production switcher installed with grant aid from the Government of Japan was used, but this was replaced with a product by Snell & Wilcox procured with the studio's own funds six years ago. Similarly, the audio mixer was replaced six years ago with a product by Sound Craft. There are three studio cameras.

2) TV Studio No.2

The studio floor has an area of 100m^2 and the studio lighting equipment was installed in 1982 with grant aid from the Government of Japan. The baton control for raising and lowering the lighting equipment is operated manually.

A production switcher installed in 1998 with grant aid from the Government of Japan is being used. The audio mixer was also installed with assistance from the Japanese Government. There are three studio cameras.

3) TV Studio No.3

The studio floor has an area of 400m^2 and the studio lighting equipment was installed in 1986 with grant aid from the Government of Japan. The baton control for raising and lowering the lighting equipment is motor-operated.

With respect to the production switcher and the audio mixer, equipment installed with the assistance of the Government of Japan has been replaced by SLRC. There are four studio cameras.

4) OB Van

The station owns 2 OB vans. The one introduced in 1992 has 8 sets of camera equipment. The other introduced with the assistance of the Government of Japan in 1998 has 4 sets of camera equipment. The OB vans are operating 200 days per year.

(3) Requirements of Studio Equipment Necessary for DTTB by Digital TV Center

The studio equipment of digital TV center consists of a master control system to deliver programs and a production/news studio to produce programs. The features of these systems are described below.

1) **Master Control System**

The master control system consists of a signal distribution system (SDS) to monitor and distribute all programs within the broadcasting station, and a master control system (MCS).

2) **Signal Distribution System (SDS)**

Various material images (materials) necessary for broadcasting, such as materials that are not packaged as programs and that are sent from outside the broadcasting station and materials sent from internal equipment, are sent to the SDS in a wide variety of signal formats. To ensure the quality of the signal at the level needed for digital broadcasting, these materials are input into the matrix switcher by way of an up-converter, down-converter, frame synchronizer and other apparatus.

The matrix switcher is a multi-format compliant routing switcher with links of 128 inputs and 128 outputs, and it can switch materials. Program monitoring is performed by a multi-viewer that monitors multiple channels as well as by a high-quality monitor and waveform monitor at the console desk.

Main components of the SDS are:

- 128 x 128 multi-format routing switcher and remote panel
- Cross converter (functions as up-converter, down-converter and frame synchronizer)
- Multi-viewer (monitors multiple digital broadcasting materials)
- Monitoring console (monitors the quality of images and audio, and switches and distributes materials)
- Synchronizer (master synchronizing generator and distributer of the station)
- Inter-room intercom (Intercom terminals are installed on major systems in the station.)

3) **Master Control System (MCS)**

The purpose of the MCS is to switch and deliver programs according to the time specified in the program guide. The program guide is controlled by the automatic program control system (APS). The program guide controlled by the APS is sent to the NOC of the DBNO with the programs switched by the master switcher. The MCS controls generation of the EPG data and multi-channel audio (stereo + surround system broadcasting) that are features of digital broadcast programs. Major equipment of the MCS is as follows:

- APS (program operation control, EPG generation audio mode control)
- Master switcher (switching of programs, delivery of superimposed text and digital programs)
- Multi-viewer (monitoring of materials and delivered programs)
- Monitoring console (monitoring and manual switching of programs)
- Generator of broadcasting station logo and superimposed time

- Character generator (generator of text information)
- Program server (delivery of long programs)
- CM server (delivery of short programs)
- Data broadcast program production system
- Alarm-monitoring system (monitoring of master equipment for failure)

4) Automatic Program Control System (APS)

Programs generated by the APS are controlled by the data server. Program data for at least 20 days is controlled, and the programs are controlled and edited in daily units. Also, the process of changing the date is carried out at a pre-determined time. To deliver programs, an automatic control PC controls the master switcher and peripherals (video recorder, program server and CM server) on a real-time basis. Audio to a maximum of 16 channels can be controlled. This enables a service, for example, of English stereo (2ch) + English (5.1ch) + Tamil stereo (2ch) + Tamil (5.1ch).

5) Master Switcher

The master switcher is capable of automatic control switching via the APS and manual switching via the monitoring console. Besides switching program materials, the master switcher also handles the superimposition of the broadcasting station logo, time information and text information. It should also be able to handle superimposition of the EWBS character as necessary. Image signals are HD-SDI (HD Serial Digital Interface) signals and the audio is input and output by embedded audio superimposed on the HD-SDI signals.

6) Program Server

The program server records long programs in the video server (HDD or SSD) and delivers the programs in accordance with the APS control. Programs are ingested as HD-SDI signals or files. 168 hours of program (1 week x 24 hours) or longer can be stocked in the program server. The program server controls materials and checks previews.

7) CM Server

The CM server records CM material in the video server (HDD or SSD) and delivers the CM material in accordance with the APS control. CM material is ingested as HD-SDI signals or files. 20 hours of CM material (4,500 CMs x 15 seconds) or longer can be stocked in the CM server. The CM server controls material and checks previews.

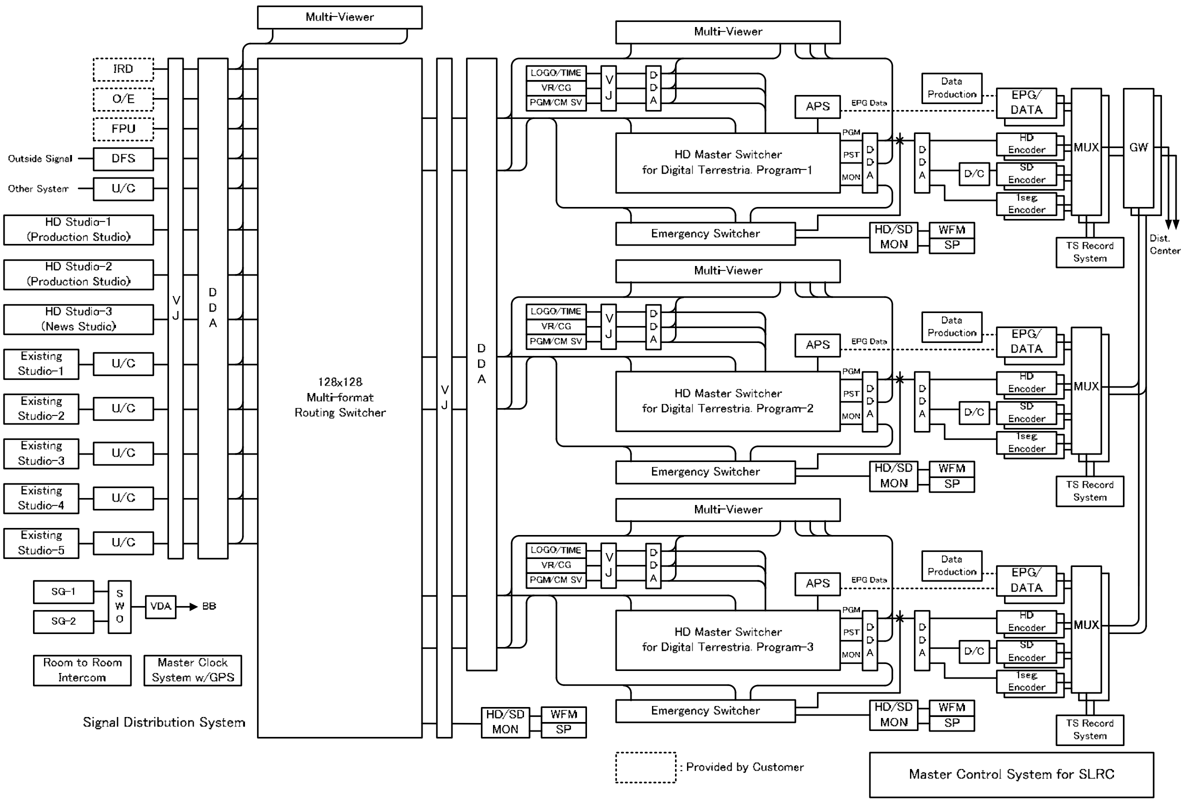
8) Data Broadcast Program Production System

The data broadcast program production system collects content information from a variety of media. The collected information is configured into data broadcast programs using the authoring function. The system also has a program delivery function to deliver specified data to be broadcast in succession.

9) Alarm-monitoring System

Failure information from all the MCS equipment is monitored by the alarm monitoring system on a real-time basis. Each piece of equipment sends SNMP trap information to the alarm-monitoring system. The SNMP (Simple Network Management Protocol) is a protocol in the TCP/IP network for monitoring and controlling communication devices connected to the network, such as routers, computers and terminals, via the network. The alarm-monitoring system displays the failure information in detail, notifies the operator and gathers all the log information.

The overall system diagram of the MCS of SLRC is shown in Figure 7.4-16 below.



Source: JICA Study Team

Figure 7.4-16 Overall System Diagram of SLRC Master Control System

10) Interface Equipment

Programs produced by the MCS are transmitted to the NOC of the DBNO. For the transmission of programs to the NOC, asynchronous serial interface (ASI) transmission by MPEG compression should be adopted to reduce the volume of the link data to be transmitted and the running cost.

The following services should be transmitted.

- Multiple fixed programs
- One-seg programs

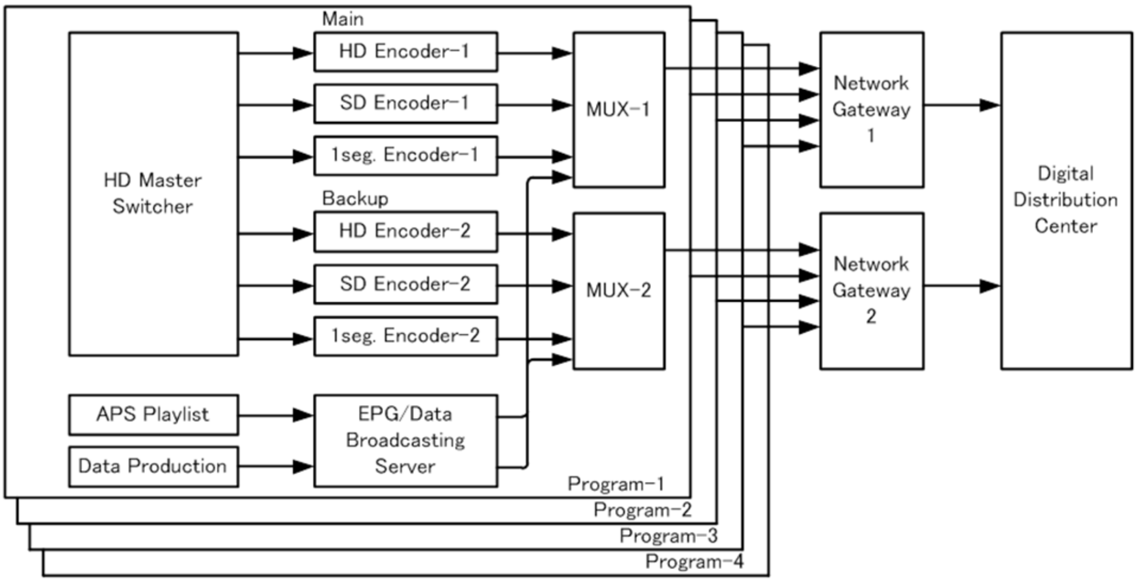
- Electronic program guide (EPG)
- Data broadcast programs

Programs transmitted by the MCS are in HD-SDI signal. The signal is encoded using encoder-based compression technology (MPEG-4). The EPG and data broadcast programs are generated by the EPG/Data server. These services are transmitted by the multiplexer as a single ASI signal to the NOC of the DBNO. The interface equipment to be installed in SLRC is as follows.

- Encoder for fixed programs
- Encoder for One-seg programs
- EPG/Data server (The EPG and data broadcast programs are produced by the MCS.)
- Multiplexer (Multiplexes the TS signal from the encoder and the EPG/Data server.)

As the program transmission link to the NOC is very important, these devices should be duplexed, providing a stand-by for each device to be used.

The system diagram for transmission to the NOC is shown in Figure 7.4-17 below.



Source: JICA Study Team

Figure 7.4-17 System Diagram for Program Encoding and Four-Service Multiplexing in SLRC

(4) TV Studio Equipment

The current TV studio equipment of digital TV center consists of three studios that are set up according to their purpose of use. Assuming the production of HD programs, the TV studios of the digital broadcasting center should also be set up according to their purpose of use. For economic efficiency, LED lighting should be adopted for the lighting equipment for the studios to reduce power consumption and operating costs.

In addition, OB vans should be deployed so that broadcasting from the field can be relayed promptly as relevant to the program. The OB vans should be so designed as to accommodate in a small space image and audio control equipment, cameras, VTS and all the other equipment necessary for relay broadcasting. A generator and an air conditioner should also be provided.

The digital broadcasting center should have the following three studios. The guidelines and the details of the design of the TV studios are given below.

Studio 1: Large studio (400 m^2), mainly used to produce TV dramas and event programs
Studio 2: Medium studio (200 m^2), mainly used to produce music programs and talk shows
Studio 3: Small studio (100 m^2), mainly used to produce news programs

1) Equipment of Studio 1

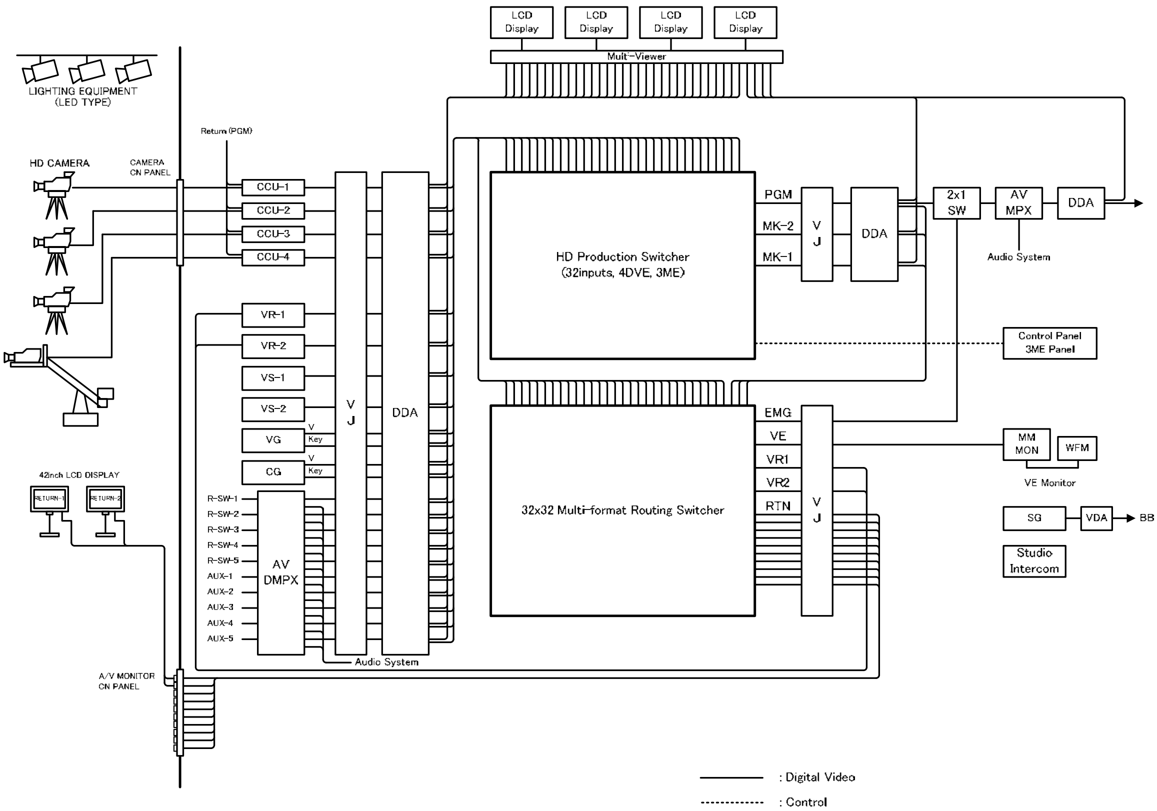
Studio 1 should be the largest studio in digital TV center, used for the production of dramas and event programs. The major equipment for Studio 1 is as follows.

- Studio cameras (four)
- Large camera crane
- Production switcher
- Video recorder (VR)
- Video server (VS)
- Character generator (CG) and video graphic generator (VG)
- Image monitoring console and multi-viewer
- Audio mixer
- Wired and wireless microphones
- Studio lighting equipment
- Studio intercom equipment

Four studio cameras should be provided. Crane cameras should also be deployed to enable the recording of programs using large cranes. Programs captured by the cameras are processed by the program switcher and sent to the MCS. The VG and CG generate character information and animation effects, which are used as program effects. Pre-recorded programs are output from the VR and the VS. The audio is produced by the digital audio mixer.

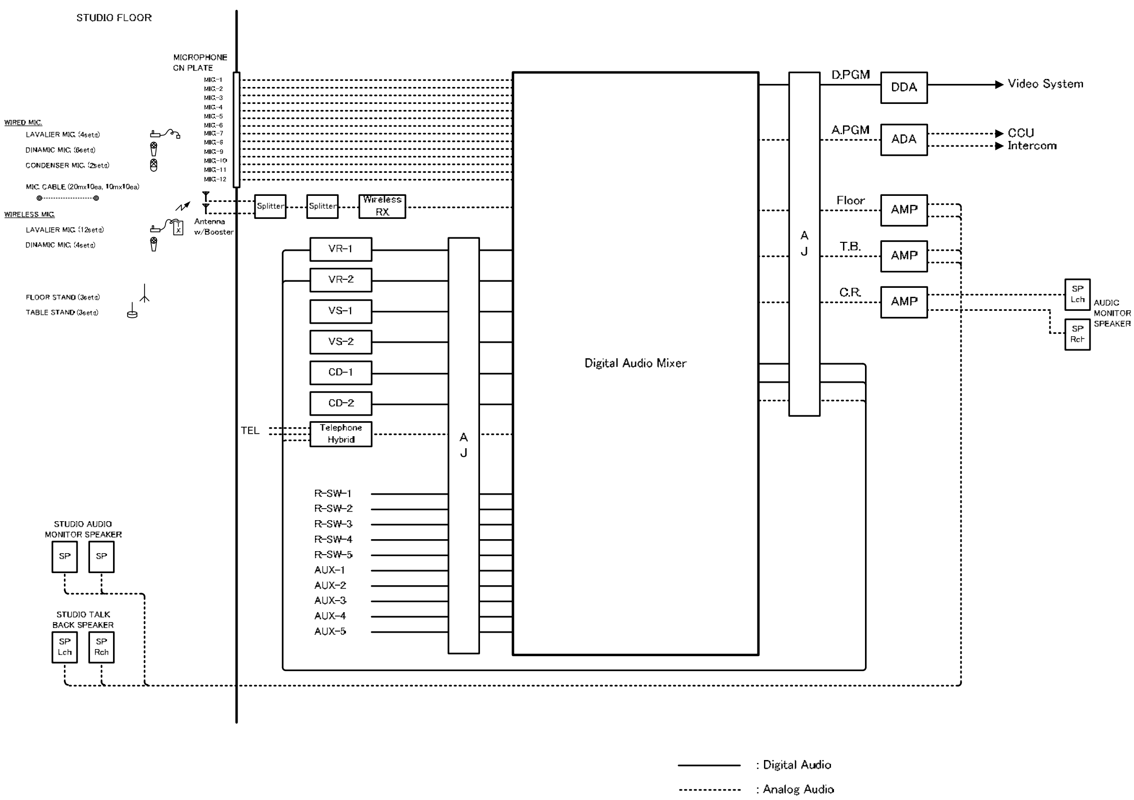
The lighting equipment should consist of spotlights, floodlights, cyclorama lights and effect lighting. In consideration of economic efficiency, LED lights should be adopted for the lighting. An automatic baton system should be adopted so that the lighting can be controlled from the lighting console and the raising and lowering of the baton can be controlled from the lighting panel.

Figure 7.4-18 below shows the image system and Figure 7.4-19 the audio system for Studio 1.



Source: JICA Study Team

Figure 7.4-18　Studio 1 Image System



Source: JICA Study Team

Figure 7.4-19　Studio 1 Audio System

2) Equipment of Studio 2

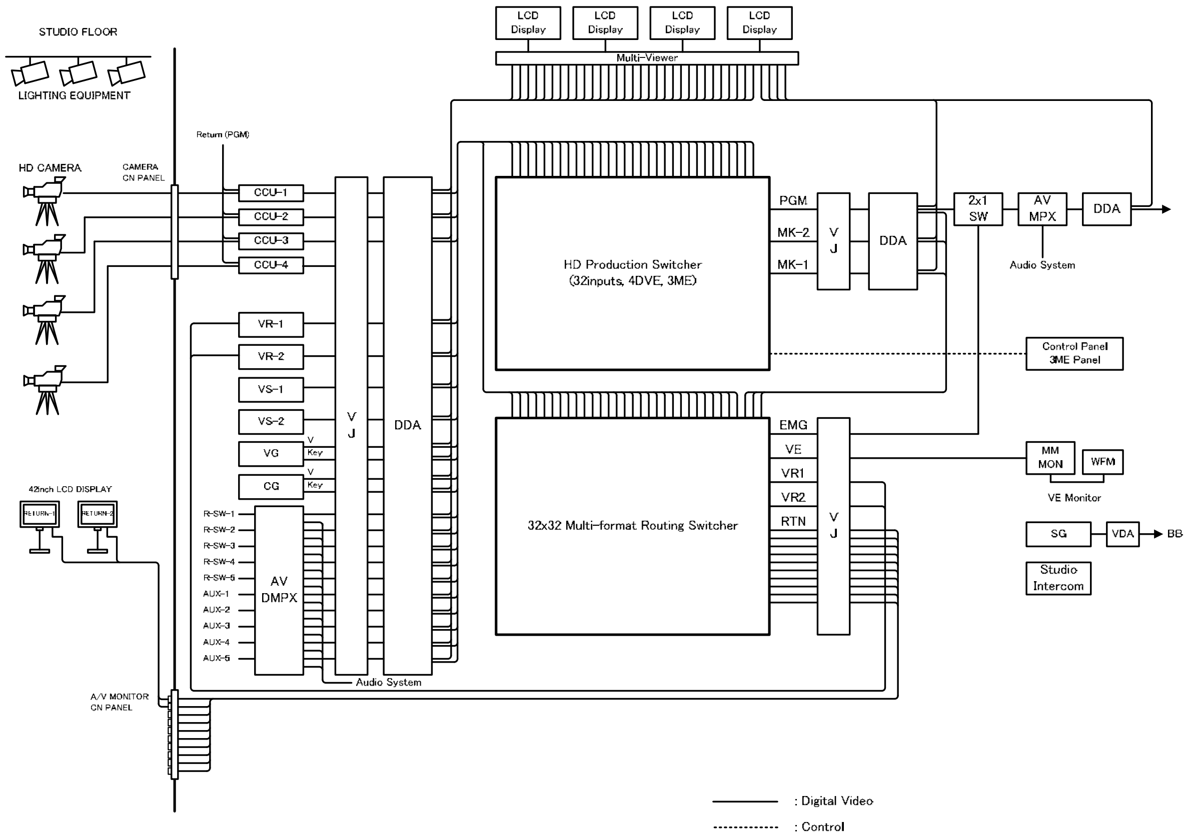
Studio 2 should be a medium-sized studio used for the production of music and talk show programs. The major equipment for Studio 2 is as follows.

- Studio cameras (four)
- Medium-sized camera crane
- Production switcher
- Video recorder (VR)
- Video server (VS)
- Character generator (CG) and video graphic generator (VG)
- Image monitoring console and multi-viewer
- Audio mixer
- Wired and wireless microphones
- Studio lighting equipment
- Studio intercom equipment

Four studio cameras should be provided. Medium-sized cranes should also be deployed to enable the recording of programs using them. Programs captured by the cameras are processed by the program switcher and sent to the MCS. The VG and CG generate character information and animation effects, which are used as program effects. Pre-recorded programs are output from the VR and the VS. The audio is produced by the digital audio mixer.

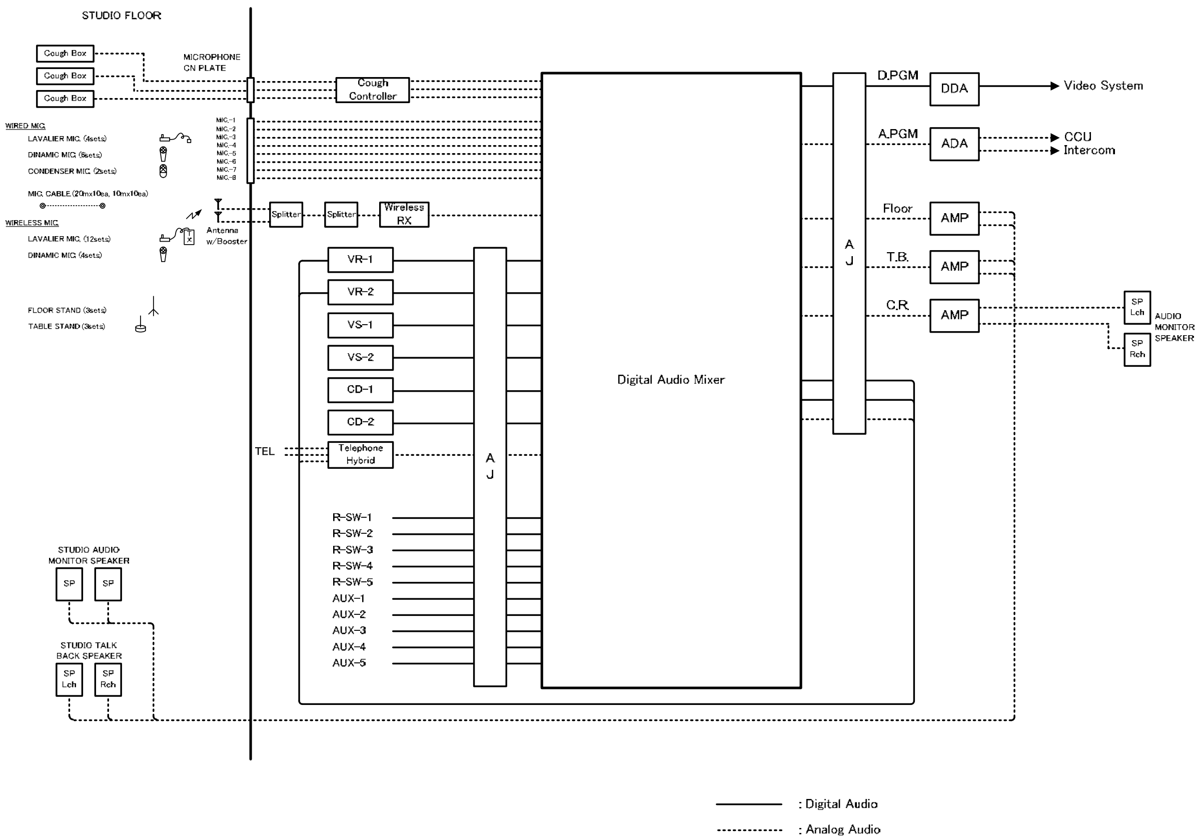
The lighting equipment should consist of spotlights, floodlights, cyclorama lights and effect lighting. In consideration of economic efficiency, LED lights should be adopted for the lighting. An automatic baton system should be adopted so that the lighting can be controlled from the lighting console and the raising and lowering of the baton can be controlled from the lighting panel.

Figure 7.4-20 below shows the image system and Figure 7.4-21 the audio system for Studio 2.



Source: JICA Study Team

Figure 7.4-20 Studio 2 Image System



Source: JICA Study Team

Figure 7.4-21 Studio 2 Audio System

3) Equipment of Studio 3

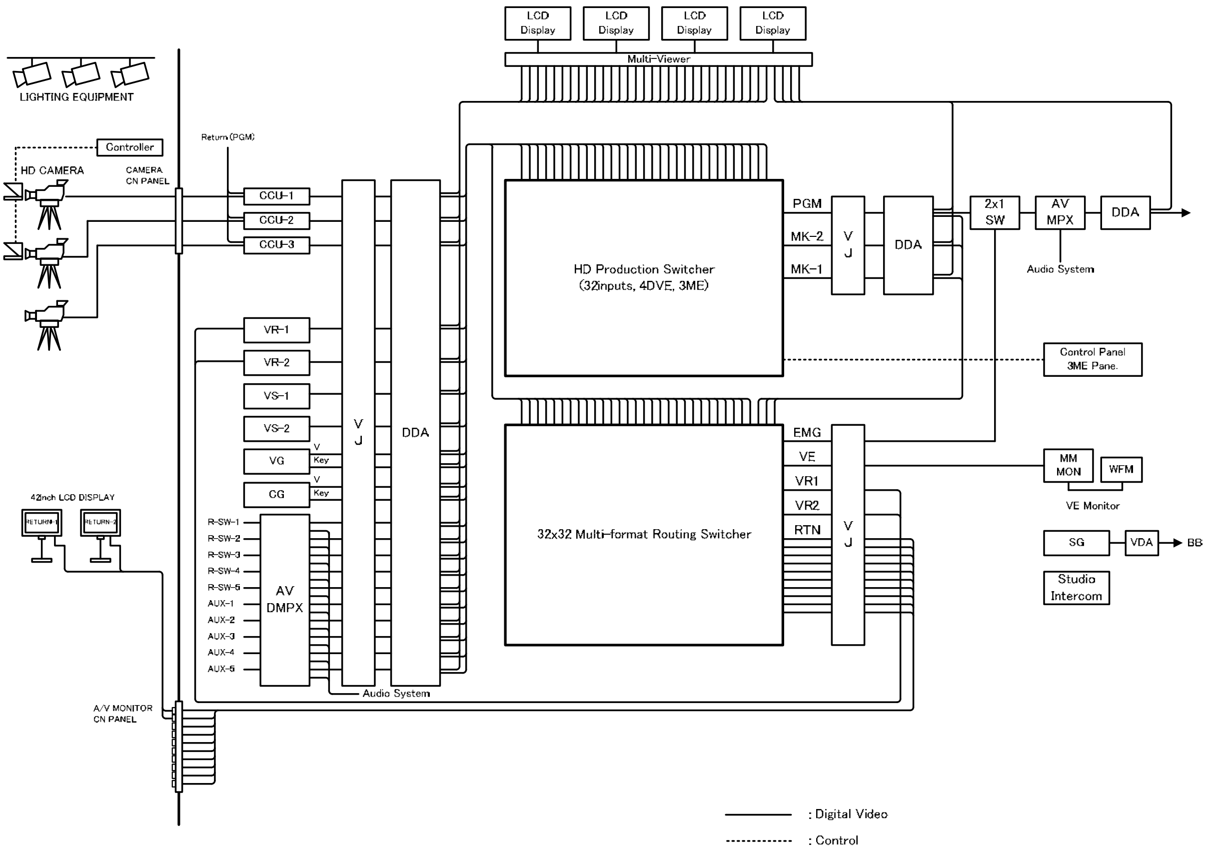
Studio 3 should be a small TV studio used for the production of news programs. Studio 3 should have the following equipment.

- Studio cameras (four)
- Prompters (two)
- Production switcher
- Video recorder (VR)
- Video server (VS)
- Character generator (CG) and video graphic generator (VG)
- Image monitoring console and multi-viewer
- Audio mixer
- Wired and wireless microphones
- Studio lighting equipment
- Studio intercom equipment

Four studio cameras should be provided. Programs captured by the cameras are processed by the program switcher and sent to the MCS. The VG and CG generate character information and animation effects, which are used as program effects. Pre-recorded programs are output from the VR and the VS. The audio is produced by the digital audio mixer.

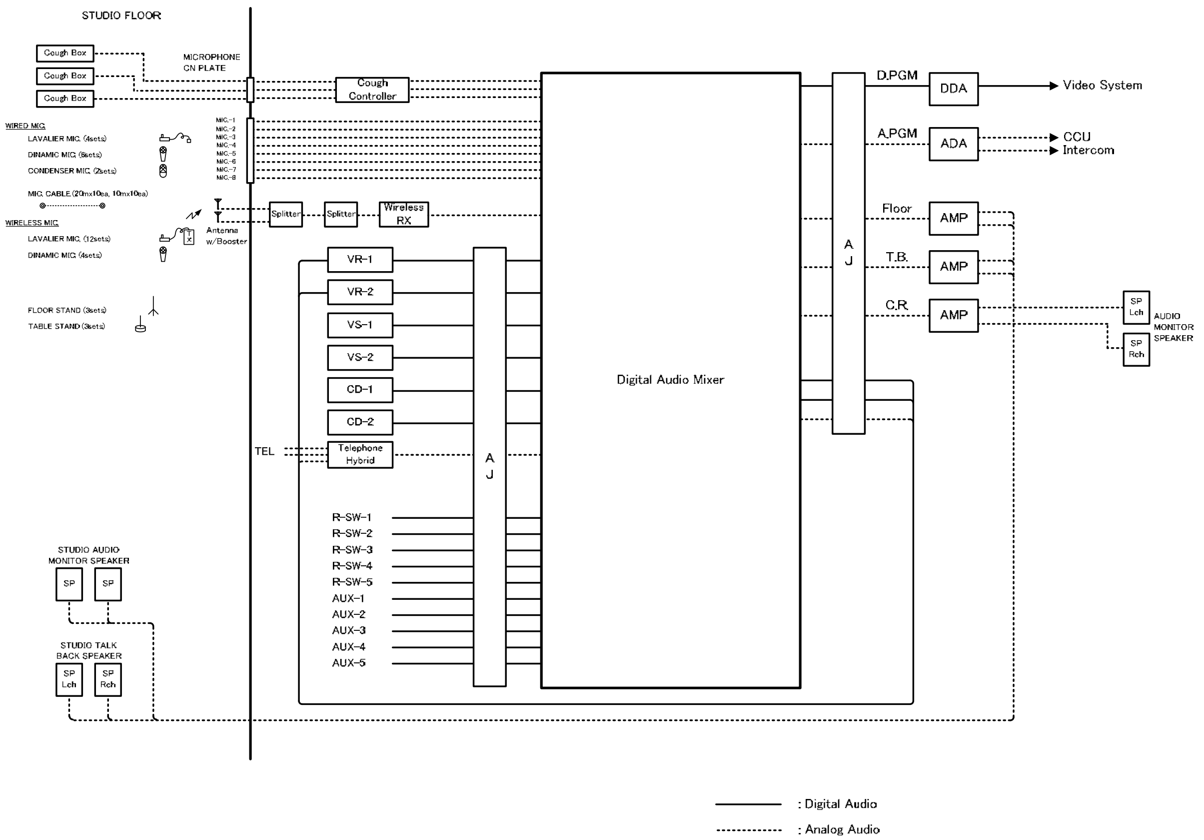
The lighting equipment should consist of spotlights, floodlights, cyclorama lights and effect lighting. In consideration of economic efficiency, LED lights should be adopted for the lighting. The lighting equipment should be fixed on the ceiling grid. The lighting should be controlled from the lighting console.

Figure 7.4-22 below shows the image system and Figure 7.4-23 the audio system for Studio 3.



Source: JICA Study Team

Figure 7.4-22 Studio 3 Image System



Source: JICA Study Team

Figure 7.4-23 Studio 3 Audio System

(5) OB Vans

Currently, SLRC has two OB vans; one small unit and one medium-sized unit. Basically, HD programs should also be produced for outside broadcasting. As SLRC intends to enhance its outside broadcasting in the future, a large unit and a medium-sized unit should be provided. Satellite transmission should be used to transmit programs from the OB vans to the SLRC broadcasting station.

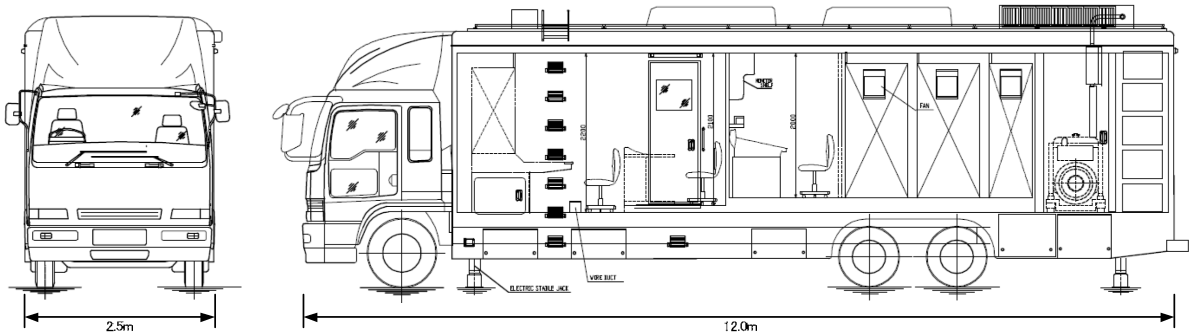
1) Large OB Van

The large OB van would be the largest OB van at SLRC and it should be used for relay broadcasting from large venues (*e.g.* relay broadcasting of cricket games). The large OB van should be equipped with the following equipment.

- OB van (12m long with built-in engine generator)
- Field cameras (12)
- Production switcher
- Video recorder (VR)
- Video server (VS)
- Character generator (CG)
- Image monitoring console and multi-viewer
- Audio mixer
- Wired and wireless microphones
- Outside lighting system
- Studio intercom system
- Satellite uplink system

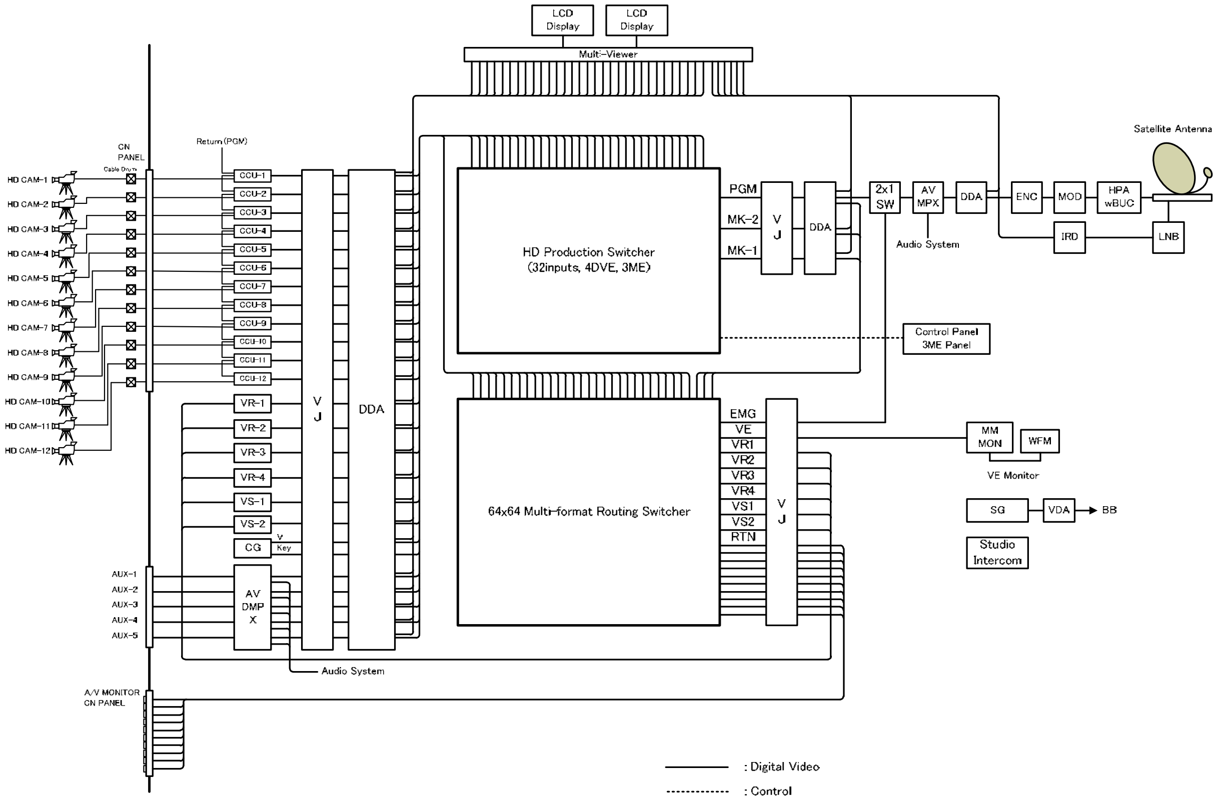
Twelve field cameras should be provided. Box cameras should be deployed to make it possible to record programs using large zoom lenses. Programs captured by the cameras are processed by the production switcher and sent to the SLRC digital broadcasting center via satellite. The CG generates character information and animation effects, which are used as program effects. The VR and the VS record programs. The audio is produced by the digital audio mixer.

Figure 7.4-24 shows the external view and Figure 7.4-25 the image system of the large OB van. In addition, Figure 7.4-26 shows the audio system of the large OB van.



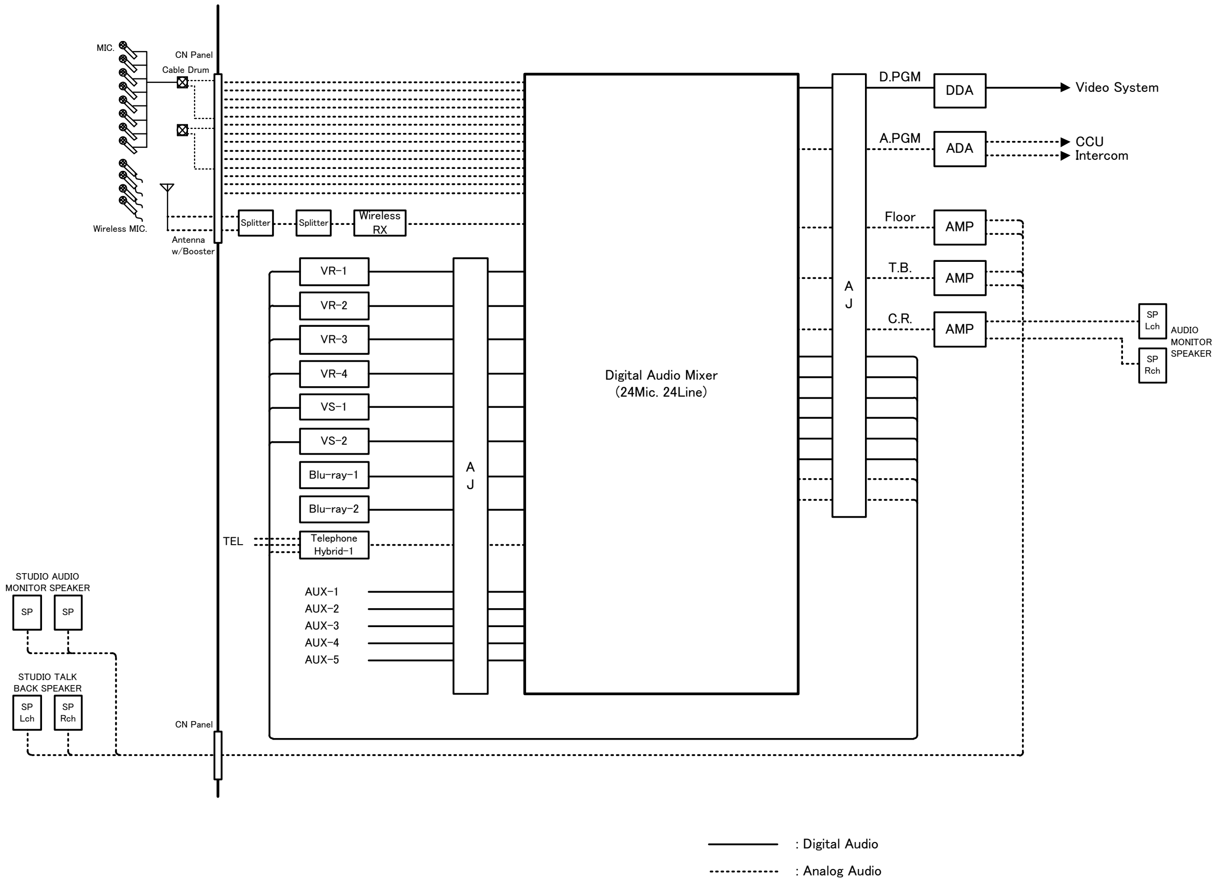
Source: JICA Study Team

Figure 7.4-24   Large OB Van External View



Source: JICA Study Team

Figure 7.4-25   Large OB Van Image System Diagram



Source: JICA Study Team

Figure 7.4-26   Large OB Van Audio System Diagram

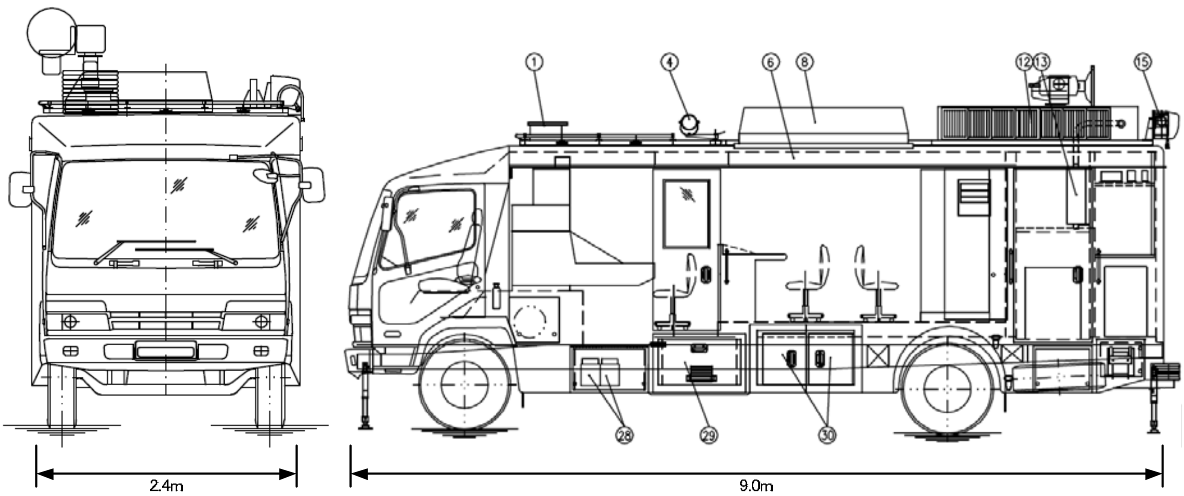
2) Medium-sized OB Van

The medium-sized OB van would be the most frequently used OB van at SLRC and it should be used for relay broadcasting from medium-sized venues. The medium-sized OB van should be equipped with the following equipment.

- OB van (9m long with built-in engine generator)
- Field cameras (6)
- Production switcher
- Video recorder (VR)
- Video server (VS)
- Character generator (CG)
- Image monitoring console and multi-viewer
- Audio mixer
- Wired and wireless microphones
- Outside lighting system
- Studio intercom system
- Satellite uplink system

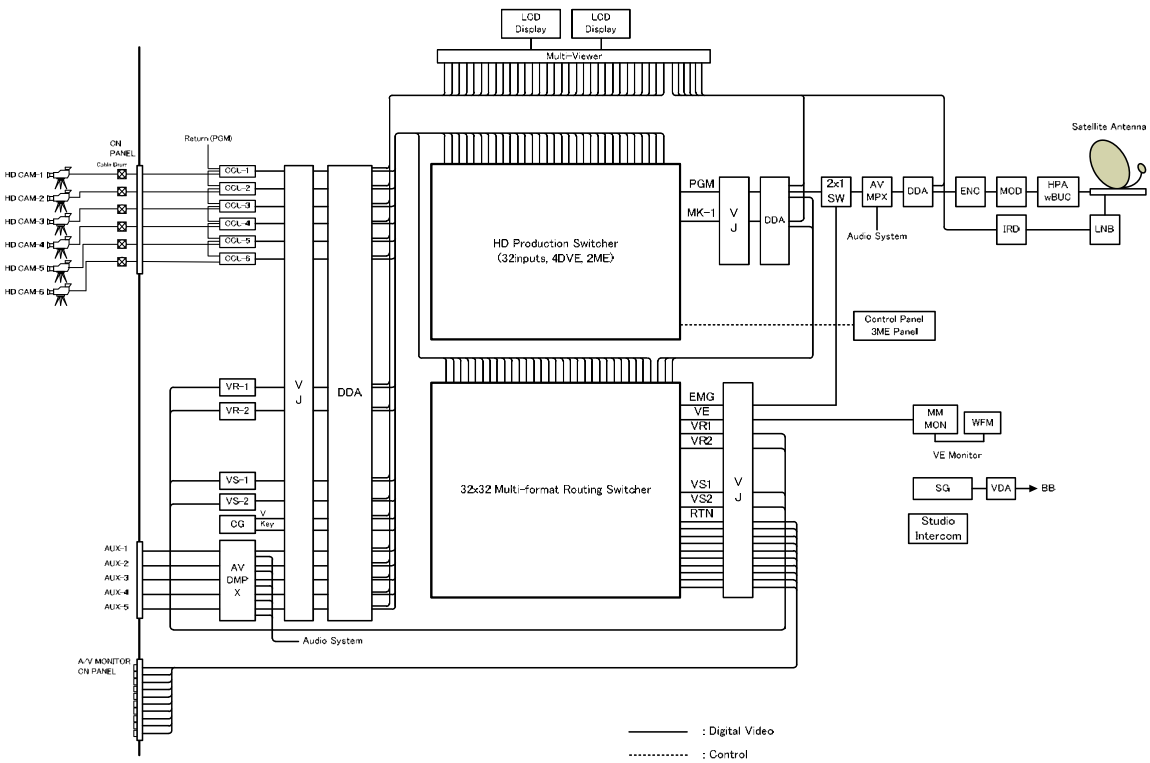
Six field cameras should be provided. They should be ENG cameras to make it possible to record programs using medium-sized zoom lenses. Programs captured by the cameras are processed by the production switcher and sent to the SLRC digital broadcasting center via satellite. The CG generates character information and animation effects, which are used as program effects. The VR and the VS record programs. The audio is produced by the digital audio mixer.

Figure 7.4-27 shows the external view and Figure 7.4-28 the image system of the medium-sized OB van. In addition, Figure 7.4-29 shows the audio system of the medium-sized OB van.



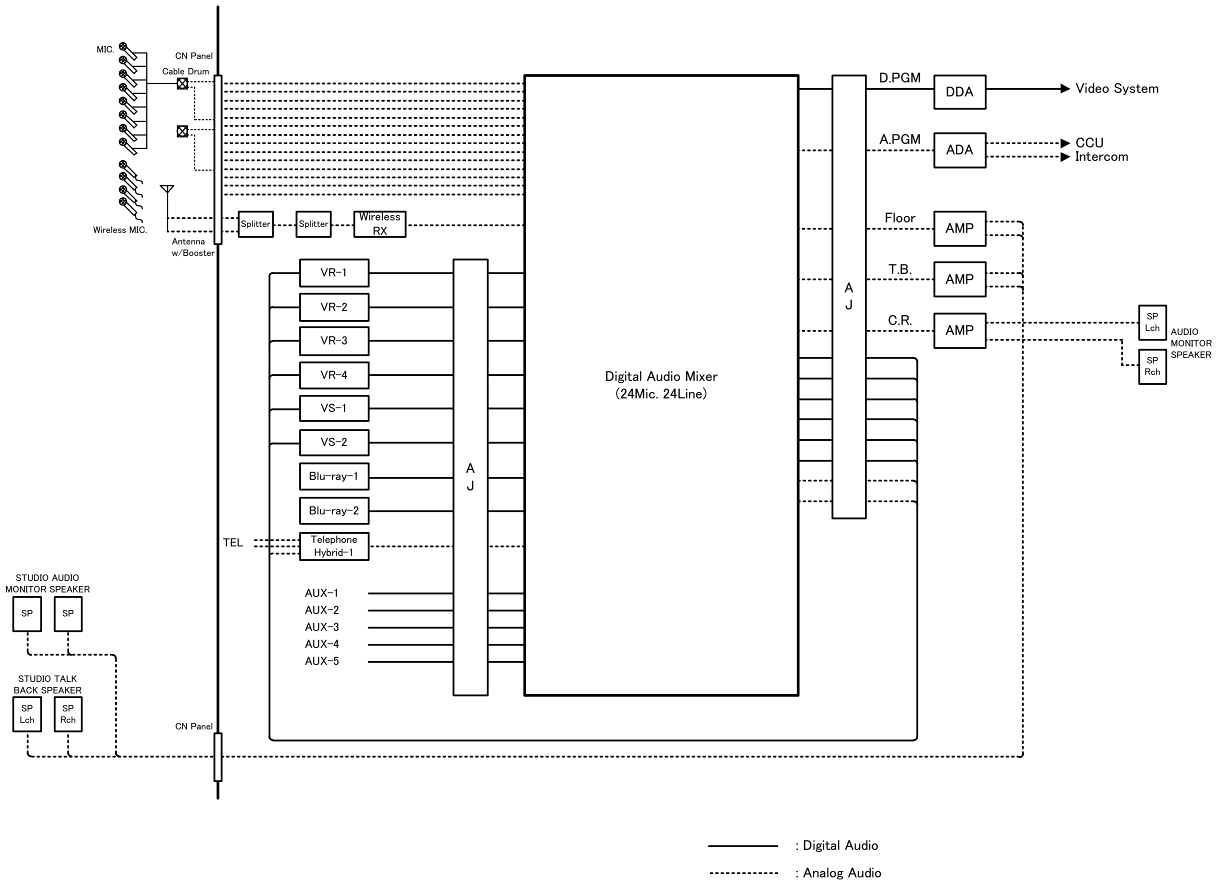
Source: JICA Study Team

Figure 7.4-27 Medium-sized OB Van External View



Source: JICA Study Team

Figure 7.4-28 Medium-sized OB Van Image System Diagram



Source: JICA Study Team

Figure 7.4-29 Medium-sized OB Van Audio System Diagram

7.4.9 Power Supply Facilities

(1) Electricity Situation in Sri Lanka

The electric power generation capacity of the Ceylon Electricity Board (CEB) as of September 28, 2013 was 32GWh, comprised of approximately 66% hydroelectric power generation, 32% thermal power generation and 2% wind power generation. The peak demand (maximum power demand) is 1,936.8MW.

The specifications of the electricity supply in Sri Lanka are two-wire single phase, 230V / 50 Hz, and four-wire three phase, 400 V / 50Hz.

The CEB is supplying commercial power to the existing transmitting station sites in the channel plan. Normally, power is converted from 11kVA to 400V (3 phase) by a transformer near the transmitting station site and supplied to the station building power receiving unit.

According to interview surveys conducted in the vicinity of the candidate sites for the placement of DTTB stations in this project, although the frequency of power failure is low, planned power outages take place two or three times a year, for about eight hours each, when the electric power company carries out inspection and maintenance; and this being the case, a backup power supply from a diesel generator is required to cover the outages. However, the power supply in the northern areas of the country is still inadequate in the aftermath of the civil war. An interview survey by the Study Team revealed that in the northern part of the country, there are power outages lasting eight hours at weekends and one to two hours on every weekday. As voltage drop is also to be expected, it is necessary that automatic voltage regulators (AVR) be installed in facilities related to TV broadcasting.

According to the Department of Meteorology of Sri Lanka, lightning strikes tend to be concentrated in the time period from afternoon to nighttime during the two seasons when the direction of the monsoon changes, namely, March to April and October to November. Therefore, the installation of lightning transformers is needed as a countermeasure to lightning strikes.

(2) Equipment Design Policy

In order to ensure that DTTB fulfills its public nature and social responsibility to the people, it is necessary that a power system be established that would never cause broadcasting to go off-the-air. The large capacity needed to operate such a system requires a high-quality power supply that will not affect the broadcasting equipment electrically.

In view of the state of the power supply in Sri Lanka, basic power equipment at each transmitting station should consist of the following.

(i) Incoming power panel
(ii) Power distribution panel
(iii) Automatic switching device
(iv) Automatic Voltage Regulator (AVR)
(v) Lightning transformer
(vi) Uninterruptible Power Supply (UPS)
(vii) Diesel generator

As the transmitter output varies from transmitting station to transmitting station, the power consumption required of the transmitter system for each station is given in Table 7.4-9 below, together with the capacity of the backup diesel generator.

The power consumption and the generating capacity of the generator were designed on the assumption that HD broadcasting will be implemented in the future.

Table 7.4-9 Transmitter Power Consumption of Generator Capacity by Transmitting Station

Site	Transmitter system power consumption (During HD broadcasting)	Diesel generator capacity (Compliant to HD broadcasting)
Jaffna	25 kVA (50 kVA)	100 kVA
Kokavil	150 kVA (300 kVA)	450 kVA
Colombo/Lotus Tower	Supplied from Lotus Tower	Supplied from Lotus Tower
Colombo/DBNO	Office building: no equipment power is needed.	Office building: no equipment power is needed.
Yatiyantota	65 kVA(130 kVA)	200 kVA

Site	Transmitter system power consumption (During HD broadcasting)	Diesel generator capacity (Compliant to HD broadcasting)
Pidurutalagala	20 kVA (40 kVA)	100 kVA
Nayabedda	90 kVA (180 kVA)	275 kVA
Gongala	40 kVA (80 kVA)	125 kVA
Karagahatenna	150 kVA (300 kVA)	450 kVA
Hunnasgiriya	40 kVA (80 kVA)	125 kVA
Vavuniya	40 kVA (80 kVA)	125 kVA
Trincomalee	40 kVA (80 kVA	125 kVA
Elpitiya	20 kVA (40 kVA)	100 kVA
Suriyakanda	40 kVA (80 kVA)	125 kVA
Deniyaya	2 kVA (4 kVA)	No need to install a new generator, as the existing generator can be used.
Primrose	2 kVA (4 kVA)	No need to install a new generator, as the existing generator can be used.
Hanthana	2 kVA (4 kVA)	No need to install a new generator, as the existing generator can be used.

Source: JICA Study Team

(3) Outline of Equipment within Power System

Table 7.4-10 gives a brief description of the incoming panel and power transformer, diesel generator, power distribution panel, AVR, UPS and lightning transformer that make up the power system.

Detailed specifications will be determined when the detailed design of other broadcasting equipment, such as the transmitter system, is carried out.

Table 7.4-10 Outline of Power System

No.	Equipment name	Outline	Reference photo
1.	Incoming panel and power transformer	The power company transmits electricity at a high voltage to reduce the transmission loss caused by long-distance transmission from power plants and substations. This means that it is necessary to lower the voltage (230V single-phase and three-phase 400V) according to the equipment to be used, and the incoming panel (high-voltage substation facility) performs this operation. The substation facility consists of the section switch, disconnecting switch, link breaker, transformer, protective relay, control equipment, measurement equipment and low-voltage power distribution equipment, and it must be designed so as to ensure safe and secure distribution of the electricity supplied by the power company.	

No.	Equipment name	Outline	Reference photo
2.	Diesel generator	Diesel generators need to be installed to ensure a continued power supply in the event of a planned or unexpected outage of commercial power. The choice of model should be determined on the basis of the maximum rate power value of the power source of the equipment to be backed up (equipment that would suffer particularly severe damage if stopped during a power supply failure) and the necessary backup time. Selection of the specification and type should take into account the altitude of the installation site, noise reduction measures, exhaust gas control measures, footprint, cooling system, vibration reduction measures, fuel efficiency, etc. In order to respond instantly to an unexpected power cut at night, an automatic switching system should be introduced rather than manual switching.	
3.	Power distribution panel	In order to avoid equipment damage, power leakage and fire caused by overloading of the link resulting from multiple connections, the power link should be branched out by providing an earth leakage link breaker of a capacity appropriate to each piece of equipment. The capacity and number of the earth leakage link breakers should be determined according to the equipment on site.	
4.	Auto voltage regulator (AVR)	To prevent equipment stoppage and malfunction, it is necessary to ensure power supply remains stable even though the input voltage fluctuates, and for this purpose, an auto voltage regulator (to stabilize alternating current) should be installed. Selection of the model should take into account the capacity, input voltage, output voltage, output voltage accuracy, response time, etc. of the equipment to be operated.	
5.	Uninterruptible power supply (UPS)	The selection of model should be determined on the basis of the maximum rate power value of the power source of the equipment to be backed up (equipment that would suffer particularly severe damage if stopped during a power supply failure) and the necessary backup time. As a UPS stores electricity in the battery and supplies the electricity to equipment during a power outage, it repeatedly recharges and discharges electricity. Therefore, the battery has a limited lifespan and needs to be replaced regularly. An economic UPS should be selected, taking into consideration, among other factors, the frequency with which the battery will need to be replaced.	
6.	Lightning transformer	A lightning transformer protects the broadcasting equipment power source by isolating a lightning surge from the power source in the equipment room. It should be preferentially designed for the equipment that would suffer particularly severe damage if stopped during a power supply failure. The grounding specification has a great impact on the performance of the lightning transformer, and as such, its adoption needs to be considered. Normally, a model should be selected that is suited to the capacity of the uninterruptible power supply (UPS) in the next stage.	

Source: JICA Study Team

(4) Capacity of Selected Equipment

Based on the outline in (3) above, the capacity of the power system equipment at each transmitting station or equipment installation site should be as indicated in Table 7.4-11 below. Figure 7.4-30 shows the proposed power system diagram.

Power system equipment for Lotus tower need to be addressed based on the discussion within the Sri Lanka side.

Table 7.4-11 Power Supply Equipment List

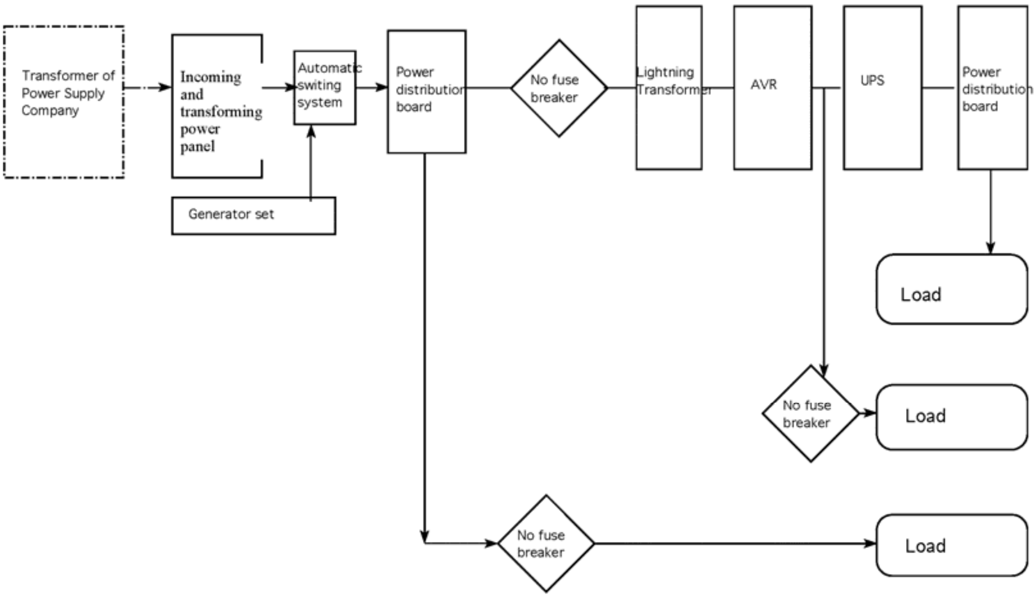
Transmitting station name/ Equipment installation site	Diesel generator for general power outage	Lightning transformer	AVR	UPS
Jaffna	100 kVA	100 kVA	100 kVA	80 kVA
Kokavil	450 kVA	400 kVA	450 kVA	400 kVA
Colombo Lotus Tower	450 kVA	400 kVA	-	400 kVA
Colombo DBNO	Power supply of Lotus Tower to be used.			
Yatiyantota	200 kVA	250 kVA	200 kVA	200 kVA
Pidurutalagala	100 kVA	100 kVA	100 kVA	80 kVA
Nayabedda	275 kVA	250 kVA	300 kVA	240 kVA
Gongala	125 kVA	160 kVA	150 kVA	120 kVA
Karagahatenna	450 kVA	400 kVA	450 kVA	400 kVA
Hunnasgiriya	125 kVA	160 kVA	150 kVA	120 kVA
Vavuniya	125 kVA	160 kVA	150 kVA	120 kVA
Trincomalee	125 kVA	100 kVA	100 kVA	80 kVA
Elpitiya	100 kVA	100 kVA	100 kVA	80 kVA
Suriyakanda	125 kVA	160 kVA	150 kVA	120 kVA
Deniyaya	As existing equipment will be used, there is no need to install new equipment.			
Primrose	As existing equipment will be used, there is no need to install new equipment.			
Hanthana	As existing equipment will be used, there is no need to install new equipment.			
SLRC	1,000 kVA	1,500 kVA	1,500 kVA	1,500 kVA

Note 1) For Kokavil Transmitting Station, use of the existing TRC facility is being considered and the Sri Lankan side is carrying out studies as to whether it is also possible for the existing air conditioner and diesel generator to be used. If it is possible to use the existing equipment, it will not be necessary to procure power system equipment.

Note 2) The SLRC entry shows the power system equipment needed for the TV studio equipment and master control system.

Note 3) An isolation transformer instead of a lightning transfer is expected to be used in Lotus Tower.

Source: JICA Study Team



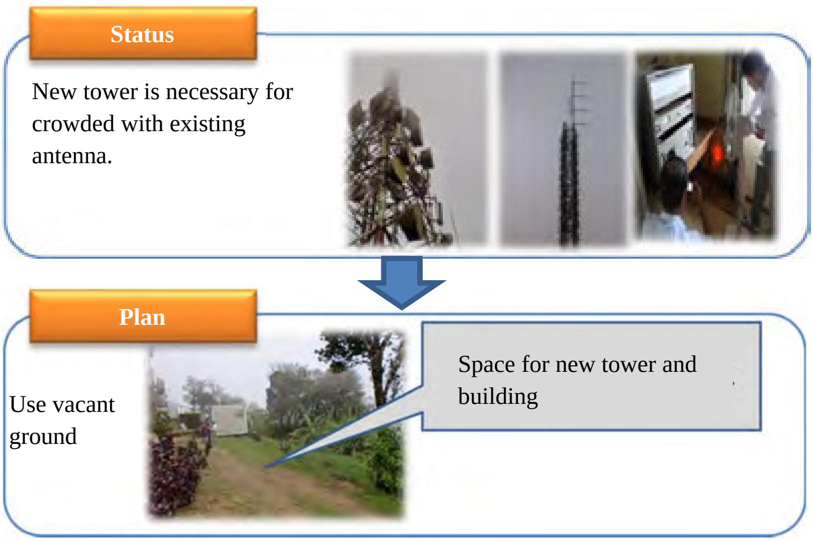
Source: JICA Study Team

Figure 7.4-30 Power System Diagram (Proposed)

7.5 Construction Plan

7.5.1 Transmitting Station Construction Plan

It is considered that in principle the UHF antenna system used for DTTB should be installed on the existing tower. However, if lack of space makes installation on the tower impossible (See Figure 7.5-1) or if the tower is not strong enough and cannot be sufficiently reinforced, it will be necessary to construct new towers. Since the new towers, if they are needed, are to be built adjacent to the existing towers in most cases, they should be designed to minimize the impact of fluctuation in the coverage area caused by antenna directionality (Candelabra Effect), ensuring that there is enough distance to avoid interference between the new and existing towers.



Source: JICA Study Team

Figure 7.5-1 Examples of Existing Antennas and New Antenna Installation at Adjacent Sites

Currently, in this project, the construction of new antenna towers is planned at nine locations, namely, Jaffna, Trincomalee, Vavuniya, Gongala, Elpitiya, Suriyakanda, Yatiyantota, Nayabedda and Pidurutalagala.

Basically, new transmitting station buildings should be of space-saving two-story concrete structure with a transmitter room and living quarters on the second floor, as well as UPS and other power supply equipment on the first floor. In addition, since transmitters of 2kW or more are the possibility of water-cooled, a heat exchanger is installed outdoors. As digital transmitters, unlike in the past, are basically monitored and controlled with no human involvement, transmitting stations where small and medium power transmission systems are installed should not be provided with accommodation facilities. In addition, the equipment and systems should be so designed that the whole transmitting station can be operated quietly via unmanned monitoring. However, it was decided that a nap room should be provided for emergencies.

The major equipment to be installed at the transmitting station consists of four transmitters that will be operated from the start of DSO-SD broadcasting until the start of DSO-HD, a combiner to synthesize four radio waves, a coaxial switching unit, a dummy load, a transmission link unit (optical terminal or microwave transmitter) and a UPS. To make it possible for the number of broadcasting waves to be increased when SD broadcasting switches to HD broadcasting in the future (the use of eight waves is planned in this project), the size of the station building was looked at to ensure the provision of enough space for the installation of four sets of transmitting equipment. It was decided to also install ancillary facilities, such as a dehydrator, a power distribution panel and an air conditioner.

The amount of space required for installation varies depending on the transmitter output: the transmitter output of each transmitting station is as indicated in the table below and as described in Section 7.4.2 Transmitting Equipment System. Field reconnaissance conducted by the Study Team revealed that of the existing station buildings, those of five transmitting stations, namely, Deniyaya, Primrose and Hanthana, which are gap-filler stations with an output of 10W, and Kokavil could be used and that new buildings would be needed for the other stations. Notes have been added where caution is required at the construction sites of transmitting stations where a new tower and station building are needed.

At the time of detailed design, it will be necessary to carry out surveys, such as plane table surveys and ground surveys, of the transmitting stations where new towers need to be built. A surveyed site may be determined unsuitable for the construction of a tower, in which case, an alternative site must be found immediately.

Table 7.5-1 Transmitter Output and Transmitting Stations

Transmitter output	Station name	Installation space required
5kW	(Colombo (As the Lotus Tower will be used, a separate study is being carried out by the Sri Lankan side.)	10m x 10m
3kW	Kokavil: The existing tower will be used.	10m x 8m
	Nayabedda: New construction Space for new construction will be secured in a tea plantation nearby.	
	Karagahatenna: The existing tower will be used. If the existing antenna tower is used, space for the construction of a new station building can be made by relocating the car park next to the existing station building.	
2kW	Yatiyantota: Space for the construction of a station building and new antenna tower are ground of ITN.	10m x8m
1kW	Vavuniya: The existing tower will be used.	9m x 7m
	Suriyakanda: New construction State-owned land nearby could be available for space of new construction.	
	Trincomalee: New construction Space for the construction of a station building is available in the grounds of a temple, which is the candidate site for the construction of new antenna tower.	
	Gongala: New construction A new tower and station building should be built in front of the meteorological radar site. If this is impossible due to interference, etc., a new antenna tower should be constructed in the vicinity of the EAP transmitting station building and a new station building next to it. (Coordination with the Sri Lanka government will be necessary.)	
	Hunnyasugiriya: The existing tower will be used. If the existing ITN antenna tower is used, space for the construction of a new station building is available next to the existing station building. Details should be determined at the implementation stage.	
500W	Jaffna: The existing tower will be used. If the existing SLT antenna tower is used, there is a vacant lot available for the construction of a new station building around the tower. Details should be confirmed at the implementation stage.	9m x 7m
300W	Elpitiya: New construction An antenna tower and a new station building should be built side by side. Details should be confirmed at the implementation stage. Land which is managed as estates could be available for space of new construction.	9m x 7m
	Pidurutalagala: The existing tower will be used. If the existing SLRC antenna tower is used, there is space available for the construction of a new station building around the tower.	
10W	Deniyaya (the existing tower to be used or Panzer Mast, etc.), Primrose (the existing tower to be used or Panzer Mast, etc.), Hanthana (the existing tower to be used or Panzer Mast, etc.) After radio waves have been emitted from the other 13 stations and the propagation status has been confirmed, exact locations will be determined and at the same time the type of tower type will be determined. Currently, use of the existing tower is considered the first preference.	4m x 4m

Source: JICA Study Team

7.5.2 Construction of DBNO Administration Building

The NOC of the DBNO will be installed within the Lotus Tower, but the Lotus Tower does not have enough space to accommodate the other offices of the DBNO. Therefore, the construction of a separate DNBO administration building is planned. It is assumed that the construction site will be next to the TV studio station building within the grounds of SLRC.

The construction costs were estimated, calculating the area required on the assumption that the following DBNO personnel will work in the administration building.

- Officers: 1 chairman, 1 director general, 1 director in charge of marketing, 1 director in charge of technical affairs
- Secretary: 1 for officers
- Administration section staff: 18
- Marketing section staff: 5
  (Technical section staff: 9 broadcast video monitoring engineers, 8 multiplexing engineers, and 8 technology development staff, for a total of 51 staff in the Lotus Tower.)
- Estimated floor area: 2,000 m^2
- The building should be a two-story, reinforced concrete (RC) structure.
- As it is possible for the building to be constructed by contractors and plumbers engaged in Sri Lanka, the cost was estimated on this assumption.

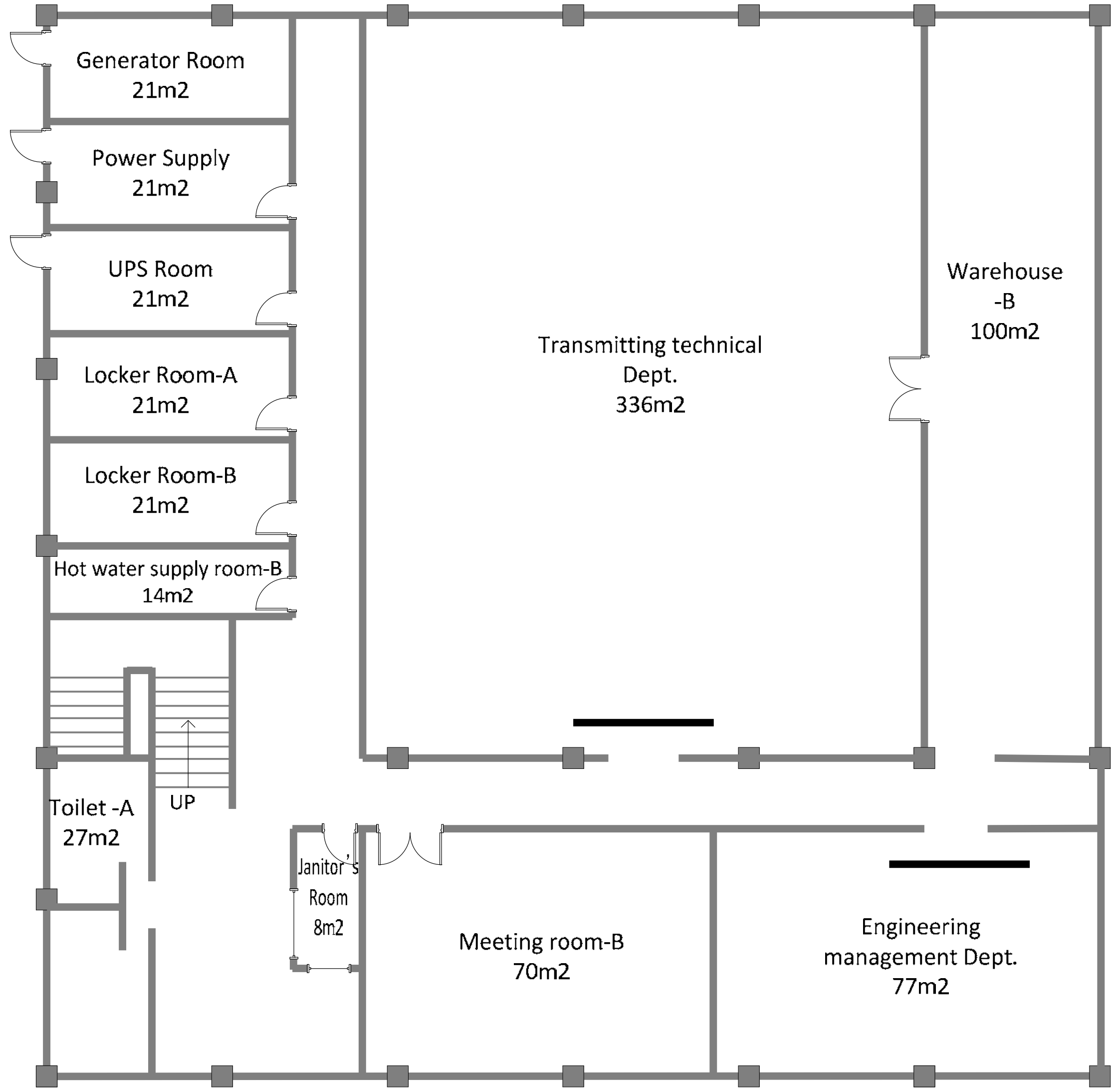
The office area excluding the area of officers' offices needs to be calculated according to the number of personnel and the size of OA equipment, and the calculation was based on desk size per person, the operating range of the chair and the aisle width. The aisles in the office should be about 1.2m wide to ensure that two persons can pass each other. Assuming the desk size to be 1,800mm (width) x 700mm (depth) and the operating range of the chair to be 500mm, 3,000 x 1,800 = 5.4m^3. There are no legal guidelines for determining office area even in Japan, but Chapter II of the Ordinance on Health Standards in the Office (Ministry of Labor Ordinance No. 43 of September 30, 1972), "Environmental Control of Office Rooms Article 2 (Air Volume)" stipulates "The employer shall make the air volume of the rooms in which workers are regularly engaged in their work, excluding the volume occupied by facilities and the space at a height exceeding 4m from the floor surface, 10m^3 or more per worker". Assuming that the ceiling height of the room is 2.8m, 10m^3÷2.8m = 3.57m^2. Accordingly, 5.4m^3+3.57 m^2= 8.97m^2 is the area required per person, and in view of the content of work to be carried out in the office, the area required was estimated at 8 – 11m^2/person.

An outline of the building, based on the above, is shown in Table 7.5-2. In addition, Figures 7.5-2 and 7.5-3 show floor plan examples for the first and second floors of the DBNO administration building.

Table 7.5-2 Material for Consideration of Area of Head Office Building of Digital Broadcasting Network Operator (DBNO)

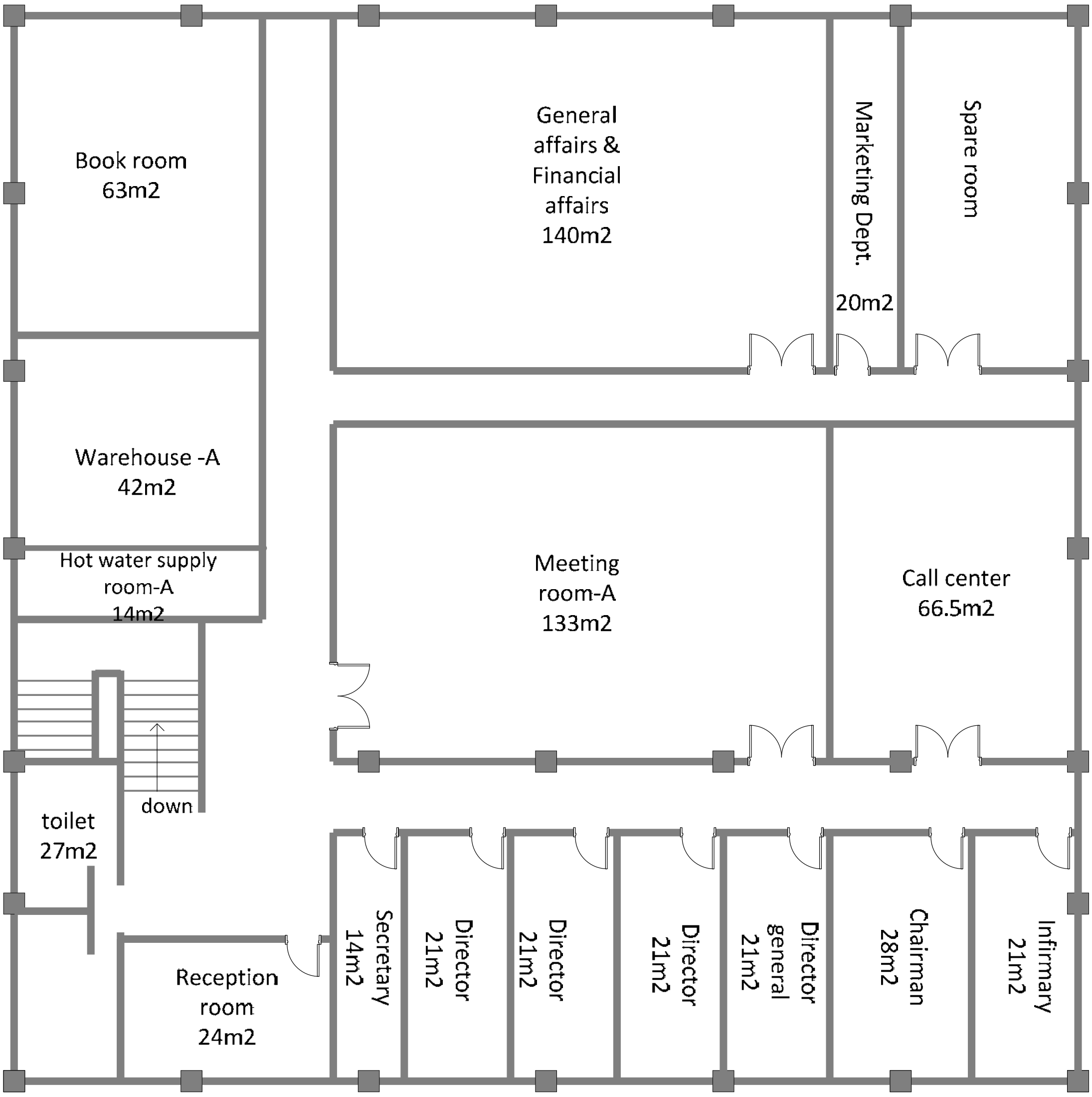
Section name	Room name	No. of personnel	Length	Width	Area	First floor	Second floor
Officers' Offices	Chairman's Office	1	7	4	27.00		27.00
	Director General's Office	1	7	3	21.00		21.00
	Reception Room		6	4	24.00		24.00
	Office of Director in charge of Marketing	1	7	3	21.00		21.00
	Office of Director in charge of Technical Affairs	1	7	3	21.00		21.00
	Office of Director in charge of Administration	1	7	3	21.00		21.00
	Secretarial Room	1	7	2	14.00		14.00
Administration	General Affairs & Financial Affairs Dept.	16	10	14	140.00		140.00
Marketing	Marketing Dept.	2	10	2	20.00		20.00
	Call Center	9	9.5	7	66.50		66.50
	EPG Production Dept.	(5)	Within Lotus Tower				
Technical	Distribution & Operations Dept.	(20)					
	Technical Management Dept.	8	7	11	77.00	77.00	
	Transmission Engineering Dept.	40	21	16	336.00	336.00	
Others	Toilet (A)		9	3	27.00	27.00	
	Toilet (B)		9	3	27.00		27.00
	Kitchen (A)		2	7	14.00		14.00
	Kitchen (B)		2	7	14.00	14.00	
	Meeting Room (A)		9.5	14	133.00		133.00
	Meeting Room (B)		7	10	70.00	70.00	
	Spare Room		10	5	50.00		50.00
	Equipment Warehouse (Warehouse B)		21	5	105.00	105.00	
	Fixture Warehouse (Warehouse A)		6	7	42.00		42.00
	Stack Room		9	7	63.00		63.00
	Locker Room (A)		3	7	21.00	21.00	
	Locker Room (B)		3	7	21.00	21.00	
	Infirmary		7	3	21.00		21.00
	Generator Room		3	7	21.00	21.00	
	Power Supply Room		3	7	21.00	21.00	
	UPS Room		3	7	21.00	21.00	
	Workshop	Within Lotus Tower					
	Nap Room						
	Janitor's Room		4	2	8.00	8.00	
	Corridors, staircases				332.5		
Total		105			1800	742	725.5

Source: JICA Study Team



Source: JICA Study Team

Figure 7.5-2 First Floor of DBNO Building



Source: JICA Study Team

Figure 7.5-3 Second Floor of DBNO Building

7.5.3 Construction of Digital Broadcasting Center

With the start of DTTB, a digital TV center with studio equipment for HD broadcasting should be constructed.

The studio equipment needs to be planned so as to enable the smooth planning, discussion, rehearsal, recording, editing and distribution of TV programs. The detailed specifications will be determined at the time of the development of employer's requirement in this project, but an outline of the specifications as described below was studied, assuming a total floor area of approximately 3,000m^2. Table 7.5-3 indicates the floor area for each studio and other work room.

(i) A vacant lot within the current grounds of SLRC is the candidate construction site. (It is located to the right of the existing TV studio building, opposite the gate.)

(ii) The building should be made of steel-frame reinforced concrete, and it should basically be a one-story building, but depending on the available area of the planned construction site, it may be designed as a multi-story building.

(iii) For the production of programs, a No. 1 HD studio (400m2), No. 2 HD studio (200m2) and an HD news studio (100m2) should be provided, and rooms ancillary to the studios, such as an art warehouse, stage setting warehouse, equipment room, greenroom, staff room, wardrobe and make up room, should be positioned around the studios.

(iv) The master control system should be placed adjacent to the studios, taking into consideration the location of each studio.

(v) As engineers monitor the programs from three systems in the master control system, this room should be considered as living quarters. Therefore, the operations monitoring room and the space for the installation of equipment should be separated so that the temperature can be controlled separately. Also, to avoid interference with the program audio from other systems, as a soundproofing measure, the operations monitoring room should be divided by system.

(vi) With respect to the No. 1 HD studio, No.2 HD studio and HD news studio, in addition to the studio floor, there should be a sub-control room provided with equipment for image switching, image control, audio control, sound effect and lighting control, and with an intercom installed.

(vii) The studios should be designed as state-of-the-art studios, with adequate consideration given to acoustics, noise, vibration, the electromagnetic environment, fire-fighting system and floor structure.

(viii) In order to set up a power supply system enabling large-capacity power consumption and ensuring a stable power supply, the studios should include space for the installation of a diesel generator, lightning transformer, voltage regulator, uninterruptible power supply, etc.

Table 7.5-3 Floor Area of Each Work Room

Item	Area (m^2)	Width (m)	Depth (m)	Height (m)	Remarks
No. 1 HD Studio	400	20	20	10	
Studio Equipment Room	25	5	5		
Sub-control Room	50	5	10		
Audio Control Room	25	5	5		
No. 2 HD Studio	200	10	20	8	
Studio Equipment Room	25	5	5		
Sub-control Room	50	5	10		
Audio Control Room	25	5	5		
HD News Studio	100	10	10	6	
Master Control System	200	20	10		
Stage Setting Room	240	30	8	6	
Make Up Room No.1	24	3	8		
Make Up Room No.2	24	3	8		
Meeting Room	32	8	4		
Rehearsal Room	150	15	10		
Staff Room	40	10	4		

Item	Area (m^2)	Width (m)	Depth (m)	Height (m)	Remarks
Toilet No.1 (for men)	32	8	4		
Toilet No.2 (for women)	32	8	4		
Kitchen No.1	100	10	10		
Kitchen No.2	100	10	10		
Reception Lobby	75	5	15		
VIP Room	24	6	4		
Equipment Room	40	8	5		
Program Storage Room	72	6	12		
Workshop	150	15	10		
Editing Room No.1	9	3	3		
Editing Room No.2	9	3	3		
Editing Room No.3	9	3	3		
Editing Room No.4	9	3	3		
Editing Room No.5	9	3	3		
Editing Room No.6	9	3	3		
Editing Room No.7	9	3	3		
Editing Room No.8	9	3	3		
Editing Room No.9	9	3	3		
Editing Room No.10	9	3	3		
Power Supply Room	36	6	6		
UPS Room	36	6	6		
Corridor	120	40	3		
Office space	300	10	30		
Generator Room	150	10	15		Outside the studio building
Car park					Basement car park
Total	2,967				

Source: JICA Study Team

7.6 Operation of DBNO

7.6.1 Organizational Structure

The Government of Sri Lanka is planning to conduct a meticulous and detailed review into the organizational structure of the DBNO. According to the MMI, it will be examined in line with the law relating to the establishment of the DBNO. On the other hand, on the basis of the surveys conducted so far, the Study Team has formulated a tentative proposal for the organizational structure of the DBNO as required for the operation of the DTTB Platform studied in this survey. Figure 7.6-1 below shows the organizational chart proposed by the Study Team.

Source: JICA Study Team

Figure 7.6-1 Proposed Organizational Chart of DBNO

7.6.2 Structure for Operation and Management of Each DBNO Division

Shown in Table 7.6-1 is the assignment of staff necessary for the operation and management of the DBNO proposed by the Study Team on the basis of the above organizational structure and the outline of the equipment to be procured in this project. It is estimated that a total of 105 members of staff will be needed. They may be seconded or transferred from existing broadcasting stations or newly recruited.

The major job description of each division is given in Table 7.6-1. The specific operational structure of the divisions is described below.

(1) Administration Division

1) General Affairs Department

The General Affairs Department is responsible for general affairs, procurement management and legal affairs.

2) Financial Affairs Department

The Financial Affairs Department is responsible for funding and accounting.

(2) Marketing Division

1) Marketing Department

The Marketing Department is in charge of customer development and handling customers.

2) Call Center

The Call Center responds to telephone inquiries from viewers, using a call center system.

As a substantial number (about 100) of staff will be needed to respond to the surge of inquiries when ASO is implemented, it is planned to outsource staff for response to the surge.

3) EPG Production Department

This Department collects several weeks' worth of TV program information from each broadcasting station, summarizes it into a week-long file and generates the EPG signals to broadcast.

(3) Technical Division

1) Distribution & Operations Department

This Department is responsible for monitoring the programs delivered from broadcasting stations, the operation and maintenance of program multiplexers and the monitoring of the output of the multiplexers.

2) Transmission Engineering Department

The Transmission Engineering Department is divided into a group that monitors the state of operation of the DBNO transmitters located around the country and a group that is in charge of the operation and maintenance of the DBNO transmitters. The operation and maintenance group is subdivided into regional sections, namely, the Metropolitan area, Northern area, Western/Eastern area, Southern area and Central Mountain area.

3) Technical Management Department

The Technical Management Department is in charge of technological development, DBNO equipment renewal planning, and transmission equipment planning and license management.

Table 7.6-1 DBNO Personnel Assignment (Proposed)

Section	Title	Division	Unit/In charge	Major responsibilities	Personnel (full-time)
1. Officer	Representative Director				1
	Officer in charge of Administration				1
	Officer in charge of Marketing				1
	Officer in charge of Technical Affairs				1
	Secretary				1
	Total				5
2. Administration	Division Director			Post filled by Officer in charge of Administration	
		General Affairs	General affairs	Administration, general affairs, external affairs, personnel and salary management, PC system	6
			Procurement management	Equipment procurement and management	3
			Legal affairs	Contracts and other legal affairs	1
		Financial Affairs	Funding	Fund planning, revenue, expenditure and sales management	4
			Accounting	Ledger management, cost management, creation of financial statements, response to accounting audit	4
	Total				18
3. Marketing	Division Director			Post filled by Officer in charge of Marketing	
		Marketing		Customer development and response to customers	2
		Call Center		Responding to viewers' inquiries	8
		EPG Production		Collection of EPG data, EPG production	4
	Total				14
4. Technical	Division Director			Post filled by Officer in charge of Technical Affairs	
		Distribution & Operation		Checking and multiplexing of input signals	20
		Transmission Engineering			
			Monitoring transmitter operation	Central monitoring room	20
			Metropolitan area	Operation and maintenance of transmitters	4
			Northern area	Operation and maintenance of transmitters	4
			Western and Eastern area	Operation and maintenance of transmitters	4
			Southern area	Operation and maintenance of transmitters	4
			Central Mountain area	Operation and maintenance of transmitters	4
		Technical Management		Technology development, renewal planning, installation planning, license management	8
	Total				68
Grand total					105

Source: JICA Study Team

7.6.3 Professional Skills of DBNO Personnel

As the officers/division directors will play a pivotal role in the management of the DBNO, all of them should have at least graduated from graduate school and have at least 15 – 20 years of experience in the work that they will be in charge of. Requirements of the staff of each division are described below.

(1) Administration Division

For this division to function as a support organization ensuring the smooth operation of the DBNO, the staff should be university graduates with at least five years of work experience.

(2) Marketing Division

The staff of this Division will often need to communicate with people, as they will be responsible for customer development and responding to viewers. They should be university graduates with at least five to ten years of work experience.

(3) Technical Division

1) Distribution & Operation Department

The staff of this Department should be communications engineers with advanced knowledge of electro-communication technology and they should have at least three or four years of work experience in this field. As this Department needs to deal with a wide range of technologies, such as multiplexing, encoding and compression, they are also required to have practical work experience in the operation and maintenance of communications equipment.

2) Transmission Engineering Department

The staff of this Department should be transmission engineers with advanced knowledge of analog transmission technology, hold a transmitter license issued by the Government of Sri Lanka, and have at least five years of work experience in this field.

Since it will be difficult to develop human resources for the Center in a short period of time, transmission engineers seconded or transferred from existing broadcasting stations may be employed.

3) Technical Management Department

The staff of this Department should be engineers with advanced knowledge of communications technology, transmission technology and multiplexing technology, and they should have three or four years of work experience in this field.

7.6.4 Operation and Maintenance Costs

The costs required for operation and maintenance of the DBNO are divided into the following seven categories for calculation; (1) Personnel costs (2) Electricity costs (3) Repair and maintenance costs (4) Tower rental fees (5) SLT optical fiber link fees (6) Frequency license fees (7) Other expenses.

Details of the grounds on which each cost category and annual costs are calculated are given below.

(1) Personnel Costs

Personnel costs are calculated as shown in Table 7.6-2, in accordance with the organization and personnel assignment of the DBNO as planned in Sections 7.6.1 and 7.6.2.

Table 7.6-2 Calculation of Personnel Costs

Basic item	Remarks	
1. Number of personnel[1)]	Board of directors	5
	Administration Division	18
	Marketing Division	14
	Technical Division	68
	Total	105
2. Monthly salary [2)] (Rs. 000)	Officers	130 to 150
	Engineers	100
	Assistant engineers	50
	Other staff	30
Annual personnel cost [3)]	Rs. million	90.2

Notes and Source: 1) Sections 7.6.1 and 7.6.2, 2) JICA Study Team, based on information from SLRC and ITN 3) JICA Study Team; addition of 10% to basic salary taking into consideration salary additions such as pension, fringe benefits, overtime allowance, the 13th month salary, etc.

(2) Electricity Costs

Based on the kVA of the transmitters planned to be installed in the DBNO Head Office and other transmitting stations, electricity consumption is calculated by multiplication, taking power conversion efficiency as 0.7 and operating hours as 19 hours per day. At the same time, the electricity rate is assumed to be Rs. 29/kWh, with reference to past data of the SLRC Head Office and transmitting stations.

The fuel costs for power generation were not taken into account in this survey, as the amount is minimal according to the past SLRC and ITN data.

Based on the above, the annual electricity costs in 2018, when DSO-SD will start across the country, are calculated to be Rs.149 million.

(3) Repair and Maintenance Costs

The repair and maintenance costs should be calculated for the following four items, namely, 1) maintenance work and parts procurement, 2) Tower painting, 3) Overhaul and 4) Equipment renewal.

1) Maintenance Work and Parts Procurement

Table 7.6-3 shows the calculation of the maintenance and parts procurements costs.

Table 7.6-3 Calculation of Maintenance and Parts Procurement Costs

(Rs. million)

Basic item	Remarks	Person/ month	Rs./person/ month	Cost/year
1. Maintenance work	Transmitter, antenna, electrical equipment	6	7,000	4.2
2. Parts procurement	0.1% of the initial investment on equipment			6.6
Annual maintenance and parts procurement costs				10.8

Source: JICA Study Team

2) Tower Painting

With reference made to information from Japanese companies, it was decided that the towers should be painted every ten years. The costs consist of the cost of paint, labor and accommodation. The calculation results are shown in Table 7.6-4.

Table 7.6-4 Calculation of Tower Painting Costs

(Rs. million)

Basic item	Remarks		Cost/10 years
1. Cost of paint	Painted area	1,500m^2/tower	2.8
	Painting frequency	3 times/tower	
	Paint volume	800 liters/tower	
	Paint price	Rs. 3,500/liter	
2. Cost of labor	Number of workers	6/tower	2.5
	Number of work days	70 days/person	
	Wage	Rs. 3,000/day	
3. Cost of accommodation	Rate	Rs. 2,000/day	0.8
4. Cost per tower (Rs. Million)			5.5
Painting costs for 11 towers for every ten years			67.5

Source: JICA Study Team

3) Overhaul

Overhaul work should be carried out every seven years, not including renewals. The cost should be 3% of the initial equipment investment. Table 7.6-5 shows the calculation results.

Table 7.6-5 Calculation of Overhaul Costs

(Rs. million)

Basic item	2024	2031	2038	2045
1. Transmitter	145	145	-	29
2. Other equipment	29	-	29	-
Overhaul cost by year	174	145	29	29

Source: JICA Study Team

4) Equipment Renewal

With reference to information from Japan, the JICA Study Team calculated the equipment renewal costs on the assumption that the transmitters and other equipment will be renewed in the 21st and 14th years respectively. The calculation results are shown in Table 7.6-6 below.

Table 7.6-6 Calculation of Equipment Renewal Costs

(Rs. million)

Basic item	2031	2038
1. Transmitter	-	4,822
2. Other equipment	977	-
Equipment renewal cost by year	977	4,822

Source: JICA Study Team

(4) Tower Rental Fees

In this project, it is planned that the DBNO will rent three towers, namely, (1) the Kokavil Tower owned by TRC, (2) the Karagahatenna Tower owned by ITN and (3) the Lotus Tower. The rental fees are calculated as shown in Table 7.6-7, with reference to the track record of SLRC and ITN.

The rental fee for the Lotus Tower is provisionally assumed to be five times greater than the rental fee for (1).

Table 7.6-7 Calculation of Tower Rental Fee

(Rs. million)

Tower name	Item	Rental fee/month	Rental fee/year
1. Kokavil Tower (TRC)	1) Renting of tower	0.1	1.2
	2) Renting of transmitter installation site within station building	0.05	0.6
2. Karagahatenna Tower (ITN)	1) Renting of tower	0.1	1.2
3. Lotus Tower (TRC)	1) Renting of tower Five times greater than the rental fee for Kokavil Tower (assumed)	0.5	6.0
Annual rental fees		-	9.0

Source: JICA Study Team

(5) SLT Optical Fiber Link Fees

Details of the DTTB network are as given in Sections 7.2.6 and 7.4.4. Optical fiber is one of the important means of connection to this network. In this project, it is planned that the DBNO will use the optical fiber links owned by SLT, and the usage fees are calculated as shown in Table 7.6-8.

Table 7.6-8 Calculation of Usage Fees of SLT-Owned Optical Fiber Links

Basic item	Usage fee/month (Rs. 000)	Usage fee/year (Rs. million)
1. Program collection link (Individual broadcasting station → DBNO)	130 / channel	35.9
2. Program distribution link (DBNO → Individual transmitting station)		
(1) Kokavil	1,673	20.1
(2) Trincomalee	1,772	21.2
(3) Yatiyantota	1,408	16.9
Annual SLT link usage fees		94.1

Source: JICA Study Team, based on information from SLT

(6) Frequency License Fees

The license fees are calculated in two stages: in the first stage, it is calculated based on the fee table set by the TRC, reflecting (1) the importance of each transmitting station (population coverage, etc.) and (2) the transmission output of each transmitter. In the second stage, the license fees calculated in the first stage are multiplied by two, in view of the complexity of the transmission system of the DBNO. As a result, the license fees are calculated to be Rs. 5 million per year.

(7) Other Expenses

Other expenses are calculated to be Rs 7.5 million per year, estimated as 3% of the total of (1), (2) and (3)-1) above.

7.7 Technological and Other Advantages of Japanese Companies

7.7.1 Need to Ensure Quality and Operational Stability of Digital TV Broadcast Network

The project to be implemented in Sri Lanka to facilitate the transition from terrestrial analog broadcasting to digital broadcasting is based on a policy aimed at simultaneous and comprehensive transition by the state-run broadcasters (SLRC and ITN) and commercial broadcasters, and consists of the establishment of a common DTTB Platform company (DBNO) to support the individual broadcasting stations in the transition to DTTB. As such, the DTTB Platform to be operated by the DBNO constitutes extremely important infrastructure that will be wholly responsible for the distribution of broadcast content to transmitting stations across the country and for terrestrial broadcasting. Accordingly, the key to further growth of the broadcasting industry in Sri Lanka will be signal quality and the reliable, stable operation of the NOC of the DBNO and of individual transmitting stations.

The plan for the transition to DTTB involves the TV studio of each broadcasting station that delivers digitized TV programs, the network to transmit TV programs as a digital signal to the NOC of the DBNO, the NOC that selects and multiplexes the digital TV signals to convert them into a format that can be broadcast, and the transmission network that delivers the multiplexed signals to the individual transmitting stations and gap-filler transmitting stations.

The broadcasting stations and the DBNO need to control the quality of the signal from these broadcasting stations, NOC, transmitting stations and relay stations, as well as part or all of the transmission links (depending on the content of the contract with the telecommunications carrier), and doing so will enable stable broadcasting to be maintained.

In order to facilitate formulation of TV broadcasting networks, technical information is released by the respective broadcast equipment manufacturers, and the manufacturers develop hardware and software for the interface portion to facilitate passing of signals by these devices, but there are many cases of incompatibility at interconnection points when a system is built. Consequently, the building of a TV broadcasting network with equipment/devices for which interconnectivity has been confirmed/corrected based on a proven track record is necessary in order to enable the smooth and sure transition to DTTB.

In order for the state-run broadcasters to play a leading role in digital broadcasting in Sri Lanka, this project also covers the upgrading of their studio equipment so that it can also be used for HD broadcasting services in the future, and thus, it is necessary that the equipment of the studios be upgraded to enable the production of programs of digital broadcasting quality.

7.7.2 Systems and Equipment for which Japanese Companies Have a Technical Advantage

(1) Consideration of the Suitability of Japanese Technology

With respect to ensuring the signal quality and stability described in Section 7.7.1 above, areas where the use of Japanese technology is essential and where such technology is not available from other countries are described in Table 7.7-1 below.

Table 7.7-1 Consideration of Suitability of Japanese Technology in the Establishment of a Digital TV Broadcasting Network

System/equipment name	Details
Transmission link system	The compressor (to be installed within the NOC of the DBNO) used to compress the “broadcasting TS” signals from four program channels and transmit them via the high-speed digital link, and the decompressor to be installed in each transmitting station to expand the compressed “broadcasting TS” signals (with PSI rewriting function), were originally developed by a Japanese companies which also holds the intellectual property rights. The multiplexer that is connected to the compressor needs to be synchronized to the compressor, therefore, manufacturers of multiplexer should be Japanese companies. In addition, the transmitter exciter to be connected to the decompressor also needs to be synchronized and therefore too, a product made by the same company should be procured.
NOC system	The NOC system is an important facility for multiplexing and sending broadcast contents, supplied from the program providers, to the digital transmitters. As NOC will handle all the DTTB contents in Sri Lanka, it needs to be of high reliability and a long life.

System/equipment name	Details
	The system consists of the multiplexer, input and output monitors, EWBS transmitting system, EPG production, equipment monitoring system and call center. This system is specific to Japan, and no other country has such a system. The multiplexer has the function of multiplexing EWBS and EPG information. Although these are commonly used in Japan, other countries do not even have the EWBS and EPG services. With respect to the input and output monitoring, particularly for monitoring the input, it has been decided to adopt a system whereby the quality of the input signals from each program providers are checked. NOC receives and verifies the alarm for the quality of input signals, if any, and if necessary inform to viewers on TV screen. The equipment monitoring system centrally collects and manages information on the status of the transmitters installed across the country and displays the information on a large screen for information sharing. The purpose of this system is to enable quick response and prevent broadcasting errors. The following conditions are needed in order to establish the system described above. ● To deliver the EWBS and EPG information, a multiplexer that is capable of multiplexing the EWBS and EPG information. In addition, EWBS content server and an EPG content server are needed. ● In order to configure a comprehensive system where alarms, such as signal interruption, are detected, captured and then sent to NOC. The distribution system in NOC receives the information via the network to give instructions to operators, it is necessary for the input and output monitoring to be integrated with the protocol for gathering alarms and other information. ● With respect to the equipment monitoring, because the transmitter status need to be monitored by NOC, it is necessary for detailed information to be disclosed to the manufacturer responsible for establishing the system in order for it to be integrated with the protocol. Taking the above into consideration, it is concluded that there is a need for the expertise of Japanese companies with achievements and experience in a wide variety of areas, such as the equipment to be used and system interface protocol, and that no other country has such expertise.
Master control system in SLRC	Sri Lanka has defined SLRC as the benchmark for DTTB and is attempting to establish a system that can be modeled by other broadcasting stations: and the master control system (hereinafter “MCS”) is a key infrastructure of SLRC. In accordance with pre-determined data, in MCS, program content produced at studios, program materials recorded in the server, CM materials, VTR materials and telop materials for text superimposition are edited and switched by the switcher and made to broadcast program contents. This content is sent to NOC as the signal of program channel. Aside from usual broadcast contents, the contents of data broadcasting, which may be linked to or independent of the broadcast content, is multiplexed with the broadcast content and sent to the NOC. To realize such functions, the system needs to be composed of a signal distributor, an automatic program transmission device, program servers, a CM server, a data broadcast transmission server and an alarm-monitoring server. The following conditions are necessary to make up such efficient system with the performances of DTTB, using these devices and system. ● The data format of the playlist and data broadcasting should be standardized to enable central management of the data.

System/equipment name	Details
	● The control protocol for each device and system should be standardized. ● The protocol for gathering alarm and other status information should be integrated for centralized alarm monitoring. ● The data need to be controlled centrally as they include information through which the automatic program delivery device directly controls the multiplexer. ● Not a few manufacturers have proposed different protocols for the gathering of alarm status, in order to promote the features of their own products. As understanding by above investigation, equipment which composes DTTB system are requested to have the functions and performances necessary for the total system operation for to realize such system, the expertise of Japanese companies with a wide range of achievements and experience is necessary: no other country has such expertise.
High power transmitter system	The high power transmitter system (1kW or higher) includes an exciter with a distortion compensation function in the pre-stage to compensate for the distortion generated in the power amplifier to the whole transmitter system. Therefore, exciter manufacturers have the advantage when it comes to supplying the system.

Source: JICA Study Team

(2) Enhancement of Unique Digital Broadcasting Services

In addition to providing high quality video and audio, the ISDB-T system also enables a wide variety of services, such as (i) the provision of mobile reception services by One-seg broadcast (ii) the enrichment of broadcast content via data broadcasting and the provision of interactive services (iii) utilization as a tool for contingencies by the EWBS delivery system. The DTTB Platform is required to not only ensure signal quality and stability but to also provide multi-faceted services, while minimizing operating costs. The provision of such services requires the technological competence and achievements of Japanese companies, as outlined below.

1) Achievement of Mobile TV/Portable TV Handset Reception Service

One-seg broadcasting is based on the “Segment Transmission System” which is a feature of the ISDB-T system. Accordingly, stable operation of broadcast program generation, multiplexing, transmission network and transmission based on the ISDB-T system are indispensable. Therefore, the utilization of the technology of Japanese companies is indispensable for the reasons outlined in Table 7.7-1.

2) Enhancement of Data Broadcasting Services

In addition to providing supplementary information for TV broadcast programs, data broadcasting is an indispensable tool for the provision of weather, news, economic information and the diversification of services. In addition, education, regional and other such services utilizing data broadcasting functions are considered to be an effective means to resolving the digital divide.

Japan stands out in terms of the use of data broadcasting in digital broadcasting. In many countries where the transition to digital broadcasting is complete, data broadcasting still remains a teletext service. In order to establish a data broadcasting system that includes production tools (called authoring terminals) in particular, it is essential that the technology of Japanese companies (manufacturers, software houses, and broadcasting stations) be utilized.

3) Establishment of EWBS Delivery System

The importance of early warnings for an emergency or disaster is becoming widely recognized overseas as a result of the Great East Japan Earthquake of March 2011. Japan which is an earthquake prone country has suffered many disasters caused by earthquakes and tsunamis since ancient times. Due to this background, broadcasting stations implemented a system from September 1985 during the age of analog broadcasting under which special signals called emergency warning signals are broadcast after fronting in an emergency in order to protect people's lives and property. Called the "Emergency Warning Broadcasting System" (EWBS), this system automatically switches on TVs and radios that are in the standby mode and relays tsunami and earthquake warnings. In the event of a major disaster such as a large earthquake or when a tsunami warning is issued, broadcasts are limited to announcement of tsunami or other warnings with the objective of preventing or minimizing loss of life and property damage.

In Japan, wide-ranging measures are being considered in preparation for the long-predicted Tonankai Earthquake, and efforts are being made in the field of broadcasting to establish an early warning system centered on broadcasting stations. The utilization of the technology of Japanese companies is indispensable in the establishment of the EWBS delivery function.

(3) Long Life

Controlling the operating costs of the DTTB Platform is relevant to the broadcasters, because the DTTB Platform usage fees will affect their operating costs.

Broadcast equipment manufacturers collect Mean Time between Failures (MTBF) data on equipment after it is delivered. The MTBF can be calculated from the failure rate of general parts and the number of parts, but it is also possible to calculate the MTBF from the actual repair records. When the MTBF value determined from actual repair records at Japanese companies is compared with the MTBF value calculated the failure rate of general parts and the numbers of parts, there have been cases in which the actual value is 10 times the calculated value. This means that devices that are designed to fail in 10,000 hours will actually operate 100,000 hours without breaking down. Japanese products and some European products have superior MTBF track record values, but there are occasionally cases in which devices made by other overseas manufacturers have a good calculated MTBF value, but actually have a higher tendency to break down.

In the planning of this project, life cycle costs need to be taken into account in equipment procurement planning, in order to ensure stable broadcasting and efficient equipment maintenance.

(4) Devices that Take Environmental Load into Consideration

1) High-Efficiency Low-Strain Transmitters

Transmitters produced by Japanese manufacturers achieve high-efficiency low-strain in the preliminary exciter, including front-end distortion compensation. In addition to reducing overall power consumption, enhancing the efficiency of transmitters which consume the most power of any device allows a system to be achieved that takes the environment into consideration in which the compact size of the devices enables the station building to be made smaller.

2) Frequency Bandwidth/Number of Transmitter Devices Reduced by Band Compression on Transmission Link

Using the bandwidth compression and expansion devices developed and manufactured by Japanese manufacturers will enable the multiple digital broadcasting TS signals sent from the NOC of the DBNO to each transmitting station to be transmitted over a single standard high-speed digital link (STM-1 standard), resulting in a reduction in the microwave frequency bandwidth for transmission and in the number of transmission devices needed. (See Table 7.7-1.)

7.8 Examination of Project Evaluation Indicators

(1) DTTB Platform Evaluation Indicators

The operation and benefit indicators of this project were examined and the proposed indicators are described in Table 7.8-1. These indicators are set for evaluation to be performed in June 2021, that is, three years after the completion of the project. The downtime ratio of the DTTB Platform transmitter system indicates if stable broadcasting is performed. In light of the nature of the DTTB Platform, this is considered to be an appropriate indicator. It is said that a transmitter is in a period of instability for one or two years after being manufactured due to the so-called bathtub characteristics. This instability period is caused by factors that cannot be completely verified in the stage of manufacturing, which are relevant to the quality of each part and program bugs. Once these factors are eliminated by trouble shooting, the transmitter enters the period of stability, but it reaches the period of instability again nearing the end of the useful life. This operation indicator was examined based on the assumption that these instability factors may be present for three years after the completion of the project and that the manufacturer needs to repair each system once a year, which takes about 30 days.

It should be noted that the whole system is so designed that broadcasting can be carried out without a problem even if such failure occurs.

With respect the number of DTTB program systems (It corresponds to the number of channels in analog broadcasting, but since digital broadcasting involves multiplexing, number of program systems may be more appropriate.), it is important to check how many program systems are actually broadcasted, because in Sri Lanka, there were unfavorable cases where license holders do not carry out broadcasting. In addition, since collection of usage fee is a prerequisite for stable operation of the DTTB Platform, naturally, 100% collection must be aimed at. However, considering the weak financial status of some commercial broadcasters, the target was set to be 70%.

On the other hand, by setting the coverage against population and the number of beneficiaries who are able to receive and view DTTB programs as the benefit indicators, it is possible to check if the essential purpose of this project has been accomplished.

The target value for the coverage against population was set to be 84.5%, because this project is designed in a manner that the coverage against population will be 84.5% by the project completion. As for the number of beneficiaries, as the ASO progress rate varies according to the provinces (See Section 7.3.1), it was decided to calculate the number for each province and obtain the total value. In other words, the target value was set by multiplying the population within province with the ASO progress rate, coverage against population, which is the requirement for implementing the ASO within the province, and household diffusion rate of digital receivers, which should be multiplied by 0.5, considering the rush demand because replacement of receivers tends to concentrate shortly before the ASO.

Table 7.8-1 DTTB Platform Operation and Effectiveness Indicators (Proposed)

<table>
<tr><th>Evaluation indicator</th><th>Indicator</th><th>Unit</th><th>Target value (by 2020)</th></tr>
<tr><td rowspan="3">Operation</td><td>(1) PF transmitter equipment downtime ratio</td><td>(Number of downtime days due to failure x 4 systems x 16 locations)/Planned number of operating days (4 sytems×16 locations)</td><td>8.2%</td></tr>
<tr><td>(2) Number of DTTB program systems</td><td>Number of DTTB program systems/Total number of program systems x 16 locations</td><td>11.1 program systems</td></tr>
<tr><td>(3) PF usage fee collection rate</td><td>Number of collections/ Number of claims</td><td>70%</td></tr>
<tr><td rowspan="5">Benefit</td><td>(1) Population coverage</td><td>Population in covered area/ Total population</td><td>84.5%</td></tr>
<tr><td rowspan="4">(2) Number of beneficiaries</td><td>Population within province x ASO progress rate x Population coverage x Household diffusion rate of TV sets x value considering rush demand for receiver replacement</td><td rowspan="4">2,474,000 persons</td></tr>
<tr><td>(Western Province: 5,837,294 x 0.95 x 0.85 x 0.6 x 0.5)</td></tr>
<tr><td>(Northern and Eastern Provinces: 2,476,840 x 0.6 x 0.7 x 0.4 x 0.5)</td></tr>
<tr><td>(Others : 8,121,321 x 0.6 x 0.7 x 0.5 x 0.5)</td></tr>
</table>

Note 1: PF = DTTB Platform
Note 2: Population coverage = Coverage against population
Source: JICA Study Team

(2) Evaluation Indicators of Digital TV Center

Table 7.8-2 shows the proposed operation and benefit indicators of the digital TV center to be established in SLRC. As the operation indicators, equipment downtime ratio and broadcasting hours of programs produced by using the digital TV center are proposed. With respect to the equipment downtime ratio, applying the same principle as with the DTTB Platform operation indicator, the target value was set based on the assumption that failure requiring repair by the manufacturer, which takes about 30 days, will occur once for each of the three TV studio systems, the OB van and the master control system. Moreover, considering that existing equipment may still be in operation when the benefit is measured due to simultaneous broadcasting of analog and digital broadcasting, the number of programs produced by using the HD system was assumed to be a half of the total.

As the benefit indicator, broadcasting hours of data broadcasting that makes use of the advantage of DTTB was adopted. The target value was set on the premises that throughout the SLRC’s daily broadcasting hours of 19 hours, data broadcasting program linked or not linked with the program is broadcasted.

Table 7.8-2 Digital TV Center Operation and Benefit Indicators (Proposed)

Evaluation indicator	Indicator	Unit	Target value (by 2020)
Operation	(1) Equipment downtime ratio	(Number of downtime days due to failure x 5 systems)/Planned number of operating days x 5 systems)	8.2%
	(2) DTTB hours by HD system	Broadcasting hours/day	10 hours
Benefit	(1) Data broadcasting program broadcasting hours	Number of data broadcasting program broadcasting hours /month (program-linked type and non-program-linked type combined)	570 hours

Source: JICA Study Team

Chapter 8　Project Implementation Plan and Cost

Chapter 8 Project Implementation Plan and Cost

8.1 General

8.1.1 Access to Planned Transmitting Stations

From a simulation analysis of the coverage area, it was planned that the DTTB Platform would be composed of 16 transmitting stations as listed below. Access from the Colombo Port area to each site will be made by truck. It is assumed that equipment will be transported from Colombo to the transmitting stations by truck, and the estimated distance from Colombo Port to each site is given in Table 8.1-1 below.

Table 8.1-1 Estimated Distance from Colombo Port Area to Each Site

Site	Straight line distance km	Distance by road km	Main national highways
Major retransmitting station			
Jaffna	302	396	A-3, 12, 9
Kokavil	265	331	A-3, 12, 9
Colombo (Lotus Tower)	2	3	(A-4)
Yatiyantota	63	80	A-4, 7 B-482
Pidurutalagala	103	205	A-1, 5
Nayabedda	130	220	A-1, 5, 16
Gongala	108	170	A-2, 17
Karagahatenna	120	165	A-1, 9
Hunnasgiriya	105	150	A-1, B-461
Vavuniya	214	266	A-3, 12, 9
Trincomalee	234	290	A-1, 6
Elpitiya	80	100	A-2, B-14
Suriyakanda	102	160	A-4, 17
Gap-filler stations			
Deniyaya	105	180	A-4, 17
Primrose	92	120	A-1
Hanthana	95	125	A-1

Note) The precise locations of the gap filler stations have yet to be determined; the distances given in the table are approximate.

Source: JICA Study Team

8.1.2 Transport of Materials and Equipment

After being unloaded at Colombo Port, the materials and equipment will be sorted according to site and transported by road. The road conditions of the national highways are generally good, and trucks hauling containers travel on the two-lane roads. Thus, transport by truck presents no problem. However, road conditions in the tea plantation areas that the trucks will have to pass through to reach transmitting stations in mountainous areas are poor, and in some areas, traffic is limited to two-ton truck. For some sites, an alternative method of transport from Colombo Port may need to be considered, such as reloading out of containers.

8.1.3 Electrical Power for Construction

Sites with existing analog broadcast transmitting stations are supplied with electricity by the Ceylon Electricity Board (CEB) even in mountainous areas including the mountain-top tea plantation areas. Since electricity is transmitted at 11kVA and then reduced to 400V by transformer, it is possible to secure the electricity supply for construction through a contract with the broadcasting stations that operate the existing transmitting stations, and CEB. However, as the construction work may be carried out during a period in which CEB has scheduled planned power outages for its regular maintenance and inspection, the construction contractor will need to prepare a mobile generator. In the northern area where power outages are frequent, it is thought that the construction contractor will have to use the mobile generator as the main power source.

8.1.4 Civil Engineering Construction

For the civil engineering construction, prior to starting the work the contractor is required to submit a construction plan setting out the necessary procedures and construction methods needed to complete the construction, . The contents of this plan are by and large as follows:

(1) Outline of the Construction

In the outline of the construction, the name, location, and period of the construction work are entered, and location drawings, general plans and standard cross-sections are attached. With regard to details of the construction, the construction classification, type of work, volumes, units, quantities, etc., are entered.

(2) Planned Schedule

The planned schedule should be prepared using a network diagram, bar charts, etc. based on the Program Evaluation and Review Technique (PERT), which is a construction management technique indicating the start and the finish of each type of work.

(3) Site Organization Chart

The site organization chart shows the on-site organizational structure, the chain of command, and the allocation of work.

(4) Specified Machinery

This shows the machinery specified in the design documents for use in the construction.

Table 8.1-2 Machinery to be Used in Construction (Example)

Name	Specification	Quantity	Period of use	Remarks
Backhoe	$0.6m^3$	1	Excavation of foundations	
Bulldozer		1		
Crane	50 tons	1	Assembly of tower	

Source: JICA Study Team

(5) Principal Materials

Specified materials and the principal materials used for the construction, material testing methods, quality certification and other methods of quality verification, as well as the timing for confirmation of materials should be set out.

Table 8.1-3 Principal Materials (Example)

Product name	Specification	Anticipated quantity	Manufacturer	Quality certification	Delivery time		
					Month	Month	Month
Angle steel	L100×100	ton	○Processing	Table of test results			
Ready-mixed concrete	21N/mm^2	m^3	○Ready-mixed concrete	Table of test results			
Rebar	D13–D29	ton	○Steel	Mill sheet			

Source: JICA Study Team

(6) Construction Methods

Construction methods will include the following details.

1) Workflow for Each of the Main Work Types

The workflow will be described for each work type.

2) Points to Note in Carrying Out Construction, and Construction Methods

The work environment, such as land-use conditions around each construction site, the natural environment and local conditions, the periods in which major types of work will be implemented and the effects of rainfall and cyclones during those periods should be described. In addition, reference points in preparation for construction and methods of protecting against buried structures and above-ground obstructions should be described.

3) Machinery to be Used

The machinery that it is planned to use for the type of construction work in question should be described.

4) Temporary Facility Layout Plan

The layout plan for the temporary facilities for the whole work should be described in concrete terms, using location diagrams, layout sketches, etc. Temporary structures, such as the site office and workers' quarters, temporary storage yard for materials and equipment, plant and other machinery needed to carry out the work, access roads including temporary and repaired roads, and temporary facilities relating to safety management, such as work-in-progress signs, safety –related signboards wire fences, etc., should also be described.

(7) Construction Management Plan

Management methods, including those listed below should be described in the construction management plan.

1) Schedule Management

The format to be used, *e.g.*, network diagram based on PERT, bar chart, etc. should be described.

2) Quality Control

A Quality Control Planning list should be prepared for the test items in the quality control carried out in the construction work.

3) Work Progress Control

The measurement items in the work progress control carried out during the construction work in question only should be described.

4) Photography Management

The photography management carried out during the construction work should be described.

(8) Safety Management

The persons responsible for safety management, the safety management structure and the safety management action plan should be described. In addition, the method for contacting the relevant organizations and victim's home, etc., in the event of an accident, and emergency hospitals, etc. should be described.

(9) Traffic Management

Traffic processing and measures to cope with traffic associated with the construction should be described. If detour routes are to be provided, a map of the detour route and drawing showing positioning of guide signs should be included and the deployment of traffic controllers, etc., should be described.

8.2 Construction Plan and Construction Schedule

8.2.1 Basic Conditions

This project is grouped into the civil engineering and building section for the construction of the DBNO administration buildings, Digital TV center buildings, antenna towers and transmitting station buildings, and into the equipment section for the installation of equipment and systems; but from the perspective of schedule management and quality control, it is not considered desirable for separate works contracts to be placed by each section. It is anticipated that equipment and systems from a number of manufacturers will be supplied to the equipment section. Accordingly, at the time of development of employer's requirement, the consultant needs to examine the division of work responsibilities between the civil engineering and building section and the equipment section, as well as within the equipment section, to examine what form of tender will enable integrated monitoring and supervision. However, since one of the purposes of the tender is to ensure that the principles of competition are given free rein in accordance with the Japanese ODA loan project procurement guidelines,, it is also necessary to consider breaking down the tender (into lots) to the extent that multiple companies will be interested in participating in the tender.

If in order to achieve rapid transition to DTTB as requested by Sri Lanka it is necessary for the construction contract for Colombo Transmitting Station that is to be installed in the Lotus Tower to be concluded separately from the contracts for the other transmitting stations, the decisions needed to comply with this need to be made at the time consulting services commence.

8.2.2 Construction Plan and Construction Schedule

The engineering works can start following the necessary license and permit procedures with government agencies, upon the completion of the development of employer's requirement of the steel towers and the foundations and the securing of the land needed for construction. With respect to the construction of the steel towers, in particular, in accordance with Sri Lanka's National Policy on Antenna Structures, it is necessary to obtain permission from the TRC.

The construction will be carried out more or less in the following order.

(1) Surveying of Construction Sites

The sites planned at the time of the study need to be resurveyed (plane survey, geological survey, etc.) at the time the construction is actually carried out.

(2) Securing Land for Temporary Works

Normally the land needed for temporary works, such as temporary accommodation, temporary offices, temporary materials stores, temporary access roads, etc., needed to carry out the construction is provided by negotiation between the contractor and the land owners. However, there are cases in which the temporary use of the land is tied up with the permit for tower construction, or where temporary roads constructed as temporary access roads are handed over to the landowner just as they are after the construction; so it is necessary for the client to negotiate with the landowner to secure land for construction.

(3) Construction of Temporary Roads and Temporary Offices, etc., for the Construction Work

Accommodation and offices will be constructed on the land required for temporary construction works leased from the landowner. In addition a materials storage site will be prepared, and roads for the transportation of materials and equipment will be built from the public roads or the existing roads to the tower construction sites. The biggest problem prior to construction is roads for the transportation of materials and equipment. Methods of transporting materials and equipment from the public roads or existing roads to the tower construction sites can be broadly divided into the following three methods.

(i) Temporary road

(ii) Cableway

(iii) Use of a helicopter

From these should be selected the method that is most economical, easiest to implement and most suited to the local environment.

From the economic and environmental conservation point of view, the construction land leased at the tower construction site is planned to be as small as possible, so it is important that the construction plan be studied in advance to determine how efficiently and safely the construction work can be carried out in a limited area.

(4) Foundation Work

The most common types of support foundations are inverted-T concrete foundations and mat foundations. The inverted-T concrete foundation is made by excavating at each leg of the tower a square or circular hole several meters deep and several meters wide, installing the anchor members at the bottom of the hole before arranging the reinforcements, encasing the footing and the anchor members in concrete in the shape of an inverted T, and backfilling and compacting the excavated soil once the concrete has set. A mat foundation is made by excavating a hole several meters deep and wide enough to accommodate the whole area of the tower legs and then continuing as for the inverted T foundation.

If the ground conditions are good, four separate foundations are constructed, one for each leg of the tower; but in locations where there is concern over even a small amount of settlement of the foundations with time due to weak ground, the four foundations are joined and unified, to prevent uneven settlement of the legs. With this form of foundation, the key is to produce a rigid structure that is capable of resisting both upward and downward forces.

The method of excavation, in particular in mountainous areas where it is difficult to bring in construction machinery, is to excavate manually using tools such as picks and shovels; but in recent years it has become common to use small excavators. Also, in locations where the ground is weak, piles are driven in to a stratum where the ground is firm, and the foundation structure constructed on top of the piles.

Piles are normally driven using the “cast-in-place pile method,” in which circular holes are sunk vertically on site and reinforcement bars and concrete are placed in situ. The most important factor technically is control of the placement of the concrete. That is to say, the sites at which towers are constructed are frequently distant from public roads, so that often it takes a considerable time to transport the ready-mixed concrete from the concrete factory to the site. Therefore, careful consideration needs to be given to the question of how efficiently the concrete can be transported within the 2-hour time limit for completing the pouring of the ready-mixed concrete (1.5 hours when the temperature is over 25°C).

(5) Tower Assembly Work

The steel towers are made by combining members of steel, such as H-shaped steel or L-shaped steel and/or steel tubes. At locations where the tower construction site is near a public road or existing road, or even if it is far from a road but vehicle access can be made possible through the construction of a temporary road, a truck crane, crawler crane or tower crane is used for the tower assembly work. If a crane cannot be used because the site is in a mountainous area or is narrow, the gin pole method is usually adopted. In this case the lifting load should be less than 500kg. This method is used because the jig used is compact, lightweight and easy to install, and the boom can be swiveled so that assembly and lifting can be carried out over a wide range. Even when a truck crane is used, if the height exceeds 70m, a gin pole is also used in the tower assembly work. Incidentally, the Kokavil Tower, which is 172m high and was built in 2011, was assembled using a 50m crawler crane in combination with a gin pole.

When a truck crane is used, there is almost no preparation work on-site or tidying up afterwards, so efficiency is good and the assembly work can be completed in a short period of time. The construction period for tower assembly varies greatly depending on the scale, but is generally in the range of 14 days to 3 months.

(6) Final Cleanup of the Construction Site

The land used for the construction is cleaned up carefully and as a rule restored to its original condition. Particular attention is paid to the collection of small tools and offcuts of materials and other metal items that were used in the construction, and after completion of the construction the land is returned promptly to the land owner.

8.3 Project Cost

8.3.1 Basic Conditions

The following conditions were taken into consideration in calculating the approximate project cost.

(1) Exchange Rates

The exchange rates use in the cost estimate where as follows, based on JICA common fact-finding items (May 26, 2014).

- Yen / dollar: US $1.00 = 102.6 JPY
- Sri Lanka rupee / dollar: US$ 1.00= 130.6 LKR
- Yen / Sri Lanka rupee: LKR 1= 0.785 JPY

(LKR 1= US$ 0.007654523 = JPY 0.785)

(2) Assumed Price Rise Rate

Consumer price indices and exchange rate fluctuations from 2009 to 2013 (average against 5 currencies: US dollar, Canadian dollar, pound sterling, euro and Japanese yen) are applied.

- Foreign currency component 2.0% per annum
- Domestic currency component 3.8% per annum

(3) Physical Work Contingency Cost

Given that land acquisition has not been completed, the location of gap fillers will not be determined until after the consultant has been hired; and in view of the possibility of the progress of the Lotus Tower project affecting the Project, the contingency cost will as a general rule be 10% for equipment procurement and engineering work and 5% for consulting services. The physical work contingency cost is calculated by multiplying the building cost or material cost by the price rise rate.

(4) Consulting Services

The cost of consulting services is calculated on the basis of the dispatch schedule during implementation of the project. The cost should include the physical contingency and price rise.

(5) Land Acquisition Cost

In cases where it is necessary to acquire land, the cost of the land acquisition should be added to the total project cost.

(6) Anticipated Management Costs

The management cost was assumed to be 5%. The management cost was obtained by multiplying the following components by this percentage.

- Construction cost
- Consulting services
- Price rise
- Unforeseen physical circumstances
- Land acquisition

(7) Customs and Other Taxes

The question of whether this project, which is financed by Japanese ODA loans, is eligible for exemption from customs duties and other taxes, is a matter for discussion with the Sri Lankan Department of External Resources, Ministry of Finance and Planning, which is the contact organization for assistance and cooperation; but in the development of employer’s requirement, confirmation was obtained of the agreement of the Department of National Planning of the

Ministry of Finance and Planning, and it is clearly stated in the official text of the E/N that tax exemption measures apply. However, in this study the cost of the project was estimated on the basis of the following conditions.

1) Sri Lankan Customs Duty:

- **Classification**
  Commercial classifications are based on the international Harmonized Commodity Description and Coding System (HS system) in accordance with the international conference on the uniform commercial classification system.

- **Tax rate for imports from Japan**
  The customs tax rate on imports from Japan is the normal customs tax rate. Japan has not concluded any local agreements with Sri Lanka. In addition to customs duties, the following taxes and charges are levied on imports.

2) Value Added Tax (VAT):

In accordance with Law No. 14 of 2002, the Value Added Tax Law (officially amended the same year), value added tax of 12% is levied on imports that are subject to value added tax.

3) Port and Airport Development Levy (PAL):

A port and airport development tax of 5% of the customs value is applied to goods imported into Sri Lanka. Goods imported for the purpose of processing and re-export or manufacture of export goods are not subject to this tax.

4) Import Tax (Import Cess):

Cess (import tax) is applied to a wide range of goods in accordance with Government Gazette 1733/6 dated November 21, 2011.

5) National Building Tax (NBT):

The National Building Tax was introduced from February 1, 2009 in accordance with the 2009 draft government budget for the purpose of reconstructing infrastructure that had suffered from acts of terrorism.

The tax rates and methods of taxation are as follows. The Sri Lankan customs tax rate on imported materials and equipment is determined according to the item, its content, and the country of origin. However, as the country of origin of the materials and equipment supplied by the contractor under this project are undecided and come under a variety of tax codes in the international Harmonized Commodity Description and Coding system (HS system), in this study it will be necessary to carry out a detailed investigation for each item. For an approximate calculation of the cost of the project, a provisional calculation of the rate for the television transmitters for the main systems and devices in this project will be carried out on the assumption that the country of origin of the materials and equipment is Japan.

Assuming that the HS code for a transmitter is 8525.50, the following conditions should be applied.

- Import tax is 0%
- Port and Airport Development Levy (PAL) is 5% of CIF value
- Value Added Tax (VAT) is 12% x (10% added to the CIF value + Port and Airport Development Levy (PAL) of 5% of the CIF value)
- National building tax (NBT) is 2% x (10% added to the CIF value + Port and Airport Development Levy (PAL) of 5% of the CIF value)
- The total is calculated to be about 21.2% of the CIF value

6) Conditions for Granting of the Japanese ODA Loan:

Interest during construction (assuming a STEP loan scheme)

It is anticipated that Japanese ODA loan will be provided to finance this project under the Special Terms for Economic Partnership (STEP), so it is considered that the following interest rates will be applied during construction:

According to United Nations and World Bank classification of the income levels of major countries in 2012, Sri Lanka, with a gross national income (GNI) per person of US$2,920.00, is a middle income country.

In the JICA conditions for the provision of an ODA loan applicable to projects announced on or after October 2013, the STEP conditions are for a fixed interest rate of 0.1%, a redemption period of 40 years, a deferment period of 10 years, and with tied procurement conditions. The interest on the consulting services component is 0.01%, and the redemption period and deferment period and procurement conditions are the same as for the main project portion.

8.3.2 Composition of Engineering Works Cost

The estimated cost of the main types of engineering works is shown below. The following are included within the scope of the cost estimates for the engineering works.

- Temporary works
- Construction of access roads
- Construction of fence around the site
- Construction of foundations for new towers
- Assembly of new towers
- Construction of new transmitting station building
- Strengthening of existing towers and installation of antennas
- Installation work for gap-fillers

8.4 Project Implementation Plan

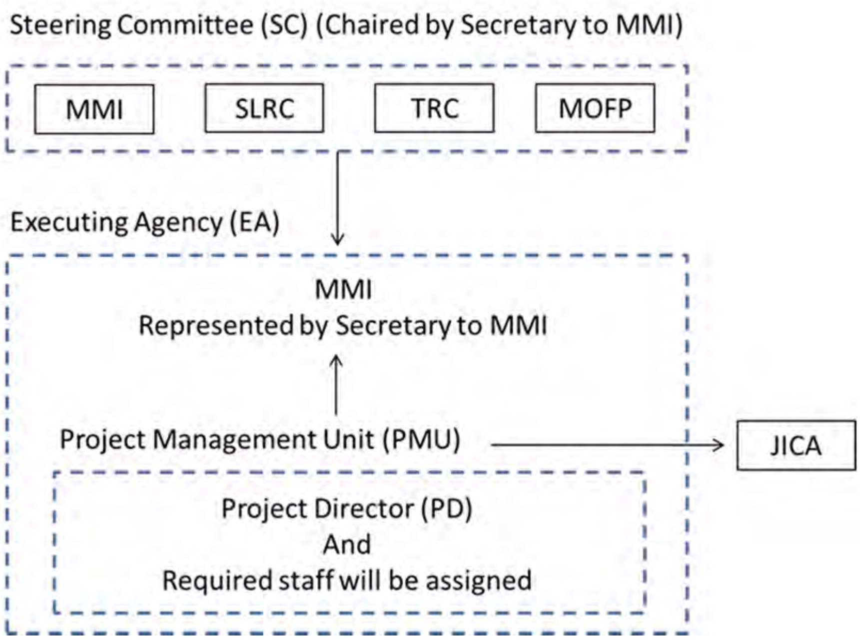
8.4.1 Examination of Project Implementation Structure

The executing agency of this project is MMI, and the project management unit (hereinafter referred to as “PMU”), which is the supervisory organization for project implementation set up by the executing agency, will be established under the auspices of MMI. The PMU operates under the supervision of the Project Director (hereinafter referred to as “the PD”) appointed by the under-secretary of MMI and is obligated to report to the under-secretary.

As mentioned in Chapter 7.1, the project components are procurement and O&M of equipment and facilities including construction of the DTTB platform, digital TV center and DBNO administration building. The components also include technical support implemented to facilitate the diffusion of DTTB (This is to be implemented as a part of the consulting service, and does not include further technical assistance). To deal with the various components of the Project, a Steering Committee (hereinafter referred to as “the SC”) chaired by the secretary of MMI will be established to coordinate the different organizations, DBNO, SLRC and TRC will be positioned under the PMU to implement each component of the Project. Figure 8.4-1 is a diagram of the implementation structure of the project, showing the relationship between the SC and the PMU. Figure 8.4-2 is the organizational chart of MMI. However, at the present time it is not clear which department in MMI will be involved in assisting the PMU.

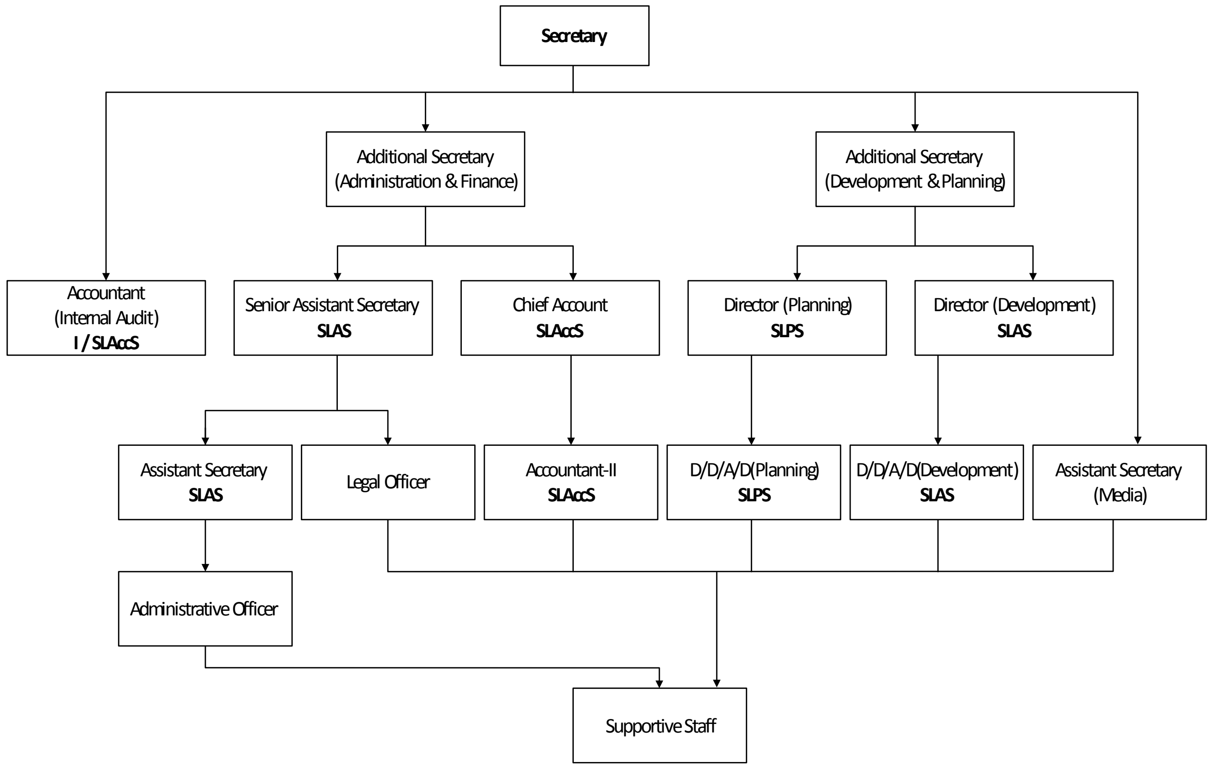
MMI plans to establish the DBNO to operate the DTTB platform. However, it will take time to establish the DBNO in terms of human resources, preparation of the relevant laws and regulations and the formation of a new organization. As a temporary measure until the DBNO is established, MMI needs to consider employing the engineers who it is expected will be employed by the DBNO so as to establish a system in which the DTTB platform can operate.

Given that the Project will start before the DBNO has been established, before the start of digital broadcasting trials MMI needs to be granted frequency licenses for digital terrestrial broadcasting and to obtain the multiplex licenses which will become necessary as a result of digitalization. As far as digital licenses and multiplex licenses are concerned, the broadcasting laws need to be amended as the licenses can be transferred only to parties who meet particular conditions. Thus it will be possible to transfer the licenses to the DBNO from MMI. However, if the DBNO were to be established before the commencement of digital broadcasting, it would be possible for the frequency and multiplex licenses to be granted directly to DBNO.



Source: JICA Study Team

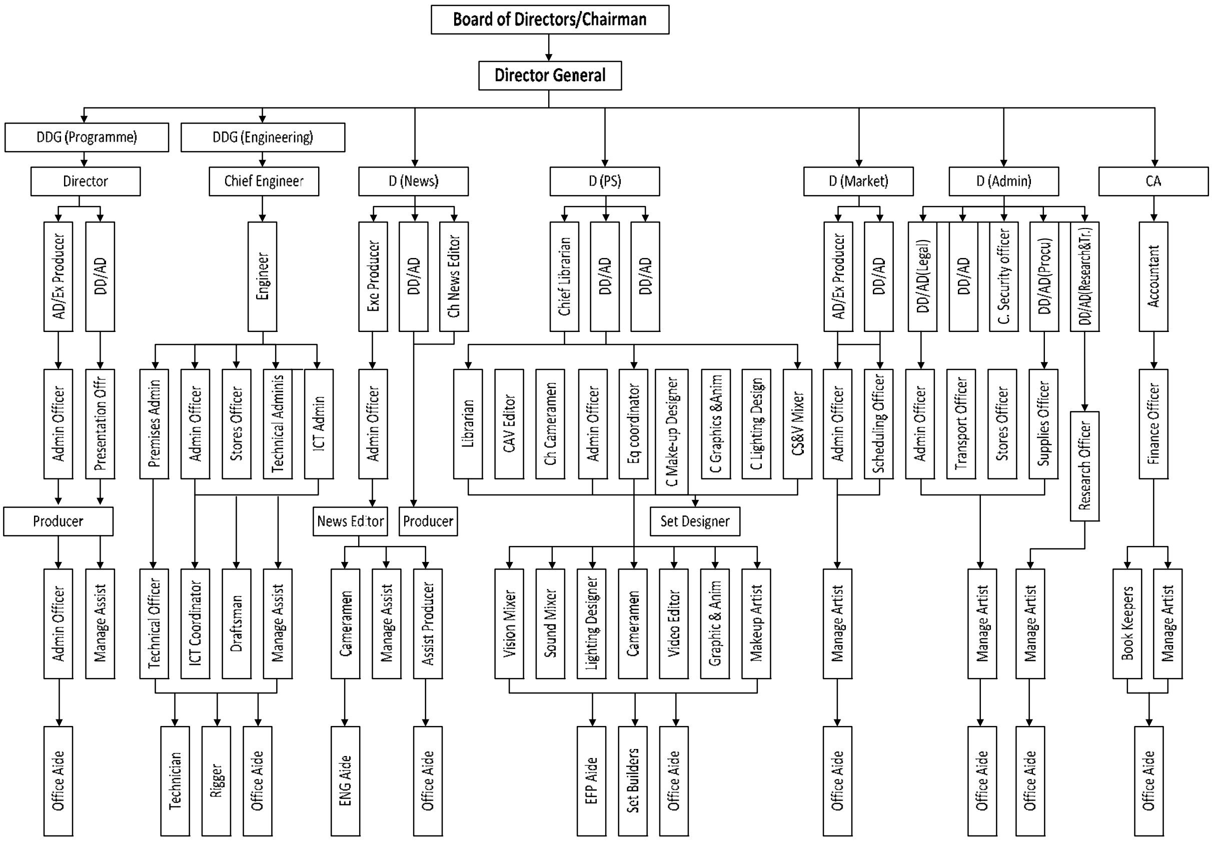
Figure 8.4-1 Implementation Structure



Source: MMI

Figure 8.4-2 MMI Organizational Chart

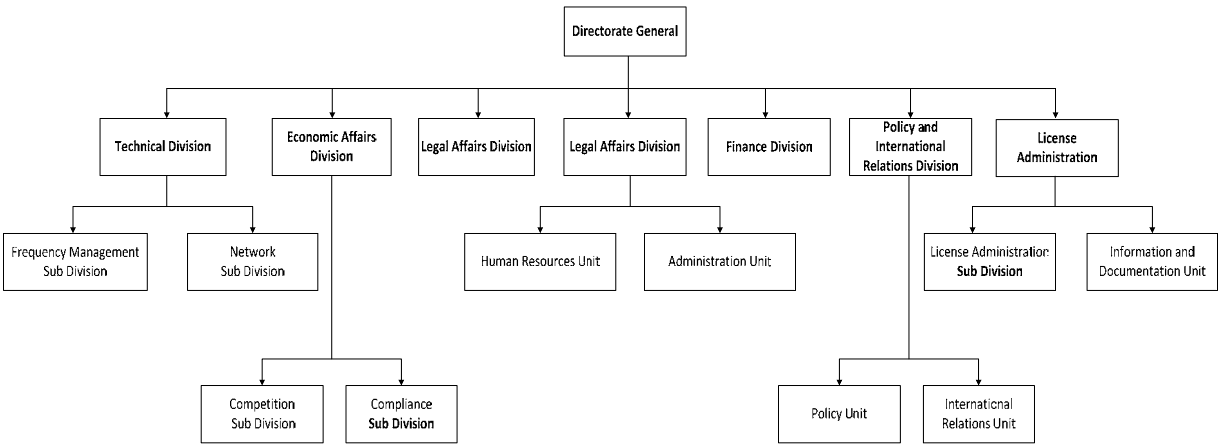
In the Project, a Digital TV Center will be built, and three new HDTV studios, a master control system and 2 OB vans will be procured for the state-run broadcasting station, SLRC. The engineering department of SLRC will be central in operating the procured equipment and facilities. Figure 8.4-3 shows the organizational chart of SLRC.



Source: SLRC

Figure 8.4-3 SLRC Organizational Chart

Meanwhile, TRC is expected to play a role in creating a frequency plan and establishing technical standards for receivers and transmitters for future HD broadcasting, which will be implemented as technical support under the Project. Therefore TRC will be responsible for the establishment of a Test Center for receivers and for the operation of the radiowave measurement vehicles and the receiver compatibility test measurement tools procured under the Project. Figure 8.4-4 shows the organizational chart of TRC. It is assumed that the Technical Division will be directly involved in this task, but this needs to be confirmed at the start of the Project.



Source: TRC

Figure 8.4-4 TRC Organizational Chart

8.4.2 Examination of Project Implementation Schedule

(1) Approach to Schedule Examination

Each item in the project implementation schedule will be examined in detail using the following study item methods to produce a bar chart in monthly units.

Table 8.4-1 Project Implementation Schedule

Schedule study item	Method of examination
Consultant and contractor procurement procedures and selection	The proposed schedule for this project will be examined on the basis of the procedures for public works in Sri Lanka and the project schedule for Japanese ODA loans (including STEP projects) implemented in the past in Sri Lanka. The schedule made possible by prompt procurement procedures should also be examined. The schedule should be such that it poses no problems in terms of the ODA loan scheme or procedures in Sri Lanka.
Employer's Requirement*	Problems pointed out during the feasibility study will be examined in detail to determine the development period of employer's requirement to be implemented by the Consultant. The employer's requirement development work needed to enable prompt DSO-SD in the Greater Colombo area should be taken into consideration.
Construction period	After finalizing the consultant and contractor procurement and selection schedules above, the period required for tender preparation (including the pre-qualification screening period) / tender response preparation / post-tender evaluation / approval by the Client and JICA ,/ advance approval for manufacturing specifications / manufacturing, procurement and construction / pre-factory shipment inspection, export packaging and export customs clearance / sea transportation,/ import customs clearance at Colombo Port / transport within Sri Lanka / installation and construction / operational adjustment / operation training should be examined in detail; the date of transfer to the Client should be provisionally set and the construction period should be defined as the period up to the expiry of the warranty period. In setting the period for each phase of the work, an appropriate schedule should be established that takes into account the technical skills of construction contractors in Sri Lanka.
Approximate estimate of construction period	It is estimated that construction will be completed within 43 months from the conclusion of the contract with the consultant following the tender, and that the warranty period will end within 55 months.

* "Employer's Requirements" means the functional design executed by the Consultant; it is expected that this Project, employer's requirement will be developed up to basic design according to the contractor's Design & Build contract.

Source: Prepared by JICA Study Team

(2) Period Relating to Signing of L/A and Procurement Implementation

With respect to the schedule for the signing of the L/A and procurement procedures, assuming that the pledge is given at the end of July 2014 and the L/A is signed in August 2014, subsequently progress up to the contract with contractors should be swift, following the schedule in Table 8.4-2.

Table 8.4-2 Schedule to L/A and Procurement Formalities

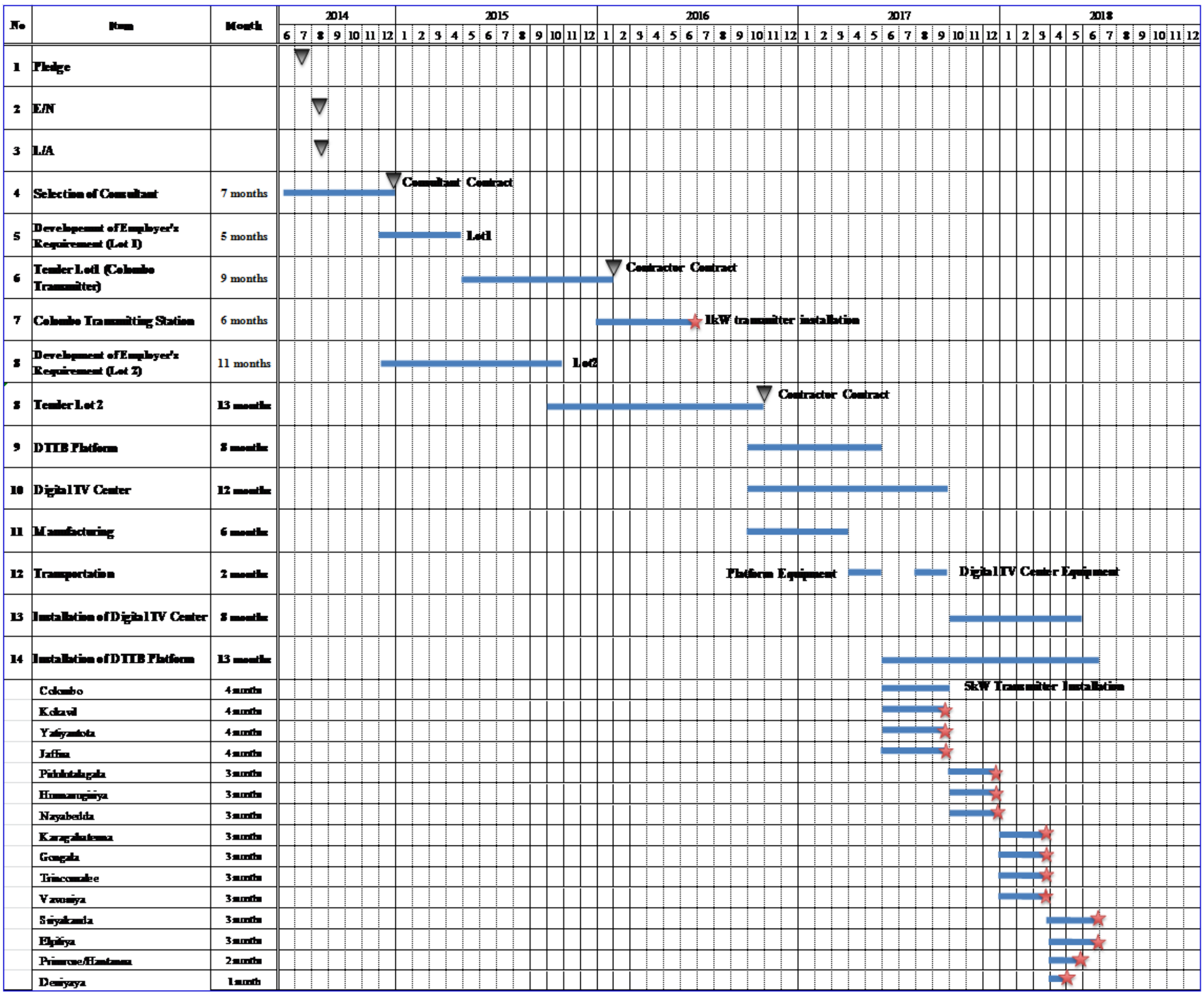
Item	Period	Remarks
Selection of Consultant	7 months	6.0 months in the case of a negotiated contract
Design & Build, Tender, JICA Agreement	7 months	Note 1) Should P/Q be required, 15 months
Tender	1.5 months	
Tender Evaluation	2.5 months	
JICA Agreement	0.5 months	
Contract Negotiation	1 month	
JICA Contract Agreement	0.5 months	
Issue of L/C and L/com	0.5 months	
Total time period (after consultant selection)	20.5 months	

Note) Some items can progress simultaneously

Source: Prepared by JICA Study Team

The overall schedule is shown in Table 8.4-3. With regard to the procurement of transmitters for the Colombo station, at the beginning of the Project 1kW transmitters will be procured instead of 5kW transmitters, which will take time to manufacture. Subsequently the 1kW transmitters will be replaced by 5kW transmitters to hasten the date of DSO-SD in Colombo.

Table 8.4-3 Implementation Schedule



Source: JICA Study Team

8.4.3 Examination of Division of Work between Lotus Tower and the Project

Lotus Tower is being constructed by the Government of Sri Lanka with funding by China. It will be used as a shared radio tower for TV and radio broadcasting and mobile phone services. With respect to operation of the facility, a private business operator to be determined by tender by the Government of Sri Lanka will install and operate the equipment, and broadcasters and telecommunication carriers will pay a usage fee for use of the facility. In other words, it is a collaborative project between the government and the private sector in which the government will undertake the construction and the private sector will be responsible for the installation of equipment and operation of the facility. The government of Sri Lanka has already concluded the tender for the installation of equipment and operation of the facility, and is ready to award the contract.

On the other hand, most of the equipment for the DTTB platform that the DBNO will operate is planned to be installed in Lotus Tower. The construction of Lotus Tower has already started. However, the design of Lotus Tower is based on the European standard for digital terrestrial broadcasting. It is necessary that MMI and TRC make the division of the work clear at the start of the Project.

8.5 Maintenance and Operation Management Plan

8.5.1 Maintenance and Operation Management Plan

Each manufacturer of equipment has their own recommended maintenance and inspection manual for studio equipment, transmission equipment, etc. It is essential that components be replaced and inspection carried out over the long term in accordance with the manuals, in order for the equipment to be kept operating normally. Naturally the necessary cost must be estimated in advance. In addition, each item of equipment has a service life, so it is necessary to have an appropriate renewal plan for each item of equipment.

8.5.2 Maintenance and Operation Management Cost

In order for the DBNO to operate properly in the future, it is necessary that the equipment to be procured in this project be replaced as appropriate. Therefore, a maintenance and operation plan for periodic equipment renewal as described in Section 8.5.3 below should be included together with the financial plan, in addition to the maintenance and operation cost of new and existing equipment.

8.5.3 Equipment Cost and Equipment Renewal Cost

This plan covers the transmission equipment, transmitting antennas, TV studio, master control system and the NOC equipment of the DBNO. In order for the equipment to be renewed in an appropriate manner, it is necessary that a certain amount of money be set aside every year in order to reduce the financial burden at the time of renewal. Table 8.5-1 shows the renewal plan and the time scale for repair and maintenance. The reserve fund for the equipment of the DBNO should be sourced from the DBNO operating revenues and from advertising, and for the SLRC equipment, from the advertising revenues of SLRC.

Table 8.5-1 Equipment Renewal Plan

	Equipment item	Renewal	Repair and maintenance
DBNO equipment	Transmitter	21 years	Every 7 years
	Transmitting antenna	40 years	Not necessary
	NOC equipment	14 years	Every 7 years
SLRC equipment	TV studio equipment and OB van	14 years	Every 7 years
	MCS equipment	14 years	Every 7 years

Source: JICA Study Team

8.6 Examination of Consulting Services

Assuming the use of Japanese consultants in the STEP ODA loan project, the principal work items of the consultants in the implementation of this project are outlined in (1) to (5) below.

(1) Development of Employer's Requirement

The consultants carry out the functional development of employer's requirement and examine the basic specifications for the equipment and materials the SLRC Master Control System, three sets of TV studio equipment and the OB vans for the DTTB Platform. They also carry out the architectural design of each transmitting station building, the DBNO Administration Building and the SLRC Digital TV Center. The development of employer's requirement also includes channel planning and frequency simulation to reconfirm the content of the channel plan prepared in this study, based on the situation at the time of the development of employer's requirement.

(2) Holding the Tender

The consultants hold the tender on behalf of the Client. Work relating to the holding of the tender is as follows:

- Preparation of tender documents based on the development of employer's requirement
- Holding of Tender
- Pre-qualification screening, technical examination
- Obtaining the agreement of JICA

The tender meeting is held after the pre-qualification, technical and financial screening. At the meeting, the submitted bid forms are examined to check the technical skills and financial status of the bidders and price negotiation takes place.

The consultants assist the Client in undertaking the following items relating to the contract.

- Tender result
- Explanation to the Client
- Checking the content of the contract documents
- Witnessing the contract

- Obtaining the agreement of JICA to the contract

(3) Construction Supervision

There are 18 construction sites in this project (16 transmitting stations or NOCs, the SLRC Digital TV Center and the DBNO Administration Building), and these multiple sites need to be managed efficiently. Construction supervision by the consultants includes schedule management, quality control, construction supervision and the preparation of a monthly report, and the consultant must maintain adequate communication with the relevant organizations so as to ensure that the work at these multiple sites progresses without a hitch.

(4) Preparation for Training in Japan

With respect to training in Japan, the consultants will arrange and coordinate the training locations and the content of the training. It is expected that training in Japan will cover the operation and maintenance of equipment specific to DTTB, such as data broadcasting programs, teletext broadcasting and EWBS. It is planned that three two-week training courses will be held for ten participants each.

(5) Technical Support

To facilitate the penetration of DTTB in Sri Lanka, ODA loans and technical cooperation projects to supplement the ODA loans are planned. The ODA loans also include the provision of consulting services. In the transition to DTTB, it is essential to develop and examine a wide variety of plans, including a frequency plan (allocation policy, necessary procedures, etc.), a channel plan, the criteria for the granting of licenses to DTTB stations, the criteria for the granting of multiplex licenses, an ASO implementation plan, measures to facilitate penetration (for viewers, broadcasting organizations, etc.), and the establishment of domestic standards for receivers and transmitter parameters. In considering these plans, a distinction should be made between those items in which Sri Lanka possesses sufficient know-how, and those for which it will be more efficient to make use of Japanese experience; doing so will further increase the possibility that the DSO-SD will be achieved by the target date.

It is necessary that the DTTB Platform in this project be established in parallel with the development of the plans described above. Considering the time constraints, preparations for each of them need to be made as soon as possible.

In addition to the basic consulting services (1) to (4) above, technical support will be provided as a consulting service in this project for the purpose of facilitating the transition to DTTB, apart from further technical assistance under this ODA loan. The basic design of the technical support covers the following three items.

- Frequency planning for the start of HD broadcasting services
- Development of technical standards

- Establishment of the Test Center

It would be efficient for assistance for these items to be provided within the consulting services of the ODA yen loan project. The Study Team considers that the content of the technical support, as well as the content of further technical assistance will be studied and determined by the Government of Sri Lanka in the future. (See Chapter 9 for consideration of technical support.)

Chapter 9 Examination of Technical Assistance

Chapter 9 Examination of Technical Assistance

9.1 Tasks Needed in the Transition to DTTB

A number of tasks will need to be undertaken simultaneously in order to bring about the transition to DTTB. In addition to creating the basic design required for the establishment of the DTTB platform and the building construction and equipment procurement required for the establishment of the Digital TV Center, this project also examined the technical assistance by Japan that appears to be essential for the transition to DTTB.

In this examination, therefore, the guidelines prepared by ITU for the creation of the ITU Roadmap for the Transition to DTTB were used as the basis from which to extract the items that generally seem to be required, because the ITU Roadmap serves as part of the master plan for the transition to DTTB in Sri Lanka. The extracted items were classified by sector and tabulated, together with notes on an indication of whether they were included as technical support in the consulting service or other technical assistance such as technical cooperation project pertaining to this Japanese ODA Loan Project.

9.1.1 Preparation of Plans and Standards

The tasks that need to be undertaken for the preparation of plans and standards can be classified into the eight items shown in Table 9.1-1. Although the ITU Roadmap provides comprehensive coverage of all the sectors, policies need to be drawn up in the future in relation to the roadmap. These items are described in outline below.

Table 9.1-1 List of Tasks Needing to be Undertaken for the Preparation of Plans and Standards

	Item	Current situation	Support/Assistance
1.	Master plan	Yes	-
2.	Frequency plan	No	C
3.	Channel plan	○	●
4.	Network construction plan	○	●
5.	Public relations activity plan to inform the people of Sri Lanka about ASO	No	○
6.	Transmitter-receiver technical standards	No	C
7.	Establishment of licensing criteria	No	■
8.	Multiplexing plan	△	□

<Legend> Current situation: Yes = “Already prepared”; No = “Not yet prepared”; ○ = “To be prepared by the Study, Team”; △ = “To be examined by the Study Team”.
Support/Assistance: C = Support to be provided in this project; ○ = Assistance to be provided by technical assistance; □ = Can be handled by the organization in charge based on the examination conducted by the Study Team; ● = Can be handled based on the examination result of the study; ■ = Japanese knowhow and experience will be provided via the joint working group.

Source: Data created by JICA Study Team

(1) Preparation of Master Plan

A master plan will be prepared that covers the period from the introduction of DTTB to ASO. The master plan will include all activities, such as plans to inform the people about ASO. The items to be implemented and its procedures must be included in the master plan.

(2) Frequency Plan

The frequency plan will be a comprehensive plan that determines how to use over 700MHz band that will become obsolete after ASO are to be used. This is named digital dividend. It is assumed that, in Sri Lanka, mobile phone service will be associated as for dividend . Comprehensive discussions will be necessary in view of the intention to provide an HD broadcasting service in the future. Therefore, the frequency plan for the DSO-HD service after ASO must be examined in detail. ITU has also indicated guidelines for the utilization of frequency bands, and these will be used in determining the frequency plan.

(3) Channel Plan

The channel plan will include the transmission frequency, effective radiated power and location of transmitters for TV broadcasting. This project has prepared a channel plan for the DTTB platform. The target for nationwide population coverage is set at 84.5%. This is a tentative goal, and it will be possible to further extend coverage through the use of gap-fillers, etc. It is necessary first of all to check the status of radio propagation after radio wave transmission, and to consider effective gap-fillers.

(4) Network Construction Plan

The network construction plan will set out the construction of the broadcasting network and determine the technologies (*e.g.*, SFN and MFM) and equipment (*e.g.*, transmission systems and gap-fillers) to be introduced, based on the availability of existing facilities.

(5) Public Relations Activity Plan to Inform the People of Sri Lanka about ASO

This activity plan will set out the public relations activities to be undertaken to inform the people of Sri Lanka about the implementation of ASO.

(6) Transmitter-receiver Technical Standards

These technical standards will make public the standards for the receivers and transmitters to be used in Sri Lanka so that appropriate equipment can be imported or manufactured. The technical standards of the Association of Radio Industries and Businesses (ARIB) of Japan can be applied or modified for use.

(7) Establishment of Licensing Criteria

It is highly likely that the transition to DTTB will change the way in which broadcasting organization licensing and frequency licensing are applied to broadcasting stations. It is assumed that licensing will take the form of DTTB frequency licensing, multiplexing licensing and TV program provider licensing. These forms of licensing will include the criteria, conditions and procedures/regulations for the granting of licenses and will also define the criteria for the granting of licenses.

(8) Multiplexing Plan

The multiplexing plan will specify the number of programs to be multiplexed per frequency and will also determine the number of bits allocated to One-seg broadcasting and the number of One-seg programs.

9.1.2 Establishment of Policies and Laws/Regulations

Policies and laws/regulations can be classified into nine items. These will serve as guidelines that sum up the various concepts that will lead to a successful transition to DTTB. At present, the items are mostly based on the decisions of the Government of Sri Lanka but good use will be made of Japanese experience, from similar policies adopted in Japan.

Table 9.1-2 List of Tasks Needing to be Undertaken for the Establishment of Policies and Laws/Regulations

	Item	Current situation	Support/Assistance
1.	Promotion policies	No	■
2.	DTTB frequency allocation guidelines	No	■
3.	Revision of the Sri Lanka Rupavahini Corporation Law and other related laws/regulations	No	
4.	Check and update of media-related permits	No	
5.	Policies for digitalization of satellite TV and CATV	No	■
6.	Revision of advertisement-related laws including data broadcasting	No	
7.	Registration of TV broadcasting channel plan to ITU	No	
8.	Establishment of EWBS operating guidelines	No	△

<Legend> Current situation: No = "Not yet prepared".
Support/Assistance: △ = Assistance to be provided in the future; ■ = Japanese knowhow and experience will be provided via the joint working group.

Source: Data created by JICA Study Team

(1) Promotion Policies

By promotion policies is meant general policies aimed at alleviating the cost burden to the stakeholders, *i.e.* the broadcasting stations, telecommunications carriers, recipients, retailers and manufacturers, of promoting the transition to DTTB.

(2) DTTB Frequency Allocation Guidelines

Allocation guidelines are needed to establish the priority with which frequencies will be allocated to broadcasting stations, not only for full-segment broadcasting but also for One-seg broadcasting. In Sri Lanka, broadcasting will be provided via a platform, so it is necessary to consider guidelines for determining which broadcasting stations will be able to broadcast programs using radio waves. If no new broadcasting stations are expected to enter the field at present, however, it will be possible for all the existing broadcasting stations to transit to DTTB.

(3) Revision of the Sri Lanka Rupavahini Corporation Law and Other Related Laws/Regulations

Multiplexing and other aspects of DTTB require legal regulation. If multiplexing is used, the number of programs that can be allocated in One-seg broadcasting is not equal to the number that can be allocated in full-seg broadcasting, but is only one or two. The law needs to be revised to specify regulations relating to allocation in One-seg broadcasting.

(4) Check and Update of Media-related Permits

The need for the renewal or addition of laws/regulations relating to media-related permits, other than the Sri Lanka Rupavahini Corporation Law, will be checked and, if necessary, the laws/regulations will be updated.

(5) Policies for Digitalization of Satellite TV and CATV

Since receivers will be replaced by digital broadcast receivers, satellite TV and cable TV services must also be changed in order to support digital broadcasting. Policies relating to the method and deadline for the transition to digitalization and the demand for the obligation to retransmit analog broadcasting during the transition phase to DTTB need to be examined.

(6) Revision of Advertisement-related Laws including Data Broadcasting

Existing laws that include any regulation of electronic public notices and advertisements in TV broadcasting need to be revised. For example, the inclusion of advertisements in data broadcasting and One-seg TV programs needs to be examined.

(7) Registration of TV Broadcasting Channel Plan to ITU

The registration of the current broadcasting stations to ITU will be checked, and they will be newly registered or re-registered if required when the DTTB platform comes into use.

(8) Establishment of EWBS Operating Guidelines

Related systems such as the EWBS server have been installed in NOC of DBNO as part of the DTTB platform. The operating guidelines for EWBS need to be established before the broadcasting stations begin EWBS operation.

9.1.3 Promotion

Promotion consists of specific tasks undertaken to ensure a smooth transition to DTTB. Promotion will target a wide range of stakeholders such as the viewers, broadcasting organizations, import agents, retailers, and telecommunications carriers. Promotion can be classified into the nine items shown in Table 9.1-3.

Table 9.1-3 List of Tasks Needing to be Undertaken for Promotion

	Item	Current situation	Support/Assistance
1.	Promotion of receiver replacement	No	□
2.	Receiver compatibility test (Test Center)	No	C
3.	Educational promotion activities for the general public	No	○
4.	Promotion activities for broadcasting/telecommunications-related companies	No	■
5.	Market research concerning digital broadcasting	△	●
6.	Customer advice (call center)	△	○

<Legend> Current situation: No = "Not yet prepared"; △= "To be examined by the Study Team".
Support/Assistance: C = Assistance to be provided in this project; ○ = Assistance to be provided by technical assistance; □ = Can be handled by the organization in charge based on the examination conducted by the Study Team; ● = Can be handled based on the examination result of the study; ■ = Japanese knowhow and experience will be provided via the joint working group.

Source: Data created by JICA Study Team

(1) Promotion of Receiver Replacement

The promotion of receiver replacement consists of measures targeting the poor, such as help in purchasing a receiver and free-of-charge distribution of receivers. In Japan, combining these measures with an environment-friendly tax exemption plan helped promote the replacement of receivers in ordinary households.

(2) Receiver Compatibility Test (Test Center)

This test will check for compatibility between broadcasting waves and receivers on the basis of the technical standards for transmitter-receivers, to determine whether receivers available on the market work properly and whether data broadcasting programs are displayed without problem. The project plan includes the construction and operation of the Test Center as a technical support item in the consulting service.

(3) Educational Promotion Activities for the General Public

Viewers will be informed about what they should do at the time of DSO-SD and ASO, such as replace their receivers and antennas (if necessary), via Web pages, advertisements, workshops, etc. These activities will be carried out on the basis of the promotion policies.

(4) Promotion Activities for Broadcasting/Telecommunications-related Companies

Actions to be taken for the transition to DTTB will be explained to broadcasting/telecommunications-related companies such as broadcasting organizations (TV program providers after the transition), import agents for transmitters, receivers, etc.

(5) Market Research Concerning Digital Broadcasting

Market research on broadcast coverage areas and assistance to low-income groups in the replacement of receivers will be conducted in order to obtain basic data for the examination of effective assistance measures.

(6) Customer Advice (Call Center)

In order to avoid confusion, an advisory service must be set up to provide viewers with advice on such matters as which DTTB receiver to purchase, and to deal with such problems as inability to watch TV. In this project plan, a call center will be established in DBNO to provide viewers with technical advice on the replacement of receivers, antennas, etc.

9.1.4 Undertakings for Effective Utilization of Digital Broadcasting

ISDB-T offers a variety of value-added services. Viewers can use them to receive a wide range of broadcasting services. The production of TV programs attractive to the viewers will be essential in encouraging viewers to replace their receivers. This section describes efforts to make use of the functions unique to DTTB to provide TV programs and information that are attractive and useful to the viewers.

Table 9.1-4 List of Tasks Needing to be Undertaken for the Effective Utilization of Digital Broadcasting

	Item	Current situation	Support/Assistance
1.	Training in data broadcasting program production	No	○
2.	Capacity development for the utilization of data broadcasting (Establishment of data broadcasting program production departments, development of educational programs and development of programs providing public information such as information on health services)	No	□
3.	Capacity development for disaster broadcasting using data broadcasting (Preparation of disaster broadcasting criteria/operating manual, improvement of emergency broadcasting program production system and preparation of EWBS operation guidelines and manuals)	No	□
4.	Development of sports programs using data broadcasting	No	□
5.	Production of public service-related programs	No	○
6.	Guidelines for the production and development of One-seg programs	No	□
7.	Training in the production of EPGs and closed-caption broadcasting programs	No	□

<Legend> Current situation: No = “Not yet prepared”
Assistance: ○ = Assistance to be provided by technical assistance; □ = Assistance to be provided by technical assistance but private organizations will not be included.

Source: Data created by JICA Study Team

(1) Training in Data Broadcasting Program Production

Training in the creation of content for data broadcasting will be provided, covering the creation of content and templates, the saving of data, the handling of data broadcasting production equipment, etc. For private broadcasting stations, in place of this training the provision of basic knowledge and know-how through seminars and workshops will be considered.

(2) Capacity development for the Utilization of Data Broadcasting

This capacity development measure for the comprehensive utilization of data broadcasting, including the establishment of a department in charge of the production of data broadcasting programs in the broadcasting station, the assignment of necessary personnel and the development of human resources, is necessary to ensure the sustainable production of data broadcasting programs.

For example, new educational programs for data broadcasting will be developed on the basis of a study into how data broadcasting can be utilized in interactive and non-interactive educational broadcasting. It is considered that the development of educational content with a bidirectional learning function will enhance the educational impact. Possible examples are as follows:

- Literacy education program
- Social studies program (A cultural program that allows the people of different ethnic groups to deepen their understanding of the different cultures in Sri Lanka)
- Basic arithmetic program

It is also worth examining the production of data broadcasting programs concerning the provision of public information, such as health services and traffic information. The development of these in collaboration with external organizations should also be considered. Possible examples are as follows:

- Primary health information
- Information on infectious diseases and epidemics
- Traffic control information
- Information supplied by local government (which can be organized differently according to the area)

(3) Capacity development for Disaster Broadcasting Using Data Broadcasting

A constant supply of weather information and disaster information will be offered to viewers through collaboration with the relevant organizations and the establishment of a system for the acquisition of real-time information. In-house criteria and guidelines on the handling of every aspect of disaster broadcasting including EWBS should be prepared, and a system for the production of emergency/disaster programs should be established in collaboration with relevant organizations. The use of EWBS in a way that is appropriate to the disaster situation and social conditions of Sri Lanka should be examined, including methods of providing EWBS information not only on natural disasters but also on terrorism and other threats to the life, safety and security of the Sri Lankan people.

(4) Development of Sports Programs Using Data Broadcasting

Data broadcasting programs linked with programs on popular sports such as cricket will be developed. At the same time that the programs are being developed, databases of cricket players and past game results, etc., will be compiled.

(5) Production of Public Service-related Programs

Assistance will be provided for the production of programs relating to public services such as education, health and fitness.

(6) Guidelines for the Production and Development of One-seg Programs

Guidelines for One-seg broadcasting for small-screen Mobile TV / Portable TV handsets will be prepared taking into consideration points to note in program production techniques, and One-seg programs will be produced in accordance with these guidelines.

(7) Training in the Production of EPGs and Closed-caption Broadcasting Programs

Training in the production of EPGs will be provided. The guidelines for the handling of equipment and information that needs to be shared will also be studied. DTTB makes possible the broadcasting of closed-caption programs using the DTTB function. Since this can be very helpful for those with hearing difficulties, the production techniques for such programs will be developed at the same time as the use of such programs is studied.

9.1.5 Operation and Maintenance Management

Table 9.1-5 List of Tasks Needing to be Undertaken for Operation and Maintenance Management

	Item	Current situation	Support/Assistance
1.	Preparation of equipment management guidelines	No	C
2.	Preparation of training plan	No	C
3.	DTTB equipment management training	No	C

<Legend> Current situation: No = “Not yet prepared”
Support/Assistance: C = Support to be provided in this project.

Source: Data created by JICA Study Team

(1) Preparation of Equipment Management Guidelines

Since the DTTB equipment needs to be managed differently from analog broadcasting equipment, guidelines will be prepared specifying management methods unique to the DTTB equipment, to ensure stable broadcasting operations.

(2) Preparation of Training Plan

A training plan covering transmission/reception technology, the production of a wide range of programs, and the production of data broadcasting programs will be prepared for local specialists and engineers. Sustainable capacity development for specialists and engineers can be achieved if a training plan is steadily implemented.

(3) DTTB Equipment Management Training

Technical training will be provided to ensure stable management through periodical inspection, troubleshooting, etc.

9.1.6 Tasks Needed to the related issues in the Transition to DTTB

There are two related issues which would be undertaken to ensure a smooth transition to DTTB shown in Table 9.1-6. Related issues will be managed by responsible agency in collaboration with relevant organizations.

Table 9.1-6 List of Tasks Needing to be Undertaken for related issues

	Item	Current situation	Support/Assistance
1.	Measures against the impact of 700MHz band use	No	■
2.	Assistance in importation of equipment	No	
3.	Assistance in equipment procurement	No	
4.	Handling of waste	No	■

<Legend> Current situation: No = “Not yet prepared”; ∆ = “To be examined by the Study Team”.
Support/Assistance: ■ = Japanese knowhow and experience will be provided via the joint working group.

Source: Data created by JICA Study Team

(1) Measures against the Impact of 700MHz Band Use

DTTB reception may be adversely affected in the future by the frequencies of mobile phones allocated to the 700 MHz band. To counter this, receivers or receiving antennas will need to be fitted with filters. If such countermeasures are announced ahead of time, they should not interfere with the promotion of DTTB.

(2) Assistance in Importation of Equipment

This assistance consists of the reduction or exemption of taxes on DTTB-related equipment purchased by broadcasting stations, etc. Most of the broadcasting equipment used in Sri Lanka will be imported. The construction of the DTTB platform means that basically the broadcasting stations will not need to invest directly in transmitter systems. With the transition to HD broadcasting, however, all the master control systems, TV studio equipment, etc., will have to be replaced. This promotion measure will have the effect of ensuring that broadcasting stations act in concert with each other as digital SD broadcasting is terminated.

(3) Assistance in Equipment Procurement

In the case of Sri Lanka, assistance in equipment procurement will be more or less the same as assistance in the importation of equipment described above. When the amount of investment required to procure DTTB-related equipment is large and burdensome for the broadcasting stations, special tax reduction measures may be taken to provide assistance in equipment procurement.

(4) Handling of Waste

Policies and guidelines need to be drawn up covering the disposal of home electric appliances, particularly the disposal of analog TV sets, in accordance with environmental protection laws. This is because a large quantity of unwanted appliances will be generated in a period as short as just a few years as analog TV sets are replaced with digital.

9.2 Scope of Technical Assistance

Section 9.1 listed measures taken in the past that will need to be taken in the future. This section deals with how the measures to be taken should be implemented as technical assistance in addition to this project, taking into consideration the three points outlined below.

(1) Period of Implementation and Items Can Be Handled Institutionally

Many of the items relating to the preparation of plans and criteria and the establishment of policies and laws/regulations should be implemented before the DTTB platform begins operation. This project and its ancillary projects, which will need some time before they are institutionally built up, must therefore be addressed promptly. It is considered that the establishment by the Government of Japan of a DTTB Working Group jointly with the Government of Sri Lanka will make it possible to implement those matters in which Japanese experience can be utilized. In the past, the Government of Japan has used joint workshops to provide Japanese know-how and experience to countries adopting ISDB-T.

(2) Support in the Revision of Laws in Sri Lanka

In the discussions held between the Study Team and the administration officials of Sri Lanka, it was learned that it is intended, when a Cabinet proposal regarding the adoption of ISDB-T is presented, that a comprehensive revision of laws be carried out in response to the adoption of the system. If the experience and know-how of Japan should be required in the revision of existing laws or the enactment of new laws, it is assumed that this help can be given as part of the technical assistance.

(3) Continuity between the Study and Technical Assistance

The scope of the technical assistance positively includes efforts to provide continued and progressive assistance to the undertakings by Sri Lanka on the basis of the results of the basic design prepared by the Study Team, and the mitigation and reduction of negative impacts on the project for the construction of the DTTB platform.

9.3 Description of Technical Assistance

9.3.1 Technical Support to be Provided through Consulting Service

(1) Frequency Plan for Start of HD Broadcasting Service

The general frequency plan will be studied in line with the channel plan of the basic design. The next task in the frequency plan is the allocation of frequencies to HD broadcasting. TV broadcasting requires more frequency bands than other operations. Therefore, it is appropriate that the allocation of frequencies to TV broadcasting be examined.

By the time this project is implemented, transmitters will have been installed in a number of areas. At that time the status of radio propagation will be checked in detail and a decision made as to whether antenna patterns need to be adjusted or gap-fillers added. Thus, information regarding mainly the status of frequency use will be obtained. Since the antennas will be installed with a view to future HD broadcasting, it will be efficient if a channel plan for HD broadcasting can be drawn up at the same time. At this time, an overall plan will be prepared, including the use of the existing analog sites that will become obsolete after ASO. With regard to the use of the obsolete sites, the technical information required by the Government of Sri Lanka to determine policy, such as using them for mobile phones, will be provided so that a farsighted, comprehensive frequency plan can be drawn up.

At this time, information will be provided to ensure appropriate decision-making in relation to measures to combat the influence of the 700MHz band. The influence of the 700MHz band refers to the possible adverse impact on DTTB reception if the frequencies in this band are used for mobile phones, etc. In Japan, mobile phone operators have joined together to form the Association of 700MHz Frequency Promotion, the purpose of which is to take measures to combat this impact.

With regard to equipment design and in particular the specifications of the transmitting antennas, the impact of previous equipment specifications in the HD frequency plan is unavoidable, because all the radio waves are transmitted by the same transmitting antennas. To prevent the exposure of tender conditions such as the equipment specifications and in order for the tender to go ahead properly, therefore, it was determined that the frequency plan should be prepared as part of the consulting service. Another reason for including it in the consulting service is from the perspective of work efficiency; frequency simulations and radio wave measurement must be carried out at intervals in order to construct transmitting stations and these items of information must be handled together in the frequency plan.

It is assumed that this frequency plan will be prepared by TRC.

The following three outputs are assumed:

(i) Channel plan for HD broadcasting (eight frequencies for HD broadcasting, effective radiated power, and transmitting station locations)
(ii) Results of frequency simulation of channel plan for HD broadcasting
(iii) Comprehensive frequency plan (including guidelines for the provision of services in each band and the preparation of plans)

(2) Preparation of Technical Standards

The technical standards for receivers and transmitters will be examined. The reception/transmission specifications will strongly influence the detailed design of this project. Most of the broadcasting equipment to be procured will be imported, and will be used to construct the platform. The determination of specifications involves the selection of the necessary parameters from among many available choices. The specifications of the Association of Radio Industries and Businesses (ARIB) of Japan will be used in the examination of the reception specifications. With regard to data broadcasting in particular, the various choices, such as the data format to be chosen, the use of restriction specifications, the production of programs and the actions of the receiver manufacturers, must be looked at flexibly.

Receivers, on the other hand, will require specifications unique to Sri Lanka in order to provide language support, such as captions in Sinhalese, Tamil and English. The standards must be announced officially as soon as they have been determined so that viewers can purchase the appropriate imported products.

It is assumed that the technical standards (transmitter/receiver specifications) will be prepared by TRC. The preparation of the specifications is included in the consulting service so that they can be prepared as part of the detailed design.

The following three outputs are assumed:

(i) Reception specifications
(ii) Transmission specifications
(iii) Guidelines for import business operators

(3) Compatibility test for receivers

Compatibility test for receivers at the Test Center will tested whether products comply with the specifications prepared in Section (2) above. In particular, the screen display for data broadcasting was determined through trial and error in Japan, and the Test Center played an exceedingly important role in ensuring the circulation of reliable products. The Test Center will check hardware, such as various models of STBs and TV sets, and will conduct device-by-device verification of data broadcasting programs. Its responsibilities will include the preparation of specifications together with broadcasting stations, the handling of imported products, and coordination with manufacturers. In other words, the Test Center must also have the capacity to carry out this kind of coordination.

The Test Center will be operated by TRC, which will supervise specifications and technical standards. The major equipment needed by the Test Center will be radio measurement vehicles and measuring instruments, both of which are to be procured in this project. As in Sections (1) and (2) above, assistance in the operation of the Test Center will be provided in the consulting service.

The following three outputs are assumed:

(i) Test Center verification manual
(ii) Radio measurement vehicle management manual
(iii) Measuring instrument operation manual

9.3.2 Technical Assistance to be Discussed

(1) Counseling on reception issues for viewers

At the present moment, the promotion policies are supposed to be prepared by the Government of Sri Lanka. If the Government of Sri Lanka requests technical assistance in establishing the promotion policies, the Study Team will consider the provision of assistance in comprehensive promotion policies including the establishment of the call center as a technical cooperation project.

At this stage, while allowing for the above possibility, it is assumed that the technical assistance will be provided in the promotion policy implementation phase after the policies have been determined. It is assumed that dissemination and promotion activities to viewers are assumed that the call center will basically cover all of the activities aimed at viewers. Since many inquiries are expected to concern radio waves and viewing conditions, the call center will be established in DBNO so that inquiries can be handled in cooperation with engineers. In fact, inquiries from viewers will have to be handled on a case-by-case basis depending on the reception status and individual household circumstances, such as the renovation of reception facilities, replacement of TV sets, or purchase of a STB. It is expected that many viewers will lack the special knowledge needed for the purchase of DTTB equipment. The call center will be established to answer inquiries, questions, etc. from the viewers at any time. The call center will not only simply answer inquiries, questions, etc. from the viewers but will also communicate information needed by the viewers and hold explanatory meetings in various areas. It will also share with broadcasting organizations (TV program providers) the information required for promotion.

This technical assistance will be provided to DBNO (or the staff of the organization that manages DTTB).

The following four outputs are assumed:

(i) Call center telephone call handling manual
(ii) Pamphlet explaining DTTB to viewers (explaining the actions viewers need to take)
(iii) Leaflets to hand out at explanatory meetings for the promotion of DTTB
(iv) Reports of explanatory meetings for the promotion of DTTB

(2) Capacity Development for Production of Data Broadcasting Programs

This assistance will be aimed to be comprehensive capacity development including the following contents.

1) Training in Data Broadcasting Program Production

The production of data broadcasting programs requires techniques, know-how and knowledge that are very different from those required for conventional broadcasting programs, such as know-how in programming and the design of user interfaces for data broadcasting programs (the means of operation by which viewers can navigate through the data broadcasting screens to select and watch data broadcasting programs, and use bidirectional functions). In the initial phase of DTTB, it is important to provide continuous data broadcasting; the needs of viewers will become apparent only after it has continued for some time. Therefore, training will be provided to enable the stable production and airing of data broadcasting that is not linked to TV programs.

In addition, workshops will be held to allow private broadcasting station personnel engaged in data broadcasting to obtain the necessary knowledge of this new technology.

It is assumed that this activity will basically target SLRC.

2) Capacity development in Data Broadcasting Utilization (Establishment of data broadcasting program production departments, development of educational programs, and development of programs providing public information on e.g. health services)

It is necessary to create a system for the acquisition and provision of public information such as weather and traffic information. Trainees need to learn how to operate an information search engine that can acquire information owned by public organizations and supply the information as content for data broadcasting, and how to write programs using BML language. Since DTTB is a technical field not supported by ordinary broadcasting stations, it is necessary to form an organization for it and to allocate an appropriate number of personnel to the production of data broadcasting. Relationships with collaborative organizations also need to be built.

It is assumed that the first educational programs to utilize data broadcasting will be language education programs. New programs covering such subjects as arithmetic/mathematics and science will be developed with a focus on programs in which the learning achievement level can be identified using bi-directional functions, or in which visual explanation can be used to achieve an effect. In the development stage, the impact of data broadcasting programs will be measured for use in the production of data broadcasting programs.

It is assumed that this activity will target SLRC.

3) Capacity development for Disaster Broadcasting Utilizing Data Broadcasting (Preparation of disaster broadcasting criteria/operating manual, improvement of emergency broadcasting program production system, and preparation of operating guidelines and manuals for EWBS)

The aim of this activity is to improve the disaster broadcasting service utilizing data broadcasting. For disaster broadcasting, the criteria and manuals for broadcasting disaster information will be prepared so that disasters can be responded to in a rational manner. In addition, the emergency broadcasting program production system will be examined and improved, the way in which EWBS is utilized will be examined and operating guidelines will be prepared. Manuals will also be prepared. The equipment for EWBS operation will be installed in DBNO, and the service will be operated by SLRC and DBNO.

4) Development of Sports Programs Utilizing Data Broadcasting

Sports programs are well suited to the production of data broadcasting programs linked with TV programs. This is because the past records of players, results of past games against opponents and other statistical information about the sport can be imported into data broadcasting and added into programs. Although the technical assistance will be provided to SLRC, a positive effort will be made to convey basic information and know-how to the producers and engineers of private broadcasting stations by means of workshops held jointly with Japanese experts.

(3) Future Assistance Measures to Be Considered (Capacity development for disaster broadcasting)

In Japan, the capacity for disaster broadcasting is exceedingly high, and the disaster broadcasting services are well developed. Sri Lanka is a country where flood disasters frequently occur every year and a country that, like Japan, must have a potentially high demand for disaster broadcasting. Disaster broadcasting cannot be effectively implemented merely by enhancing the disaster broadcasting capacity of broadcasting stations. Collaboration with the organizations that monitor disasters is essential. Therefore, it is desirable that a separate plan be drawn up so that when SLRC starts to provide a stable DTTB service and collaboration has been established between the Disaster Management Center and SLRC, good use can be made of the experience of Japan.

The content of the assistance is assumed to be the four points listed below, including the preparation of guidelines, training of broadcasting station personnel in providing emergency broadcasting in a time of disaster, and EWBS operation training:

- Establishment of an EWBS operation plan

  Japan is the only country that operates EWBS. If EWBS is operated in Sri Lanka, both SLRC and DBNO will need to take action. An EWBS operation plan needs to be established, including the division of responsibilities between the two parties.

- Preparation of equipment management guidelines

  EWBS operation requires equipment management guidelines so that warnings can be issued without delay. The guidelines will be provided mainly to DBNO and SLRC.

- Preparation of disaster broadcasting guidelines

  The guidelines will describe how decisions on the provision of warning information and the issuing of alarms are made, as well setting out as the rules, methods, etc. for the interruption of programs being broadcast. Disaster broadcasting will be implemented using these guidelines and based on definite decision-making criteria such as short-term precipitation figures and rise in river water levels. Guidelines and decision criteria prepared in advance enable responses to be made quickly. This assistance will be provided to SLRC.

- Preparation of a disaster broadcasting manual

  The disaster broadcasting manual, together with the disaster broadcasting guidelines, sets out what kind of actions the SLRC personnel should take and how the information should be communicated. This manual will be used in daily disaster broadcasting training to build the capacity of the production and program personnel so that all of them are capable of providing disaster broadcasting. This assistance will be provided to SLRC.

Chapter 10 Actions for DTTB Recommended by the Study Team

Chapter 10 Actions for DTTB Recommended by the Study Team

Actions the Government of Sri Lanka needs to carry out for the transition to DTTB are described in this chapter.

10.1 Planning and Formulation of Standards

(1) Examination of frequency plan

The frequency plan should be formulated in the first stages of the transition to DTTB. Decisions as to which bands to use for TV and radio broadcasting, mobile phone, etc., need to be made on the basis of a vision for the future.

The purpose in reviewing the frequency plan in the transition is to decide how after ASO to use the frequency bands that have been used in analog broadcasting. Sri Lanka also wants to make the transition to HD broadcasting after ASO. SD broadcasting will be continued as the gradual switch to HD broadcasting is made. Thus, the number of multiplexed HD programs per frequency needs to be decided in advance, and the frequencies needed for HD broadcasting need to be secured. As the frequency band is the same for SD and HD, HD broadcasting requires more frequencies than SD broadcasting.

The transition to DTTB enables many frequencies to be used for purposes other than TV broadcasting. Thus, it is necessary to consider the efficiency of future frequency assignment so that a fixed range can be used for HD broadcasting, thus preventing the random assignment of channels.

The three issues listed below need to be considered in frequency planning.

- Policy of redevelopment of former analog broadcasting sites
- Number of HD broadcasting programs to be multiplexed
- Consideration of efficiency in future frequency assignment

The frequency plan should be reviewed before completion of the development of employer’s requirement of the Project. Information on the frequencies is needed for equipment procurement. The frequency or approximate range of frequencies to be assigned should ideally be clarified before the employer’s requirement in particular of such equipment as the transmitters, exciters and antenna systems. From the viewpoint of economy, the DTTB platform should consist of equipment that can be used also for HD broadcasting. If the frequency is decided after equipment procurement, specifications will need to be reviewed, which is financially inefficient. If the whole transmission system is procured at the same time so as to reduce the cost of investment to set up the platform for the transition to DTTB, including private broadcasting companies, consideration must be given to completing the frequency plan before the development of employer’s requirement to enable the equipment to be procured economically.

(2) Formulation of receiver and transmitter standards

The reception and transmission standards should be formulated early to determine the transmitters and receivers that should be made available in Sri Lanka. ISDB-T broadcasting has already started on a trial basis, and even during this test period viewers are able to purchase receivers. Although the setting up of the platform means that broadcasters will not need to purchase transmitting equipment, it is preferable that in the case of commercial promotion including mobile TV, etc., there should be restrictions on imported equipment.

(3) Formulation of licensing criteria

As described in Section 9.1.1, the form of frequency licensing is likely to change in line with the transition to DTTB. There have been legal requirements for opening a transmitting station, in which field strength, signal format and other screening criteria and procedures for opening a transmitting station are clearly set out. These need to be revised for application to DTTB and standards need to be added for division into segments in order to accommodate data broadcasting and One-seg broadcasting.

The radio waves will be transmitted by DBNO and unlike the current broadcasting system the broadcasting content will be provided by content providers. It is necessary to determine and clarify at an early stage the requirements needed to obtain a content provider license, so that current broadcasters can make a smooth shift to content provider. It is hoped that these criteria will be formulated in coordination with the legal amendments.

As with the frequency plan, the formulation of criteria needs to be completed before development of employer’s requirement.

10.2 Establishment and Revision of Relevant Laws and Regulations

(1) Revision of broadcasting laws and regulations

Neither the Sri Lanka Rupavahini Corporation Act nor the Sri Lanka Telecommunications Act has any provision relating to content providers or facility providers. When the DTTB platform is developed, these two entities need to be defined clearly and their responsibilities clarified. The laws need to be revised with regard to the following issues:

- Clear definition of business content and responsibilities of content provider and facility provider
- Regulations relating to content provider and facility provider (related to the criteria mentioned in (3) above)
- Requirements for license renewal of content provider and facility provider
- License categories (Sri Lanka Rupavahini Corporation Act: license for content provider and facility provider, Sri Lanka Telecommunications Act: frequency license and multiplexing license, etc.)

- Procedures and screening criteria related to the acquisition of the DTTB license (related to criteria mentioned in (3) above)
- Requirements and regulations related to the acquisition and renewal of the DTTB license
- Definitions and regulations relating to program multiplexing
- DTTB license and multiplexing license fees
- Definitions and regulations relating to SD and HD broadcasting
- Definitions and regulations relating to functions unique to DTTB, including data broadcasting and One-seg broadcasting
- Obligation of content provider to use the DTTB Platform

The Government of Sri Lanka is considering the revision of current laws to include the above matters. However, it is hoped that the, legal system including regulations and criteria be looked at, as the existing broadcasting-related laws are limited to the Sri Lanka Rupavahini Corporation Act and the Sri Lanka Telecommunications Act. It is also necessary to consider the promotion of new entries into the field and the careful implementation of license renewal screening for current service providers, in order to create a diverse and healthy broadcasting culture taking local characteristics into consideration. In view of the current existence of licensed broadcasting service providers that are not in operation, this is a sensitive issue that may lead to a waste of publicly-shared national assets.

(2) Enactment of DBNO Act and Establishment of DBNO

The roles, responsibilities, funding and means of gathering funds of the DTTB platform operator, or Digital Broadcasting Network Operator (hereinafter referred to as “DBNO”), need to be legally defined prior to its establishment. As the DBNO provides facilities and equipment for private and state-run broadcasting stations, consideration needs to be given to providing a balance so as to avoid a bias towards either commercial use or public standards. Although it is unclear how this balance should be struck, as the responsibilities and business content of a DBNO are yet to be defined, the appointment and responsibilities of its chief executive should be legally defined. The contents that should be included in the law for the establishment of a DBNO are described below.

Although it is assumed that only one DBNO will be established at present, a study should be made as to whether to allow the entry of other organizations in the future. The future course should be decided through discussions based on a long-term vision rather than a short-term view.

With respect to the establishment of a DBNO, matters concerning funding and user fee collection need to be examined carefully to guarantee that it can broadcast appropriately and stably as a public entity. A shortage of maintenance funds may hinder the operation of transmission systems. The DBNO should be established in such a way that profits can be returned to the broadcasting companies. The funds management system and organizational structure such as public funds and PPP, needed for the creation of a DBNO, need to be determined as soon as possible in order to ensure a smooth transition to DTTB.

It is essential to secure skilled employees to provide a stable, technically reliable broadcasting service. Establishment of the DBNO law will enable the appointment of an adequate workforce. Consideration should also be given to the implementation of the staff training necessary for smooth operation.

10.3 Assistance with Policy Development and Penetration

(1) Promotion of DTTB Penetration

Activities to promote DTTB to viewers are the key to the smooth transition to DTTB. This will necessitate making viewers understand why they need to purchase a digital terrestrial broadcasting receiver. In Sri Lanka there are households that use an indoor antenna or use an antenna with insufficient antenna gain. Although currently analog broadcasting allows them to view TV, albeit with low image quality, after the switch to DTTB no image at all will be displayed when the signal is below a certain level. Thus, support needs to be given to help people make the proper decision as to whether they need to set up a receiving antenna when they purchase a new receiver.

Although for the reasons described in Chapter 10 the study team did not include assistance for the promotion policy in the project components, the formulation of comprehensive promotion measures will directly affect whether ASO can be carried out as scheduled (See Table 5.1-2). In Japan, multifaceted promotion measures were implemented to enable ASO as planned. If the Sri Lankan government conducts a review of the measures taken in Japan and considers whether they can be put to use in Sri Lanka, the greater part of the study of promotion measures will have been achieved.

In particular, PR activities aimed at viewers should be carried out continuously and in sufficient volume, and viewer should be given assistance so as to avoid the situation of households that were previously able to watch TV not being able to watch DTTB for financial reasons. As explained in Section 7.2.8, statistically, the free distribution of STBs may be necessary in the northern and eastern regions and in Uva Province. It is also worth examining to what degree cable and satellite TV should be obliged to retransmit DTTB programs. What is important is that a variety of measures be taken, rather than a single measure. A comparison of the cost between the installation of additional gap fillers and the free distribution of STBs can help to determine whether the free distribution would be good or not.

(2) Import of equipment compatible with DTTB

It is likely to be difficult for Sri Lankan manufacturers to produce receivers, STBs and mobile terminals compatible with DTTB immediately after the transition to digital terrestrial broadcasting. Although local manufacturers of receivers will emerge, Sri Lanka will have to depend on imported products for the time being. One way to help this situation is the exemption of customs duty on DTTB receivers for a certain period. The current import tax rate is 15 percent. If a special tax exemption is allowed for receivers, this will result in a reduction of 225 yen per STB assuming a retail price of 2,000 yen, for example (225 yen is equivalent to 15% customs duty assuming the retailer's margin of 10% and value added tax of 13% are subtracted from the price). Retailers would also benefit from the exemption in terms of the procurement of funds needed to import the products. If every Sri Lankan household bought an STB imported tax-free, the Government of Sri Lanka would take 790 million yen less in tax revenues, which would be offset by the 13 percent value added tax on the purchase of the STBs. When sales of mobile terminals, etc., are included as described in Clause 5.1, the economic impact is estimated to be several tens of billions of yen, resulting in a total increase in tax revenues. This will lead to indirect financial assistance for viewers and will have a verifiable impact.

Meanwhile, broadcasting companies will need to take measures to make their TV studios and master control systems compatible with HD. Like the receivers, the devices and equipment that are needed will also be imported. Although the Government of Sri Lanka is not planning to provide direct financial assistance, facility replacement will require a large amount of investment, and tax exemption measures leading to indirect financial assistance will provide effective assistance.

(3) Conducting compatibility test for receivers by test center

The appropriate receivers need to be available in the retail market so that penetration will not be hindered. To this end, a test center should be set up to verify compatibility before the products are released onto the market. An overview of the test center is given in Section 9.3.2. It will be operated as a public entity and people will be able to purchase products certified by the center without any worries as to compatibility.

As described in Chapter 9, conduction compatibility testing for receivers at the test center is included in the scope of the technical support. The test center should be established in advance, at the preparation stage. It is hoped that the equipment will be procured quickly following the launch of the Project so that the verification can begin promptly. If the center is not established until after the launch of the Project, it may not be able to fully cope with DSO-SD in early 2016 in the Greater Colombo area. The test center needs to be established in advance so that it can be in operation immediately after the Project consultants are appointed.

10.4 Capacity Development for the Use of Digital Broadcasting

The three working groups (WGs) listed below are expected to be set up to address capacity development for the effective use of the functions unique to digital broadcasting. It is important that personnel from private broadcasting companies be included in the WGs.

(1) **Technical standards WG**

The establishment of technical standards for transmission and reception is essential. The specifications of equipment and receivers to be purchased need to be regulated in accordance with the standards. Without technical standards, the situation may occur in which items procured are not compatible with the interface. The technical standards WG members need to include people involved in the transition to DTTB, in the telecommunications industry with relation to data transmission, and retailers, in addition to people from broadcasting companies.

(2) **Contents WG**

The setting up of a WG to carefully examine the program contents will be effective in providing advanced, quality services unique to ISDB-T such as data broadcasting, mobile TV, EPG, closed-caption broadcasting and EWBS. Specifically, this WG will mainly tackle across-the-board issues and those issues that can be resolved more efficiently when tackled jointly, on the basis of the efforts described in Section 9.1.4. Early establishment of the WG will accelerate the examination of basic guidelines related to program production and lead to the early broadcasting of quality programs.

Research into specific production techniques and the formulation of production guidelines based on discussions within the WG will help improve the overall level of the programs produced. From a proactive point of view, there is room for discussing the establishment of the WG in the form of an association or some such, organized by the broadcasting companies. In that case, it will be possible for technical assistance to be provided to employees of private broadcasting companies as Japanese ODA projects, through the association.

(3) **HR development WG**

Digital technology requires approaches to equipment operation and management and to production that are different from the current approach. Human resources need to be developed targeting not only government employees but also private broadcasting company employees, in order to bring about reliable broadcasting using the DTTB platform. As in the case of (2) above, it will be possible to provide technical training programs as Japanese ODA projects if the broadcasting organizations operate the WG in the form of an association. In which fields and to what scale HR training is needed should be examined carefully, together with whether it will be possible to conduct the HR development training in Sri Lanka; and the WG should formulate guidelines for HR development.

10.5 Lotus Tower Demarcation and Adopted Design for HDTV

Through discussions between the study team and concerned parties it seems likely that it will be possible for the Lotus Tower to be used as the Colombo transmitting station that will be the prominent transmitting station of the DTTB Platform, and as the DTTB Platform network operations center. This is because TRC and the Lotus Tower Project carried out the review needed to apply to the Lotus Tower the basic design policy of the study team. However, the demarcation of work between the Lotus Tower project and this Project has not yet been determined; thus, the Government of Sri Lanka needs to decide the demarcation of work promptly.

10.6 Land Acquisition

(1) Land for transmitting stations

Although most of the existing transmitting stations are to be used, five new stations are to be constructed. It is important that the land acquisition be completed before the consulting services begin, so that the plan will not be affected. If the land is not acquired in advance, the consulting services, frequencies and change of transmission link routes from the DTTB Platform network operation center will need to be re-examined, and this will significantly affect the implementation schedule of the consulting services.

(2) Land for DBNO administration building

Because there is no space for the DBNO administration in the Lotus Tower, according to the basic study an administration building will be built separately from the Lotus Tower. However, because it is planned to install remote monitoring equipment in the administration building also, it is preferable that the land be acquired before the beginning of consulting services.

10.7 PMU Launch

A project management unit (PMU) will be set up during the implementation period of the yen loan project. The PMU needs to build a structure for proper implementation of procurement, operation and management in the Project. The participation in the PMU of human resources capable of working cross-organizationally needs to be considered.

10.8 Launch of Trial Broadcasting

ISDB-T test broadcasting is currently being carried out in Sri Lanka with assistance from the Japanese government. If the Project is implemented, it will progress according to the schedule shown in Section 8.4.2. The test broadcasting will be followed by experimental broadcasting and then full-scale broadcasting. DSO-SD refers to full-scale broadcasting. Experimental broadcasting differs from DSO-SD in that the latter includes TV commercials. In other words, the experimental broadcasting is identical to DSO-SD, using the same frequency, except that it has no TV commercials. During the experimental broadcasting, test images or programs are being aired for a certain period of time every day to detect problems and measure radio wave propagation.

The Study Team proposes DSO-SD in the Greater Colombo area in early 2016. The equipment to be procured in the Project will be considered to provide the shortest schedule to the launch of DSO-SD. A decision needs to be made whether to conduct a seamless shift from the current test broadcasting to experimental broadcasting or to conduct the experimental broadcasting for just a short period during installation work when the test waves are being transmitted.

10.9 Tasks to be Performed and Their Deadlines

The seven tasks described above that need to be carried out, not including the launch of trial broadcasting, are summarized in Table 10.9-1 below together with their deadlines. Because the transition to DTTB involves many issues, project schedule management is important. The plan needs to be implemented promptly after the decision on the broadcasting standard is made.

Table 10.9-1 Tasks to be Performed before Transition to DTTB and Their Deadlines

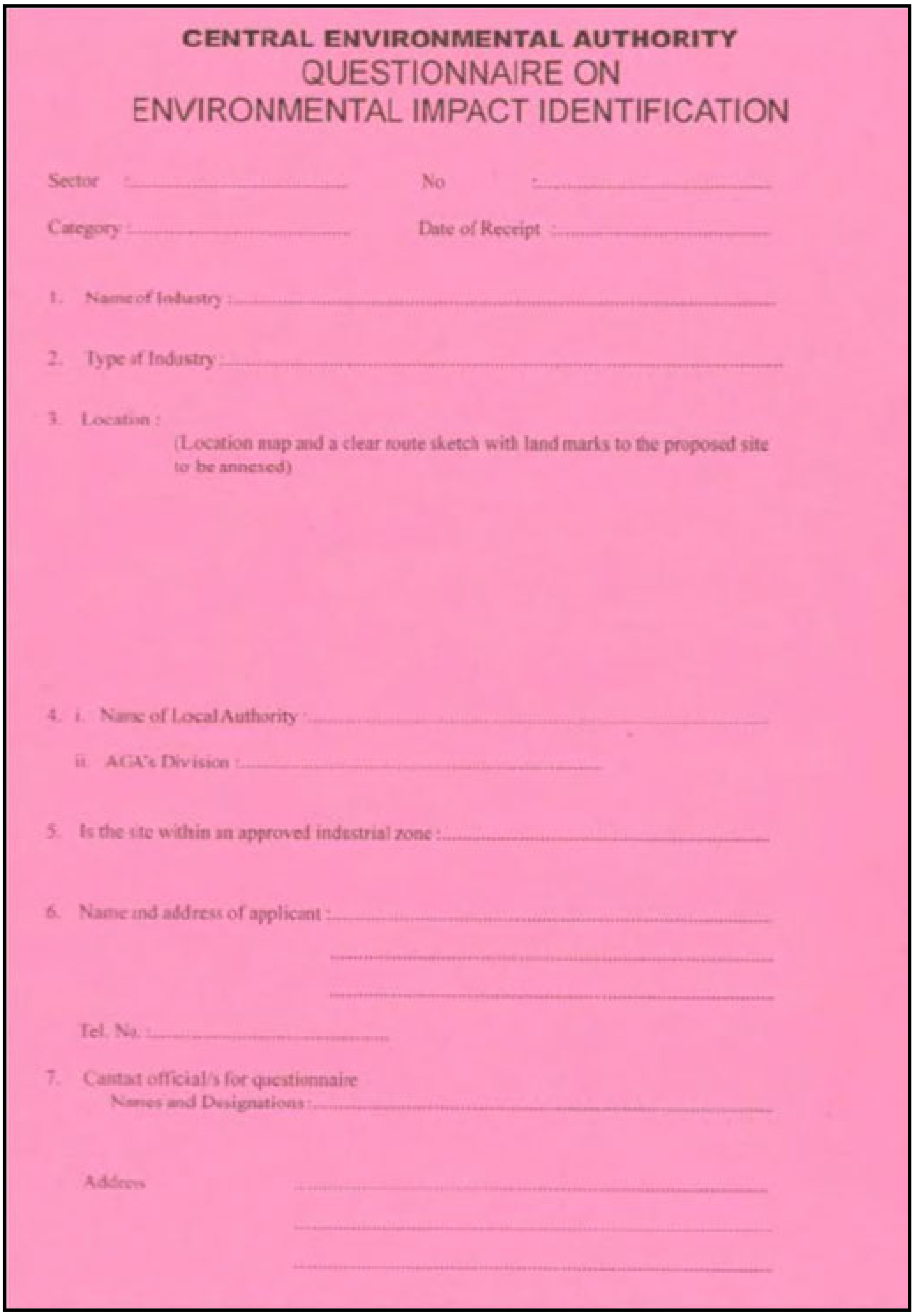
	Task to be Performed	Deadline
1. Planning and Formulation of Standards		
(1)	Examination of frequency plan	Before completion of development of employer's requirement of the Project
(2)	Formulation of receiver and transmitter standards	Before completion of development of employer's requirement for Colombo part plan of the Project
(3)	Formulation of licensing criteria	Before launch of DSO-SD trial broadcasting
2. Establishment and Revision of Relevant Laws and Regulations		
(1)	Revision of broadcasting laws and regulations	Immediately after determination of broadcasting standards
(2)	Enactment of DBNO Act and Establishment of DBNO	Bill to be approved before appraisal of the Project
3. Assistance with Policy Development and Penetration		
(1)	Promotion of DTTB Penetration	At launch of trial DSO-SD broadcasting
(2)	Import of equipment compatible with DTTB	Before launch of trial DSO-SD broadcasting
(3)	Establishment of a test center for digital terrestrial broadcasting equipment	At launch of trial DSO-SD broadcasting
4.	Capacity development for the use of digital broadcasting	
(1)	Technical standards WG	Immediately after determination of broadcasting standard
(2)	Contents WG	Immediately after determination of broadcasting standard
(3)	HR development WG	Immediately after determination of broadcasting standard
5.	Lotus Tower demarcation and adopted design for HDTV	Before development of employer's requirement of the Project
6.	Land acquisition	
(1)	Land for new transmitting stations	Before development of employer's requirement of the Project
(2)	Land for DBNO administration building	Before development of employer's requirement of the Project
7.	PMU launch	Immediately after appraisal of the Project

Source: JICA Study Team

Attachment 1　CEA Evaluation Sheet

CEA Evaluation Sheet

＜Simple kind of evaluation＞



CENTRAL ENVIRONMENTAL AUTHORITY

QUESTIONNAIRE ON

ENVIRONMENTAL IMPACT IDENTIFICATION

Sector : .... No : ....

Category : .... Date of Receipt : ....

1. Name of Industry : ....
2. Type of Industry : ....
3. Location :

   (Location map and a clear route sketch with land marks to the proposed site to be annexed)

4. i. Name of Local Authority : ....

   ii. AGA's Division : ....

5. Is the site within an approved industrial zone : ....
6. Name and address of applicant : ....

   ....

   ....

   Tel. No. : ....

7. Contact official/s for questionnaire

   Names and Designations : ....

   Address ....

   ....

   ....

「Simple kind of evaluation」1/5

CEA Evaluation Sheet

＜Simple kind of evaluation＞

8. Factory Layout Plan - (Layout Plan to be annexed) :...

9. Amount of capital investment - Local :
Foreign :

10. Date of commencement of operation :...

Any phased programms (Details) :

11. Number of shifts per day and times :...

12. Number of workers in each shift ....

13. i. Area of the land to be developed : Acres / Hectares

ii. Ownership - Private land / Crown land

14. Extent of buffer zone that can be provided around the operation :............................ (Meters)

15. present use of land :...

16. Land use of the area within 5 km radius :

17. List of exising industries / institutions / agricultural land within 2 km radius :

18. List of main manufactured products and capacities :

19. List of by products :

20. Processes used - brief description :
(Attach process flow diagram)

「Simple kind of evaluation」2/5

CEA Evaluation Sheet

＜Simple kind of evaluation＞

21. All raw - materials used :
(State itemwise quantity / day at design capacity)

22. Water - Total water requirements :
State requirements / consumption for

a Domestic :..

b Cooling :..

c Process :..

d Any other use :..

23. Source of water (Delete whichever is inapplicable)

a Public supply

b Ground water (Wells, Springs)

c Surface water (Stream, River etc.)

24. Quality of waste water : :.......................... :..

25. Proposed method of discharge of waste water : Open channel / Pipeline / Covered drains /Other (specify) :
(Delete whichever is inapplicable)

26. Final point /s of discharge of waste water :..

27. Proposed method/s of treatment of waste water : :..

28. Type and quantity of solid wastes generated daily : :..

「Simple kind of evaluation」3/5

CEA Evaluation Sheet

＜Simple kind of evaluation＞

29. Proposed method/s of disposal of solid wastes :...

30. Total energy consumption :

a In plant generation (kw) :..

b Public supply (kw) ::...

31. Details of machinery to be used in the industry and their horse power ratings :

Type	*HP Rating*	*No. of Units*

32. Details of fuels used :

a Type ....

b Purposes :...

c Daily consumption :...

33. Number of stacks / chimneys and their heights :...

34. Possible emissions :

a Oxides of nitrogen : Yes / No (Delete whichever is inapplicable)

b Oxides of sulphur : Yes / No

c Dust and soot : Yes / No

d Any other (Specify)

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CEA Evaluation Sheet

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35. Possible sources of noise :..

36. Methods proposed to minimise excessive noise :..

37 Possible salvage of any waste material for use - specify :..

38. Describe your plans for future expansion of your industry at the proposed location. State whether the expansion alters the type, nature and manufacturing process of the industry. Also state the proposed time span.

I hereby certify that the particulars furnished by me in this application are true and correct. I am aware that if any particulars herein are found to be false or incorrect, my application will be refused and the licence, if issued, will be cancelled. Further, I am also aware that one month prior to the commencement of operations of the proposed industry / activity, the Central Environmental Authority shall be so informed through the relevant Local Authority and that I shall not commence the said operations without obtaining an Environmental Protection Licence from the Central Environmental Authority or the relevent Local Authority.

Name :..

Designation :..

Signature :..

Date :..

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