

Data Collection Survey for Intelligent Transport System (Phase II)

FINAL REPORT Summary

February, 2015

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NIPPON KOEI CO. LTD.

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**Data Collection Survey for
Intelligent Transport System (Phase II)**

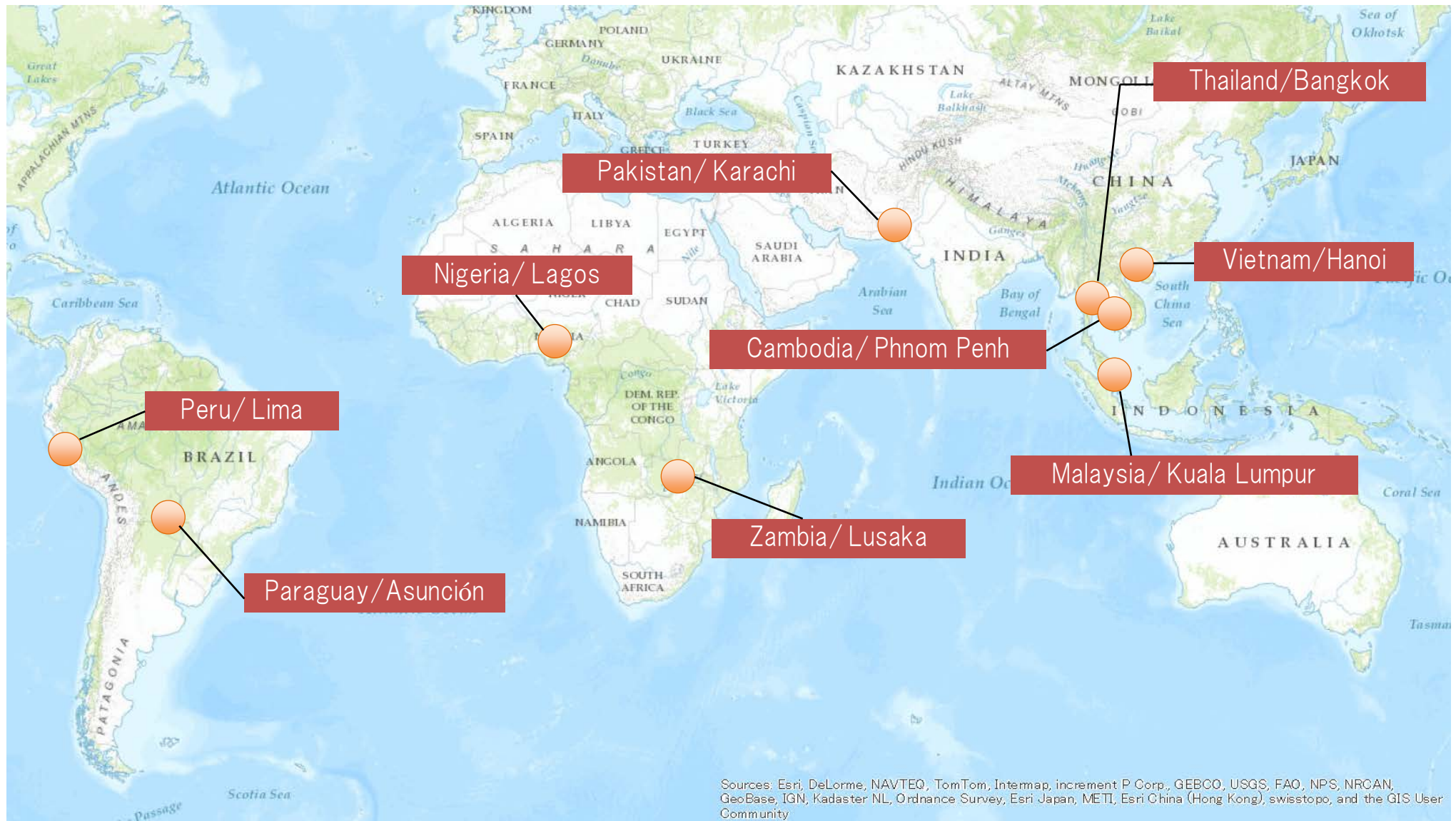
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Location Map



Source: Open Street Map

Location Map of the Study Area

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Location Map

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Abbreviations

ADB	Asian Development Bank
AfDB	African Development Bank
BOT	Build Operate Transfer
BRT	Bus Rapid Transit
CCTV	Closed-Circuit Television
DSRC	Dedicated Short Range Communications
ERP	Electronic Road Pricing
ETC	Electronic Toll Collection System
EV	Electric Vehicle
GDP	Gross Domestic Product
GPS	Global Positioning System
HPC	Hanoi People's committee
IC	Integrated Circuit
ICT	Information and Communication Technology
IDI	ICT Development Index
ISO	International Organization for Standardization
ITS	Intelligent Transport Systems
ITU	International Telecommunication Union
JICA	Japan International Cooperation Agency
MODERATO	Management by Origin-Destination Related Adaptation for Traffic Optimization
MRT	Mass Rapid Transit
OBU	On Board Unit
OD	Origin Destination
PTPS	Public Transportation Priority System
RFID	Radio Frequency IDentification
SCAT	Sydney Coordinated Adaptive Traffic System
SCOOT	Split, Cycle and Offset Optimisation Technique
SMS	Short Message Service
VICS	Vehicle Information and Communication System

CHAPTER 1 INTRODUCTION

1.1 STUDY BACK GROUND

The survey is a data collection survey for understanding the intelligent transport systems (ITS) situation in developing countries and in middle income countries in order to consider the direction of Japanese assistance for ITS. This survey is beneficial from the point of view of increasing the overseas deployment of Japanese technology in profitable fields.

1.2 OBJECTIVE

The objective of the survey is to collect and grasp basic information on ITS in target cities, and consider the direction of future assistance for technical cooperation using Japanese ITS technology which aim to improve traffic management and safety. In addition, this is to provide information for contributing to the overseas expansion of Japanese ITS related companies/manufacturers.

1.3 TARGET CITIES

The target cities are shown in Table 1-1 below.

Table 1-1 Target Cities

South east Asia	South Asia	South American	Africa
Vietnam/Hanoi	Pakistan/Karachi	Peru/Lima	Nigeria/Lagos
Thailand/Bangkok		Paraguay/Asuncion	Zambia/Lusaka
Cambodia/Phnom Penh			
Malaysia/Kuala Lumpur			

Source: JICA Study Team

1.4 SCOPE OF WORKS

The scope of works is shown as follows:

- (1) To collect ITS related information and documents
- (2) To conduct field survey
 - 1) To grasp ITS related policy of target cities
 - 2) To grasp current ITS situation and future plan
 - 3) To grasp ITS needs
 - 4) Pre-explanation and report to JICA Office
- (3) To summarize survey results, to prepare reports and to report to ITS assistance committee

CHAPTER 2 ITS WORLD CONGRESS AND DOMESTIC MANUFACTURERS' INTERVIEWS

2.1 ITS WORLD CONGRESS TOKYO 2013

2.1.1 Outline of ITS World Congress

(1) Number of Participants and Participating Countries

The number of participants and participating countries at the ITS World Congress Tokyo 2013 are as follows:

- Number of participants: 21,029 persons (including 3,935 registered persons)
- Number of participating countries: 69 countries
- Number of exhibitors: 238 groups (Domestic: 114, Overseas: 124 (Asia Pacific: 44, European Union: 59, North/South America: 21)

Source: ITS World Congress Tokyo 2013 Homepage

(2) Main Program

The main programs and the speakers at the ITS World Congress Tokyo 2013 are as listed in Table 2-1 below.

Table 2-1 Main Program and Speaker of ITS World Congress Tokyo 2013

Name of Program	Speaker or Contents
Opening Ceremony	- Mr. Keiji Furuya, Chairman, National Public Safety Commission, Japan - Dr. Hiroyuki Watanabe, Chairman, Japan Organizing Committee, Japan
Plenary Session 1	- Mr. Malcolm Dougherty, Director, California Department of Transportation, USA - Mr. Fotis Karamitsos, Acting Deputy Director General, DG MOVE, European Commission
Plenary Session 2	Cancelled because of typhoon
Plenary Session 3	- Prof. Masao Sakauchi, Vice Chairman, ITS Japan, Japan - Dr. Peter Sweatman, Director, University of Michigan Transportation Research Institute (UMTRI), USA
Closing Ceremony	• Summary of ITS World Congress Tokyo 2013 • Highlights Video、• Paper Awards
Executive Sessions	12 sessions
Special Interest Sessions	65 sessions
Others	Host Selected Sessions、 Technical/Scientific Sessions、 Interactive Sessions、 Ancillary Events、 Showcase Demonstrations

Source: ITS World Congress Tokyo 2013 Final Program

2.1.2 Information Collection on ITS in Each Country

(1) Outline of Method of Information Collection

The JICA Study Team picked the candidate sessions in order to grasp the latest ITS situation and trends, and participated in the sessions and summarised the results. In addition, the JICA Study Team checked the exhibition booth and interviewed some exhibitors to grasping their ITS products and actual achievements.

(2) Session Attendees

The JICA Study Team attended a total of 17 sessions, and summarised the results. Outline of the contents is shown in Table 2-2.

Technically-advanced contents, such as automated driving, big data analysis, etc., were debated in this congress. For the developing countries, a presentation was made by ITS Japan regarding “ITS guideline” for Asia Pacific countries in a session (HS16).

(3) Exhibition Booth







There were various exhibition booths by Japanese ministries, ITS-related agencies (ITS Japan, ITS America, etc.), car manufacturers and ITS product manufacturers. ITS-related agencies of each countries introduced the history of ITS and current situation in their own country. ITS Korea and a Turkish company (VENDEKA) introduced their activities about donation/assistance situation to other countries


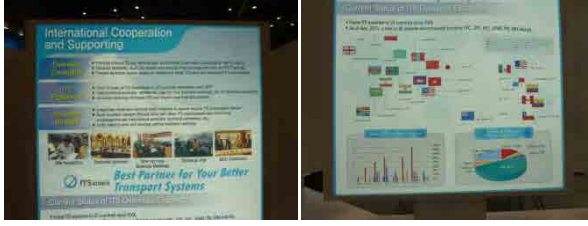
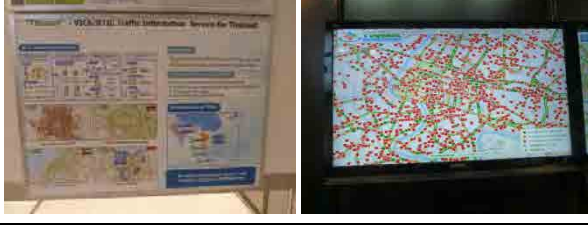

Table 2-2 Outline of attended Session

Date	Time	No	Title	Keyword	Survey Outline
15th October, 2013 Tuesday	9:00-10:30	PL01	Open ITS to the NEXT: Aim and Issues in Moving Towards the Next Stage	-New Technology -Asia-Pacific -Safety and Traffic Management	Each speaker made a presentation about movement of next generation ITS developing and Implementation. To utilize ITS technology for further development and dissemination of ITS, for instance, the use of new technologies and devices such as a smart phone, shared with infrastructure (maintenance and management (including disaster response), collaboration with industry-government-academia and environment was proposed.
	11:00-12:30	ES01	Autonomous Vehicles - the Path to Implementation	-Autonomous Vehicle -Architecture and Deployment Strategies -New Business Model, Productivity Improvements and New Model	Developing situation of automated vehicle on Japan, USA and EU was introduced. Although automated vehicle technology in each countries are under developing, its situation is progressing. This technology is expected the effect of reduce traffic congestion, traffic accident, etc. But there are some issues on safety, reliability and legal part.
		HS01	Education for Next Generation ITS in Asia	-Asia -Metropolitan area -Suburban city area -How to develop human resource	Based on the traffic situation and the past change in the Asian countries, the necessity and measure of the education for ITS was reported. ITS is effective against solve traffic problem, but there are some challenge in human resources, policy decision, education of ITS, private participation and etc. in asian countries. To encourage human resource development and business promotion for the private sector participation and to share the educational scheme between countries was discussed.
	14:00-15:30	ES02	Connected Vehicles - Preparing for Deployment	-Connected and Cooperative Vehicle -Implementation of cooperative system and service	Based on the 'national ITS Plan 2020', speaker of South Korea explained about promotion of Cooperative-ITS (C-ITS) and effort of the administrative support, policy and standard. ASFINAG, Austrian company, they manage European road network, explained effort of full-scale development of C-ITS. BMW corporation reported the development and experimental situation of "Connected Vehicle", and explained about deployment of the V2X. GM corporation explained about the efforts of automated vehicle. They have done the efforts with a view to integration of V2V and V2I.
		HS03	For the Practical Use of Fully Automated Platoon System (on Energy ITS Project)	-Energy saving -METI Project	Development status of display running and its results were reported.
		HS04	New Services Enabled by Distributing the Road Related Information	-Road Section Identification Data set -Spread of future ITS services	Hanshin Expressway introduced about Road Section Identification Data Set (RSIDs). Zenrin explained about map navigation system and application. ITS Norway explained about development digital road map, and cooperative framework with Sweden (road map, Architecture, etc).
16:00-17:30	ES03	Deployment of Cooperative Safety and Energy Efficient Services	-Accidents -Smart mobility services -Extensive collaboration	Traffic safety of Japan, US, and EU was debated. The effort and technology development status of autopilot and risk aversion (automatically adjust the vehicle speed based on the around parking situation, etc.) was introduced.	
16th October, 2013 Wednesday ※Morning program was canceled by Typhoon	14:00-15:30	ES05	Cooperative Strategies for Urban Traffic Management	-Mobile device -Smarter Traffic Management -More optimised usage of infrastructure	Metropolitan Police Department reported about technical development trend of UTMS. ITERIS reported about development status and utilization of "Big Data" and "Connected Vehicle", and and scheme of real time information provision. In addition, ITS European Congress explained about growing ITS needs, its issue, technology innovation, as an example of effort of Helsinki. NXP company described the effort of automation, as well as explain the efforts related to toll collection and information communication, and discussed security issues as future challenges.
		SIS23	Radiocommunication Technologies for Advanced ITS	-700MHz band ITS -5.9 GHz WAVE standards -Radiocommunication standards	ITS wireless communication technology is reported. Development and efforts of frequency in Japan, US and Europe and research on communication with the tram in Hiroshima was introduced.
		HS10	Automated Driving - Next Generation Vehicle-Highway System	-Automated driving system -Future R&D and Implementation	Development status for automatic communication in Japan, US, and European and cooperation with car manufacturer was explained.
	16:00-17:30	ES06	ITS Policy and Vision	-Policy and Vision -Sustainably mobile society	ITS policy in Japan, US, European, and Indonesia was reported. Speaker of Japan explained about ITS history in Japan, future development of safe driving support and handling Big Data. US proposed about laws, regulations, and handling method of the data as for the future challenge to the "Smart City". EU reported about further development of information sharing technology and traffic management through a V2V and V2I. Indonesia explained about efforts of introducing smart tachograph based on increasing traffic accidents.
17th October, 2013 Thursday	11:00-12:30	SIS42	Harmonization for Open ITS Communication Standards	-Information of standardization activities	Explanation of ITU efforts. In addition, TOYOTA explained about utilization of information communication using current ITS technology, and TNO explained about efforts of ITS standard in Europe.
	14:00-15:30	ES09	International Spectrum Allocation Policies	-Spectrum Allowcation -Wireless Communication	Current situation of wireless communication and frequency allocation, etc. were explained by Japan, US, China, Austria. In addition, international cooperation situation and usage situation of the frequency on ITS was reported.
		HS16	Deliverables from ITS Asia-Pacific Collaboration	-Asia-Pacific region -ITS Guideline -Collaborative issues	ITS Japan explained about ITS guideline for Asian-Pacific. Prof. Kamijo, Tokyo university, introduced about analysis results using camera image and traffic signal system, Philippines explained about ITS development strategy. Thailand explained about current ITS situation and issues. ADB introduced about some past ITS related project, and reported about its lesson learned (different ITS needs in each country, lack of ITS policy, connection of the infrastructure development).
		SIS45	Sustainable Urban Mobility Solution to Address Challenges in Mega Cities	-Sustainable urban mobility solutions -Passengers and urban logistic	Effort of BRT, EV car sharing in each country, and effort of information provision by handling Big Data were reported.
16:00-17:30	HS19	Data Integration Issues and Standardization - Creating Connected World Around Vehicles	-ITS system -Common framework of information unification	App development for information sharing, communication technology development efforts for V2X, joint project with car manufacturers was reported. As a problem of information sharing, how utilize it to business opportunities, and how promote private initiatives was debated. And necessity for solving the security and privacy issues by opened data was also discussed.	
18th October, 2013 Friday	14:00-15:00	PL03	Beyond ITS: from Conventional Approaches to Four Aspects of "Open"	-Transport Problem -Navigating and Analyzing data -Evolution of Device Technology	The ITS initiatives and future development in Japan, US and Europe was described. Deployment of V2V and V2I technology, utilization of Big Data, and further ITS efficacy enhancement by open data was reported.

Source: JICA Study Team

Table 2-3 Exhibition Booths

<p>1.</p>		<p>ARH Inc. (Hungary) : Exhibition of automated vehicle number plate recognition (ANPR)/License plate recognition (LPR). Car plate reading ability of this equipment is optimized for Japan, the Americas, Europe, Arabic, Chinese, Korean and Thai. In addition, they have toll collection, speed enforcement, ITS systems, parking system, vehicle access control, border control, etc.</p>
<p>2.</p>		<p>Shenzhen Genvict Technologies Co., Ltd. (China) : They have core equipment for highway ETC, intelligent parking, commercial vehicle networking and radio frequency identification (RFID) applications.</p>
<p>3</p>		<p>HUAWEI (China) : In this exhibition, they have enhanced long-term evolution (eLTE) multimedia broadband trunking solutions, massive storage and cloud computing for big data in transport, and an intelligent bearer network solution for transport.</p>
<p>4</p>		<p>TOMTOM (Netherland) : TomTom showcased their smartphone application and latest mapping technology. They also have a car navigation system, and sells their products around the world.</p>
<p>5</p>		<p>VENDEKA (Turkey) : Vendeka is a systems provider and developer for ITS and ETC solutions. They assist other countries, such as the Philippines.</p>
<p>6</p>		<p>Kapsch TrafficCom AG (Austria) : Kapsch TrafficCom has solutions for road user charging, urban access and parking, road safety enforcement, commercial vehicle operations, electronic vehicle registration, traffic management and V2X cooperative systems. They provide information in</p>

		India, Bangladesh, the Philippines, Thailand, Vietnam and China.
7		<p>Q-Free ASA (Norway) : Q-Free is a leading global supplier of products and solutions in ITS for road user charging and advanced transportation management. Their actual achievements are in highway tolling, electronic law enforcement, congestion charging, parking guidance, etc.. They have experience in Thailand, Malaysia and Indonesia.</p>
8		<p>ITS Korea (South Korea) : They showcased the current situation of Korea’s ITS, interim goal, ITS plan, etc.. In this exhibition, they showed the achievement of assistance to other countries, and they conducted 49 project around the world.</p>
9		<p>Toyota Tsusho electronics Co., Ltd. (Thailand) : They provide traffic information service, called T-Square, in Thailand, Indonesia and the UAE. And their group have experience in China, Singapore, etc.</p>
10		<p>Mitsubishi Heavy Industries, Ltd. (Japan) : They have a proven data management system, ETC, various on-board units (OBU) for ERP in Singapore, DSRC services in Japan, etc. Regarding ETC, they provide RFID to India.</p>

Source: JICA Study Team

(4) Conclusion

Since this congress was held in Japan, many new ITS technologies, such as vehicle-to-vehicle communication, big data, and automatic driving, were introduced. However, the announcement of “ITS guideline” for Asia-Pacific and ITS equipment, for promoting expansion into Asian countries have been conducted in this congress. Many countries participate in the ITS World Congress, and this congress is one of the most important opportunities for introducing Japanese ITS. Therefore, it is desirable for some institutions to utilize this congress and cooperate with ITS Japan in order to promote Japanese ITS.

CHAPTER 3 SOCIALIST REPUBLIC OF VIETNAM

3.1 OUTLINE OF ITS-RELATED MEASURES AT THE NATIONAL AND CITY LEVELS

3.1.1 RELEVANT STAKEHOLDERS

The name, interview date, and overview of roles of each organization are shown in Table 3-1 below. These organizations have roles of planning and management at the national and city levels.

Table 3-1 Interview List

No	Organization Name	Level	Overview of Roles
1	Hanoi Department of Transportation (HDOT)	City	Development of road traffic planning, management of public roads/transportation infrastructure, budget management in Hanoi
2	Directorate for Roads of Vietnam	National	Enactment of laws in Vietnam, planning, and maintenance of national roads
3	Hanoi Traffic Police Division (HTPD)	City	Safety in Hanoi based on traffic law, and traffic order
4	Urban Transport Management and Operation Centre, HDOT	City	Plan, research, and business management relating to public traffic management in Hanoi
5	Vietnam Expressway Corporation (VEC)	Governmental Enterprise	The investment, operation, maintenance, management, toll collection, etc. in highways
6	VEC O&M	Private	Monitoring of traffic conditions in highways
7	Mai Linh Taxi	Private	Operation and management of taxis
8	Ministry of Information and Communications	National	Development of policies and regulations related to information and communications in Vietnam
9	Transport Development and Strategy Institute, Ministry of Transport (MOT)	National	Research on REMON Project – Real Time Monitoring of Urban Transport – Solutions for Traffic Management and Urban Development in Hanoi
10	HANOI TRANSPORT & SERVICES CORPORATION (TRANSERCO)	Governmental Enterprise	Management of buses in Hanoi

Source: JICA Study Team

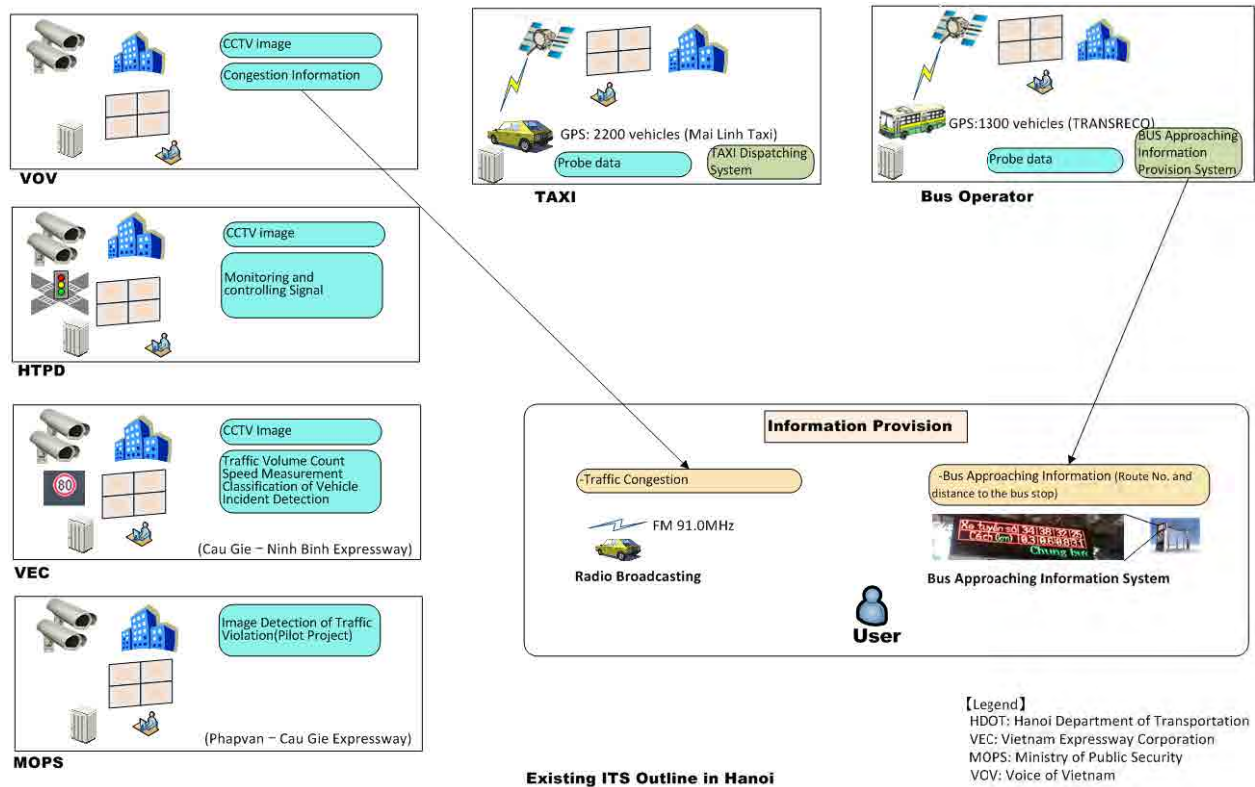
3.1.2 ITS ARCHITECTURE AND STANDARDIZATION AREA

ITS standards are formulated by the Department of Science and Technology (DOST) and, Ministry of Transport (MOT).

In addition, the ITS master plan for highways has been developed by the Study on the National Transport Development Strategy in Vietnam 2 (VITRANSS2).

3.1.3 EXISTING ITS RELATED FACILITIES AND EQUIPMENT

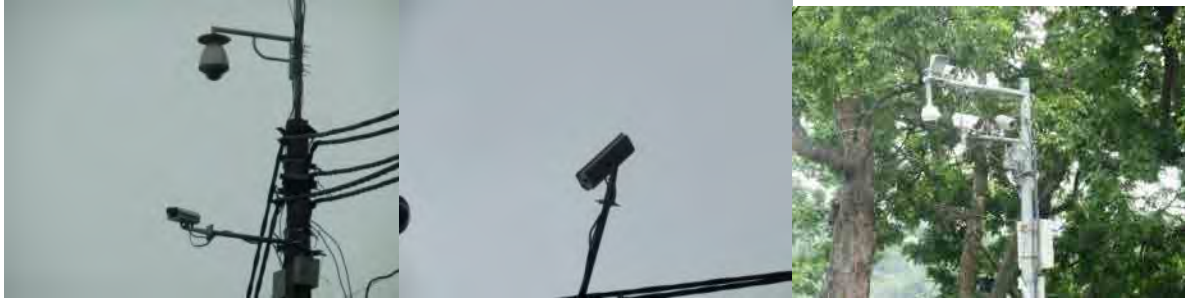
A diagram of the overall system of existing ITS-related facilities and equipment in Hanoi is shown in Figure 3-1 below. The Hanoi Traffic Police Division (HTPD) manages traffic signals, and HTPD and Voice of Vietnam (VOV) perform maintenance of closed-circuit televisions (CCTVs).



Source: JICA Study Team

Figure 3-1 Existing ITS Facilities and Equipment - Overall Systems Diagram

- (1) Collection System Equipment
 - 1) CCTV
 - Hanoi City has a total of 86 CCTVs (HTPD: 34 (dome type), VOV: 5).
 - The application of CCTVs is for monitoring of traffic events (traffic accidents, congestion, etc.), and use them for instructions to the site as required.
 - The video is monitored at the center, and the image is stored for seven days.
 - Police CCTV is connected to the center via fiber optic cable. VOV’s CCTV is connected via Wi-Fi.
 - VOV’s CCTV image information is provided to HTPD via an optical fiber from the VOV center, but the image information from HTPD has not been provided to VOV.



Source: JICA Study Team

Figure 3-2 CCTVs in Hanoi

- 2) Highway (CCTV, ETC, highway card)
 - i) **CCTV**
 - There are 56 CCTVs installed in Cau Gie – Ninh Binh.
 - CCTV has two uses, one is for counting traffic volume, and another is for image monitoring.
 - The information collected are traffic volume, vehicle classification, vehicle speed, traffic accidents, and traffic violations. Speeding and traveling against the flow of traffic are detected automatically.
 - Recorded CCTV images are stored for one month.
 - Two variable message sign (VMSs) (direction/equipment) are planned to be installed in the future.
 - Power supply of CCTVs has two types, one is by cable that is connected to the toll gate, and another is solar powered.
 - ii) **Electronic Toll Collection (ETC)**
 - ETC (RFID system, toll fee by distance) is planned to be installed, but the situation has been put on the hold because dissemination of on-board unit (OBU) requires more time and handling between banks related to electronic payment and ITS standards are undecided.
 - iii) **Highway Card**
 - Highway card for toll collection has been introduced.
 - IC chip is embedded in the highway card, and this system is automatically calculated by means of the card that the user receives at the toll gate (entrance). The card determines vehicle classification and the CCTV matches the number plate and then the toll gate staff at the toll gate (exit) reads the card information.
 - There are four ETC gates.
 - iv) **Others**
 - Weather meters are planned to be installed for monitoring weather.
 - The information from the user (by telephone call) and patrol car (by walkie-talkie) has also been utilized.



CCTV

Highway Card

Toll Gate (Cau Gie)



ETC Antenna (Cau Gie – Ninh Binh)



Toll Collection



Toll Gate (Ninh Binh)

Source: JICA Study Team

Figure 3-3 ITS-Related Facilities and Highway Equipment

(2) Provision System Equipment

1) Traffic Signals

- A total of 242 traffic signals have been installed (90 signals are connected to the Traffic Control Centre (TCC), while 152 signals are not connected).



Source: JICA Study Team

Figure 3-4 Traffic Signals

2) VMS

- VMS is installed and managed by Hanoi People's Committee (HPC) and maintenance and repair are conducted by HDOT.
 - There is no center for VMS. HPC district set the character contents of VMS.
 - Two-thirds of VMS's contents are traffic-related regulatory information, and one-third of them are advertisements.



Source: JICA Study Team

Figure 3-5 VMS (Underpass, Private Advertisement, and Guidance)

3) Bus Approach System

- The bus arrival information is announced to passengers when the bus is 500m away from the bus stop based on bus location information by global positioning system (GPS).
- Information boards have been installed at 24 bus stops, but the information disseminated are only from TRANSERCO because this is a pilot stage project. This information is provided via short service message (SMS) (automatically every 3 to 5 seconds).



Source: JICA Study Team

Figure 3-6 Bus Arrival Information

4) Car Navigation System

- Vietmap is selling the car navigation system. This company has produced a digital map and car navigation equipment. The map covers the 63 provinces of Vietnam.
- The digital map is updated every three months, and they update for free if the user brings the car navigation equipment to their counter.
- The equipment was brought from Taiwan, and navigation software and map data are installed in Vietnam.
- This equipment and system have been installed in private cars, taxis, etc.



Source: JICA Study Team

Figure 3-7 Car Navigation System

(3) Central System

1) Traffic Control Center and CCTV Control Center (HTPD)

- The functions of traffic control center are signal adjustment, signal system (Green Wave), turning the signals on/off, and operations monitoring.
- Installed software are from the French system and Singapore system. Interviewee said that this system is planned to be integrated into one system in the future.

2) Traffic Control Center and CCTV Control Center (HTPD)

- Traffic condition is monitored by CCTV, and this information is provided by radio and handling customer calls.



Source: Preliminary Study on Traffic Control Center in Hanoi, Socialist Republic of Vietnam (left, middle), Tran Vu Tuan Phan ITS in Vietnam (right)

Figure 3-8 Traffic Control Center (left, middle: HTPD, right: VOV)

3) Bus Operation Center (TRANSERCO)

- The center enables the collection of operation routes, arrival and departure time, speed, stop point, opening/closing of doors, etc., and monitor whether the bus is properly operated.
- Some of this information is planned to be provided on the internet in the future.
- If they need to contact the bus driver, they will first contact one of the nine control centers to which the bus companies is a member, and then individual center representatives will communicate with the driver by transceiver. The driver will then report the situation to the control center using a mobile phone.
- A pilot project in which cameras are installed in their bus, and monitors the inside/outside of the bus (including voice), has been conducted.



Source: JICA Study Team

Figure 3-9 Bus Operation Center (TRANSERCO)

3.1.4 PROCUREMENT SYSTEM OF ITS-RELATED FACILITIES AND EQUIPMENT

(1) Procurement System

The procurement system is by competitive tendering.

(2) Contract Type and Role of Procurement Officer and Contractor

The Hanoi government (HDOT, etc.) prepares the tender documents, and tender is performed after approval from HPC. Contractors procure materials and equipment basically based on the procurement law. The procuring party manages the facilities after the completion of the project. In addition, traffic signals in Hanoi have been managed and operated by HTPD, and CCTV has been managed and operated by HTPD and VOV.

3.2 TREND OF OTHER DONORS

The BRT project is implemented by the World Bank.

1) Hanoi BRT components (in January 2014)

- Kim Ma Terminal Building Construction (contractor has already been selected)
- BRT Lane (Contractor has already been selected. It is divided into three lots in each area.)
- Bus (currently in tender document preparation stage)
- Signal System (currently in tender document preparation stage)
- Depot (currently in tender document preparation stage)
- Ticketing System (currently in tender document preparation stage)
 - Loan total is USD 150 million.
 - Scope of World Bank is civil engineering, construction, system and bus procurement related to BRT.
 - Control center of HDOT and HTPD are not included.
 - World Bank is not concerned with technical specifications including specifications of IC Card.

3.3 SUGGESTION OF DIRECTION FOR ITS DEVELOPMENT

3.3.1 ITS MENUS TO BE INTRODUCED

(1) Consideration of ITS Development Phase

ITS equipment and systems for improvement of traffic congestion and traffic accidents should be developed preferentially, because Hanoi City is experiencing increasing traffic congestion and accidents. Furthermore, the development of public transport assist system is expected to have a higher effect in the short and medium term, since bus traffic is one of the most popular transportation modes in Hanoi.

Table 3-2 Introduction Phase of ITS Menu and Assumed Impacts of ITS

Introduction Possibility Period (assumed)	Name of the System	Expected Impact
Short	Basic information collection equipment, such as congestion situation monitoring system, full time traffic volume counting system, etc.	(Under preparation) Congestion improvement and traffic situational awareness of urban areas
	CCTV monitoring system	(Already introduced but insufficient) Congestion scale, situational awareness of the event of an accident, speeding the correspondence
	Signal optimization system	Congestion improvement of surrounding route and congestion intersection by optimization of traffic flow
	Accident statistics database system	Understanding accident situation and accident types, Utilization as basic data for considering measures
	Traffic accident detection system	Rapid rescue of accident vehicle and users
	Traffic violation enforcement system (over speed, signal jumping, etc.)	Quick and labor-saving of violation vehicle identification
	Roadside equipment, Ledger DB	Collection of basic data, database
	Public transportation transit search system	Improvement of user experience
	Congestion information by road information boards and radio, etc., Information providing system such as route information	Congestion improvement by promoting traffic conversion by the route guidance
	Regulatory information providing system (by information boards, radio, car navigation systems, etc.)	Provides information passable route along with information from various sensors, and avoids the traffic stagnation
	The monitoring system by various sensors (weather meter (rainfall, road temperature), etc.)	Conducted user services such as route guidance information by providing information of closures and etc. to the road user by weather information
	ETC	(To be introduced in highway) Service improvement by simplification of payment, reduction of labor costs in tollgate, congestion improvement due to a reduction of queue length by permit waiting
	Information integration between organizations	Efficiency and optimizing the sharing information by information integration of basic data, management, etc.
	Information terminal such as Car navigation system, Smartphone, WEB system, digital signage, etc.	(Car navigation system is developed by private companies) Improvement of information services by expanding the information available methods
	The overload detection system by weigh in motion, etc.	Avoid damage to the road by overloaded vehicles, reduction of maintenance costs
Middle	Expansion of information communication network of Telematics, 3G, etc.	Expansion of the information provision methods to the road user
	Operation management, Operation status provision system (bus)	(Implemented Pilot Project) Efficiency of management, Service improvement by providing information of operation status to the user
	Public transportation priority signal system	Mitigation of service inhibition of public transport, improving convenience of punctuality securing of arrival and departure time
	Maintenance operational efficiency systems, etc.	Support for the maintenance of Road, ITS facilities, etc., Cost savings
	Illegal parking enforcement system	Reduce the traffic inhibition due to parked vehicle by the illegal vehicle is reduced
	Roads and structures ledger DB	Efficiency of road maintenance and repair by database
	Business support systems, etc.	Operational efficiency, Cost reduction
	Road information provision to the other agencies	Sharing road information by information integration
	Cashless transit system using the IC card	Improve user experience, reduction of waiting time in the ticket office, etc. (service improvement)
	Various DB for the destination information provision	Implementation of information provision in conjunction with the needs of road users
	The route guidance and information provision by car navigation system, WEB, etc.,	Optimizing traffic flow by providing congestion information and regulations in advance
	Electronic system of vehicle passage application permission	Reduce labor costs of tollgate, congestion improvement due to a reduction queue length by permit waiting
Long	Demand bus system	Improvement of transportation services by securing transportation mode and supporting for the elderly, etc.
	Other public transport information cooperation system	Improvement of transit convenience, Improved transfer efficiency by providing information of other transportation means selection
	Reversible lane system	Optimization of traffic processing by the road users tailored to traffic conditions
	Parking investigation DB	By the understanding of the parking scale, utilized for study materials of expansion and maintenance of parking
	Parking situation information providing system	Guidance to the parking place, the reduction of illegal parking, reduction of traffic to look for parking (improvement of traffic flow)
	Cargo management system	Induction to the appropriate route based on the information of luggage of trucks, delivery location, etc., Efficiency of management
	Pedestrian priority signal system	Reduction of accidents by pedestrian priority, Rectification of the flow of people
	ERP	Conversion promotion of traffic due to the inflow regulation of vehicle, Congestion improvement, Reduction of accident
	Automatic payment system for parking	Reduction of payment waiting queue and labor costs
	The traffic control system for vehicle alone or vehicle-to-vehicle, roadside-to-vehicle communication	Facilitation of movement by providing information and collection from the other vehicle
Long	Disaster information collection, sharing and providing system	Share of the movement, correspondence (road manager) and situation in an emergency by providing and collecting detailed information of the road such as in the event of a disaster
	Travel assistance system (tourist information provision)	Improve usability of the information providing service in tourist facilities, accommodation, etc.
	Automatic driving system for vehicle	Improve user experience
	Pedestrian support system (the disabilities, the elderly, etc.)	Improve safety and convenience of the move of the elderly, disabilities, etc.
	Vehicle control system (by roadside-to-vehicle communication and inter-vehicle communication)	Improve user safety
	Location information provision for the elderly, etc.	Reduction of accidents, improve user safety

Priority High: Medium: Low:

Source: JICA Study Team

(2) Trend of Japanese Companies

There are many companies which are dealing in electronic equipment and system construction, and ITS related companies are mainly deployed in the software business. Therefore, there are less ITS-related companies for incidental facilities such as communications network or traffic signals poles.

(3) Draft ITS Menus to be Introduced

Hanoi's ITS situation is as follows;

- Traffic signals, CCTVs, VMSs and traffic detectors, which are the basic equipment of ITS, are few
- There is no ITS master plan in Hanoi.
- There is highway traffic control center (VEC), traffic control center (HTPD), and CCTV monitoring center (VOV), and the introduction of a new traffic control center, in conjunction with the implementation of the BRT project, has been studied by HDOT.
- Regarding traffic congestion information, there is CCTV image, and utilization of probe data has also been considered.
- Bus location system, although this is a pilot project, has been introduced in some public transport, and introduction of IC card has also been considered.

Based on this situation, draft ITS menus to be introduced are shown below.

- The formulation of ITS master plan
- Installation of basic ITS equipment, development of ITS-related facilities
- Training
- The system which was conducted as a pilot project or considered to be installed in the future, should be installed in the medium term.
- Foundation of ITS-related organizations, for instance ITS Vietnam, is beneficial for future ITS development.
- System construction and upgrade for performing more extensive information provision and collection should be done in the long term.

Note that ITS standard is under development in Vietnam, and it is expected that ITS will be introduced based on this national standard after formulation of ITS standard.

3.3.2 DIRECTION OF TECHNICAL AND FINANCIAL ASSISTANCE

The direction of technical and financial assistance is suggested in the following.

For the direction of ITS development assistance from Japan, installation of basic ITS equipment and system that matches the local conditions, research that supports ITS development in this country in the future, and short-term ITS menu as mentioned above, are recommended.

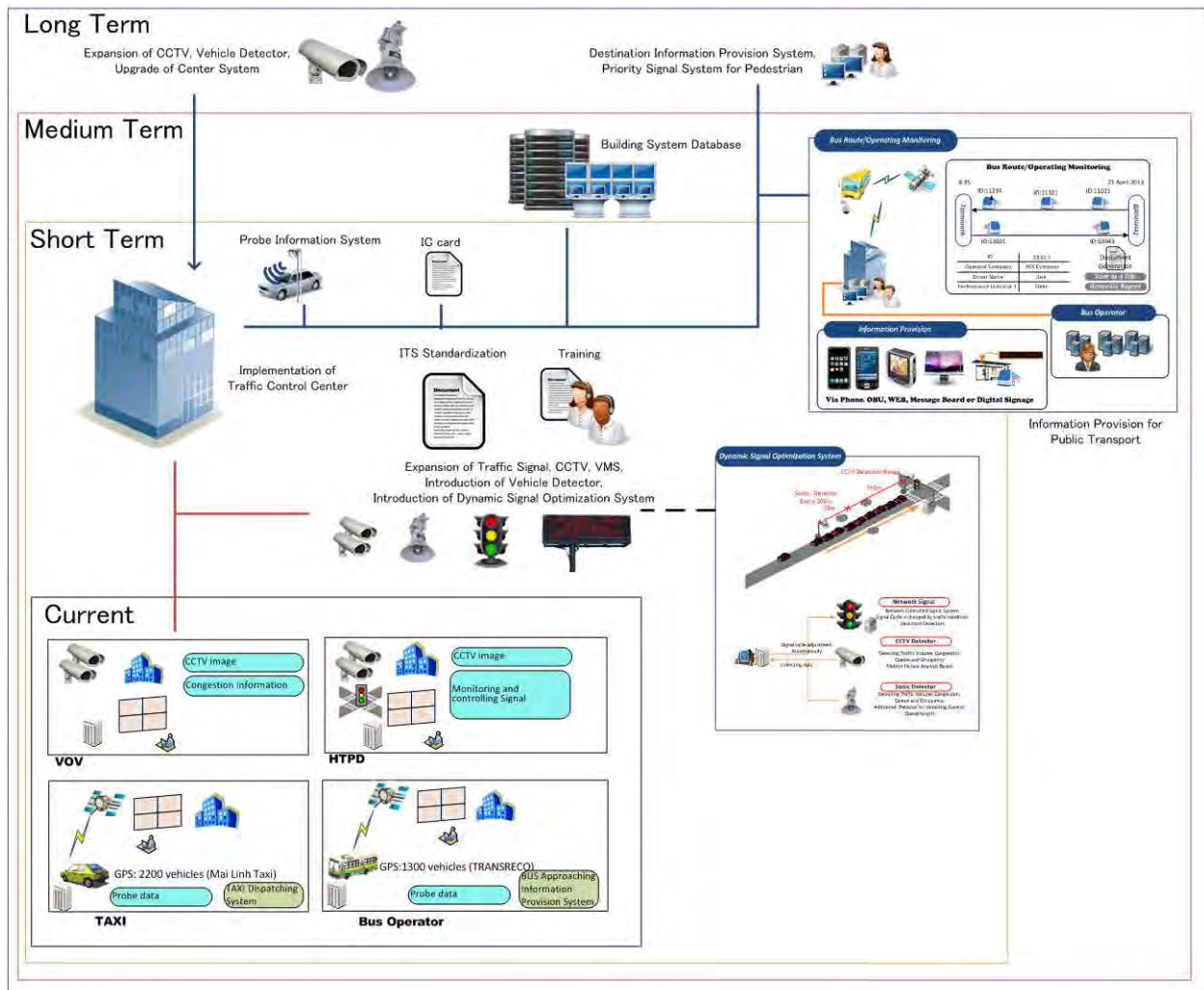
The research and development support by private companies such as on probe technology is not only beneficial for the improvement of ITS technology in Vietnam but also for deployment of Japanese

companies to Vietnam and introduction of Japanese ITS. Also, it promotes the appeal of Japanese ITS technology in Vietnam.

Table 3-3 Draft Direction of Technical and Financial Assistance

No	Type of Assistance	Objective
1	Technical Assistance: Training, Implementation Assist of Pilot Project, Formulation of M/P, Foundation of ITS Organization	- Dispatch of experts related to traffic control system - Technical assistance for pilot projects related to ITS - Training in Japan - formulation of ITS master plan - Foundation of integrated organization
2	Technical Assistance: Implementation Support of Collaborative Research	- Implementation of technical research related to development of ITS-related systems, financial cooperation, and information sharing
3	Financial Assistance: Loan	- Loan assistance for implementation of the ITS menu

Source: JICA Study Team



Source: JICA Study Team

Figure 3-10 ITS Introduction Conceptual Diagram (Hanoi, Vietnam)

CHAPTER 4 KINGDOM OF THAILAND

4.1 OUTLINE OF ITS-RELATED MEASURES AT THE NATIONAL AND CITY LEVELS

4.1.1 RELEVANT STAKEHOLDERS

The name, interview date, and overview of roles of each organization are shown in Table 4-1 below. These organizations have roles of planning and management at the national and city levels.

Table 4-1 Interview List

No	Organization Name	Level	Overview of Roles
1	Toyota Tsusho Electronics Thailand (TTET)	Private	Japanese company. conducted congestion information provided by smartphone apps in Bangkok
2	Bangkok Metropolitan Authority (BMA)	City	Traffic management, public transport management, development of traffic/transportation policy, etc. in Bangkok
3	Expressway Authority of Thailand (EXAT)	Governmental Enterprise	Operation, management, and maintenance of urban highway
4	Chulalongkorn University	University	- (In this case, interviewed about overview about the ITS in Thailand)
5	National Electronics and Computer Technology Center (NECTEC)	National	Analysis of the basic technology assigned to each institute
6	National Broadcasting and Telecommunications Commission	National	Monitoring the broadcasting and communication (Development of a master plan in accordance with the frequency, frequency allocation, licensing, etc.)
7	BMA CCTV Center	City	Monitoring CCTV owned by BMA
8	Royal Thai Police	City	Traffic management, reduction of road traffic accidents, security
9	Bangkok Mass Transit Authority (BMTA)	Governmental Enterprise	Management and operation of buses in Bangkok
10	Department of Highways (DOH)	National	Road network development in Thailand, maintenance and monitoring of road infrastructure
11	The Office of Transport and Traffic Policy and Planning (OTP)	National	Planning policy and standardization related to traffic in Thailand, promotion of pilot projects

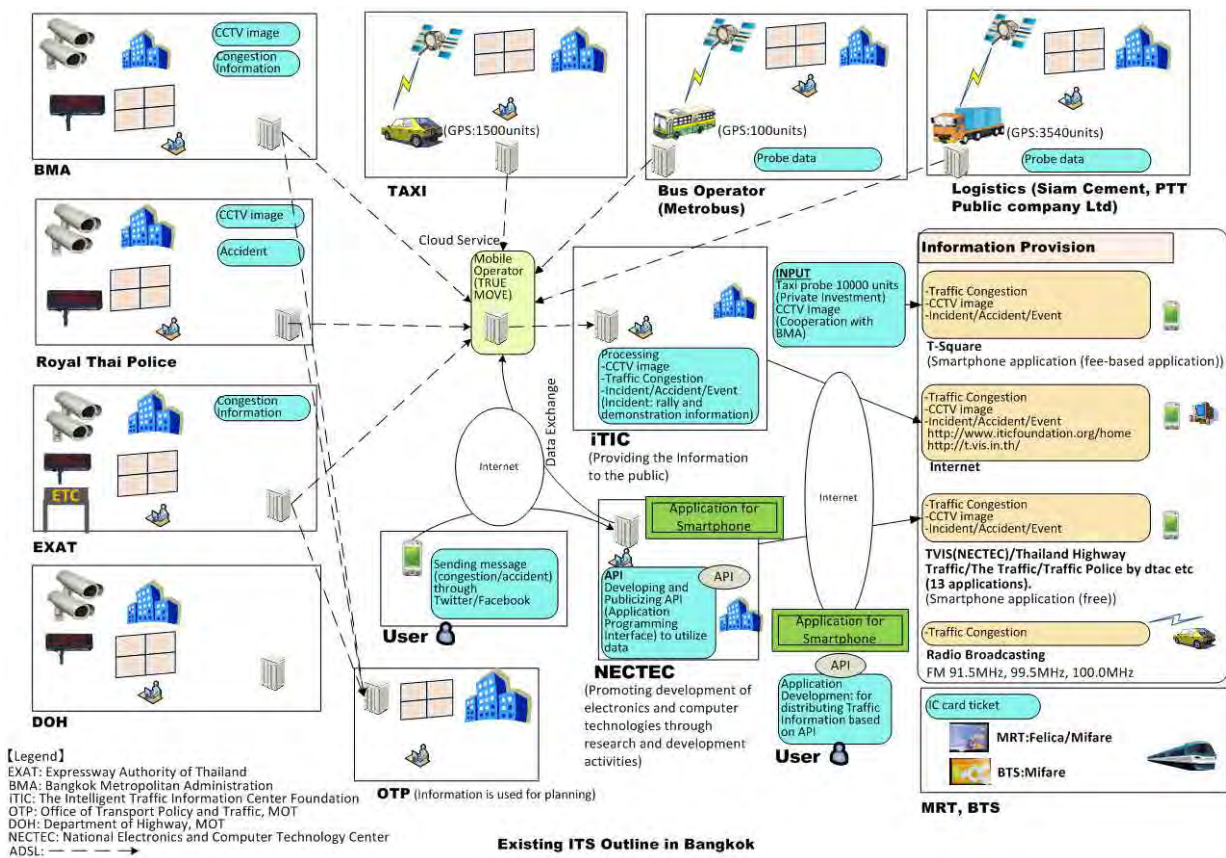
Source: JICA Study Team

4.1.2 ITS ARCHITECTURE AND STANDARDIZATION AREA

The Office of Transport and Traffic Policy and Planning (OTP) said during the interview that ITS standards and ITS architecture are already developed in Thailand, but these documents were not provided to the JICA Study Team.

4.1.3 EXISTING ITS-RELATED FACILITIES AND EQUIPMENT

A diagram of the overall system of existing ITS-related facilities and equipment in Bangkok is shown in Figure 4-1 below. The Bangkok Metropolitan Authority (BMA) has installed and manages traffic signals, and the traffic police operates it. BMA, the traffic police, and the Expressway Authority of Thailand (EXAT) manages and operates their own closed-circuit televisions (CCTVs).



Source: JICA Study Team

Figure 4-1 Existing ITS Facilities and Equipment - Overall System Diagram

- (1) Collection System Equipment
 - 1) CCTV
 - CCTV has been installed at 230 intersections for intersection monitoring (BMA: 150 intersections, traffic police: 80 intersections) and 2,000 CCTVs have been installed for security, and the video images have been monitored at the monitoring centers of BMA and the traffic police.
 - Installation and maintenance is implemented by BMA, and operation is implemented by traffic police.
 - DOH has 100 CCTVs in national roads, and video image is stored for 30 days. In addition, traffic

volume, vehicle classification, vehicle speed, gap, occupancy, etc., is counted or monitored by microwave radar.

- Red light cameras are installed at 30 intersections by traffic police, and traffic police conducts its management, maintenance, and operation. The red light camera is made in Spain, and it automatically detects signal jumping. Traffic police registers the number plates manually through monitoring of the red light camera, and then they send a fine notification letter to violators.



Source: JICA Study Team

Figure 4-2 CCTV

2) Expressway (CCTV, ETC, highway card)

i) **CCTV**

- There are 293 CCTVs installed, and the type is image monitoring and motion picture (20 motion picture cameras have been installed. There are three vehicle classifications (small, medium and large), and traffic volume, speed and density are measured.
- CCTVs are installed every 2 km at auto parts stores, and monitored by image and motion picture.
- Accidents are detected automatically, and the event is notified to the rescuers and the police is contacted by transceiver when the event has occurred.

ii) **Speed Sensor**

- Vehicle speed is monitored by speed sensors, but almost all of them are not working.

iii) **ETC(EasyPass)**

- Electronic toll collection (ETC) is introduced in a part of the Metropolitan Expressway in Bangkok, and it is used for highway toll collection. Communication method is 5.8 GHz passive, TC 278 format.



Source: JICA Study Team

Figure 4-3 ITS-Related Facilities and Highway Equipment

(2) Provision System Equipment

1) Traffic Signal

- Traffic signals are installed in about 400 intersections (all are stand alone type).
- Traffic signals are installed and managed by BMA, and operated by the traffic police.
- The signal cycle is preset, but police officers can manually change the cycle in response to traffic conditions.



Source: JICA Study Team

Figure 4-4 Traffic Signal

2) VMS

- BMA has 40 VMSs. Four of them are installed near the expressway entrance and provides the expressway congestion information. Information source is from radio broadcast and users, and is not provided from EXAT. The 36 other VMSs provide the congestion situation of general roads.
- VMS data is sent to the NECTEC center, and NECTEC manually encodes the data based on CCTV information.
- The traffic police have 80 VMSs, and encodes the text content for VMS at the police control center. VMS shows traffic information, event information and traffic campaign ((helmet, seat belt, etc.). Congestion situation is shown in to the VMS through the CCTV and visually by local police officers.
- There are 60 VMSs installed on highways. Sixteen VMSs are installed before toll gates, and the others (44 VMSs) are installed for providing traffic regulation and basic information such as travel time.
- In addition, a VMS is installed on the motorway.



Source: JICA Study Team

Figure 4-5 VMS

3) Car Navigation Systems

- Although car navigation systems are commercially available, it has not been very popular.

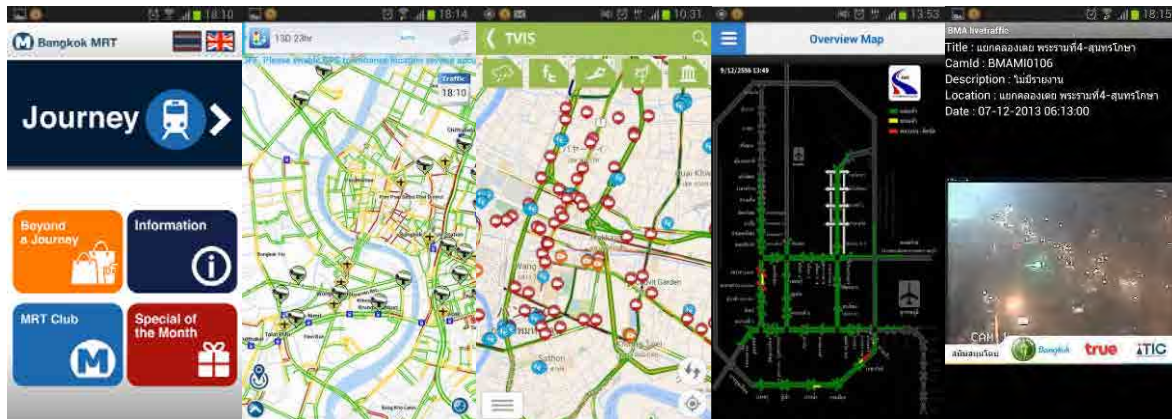


Source: JICA Study Team

Figure 4-6 Car Navigation System

4) Smartphone Application, Web

- Smartphone application for providing congestion information related to the traffic situation have been published by some agencies and companies (BMA, NECTEC, TTET, etc.).
- In addition, Intelligent Traffic Information Center (iTIC), which is a part of iTIC Foundation, provides information about traffic congestion, accidents, etc., using CCTV image, location information, Social Network Service (SNS) based on the CCTV, GPS of trucks, buses and taxis, and information from users on their web site (<http://www.iticfoundation.org/home>).



Source: JICA Study Team

Figure 4-7 Smartphone Application, Information Provision by Web

(3) Center System

1) BMA

- CCTVs are installed in about 150 intersections for traffic monitoring and 2,000 units for security. Video image is monitored at the CCTV control center.
- It is for image monitoring only, and there are no CCTVs for traffic counting.
- CCTV suppliers are stationed at the control center for maintenance and management, and traffic control function is not fulfilled.
- Congestion situation map based on CCTV image is provided by an information board at the VMS control center.
- There are 40 variable message signs (VMSs) in Bangkok, and four of them are installed near the toll

gates of the expressway.



Source: JICA Study Team

Figure 4-8 CCTV Control Center - BMA

2) Traffic Police

- Traffic police monitors, operates, and controls CCTV (80 intersections), red light cameras (30 intersections, signal jumping vehicle detection), and VMS (80 units).
- CCTV is only for image monitoring, and is not used for traffic counting. Red light cameras automatically detect the violating vehicle (information on violating vehicle, such as license plate, is manually encoded).
- Traffic police also operate traffic signals (400 intersections in the city), and adjust signal cycle on site based on the CCTV image and traffic situation.



Source: JICA Study Team

Figure 4-9 CCTV Control Center – Traffic Police

3) EXAT

- CCTV, VMS and speed sensor for traffic monitoring, management and information provision are installed in expressways, and monitored.
- Some CCTVs are able to count the traffic volume. Congestion map of expressway based on these information is provided through VMS, smartphone application, etc.

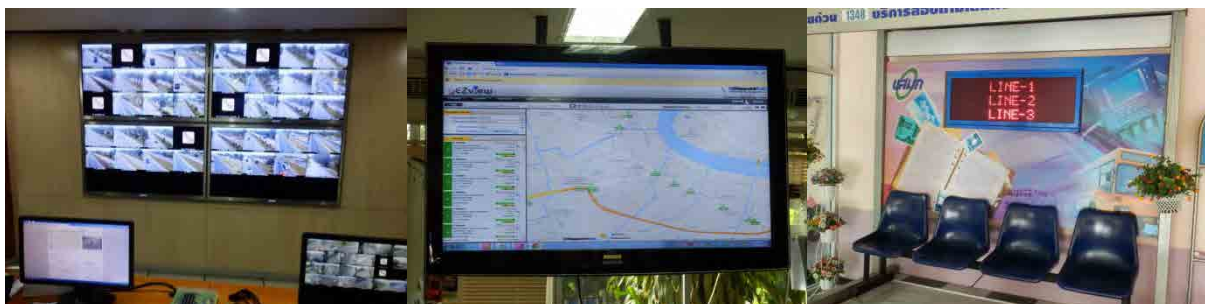


Source: JICA Study Team

Figure 4-10 ITS Center – EXAT

4) Others

- DOH monitors traffic situation on the motorway and some national roads. Data collection is the main purpose, and its function as control center is limited. Pilot project for CCTV monitoring has implemented in NH304.
- OTP collects the traffic-related information at ITS data center for collecting basic data for road planning, but its activities have stopped.
- The Department of Land Transportation (DoLT) monitors the GPS location information of the truck.
- NECTEC developed the API-based application called “Trafy” and “TVIS” based on traffic-related information. It is widely shared as open source. Basically, it is analyzed and predicted based on traffic-related information. Application development is not the main purpose, and it is developed as a maintenance platform. NECTEC has shared the information with iTIC.
- Bus operation center is operated by a private company (Transport Co., Ltd.) operating inter city buses, but they have only one center because the current situation is only the first phase. GPS is installed in some of the buses.
- Taxi operation center is operated by a taxi union. They union dispatches the taxis and communicates with drivers by radio communication.



Source: JICA Study Team

Figure 4-11 Monitoring System in the DOH (left) and BMTA GPS Centers (middle and right)

4.1.4 PROCUREMENT SYSTEM OF ITS-RELATED FACILITIES AND EQUIPMENT

(1) Procurement System

The procurement system is by competitive tendering.

(2) Contract Type and Role of Procurement Officer and Contractor

Management is carried out by organizations such as BMA, and operation is carried out by private companies as contractors. Private companies also carry out the maintenance and repairs of CCTVs.

4.2 TREND OF OTHER DONORS

South Korea built a common card system (LG system), and conducted a preliminary experiment.

4.3 SUGGESTION OF DIRECTION FOR ITS DEVELOPMENT

4.3.1 ITS MENUS TO BE INTRODUCED

(1) Consideration of ITS Development Phase

ITS equipment and systems for improvement of traffic congestion and traffic accidents should be developed preferentially, because Bangkok is experiencing increasing traffic congestion and accidents. Furthermore, the development of public transport assist system is expected to have a higher effect in the short and medium terms, since bus transport is one of the most popular transportation modes in Bangkok.

Table 4-2 Introduction Phase of ITS Menu and Assumed Impacts of ITS

Introduction Possibility Period (assumed)	Name of the System	Expected Impact	
Short	Basic information collection equipment, such as congestion situation monitoring system, full time traffic volume counting system, etc.	(Under preparation) Congestion improvement and traffic situational awareness of urban areas	
	CCTV monitoring system	(Already introduced but insufficient) Congestion scale, situational awareness of the event	
	Signal optimization system	Congestion improvement of surrounding route and congestion intersection by	
	Accident statistics database system	Understanding accident situation and accident types, Utilization as basic data for	
	Traffic accident detection system	Rapid rescue of accident vehicle and users	
	Traffic violation enforcement system (over speed, signal jumping, etc.)	Quick and labor-saving of violation vehicle identification	
	Roadside equipment, Ledger DB	Collection of basic data, database	
	Information terminal such as Car navigation system, Smartphone, WEB system, digital signage, etc.	(Car navigation system is developed by private companies) Improvement of information services by expanding the information available methods	
	The route guidance and information provision by car navigation system,	Optimizing traffic flow by providing congestion information and regulations in advance	
	Cashless transit system using the IC card	Improve user experience, reduction of waiting time in the ticket office, etc. (service	
	Parking investigation DB	By the understanding of the parking scale, utilized for study materials of expansion and maintenance of parking	
	Parking situation information providing system	Guidance to the parking place, the reduction of illegal parking, reduction of traffic to look	
	Disaster information collection, sharing and providing system	Share of the movement, correspondence (road manager) and situation in an emergency by providing and collecting detailed information of the road such as in the event of a disaster	
	Congestion information by road information boards and radio, etc., Information providing system such as route information	Congestion improvement by promoting traffic conversion by the route guidance	
	Regulatory information providing system (by information boards, radio, The monitoring system by various sensors (weather meter (rainfall, road temperature), etc.)	Provides information passable route along with information from various sensors, and Conducted user services such as route guidance information by providing information of closures and etc. to the road user by weather information	
	Information integration between organizations	Efficiency and optimizing the sharing information by information integration of basic	
	The overload detection system by weigh in motion, etc.	Avoid damage to the road by overloaded vehicles, reduction of maintenance costs	
	Expansion of information communication network of Telematics, 3G,	Expansion of the information provision methods to the road user	
	Middle	Operation management, Operation status provision system (bus)	(Implemented Pilot Project) Efficiency of management, Service improvement by providing information of operation status to the user
		Public transportation priority signal system	Mitigation of service inhibition of public transport, improving convenience of punctuality
Maintenance operational efficiency systems, etc.		Support for the maintenance of Road, ITS facilities, etc., Cost savings	
Various DB for the destination information provision		Implementation of information provision in conjunction with the needs of road users	
Pedestrian support system (the disabilities, the elderly, etc.)		Improve safety and convenience of the move of the elderly, disabilities, etc.	
Location information provision for the elderly, etc.		Reduction of accidents, improve user safety	
Pedestrian priority signal system		Reduction of accidents by pedestrian priority, Rectification of the flow of people	
Illegal parking enforcement system		Reduce the traffic inhibition due to parked vehicle by the illegal vehicle is reduced	
Roads and structures ledger DB		Efficiency of road maintenance and repair by database	
Business support systems, etc.		Operational efficiency, Cost reduction	
Road information provision to the other agencies		Sharing road information by information integration	
Public transportation transit search system		Improvement of user experience	
Electronic system of vehicle passage application permission		Reduce labor costs of tollgate, congestion improvement due to a reduction queue length	
Demand bus system		Improvement of transportation services by securing transportation mode and supporting	
Automatic payment system for parking		Reduction of payment waiting queue and labor costs	
Long	Travel assistance system (tourist information provision)	Improve usability of the information providing service in tourist facilities,	
	Other public transport information cooperation system	Improvement of transit convenience, Improved transfer efficiency by providing	
	Cargo management system	Induction to the appropriate route based on the information of luggage of trucks, delivery	
	ERP	Conversion promotion of traffic due to the inflow regulation of vehicle, Congestion	
	The traffic control system for vehicle alone or vehicle-to-vehicle, Automatic driving system for vehicle	Facilitation of movement by providing information and collection from the other vehicle Improve user experience	
Already Introduced	Vehicle control system (by roadside-to-vehicle communication and	Improve user safety	
	ETC	Service improvement by simplification of payment, reduction of labor costs in tollgate, congestion improvement due to a reduction of queue length by permit waiting	
	Reversible lane system	Optimization of traffic processing by the road users tailored to traffic conditions	

Priority High : Medium : Low :

Source: JICA Study Team

(2) Trend of Japanese Companies

There are many companies which are dealing in communications equipment and facilities, and ITS-related companies are mainly deployed in the software business. Therefore, there are less ITS-related companies for incidental facilities such as ITS-related equipment or traffic signal pole.

(3) Draft ITS Menus to be Introduced

Bangkok City's ITS situation is as follows;

- Many traffic signals, CCTVs and VMSs have already been installed.
- Traffic control center and CCTV control center. has already been installed. In addition, congestion information, information provision for public transportation, etc., by smartphone, has been provided.
- In the smartphone application, TTET has provided probe information.
- The current ITS is limited because it is based on numerical data, and traffic management based on actual situation is not implemented.
- Although integration of traffic-related information is attempted individually in each organization, ITS is not adequate.

Based on this situation, draft ITS menus to be introduced are shown below.

- The introduction of signal control system and integration of existing system should be conducted in the short term,
- Upgrading of the existing system and introduction of advanced ITS technology should be done in the medium and long terms.

4.3.2 DIRECTION OF TECHNICAL AND FINANCIAL ASSISTANCE

The direction of technical and financial assistance is suggested as follows:

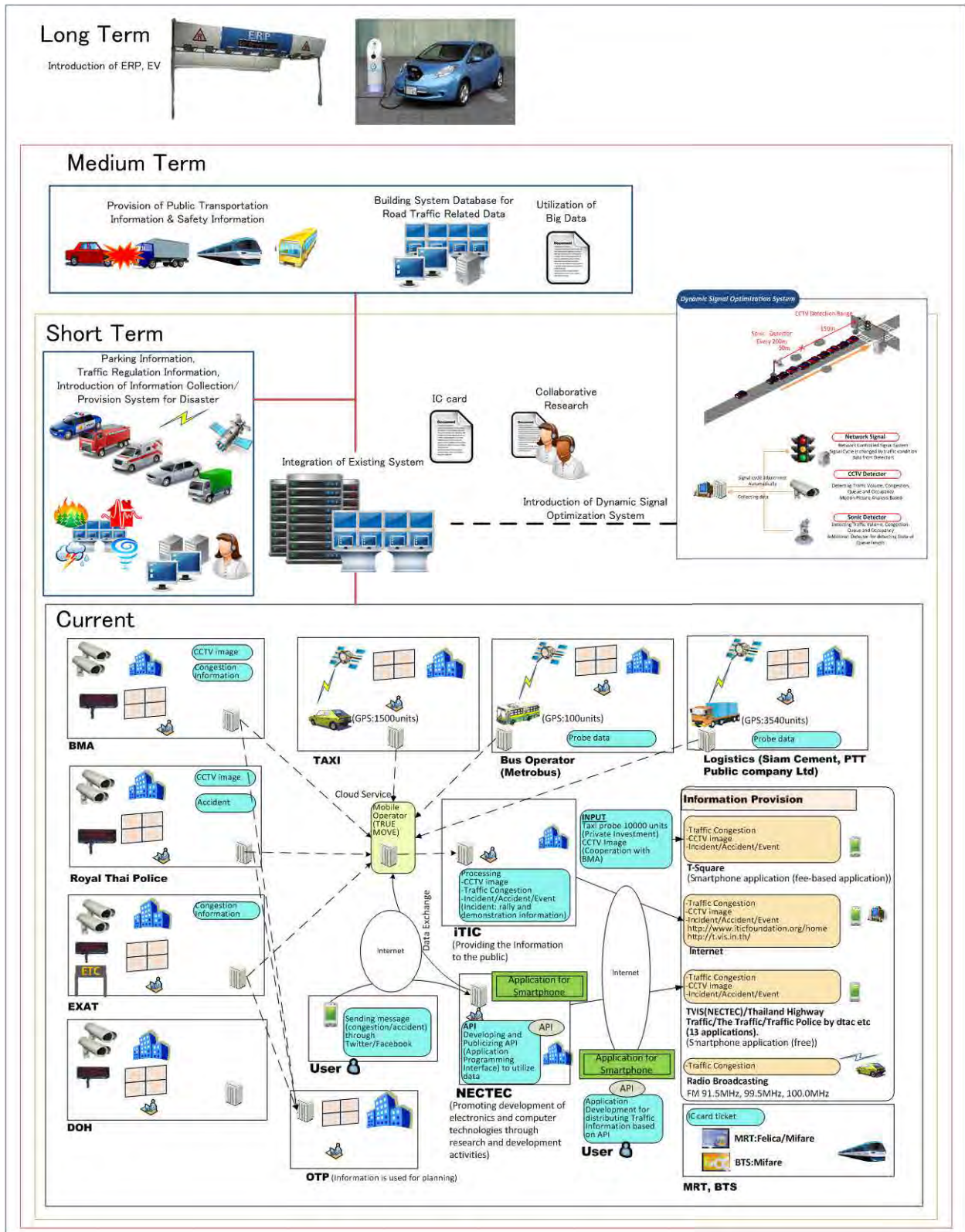
For the direction of ITS development assistance from Japan, training that will support future ITS development in this country, and collaborative research for technical development are recommended. In addition, there is a possibility of overseas deployment of Japanese companies to local businesses, for the updating and expansion of existing control center.

In the medium and long terms, technical assistance for integration of existing information, private sector participation on the development of traffic-related information database, and utilization of advanced technology such as use of quasi-zenith satellite system, are recommended.

Table 4-3 Draft Direction of Technical and Financial Assistance

No	Type of Assistance	Objective
1	Technical Assistance: Collaborative Research	- Implementation of collaborative research related to development of ITS-related system, financial cooperation and sharing information
2	Technical Assistance: Study and Assistance on Utilization of Advanced ITS	- Promotion of private participation and implementation of technical assistance for the medium and long-term ITS menus.

Source: JICA Study Team



Source: JICA Study Team

Figure 4-12 ITS Introduction Conceptual Diagram (Bangkok, Thailand)

CHAPTER 5 KINGDOM OF CAMBODIA

5.1 SURVEY OBJECTIVE

Although the intelligent transport system (ITS) situation in Phnom Penh, Kingdom of Cambodia, was surveyed in Phase 1, the application form for installation of traffic control system in Phnom Penh (100 traffic signals, closed-circuit television (CCTV) and traffic control center) was submitted by the government of Cambodia to JICA. Therefore, additional research and confirmation of current traffic and ITS situation in Phnom Penh, the requirements of ITS-related organizations for traffic control, and current effort, was conducted in this study. Based on this survey, the challenges for traffic control introduction are extracted, and the JICA Study Team suggested the corresponding items at the time of introduction.

5.2 STAKEHOLDERS RELATED TO TRAFFIC CONTROL

The JICA Study Team interviewed ITS-related organizations about traffic control. The name and overview of roles of each organization are shown in Table 5-1 below. These organizations have roles of planning and management at the national and city levels. Phnom Penh Capital Hall (PPCH) is also an ITS-related organization, but they declined to be interviewed during the survey period.

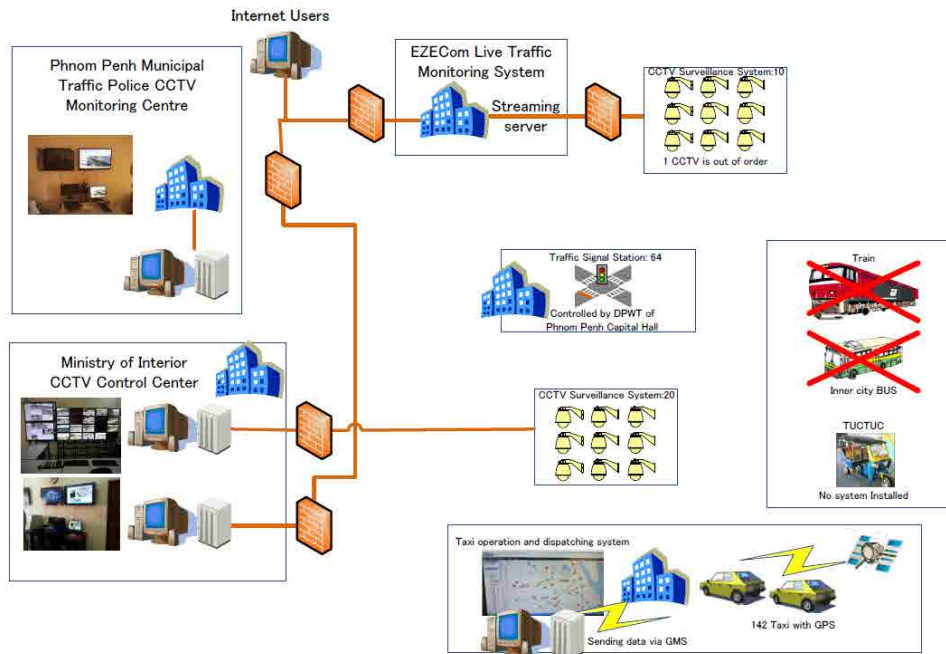
Table 5-1 Interview List

No	Organization Name	Overview of Roles
1	Telecom Cambodia	Operator of telecommunication in Cambodia
2	Department of Public Works and Transport (DPWT)	Office management and human resources development plan, Transportation mode/bus terminal/construction management, maintenance of road/transportation infrastructure, formulating public works and transport-related plans in the city or province
3	Ministry of Interior (MOI), Radio Communication Department	Traffic management on roads, traffic management on rivers, public security
4	National Information Communications Technology Development Authority	Operation and maintenance of communications network of the government
5	Municipal Traffic Police	Safety, traffic management, detection of traffic accidents or violations by CCTV monitoring

Source: JICA Study Team

5.3 ITS SITUATION

A diagram of the overall system of existing ITS-related facilities and equipment in Phnom Penh is shown in Figure 5-1 below. The equipment for information collection and provision is same as in the previous survey. Traffic signal is managed by the Department of Public Works and Transport (DPWT), and CCTVs are managed by the Ministry of Interior (MOI) and EZECOM.



Source: Data Collection Survey for Intelligent Transportation System (Phase I)

Figure 5-1 Existing ITS Facilities and Equipment - Overall System Diagram

- 1) Collection System Equipment
 - CCTV: MOI has 20 units and EZECOM has ten units
- 2) Provision System Equipment
 - Traffic signal: Planning, design, and operation of traffic signals. DPWT is in charge of maintenance.
- 3) Central System
 - CCTV Monitoring Room:
 - MOI: for security and for receiving data from EZECOM (left and middle photo)
 - Municipal traffic police: for security (right photo)



Source: JICA Study Team

Figure 5-2 CCTV Monitoring Room (left and middle: MOI, right: Municipal Traffic Police)

4) Center System

- Telecom Cambodia and National ICT Development Authority (NiDA) are communication-related organizations. Both organizations have fiber optic networks, but the roles are different depending on the organization.
- Telecom Cambodia, which is communications operator, requests cost depending on the number of equipment or data usage in cases where the CCTV is connected by fiber optics. In case of the extension of existing communication network, the cost, depending on the distance from the network to the ITS equipment, is needed.



Source: Telecom Cambodia

Figure 5-3 Communication Network Plan - Telecom Cambodia

- NiDA, which manages and operates the communications network of government agencies, said that there is no problem in using NiDA's fiber optic network as a communication line for connecting the signal to the traffic control center. However, it is necessary to consider a detailed study about separation of NiDA's communication line at each traffic signal location.

5.4 SUGGESTIONS RELATED TO TRAFFIC CONTROL SYSTEM

5.4.1 EFFECTIVENESS OF TRAFFIC CONTROL SYSTEM IN PHNOM PENH

In the results of this survey, traffic condition becomes worse due to increasing the number of cars and motor-cycles, and traffic accidents are also increasing (number of fatalities is five persons/day). Challenges in Phnom Penh which were grasped by previous study and this study, are applicable. Problems which should be solved, such as on control of traffic rules and signals, have been increasing.

Under such circumstances, road construction in the city is important for drastic improvement of traffic situation. However, infrastructure development needs a long time and a huge cost, and large-scale construction is difficult because of traffic congestion and appropriation of land. Although traffic congestion occurs at main roads in Phnom Penh, signal control according to the traffic condition is not performed. Therefore, the introduction of a signal control system is expected to improve the traffic flow by optimizing the signal cycle in accordance with the traffic volume in each hour. It is possible to ensure the collection of previous data for solving future traffic issues through effective traffic management by the traffic control center. Introduction of traffic control center is expected to have the greatest effect on traffic improvement in Phnom Penh.

Table 5-2 Issues on Regional Transportation and ITS in Phnom Penh

Item	Issue
Regional	<ul style="list-style-type: none"> • Population and economy have continued to grow, and transportation system construction in order to continue the sustainable development is needed. • There is a flood point/interval depending on the season by region-specific climate
Traffic	<ul style="list-style-type: none"> • Congestion occurs during morning and evening peak hours, and traffic measures during peak times are problems • The increase of on-street parking in the city, traffic violations such as signal jumping, sidewalk running, etc. • Lack of urban public transport • Congestion caused by signal intersection shape, signal phase, development of a right or left turn lane
Existing facilities and equipment	<ul style="list-style-type: none"> • There is no ITS master plan • There is no system for communicating basic awareness of current road traffic situation • There is no national standard for ITS equipment • Improper signal control
Organizational structure	<ul style="list-style-type: none"> • CCTV monitoring room is installed to ensure security at the traffic police center. Since DPWT installed, controls, and maintains the traffic signals, issues include clarification of roles, sharing of information and integration in the future. • Funding for facility maintenance is a problem
Architecture	<ul style="list-style-type: none"> • The system expansion and integrated study for road management efficiency and traffic management optimization • Development of the implementation plan in untouched part • Enhancement of collection system, processing system, and providing system equipment
Technical level	<ul style="list-style-type: none"> • Since the traffic control agencies are lacking in technical capabilities, signal system is not operating normally. • Technologies for traffic control have not been accumulated.

Source: JICA Study Team

CHAPTER 6 ISLAMIC REPUBLIC OF PAKISTAN

6.1.1 THE RELEVANT STAKEHOLDERS

The name, interview date, and overview of roles of each organization are shown in Table 6-1 below. They have the roles of planning and management in the national and city levels. The JICA Study Team also interviewed the Defense Housing Authority (DHA), which is located within Karachi City, and grasped the information on ITS in Pakistan.

Table 6-1 Interview List

No	Organization Name	Level	Overview of Roles
1	National Highway Authority (NHA)	National	Construction, development, operation, repair and maintenance of highways and national roads
2	Pakistan Telecommunication Authority (PTA)	National	The establishment, management, maintenance of the telecommunications system, and the provision and regulation of telecommunications services
3	Pakistan Telecommunications Company Limited (PTCL)	Governmental Enterprise	Operation and provision of telecommunications service (except mobile phones)
4	Karachi Metropolitan Corporation (KMC) 1. Transport & Communication 2. Engineering Department 3. Karachi Mass Transit Cell 4. IT department 5. Provincial Transport Authority	City	1. Planning and design of the road network, signal installation, maintenance and operation, etc. 2. Construction, maintenance, and update of infrastructure in KMC jurisdictions 3. Project implementation and collaboration with the PPP unit regarding BRT introduction 4. IT infrastructure promotion in Karachi City 5. Control and regulation of the state and private/public transport sector
5	Transport and Mass Transit Department, Government of Sindh	State	Implementation of appropriate regulations on public transport based on the car ordinance
6	PPP Unit, Government of Sindh	State	Promote the implementation of PPP with project implementation agency
7	Defense Housing Authority (DHA)	City	Planning, road, water supply, communications, power, etc., related to infrastructure development and maintenance in DHA.
8	Metro Radio Cab Airport	Private	Operation of the airport taxi
9	Karachi Transport Ittehad (Bus/Mini bus/Coaches/Taxi)	Association	Respond to requests and complaints from each owner, and transfer them to the government

	operators Associations)		agencies
10	Traffic Police (DIG Traffic)	State	Monitoring and enforcement of traffic rules and regulations
11	Frequency Allocation Board	Committee	Deliberation and decision on matters related to frequency allocation

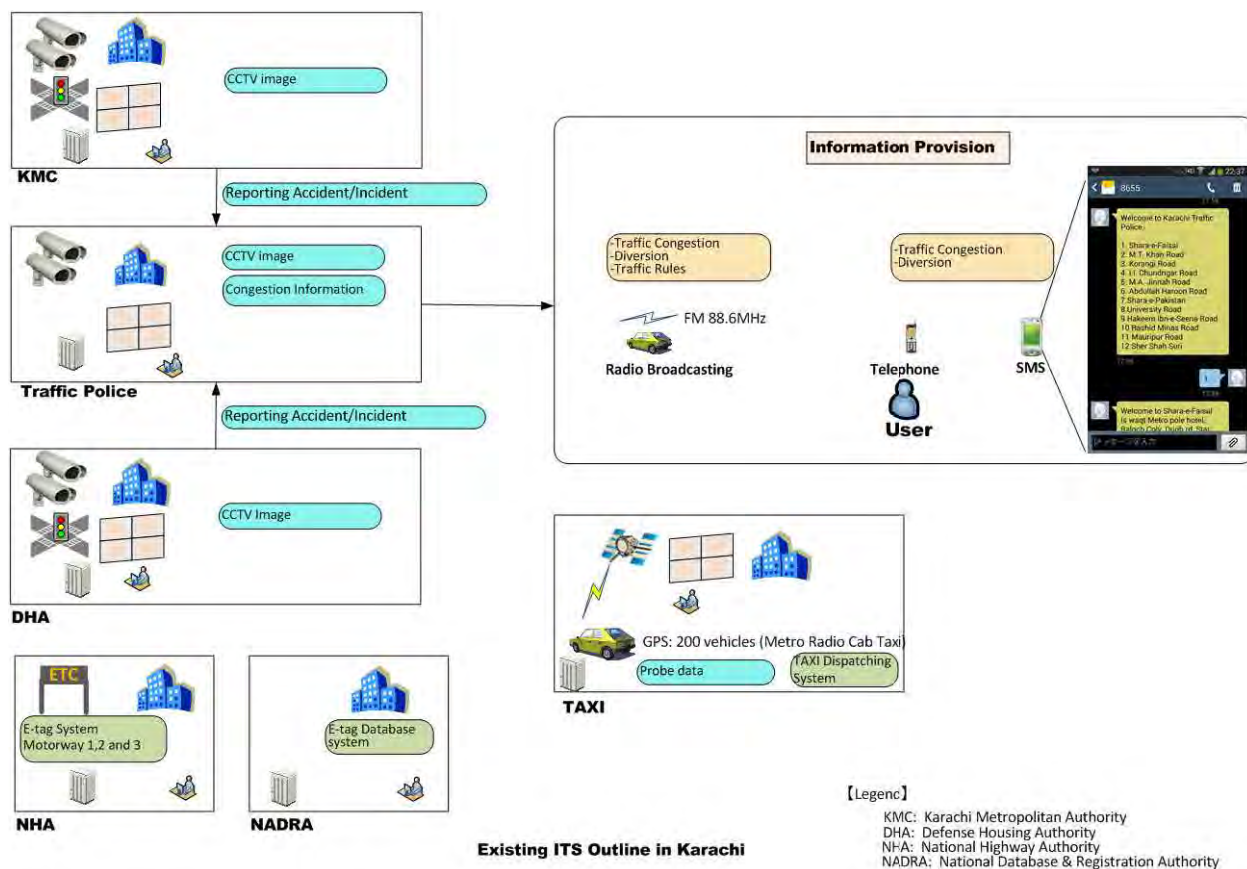
Source: JICA Study Team

6.1.2 ITS ARCHITECTURE AND STANDARDIZATION AREA

There is no ITS standard and ITS architecture in this country. Therefore, it is possible that the standard will be determined based on the specifications and other technical information to be introduced in the ETC proposal by the operation maintenance company.

6.1.3 EXISTING ITS-RELATED FACILITIES AND EQUIPMENTS

Overall system diagram of existing ITS-related facilities and equipment in Karachi is shown in Figure 6-1 below. Karachi Metropolitan Corporation (KMC) installed, manages and operates the traffic signals, and CCTV is installed for monitoring the traffic situation and security by KMC and traffic police. DHA also installed, manages, and operates the traffic signals and CCTVs in the DHA area. NHA operates the e-Tag system (NADRA manages this system).



Source: JICA Study Team

Figure 6-1 Existing ITS Facilities and Equipment - Overall System Diagram

(1) Collection System Equipment

1) CCTV

- CCTVs are installed in intersections for monitoring traffic situation and security (KMC: 500, traffic police: 120, DHA: 500).
- Observed image is being monitored by the monitoring center owned by each organization (KMC, traffic police, and DHA).
- Installation, operation and maintenance is conducted by each organization (KMC, traffic police, and DHA), but KMC has the commissioned management and maintenance to local consultants (Silicon Co., Ltd.).



Source: JICA Study Team

Figure 6-2 CCTV

2) e-Tag

- The e-Tag is an radio-frequency identification (RFID) system. By attaching the RFID on the front glass of vehicles, this system is able to read the vehicle ID when the vehicle passes through the toll booth, then it deducts the toll charge from the prepaid credit when the vehicle passes through the toll booth exit.
- The e-Tag system has established the National Database and Registration Authority (NADRA), and NHA operates it.
- Personal information, car license plate information, and the credit balance are recorded in the e-Tag, and the same data are also recorded in the NADRA server.
- Payment is prepaid-type, the user can reload at the e-Tag registry counter. The e-Tag information and entrance gate information is recorded at the toll booth entrance of motorway, then the toll charge is deducted at the toll booth exit based on these information and the fee which is set for each interval. If the balance is not enough, it is collected at the next reloading.
- The e-Tag information sensor for reading is installed at the entrance (one unit) and at the exit (two units). The entrance information is transmitted to the e-Tag at the entrance, and then balance information is transmitted to the e-Tag after reading the e-Tag information and deduction of payment at the exit.
- Additional e-Tag booths are planned for further installation. Twelve locations were added at the beginning of 2014, and 11 locations were added during 2014. A total of 32 e-Tag booth locations are planned to be installed (There are nine e-Tag booth locations as of February 2014).

- If a user passes through the toll booth using e-Tag system, it can only be used in the section where an e-Tag booth is installed.
- The number of e-Tags issued per month is 4,500, and a total of about 250,000 e-Tags have been issued as of early February 2014. In addition, the e-Tags were made in the United States.



Source: JICA Study Team

Figure 6-3 Toll Booth and e-Tag Related Equipment

(2) Provision System Equipment

1) Traffic Signal

- KMC has been installed in 126 intersections in their jurisdiction, and all of these are stand-alone type.
- Installation, management, and operations are conducted by KMC.
- Current traffic signals are not controlled in accordance with the traffic volume, and five signal cycle patterns (morning peak, off-peak, evening peak, night, and holiday) have been set. Police officers can turn off the power of traffic signals during heavy traffic congestion, so that they manage traffic control manually (hand signal).
- Signal lights and controllers have been delivered by SIEMENS PLESSEY. Silicon, which is the local consultant, has carried out maintenance based on the contract with KMC.
- LED has been introduced and makes up about 10% of the total, and is mostly made in Taiwan. For power failure measures, experiments using solar power have been carried out. Standards are not uniform because there is no standard for signals.
- KMC is considering the development of synchronized traffic signal system and construction of parking facilities and a truck terminal. However, the synchronized traffic signal system was a late 1990s plan by the Asian Development Bank (ADB) that was not implemented.



Source: JICA Study Team

Figure 6-4 Traffic Signal

- The above-mentioned maintenance company is conducting, on a voluntary basis, the pilot project for adjusting the signal cycle based on traffic flow observed by CCTV (three aircrafts) in one intersection (as of January 2014).
- The CCTV is only detecting the traffic flow, and it is not able to count the traffic volume. The green time assigned is 10 seconds (minimum) to 40 seconds (maximum) each direction depending on the traffic flow. CCTV image processing unit is put in the controller, and the result of the observed traffic flow is passed to the signal controller unit.



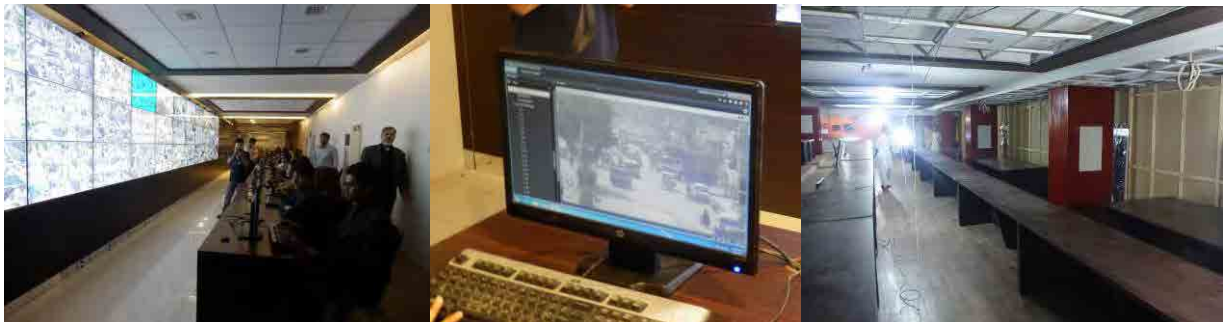
Source: JICA Study Team

Figure 6-5 Signal Controller Panel, Solar System, Signal/ CCTV/ Controller for Pilot Project

(3) Center System

1) KMC (Command and Control Centre)

- Command and control centre is located on the second floor of KMC building, and it monitors the 500 CCTVs which are installed in the KMC jurisdiction. In February 2014, an additional 600 CCTVs are planned to be installed, and the center is extended to suit the CCTV expansion.
- The center can turn on/off and control the magnification of the CCTVs remotely. CCTV image monitoring is being conducted by 30 persons and 24 hours a day at the center. Monitoring personnel detect the accidents, violations, and events, and then they pass this information on to relevant agencies (police, ambulance, ranger, and mass media).
- Police and rangers are also stationed in the center. Communication lines are using fiber optic and WiMAX.
- The delivery company is Global Communication System, Inc. (PK), and the CCTV system software is Xprotect, which was developed by Milestone System, Inc. (Denmark).



Source: JICA Study Team

Figure 6-6 Control and Command Centre - KMC

- 2) Traffic Police
- The CCTV video is monitored, and it confirms the traffic situation, violations, etc., in real time.

6.1.4 PROCUREMENT SYSTEM OF ITS RELATED FACILITIES AND EQUIPMENTS

- (1) Procurement System

The procurement system is by competition tendering.

- (2) Contract Type and Role of Procurement Officer and Contractor

Management is carried out by organizations such as NHA and, KMC, and operation is carried out by private companies as contractors. Local companies carry out the maintenance and repair of traffic signals and CCTVs in Karachi.

6.2 TREND OF OTHER DONORS

In the interview with the ADB person in charge of the bus rapid transit (BRT) project (Red Line and Green Line), although there is an idea about ITS components such as information provision for toll collection and use, and installation of control center, detailed planning is undecided because the current stage is under consideration.

6.3 SUGGESTION OF DIRECTION FOR ITS DEVELOPMENT

6.3.1 ITS MENUS TO BE INTRODUCED

- (1) Consideration of ITS Development Phase

ITS equipment and systems for improvement of traffic congestion and traffic accidents should be developed preferentially, because Karachi is experiencing increasing traffic congestion and accidents. From the viewpoint of optimization of traffic management, optimization of signal system and installation of equipment/system related to information collection and provision with priority is effective.

Table 6-2 Introduction Phase of ITS Menu and Assumed Impacts of ITS

Introduction Possibility Period (assumed)	Name of the System	Expected Impact
Short	Basic information collection equipment, such as congestion situation monitoring system, full time traffic volume counting system, etc.	Congestion improvement and traffic situational awareness of urban areas
	CCTV monitoring system	(Already introduced but insufficient) Congestion scale, situational awareness of the event of an accident, speeding the correspondence
	Signal optimization system	Congestion improvement of surrounding route and congestion intersection by optimization of traffic flow
	Congestion information by road information boards and radio, etc., Information providing system such as route information	Congestion improvement by promoting traffic conversion by the route guidance
	Regulatory information providing system (by information boards, radio, car navigation systems, etc.)	Provides information passable route along with information from various sensors, and avoids the traffic stagnation
	Information integration between organizations	Efficiency and optimizing the sharing information by information integration of basic data, management, etc.
	Roadside equipment, Ledger DB	Collection of basic data, database
	Accident statistics database system	Understanding accident situation and accident types, Utilization as basic data for considering measures
	Traffic accident detection system	Rapid rescue of accident vehicle and users
	Traffic violation enforcement system (over speed, signal jumping, etc.)	Quick and labor-saving of violation vehicle identification
	The monitoring system by various sensors (weather meter (rainfall, road temperature), etc.)	Conducted user services such as route guidance information by providing information of closures and etc. to the road user by weather information
	Information terminal such as Car navigation system, Smartphone, WEB system, digital signage, etc.	Improvement of information services by expanding the information available methods *Development of car navigation system is assumed in middle-term
	The overload detection system by weigh in motion, etc.	Avoid damage to the road by overloaded vehicles, reduction of maintenance costs
	Expansion of information communication network of Telematics, 3G, etc.	Expansion of the information provision methods to the road user
Middle	Operation management, Operation status provision system (bus)	(Introduction to BRT is desirable) Efficiency of management, Service improvement by providing information of operation status to the user
	Public transportation priority signal system	(Introduction to BRT is desirable) Mitigation of service inhibition of public transport, improving convenience of punctuality securing of arrival and departure time
	Maintenance operational efficiency systems, etc.	Support for the maintenance of Road, ITS facilities, etc., Cost savings
	Illegal parking enforcement system	Reduce the traffic inhibition due to parked vehicle by the illegal vehicle is reduced
	Roads and structures ledger DB	Efficiency of road maintenance and repair by database
	Business support systems, etc.	Operational efficiency, Cost reduction
	Road information provision to the other agencies	Sharing road information by information integration
	Public transportation transit search system	Improvement of user experience
	Other public transport information cooperation system	Improvement of transit convenience, Improved transfer efficiency by providing information of other transportation means selection
	Electronic system of vehicle passage application permission	Reduce labor costs of tollgate, congestion improvement due to a reduction queue length by permit waiting
Demand bus system	Improvement of transportation services by securing transportation mode and supporting for the elderly, etc.	
Long	Reversible lane system	Optimization of traffic processing by the road users tailored to traffic conditions
	Various DB for the destination information provision	Implementation of information provision in conjunction with the needs of road users
	Parking investigation DB	By the understanding of the parking scale, utilized for study materials of expansion and maintenance of parking
	Parking situation information providing system	Guidance to the parking place, the reduction of illegal parking, reduction of traffic to look for parking (improvement of traffic flow)
	Cargo management system	Induction to the appropriate route based on the information of luggage of trucks, delivery location, etc., Efficiency of management
	Pedestrian priority signal system	Reduction of accidents by pedestrian priority, Rectification of the flow of people
	Cashless transit system using the IC card	Improve user experience, reduction of waiting time in the ticket office, etc. (service improvement)
	The route guidance and information provision by car navigation system, WEB, etc.,	Optimizing traffic flow by providing congestion information and regulations in advance
	ERP	Conversion promotion of traffic due to the inflow regulation of vehicle, Congestion improvement, Reduction of accident
	Automatic payment system for parking	Reduction of payment waiting queue and labor costs
	The traffic control system for vehicle alone or vehicle-to-vehicle, roadside-to-vehicle communication	Facilitation of movement by providing information and collection from the other vehicle
	Disaster information collection, sharing and providing system	Share of the movement, correspondence (road manager) and situation in an emergency by providing and collecting detailed information of the road such as in the event of a disaster
	Travel assistance system (tourist information provision)	Improve usability of the information providing service in tourist facilities, accommodation, etc.
	Automatic driving system for vehicle	Improve user experience
	Pedestrian support system (the disabilities, the elderly, etc.)	Improve safety and convenience of the move of the elderly, disabilities, etc.
	Vehicle control system (by roadside-to-vehicle communication and inter-vehicle communication)	Improve user safety
Location information provision for the elderly, etc.	Reduction of accidents, improve user safety	
Already Introduced	ETC	(Already introduced to the expressway, RFID) Service improvement by simplification of payment, reduction of labor costs in tollgate, congestion improvement due to a reduction of queue length by permit waiting

Priority High: Medium: Low:

Source: JICA Study Team

(2) Trend of Japanese Companies

There are 48 Japanese companies in Pakistan. The main category is automotive, manufacturing industry, trading, banks, etc. Overview and challenges in this country are the following:

- The vehicles produced are 150,000 to 200,000 cars per year. At the same time, 50,000 cars are imported. If there are 30,000 cars required in a year, it is said that foreign companies consider overseas deployment. Regarding automotive, only Japanese companies have deployed in this country, and this is rare a case in the world.
- The reasons that this country is not developed are because the people have poor ambition and there is no leader with strong leadership qualities that can effectively implement government policies.
- For Japan to proceed with the project successfully, it is important to quickly find the key person who understands the intentions of the Japanese side and can implement it.
- It is necessary to take the policy such as Thailand or Indonesia, countries that have successfully put in place a favorable investment environment for foreign companies in the 2000s.
- Although there is a disadvantage because this country cannot produce oil, it has a population of 180 million people. If it would be able to give employment to many people, activity of companies will be more advanced by increasing the people's revenue and consumption.
- There was a Japanese consumer electronics manufacturer in the 1990s, but this company withdrew from this country because there is no benefit for production (consumer electronics are allowed to be brought in from other countries as hand carry). Currently, Philips is the only company with local production.
- Safety has been improved by the establishment of the rangers as a security response organization.
- ITS development, in parallel with the infrastructure, is effective as a traffic congestion measure in Karachi.

(3) Draft ITS Menus to be introduced

Karachi City's ITS situation is as follows;

- There are traffic signals and CCTVs which are the basic ITS equipment in Karachi, but the numbers are not sufficient and their condition is faulty or not utilized.
- An ITS master plan has not been developed
- While CCTV monitoring center is used only for security and there are no traffic control centers including the signal control.
- It is also expected that sharing information with public transportation is needed in accordance with the development of BRT and KMC.

ITS measures for solving the current traffic problems, which have immediate effects, such as signal control in accordance with the traffic volume and traffic management measures in order to promote traffic guidance to the user by providing congestion information through variable message sign (VMS) are desirable. It is assumed that the local consultant has appropriate technical capabilities because they have managed and maintained the traffic signals in Karachi City. In addition, this country is in the ITS introduction phase, and ITS master plan is needed because there is a risk that ITS service

would be introduced with a different model, and there is no ITS standard for traffic signals and other ITS services. Based on this situation, draft ITS menus to be introduced are shown below.

- Formulation of ITS master plan
- Introduction of IC card, traffic related information provision, and traffic control center, and also expansion of traffic signal in accordance with the development of public transportation in the future.

6.3.2 DIRECTION OF TECHNICAL AND FINANCIAL ASSISTANCE

The direction of technical and financial assistance is suggested in the following.

For the direction of ITS development assistance from Japan, the following are considered appropriate:

Short Term: Introduction of traffic signal system and development study, assistance on research and development in the future.

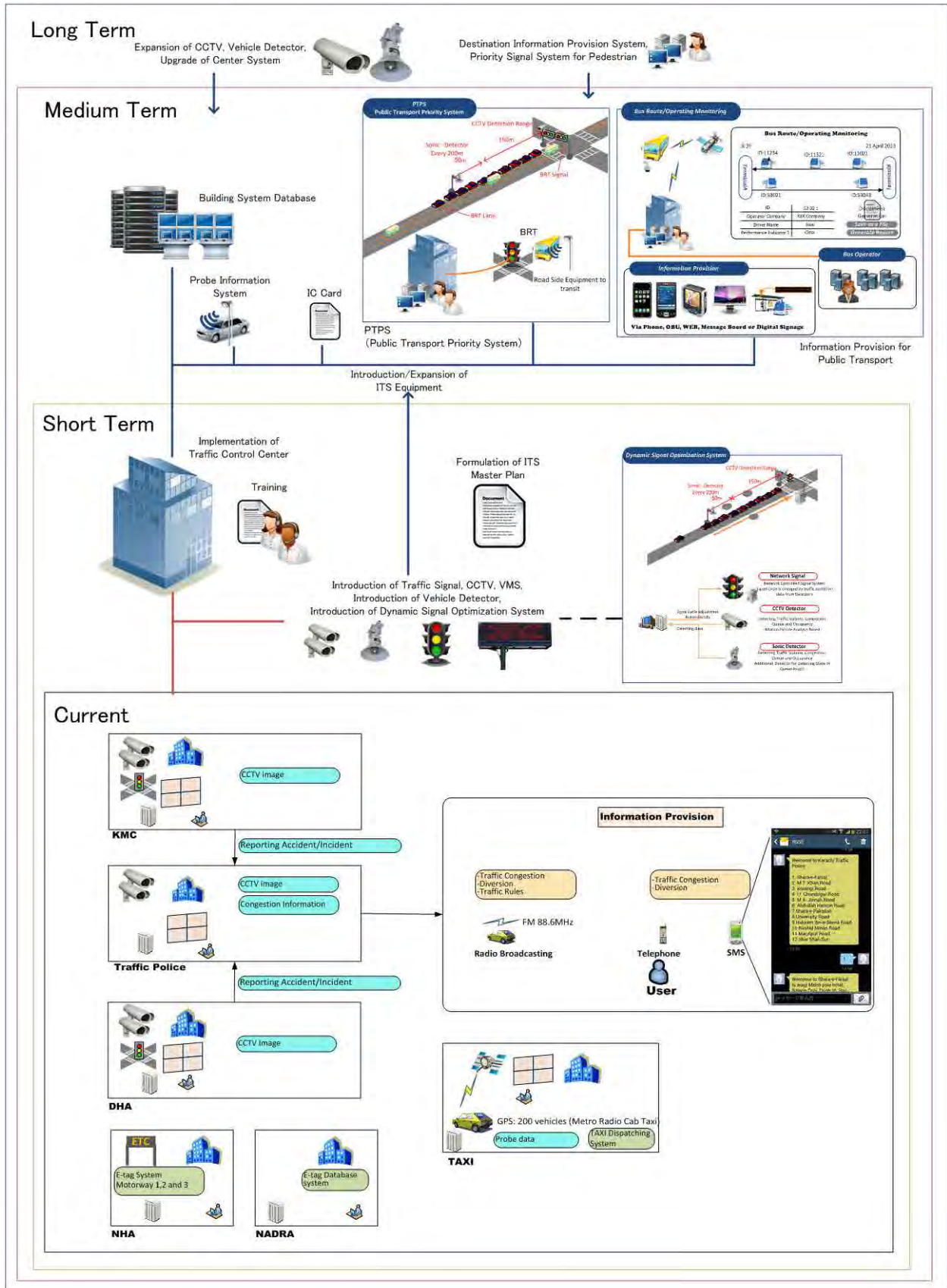
Medium and Long Term: Loan assistance for the development study for expansion of ITS introduction and implementation.

Although the advance of Japanese companies is quite small in this country, assistance on ITS introduction is beneficial for the improvement of safety and economic activity by solving congestion, and also helps the future Japanese companies' advance and overseas deployment.

Table 6-3 Draft Direction of Technical and Financial Assistance

No	Type of Assistance	Objective
1	Technical Assistance: Training, Implementation Assist of Pilot Project, Formulation of M/P, Foundation of ITS Organization Financial Assistance: Grant	- Training related to traffic control system - Technical assistance of pilot projects related to ITS - Training in Japan - Formulation of ITS master plan - Foundation of the integrated organization
2	Financial Assistance: Loan	- Loan assistance for implementation of the ITS menu in the medium and long term

Source: JICA Study Team



Source: JICA Study Team

Figure 6-7 ITS Introduction Conceptual Diagram (Karachi, Pakistan)

CHAPTER 7 MALAYSIA

7.1.1 RELEVANT STAKEHOLDERS

The name, interview date, and overview of roles of each organization are shown in Table 7-1 below. National organizations have the roles of planning and management at the national level, and city organizations have the roles of planning, management, and operation at the city level.

Table 7-1 Interview List

No	Organization Name	Level	Overview of Roles
1	Touch' n Go	Private	ETC services, public transportation, service of parking and retail storage agency
2	Highway Planning Unit (HPU), Ministry of Works	National	Planning, coordination, monitoring, toll collection (national highway), support, advice for national roads
3	Putrajaya Corporation	City	Execution of the function of Putrajaya
4	Malaysian Highway Authority (MHA)	National	Design, maintenance, operation, and monitoring of the toll highway
5	PLUS	Private	Management of the concession section of the highway
6	Suruhanjaya Pengangkutan Awam Darat	National	Formulation of policy, planning, regulation of railway, buses, taxis, and other cargo transport
7	Jabatan Kerja Raya Malaysia	National	Services for national infrastructure development (roads, buildings, etc.)
8	ITS Malaysia	Association	Policy and development of ITS technology, support and information provision to the public institutions on investment
9	Dewan Bandaraya Kuala Lumpur (DBKL) ※Kuala Lumpur City Hall	City	Provision of service and facilities for comfortable and safe urban transport system
10	Sunlight Cab	Private	Operation and management of taxis
11	Stormwater Management and Road Tunnel (SMART)	Private	Operation and management of SMART
12	Malaysian Institute of Road Safety Research	National	Collection and dissemination of road safety information
13	Malaysian Communications and Multimedia Commission	National	Regulation of communications, postal services, electronic signature

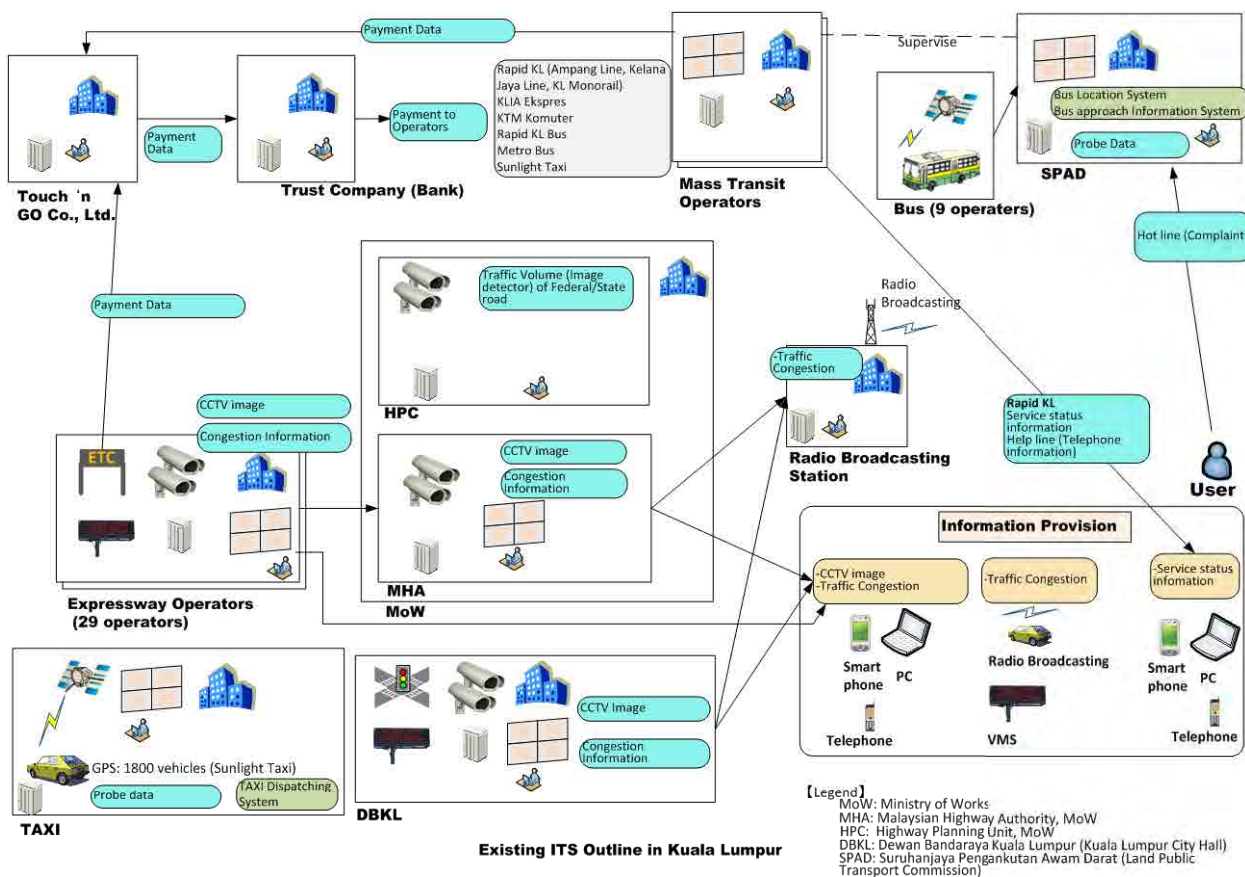
Source: JICA Study Team

7.1.2 ITS ARCHITECTURE AND STANDARDIZATION AREA

Although there are no national standards for intelligent transport systems (ITS), research on ITS architecture has been performed. However, it is assumed that revision of this plan is required because a few years have passed from implementation period, and the Highway Planning Unit (HPU), which developed the plan, is not currently performing activities related to ITS.

7.1.3 EXISTING ITS-RELATED FACILITIES AND EQUIPMENT

Overall system diagram in existing ITS-related facilities and equipment in Kuala Lumpur (KL) is shown in Figure 7-1 below. Traffic signals, closed-circuit television (CCTV) and variable message sign (VMS) are installed, managed, and operated by DBKL. The Malaysian Highway Authority (MHA) or a concession company is performing the management and operation of each highway.



Source: JICA Study Team

Figure 7-1 Existing ITS Facilities and Equipment - Overall System Diagram

- (1) Collection System Equipment
 - 1) CCTV
 - There are 1,000 CCTVs installed in KL for monitoring intersections.
 - Installation, operation, and maintenance are conducted by DBKL.
 - In addition, 90 CCTVs are installed by HPU across the country, and these CCTVs count the traffic volume.



Source: JICA Study Team

Figure 7-2 CCTV

2) Expressway (CCTV, Speed Sensor, ETC)

i) **CCTV**

- A concession company is performing the installation, management, operation and monitoring, and MHA has also been monitoring their video. PLUS owns more than 100 CCTVs, and CCTV image is stored for one month.

ii) **ETC(Smart TAG, Touch' n Go)**

- ETC has been introduced in highways, and it is used for toll collection. The method of toll collection in highways is by manual method and ETC system (Touch'n Go (TG) and Smart TAG).
- In the manual method, vehicle information is confirmed at the toll booth by visual inspection, and a fee based on the information is collected from the user.
- In ETC system, although toll collection is conducted by IC card, since IC card does not record vehicle information, toll collection personnel in the toll booth of TG lane inputs the vehicle classification manually, and then the toll fee is charged. Since there are no toll collection personnel in the Smart TAG lane, Smart TAG is only available for standard-size cars.
- About 11 million TG cards have been issued, and it is available for highways, public transportation, parking, and retail stores.



Source: JICA Study Team

Figure 7-3 ITS-related Facilities and Equipment in Malaysia Highways

(2) Provision System Equipment

1) Traffic Signal

- Traffic signals are installed in 400 to 500 intersections in KL, and Sydney Coordinated Adaptive Traffic (SCAT) system, which is a dynamic signal control system, has been introduced.
- Installation, management and operation are performed by DBKL.

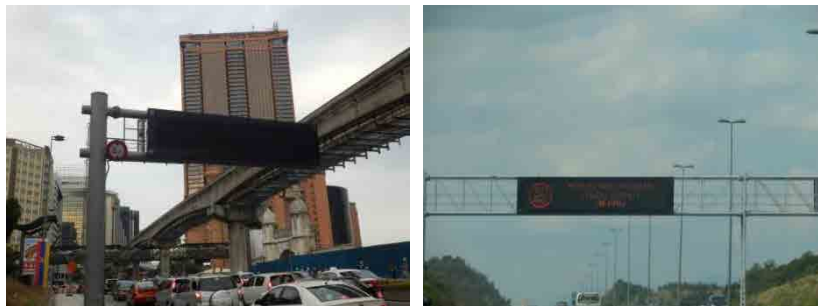


Source: JICA Study Team

Figure 7-4 Traffic Signals

2) VMS

- DBKL owns 34 VMSs. Although these are not working (as of February 2014), the current situation is that repairs cannot be done due to lack of equipment stock or because the company that introduced the system went bankrupt. However, there are plans to update the system in conjunction with renovation of Integrated Transport Information System (IT IS).
- A concession company is performing the installation, management and operation of VMS in the highway. PLUS owns 50 VMSs, and inputs character information at the center.



Source: JICA Study Team

Figure 7-5 VMS

3) Car Navigation System

- Garmin is available for car navigation system, but its use has not been widespread.



Source: JICA Study Team

Figure 7-6 Car Navigation System

- 4) Smartphone Application, Web
- Some organizations and companies (PLUS, taxi company, etc.) have provided information by smartphone application.
 - DBKL is also developing a smartphone application for information provision.
 - Waze, which is a traffic information and provision application, has been widely used. It has not only congestion and traffic accident information, but also functions as a car navigation system.



Source: JICA Study Team

Figure 7-7 Smartphone Application

- (3) Central System
- 1) DBKL
- About 1,000 CCTVs, 34 VMSs, 300 Automated Enforcement System (AES) equipment, and some systems in KL are managed by integrated information center (called ITIS). The renovation of these ITS equipment and center is being performed, and it was planned to be completed in the middle of 2014.
 - Information provision is performed by VMS, internet, call center, Twitter, Facebook, and radio broadcast. CCTV image and congestion information is provided on the internet, and smartphone application for information provision was developed. Radio broadcast provides traffic information

through phone calls to Radio Malaysia once every 15 minutes, and this information is provided through radio announcements. In conjunction with the renovation of ITIS, traffic signal control center, which located in the KL building, was relocated to ITIS, and the traffic control in KL is planned to be managed centrally.

- Communication line of traffic signal is being changed from a dedicated line to radio network, and the existing SCAT system is used as the signal control system. There are about 400 to 500 signal intersections.



Source: ITIS homepage, JICA Study Team

Figure 7-8 ITIS (left), Traffic Signal Control Center (right) - DBKL

2) MHA

- MHA monitors the highway traffic conditions, and collects and monitors the CCTV image and VMS which are monitored at the center owned by 12 concession companies.
- Information collected are traffic conditions, traffic incidents, video images, congestion map, GIS map, travel time, and toll charge. These information are provided through the website of MHA (Internet, PDA, and WAP), SMS (My SMS 15888), some media (radio and television), global positioning system (GPS), mobile applications, etc.



Source: JICA Study Team

Figure 7-9 CCTV Monitoring Center - MHA

3) PLUS

- PLUS monitors the 848 km of highway to be managed, and has 50 VMSs and more than 100 CCTVs.
- Information collected by the center is provided through radio, twitter and smartphone applications.
- CCTV is capable of being controlled (zoom and turn) at the center, and VMS is capable of pre-set text information and encoding the text directly at the center.
- Center system and equipment were introduced by TERAS (ML).



Source: JICA Study Team

Figure 7-10 Highway Management Center - PLUS

4) SMART

- Traffic situation in the SMART tunnel (usually: road tunnel, flood: drainage tunnel) and water level due to floods and heavy rain is monitored.
- They have Automatic Incident Detector (AID), 220 CCTVs and VMSs, and monitoring traffic situation and information provision is performed by using these equipment. If the SMART tunnel is closed due to water injection, related information is provided by using some other form of media, such as VMS, radio, TV, and Twitter.



Source: JICA Study Team

Figure 7-11 SMART Tunnel Monitoring Center - PLUS

5) Taxi Company

- Sunlight Cab has been operating in Malaysia nationwide, and they manage a dispatch system based on information from taxis with GPS.
- Customer information based on the customer’s and taxi’s location information is provided to the taxi driver which is close to the customer location.

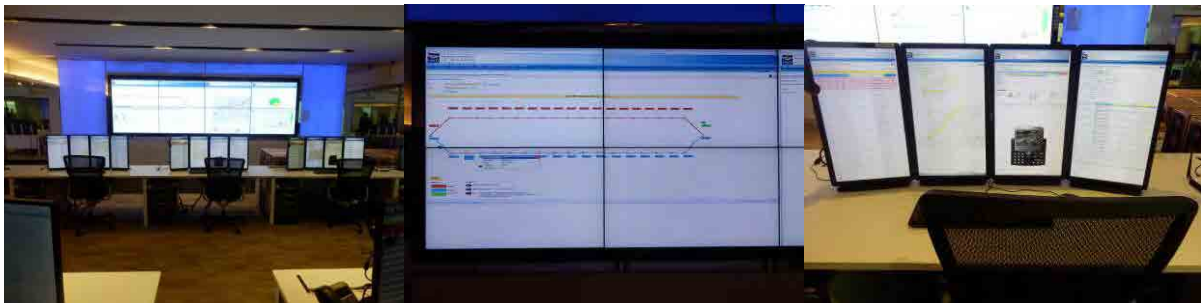


Source: JICA Study Team

Figure 7-12 Taxi Dispatch Center

6) Public Transportation Information Center

- Suruhanjaya Pengangkutan Awam Darat (SPAD) aims to have an efficient taxi service by means of an integrated taxi dispatch system for each taxi company using a centralized taxi service system(CTSS).
- On the command control center which is introduced in this system, CTSS is the system that will be able to dispatch the closest taxi to users by connecting to the taxi dispatch system on the network. Also, each company's taxi is monitored centrally in this center.
- In addition, a performance monitor hub system (PMHS) is introduced, and it is planned to conduct an integrated management of buses. The system itself was already introduced in the SPAD building, and it will be scheduled to start operations from March 2014. This system is able to monitor the operation of the nine bus companies which operates within the Greater KL area(except for the Rapid KL).
※Rapid KL has its own monitoring center.



Source: JICA Study Team

Figure 7-13 Public Transportation Information Center

7.1.4 PROCUREMENT SYSTEM OF ITS RELATED FACILITIES AND EQUIPMENT

(1) Procurement System

The procurement system is by competition tendering.

(2) Contract Type and Role of Procurement Officer and Contractor

Management and operation are carried out by organizations such as DBKL, while implementation is carried out by private companies as contractors. Highways are managed and operated by a concession companies which are entrusted to the contract operators.

7.2 TREND OF OTHER DONORS

A trend of other donors is few, and a local company conducts the implementation of development.

7.3 SUGGESTION OF DIRECTION FOR ITS DEVELOPMENT

7.3.1 ITS MENUS TO BE INTRODUCED

(1) Consideration of ITS Development Phase

Upgrading and expansion of ITS for information provision should be developed, because Kuala Lumpur is experiencing increasing traffic congestion and accidents. Therefore, optimal traffic management and information provision is needed. Furthermore, the development of public transport assist system is expected to have a higher effect in the medium term, since bus traffic is one of the most popular transportation modes in KL.

(2) Trend of Japanese Companies

According to interviews with the Japanese Chamber of Trade and Industry, Malaysia (JACTIM), information related to the local Japanese companies is as follows:

- Malaysia's population is less than 30 million people, and small population is a feature of a disadvantage in Malaysia.
- Although the number of Japanese companies are 1,409, most of them are located at Selangor State or KL. Business types occupy the 50 % in manufacturing and other in non-manufacturing industries.
- Attractiveness of investment in Malaysia is political stability, English skills of local labor force, enhanced infrastructure, security, pro-Japanese, etc.
- There are currently 577 JACTIM member companies and 70% of that is in the manufacturing industry, especially consumer electronics manufacturers. The usual pattern is the products are produced in Malaysia and then exported to other countries. An additional 20 companies became members in 2013, majority coming from the service business (IT, real estate, Japanese restaurants, etc.).
- Electric power is stable, and information communication system is advanced compared with other asian countries. IT business by the Multimedia Super Corridor (MSC) has been promoted.
- Although the largest export destination of Malaysia is China, Japanese companies have more presence in Malaysia.

Table 7-2 Introduction Phase of ITS Menu and Assumed Impacts of ITS

Introduction Possibility Period (assumed)	Name of the System	Expected Impact
Short	Basic information collection equipment, such as congestion situation monitoring system, full time traffic volume counting system, etc.	(Expansion) Congestion improvement and traffic situational awareness of urban areas
	CCTV monitoring system	(Expansion) Congestion scale, situational awareness of the event of an accident, speeding the correspondence
	Signal optimization system	(Expansion) Congestion improvement of surrounding route and congestion intersection by optimization of traffic flow
	Accident statistics database system	Understanding accident situation and accident types, Utilization as basic data for considering measures
	Traffic accident detection system	Rapid rescue of accident vehicle and users
	Traffic violation enforcement system (over speed, signal jumping, etc.)	(Expansion) Quick and labor-saving of violation vehicle identification
	Roadside equipment, Ledger DB	Collection of basic data, database
	Information terminal such as Car navigation system, Smartphone, WEB system, digital signage, etc.	(Car navigation system is developed by private companies) Improvement of information services by expanding the information available methods
	The route guidance and information provision by car navigation system, WEB, etc.,	Optimizing traffic flow by providing congestion information and regulations in advance
	Operation management, Operation status provision system (bus)	(Introduction to BRT is desirable) Efficiency of management, Service improvement by providing information of operation status to the user
	Parking investigation DB	By the understanding of the parking scale, utilized for study materials of expansion and maintenance of parking
	Parking situation information providing system	Guidance to the parking place, the reduction of illegal parking, reduction of traffic to look for parking (improvement of traffic flow)
	Disaster information collection, sharing and providing system	Share of the movement, correspondence (road manager) and situation in an emergency by providing and collecting detailed information of the road such as in the event of a disaster
	Congestion information by road information boards and radio, etc., Information providing system such as route information	Congestion improvement by promoting traffic conversion by the route guidance
	Regulatory information providing system (by information boards, radio, car navigation systems, etc.)	Provides information passable route along with information from various sensors, and avoids the traffic stagnation
	The monitoring system by various sensors (weather meter (rainfall, road temperature), etc.)	Conducted user services such as route guidance information by providing information of closures and etc. to the road user by weather information
	Information integration between organizations	Efficiency and optimizing the sharing information by information integration of basic data, management, etc.
	The overload detection system by weigh in motion, etc.	Avoid damage to the road by overloaded vehicles, reduction of maintenance costs
Expansion of information communication network of Telematics, 3G, etc.	Expansion of the information provision methods to the road user	
Middle	Public transportation priority signal system	(Introduction to BRT is desirable) Mitigation of service inhibition of public transport, improving convenience of punctuality securing of arrival and departure time
	Maintenance operational efficiency systems, etc.	Support for the maintenance of Road, ITS facilities, etc., Cost savings
	Various DB for the destination information provision	Implementation of information provision in conjunction with the needs of road users
	Pedestrian support system (the disabilities, the elderly, etc.)	Improve safety and convenience of the move of the elderly, disabilities, etc.
	Location information provision for the elderly, etc.	Reduction of accidents, improve user safety
	Pedestrian priority signal system	Reduction of accidents by pedestrian priority, Rectification of the flow of people
	Illegal parking enforcement system	Reduce the traffic inhibition due to parked vehicle by the illegal vehicle is reduced
	Roads and structures ledger DB	Efficiency of road maintenance and repair by database
	Business support systems, etc.	Operational efficiency, Cost reduction
	Road information provision to the other agencies	Sharing road information by information integration
	Public transportation transit search system	Improvement of user experience
	Electronic system of vehicle passage application permission	Reduce labor costs of tollgate, congestion improvement due to a reduction queue length by permit waiting
	Demand bus system	Improvement of transportation services by securing transportation mode and supporting for the elderly, etc.
	Automatic payment system for parking	Reduction of payment waiting queue and labor costs
	Travel assistance system (tourist information provision)	Improve usability of the information providing service in tourist facilities, accommodation, etc.
Reversible lane system	Optimization of traffic processing by the road users tailored to traffic conditions	
Other public transport information cooperation system	Improvement of transit convenience, Improved transfer efficiency by providing information of other transportation means selection	
Long	Cargo management system	Induction to the appropriate route based on the information of luggage of trucks, delivery location, etc., Efficiency of management
	ERP	Conversion promotion of traffic due to the inflow regulation of vehicle, Congestion improvement, Reduction of accident
	The traffic control system for vehicle alone or vehicle-to-vehicle, roadside-to-vehicle communication	Facilitation of movement by providing information and collection from the other vehicle
	Automatic driving system for vehicle	Improve user experience
	Vehicle control system (by roadside-to-vehicle communication and inter-vehicle communication)	Improve user safety
Already Introduced	ETC	Service improvement by simplification of payment, reduction of labor costs in tollgate, congestion improvement due to a reduction of queue length by permit waiting
	Cashless transit system using the IC card	Improve user experience, reduction of waiting time in the ticket office, etc. (service improvement)

Priority High: Medium: Low:

Source: JICA Study Team

(3) Draft ITS Menus to be Introduced

KL's ITS situation is as follows;

- KL has many traffic signals, CCTVs and VMSs, and also has a traffic control center and CCTV control center.
- In addition, congestion information, information provision for public transportation, etc., by smartphone, has been provided.
- Related organizations are active in ITS introduction for the improvement and understanding of the current traffic-congestion situation, and also have high needs.
- Additionally, level of technical capability is high compared with other Asian countries because much of the center system and equipment is developed by local companies.
- On the other hand, cooperation between ITS-related organizations is not sufficient, and information collection and provision is limited.

Based on this situation, draft ITS menus to be introduced are shown below.

- Integration of ITS-related system is needed in the short term after the ITS propulsion agency was founded.
- Furthermore, it is important to introduce the common IC card.
- Upgrading the public transportation information provision and introduction of high level ITS, such as traffic safety, disaster information provision, etc., are effective.

7.3.2 DIRECTION OF TECHNICAL AND FINANCIAL ASSISTANCE

The direction of technical and financial assistance is suggested in the following:

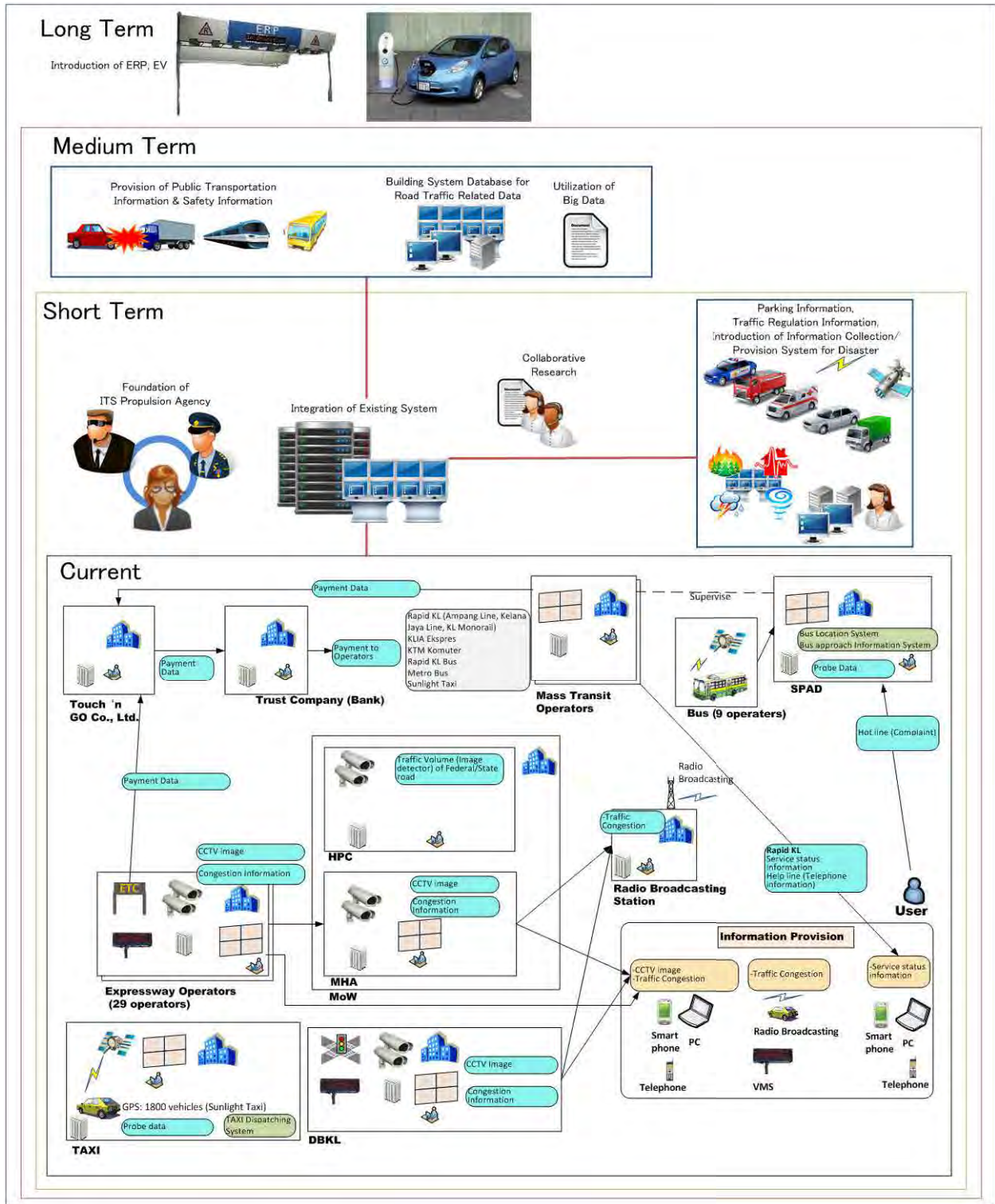
For the direction of ITS development assistance from Japan, training that supports future ITS development in this country, and collaborative research for technical development, are recommended. It also has a possibility as a place of third country training.

As ITS situation of KL, ITS was not operated properly because of manufacturers that went bankrupt and out of stock of ITS equipment. Therefore, in addition to the introduction and provision of technology, there may be a business opportunity for Japanese companies to introduce ITS equipment and systems by updating or upgrading ITS. Also, there is the possibility of public-private partnership (PPP) by Japanese companies and manufacturers.

Table 7-3 Draft Direction of Technical and Financial Assistance

No	Type of Assistance	Objective
1	Technical Assistance: Training	- Building of institutions of ITS-related organizations (decision of the driving force, etc.), - Dispatch of experts relating to traffic control system and training
2	Technical Assistance: Assistance on Technical Research	- Implementation of technical research related to the development of ITS-related systems and sharing information
3	Technical Assistance: Study and Assistance on Utilization of Advanced ITS	- Promotion of private participation and implementation of technical assistance for the medium-and long-term ITS menus

Source: JICA Study Team



Source: JICA Study Team

Figure 7-14 ITS Introduction Conceptual Diagram (Kuala Lumpur, Malaysia)

CHAPTER 8 FEDERAL REPUBLIC OF NIGERIA

8.1.1 RELEVANT STAKEHOLDERS

The name, interview date, and overview of roles of each organization are shown in Table 8-1 below. These organizations have roles of planning and management at the national and city levels. The National organization is located in Abuja, and Lagos State is the main organization responsible for traffic/transportation in Lagos City, excluding the Federal Highway.

Table 8-1 Interview List

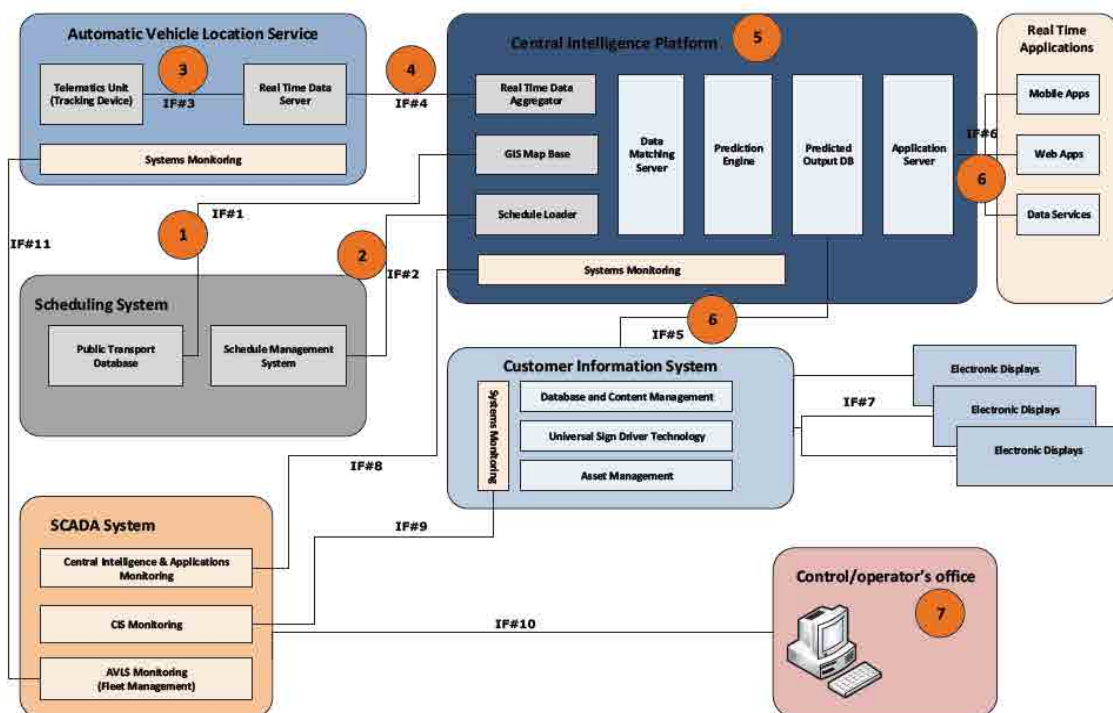
No	Organization Name	Level	Overview of Roles
1	Federal Capital Territory Administration	National	Management organization of the federal capital
2	Federal Ministry of Works	National	Construction, repair, planning and design of federal roads, maintenance , etc. of nationwide federal roads and bridges
3	National Automotive Council	Council	Promotion of production of equipment parts and international standard vehicles in Nigeria's automotive industry
4	Lagos Metropolitan Area Transport Authority	City	Public transport (bus, train, cable car) and transportation planning in general, and coordination
5	Federal Road Safety Commission, Abuja and Lagos Sector	National	Road safety, advice relating to accident reduction, education, etc. according to traffic rules
6	Nigeria Police Force, Lagos Command	National	Security, traffic management, enforcement
7	LAGBUS	Private	Bus service, management
8	Office of Public Private Partnerships	City	Promoting the development of Lagos State's public infrastructure through PPP
9	Courteville	Private	Vehicle registration information management utilizing AutoReg, issuance of vehicle license (certification of car tax payment)
10	Lekki Concession Company	Private	Provision of related services and high quality road infrastructure in Lekki-Epe Expressway
11	Ministry of Transportation (MOT), LSG	State	Development of transport policies and planning in Lagos State, coordination, supervision, etc. of public transport sector activities
12	Ministry of Works and Infrastructure, LSG	State	Planning, design, implementation, maintenance, repair, etc. of road infrastructure projects

13	Metro Taxi	Private	Operation and management of taxi
14	ABC Transport	Private	Operation and management of international bus and inter-city bus service
15	Federal Ministry of Transport (FMOT) and National Institute of Transportation Technology	National	Supervision, regulation and safety of the overall railway policy, design of traffic control and safety standards of roads between inter city roads
16	Vehicle Inspection Office	National	Implementation of traffic management and enforcement in the Federal Capital Territory (FCT), vehicle management such as vehicle registration, test and driver's license issuance
17	Nigerian Communications Commission	National	Promotion of implementation of national information and communication policy
※	Economic Community of West African States	Community	Sub-regional organizations to promote regional economic integration in West Africa, and establishment of a regulatory framework

Source: JICA Study Team

8.1.2 ITS ARCHITECTURE AND STANDARDIZATION AREA

Lagos Metropolitan Area Transport Authority (LAMATA) has developed intelligent transport systems (ITS) architecture in detailed design with World Bank assistance.

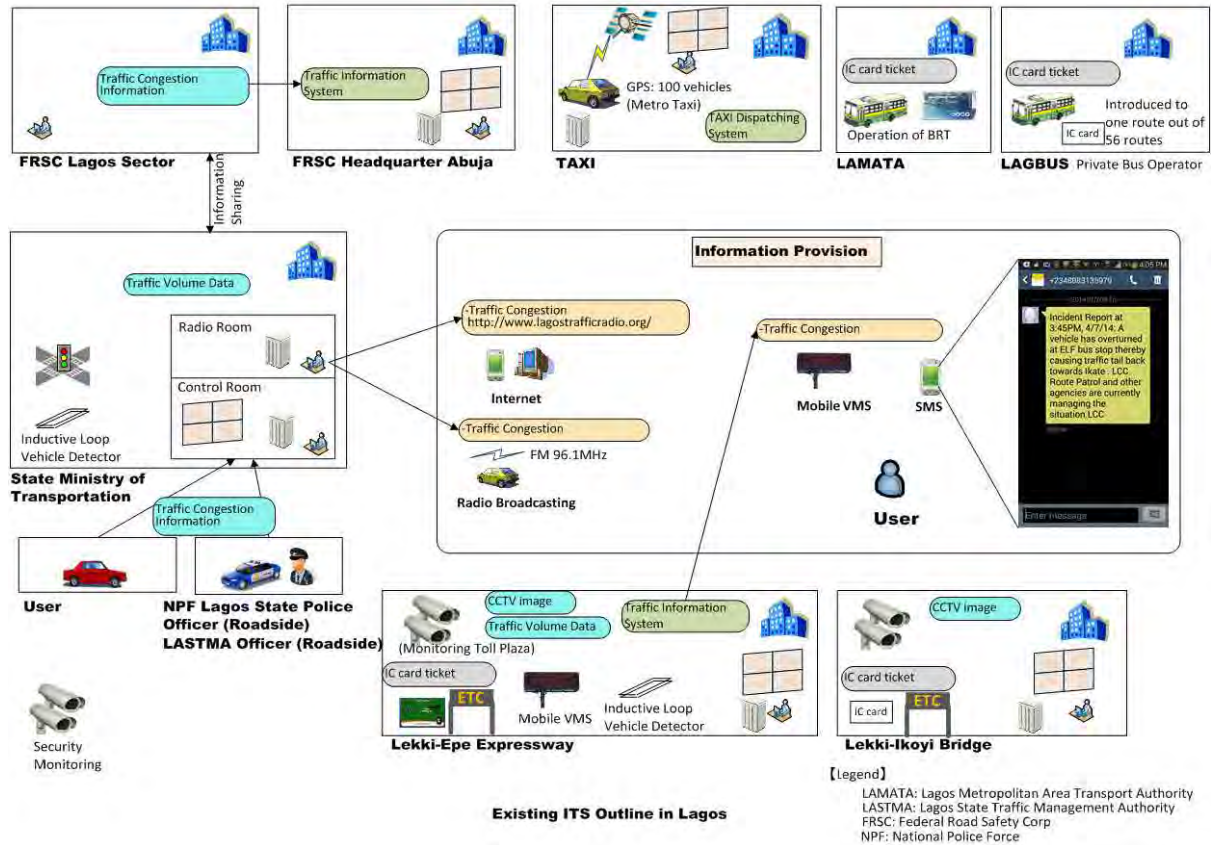


Source: Document from LAMATA

Figure 8-1 ITS Architecture

8.1.3 EXISTING ITS RELATED FACILITIES AND EQUIPMENT

A diagram of the overall system of existing ITS-related facilities and equipment in Lagos is shown in Figure 8-2 below. Traffic signals are installed, managed, and operated by Ministry of Transport (MOT), Lagos State. In addition, e-Tag system is operated at Lekki-Epe Expressway and Lekki-Ikoyi Bridge.



Source: JICA Study Team

Figure 8-2 Existing ITS Facilities and Equipment - Overall System Diagram

- (1) Collection System Equipment
 - 1) CCTV
 - CCTVs are installed on the main road and in important places for security purposes.



Source: JICA Study Team

Figure 8-3 CCTV

2) e-Tag

- Electronic toll collection (ETC) system called e-Tag is installed at Lekki-Epe Expressway (average users of about 70,000 vehicles/day) and at Lekki-Ikoyi Bridge (average users of about 22,000 vehicles/day), both are payable via IC tag (RFID) or contactless cards.
- Since the mutual use of tags is not possible on the ETC system of Lekki-Epe Expressway and Lekki-Ikoyi Bridge, a user needs to put two types of tags on the vehicle's windshield if the user wants to use both ETC systems.
- CCTV is installed at the toll booths in Lekki-Epe Expressway, and at the middle portion and toll booth of Lekki-Ikoyi Bridge. CCTV is monitored at the CCTV monitoring room.



ETC Gate (Lekki-Epe Expressway) ETC Gate (Lekki-Epe Expressway) Antenna for ETC (Lekki-Ikoyi Bridge)



e-Tag

Swift Pass

Information provision by SMS

Source: JICA Study Team

Figure 8-4 Toll Booth, e-Tag Related Equipment, and Information Provision by SMS

- Lekki-Epe Expressway is operated by Lekki Concession Company Limited (LCC). e-Tag users can use the e-Tag lanes at the toll gate, and avoid the congestion at the regular toll booths.
- Users of e-Tag, which is available in Lekki-Epe Expressway, are able to use the automatic toll collection facility at a toll gate by communicating with the RFID tag registered with the vehicle's information. Contactless cards called Swift Pass are also issued, and toll collection is also possible by using this card.
- e-Tag of Lekki-Epe Expressway is provided free of charge.
- e-Tag users are given 10% discount, and there is also further discount from frequency of use. One e-Tag is issued per vehicle.
- The Swift Pass can be registered to multiple e-Tag vehicles. Registration is possible at the toll booth of LCC, online at the website, and at various banks. Toll charge has adopted flat rate.

- RFID system is by Electronic Vehicle Identification (EVI) made by IPICO (Canada).
- In addition, LCC has a small portable variable message sign (VMS), and also has installed traffic counters of loop coil type in their expressway.
- Moreover, fiber optics has been laid on the main line, and it is connected to three toll booths (3 km point, 13 km point, and 23 km point) and its head office.
- LCC provides traffic information by short message service (SMS), and such information collected from the road patrol is sent from the monitoring center.

3) Bus IC Card

- The Lagos Connect Card has been introduced to the bus rapid transit (BRT) system in July 2013 (electronic fare ticketing system), and it is used for fare collection when riding the bus.
- The normal fare is NGN 70, but when using the Lagos Connect Card, the fare is discounted to NGN 50 at peak times and NGN 45 at off-peak times.
- Top-up of balance is possible at all bus stops.
- IC card is available in one out of the 56 routes of LAGBUS.



Source: JICA Study Team

Figure 8-5 IC Card for BRT

4) Vehicle Registration

- Courteville Business Solutions PLC. (100% private) has a vehicle registration information database called AutoReg, and they conduct vehicle registration information management utilizing AutoReg and issuance of vehicle license (certification of car tax payment) in 21 of Nigeria's 36 states.

(2) Provision System Equipment

1) Traffic Signal

- Traffic signals are installed at the 119 intersections in the city, and MOT, Lagos State conduct their installation, management, and operation.
- Traffic signals are of a stand alone type, and their controllers are from America (Zweiser Inc.), India (Envoys, Inc.), United Kingdom (Siemens Inc.), and China (company unknown).
- Traffic management is conducted by the Federal Road Safety Corps (FRSC), the state police, and the Lagos State Traffic Management Authority (LASTMA). In times of congestion, traffic control is performed by LASTMA by hand signals.



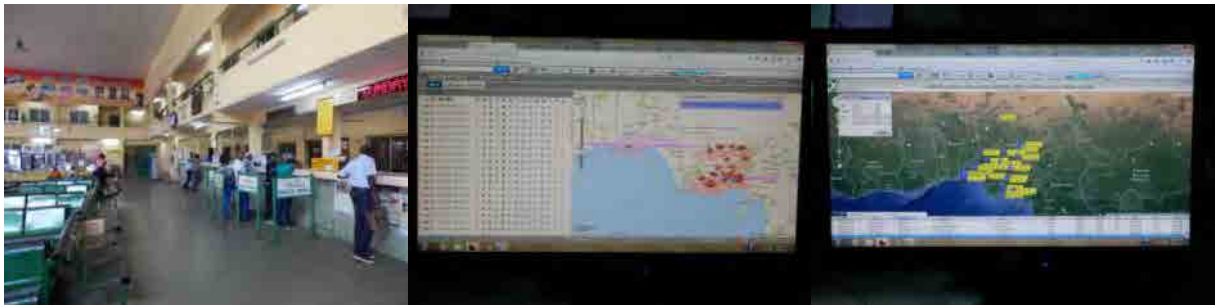
Source: JICA Study Team

Figure 8-6 Traffic Signals

(3) Center System

1) Bus Truck Tracking System

- ABC Transport, which operates inter-city and international buses, has introduced a bus truck tracking system in collaboration with Xnet Security Technologies Limited and Universal Fleet and Tracking Limited, and has conducted operations management of buses and trucks in the regional office.
- Although CCTV is installed inside new buses (made in China), it cannot be monitored in real time, and only the video recorded on DVD can be reviewed. Bus arrival time information based on bus location information is provided to bus terminals by announcement.



Source: JICA Study Team

Figure 8-7 Bus and Truck Traffic Control System - ABC Transport

2) Taxi Dispatch System

- Metro Taxi, which operates taxis, has a taxi dispatch system, which was developed by their own engineers and introduced in 2013. They determine a taxi's position by global positioning system (GPS), which is installed in the taxi's smartphone, and the taxi closest to the customer is dispatched. This system is also able to confirm whether there is a customer riding in the taxi.
- In addition, the number of taxis owned by Metro Taxi is 200, of which 100 have been installed with a smartphone. The remaining 100 vehicles are dispatched by contact from the call center.

(4) Others

- Although a car navigation system by TomTom is available for use, it is not popular.

8.1.4 PROCUREMENT SYSTEM OF ITS-RELATED FACILITIES AND EQUIPMENT

(1) Procurement System

The procurement system is by competition tendering.

(2) Contract Type and Role of Ordering Person and Contractor

MOT, Lagos State is in charge of management, while implementation is carried out by private companies as contractor. In addition, there is also a concession contract by public-private partnership (PPP) scheme, financial cooperation by Lagos State, management by the PPP Office, and construction and operation by private companies.

8.2 TREND OF OTHER DONORS

In Lagos, the World Bank is conducting detailed design (DD) of BRT control centers, automatic vehicle location system, and customer information system (CIS). In addition, the Blue Line (MRT) is under construction with assistance from China. The Blue Line is scheduled to open in 2016. Also, DD of the Red Line is complete, and DD of the Green Line is being carried out.



Source: JICA Study Team

Figure 8-8 Construction Situation of the Blue Line

In addition to the above, FMOT has signed a memorandum of understanding (MOU), which comprise 15 fields (technical cooperation and sharing knowledge relating to the transport sector, etc.) that support traffic, with the Korea Transport Institute (KOTI) on 8 October 2013. FMOT has also signed an MOU with China in the railway field. FMOT also has cooperative relationships with India, Pakistan and Indonesia.

8.3 SUGGESTION OF DIRECTION FOR ITS DEVELOPMENT

8.3.1 ITS MENUS TO BE INTRODUCED

(1) Consideration of ITS Development Phase

ITS equipment and systems for improvement of traffic congestion and traffic accidents should be developed preferentially because Lagos is under the situation of increasing traffic congestion and number of accidents. From the viewpoint of optimization of traffic management, optimization of signal systems and installation of equipment / system related to information collection and provision with priority are effective.

Table 8-2 Introduction Phase of ITS Menu and Assumed Impacts of ITS

Introduction Possibility Period (assumed)	Name of the System	Expected Impact
Short	Basic information collection equipment, such as congestion situation monitoring system, full time traffic volume counting system, etc.	Congestion improvement and traffic situational awareness of urban areas
	CCTV monitoring system	(For traffic monitoring) Congestion scale, situational awareness of the event of an accident, speeding the correspondence
	Signal optimization system	Congestion improvement of surrounding route and congestion intersection by optimization of traffic flow
	Congestion information by road information boards and radio, etc., Information providing system such as route information	Congestion improvement by promoting traffic conversion by the route guidance
	Regulatory information providing system (by information boards, radio, car navigation systems, etc.)	Provides information passable route along with information from various sensors, and avoids the traffic stagnation
	Information integration between organizations	Efficiency and optimizing the sharing information by information integration of basic data, management, etc.
	Roadside equipment, Ledger DB	Collection of basic data, database
	Accident statistics database system	Understanding accident situation and accident types, Utilization as basic data for considering measures
	Traffic accident detection system	Rapid rescue of accident vehicle and users
	Traffic violation enforcement system (over speed, signal jumping, etc.)	Quick and labor-saving of violation vehicle identification
	The monitoring system by various sensors (weather meter (rainfall, road temperature), etc.)	Conducted user services such as route guidance information by providing information of closures and etc. to the road user by weather information
	Information terminal such as Car navigation system, Smartphone, WEB system, digital signage, etc.	Improvement of information services by expanding the information available methods *Development of car navigation system is assumed in middle-term
	The overload detection system by weigh in motion, etc.	Avoid damage to the road by overloaded vehicles, reduction of maintenance costs
	Expansion of information communication network of Telematics, 3G, etc.	Expansion of the information provision methods to the road user
Middle	Operation management, Operation status provision system (bus)	(To be introduced to BRT) Efficiency of management, Service improvement by providing information of operation status to the user
	Public transportation priority signal system	(Introduction to BRT is desirable) Mitigation of service inhibition of public transport, improving convenience of punctuality securing of arrival and departure time
	Maintenance operational efficiency systems, etc.	Support for the maintenance of Road, ITS facilities, etc., Cost savings
	Illegal parking enforcement system	Reduce the traffic inhibition due to parked vehicle by the illegal vehicle is reduced
	Roads and structures ledger DB	Efficiency of road maintenance and repair by database
	Business support systems, etc.	Operational efficiency, Cost reduction
	Road information provision to the other agencies	Sharing road information by information integration
	Public transportation transit search system	Improvement of user experience
	Other public transport information cooperation system	Improvement of transit convenience, Improved transfer efficiency by providing information of other transportation means selection
	Electronic system of vehicle passage application permission	Reduce labor costs of tollgate, congestion improvement due to a reduction queue length by permit waiting
	The route guidance and information provision by car navigation system, WEB, etc.,	Optimizing traffic flow by providing congestion information and regulations in advance
Long	Reversible lane system	Optimization of traffic processing by the road users tailored to traffic conditions
	Various DB for the destination information provision	Implementation of information provision in conjunction with the needs of road users
	Parking investigation DB	By the understanding of the parking scale, utilized for study materials of expansion and maintenance of parking
	Parking situation information providing system	Guidance to the parking place, the reduction of illegal parking, reduction of traffic to look for parking (improvement of traffic flow)
	Cargo management system	Induction to the appropriate route based on the information of luggage of trucks, delivery location, etc., Efficiency of management
	Pedestrian priority signal system	Reduction of accidents by pedestrian priority, Rectification of the flow of people
	ERP	Conversion promotion of traffic due to the inflow regulation of vehicle, Congestion improvement, Reduction of accident
	Automatic payment system for parking	Reduction of payment waiting queue and labor costs
	The traffic control system for vehicle alone or vehicle-to-vehicle, roadside-to-vehicle communication	Facilitation of movement by providing information and collection from the other vehicle
	Disaster information collection, sharing and providing system	Share of the movement, correspondence (road manager) and situation in an emergency by providing and collecting detailed information of the road such as in the event of a disaster
	Travel assistance system (tourist information provision)	Improve usability of the information providing service in tourist facilities, accommodation, etc.
	Automatic driving system for vehicle	Improve user experience
	Pedestrian support system (the disabilities, the elderly, etc.)	Improve safety and convenience of the move of the elderly, disabilities, etc.
	Vehicle control system (by roadside-to-vehicle communication and inter-vehicle communication)	Improve user safety
	Demand bus system	Improvement of transportation services by securing transportation mode and supporting for the elderly, etc.
Location information provision for the elderly, etc.	Reduction of accidents, improve user safety	
Already Introduced	ETC	(Already introduced to Lekki-Epe Expressway, Lekki-Ikoyi Bridge, RFID) Service improvement by simplification of payment, reduction of labor costs in tollgate, congestion improvement due to a reduction of queue length by permit waiting
	Cashless transit system using the IC card	(Already introduced in BRT and a part of city bus) Improve user experience, reduction of waiting time in the ticket office, etc. (service improvement)

Priority High: Medium: Low:

Source: JICA Study Team

(2) Trend of Japanese Companies

In the JICA Nigeria Office, the JICA Study Team shared the following information about the trend of Japanese companies in Nigeria:

- The Japanese companies in Nigeria are Nishizawa, Mitsubishi Corporation, Marubeni, Sojitz, Itochu, Mitsui & Co., Ltd., Ajinomoto, Honda, Toyota + Sumitomo Corporation, Nissan, etc.
- A human resource training school for Japanese animation production is planned.
- Although there were about 2,000 Japanese people in Nigeria in the 1970s, the current number decreased to about 150. There are 21 Japanese companies. The number of Japanese companies showing interest in Nigeria has been increasing after the Tokyo International Conference on African Development (TICAD).
- Although there is a Japanese Chamber of Commerce in Nigeria, it does not actually function.

(3) Draft ITS Menus to be Introduced

ITS situation in Lagos is as follows;

- There are basic ITS equipment in Lagos such as traffic signals and CCTV, but their numbers are not sufficient and their conditions are faulty or unutilized.
- CCTV is installed for security purposes, and not for traffic monitoring.
- An ITS master plan has not been developed, and there are no traffic control centers.
- In addition, there is no ITS standardization organization.

Based on this situation, draft ITS menus to be introduced are shown below.

- Introduction of signal control in accordance with traffic volume
- Introduction of CCTV for grasping traffic/congestion situation
- Traffic management measures that promote traffic guidance to users by providing congestion information through the VMS
- Introduction of traffic control center which integrates the above measures.
- ITS master plan is needed for development of ITS standards for traffic signals and other ITS services, foundation of an ITS organization, and planned development of ITS.

In addition, traffic congestion in Lagos and in Nigeria has become worse with increased traffic volume and economic growth, and the lack of roads and public transport is also an issue (for example, deceleration of speed due to bad road conditions, poor drainage function, lack of path to southern Lagos State (crossing part of bridges), parked vehicles, car failure on the road, and “Danfo” parking in various places).

Therefore, improvement of traffic situation by infrastructure development and strengthening of public transport is needed, and implementing effective soft and hard traffic measures such as developing road traffic infrastructure (roads, bridges, public transportation, etc.) and strengthening of future traffic management functions by ITS (utilization of existing IC cards and ETC, provision of relevant information (bus location information, transit information, etc.), and expansion of signal-related ITS, is desirable.

8.3.2 DIRECTION OF TECHNICAL AND FINANCIAL ASSISTANCE

The direction of technical and financial assistance is suggested as follows.

For the direction of ITS development assistance from Japan, the following are considered appropriate:

Short Term: Introduction of traffic management system (traffic signal and CCTV) and development study, implementation of ITS pilot project, study of ITS master plan, and technical training related to traffic management

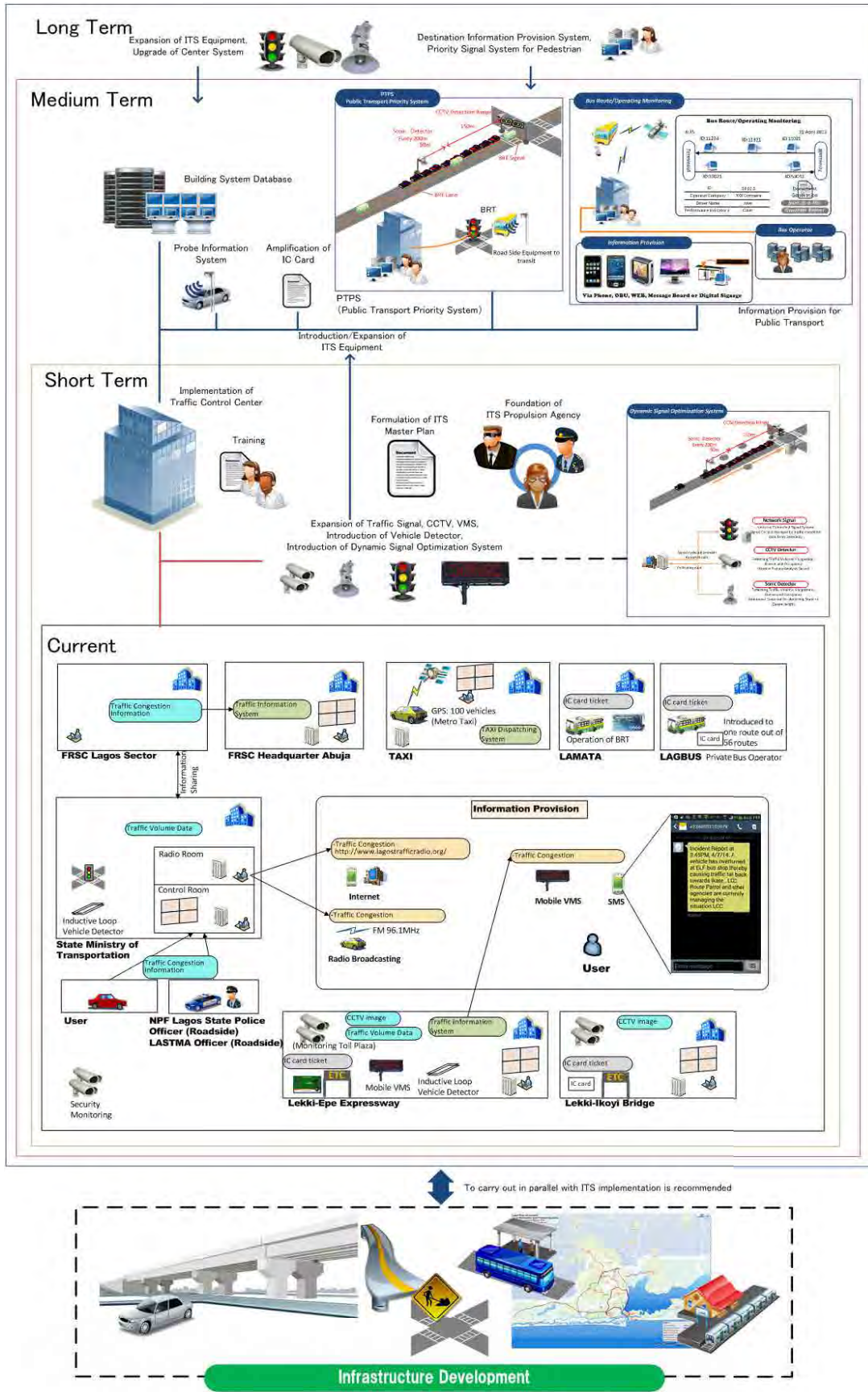
Medium and Long Term: Loan assistance for the development study on expansion of ITS introduction and implementation, technology education and dispatch of experts on highly-developed ITS

To attain the effects of ITS synergistic congestion improvement, it is desirable to conduct such assistance in conjunction with road and intersection improvement projects and public transport development. Although Japanese companies in Nigeria are few, assistance on ITS introduction is beneficial for the improvement of safety and economic activities by solving congestion, and this also helps Japanese companies to advance and deploy overseas in the future.

Table 8-3 Draft Direction of Technical and Financial Assistance

No	Type of Assistance	Objective
1	Technical Assistance: Training, Implementation assistance on pilot projects, formulation of M/P, foundation of ITS organization Financial Assistance: Grant	- Training related to traffic control system - Technical assistance on pilot projects related to ITS - Training in Japan, formulation of ITS master plan - Foundation of integrated organization, introduction of ITS
2	Financial Assistance: Loan	- Loan assistance for implementation of the ITS menu in the medium and long term

Source: JICA Study Team



Source: JICA Study Team

Figure 8-9 ITS Introduction Conceptual Diagram (Lagos, Nigeria)

CHAPTER 9 REPUBLIC OF ZAMBIA

9.1.1 RELEVANT STAKEHOLDERS

The name, interview date, and overview of roles of each organization are shown in Table 9-1 below. These organizations have roles of planning and management at the national and city levels. Also, there are many traffic management organizations, and the roles of each organization are complicated.

Table 9-1 Interview List

No	Organization Name	Level	Overview of Roles
1	Lusaka City Council (LCC)	City	Design and drawings, construction and maintenance of public facilities, planning and implementation of projects.
2	Zambia Information and Communications Technology Authority (ZICTA)	National	Regulation of provision of telecommunications services and products, provision of national frequency and numbering plan, etc.
3	Zambia Police, Lusaka Headquarter	National	Public order, protection of victims, traffic management, enforcement
4	InterCape	Private	Management of inter city passenger transport services (bus)
5	Ministry of Information and Broadcasting Services	National	Coordination and facilitation relating to domestic media management
6	Ministry of Transport, Works, Supply and Communications	National	Management of related organizations (RTSA, RDA, ZICTA, etc.), planning of the entire transportation and infrastructure policy
7	Road Development Agency (RDA)	National	Planning, design, development and maintenance of national roads in Zambia
8	Ministry of Local Government and Housing	National	Coordination with local administration, urban planning and local planning, provision of feeder roads, community roads and urban road
9	Road Transport and Safety Agency (RTSA)	National	Traffic enforcement, traffic management, publicity and educational activities related to traffic safety, vehicle registration management, etc.

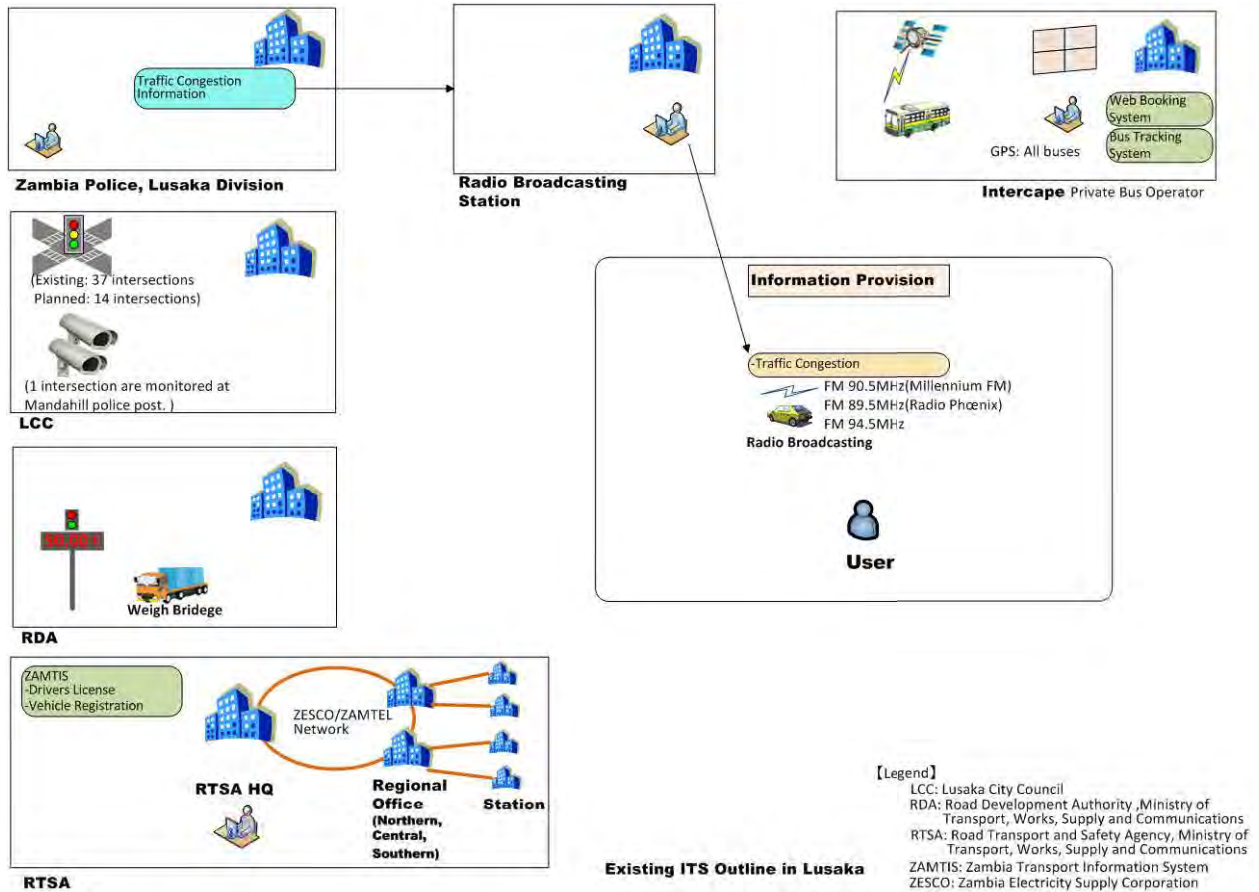
Source: JICA Study Team

9.1.2 ITS ARCHITECTURE AND STANDARDIZATION AREA

There are no ITS standards and ITS architecture in Zambia.

9.1.3 EXISTING ITS RELATED FACILITIES AND EQUIPMENT

A diagram of the overall system of existing ITS-related facilities and equipment in Lusaka is shown in Figure 9-1 below. Lusaka City Council (LCC) is in charge of installation, management and operation of traffic signals, and CCTV was installed as an experiment by the Manda Hill Police Post for monitoring the traffic and security situation at Manda Hill intersection. In addition, a weigh bridge was installed to measure weight toll to be collected in the suburbs of Lusaka.



Source: JICA Study Team

Figure 9-1 Existing ITS Facilities and Equipment - Overall System Diagram

(1) Collection System Equipment

1) CCTV

- CCTVs are installed at the Manda Hill intersection as an experiment from June 2014. There are 2 gun-type CCTVs and 2 dome-type CCTVs, they are monitored inside the police station which is placed near the intersection.



Source: JICA Study Team

Figure 9-2 CCTV, Manda Hill Police Post, and CCTV Monitoring Screen

2) Weigh bridge

- Toll collection at the border and main road is conducted using weighbridge.
- It is conducted at 9 out of total of 26 locations for the first stage (although it was launched in June 2014, some toll booths are planned to be started only in September).
- Although collection of fees is currently done manually, automatic toll collection by electronic card has been considered for the future. The collected fees are used to maintain the road.
- In Phase II, the main road is planned to be changed to a toll road, and it is planned to carry out toll collection for all vehicle types. Regarding ETC, there has been some marketing efforts with several companies from various countries.



Source: JICA Study Team

Figure 9-3 Kafue Weighbridge

3) Vehicle and License Information Registration

- Zambia Transport Information System (ZAMTIS) has been developed to manage vehicle registration information (including plate number information) and driver's license information.
- A communications network between the RTSA, regional center, and station is developed by using the communication lines of Zambia Electricity Supply Corporation Limited (ZESCO) (a power company) and Zamtel (a state-owned telecom operator). Vehicle registration and other related

activities can also be carried out even in rural areas.

4) Bus Tracking System

- InterCape, which operates international and inter city buses, carries out bus service management and has a bus location information system for driver management, speed and revolution per minute (RPM).
- The name of bus tracking system software is PowerTrack which is made by ComTech (Pty) Ltd. (South Africa). Tracking system information is sent from the bus mobile phone. This system has already been installed in all buses, and information is updated every two minutes.
- In addition, a camera is installed in the bus, and it records video of the driver and outside view of the bus. If an accident occurs, the situation seven seconds before the accident occurs is automatically recorded.



Source: JICA Study Team

Figure 9-4 Camera in the Bus

(2) Provision System Equipment

1) Traffic Signal

- LCC installs, manages and operates traffic signals (including set of signal cycle). Traffic signals are installed at 37 intersections, and there is a plan to install traffic signals at 14 more intersections. Traffic signals have been installed through assistance from Japan, the World Bank, etc. or by LCC's own funds. There are no local traffic signal products. According to results of international bidding, there are many products from South Africa (Syntell Inc.) which have low prices.
- Signals are of stand alone type, but there are synchronized signals are installed at three intersections.
- Signal phase is set at five patterns in one day, but such patterns have not been changed since the time of introduction. Also, the pattern during holidays has also not been changed.
- When the power company implements rolling blackouts, the signals in the target area does not work. However recently, there has been no such problem because the signals had been installed with uninterruptible power supply (UPS).



Source: JICA Study Team

Figure 9-5 Traffic Signals

2) Radio for Traffic Information Provision

- Police have been broadcasting traffic information through Millennium Radio (FM 90.5 MHz). Information are provided by police officers on site (some information are from citizens), and information related to safety are provided by the traffic police radio unit.
- Traffic information are also broadcasted through Radio Phoenix (89.5MHz) and 94.5 MHz.

3) Car Navigation System

- Car navigation systems are sold by TomTom and Garmin.
- Car navigation units of TomTom cover major cities such as Zambia, including southern Africa and Lusaka (some models cover Nigeria and Morocco).



Source: JICA Study Team

Figure 9-6 Car Navigation System

4) Variable Speed Display Board

- A variable speed display board is installed at Church Road. This was installed by some manufacturer (DMV, Serbia) as a demonstration.



Source: JICA Study Team

Figure 9-7 Variable Speed Display Board

(3) Communications Network

- LCC plans to use fiber optics for traffic control. Fiber optics in Lusaka has been laid by Zamtel. Zambia has changed to digital broadcasting, and they made a contract with Chinese manufacturers for procurement of related equipment. Digital broadcasting will start probably in 2015.

9.1.4 PROCUREMENT SYSTEM OF ITS RELATED FACILITIES AND EQUIPMENTS

(1) Procurement System

The procurement system is by competition tendering.

(2) Contract Type and Role of Ordering Person and Contractor

LCC is in charge of management of the city, and RDA and other ministries are in charge of management of national roads. Implementation is carried out by private companies as contractor.

9.2 TREND OF OTHER DONORS

- 1) L400 Project
 - The L400 Project has been implemented through Chinese loan assistance. The design consultant is CHELBI ENGINEERING CONSULTANTS (China), and the construction contractor is AVIC International Holding Corporation. In the implementation of this project, despite the city's road improvement project, the Ministry of Local Government and Housing (MLGH) and LCC do not know the details of the L400 Project because the Ministry of Finance has promoted coordination with RDA assuming that a loan will be taken from China. Also, the committee for coordination is not regularly held. This project does not include installation of traffic signals.
- 2) High-Speed Rail
 - A high-speed rail is introduced through cooperation between China and Bombardier. A railway tracking system is also introduced in this scheme. According to information online, Huawei (China) is planning to utilize wireless communication system (GSM-R) for mobile phones and train control.
- 3) Traffic Planning
 - In July 2014, the National Transport Master Plan is to developed with assistance from the African Development Bank (AfDB), and currently is in the stage of selection of consultants. Also, the International Airport Master Plan is under consideration of being developed with assistance from the United States.

9.3 SUGGESTION OF DIRECTION FOR ITS DEVELOPMENT

9.3.1 ITS MENUS TO BE INTRODUCED

(1) Consideration of ITS Development Phase

ITS equipment and systems for improvement of traffic congestion should be developed preferentially because Lusaka is under the situation of increasing traffic congestion. From the viewpoint of optimization of traffic management, optimization of signal systems and installation of equipment / system related to information collection and provision with priority, are effective.

Table 9-2 Introduction Phase of ITS Menu, Assumed Impacts of ITS

Introduction Possibility Period (assumed)	Name of the System	Expected Impact
Short	Basic information collection equipment, such as congestion situation monitoring system, full time traffic volume counting system, etc.	Congestion improvement and traffic situational awareness of urban areas
	CCTV monitoring system	(For traffic monitoring) Congestion scale, situational awareness of the event of an accident, speeding the correspondence
	Signal optimization system	Congestion improvement of surrounding route and congestion intersection by optimization of traffic flow
	Congestion information by road information boards and radio, etc., Information providing system such as route information	Congestion improvement by promoting traffic conversion by the route guidance
	Regulatory information providing system (by information boards, radio, car navigation systems, etc.)	Provides information passable route along with information from various sensors, and avoids the traffic stagnation
	Information integration between organizations	Efficiency and optimizing the sharing information by information integration of basic data, management, etc.
	Roadside equipment, Ledger DB	Collection of basic data, database
	Accident statistics database system	Understanding accident situation and accident types, Utilization as basic data for considering measures
	Traffic accident detection system	Rapid rescue of accident vehicle and users
	Traffic violation enforcement system (over speed, signal jumping, etc.)	Quick and labor-saving of violation vehicle identification
	The monitoring system by various sensors (weather meter (rainfall, road temperature), etc.)	Conducted user services such as route guidance information by providing information of closures and etc. to the road user by weather information
	Information terminal such as Car navigation system, Smartphone, WEB system, digital signage, etc.	Improvement of information services by expanding the information available methods
	The route guidance and information provision by car navigation system, WEB, etc.,	(Car navigation systems have been sold) Optimizing traffic flow by providing congestion information and regulations in advance
	Expansion of information communication network of Telematics, 3G, etc.	Expansion of the information provision methods to the road user
Middle	Operation management, Operation status provision system (bus)	(Considering development of BRT) Efficiency of management, Service improvement by providing information of operation status to the user
	Public transportation priority signal system	(Considering development of BRT) Mitigation of service inhibition of public transport, improving convenience of punctuality securing of arrival and departure time
	Maintenance operational efficiency systems, etc.	Support for the maintenance of Road, ITS facilities, etc., Cost savings
	Cashless transit system using the IC card	(Considering BRT and urban railway) Improve user experience, reduction of waiting time in the ticket office, etc. (service improvement)
	Roads and structures ledger DB	Efficiency of road maintenance and repair by database
	Business support systems, etc.	Operational efficiency, Cost reduction
	Road information provision to the other agencies	Sharing road information by information integration
	Public transportation transit search system	Improvement of user experience
	Other public transport information cooperation system	Improvement of transit convenience, Improved transfer efficiency by providing information of other transportation means selection
	Illegal parking enforcement system	Reduce the traffic inhibition due to parked vehicle by the illegal vehicle is reduced
	Electronic system of vehicle passage application permission	Reduce labor costs of tollgate, congestion improvement due to a reduction queue length by permit waiting
Long	Reversible lane system	Optimization of traffic processing by the road users tailored to traffic conditions
	Various DB for the destination information provision	Implementation of information provision in conjunction with the needs of road users
	Parking investigation DB	By the understanding of the parking scale, utilized for study materials of expansion and maintenance of parking
	Parking situation information providing system	Guidance to the parking place, the reduction of illegal parking, reduction of traffic to look for parking (improvement of traffic flow)
	Cargo management system	Induction to the appropriate route based on the information of luggage of trucks, delivery location, etc., Efficiency of management
	Pedestrian priority signal system	Reduction of accidents by pedestrian priority, Rectification of the flow of people
	ERP	Conversion promotion of traffic due to the inflow regulation of vehicle, Congestion improvement, Reduction of accident
	ETC	Service improvement by simplification of payment, reduction of labor costs in tollgate, congestion improvement due to a reduction of queue length by permit waiting
	Automatic payment system for parking	Reduction of payment waiting queue and labor costs
	The traffic control system for vehicle alone or vehicle-to-vehicle, roadside-to-vehicle communication	Facilitation of movement by providing information and collection from the other vehicle
	Disaster information collection, sharing and providing system	Share of the movement, correspondence (road manager) and situation in an emergency by providing and collecting detailed information of the road such as in the event of a disaster
	Travel assistance system (tourist information provision)	Improve usability of the information providing service in tourist facilities, accommodation, etc.
	Automatic driving system for vehicle	Improve user experience
	Pedestrian support system (the disabilities, the elderly, etc.)	Improve safety and convenience of the move of the elderly, disabilities, etc.
	Vehicle control system (by roadside-to-vehicle communication and inter-vehicle communication)	Improve user safety
	Demand bus system	Improvement of transportation services by securing transportation mode and supporting for the elderly, etc.
Location information provision for the elderly, etc.	Reduction of accidents, improve user safety	
Already Introduced	The overload detection system by weigh in motion, etc.	(Weigh Bridge is already introduced) Avoid damage to the road by overloaded vehicles, reduction of maintenance costs

Priority High: Medium: Low:

Source: JICA Study Team

(2) Trend of Japanese Companies

There is no Japan Chamber of Commerce and Industry in Zambia. According to information from the JICA Zambia Office, there are three Japanese companies in Zambia, namely, Toyota, Toyota Tsusho., and Hitachi Construction Machinery, and these companies have recently posted expatriates. A general manager (GM), who is not Japanese, is stationed in Japan Tobacco International (JTI). There are ten small/medium-size businesses or sole proprietors. Moreover, Shimizu Corporation, Katahira, Japan Design, and Japan Techno has also deployed in Zambia.

(3) Draft ITS Menus to be introduced

Congestion is getting worse in Lusaka due to concentration of traffic associated with economic growth. Although the development of road traffic infrastructure, such as road construction through JICA assistance, road maintenance and rehabilitation by the L400 Project, has been carried out so far, traffic congestion occurs at major roundabouts or on roads at morning, noon, and evening peak times. The causes are due to multiple factors, such as exceeding road capacity, unsuitable signal operations, and lack of mass transport and based on the situation where 70% of cars for domestic use are concentrated in Lusaka and due to economic growth, further increase of congestion and traffic accidents is a concern in the future.

ITS situation in Lagos is as follows;

- ITS in Lusaka is limited (37 traffic signals and 1 CCTV).
- Technical level is assumed low because Lusaka is in the ITS introduction stage.

In order to improve traffic conditions in Lusaka, it is necessary to introduce and enhance traffic management technology including ITS in parallel with development of infrastructure, enhancement of public transport, and strengthening of future traffic management based on the development of infrastructure and public transport. The relevant organizations have conducted development of infrastructure based on JICA's master plan in 2009. From the viewpoint of consistency with the development vision for Lusaka, implementation of projects based on JICA's master plan is desirable. Based on this situation, draft ITS menus to be introduced are shown below.

- Implementation of a traffic management master plan, such as signal maintenance including intersection improvements and central control, traffic information collection by CCTV, traffic information provision, training on signal control, consideration of integrated traffic management organization, and implementation of pilot project.
- It is effective to implement a concrete project by prioritizing which project is necessary.
- Acceptance of trainees and dispatch of experts are also valuable.

9.3.2 DIRECTION OF TECHNICAL AND FINANCIAL ASSISTANCE

The direction of technical and financial assistance is suggested as follows:

For the direction of ITS development assistance from Japan, the following are considered appropriate:

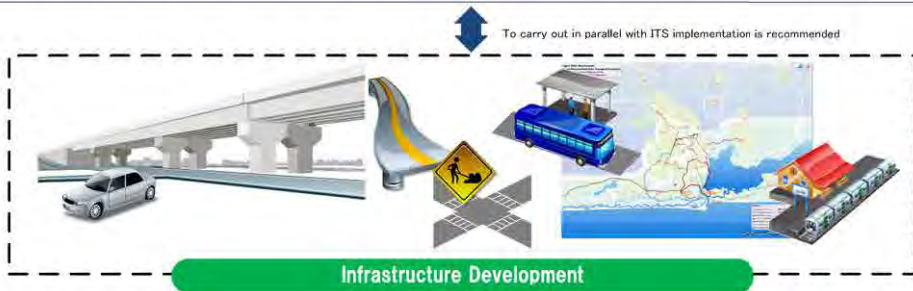
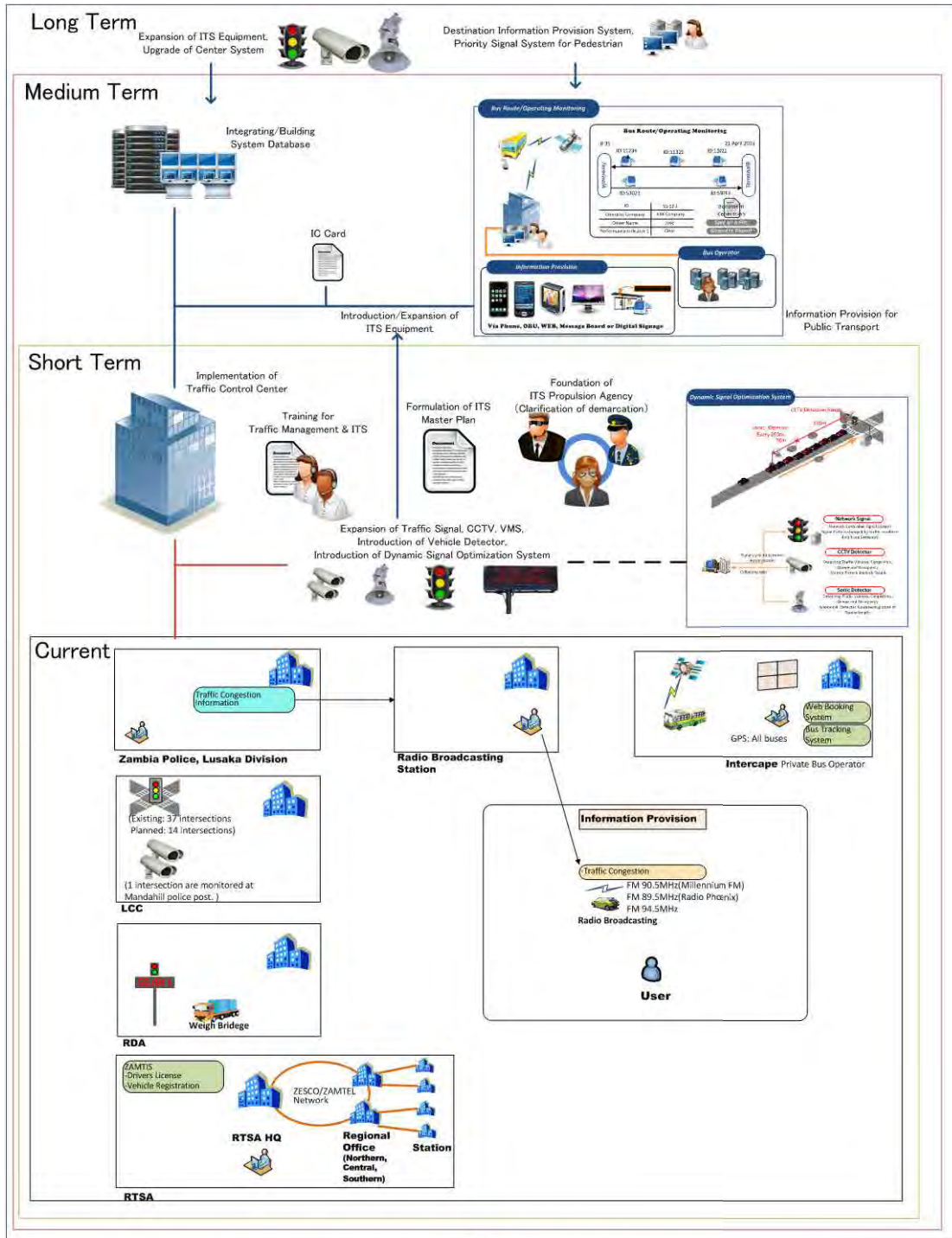
Short Term: Introduction of signal system and CCTV and implementation of pilot project, and training on traffic management

Medium and Long Term: Loan assistance for expansion of ITS introduction and system enhancement regarding ITS, the possibility of deployment of Japanese companies is expected for introduction of basic equipment such as signals and CCTV, signal control system, and probe car system. The number of motorcycles is lowness in Lusaka, and Lusaka's traffic situation is similar with Japan's because drivers obey the traffic signals and lanes. Therefore, it is highly possible to introduce Japanese traffic signal technology, and its effects are expected sufficiently. However, since the basic equipment and systems are also present in other countries and price range is also approximated to be of low cost, it is desirable to make a project to promote deployment of Japanese companies together with technical education and development studies and pilot project.

Table 9-3 Draft Direction of Technical and Financial Assistance

No	Type of Assistance	Objective
1	Technical Assistance: Training, implementation assistance on pilot project, formulation of M/P, foundation of ITS organization Financial Assistance: Grant	- Technical assistance and training related to traffic control system - Technical assistance of pilot projects related to ITS - Training in Japan - Formulation of ITS master plan - Foundation of the integrated organization, introduction of ITS
2	Financial Assistance: Loan	- Loan assistance for implementation of ITS menu in the medium and long term

Source: JICA Study Team



Source: JICA Study Team

Figure 9-8 ITS Introduction Conceptual Diagram (Lusaka, Zambia)

CHAPTER 10 REPUBLIC OF PARAGUAY

10.1.1 RELEVANT STAKEHOLDERS

The name, interview date, and overview of roles of each organization are shown in Table 10-1 below. These organizations have roles of planning and management at the national and city levels. Asuncion City is a borough, and planning, maintenance and management of roads in Asuncion has been done on its own.

Table 10-1 Interview List

No	Organization Name	Level	Overview of Roles
1	Ministerio de Obras Públicas y Comunicaciones (MOPC)	National	There are four vice ministers, and they are in charge of traffic measures, public works, finance, and energy
2	Municipalidad de Asunción	City	Public works in Asuncion City, planning, design, maintenance, etc. in the road sector
3	Dirección del Centro de Seguridad y Emergencias, Policía Nacional del Paraguay	National	Call center (911) of the National Police, monitoring the city's security situation, dispatch of police officers
4	Secretaría Nacional de Tecnologías de la Información y Comunicaciones (SENATICS)	National	SENATIC belongs to the President's Office, and it has implemented cross-cutting measures to reliably perform the utilization of information and communications technology.
5	Dirección del Registro de Automotores	National	This organization is under the Supreme Court, and in charge of vehicle registration, and issuance of vehicle ID card and license plates.
6	Directora Policía Municipal de Tránsito	City	Operation and enforcement related to traffic in Asuncion.
7	Comisión Nacional de Telecomunicaciones del Paraguay	National	Planning and control related to telecommunications in Paraguay. This agency is responsible for frequency allocation.
8	Ferrocarriles del Paraguay SA	Private	It is a company that is 99% owned by the government, and has implemented railway businesses nationwide.
9	Dirección Nacional de Transporte (DINATRAN)	National	Monitoring, management, inspection, licensing, etc. related to public transportation and logistics except for the Asuncion metropolitan area and city
10	Asociación de Profesional TAXISTAS de Asunción (APTA)	Association	Non-Profit Organization (NPO). Maintenance and improvement of the taxi service. They have a dispatch system using GPS.
11	Nuestra Señora de la Asuncion (NSA)	Private	Implementation of bus business and transportation business. Its buses serve inter city and international routes.

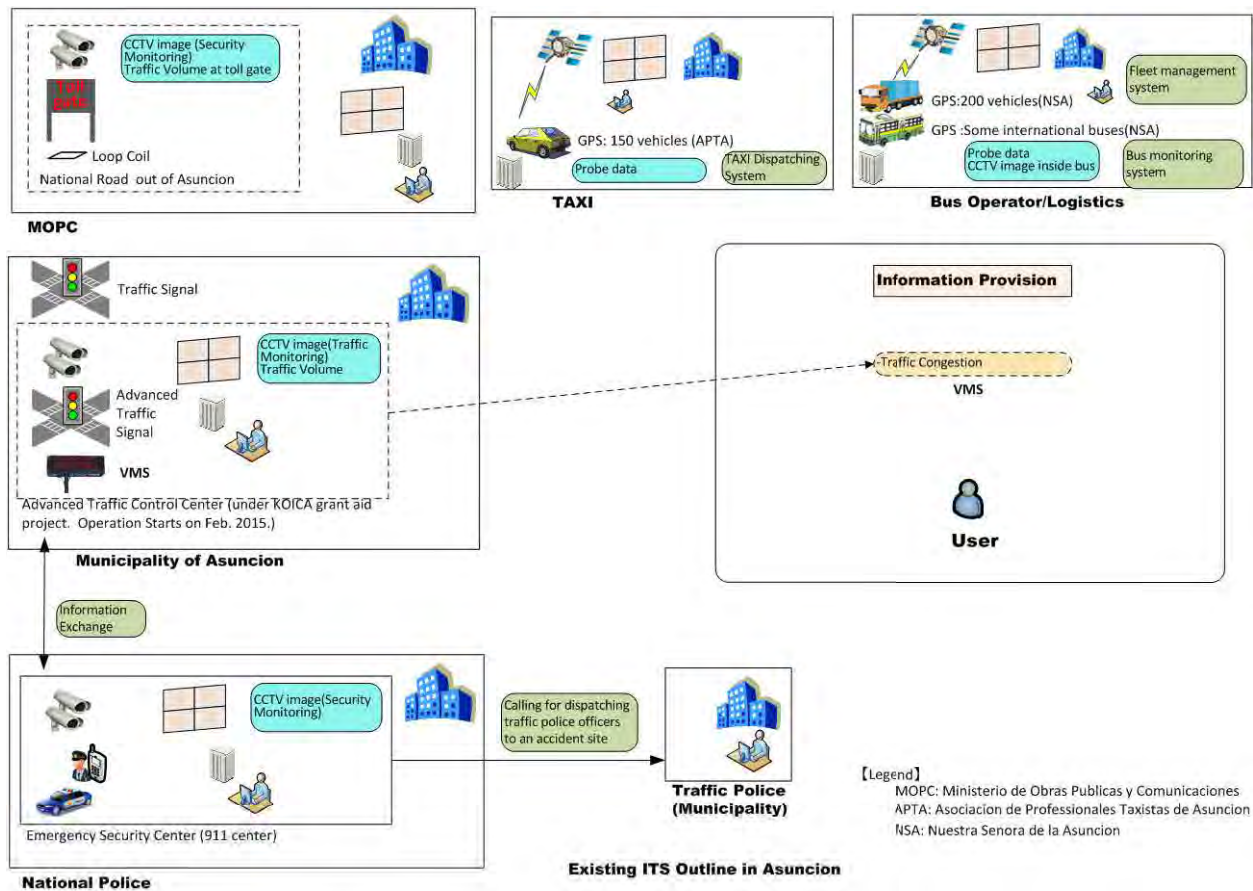
Source: JICA Study Team

10.1.2 ITS ARCHITECTURE AND STANDARDIZATION AREA

There are no ITS standards and ITS architecture in Paraguay.

10.1.3 EXISTING ITS RELATED FACILITIES AND EQUIPMENT

A diagram of the overall system of existing ITS-related facilities and equipment in Asuncion is shown in Figure 10-1 below. Asuncion City government is responsible for installing, managing and operating the traffic signals. The Ministerio de Obras Públicas y Comunicaciones (MOPC) monitors and operates CCTVs at toll booths, and the National police monitors and operates CCTVs for security purpose. In addition, a location information system is introduced in private taxis, buses and logistics.



Source: JICA Study Team

Figure 10-1 Existing ITS Facilities and Equipment - Overall System Diagram

- (1) Collection System Equipment
 - 1) CCTV
 - CCTVs are installed by National Police for security purpose.
 - There are 78 CCTVs installed on Costanela Expressway, and real-time monitoring is being carried out at the 911 Center.



Source: JICA Study Team

Figure 10-2 CCTV

2) Vehicle Registration Information

- Direccion del Registro de Automotores (DRA) is responsible for vehicle information.
- Vehicle registration information is shared with the National Police and with each city through the database of Organización Paraguaya de Cooperación Intermunicipal (OPACI).
- The city government is responsible for vehicle inspection, license issuance and tax, while the National Police is responsible for ID cards.

3) Toll Gate

- There are 15 toll gates nationwide.
- The Toll fee can only be paid by cash. Although electronic toll collection (ETC) is considered, the period for its introduction is undecided.
- They carry out monitoring by CCTV, but it is for security purposes and revenue management (monitoring for embezzlement prevention of toll booth staff).
- Some CCTV videos can be monitored at the MOPC headquarters.

UBICACIÓN GEOGRÁFICA DE LOS PUESTOS DE PEAJE DEL MOPC



Source: JICA Study Team

Figure 10-3 Ypacarai Toll Booth, Surveillance Video, and CCTV

(2) Provision System Equipment

1) Traffic Signal

- Traffic signals are installed at 195 intersections in the city, and the countries of production include France, Germany, and China. All are of stand-alone type.
- A project of the Korea International Cooperation Agency (KOICA) plans to upgrade traffic signals at 150 intersections (78 locations in Phase I, and 72 locations in Phase II). One traffic signal was installed at the intersection before Asuncion City Hall.



Source: JICA Study Team

Figure 10-4 Traffic Signal

(3) Center System

1) Emergency Security Center (911 Center)

- There are 648 CCTVs being monitored for security purposes.
- This 911 Center consists of Call Center Division, Dispatch Division, and Supervision/Monitoring Division, and is operated by 40 staff.
- Camera images are transmitted via wireless communication to the nearest police station. Information on the location of police cars can be determined, and location of patrol cars in three major cities can be confirmed.

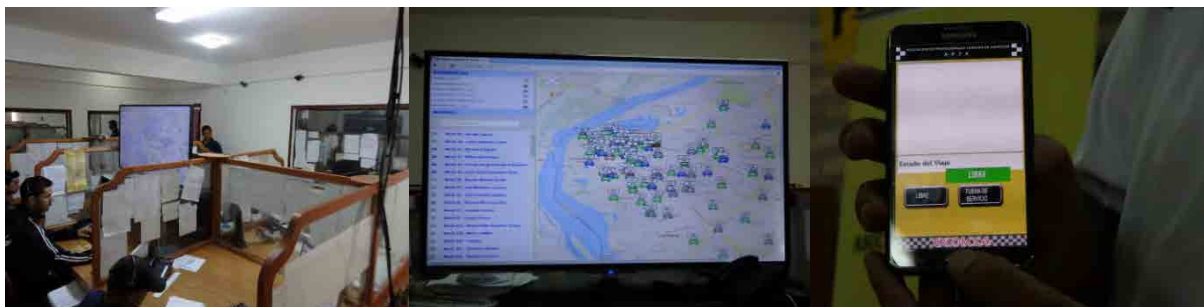


Source: JICA Study Team

Figure 10-5 911Center, CCTV Surveillance Video, and Police Car Location System

2) Taxi Dispatch System

- APTA uses taxi dispatch system. There are 150 out of a total of 1,329 taxis installed with global positioning system (GPS) units, which determine location information and operation situation.
- This system is developed by a domestic company, and the GPS units are made in China.
- The dispatch method is currently by radio, but a dispatch system by smartphone is being developed.



Source: JICA Study Team

Figure 10-6 Taxi Dispatch Center (APTA), Dispatch System, and Smartphone Application (Under Development)

3) Track Location System, Others

- NSA, which operates logistics, intercity buses and international buses, manages location information and operating situation (driving or stopping, etc.) for management of its vehicles and drivers.
- There are two types of bus service, first goes directly to the destination, and the other stops at each city before reaching the destination. Buses of the latter type are installed with cameras.
- The main purpose of camera surveillance is for security and for the anti-fraud related to toll collection of crew, and this camera records video inside the bus and of the driver.



Source: JICA Study Team

Figure 10-7 Truck Location System, Bus Service Information (at NSA), and Camera Surveillance System

10.1.4 PROCUREMENT SYSTEM OF ITS RELATED FACILITIES AND EQUIPMENTS

(1) Procurement System

The procurement system is by competition tendering.

(2) Contract Type and Role of Procurement Officer and Contractor

All public procurement is carried out following Law No. 2051. Direction Nacional de Contrataciones Publicas (DNCP) is responsible for organizing the bidding documents. After this, if construction is in Asuncion City, bidding documents will be sent to the City Council again, then

bidding information is advertised to the public through DNCP's website (www.dncp.gov.py) with the mayor's approval. Normally, more than eight to nine months is needed from the preparation of design documents until public notice. In case of international procurement, the contract method is according to arrangements at that time.

10.2 TREND OF OTHER DONORS

(1) KOICA Project

This project involves the development of a total of 150 signalized intersections and a traffic control center. The traffic signals are to be installed at intersections in six major roads. This project considers the bus rapid transit (BRT) project.

Table 10-2 Outline of the KOICA Project

	Phase I	Phase II
Traffic Control Center	Development of Phase I	
Traffic Signal	78 intersections	72 intersection
CCTV	6 locations	72 locations
VMS	6 locations	
Optic Fiber	80 km	

Source: JICA Study Team

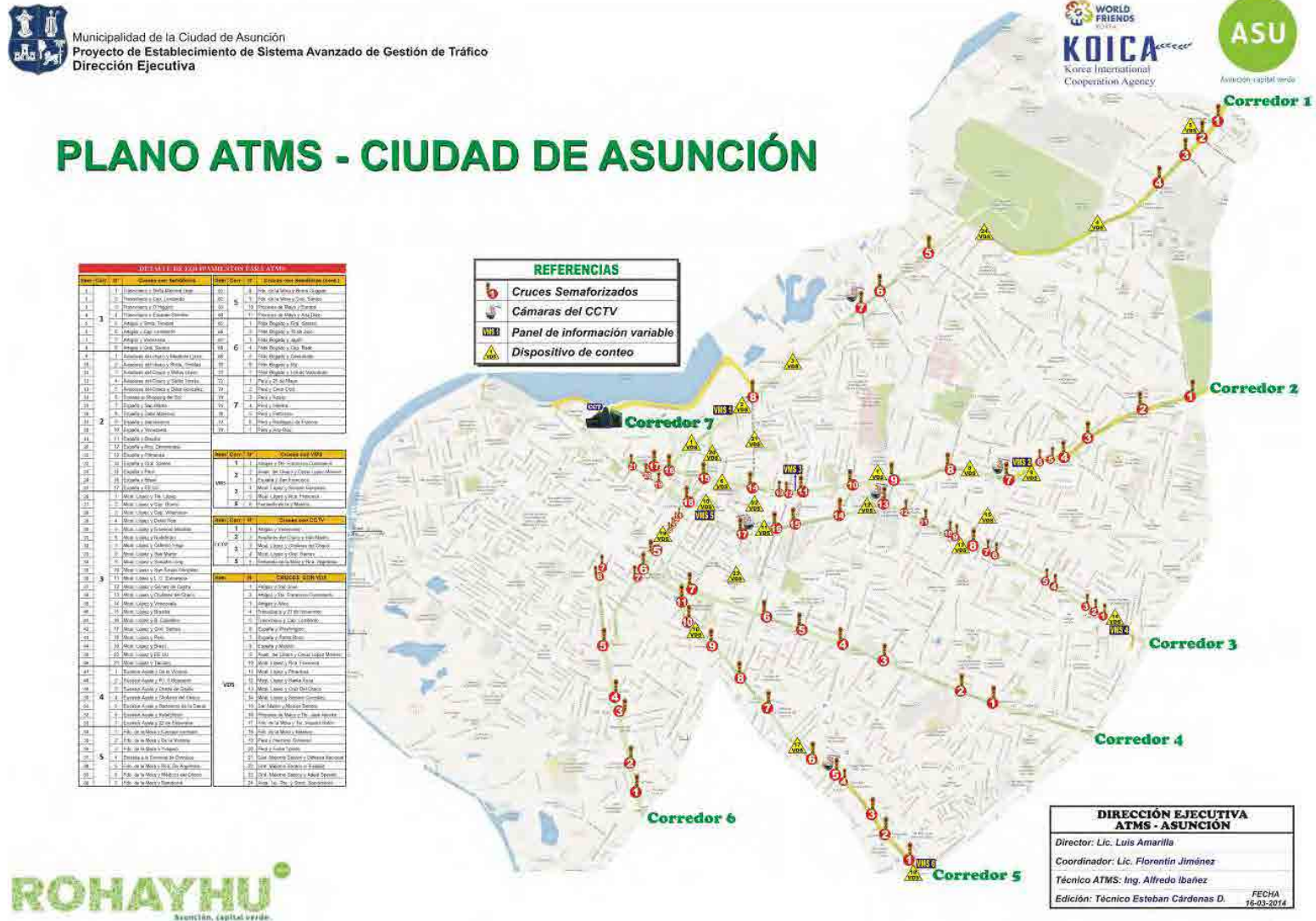
Signal system is controlled in accordance with the traffic volume, and vehicle detection system (VDS) is also installed. CCTV images can be seen on the homepage.

Installation of traffic signals in Phase I will be completed by January 2015, and the traffic control center is scheduled to start operation after its completion in February 2015. Installation of traffic signals in Phase II is estimated to be completed in June 2015. Budget from the Korean side is USD 5.3million, and budget from the city side is USD 2.5million. The location of the traffic control center is along Costanela Ave, and the building is currently under construction. The controller of the signal is made by TRACOM, a Korean company, and all equipment are made in Korea. CCTV system is planned to be connected with the 911 Center.



Source: JICA Study Team

Figure 10-8 Traffic Signal, Controller, and Traffic Control Center (inside building) by KOICA Grant Aid



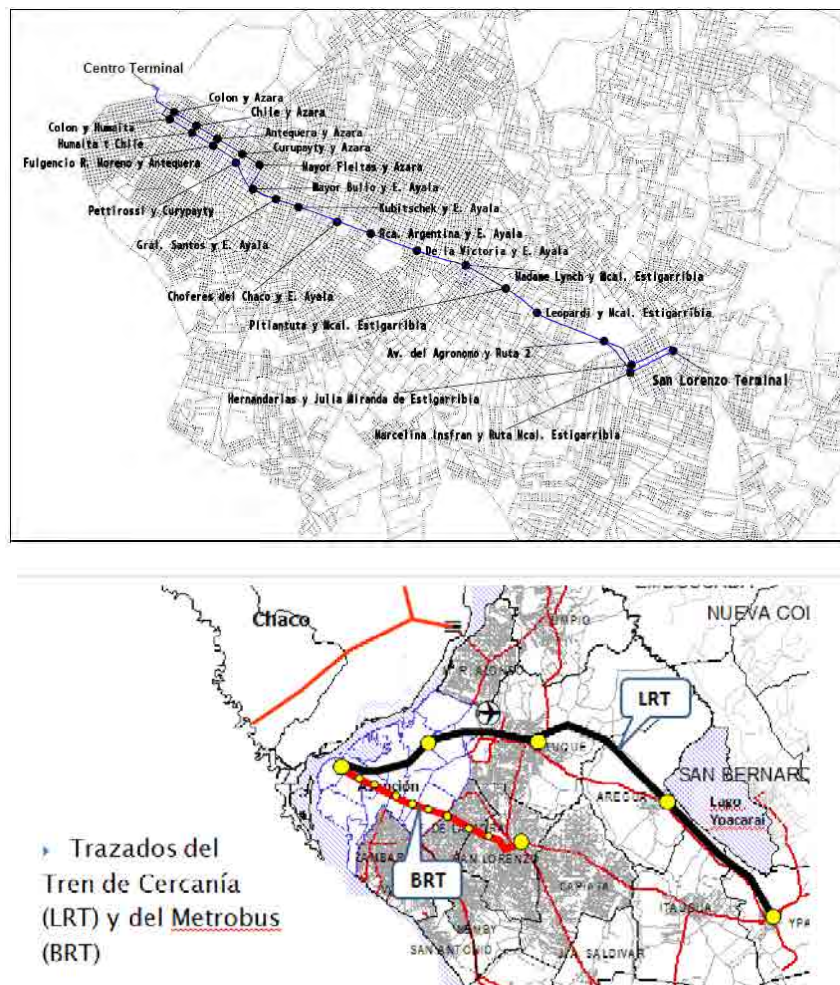
Source: Municipalidad de Asunción

Figure 10-9 Location of Traffic Signals, CCTV, VMS, and VDS (KOICA Project Phase 1)

(2) BRT and LRT

There is a development plan for BRT under assistance from the Inter-American Development Bank (IDB). The BRT route is planned from Asuncion Center to San Lorenzo. MOPC is responsible for this project (IDB: USD 115million, Banco de Desarrollo de América Latina (CAF): USD 35million, Paraguay: USD 55million). The length is 30 km, and it is planned to carry out the bidding in April 2015. There are two stages (Asuncion side and San Lorenzo side) of construction. The Asuncion side is scheduled to start construction in November 2015, and the San Lorenzo side is scheduled to carry out the bidding in October 2015 and to start construction in March 2016. Completion is scheduled by November 2017.

In addition, Ferrocarriles del Paraguay S.A. (FEPASA) has ordered the National University of Asuncion, Korea Rail Network Authority (KRNA) and Korea Transport Institute (KOTI), to carry out a feasibility study on high rail transit (LRT) construction and it is scheduled to be completed in June 2015. The LRT is planned to operate for 44 km from Asuncion to Ypakarai. Construction is planned to be implemented by build-operate-transfer (BOT), and it is scheduled to start construction in April 2015 by the project implementation company.



Source: MOPC

Figure 10-10 BRT and LRT Routes

10.3 SUGGESTION OF DIRECTION FOR ITS DEVELOPMENT

10.3.1 ITS MENUS TO BE INTRODUCED

(1) Consideration of ITS Development Phase

To develop a system that would introduce and utilize ITS is desirable because basic ITS equipment and facilities such as traffic signals, CCTV, traffic control center, etc., and BRT are planned to be developed in Asuncion. From the viewpoint of optimization of traffic management, introduction of equipment and system related to information collection and provision with priority are effective.

(2) Trend of Japanese Companies

The JICA Study Team interviewed the Japan Chamber of Commerce and Industry Paraguay about trends of Japanese companies in Paraguay.

- Paraguay's market is small, therefore Japanese companies in Paraguay are few. Currently the Japanese companies in Paraguay are Mitsubishi Corporation, NEC, Tsuneishi Shipbuilding Co.,Ltd., Fujikura and Yazaki. Sumitomo Wiring Systems, Ltd is planning to deploy to Paraguay. There had been seven trading companies in the past, but currently Mitsubishi Corporation is the only one.
- Since the domestic market is small, business in Paraguay has become overseas deployment aimed at business development toward the members of Mercosur, such as Brazil and Uruguay.
- The environment for hiring workers is better in Paraguay than in other South American countries.
- The Chamber of Commerce has 25 member companies, and it has been holding regular meetings once a month.
- Construction of a bypass for that would detour from the city should be promoted.
- Infrastructure development in suburban areas and traffic education should be promoted.

(3) Draft ITS Menus to be Introduced

ITS situation in Asuncion is as follows;

- KOICA has assisted the introduction of basic ITS equipment and traffic control center
- On the other hand, since information provision for traffic has not been considered yet

Based on this situation, draft ITS menus to be introduced are shown below.

- Information provision using probe car system.
- Introduction of bus location system, bus arrival information system, E-ticketing system
- Development of ITS master plan and ITS pilot project
- In addition, since the problem with street parking is also observed, there is a possibility to assist regarding introduction of parking information provision system and ITS for traffic safety as a countermeasure against traffic accidents.
- It is also conceivable to provide such information by digital broadcasting.

Also, although details of the following are not grasped in this study, it is assumed that there is also a possibility to assist in the introduction of vehicle detector, traffic information provision system, ETC, and weighbridge in intercity roads.

Table 10-3 Introduction Phase of ITS Menu, and Assumed Impacts of ITS

Introduction Possibility Period (assumed)	Name of the System	Expected Impact
Short	Basic information collection equipment, such as congestion situation monitoring system, full time traffic volume counting	(To be introduced by KOICA project) Congestion improvement and traffic situational awareness of urban areas
	CCTV monitoring system	(To be introduced by KOICA project) Congestion scale, situational awareness of the event of an accident, speeding the correspondence
	Signal optimization system	(To be introduced by KOICA project) Congestion improvement of surrounding route and congestion intersection by optimization of traffic flow
	Congestion information by road information boards and radio, etc., Information providing system such as route information	Congestion improvement by promoting traffic conversion by the route guidance
	Regulatory information providing system (by information boards, radio, car navigation systems, etc.)	Provides information passable route along with information from various sensors, and avoids the traffic stagnation
	Information integration between organizations	Efficiency and optimizing the sharing information by information integration of basic data, management, etc.
	Roadside equipment, Ledger DB	Collection of basic data, database
	Operation management, Operation status provision system (bus)	(Considering development of BRT) providing information of operation status to the user
	Public transportation priority signal system	Mitigation of service inhibition of public transport, improving convenience of punctuality securing of arrival and departure time
	Accident statistics database system	Understanding accident situation and accident types, Utilization as basic data for considering measures
	Traffic accident detection system	Rapid rescue of accident vehicle and users
	Traffic violation enforcement system (over speed, signal jumping, etc.)	Quick and labor-saving of violation vehicle identification
	The monitoring system by various sensors (weather meter (rainfall, road temperature), etc.)	Conducted user services such as route guidance information by providing information of closures and etc. to the road user by weather information
	Information terminal such as Car navigation system, Smartphone, WEB system, digital signage, etc.	Improvement of information services by expanding the information available methods
	The route guidance and information provision by car navigation system, WEB, etc.,	(Car navigation systems have been sold) Optimizing traffic flow by providing congestion information and regulations in advance
Expansion of information communication network of Telematics, 3G, etc.	Expansion of the information provision methods to the road user	
Middle	Maintenance operational efficiency systems, etc.	Support for the maintenance of Road, ITS facilities, etc., Cost savings
	Cashless transit system using the IC card	(Considering introduction) Improve user experience, reduction of waiting time in the ticket office, etc. (service improvement)
	Illegal parking enforcement system	Reduce the traffic inhibition due to parked vehicle by the illegal vehicle is reduced
	Parking investigation DB	By the understanding of the parking scale, utilized for study materials of expansion and maintenance of parking
	Parking situation information providing system	Guidance to the parking place, the reduction of illegal parking, reduction of traffic to look for parking (improvement of traffic flow)
	Public transportation transit search system	Improvement of user experience
	Other public transport information cooperation system	Improvement of transit convenience, Improved transfer efficiency by providing information of other transportation means selection
	Roads and structures ledger DB	Efficiency of road maintenance and repair by database
	Business support systems, etc.	Operational efficiency, Cost reduction
	Road information provision to the other agencies	Sharing road information by information integration
Long	Electronic system of vehicle passage application permission	Reduce labor costs of tollgate, congestion improvement due to a reduction queue length by permit waiting
	Reversible lane system	Optimization of traffic processing by the road users tailored to traffic conditions
	Various DB for the destination information provision	Implementation of information provision in conjunction with the needs of road users
	Cargo management system	Induction to the appropriate route based on the information of luggage of trucks, delivery location, etc., Efficiency of management
	Pedestrian priority signal system	Reduction of accidents by pedestrian priority, Rectification of the flow of people
	ERP	Conversion promotion of traffic due to the inflow regulation of vehicle, Congestion improvement, Reduction of accident
	ETC	(Considering introduction) Service improvement by simplification of payment, reduction of labor costs in tollgate, congestion improvement due to a reduction of queue length by permit waiting
	Automatic payment system for parking	Reduction of payment waiting queue and labor costs
	The traffic control system for vehicle alone or vehicle-to-vehicle, roadside-to-vehicle communication	Facilitation of movement by providing information and collection from the other vehicle
	Disaster information collection, sharing and providing system	Share of the movement, correspondence (road manager) and situation in an emergency by providing and collecting detailed information of the road such as in the event of a disaster
	Travel assistance system (tourist information provision)	Improve usability of the information providing service in tourist facilities, accommodation, etc.
	Automatic driving system for vehicle	Improve user experience
	Pedestrian support system (the disabilities, the elderly, etc.)	Improve safety and convenience of the move of the elderly, disabilities, etc.
	Vehicle control system (by roadside-to-vehicle communication and inter-vehicle communication)	Improve user safety
	Demand bus system	Improvement of transportation services by securing transportation mode and supporting for the elderly, etc.
Location information provision for the elderly, etc.	Reduction of accidents, improve user safety	
Already Introduced	The overload detection system by weigh in motion, etc.	(Weigh Bridge is already introduced) Avoid damage to the road by overloaded vehicles, reduction of maintenance costs

Priority High: Medium: Low:

Source: JICA Study Team

10.3.2 DIRECTION OF TECHNICAL AND FINANCIAL ASSISTANCE

The direction of technical and financial assistance is suggested as follows:

For the direction of ITS development assistance from Japan, the following are considered appropriate:

Short Term: Implementation of update of urban transportation management (urban and transportation planning, and ITS planning), introduction of traffic information provision system, and acceptance of trainees

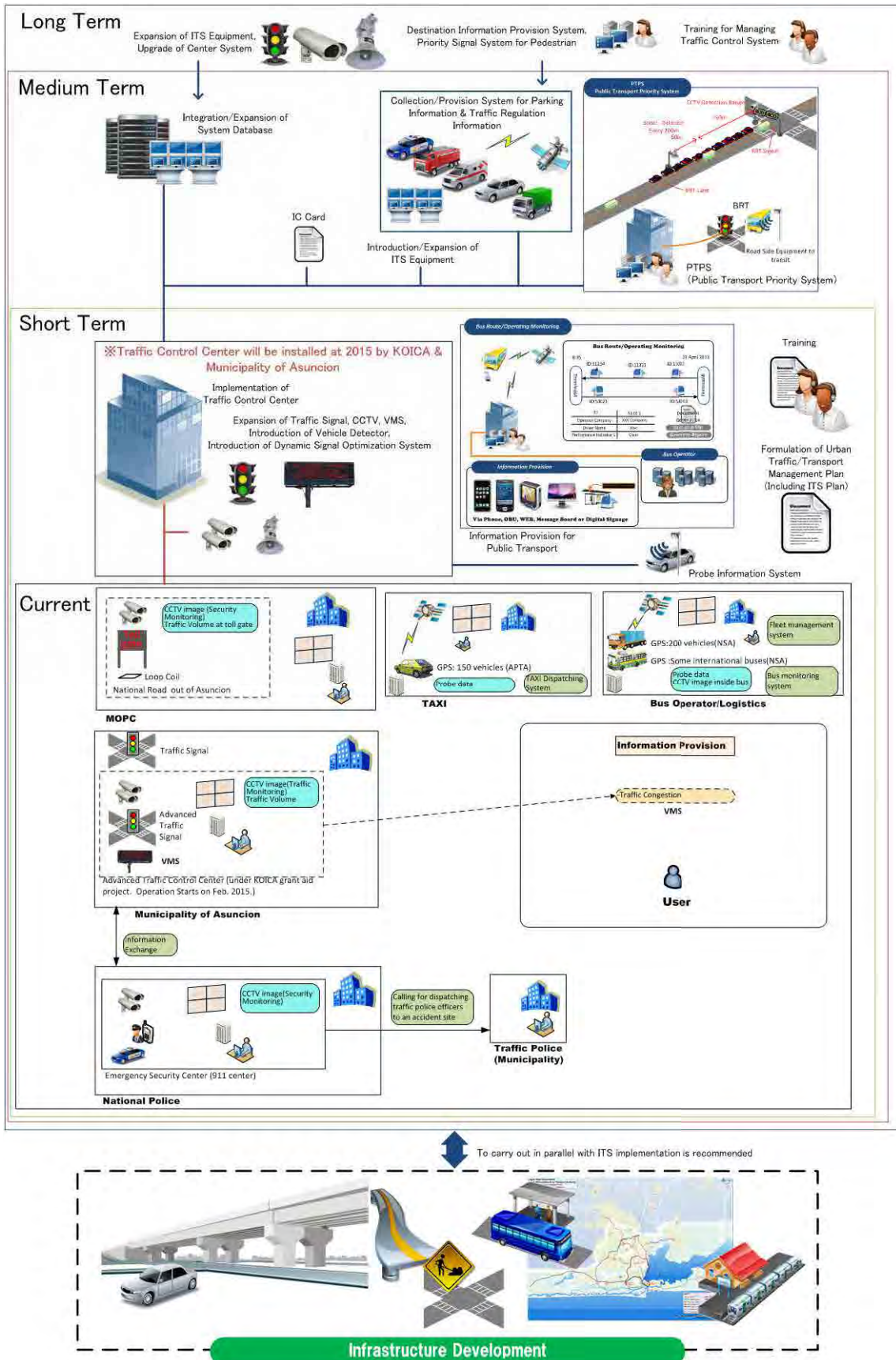
Medium and Long Term: Loan assistance for the development study on expansion of ITS introduction and implementation, technology education and dispatch of experts on highly-developed ITS

Attaining the synergistic effects of congestion improvement by infrastructure development and ITS is desirable by performing integrated infrastructure development, such as road and intersection improvement, and development of public transport (BRT/LRT). Although Japanese companies in Paraguay are few, assistance on ITS introduction is beneficial for improvement of safety and economic activities by solving congestion, and this would also help future Japanese companies advance and deploy overseas. In addition, depending on the outcome of the Korean aid for traffic control center development that is currently being carried out, there is the possibility of assistance to update the central system for the purpose of improving the technology and maintenance capacity of the traffic control center. Therefore, these trends require attention.

Table 10-4 Draft Direction of Technical and Financial Assistance

No	Type of Assistance	Objective
1	Technical Assistance: Training, implementation of pilot project and master plan, foundation of ITS organization Financial Assistance: Grant, technology from private sector	- Technical assistance and training related to traffic control system - Technical assistance for development of urban transportation management plan and implementation of pilot projects related to ITS, training in Japan - Introduction of ITS (congestion information, location information provision, etc.) - Foundation of integrated organization
2	Financial Assistance: Loan Technical Assistance: Dispatch of experts	- Dispatch of experts relating to traffic control system - Update of traffic control center system (depending on the situation) - Loan assistance for implementation of the ITS menu in the medium and long term

Source: JICA Study Team



Source: JICA Study Team

Figure 10-11 ITS Introduction Conceptual Diagram (Asuncion, Paraguay)

CHAPTER 11 REPUBLIC OF PERU

11.1.1 RELEVANT STAKEHOLDERS

The name, interview date, and overview of roles of each organization are shown in Table 11-1 below. Although many organizations at the national and city levels are responsible for planning and management, there are some concession companies that are responsible for road construction and maintenance, bus operation, etc.. In addition, the JICA Study Team interviewed Callao in this survey.

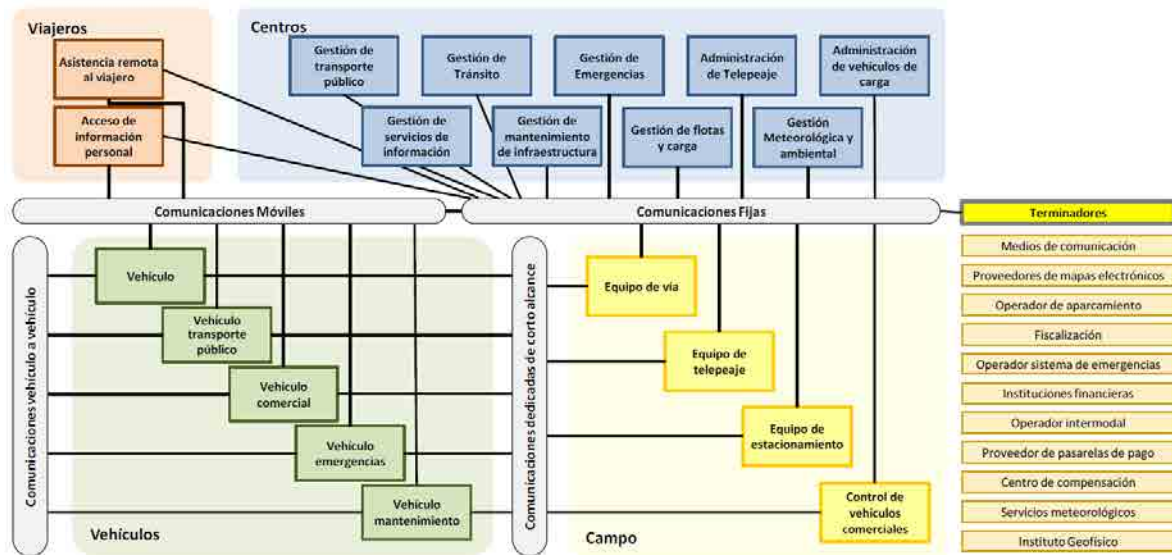
Table 11-1 Interview List

No	Organization Name	Level	Overview of Roles
1	PROTRANSPORTE	City	Management of BRT (Metropolitano)
2	Ministerio de Transporte y Comunicaciones (MTC)	National	Planning, monitoring, license approval, etc. related to the transportation and communications fields
3	Autonomous Authority Mass Transport Electric System of Lima and Callao, MTC	National	Planning, construction, operation, etc., related to electric transport system (metro, monorail, etc.)
4	Via Parque Rimac	Private	Concession company. Development, financing, management, operation, etc. of Amarilla Road
5	Municipalidad Metropolitana de Lima	City	Planning, design, construction, operation, maintenance, etc. related to the road transport sector
6	Instituto Metropolitano de Planificasion	City	Instructions, advice, evaluation, etc. related to the medium and long term development plan in the Lima metropolitan area
7	Transporte Terrestre, MTC	National	Maintenance and operation of roads, license approval, vehicle inspection, etc.
8	Rutas de Lima SAC	Private	Concession company. Development, financing, management, operation, etc. of Panamericana Road and other roads.
9	Policia Nacional de Peru, Director de Transito	National	Improvement of traffic flow, traffic management, enforcement (for traffic police)
10	Metropolitan Municipality of Callao	City	Management, operation, and enforcement of urban traffic/transportation
11	Zeta Taxi	Private	Operation and management of taxies
12	Cruz del Sur	Private	Operation and management of international and inter-city buses and logistics
13	Asociación Automotriz del Perú (AAP)	NPO	Issuance of license plate and third plate, etc. (in the ITS field)

Source: JICA Study Team

11.1.2 ITS ARCHITECTURE AND STANDARDIZATION AREA

The ITS master plan was formulated by the Ministerio de Transporte y Comunicaciones (MTC), and ITS architecture is also presented in the ITS master plan. However, only basic ITS services are detailed and specific implementation methods are not specified in the master plan. Also, there are no ITS standards described.

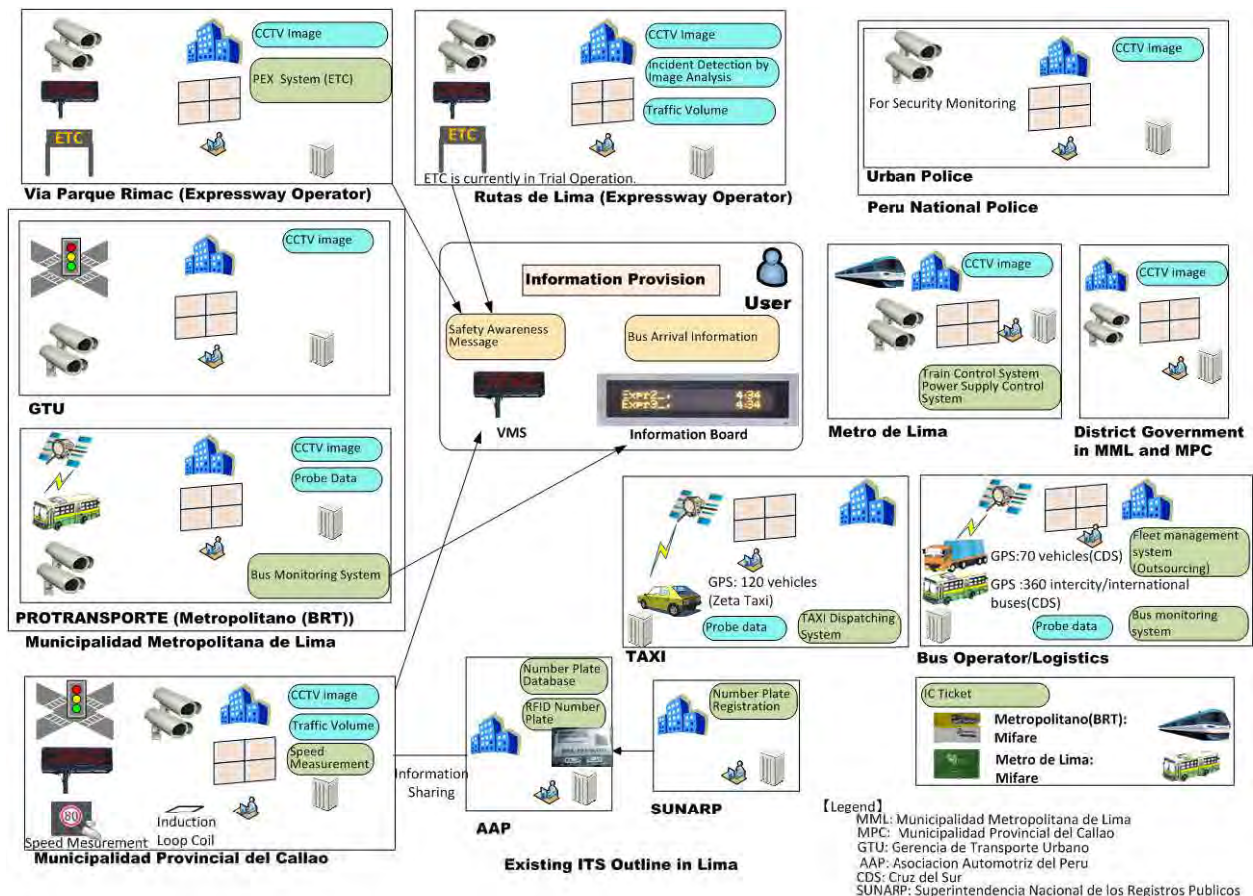


Source: Desarrollo de la Arquitectura y Plan de Sistemas Inteligentes de Transporte (ITS) de Perú

Figure 11-1 ITS Architecture

11.1.1 EXISTING ITS RELATED FACILITIES AND EQUIPMENTS

A diagram of the overall system of existing ITS-related facilities and equipment in Lima is shown in Figure 11-2 below. Traffic signals are installed, managed and operated by Lima municipality or each ward, and electronic toll collection (ETC) is operated by road concessionaire. In addition, CCTV is used for security monitoring purposes, and CCTVs have been installed by Lima municipality, each ward, and the National Police. However, these ITS equipment and systems have been introduced separately, and there is no uniformity in the system. In Callao, traffic management has been conducted by a concession company, which installed, manage and operate the ITS equipment and system.



Source: JICA Study Team

Figure 11-2 Existing ITS Facilities and Equipment - Overall System Diagram

- (1) Collection System Equipment
 - 1) CCTV
 - CCTVs were installed by Lima Municipality, wards and urban police for security monitoring. Some were installed by concession companies. Some CCTVs are not working.
 - 2) Speed Sensor
 - Speed sensor is installed by Miraflores Ward as an experiment.



Source: JICA Study Team

Figure 11-3 CCTV and Speed Sensor

3) ETC and Toll Booth

- There is a toll booth on the concession road, and ETC is installed Via Parque Rimac(VPR) and Rutas de Lima (RdL). ETC utilizes different IC tags for each concession, and both ETC systems are not compatible with each other. *VPRs ETC system is called PEX.
- Although discussions about the compatibility of ETC systems have been carried out, there are no specific goals yet to be realized.



Toll Booth (VPR)

PEX lane (VPR)

Toll Booth (RdL)

PEX Tag (VPR)

Source: JICA Study Team

Figure 11-4 Toll Booth and ETC

4) IC Card

- IC cards have been introduced by Metropolitano and Metro de Lima (Line 1). Although both card types are by Mifare, they can not be used for the other. For the metro, it is planned to use a common card for Line 1 and Line 2, which is to be developed in the future.
- Although integration of IC cards between Metropolitano and Metro de Lima is technically possible, there are some problems because they are currently operated by different companies. MTC has commissioned a study by a Spanish consulting firm (IDOM) about the use of a common IC card.



Source: JICA Study Team

Figure 11-5 IC Card (left: Metro, right: Metropolitano)

5) Vehicle Registration Information

- MTC has commissioned the issuance of license plates to AAP. License plates are currently shifting to the use of a third number plates, and the issuance of such to public transportation vehicles has been completed. It is scheduled to issue the third number plates to private cars and motorcycles.
- The third number plate is recorded with a tag ID, and it is possible to know the information of the vehicle owner through the vehicle information database owned by APP. Some functions of this system include identifying violations and utilization for traffic-related services.



Source: JICA Study Team

Figure 11-6 The Third Number Plate (left) and Antenna (right)

6) GPS System (Bus, Taxi, Truck, etc)

- There are 600 Metropolitan buses in operation, and there are GPS units installed in each bus.
- For Zeta Taxi, all their taxies have a smartphone with GPS for determining location information. Operation information are shared using smartphone.
- For Cruz del Sur, which operates long-distance buses, their buses and trucks are installed with GPS units, which are used for managing location information and operation information.
- Road concession companies have installed GPS in their patrol cars for determining location information.

(2) Provision System Equipment

1) Traffic Signal

- According to the law, the municipality is responsible for installing traffic signals. However, the wards actually have installed the traffic signals through an agreement with the municipality.
- There are 1,500 traffic signals installed at intersections in the city. However, information on them are not shared with the municipality and wards, and there are no standards on traffic signals.

2) VMS

- Road concession companies own VMS to broadcast reminders on traffic safety (fastening of seat belts, drunk driving warning, etc.).



Source: JICA Study Team

Figure 11-7 Traffic Signal and VMS

3) Others

- Information on traffic congestion is broadcast by private radio stations.
- Operational information are provided at private and Metropolitano bus terminals
- Google and Waze (smartphone applications) are commonly used for understanding the congestion situation.



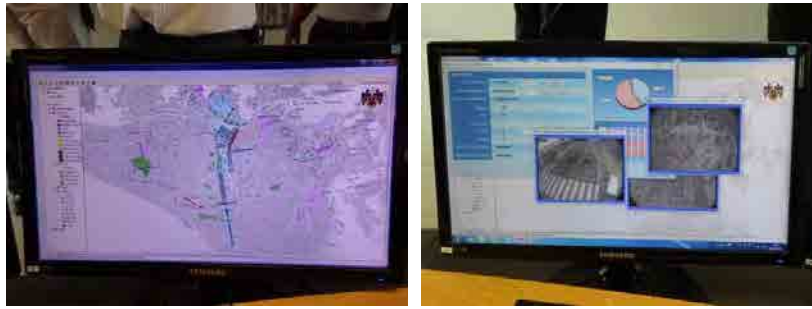
Source: JICA Study Team

Figure 11-8 Bus Information Provision (left: Metropolitano, right: Private Bus Terminal)

(3) Center System

1) Traffic Control Center

- Management and control of signal cycle is conducted for 364 signalized intersections of total 1,500 signalized intersections. Seventy-five of the signalized intersections are located along Metropolitano's route.
- Signal cycle at 15 intersections has been adjusted so that buses can pass preferentially, but it is not automatically adjusted. Forty-eight signal intersections are connected by wireless communication, and others are connected by fiber optics.
- CCTV is used for determining traffic volume by lane, and real-time signal management is conducted at two locations.
- The system of traffic control center has been introduced by SICE Inc. (Spain).



Source: JICA Study Team

Figure 11-9 Signal Management Area by Lima Municipality (left) and Camera System (right)

2) Public Transport Operation Center (Metropolitano)

- Operation is conducted for 24 hours and in three shifts. Bus operation management is conducted by video surveillance and location information system, and PROTRANSPORTE issues instructions to each bus concession company about bus operations from this center. If some problem occurs, they check the situation using the camera, and then contacts the police as needed. In addition, representatives of each company are stationed in the center.
- Information from the GPS unit installed in each bus are communicated using general packet radio service (GPRS). Stations on main routes and the center are connected by fiber optic.
- The bus location system displays all bus operating information. The system has been introduced by ACS Inc. (France). Bus rapid transit (BRT) monitoring system was introduced by SICE, Inc (Spain) and SUTEC Inc. (Argentina)



Source: JICA Study Team

Figure 11-10 Metropolitan Operation Center (left), Operating (middle), and CCTV Surveillance

3) Metro Operation Center (Line 1 Control Center)

- This center is located near the south endpoint station (Villa El Salvador Station). Vehicle operation and power supply are being monitored and controlled at this center. The train operation system is made by Bombardier (Canada), and the power supply system is made by SIEMENS (Germany).
- Automatic train protection (ATP) is installed as a safety device
- Seven to eight CCTVs are installed in each station, and all video footages from the 26 CCTVs are collected by the Line 1 Control Center through fiber optics.
- This center is able to contact train drivers by wireless communication, and it is possible to announce information to the stations.



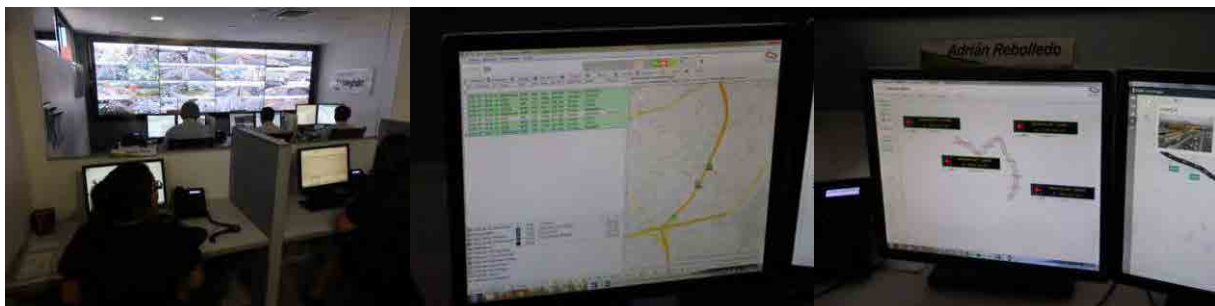
Source: JICA Study Team

Figure 11-11 Line 1 Control Center (left) and Rail Yard (right)

4) Road Concessionaire

■ Via Parque Rimac (VPR)

- VPR is a road concessionaire which manages Amarilla Road, and they monitored their CCTV from their central de control de operaciones (CCO). They can input text for four VMSs which are installed on their road from the CCO.
- They conduct dispatch of service car/patrol car/towing car, reporting to the police, and collection of location information of the service car/patrol car/towing car through mobile application, phone call, and GPS. The system is called KCOR (KRIA Tecnologia, Inc. of Brazil)



Source: JICA Study Team

Figure 11-12 CCO (left), Location Information (middle), and VMS Control (right)

■ Rutas de Lima (RdL)

- RdL is a concession company under ODEBRECHT (Brazil), and they manage three lines (Panamericana Norte, Panamericana Sur and Ramiro Priale).
- Thirty-one traffic control cameras (none dome type, and the remaining are automatic surveillance and traffic monitoring cameras) are installed on their road, and are being monitored from their CCO. The cameras are made by Pelco (USA). Four VMSs are installed at Panamericana Norte and Panamericana Sur each, and the text shown by these VMS are input from the CCO.
- CCTV, VMS, and their control systems were introduced by Schneider Electric (France).



Source: JICA Study Team

Figure 11-13 CCO

5) Others

- The National Police (urban police) has their CCO for security purpose. They monitor the security situation and traffic situation. Information collected at the CCO are shared with the police officers. However, information provision to Lima Municipality is not performed.
- Some wards have small traffic control centers.

11.1.2 PROCUREMENT SYSTEM OF ITS RELATED FACILITIES AND EQUIPMENTS

(1) Procurement System

The procurement system is by build-operate-transfer (BOT) or lump-sum contract.

(2) Contract Type and Role of Ordering Person and Contractor

Relevant organizations, such as national organizations and the municipality, entrust the ordering to the contractor. Development, management, administration, and financial planning are conducted by the private sector.

11.2 TREND OF OTHER DONORS

The ITS master plan is developed through IDB assistance. Operation of some roads, BRT, metro, etc. are entrusted to private companies. In the interview with MTC, they said that a new authority for mass transportation and ITS is needed for coordination with the national, municipal and ward governments. In addition, they said that two consulting firms have studied the establishment of such authority (order from MTC), and this study has considered functional and legal aspects. The functional aspects study is completed.

11.3 SUGGESTION OF DIRECTION FOR ITS DEVELOPMENT

11.3.1 ITS MENUS TO BE INTRODUCED

(1) Consideration of ITS Development Phase

ITS equipment and systems for improvement of traffic congestion should be developed preferentially because Lima is under the situation of increasing traffic congestion. From the viewpoint of optimization of traffic management, expansion of signal systems and installation of equipment / system related to information collection and provision with priority are effective. However, the

unification of the system by information integration between organizations is required the most. In addition, the ITS measures for public transportation which are planned to be extended in the future will also be effective.

(2) Trend of Japanese Companies

JICA Study Team interviewed a Japanese company in Peru about the trends of Japanese companies in Peru. The following is a summary of the interview:

- One problem is that there are no ITS standards. Each stakeholder is promoting their own development in Lima.
- Information handling is required to protect privacy sufficiently.
- Peru has continued economic growth, and has a budget. However, effective infrastructure development is not conducted because the technical capability of the National Public Service is insufficient. Donors such as JICA should consider assistance for the development of a master plan related to infrastructure development.
- Seminars that would introduce Japanese technology are effective.
- Peru has a preferable environment for deploying foreign companies.

(3) Draft ITS Menus to be Introduced

ITS situation in Asuncion is as follows;

- There are many ITS equipment and facilities in Lima
- Development of ITS master plan, introduction of ETC, upgrading of traffic control center, etc. are considered by Lima municipal and national organizations.
- On the other hand, ITS in Lima is introduced individually, and there are many issues such as no information sharing, introduction of different systems, lack of ITS standards, and no coordination between stakeholders.

Therefore it is assumed to interfere with information integration and collaboration for ITS (for example, poor signal management, issuance of IC cards for each transportation route, and various frequencies related to ITS).

The entry of Japanese companies for the introduction of basic ITS equipment is assumed difficult at the moment because there are already many basic ITS equipment and systems in Lima. However, with regard to public transport (Metroplitano), since PROTRANSPORTE requires further efficiency of public transport. Based on this situation, draft ITS menus to be introduced are shown below.

- Introduction of public transport priority system (PTPS)
- Traffic information provision by probe car system
- Introduction of common IC card system
- Development of ITS master plan
- Strengthening of traffic management capability and coordination of organization, ITS standardization related to traffic, and information sharing are also effective.

Table 11-2 Introduction Phase of ITS Menu, and Assumed Impacts of ITS

Introduction Possibility Period (assumed)	Name of the System	Expected Impact
Short	Basic information collection equipment, such as congestion situation monitoring system, full time traffic volume counting system, etc.	Congestion improvement and traffic situational awareness of urban areas
	CCTV monitoring system	(For traffic monitoring) Congestion scale, situational awareness of the event of an accident, speeding the correspondence
	Signal optimization system	Congestion improvement of surrounding route and congestion intersection by optimization of traffic flow
	Congestion information by road information boards and radio, etc., Information providing system such as route information	Congestion improvement by promoting traffic conversion by the route guidance
	Regulatory information providing system (by information boards, radio, car navigation systems, etc.)	Provides information passable route along with information from various sensors, and avoids the traffic stagnation
	Information integration between organizations	Efficiency and optimizing the sharing information by information integration of basic data, management, etc.
	Roadside equipment, Ledger DB	Collection of basic data, database
	Operation management, Operation status provision system (bus)	(Operation management is conducted but information provision is not conducted) providing information of operation status to the user
	Public transportation priority signal system	Mitigation of service inhibition of public transport, improving convenience of punctuality securing of arrival and departure time
	Accident statistics database system	Understanding accident situation and accident types, Utilization as basic data for considering measures
	Traffic accident detection system	Rapid rescue of accident vehicle and users
	Traffic violation enforcement system (over speed, signal jumping, etc.)	(Experiment is conducted in a part of Lima) with some of Lima) Quick and labor-saving of violation vehicle identification
	The monitoring system by various sensors (weather meter (rainfall, road temperature), etc.)	Conducted user services such as route guidance information by providing information of closures and etc. to the road user by weather information
	Information terminal such as Car navigation system, Smartphone, WEB system, digital signage, etc.	Improvement of information services by expanding the information available methods
Middle	The route guidance and information provision by car navigation system, WEB, etc.,	(Car navigation systems have been sold) Optimizing traffic flow by providing congestion information and regulations in advance
	Expansion of information communication network of Telematics, 3G, etc.	Expansion of the information provision methods to the road user
	Operation management, Operation status provision system (bus)	(Considering development of BRT) Efficiency of management, Service improvement by providing information of operation status to the user
	Illegal parking enforcement system	Reduce the traffic inhibition due to parked vehicle by the illegal vehicle is reduced
	Public transportation transit search system	Improvement of user experience
	Other public transport information cooperation system	Improvement of transit convenience, Improved transfer efficiency by providing information of other transportation means selection
	Parking investigation DB	By the understanding of the parking scale, utilized for study materials of expansion and maintenance of parking
	Parking situation information providing system	Guidance to the parking place, the reduction of illegal parking, reduction of traffic to look for parking (improvement of traffic flow)
	Roads and structures ledger DB	Efficiency of road maintenance and repair by database
	Business support systems, etc.	Operational efficiency, Cost reduction
Long	Road information provision to the other agencies	Sharing road information by information integration
	Automatic payment system for parking	Reduction of payment waiting queue and labor costs
	Electronic system of vehicle passage application permission	Reduce labor costs of tollgate, congestion improvement due to a reduction queue length by permit waiting
	Reversible lane system	Optimization of traffic processing by the road users tailored to traffic conditions
	Various DB for the destination information provision	Implementation of information provision in conjunction with the needs of road users
	Cargo management system	Induction to the appropriate route based on the information of luggage of trucks, delivery location, etc., Efficiency of management
	Pedestrian priority signal system	Reduction of accidents by pedestrian priority, Rectification of the flow of people
	ERP	Conversion promotion of traffic due to the inflow regulation of vehicle, Congestion improvement, Reduction of accident
	The overload detection system by weigh in motion, etc.	(Rutas de Lima has Weigh Bridge) Avoid damage to the road by overloaded vehicles, reduction of maintenance costs
	The traffic control system for vehicle alone or vehicle-to-vehicle, roadside-to-vehicle communication	Facilitation of movement by providing information and collection from the other vehicle
	Disaster information collection, sharing and providing system	Share of the movement, correspondence (road manager) and situation in an emergency by providing and collecting detailed information of the road such as in the event of a disaster
	Travel assistance system (tourist information provision)	Improve usability of the information providing service in tourist facilities, accommodation, etc.
	Automatic driving system for vehicle	Improve user experience
	Pedestrian support system (the disabilities, the elderly, etc.)	Improve safety and convenience of the move of the elderly, disabilities, etc.
Already Introduced	Vehicle control system (by roadside-to-vehicle communication and inter-vehicle communication)	Improve user safety
	Demand bus system	Improvement of transportation services by securing transportation mode and supporting for the elderly, etc.
Already Introduced	Location information provision for the elderly, etc.	Reduction of accidents, improve user safety
	Cashless transit system using the IC card	(Considering introduction) Improve user experience, reduction of waiting time in the ticket office, etc. (service improvement)
	ETC	(Road concessionair is introduced) Service improvement by simplification of payment, reduction of labor costs in tollgate, congestion improvement due to a reduction of queue length by permit waiting

Priority High: Medium: Low:

Source: JICA Study Team

11.3.2 DIRECTION OF TECHNICAL AND FINANCIAL ASSISTANCE

The direction of technical and financial assistance is suggested as follows:

For the direction of ITS development assistance from Japan, the following are considered appropriate:

Short Term: PTPS, ITS master plan study in conjunction with introduction and upgrading of individual system such as congestion information provision, technical education on traffic management, and acceptance of trainees

Medium Term: Expansion and integration of ITS related systems (required national ITS standards)

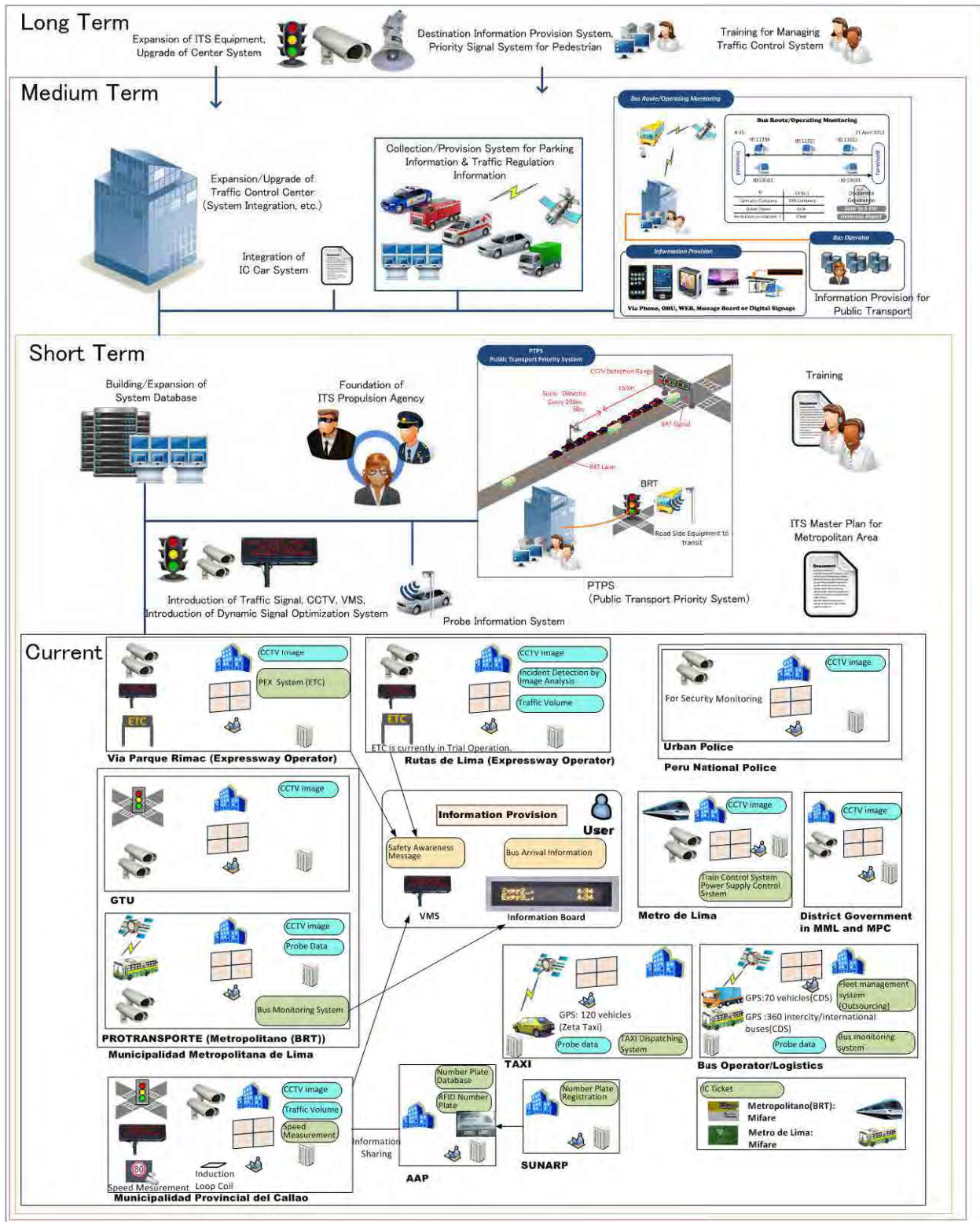
Long Term: Loan assistance for the development study on expansion of ITS introduction and implementation, technology education and dispatch of experts on highly-developed ITS

To attain the effects of ITS synergistic congestion improvement, it is desirable to conduct such assistance in conjunction with road and intersection improvement projects and public transport development. Although Japanese companies in Peru are few, assistance on ITS introduction is beneficial for improvement of safety and economic activities by solving congestion, and this also helps Japanese companies to advance and deploy overseas in the future.

Table 11-3 Draft Direction of Technical and Financial Assistance

No	Type of Assistance	Objective
1	Technical Assistance: Training, formulation of M/P, foundation of ITS organization Financial Assistance: Grant	- Training related to traffic management - Formulation of ITS master plan - Foundation of integrated organization - Expansion of ITS (PTPS, congestion information, etc.)
2	Financial Assistance: Loan Technical Assistance: Dispatch of experts	- Dispatch of experts relating to traffic control system - Loan assistance for implementation of the ITS menu in the medium and long terms

Source: JICA Study Team



Source: JICA Study Team

Figure 11-14 ITS Introduction Conceptual Diagram (Lima, Peru)

CHAPTER 12 ITS OVERVIEW COMPARISON AND SUMMARY

12.1 SUMMARY AND COMPARISON OF ITS INTRODUCTION SITUATION IN THE SURVEYED COUNTRIES/CITIES

For this study, the JICA Study Team surveyed urban areas in Vietnam, Thailand, Pakistan, Malaysia, Nigeria, Zambia, Paraguay, and Peru, and understood the ITS introduction situation of each city. Based on the survey results, the direction of future ITS introduction has summarized in matrix form. The matrix is shown as Table 12-1 below.

All the surveyed countries have basic ITS equipment such as traffic signals, CCTV, and some of them have a traffic control center and CCTV monitoring center. Although some cities have an ITS master plan or ITS architecture, almost all countries do not have ITS standards. In addition, ITS equipment have been installed in some countries without having an ITS master plan. Since ITS equipment are installed individually and systems are also not integrated in some cities, there is a possibility that integrations will become difficult, if this situation is continued in the future.

Table 12-1 ITS Overview Matrix

Category	Country	Transport Master Plan		ITS Master Plan		Enabling ITS Facility		ITS Standardization (Reference: ISO TC204)											Future ITS Assistance Detection					
		Road Plan	Mass Tra	Architecture	M.P	Inner City	Express Way	Architecture	ITS Database Technology	Automatic Vehicle and Equipment Identification	Fee and toll Collection	General Fleet management and Commercial/Freight	Public Transport/emergency	Integrated Transport Information, Management and Control	Traveler Information Systems	Vehicle/Roadway Warning and Control Systems	Dedicated Short Range Communications	Wide Area Communications/Protocols and interfaces		Nomadic Devices in ITS Systems				
4	Korea			*National ITS Master Plan for the 21st Century	*National ITS Master Plan for the 21st Century *Intelligent Transport Systems in Korea	*Public transportation ITS *Road management, traffic management control *Vehicle ITS	Highway ITS, ETC	*Korea ITS Standard (MOCT) *Korea Information and Communication Standard (MIC) *Korea Standard (MOCTE)														*Deployment of ITS in the public and private sectors		
	Japan	*National road network plan *City road plan	*Maintenance of Shinkansen line: Nationwide Shinkansen Railway Development Law *Rail bying law *City subway, monorail, etc. Development Plan	ITS Architecture, 1999	*The concept of Intelligent Transport Systems Promotion	*Expressway control *Public transportation ITS *Road management, traffic management control *Vehicle ITS etc.,	*Expressway ITS ETC, CCTV,VMS etc.,	*ITS Architecture, 1999 *Road communication standard	*National digital road map database standard DRM21															
	Singapore	*LT Master Plan	*LT Master Plan		*ITS MASTER PLAN	*GLIDE-SCATS Based-transport (System Integration) *ITS Centre *ERP *EZ BNK	*VMS																*Consideration of ERP2.0 taking into account the landscape	
	U.S.	Development plan by each state, etc.	*1992-1996年年度 ISTEA USDOT *1998-2003年年度 TEA-21 USDOT *2005-2009年年度 SAFETY LE	*2012年 National Intelligent Transportation System (ITS) Architecture Version 7 (US DOT)	*ITS Strategic Research Plan 2010-2014 USDOT RITA	*Expressway control *Public transportation ITS *Road management, traffic management control *Vehicle ITS etc.,	*Expressway ITS ETC, CCTV,VMS etc.,	*2012年 National Intelligent Transportation System (ITS) Architecture Version 7 (US DOT)	*5.8GHz DSRC/WAVE *Wireless LAN, 3G/4G		*915MHz band DSRC													
	EU	Development plan by each state, etc.	*TEN-T (Trans European Transport Network) EC	*FRAME Architecture (Version 4.1)	*eSafety Initiative EC, 2002 *Action Plan for the Deployment of ITS in Europe EC, 2008	*Expressway control *Public transportation ITS *Road management, traffic management control *Automotive system ITS, etc.	*Expressway ITS ETC, CCTV,VMS etc.,	*FRAME Architecture (Version 4.1)																*Focus to large-scale field test with the aim of actual deployment
3	Malaysia	Kuala Lumpur Structure Plan	Kuala Lumpur Structure Plan	*Development of ITS System Architecture for Malaysia	*ITS Master Plan Study for Malaysia *ITS Strategic Plan for Malaysia	*ITS (CCTV, Speed Sensor, etc.) *SMART *Parking Information System *Signal Control System	*PLUS Express way control *Tropic's Go	only outline															*Technical support such as education and training to the introduction of ITS, joint research	
	Thailand	*Planning in each city-based	*Mass Rapid Transit Master Plan in Bangkok Metropolitan Region *M-MAP/Bangkok	*Details are unknown	*ITS Master Plan	*Urban traffic control *Public transportation ITS *Car Parking Management *Road management, traffic management control	*Expressway ITS ETC, CCTV,VMS etc.,	*Details are unknown	*Details are unknown	*Details are unknown	*Details are unknown	*Details are unknown	*Details are unknown	*Details are unknown	*Details are unknown	*Details are unknown	*Details are unknown	*Details are unknown	*Details are unknown	*Details are unknown	*Details are unknown	*Details are unknown	*Technical support such as education and training to the introduction of ITS, joint research	
	Peru	*Master plan for urban Transportation in Lima-Callao metropolitan area (PMTU-2025), 2005	*Metro rail network plan in metropolitan area, 2010	*Desarrollo de la Arquitectura y Plan de Sistemas Inteligentes de Transporte (ITS) de Perú	*Desarrollo de la Arquitectura y Plan de Sistemas Inteligentes de Transporte (ITS) de Perú	*Signal control system *CCTV Monitoring *Control Traffic Signal, CCTV *IC card	*ETC/PEX etc., (road concessionaire)	*service content only																*PTPS, the introduction of individual systems, such as providing traffic information *ITS Master Plan *Technical education related to traffic management *Acceptance of trainees
	Turkey	*Integrated Urban Transportation Master Plan for Istanbul Metropolitan Area in The Republic of Turkey (IACA)	*Integrated Urban Transportation Master Plan for Istanbul Metropolitan Area in The Republic of Turkey (IACA)			*Signal control system *Microwave sensors *Camera	*CCTV monitoring system *Car detection system																	*Development of the national ITS Master Plan
	Brazil	*PDTU/RMRJ *PDTU/DF	*PDTU/RMRJ *PDTU/DF			*Urban traffic control *Road management, traffic management control *Public transportation ITS etc.,	*Expressway ITS ETC, CCTV,VMS etc.,																	*5.8GHz Passive (CEN), but there is no unified standard
2	China				*Developed in State and city	*Expressway control *Urban Traffic Information Center *Public transportation ITS *Road management, traffic management control *Automotive system ITS, etc.	*Expressway ITS ETC, CCTV,VMS etc.,																*Promotion of large-scale ITS projects	
	Mongolia	*National transportation strategy	*National transportation strategy			*Traffic Control Center *Traffic Police CCTV Monitoring Room																	Development of ITS Master Plan *Technical education	
	Urbekestan																						Development of ITS Master Plan *Technical education	
	Kenya	*Integrated National Transport Policy	*Integrated National Transport Policy			*CCTV (Private Access Kenya) *Traffic Police Control Center																	Development of ITS Master Plan *Technical education	
	Vietnam	*VITRANSSE *The Hanoi Capital Construction Master Plan to 2030 and vision to 2050 (for Subway)	*Master Plan for Vietnam's railway towards 2020 *The Hanoi Capital Construction Master Plan to 2030 and vision to 2050 (for Subway)	*Prepared by JICA only for Expressway	*Prepared by JICA in VITRANSSE only for Expressway	*CCTV Monitoring Room *Ho Chi Minh City Planned for Improvement of Traffic Control Center	*Expressway ITS, ETC	*Under developing	*Under developing	*Under developing	*Under developing	*Under developing	*Under developing	*Under developing	*Under developing	*Under developing	*Under developing	*Under developing	*Under developing	*Under developing	*Under developing	*Under developing	*Under developing	equipment procurement in update the time *Technical education
1	Paraguay	*Urban transportation development plan in Asuncion metropolitan area (IACA)	*Urban transportation development plan in Asuncion metropolitan area (IACA)			*Emergency Security Center(Police) *Basic equipment (traffic signal, CCTV)																	*Urban traffic management (urban and transportation planning -ITS Plan) *Deployment of Traffic information provision system *Acceptance of trainees, dispatch of experts	
	Philippines				Under Preparation *Mega Manila Region Highway Network Intelligent Transport System Integration Project (IACA)	*Signal system depend on traffic volume	*ETC																*Development of ITS Master Plan *Establishment of ITS Philippines	
	Indonesia				Perencanaan Pengembangan IT untuk Kecepatan Laju Jalan Perkotaan (JABODETABEK ITS MASTER PLAN: only for expressway	*Urban traffic control *Road management, traffic management control etc.	*Expressway ITS ETC, CCTV,VMS etc.,																	
	India	*National Highway Development Plan			Under Preparation- HYD ITS Master Plan	*Traffic Police Control Center *BRT Control Center																		
	Laos PDR	*Urban Development Master Plan project in/Vientiane capital (IACA) *Survey for comprehensive urban transportation plan in/Vientiane capital (IACA)	*Urban Development Master Plan project in/Vientiane capital (IACA)			*Traffic Police CCTV Control Center *Traffic Light Control Center																		Development of ITS Master Plan *Introduction of basic ITS facilities *Technical education
1	Cambodia	*Urban Master Plan Phnom Penh Capital City for 2020	*Study for Transportation Plan in Phnom Penh Capital City (IACA)			*Traffic Police CCTV Monitoring Room *CCTV Control Center *CCTV (Private/EZECOM) *Taxi GPS (Taxi Company)																	Development of ITS Master Plan *Introduction of basic ITS facilities *Technical education	
	Pakistan	*The Study for Karachi Transportation Improvement Project in The Islamic Republic of Pakistan (KTIPI) (IACA)	*The Study for Karachi Transportation Improvement Project in The Islamic Republic of Pakistan (KTIPI) (IACA)			*CCTV Monitoring Center (KMC, Traffic Police)	*e-Tag(RFID)																Development of ITS Master Plan *Signal system introduced assistant and technical education *R & D support	
	Zambia	*The Study on Comprehensive Urban Development Plan for the City of Lusaka in the Republic of Zambia (IACA) *Link Zambia 8000 Road Project *Para Zambia 2000 Project *Lusaka 400 Project	*The Study on Comprehensive Urban Development Plan for the City of Lusaka in the Republic of Zambia (IACA)			*Basic equipment (traffic signal, CCTV)																	Development of ITS Master Plan *Signal system introduction assistance and technical education *Dispatch of experts	
	Nigeria	*Strategic Transport Master Plan	*Strategic Transport Master Plan	only rough service content		*IC card for bus *Basic equipment (traffic signal, CCTV)	*e-Tag(RFID) (road concessionaire)	*Developed by the World Bank's assistance																*Transportation management system (signal, CCTV) introduction assistance ITS pilot project Development of ITS Master Plan *Technical education related to traffic management
	Bangladesh	*Road Master Plan	*Strategic Transport Plan			*CCTV Control Center																		Development of ITS Master Plan *Restoration and expansion of basic ITS facilities *Technical education
Myanmar	*The Project for the Strategic Urban Development Plan of the Greater Yangon (IACA) *Project for Comprehensive Urban Transport Plan of the Greater Yangon (IACA)	*The Project for the Strategic Urban Development Plan of the Greater Yangon (IACA) *Project for Comprehensive Urban Transport Plan of the Greater Yangon (IACA)			*CCTV Monitoring Room *IC3—F																		Development of ITS Master Plan *Early introduction of expansion and traffic control centers of existing ITS facilities *Technical education	

Source: JICA Study Team

12.2 DRAFT ASSISTANCE MEASURES FOR ITS INTRODUCTION

12.2.1 DIRECTION OF ITS INTRODUCTION ASSISTANCE IN EACH COUNTRY

Table 12-2 shows a summary of the results of this survey.

Table 12-2 Challenges and ITS Direction of Each Country

Country	Challenge	ITS Direction
Vietnam	Expansion of basic ITS equipment, planning and basic development and coordination such as introduction of IC cards are required	Introduction of traffic control center and dispatch of experts, Implementation of pilot projects related to ITS (including IC card), Development of ITS master plan (including coordination between organizations)
Thailand	Integration of information, expansion of traffic-related databases, private sector participation promotion	Joint research (handling of big data, etc.), central system integration
Cambodia	Road traffic, basic ITS facilities, and basic maintenance and coordination of planning, etc. are required.	ITS introduction promotion based on a signal and a control center system currently introduced, development of ITS master plan, dispatch of experts
Pakistan	Expansion and upgrading of basic ITS equipment and facilities, basic maintenance and coordination of planning, etc. are required.	Introduction and traffic control center and technical training, development of ITS master plan
Malaysia	Coordination between organizations, promotion of advanced ITS introduction	Foundation of ITS promotion organization and systems integration, technical training, joint research (big data, disaster information utilization, etc.)
Nigeria	Expansion and upgrading of basic ITS equipment and facilities, basic maintenance and coordination of planning, etc. are required	Development of ITS master plan (organization including construction), expansion of ITS, Technical training
Zambia	Road traffic, basic ITS facilities, basic maintenance and coordination of planning, etc. are required	Development of ITS master plan (including equipment and facilities introduction), introduction of traffic control center and technical training
Paraguay	Expansion and sophistication of basic ITS equipment and facilities, basic maintenance and coordination of planning, etc. are required. *There exist introduction assistance on traffic signal control systems by South Korea.	Development of traffic information provision system based on update of traffic control center system, traffic safety, update of urban transport master plan, information sharing on Japanese ITS by acceptance of trainees
Peru	Coordination between organizations, promotion of advanced ITS introduction, system integration	Development of public transport ITS (PTPS, etc.), Integration of various systems (control centers, IC card, etc.)

Source: JICA Study Team

Almost all countries do not have an ITS master plan and ITS standards, and their technology and knowledge on ITS are insufficient. Therefore, the development of an ITS master plan is put as a basic measure, and the introduction and expansion of ITS equipment and facilities, development of ITS standards, and performing technical education are desirable. Also, since all countries are proactive toward the ITS introduction, the introduction of other ITS (public transportation, IC card, traffic information, etc.) is effective, and assistance based on the ITS development status of each country is required.

12.2.2 JAPANESE ITS ASSISTANCE SPECIFIC MEASURES (DRAFT)

Based on the challenges and ITS direction of this survey's results, the following measures are considered as Japanese ITS assistance. In addition, it is desirable to exchange views about the entry potential of Japanese ITS assistance with ITS assistance committees and meeting with ITS related organizations.

(1) Vietnam

1) Development of Urban ITS Master Plan

While ITS standardization is advanced, ITS related equipment and a control center have been developed, and utilization of probe data and introduction of IC cards are also expected. Therefore, the development of an urban ITS master plan is examined in order to facilitate efficient introduction of future ITS. In this measure, introduction of traffic control center and central control of traffic signals, training, assistance to foundation of an ITS organization, consideration of information provision method and system introduction by pilot project are considered.

2) Private Participation Support Based on Technical Cooperation

Probe data information provision is a system which can be developed by the private sector. Therefore, it is considered whether it is possible for private sector participation in ITS introduction assistance through technical research related to ITS.

3) Training in Japan, Dispatch of Experts, and Human Resources Training

In order to be able to manage ITS on their own, technical transfer by training or dispatch of experts and utilization of training in Japan for improving technical capabilities and Japanese ITS publicity are considered.

(2) Thailand

1) Joint Research

Since Thailand has many ITS, assistance toward ITS upgrading through joint research for future engagement of the private sector is considered.

(3) Cambodia

1) Center Maintenance Capacity Improvement, and Expansion of ITS

Since the development of traffic signals and traffic control center has been carried out using Japanese grant aid, technical cooperation project, dispatch of experts, training in Japan for improvement of maintenance capability after implementation of the traffic control center are considered. Also, the development of an ITS master plan is considered for promoting effective introduction of ITS in the future.

(4) Pakistan

1) Development of ITS Master Plan

The development of an ITS master plan is examined in order to facilitate efficient introduction of future ITS. For the implementation of the ITS master plan, it is also considered that sophistication of traffic signals and introduction of a traffic control center will be implemented under a pilot project or grant aid.

2) Grant Aid

Although traffic monitoring is done by CCTV, CCTV has not been applied for traffic congestion improvement. Also, traffic management by utilizing traffic signals is insufficient. Therefore, the introduction and expansion of ITS equipment and grant aid for the purpose of carrying out traffic management by introducing the traffic control center are considered.

3) Training in Japan

As for the purpose of improvement of general technical capability and Japanese ITS promotion, training on ITS in Japan is considered.

(5) Malaysia

1) Dispatch of Experts, Training, and Seminars

Since Malaysia has many ITS, assistance toward ITS upgrading through joint research for future engagement of the private sector is considered. In addition, it is considered a private foray support possibility of holding an ITS seminar.

2) Assistance for Building of ITS Promotion Organization

Within the framework of development studies, assistance toward establishing an ITS promotion organization and system integration are considered.

3) Assistance for Traffic Safety ITS

Dispatch of experts or implementation of technical cooperation projects as ITS model project of Japan's traffic safety field is being examined.

4) Third Country Training

Utilization of Malaysia's ITS for training is considered.

(6) Nigeria

1) Development of ITS Master Plan

The development of an ITS master plan is examined in order to facilitate efficient introduction of future ITS. The development of ITS standards, establishment of ITS-related association and preparation of comprehensive ITS introduction plan are required.

2) Grant Aid

After the development survey, the introduction of basic ITS equipment, such as traffic signals, CCTV, and VMS by grant aid is considered.

3) Training in Japan

As for the purpose of improving the general technical capability and Japanese ITS promotion, training on ITS in Japan is considered.

(7) Zambia

1) Development of ITS Master Plan

The development of an ITS master plan is examined in order to facilitate efficient introduction of future ITS. It is also effective to experimentally implement measures of system introduction such as signal control depending on the traffic volume and traffic information provision as pilot project.

2) Grant Aid

The introduction of basic ITS equipment (traffic signals, CCTV, VMS, etc.) and traffic control center by grant aid is considered.

3) Training in Japan

As for the purpose of improving the general technical capability and Japanese ITS promotion, training on ITS in Japan is considered.

(8) Paraguay

1) Consider Cooperation Possibility by Observing the Situation of Existing ITS Equipment Operations

It is difficult to receive Japanese assistance for the introduction of basic ITS equipment because South Korea is already providing assistance for the introduction of traffic signals and traffic control center in Asuncion. Therefore, cooperation possibility by observing the situation of existing ITS equipment operations is considered.

2) Utilization of ITS for Urban Transportation Plan and Introduction of Probe Information System

The preparation and utilization of an ITS plan in the urban traffic management field and the introduction of an individual system such as congestion information system utilizing probe information are considered.

3) Traffic Safety Project

Since the number of traffic accidents has been increasing with motorization in Paraguay, the introduction of ITS related to traffic safety based on understanding the situation of traffic accidents is

considered.

4) Training in Japan

Japanese technical transfer, in the form of training in Japan, to improve traffic management capacity is considered. In addition, for the purpose of improving the general technical capability and Japanese ITS promotion, training on ITS in Japan is considered.

(9) Peru

1) Development of ITS Master Plan

Although Peru has many ITS equipment and facilities and an ITS master plan, there are no ITS standards and coordination between organizations, and information integration is insufficient. Therefore, the development of an ITS master plan for urban area and implementation of pilot project for ITS introduction as priority project are considered.

2) Introduction of Individual Systems (also examined as a pilot project)

For the effective use of public transportation, the introduction of individual systems such as PTPS, congestion information provision system by utilizing traffic-related data, etc. (assuming a development study+pilot project) are considered. However, it should be noted that there are no ITS standards (development of individual system standards and assistance toward development of ITS standards are examined).

3) Training in Japan

Japanese technical transfer, in the form of training in Japan, to improve traffic management capacity is considered. In addition, for the purpose of improving the general technical capability and Japanese ITS promotion, training on ITS in Japan is considered.

CHAPTER 13 ITS SEMINAR IN PAKISTAN

13.1 OUTLINE OF ITS SEMINAR IN PAKISTAN

JICA Study Team conducted ITS seminar in Pakistan for sharing information of this survey result and providing information of IC card for public transportation toll collection. Locations, dates and number of participants are as follows.

- (1) Location
Karachi, Lahore and Islamabad
- (2) Schedule

Table 13-1 Schedule of ITS Seminar in Pakistan

Date	Location	Contents
16th February, 2015	Karachi	<ul style="list-style-type: none"> • Venue visit (Confirmation and instruction of venue setting and preparation) • Meeting with JICA Pakistan Office
17th February, 2015	Karachi	<ul style="list-style-type: none"> • Seminar in Karachi (Venue: Pearl Continental Karachi) • Some meeting after the seminar (PPP Unit, Consultants of Blue Line)
18th February, 2015	Lahore	<ul style="list-style-type: none"> • Venue visit (Confirmation and instruction of venue setting and preparation) • Ride a BRT, Meeting with Punjab Metrobus Authority
19th February, 2015	Lahore	<ul style="list-style-type: none"> • Seminar in Lahore (Venue: Aavri Lahore)
20th February, 2015	Islamabad	<ul style="list-style-type: none"> • Seminar in Islamabad (Venue: JICA Pakistan Office)

Source: JICA Study Team

- (3) Participants
Karachi : 41 persons、Lahore : 31 persons、Islamabad : 18 persons

13.2 Q&A

There were some questions about IC card for fare collection and clearing house, since BRT is already developed or under planning in location which was conducted the seminar. In addition, there were some question about ITS master plan in Karachi and Islamabad. High interest was shown about the integration and cooperation of the system and organization mainly.