CHAPTER 6
CURRENT ITS APPLICATION

6.1 DPWH

DPWH is responsible for traffic systems on national roads outside of Metro Manila. This section discusses the following items of DPWH's jurisdiction.

- Traffic Counters
- Traffic Signals
- CCTV
- Overload Measures
- Communication Network
- Information Dissemination
- Database

6.1.1 Traffic Counters

(1) Existing Situation

DPWH operates a total of 2,849 traffic survey stations nationwide, as shown in **Table 6.1-1**. Out of these, 578 stations have automated in-ground sensors, and 9 out of the 578 are located in the Study Area. However, none of the automated counters is connected to the DPWH traffic database via communication lines. Therefore, DPWH is not capable of collecting the traffic volume in real time. Actually, when DPWH needs to collect traffic volume data, it has to dispatch its staff to the stations and collect the data manually.

In the traffic surveys, the vehicles are classified into 15 types (see **Table 6.1-2**), as determined by the number of axles and the gaps between axles. Therefore, DPWH has installed survey equipment that is capable of measuring such number of axles and gaps between axles of passing vehicles, by using Loop-coil sensor and Piezo sensor. (see **Figure 6.1-2**)

The operations of the Automatic Traffic Counts and axle load surveys are supervised by the DPWH Regional Offices, while the manual traffic count surveys are assigned to the District Engineering Offices.

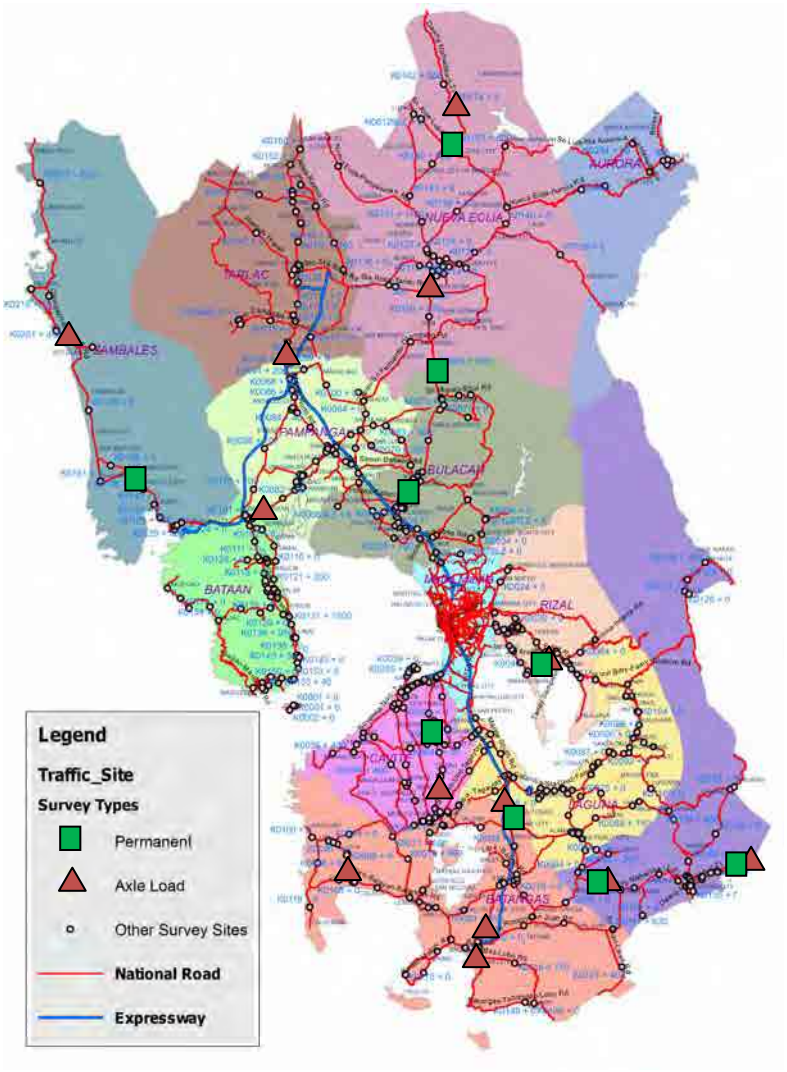
TABLE 6.1-1 NUMBER OF TRAFFIC SURVEY POINTS

Type of Survey Point	Number of Stations
Automated Count Point	1,350
In-ground sensor (Permanent Stations)	**578**
On-ground sensor (Temporary Stations)	772
Manual Count Point	1,499
	2,849

Source: DPWH

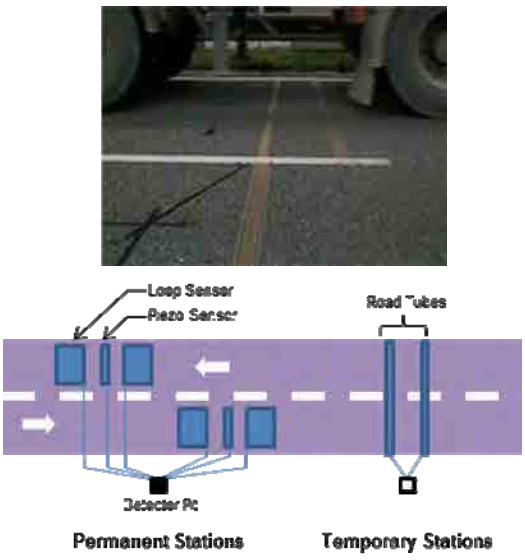
DPWH has three data collection and management applications, namely, Road and Bridge Information Application (RBIA), Road Traffic Information Application (RTIA) and Traffic Accident Recording and Analysis System (TARAS). These are vital elements of the database employed in the highway planning process.

The traffic data are imported into the RTIA. (see **Figure 6.1-4**) Traffic data are being used in project studies and analyses; hence, the Department through Business Improvement and Implementation Projects (BIIPs) of the Road Information and Management Support System (RIMSS) initiated the implementation of the National Road Traffic Survey Program (NRTSP) and the RTIA to generate accurate and more reliable traffic data.



Source: DPWH

FIGURE 6.1-1 TRAFFIC SURVEY POINTS IN THE STUDY AREA



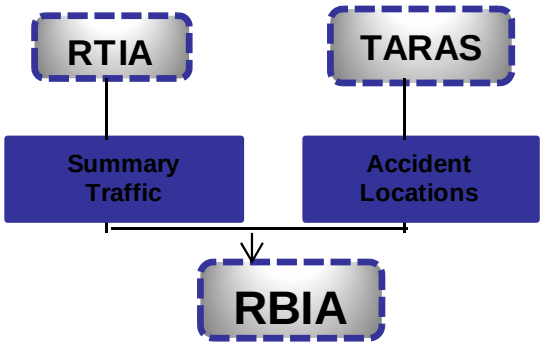
Source: DPWH

FIGURE 6.1-2 AUTOMATIC "IN-GROUND SENSOR"

TABLE 6.1-2 DPWH VEHICLE CLASSIFICATION (METRIC)

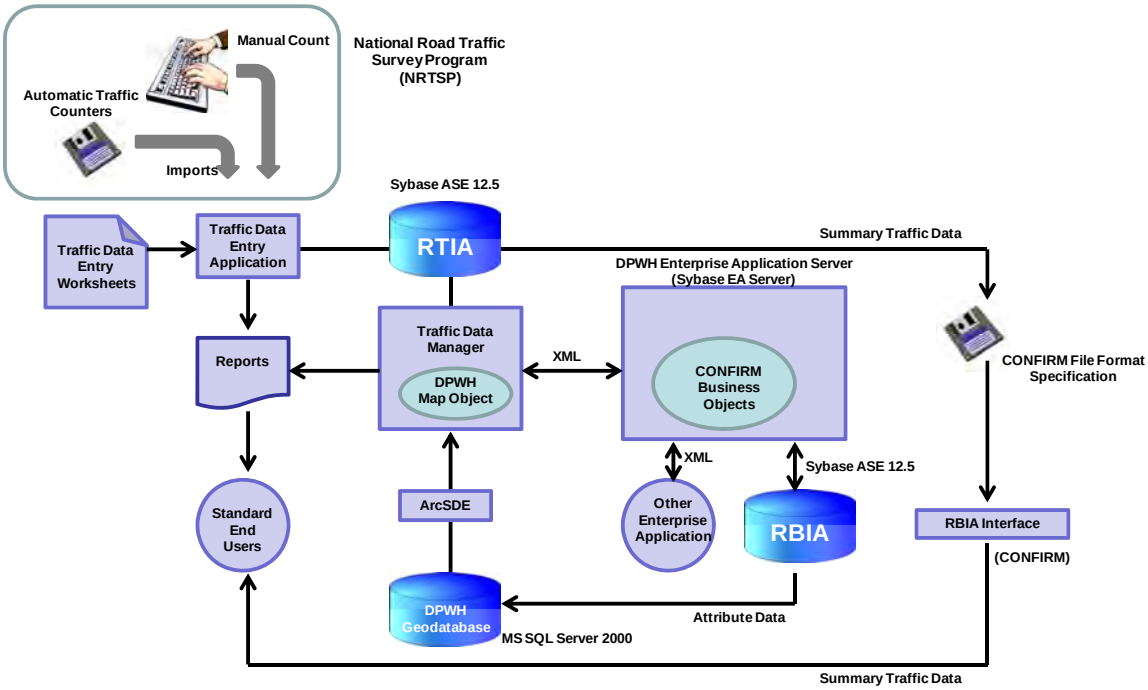
Class	Description	Axles	GAP 1	GAP 2	GAP 3	GAP 4	GAP 5
1	Motorcycle/ Motor-Tricycle	2	1.20-1.70				
2	Passenger Car	2	1.71-2.50				
3	Passenger Utility	2	3.01-3.60				
4	Small Truck/Pickup/Van/SUV/Large Jeepney	2	2.51-3.00				
5	Large Jeepney/Small Bus	2	3.61-4.20				
6	Large Bus	2	4.21-6.00				
7	2-Ax Rigid Truck	2	6.01-7.20				
8	3-Ax Rigid Truck	3	3.11-7.50	0.76-1.88			
8	3-Ax Rigid Truck	3	0.76-1.88	3.11-7.50			
9	4-Ax Semi-Trailer	4	2.80-3.60	4.60-10.00	0.76-1.88		
9	4-Ax Semi-Trailer	4	2.80-3.60	0.76-1.88	4.60-10.00		
10	5-Ax Semi-Trailer	5	2.80-3.60	0.76-1.88	4.60-10.00	0.76-1.88	
10	6-Ax Semi-Trailer	6	2.80-3.60	0.76-1.88	4.60-10.00	0.76-1.88	0.76-1.88
11	2 Ax Rigid Truck with 2 Ax Trailer	4	2.80-3.60	2.50-3.50	6.00-10.00		
12	3 Ax Rigid Truck with 2 Ax Trailer	5	3.11-7.50	0.76-1.88	2.50-3.50	6.00-10.00	
12	3 Ax Rigid Truck with 3 Ax Trailer	6	3.11-7.50	0.76-1.88	4.60-6.00	1.89-10.00	0.76-1.88
14	User Defined - NOT APPLICABLE						
15	Unclassified						

Source: DPWH



Source: DPWH

FIGURE 6.1-3 DPWH'S DATABASE FOR THE HIGHWAY PLANNING PROCESS



Source: DPWH

FIGURE 6.1-4 UTILIZATION OF TRAFFIC DATA INTO RTIA AND RBIA

(2) Future plan

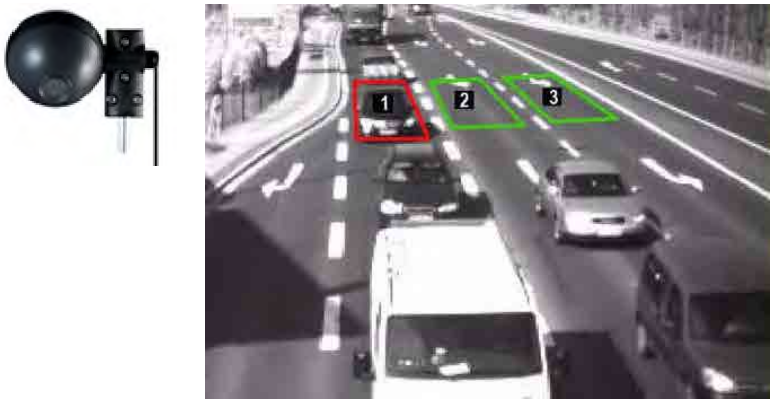
There is no future plan for the improvement and implementation of specified Traffic Counters. However, as discussed below, DPWH has a plan for the installation and operation of CCTV and Image Recognition and Control Center covering the Manila North Road (MNR). These facilities are intended for the observation of traffic conditions and traffic signals on selected sections of the MNR. The plan contains image recognition that is capable of measuring the traffic volume by using camera images. However, it is not capable of recognitzing the vehicle classification of DPWH. Therefore, the collected traffic data may not be directly imported into the RTIA.

Incidentally, Traficam (see **Figure 6.1-5**) is a product of Traficon (Belgium), one of the major companies for image recognition system in the world. Traficam has the experience of having installed more than 45,000 vehicle presence detectors in over 60 countries.

TABLE 6.1-3 LIST OF PROPOSED CCTV CAMERA SENSORS (IMAGE RECOGNITION)

Name of Intersection	LGU
1. MNR – ROMULO	Tarlac City, Tarlac
2. MNR – FAUSTA	Malolos, Pampanga
3. MNR – TIKAY	Malolos, Pampanga
4. MNR - MERCADO	Guiguinto, Bulacan
5. MNR - SULLERA	Meycauayan, Bulacan

Source: DPWH



Source: DPWH

FIGURE 6.1-5 CCTV CAMERA SENSOR (TRAFICAM)

6.1.2 Traffic Signal

(1) Existing Situation

There is a total of 66 intersections in Manila North Road (MNR), 53 of which are signalized. However, all signals are not monitored by DPWH in real time. According to the Technical Specification for Microprocessor Traffic Signal Controller for Use in the Philippines which is issued by Traffic Engineering and Management (TEAM)-DPWH, there are three modes of signals: Isolated mode, Cable-link mode and ATC mode. The53 signals are of the isolated mode only.

The definitions of the three control modes are as follows:

- **Isolated mode**: It is a control mode whereby the controller operates without reference to the operation of any other controller. Phases may be fixed time or vehicle actuated and/or demand dependent, as specified in the plan data with phase times and sequence under the control of selected local timetable plans.
- **Cable-Linked mode**: It is a control mode whereby a number of adjacent controllers are coordinated via a linking cable. Phases may be fixed time or vehicle actuated and/or demand dependent as in the isolated mode.
- **ATC mode**: It is a control mode whereby the duration and sequence of phases are controlled by an A.T.C. central/master computer, and coordination of adjacent controllers is effected by the central/master computer. Phases may be fixed time or vehicle actuated and/or demand dependent as defined in the master computer plan data. In the A.T.C. mode, all local plan and timetable information can be ignored dependent on the type of control strategy used.

The signal system of Metro Manila was originally under the supervision of DPWH; however, in 2003 it was transferred to MMDA. The system is called Sydney Coordinated Adaptive Traffic System (SCATS).

TABLE 6.1-4 NUMBER OF SIGNALIZED AND UN-SIGNALIZED INTERSECTIONS ON MNR

Type of intersections	Number of intersections
Number of Intersections	66
Signalized	53
Un-signalized	13

Source: DPWH

Source: Study Team

FIGURE 6.1-6 EXISTING CONDITION OF SIGNAL AT MNR

Source: DPWH

FIGURE 6.1-7 LOCATION OF MANILA NORTH ROAD (MNR)

(2) Future plan

DPWH has a future plan for the improvement and implementation of a specified traffic signal system.

The plan contains the provisions and operation of CCTV for monitoring, CCTV for traffic counts, and a Signal Monitoring and Traffic Monitoring Center. Ordinary, loop-coil is used for traffic volume counts in the signal system; however, loop-coil is not capable for use in pavements because it may be affected by floods, overloaded vehicles, and related incidents. Therefore, TEAM-DPWH utilizes the image recognition technology like CCTV camera sensors instead of loop-coil. The newer signal system is capable of changes of signal phasing dependent on the

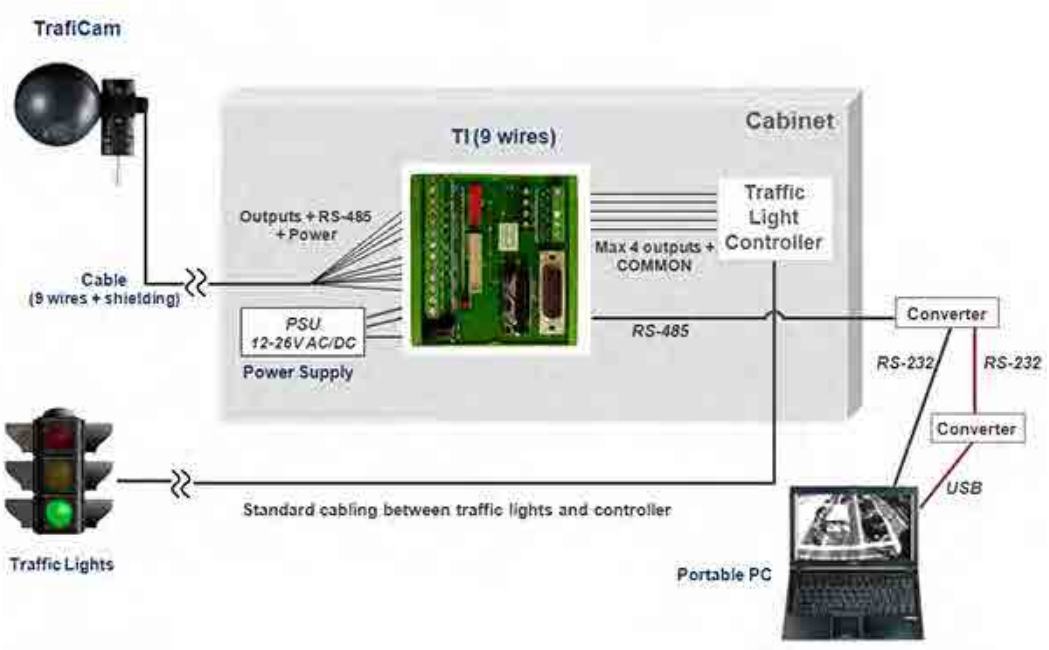
traffic condition. The target intersections are listed in **Table 6.1-5**.

SCATS is a product of Aldridge Traffic Controllers (Australia) and most of the signal lights are products of SWARCO (Austria).

TABLE 6.1-5 LIST OF PROPOSED LOCATIONS FOR FUTURE TRAFFIC SIGNAL SYSTEM

Name of Intersection	LGU
1. MNR – ROMULO	Tarlac City, Tarlac
2. MNR – FAUSTA	Malolos, Pampanga
3. MNR – TIKAY	Malolos, Pampanga
4. MNR - MERCADO	Guiguinto, Bulacan
5. MNR - SULLERA	Meycauayan, Bulacan

Source: DPWH



Source: DPWH

FIGURE 6.1-8 FUTURE SIGNAL SYSTEM

6.1.3 CCTV

(1) Existing

There is no CCTV monitoring system under the control of DPWH. However, there is a future DPWH plan for CCTV as discussed in the next paragraph.

(2) Future plan

DPWH has a future plan of implementation of the CCTV monitoring system. The plan contains the provision and operation of CCTV for monitoring, CCTV for traffic counts, and a Signal Monitoring and Traffic Monitoring Center. According to the DPWH documents, the Traffic Monitoring Center (TMC) shall have the following functions:

- Display intersection traffic signal equipment status.
- Display traffic conditions.
- Dispatch resources to fix malfunctioning traffic signal equipment.
- Store data for long term archives.
- Implement dynamic selection and/or modification of traffic signal timings.
- Manage incidents and special events.
- Provide coordination among other agencies.

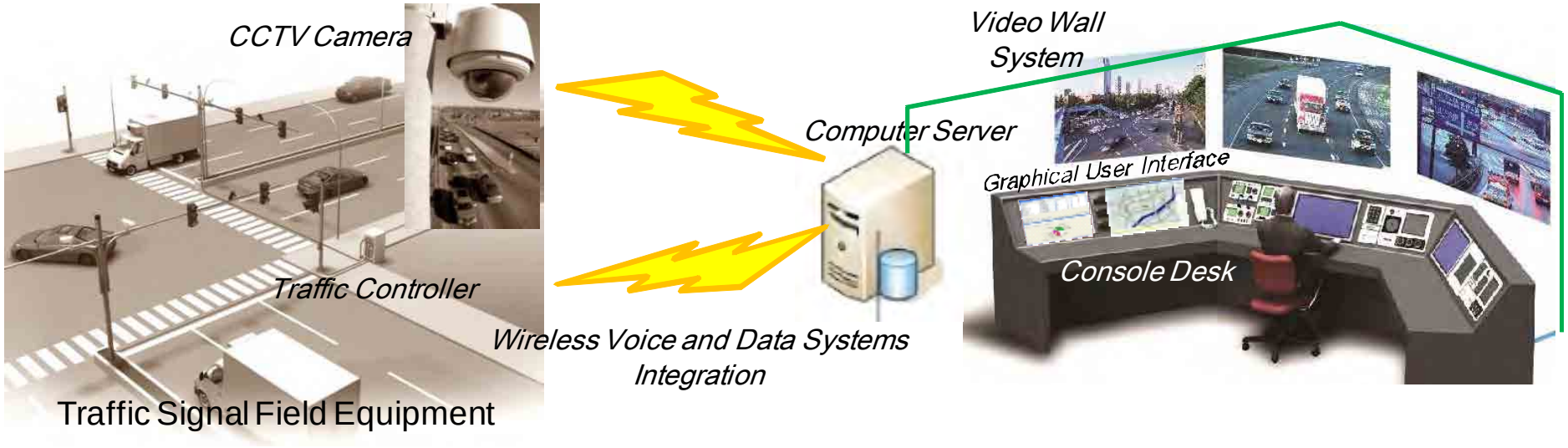
The TMC equipment shall consist of the following;

- Computer server.
- Large scale display consisting of an LCD video wall (tiled/multi-screen system), and. capable of displaying a system map with active icons.
- Traffic management software with graphical user interface (GUI).
- Operator workstation and console desk.
- Incident and accident monitoring system.

TABLE 6.1-6 LIST OF PROPOSED LOCATIONS FOR CCTV MONITORING

Name of Intersection	LGU
1. MNR – METRO TOWN	Tarlac City, Tarlac
2. MNR – STA. INES	Mabalacat, Pampanga
3. MNR – GSO ROAD	San Fernando, Pampanga
4. MNR - BALAGTAS	Balagtas, Bulacan
5. MNR - PACHECO	Meycauayan, Bulacan

Source: DPWH



Source: DPWH

FIGURE 6.1-9 FUTURE CCTV MONITORING SYSTEM

6.1.4 Overload Measurement

(1) Existing Situation

DPWH has 24 permanent stations that measure vehicle overload nationwide (see **Table 6.1-8**); of these, 8 stations have been decommissioned, and 2 stations are not working. On the enforcement of overloading, the Land Transportation Office (LTO) has the capability to apprehend overloading vehicles. LTO has deputized other Government agencies such as DPWH, MMDA, PNP, etc. DPWH has the capability to apprehend violators of overloading rules with assistance from the police. Both the driver and the owner will be apprehended if the vehicle is found overloaded. Some disputes arise between the driver and the enforcer when the apprehension is done by the agencies. Therefore, they plan to implement a non-physical contact apprehension procedure. However, at this time all apprehensions made for overloading vehicles are all through physical contact, thus the number of apprehended violations is low.

In addition, the permanent overload measuring equipment is manufactured by Aldridge Traffic Controllers (Australia) or SWARCO (Austria).

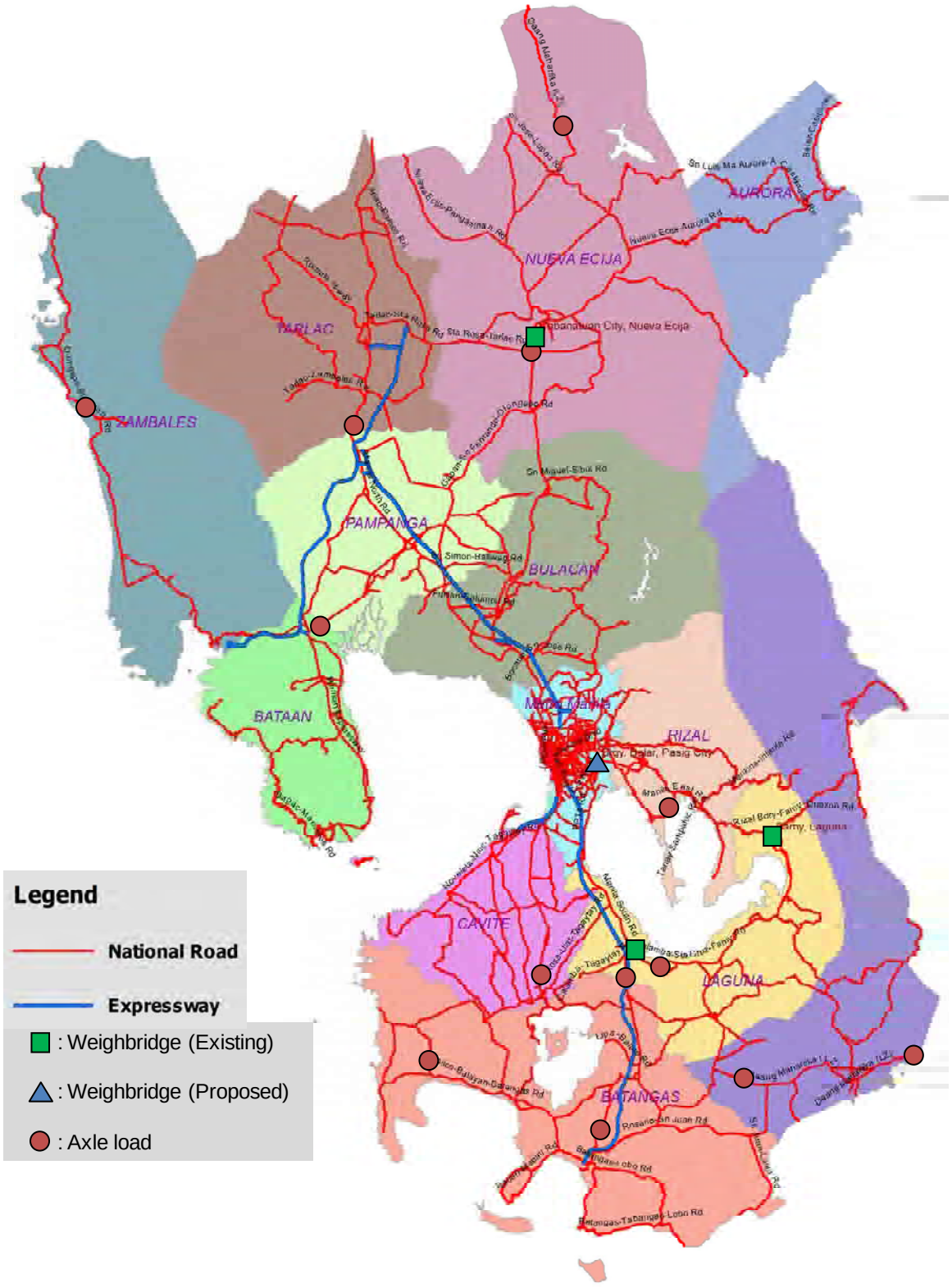
TABLE 6.1-7 LIST OF NUMBER OF OVERLOAD MEASURE STATIONS IN STUDY AREA

Type of overload sensor	Number of stations
Weighbridge (Existing)	3
Weighbridge (Proposed)	1
Axle load	12
Total	16

Source: DPWH

Source: JICA Study Team

FIGURE 6.1-10 WEIGHBRIDGE STATION AT KM 51+500 MAHARLIKA HIGHWAY



Source: DPWH

FIGURE 6.1-11 WEIGHBRIDGE STATIONS IN THE STUDY AREA

TABLE 6.1-8 LIST OF WEIGHBRIDGE STATIONS NATIONWIDE (AUGUST – SEPTEMBER 2011)

NO.	REGION	STATION	TYPE OF MACHINE	LOCATION	STUDY'S PROPOSAL	WB MACHINE STATUS- AS OFAUG 2011	PAWM NO.	STATUS AS PER BOM ASSESSMENT	No. of Shifts in Operation	Assigned LTO Deputized Personnel	REMARKS
1	NCR	Villamor, SLEX, Pasay City **	Electronic	km.10+000 Manila South Expressway	For Decommisioning						
2	CAR	Yagyagan, Tuba Benguet	Electronic	km.296+000 Baguio-Bauang Road		Operational		Fully operational, control house in good condition	■	✓	with 6 deputized DPWH personnel
3	II	Kilkiling, Claveria, Cagayan	Electronic	km.606+079 Manila North Road		Using PAWM *	2	WB needs repair	■	✗	
4	II	Aritao, Nueva Vizcaya	Mechanical	km.223+050 Maharlika Highway		non operational		Closed, non operational, unserviceable machine			
5	III	Cabanatuan City	Electronic	km.111+000 Maharlika Highway		Operational	2	Fully operational	■	✓	with 1 deputized DPWH personnel, 4 PNP on duty
	III	Tabang, Guiguinto, Bulacan	none	(this station is not in operation since its construction in 2006)		non operational		Control house is poorly maintained			
	III	Capas, Tarlac	none	(this station is not in operation since its construction in 2007)		non operational		Control house has deteriorated			
6	IV-A	Brgy. Tulo, Calamba, Laguna	Electronic	km.51+500 Maharlika Highway							
7	IV-A	Famy, Laguna **	Electronic	km.78+600 Manila East Road	For Decommisioning						
8	V	Polangui, Albay	Electronic	km.490+000 Maharlika Highway		Using PAWM *	1	WB machine not operational, using 1 PAWM, control house needs repair	■	✗	with deputized PNP
9	VI	Buhang Joro, Iloilo City **	Mechanical	km.5+956 Iloilo East Coastal Road	For Decommisioning						
10	VI	Talisay, Negros Occidental **	Mechanical	km.4+700 Bacolod North Road	For Decommisioning						
11	VI	Aglalana, Dumarao, Capiz	Electronic	km.63+900 Iloilo-Capiz Road (New Route)		Using PAWM *	1	WB control house premises in good condition	●	✗	
12	VI	Bo. Taloc, Bago City **	Mechanical	km.12+500 Bacolod South Road	For Decommisioning						
13	VII	Mandaue City ***	Mechanical	km.7+250 A.C. Cortes Avenue	For Decommisioning						
14	VII	Minglanilla, Cebu	Electronic	km.16+000 Cebu Road		Operational		WB control house needs repair	■	✓	With 5 deputized DPWH personnel
15	VII	Tamiso, Bais City	Electronic	km.57+000 Dumaguete North Road		Operational		WB control house in good condition, approaches are poor	■	✓	With 6 deputized DPWH personnel
16	VIII	Sta. Rita, Samar	Electronic	km.895+129 Maharlika Highway		Using PAWM *	1	WB elec machine not operational, cntrl house roofing for repairing. Using 1 PAWM	■	✗	
17	IX	Tawagan Sur, Pagadian City	Electronic	km.1651+000 Zam.-Pag.-Cotabato Road		Using PAWM *	2	WB elec machine not operational, cntrl house ceiling needs repair. Using 2 PAWM	■	✗	
18	X	Bo. Puerto, Cagayan de Oro City	Mechanical	km.1425+100 Iligan-Cag. De Oro Butuan Road	For Decommisioning						
19	X	El Salvador, Misamis Oriental	Electronic	km.1452+900 Iligan-Cag. De Oro Butuan Road		Using PAWM *	2	WB elec machine not operational, Using 2 PAWM	■	✓	with 4 deputized DPWH personnel
20	XI	Digos, Davao del Sur	Electronic	km.1566+712 Davao-Cotabato Road		Operational		WB elec. machine in good condition, control house is fair	■	✗	
21	XI	Panabo, Davao del Norte	Electronic	km.1481+029 Maharlika Highway		Using PAWM *	2	WB elec. Machine defective, control house is fair, Using 2 PAWM	■	✗	with deputized PNP
22	XII	Gen. Santos City, South Cotabato	Electronic	km.1655+684 Makar-Marbel Road		Using PAWM *	1	WB elec. Machine defective, Control house in fair condition, Using 1PAWM	●	✗	with deputized PNP
23	XII	Simuay, Maguindanao	Electronic	km.1724+004 Cotabato-Davao Road	For Decommisioning						
24	XIII	Ampayon Jct. Butuan City	Electronic	km.1233+100 Iligan-Cag.-Butuan Road		Operational	2	WB elec machine in good condition, control is well maint., with 2 reserved PAWM	■	✗	No deputized DPWH person but with 2 LTO officers

▲ One shift
● Two shifts
■ Three shifts

✓ with LTO Deputized DPWH Personnel
✗ without LTO Deputized DPWH Personnel

* The Weighbridge (WB) stations is temporarily using Portable Axle Weighing Machine (PAWM) for weighing loaded trucks due to defective WB machine

** For relocation

*** Not Operational due to prohibition of trucks/trailers passing the Mandaue Opon Bridge per court order of RTC Cebu City

Number of Overloaded Vehicles

There are 24 weighbridge stations nationwide (see **Table 6.1-8**), of which 12 stations are operated in three shifts. In the Study Area, only one station is operated three shifts, i.e., "Cabanatuan City" which is located at Km 111+000, Maharlika Highway.

DPWH has collected the measured data of overloading at "Cabanatuan (Region III)" and "Yagyagan (CAR)" from July, 2010 to July, 2012. The data of "Yagyagan (CAR)" is for comparison of the difference between regions.

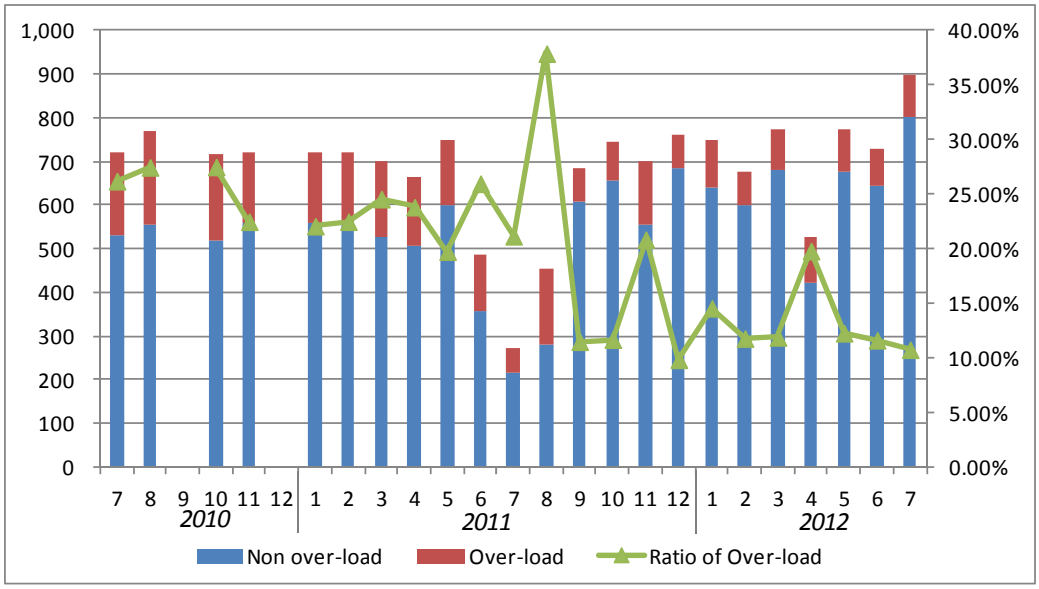
According to the data provided by DPWH, the total number of overloaded trucks at Cabanatuan is 2,963, with an 18.86% ratio of overload. (see **Table 6.1-9**). This ratio is so high that the overloaded trucks cause a significant damage on the road. By comparison, at Yagyagan, the total number of overloaded trucks is 146, with a 0.50% ratio of overload.(see **Table 6.1-10**)

The Cabanatuan station is located at Maharlika Highway which is a backbone road of Northern Luzon. The Maharlika Highway is a very important road for the logistics of northern Luzon, therefore suppression of overloaded vehicles is an urgent issue.

TABLE 6.1-9 NUMBER OF OVERLOADED TRUCKS AT "CABANATUAN (REGION III)" STATION

Year	Month	Total No. of Truck	No. of Non over-load Truck	No. of Over-load Truck	Ratio of over-load Truck
2010	7	721	532	189	26.21%
	8	768	557	211	27.47%
	9	0	0	0	
	10	716	519	197	27.51%
	11	720	558	162	22.50%
	12	0	0	0	
2011	1	720	561	159	22.08%
	2	720	558	162	22.50%
	3	700	528	172	24.57%
	4	663	505	158	23.83%
	5	749	601	148	19.76%
	6	485	359	126	25.98%
	7	274	216	58	21.17%
	8	454	282	172	37.89%
	9	686	607	79	11.52%
	10	744	657	87	11.69%
	11	700	554	146	20.86%
	12	761	686	75	9.86%
2012	1	748	639	109	14.57%
	2	678	598	80	11.80%
	3	773	681	92	11.90%
	4	525	421	104	19.81%
	5	773	678	95	12.29%
	6	730	645	85	11.64%
	7	900	803	97	10.78%
Total		15,708	12,745	2,963	18.86%

Source : DPWH



Source: DPWH

FIGURE 6.1-12 NUMBER OF OVERLOADED TRUCKS AT "CABANATUAN (REGION III)" STATION

TABLE 6.1-10 NUMBER OF OVERLOADED TRUCKS AT "YAGYAGAN (CAR)" STATION

Year	Month	Total No. of Truck	No. of Non over-load Truck	No. of Over-load Truck	Ratio of over-load Truck
2010	7	780	777	3	0.38%
	8	830	828	2	0.24%
	9	653	646	7	1.07%
	10	652	651	1	0.15%
	11	669	663	6	0.90%
	12	584	583	1	0.17%
2011	1	1,194	1,180	14	1.17%
	2	1,194	1,186	8	0.67%
	3	1,526	1,518	8	0.52%
	4	1,038	1,034	4	0.39%
	5	1,583	1,576	7	0.44%
	6	1,628	1,627	1	0.06%
	7	1,488	1,483	5	0.34%
	8	1,204	1,196	8	0.66%
	9	1,296	1,280	16	1.23%
	10	1,222	1,218	4	0.33%
	11	1,214	1,211	3	0.25%
	12	1,220	1,213	7	0.57%
2012	1	1,471	1,468	3	0.20%
	2	1,552	1,539	13	0.84%
	3	1,551	1,545	6	0.39%
	4	1,204	1,198	6	0.50%
	5	1,317	1,314	3	0.23%
	6	1,033	1,028	5	0.48%
	7	1,155	1,150	5	0.43%
Total		29,258	29,112	146	0.50%

Source : DPWH

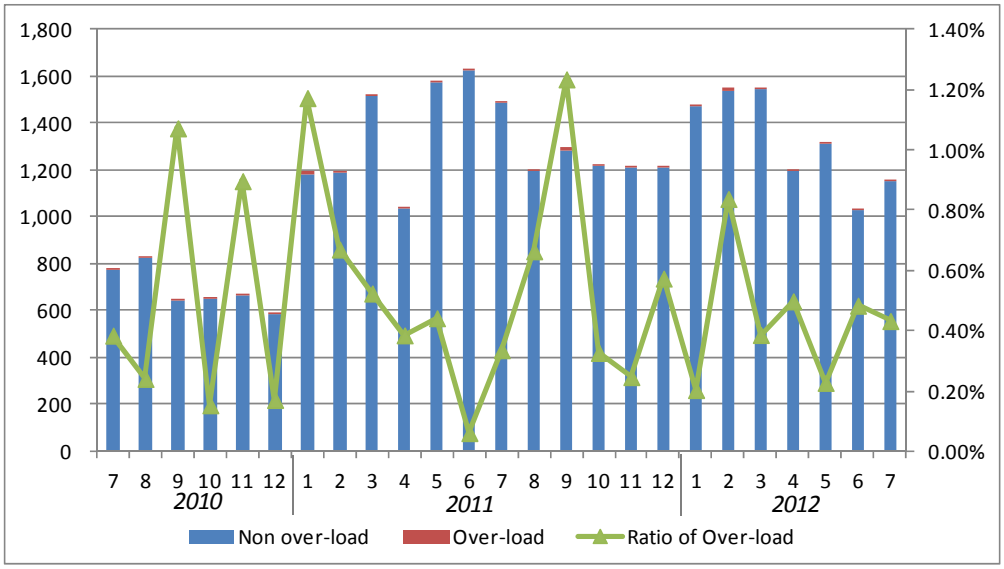


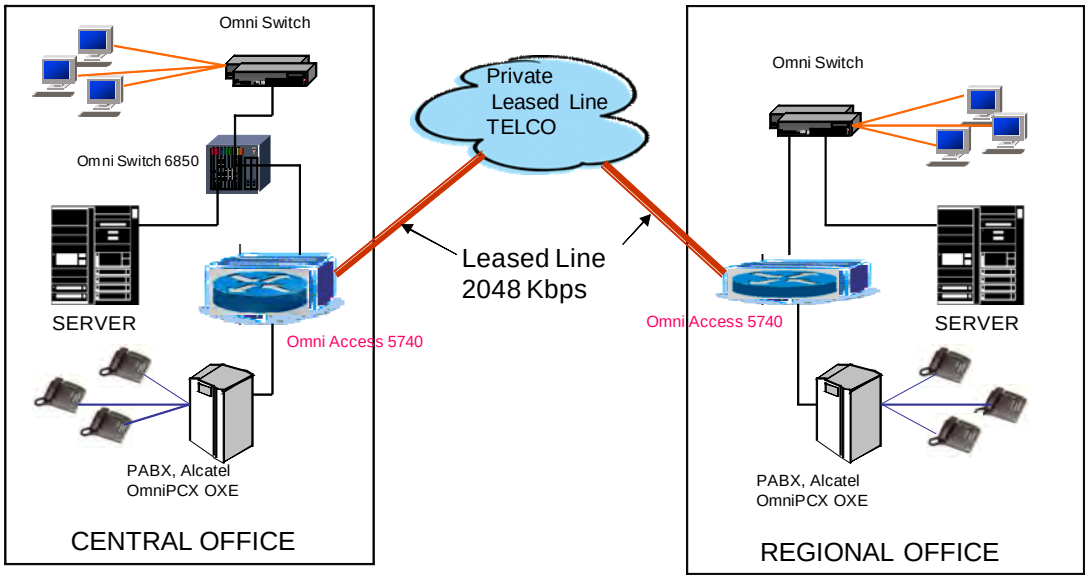
FIGURE 6.1-13 NUMBER OF OVERLOAD TRUCK AT "YAGYAGAN (CAR)" STATION

6.1.5 Communication Network

(1) Existing

DPWH has a nationwide communication network for the transmission of voice and data between the Central Office and the 16 regional offices. The existing communications network provides data and voice communications links between Regions and the Central Office. The capacity of line is 2,048 kbps, leased from a Telecommunications Company.

As part of this technology infrastructure, 1,175 computers (PCs) and 86 servers have been installed as well as associated software and printers.



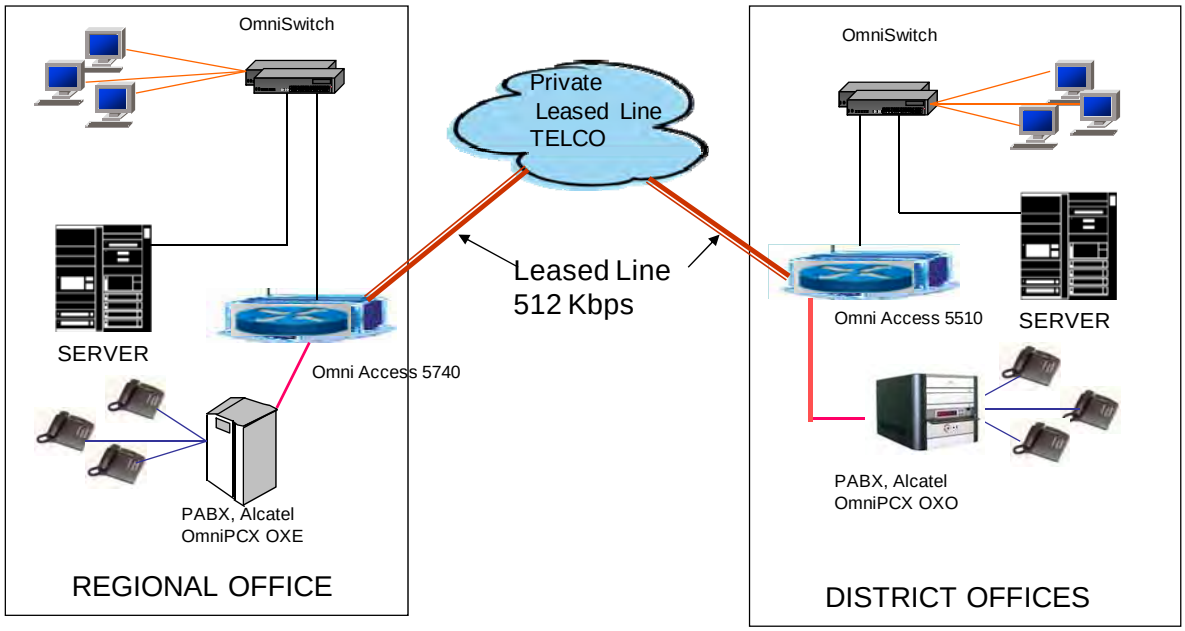
Source: DPWH

FIGURE 6.1-14 EXISTING COMMUNICATION NETWORK BETWEEN CENTRAL OFFICE AND REGIONAL OFFICE

(2) Future Plan

There is a nationwide communication network in DPWH, however, it is yet not connected to all District Offices and Project Offices. Thus, DPWH plans to implement the improvement of its communication network. The purpose of this project is to provide and operate the infrastructure needed by DPWH to effectively utilize voice and data communications, and more importantly to improve the efficiency of operations through computerized systems, increasing transparency in all offices.

According to the plan, the capacity of a line is 512 kbps, it will be leased from a Telecommunication Company like the existing lines. Then the project will be done from 2010 to 2014.



Source: DPWH

FIGURE 6.1-15 PROPOSED COMMUNICATION NETWORK BETWEEN REGIONAL OFFICE AND DISTRICT OFFICE

However, there is an issue for the project in rural areas. The broadband communication network service is not provided by a Telecommunication Company. If a private company will provide the service, then it will be of low profitability. Therefore, the Government Telecommunications Office (TELOF) has constructed communication infrastructure for rural areas but it is not a broadband communication network. The communication infrastructure is most important for the growth of economic in modern days; the implementation of communication network shall be done on the initiative of the public sector.

6.1.6 Information Dissemination

(1) Existing

A driver needs relevant road information, such as traffic condition, construction point, etc. to make a decision as to which route is best for driving. The information is provided by Variable Message Sign (VMS), TV broadcast, Radio, Internet, Telephone, etc. At present, the Metropolitan Manila Development Authority (MMDA) is already providing the information by using VMS, Internet, etc. especially using Smart Phones. However, the information covers selected arterial roads of Metro Manila only; it does not include the other national roads which are operated/maintained by DPWH. On the other hand, DPWH has Mobile Information Dissemination Vehicles (see **Figure 6.1-16**); the vehicle is deployed near a construction site and informs drivers and the public of construction works ahead which could cause traffic congestion. DPWH has not yet implemented the VMS.

Source: Study team

FIGURE 6.1-16 MOBILE INFORMATION DISSEMINATION VEHICLE FOR CONSTRUCTION SITE

(2) Future Plan

DPWH has a future plan to establish a Traffic Monitoring Center (TMC). The function of TMC is to display traffic conditions, manage incidents and special events, and provide coordination among other agencies. The TMC would be able to disseminate road information via other agencies such as MMDA by using Traffic Navigator. TEAM-DPWH is likewise considering wider information dissemination directly to the public through the TMC, but the specific features of this plan are still being studied.

6.1.7 Databases

(1) Present Conditions

The DPWH has developed and been using a Highway Planning Manual, 2004/2006. The HPM process covers all stages and levels - strategic analysis, long-term planning, multi-year planning, and annual programming for the National Roads network.

The DPWH planning process has been strengthened by modern Information Technology (IT)-based technical planning and information systems and tools, mostly established under the **RIMSS:** Road Improvement and Management Support System with World Bank and Asian Development Bank assistance. Of particular relevance to transport information systems are the following databases established by the DPWH Planning Service:

- **RBIA:** Road and Bridge Information Application – This is the main highway database of the DPWH. It is a repository of data on the National Road network inventory and conditions – e.g., layout, length, width, number of lanes, type of surface, right-of-way, bridges, drainage, etc. The data are used for planning and programming road construction and maintenance projects through the different planning systems mentioned below. The database includes the use of Geographic Information System (GIS). Road condition data are based on the Visual Road Condition (ROCOND) system adapted from Australia, but supplemented by the International Roughness Index or IRI system. The RTIA (see below) feeds traffic data to the RBIA. Eventually, the TARAS (see below) will also be linked and feed traffic accident data to the RBIA.

- **RTIA:** Road Traffic Information Application – This is a database of traffic volumes and vehicle axle load information along National Roads collected from regular traffic counting surveys, using manual and automatic counts, at almost 3,000 sites. Automatic traffic counts are collected through in-ground and on-ground sensors and traffic classifiers installed at selected sites on National Roads. Out of 578 in-ground sensors, only 60 are permanent which can provide real time data as they automatically record traffic volumes by type of vehicle, 24 hours a day. On-ground sensors are of the rubber tube type. Axle load data are obtained from periodic surveys using 86 portable weighing scales. Except for the data generated "24/7" by the 60 permanent sensors, the traffic volume and axle load data collected are valid only on the specific dates of the traffic surveys, e.g., 12, 4, 2, and 1 times a year. The traffic data collected in the field are stored in the RTIA and used mainly for traffic demand projections, project analyses, and programming of projects.

- **TARAS:** Traffic Accident Recording and Analysis System – This is a system which stores and processes information on traffic accidents on National Roads to identify accident black spots and prioritize road sections requiring safety measures. Information on accidents is supplied by the Philippine National Police (PNP).

- **PMS:** Pavement Management System – This is a system which assists DPWH in finding optimum strategies for providing and maintaining pavements in a serviceable condition over a given period of time.

- **BMS:** Bridge Management System – This is a system designed for monitoring of bridge conditions and planning of major maintenance and development works necessary to provide a sustainable bridge infrastructure, and

- **MYPS:** Multi Year Programming and Scheduling – This is a computer application that interfaces with the other applications in order to produce the Annual and Medium Term (six year) road investment programs.

(2) Future Plan

The DPWH RBIA, RTIA, and TARAS databases can be enhanced to incorporate traffic data generated by an ITS, and/or they can be interfaced with separate ITS – e.g., the MMDA system – in order to collect, process, and deliver to users relevant traffic information.

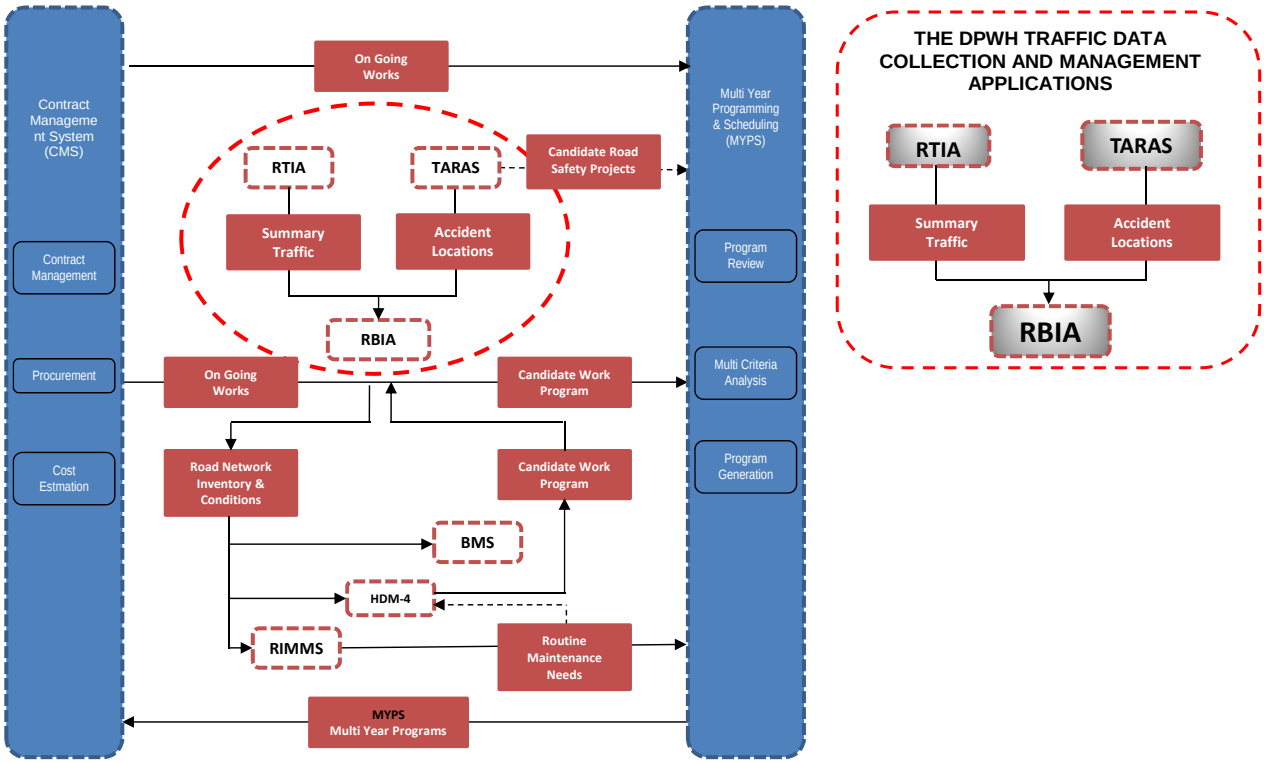


FIGURE 6.1-17 DPWH INTEGRATED INFRASTRUCTURE PLANNING SYSTEM

With information imported from these databases, the DPWH employs the following planning systems, as described above, to systematically generate priority lists of road construction and maintenance projects based on objective criteria using life cycle cost-benefit analyses under alternative budget envelopes.

- Pavement Management System (PMS)
- Highway Development and Management Version 4 (HDM-4)
- Bridge Management System

- Multi-Year Programming and Scheduling System
- Routine Maintenance Management System

Funds for the data collection and processing for the RTIA, RBIA, TARAS and related systems come from the budget of the DPWH under the General Appropriations Act (GAA) and the Motor Vehicle User's Charge (MVUC) Special Funds.

While the DPWH collects information on National Roads, including inventory, condition, traffic, and accident data, and maintains databases for this purpose – mainly RBIA, RTIA, and TARAS – other agencies are also involved in related data collection.

- The LGUs collect information on their respective local roads
- The MMDA gathers road (National) and traffic data for Metropolitan Manila.

The toll road operators – viz.,

- Manila North Tollways Corporation (MNTC) for the North Luzon Expressway (NLEX),
- South Luzon Tollways Corporation (SLTC) and Manila Toll Expressway Systems for the South Luzon Expressway (SLEX),
- Citra Metro Manila Tollways Corporation (CMMTC) for the Skyway and SLEX from Magallanes to Alabang,
- Philippine Reclamation – UEM-MARA Corporation for the Manila-Cavite Toll Expressway (MCTE),
- Bases Conversion Development Authority (BCDA) for the Subic-Clark-Tarlac Expressway (SCTEX), and
- Star Infrastructure Development Corporation (SIDC) for the Southern Tagalog Arterial Road (STAR)

– also collect road and traffic information for their respective toll roads.

6.1.8 DPWH Role in ITS

From the foregoing discussion of the mandate, functions, and budget of the DPWH, the following may be deduced insofar as the role of the DPWH in ITS is concerned:

- The DPWH, as the State's engineering and construction arm, may develop and implement standards and guidelines to ensure the safety of public roads and the efficiency and quality of construction. These standards/guidelines may include standards, where feasible, for the use of ITS and ETC for public roads – whether national or local roads, and whether ordinary (non-toll) or toll roads – in order to promote public safety, convenience, and efficiency in transportation and traffic flow.

- The DPWH is directly responsible for the funding, design, construction and maintenance of National Roads. These activities inherently include “street furniture” and other appurtenant on-road and off-road facilities necessary for the safe and efficient use of these National Roads, such as ITS infrastructure, e.g., traffic lights, CCTV, traffic sensors, monitoring centers, etc.

- The DPWH is also mandated to carry out the integrated or network planning for highways of all categories – national/local roads, and ordinary non-toll roads/tollways – which may include accessory facilities, e.g., ITS, that will promote the coordinated flow of traffic within the road network.

6.2 TOLL EXPRESSWAY OPERATORS

6.2.1 Overview of Expressway

As for Mega Manila expressways, the Subic-Clark-Tarlac Expressway (SCTEX) and North-Luzon Expressway (NLEX) are in operation, and the Tarlac-Pangasinan-La Union Expressway (TPLEX) is now under construction in the northern area. In addition, the Central-Luzon-Link Expressway (CLLEX) is now at the planning phase, which is to be constructed through a Yen loan project. The Metro Manila SKYWAY (Skyway), South-Luzon Expressway (SLEX), Manila Cavite Toll Expressway (Cavitex), Southern Tagalog Arterial Road (STAR) are now in operation in the southern area. The Cavite-Laguna Expressway (CALAX) is now under preparation of construction through PPP and Yen loan project.

All of the above-mentioned expressways are operated by private entities and apply the PPP business scheme. The operation has been conducted in two ways. One is through a joint venture scheme under which a private company formed a consortium with a state-owned enterprise with a toll road franchises. The other way is by a BOT scheme under which a private entity entered into a concession agreement with DPWH. The latter business scheme is applied to the STAR and TPLEX. The number of expressways operated under the BOT business scheme is so far not many. However, it is proposed that the PPP law and its implementing rules and regulations, which are in the process of review, will articulate that DPWH will be the agency concerned for making concession agreements with private concessionaires; therefore, DPWH will be increasingly involved with concession agreements which will be the basis for expressway construction projects.

(1) Present Situation of Toll Collection of Expressways

Two different types of ETC systems are in operation in the three toll expressways in Mega Manila. One is called as EC-tag/Easy-trip pass which was introduced in NLEX. The other is called E-Pass which was introduced in SKYWAY and SLEX. These two systems are

incompatible with each other. Therefore, road users must have two types of on-board units in their vehicles when they use the two expressways.

At present, E-tap is introduced in CAVITEX. E-tap is a touch-and-go IC Card used at toll gates. As for other toll expressways, toll collection is done on cash basis. **Table 6.2-1** shows the toll collection type of each expressway.

TABLE 6.2-1 PRESENT TOLL COLLECTION TYPE

Area	Exp.	Length (km)	O&M co.	Toll Structure	Toll Collection Type
North	NLEX	82.6	MNTC	Closed System (partially open)	Cash Easy-trip (DSRC Passive) Magnetic Card
	SCTEX	93.8	BCDA(MNTC O&M)	Closed System	Cash only
South	SKYWAY (elevated)	16.2	CITRA/ San Miguel Corp.	Closed System	Cash E-pass (DSRC Passive)
	SLEX(at grade)	13.4			
	SLEX	37.2	San Miguel Corp.	Closed System	Cash E-pass (DSRC Passive)
	CAVITEX	18.0	PEA tollway Corp.	Open System	Cash E-tap (Touch and Go)
	STAR	41.9	San Miguel Corp.	Closed System	Cash only

NLEX (Easy Trip) OBU 1700 peso
inc. 300 peso toll free

CAVITEX (E-tap) Card 100 peso
(touch and go)

SLEX & Skyway (E-pass) OBU 2400 peso

- Easy trip and E-pass are both 5.8GHz-Passive DSRC.
- Not compatible, but technically compatible

OBU: On-Board Unit

FIGURE 6.2-1 ETC OBU AND IC CARD

(2) Present Status of Traffic Control Center the Expressway

At present, three expressways have installed traffic control centers shown in **Table 6.2-2**.

TABLE 6.2-2 PRESENT TRAFFIC CONTROL SYSTEM FOR EXPRESSWAY

	NLEX	SCTEX	SKYWAY/ SLEX	SLEX	STAR	Cavitex
Traffic control center	+	Not yet	+	+	Not yet	Not yet
Traffic between IC	Loop coil	Only toll gate data	CCTV, motion detector (10)	Only toll gate data	Only toll gate data	Only toll gate data
Traffic congestion	Monitoring by CCTV (63), travel speed	Patrol car	Monitoring by CCTV (48)	Monitoring by CCTV (39)	Patrol car	Patrol car
Travel speed	Measure for each lane	Not yet	motion detector	Not yet	Not yet	Not yet
Accident, incident	CCTV, Emergency phone, Cell phone, or Patrol car	Cell phone, or Patrol car	CCTV, Cell phone, or Patrol car	CCTV, Cell phone, or Patrol car	Cell phone, or Patrol car	Cell phone, or Patrol car
Variable Message Sign	+ (31)	Not yet	+	+ (2)	Not yet	Not yet
Traffic information provision	Not yet	Not yet	Website, smartphone with MMDA	Not yet	Not yet	Not yet
Overweigh	Weigh in bridge (4)	Not yet	Weigh in bridge (1)	Weigh in bridge (mobile 1)	Not yet	Not yet

6.2.2 North Luzon Expressway (NLEX)

Traffic control of NLEX is in operation in the Traffic Control Room (TCR), which is managed by MNTC, for 24 hours per day and 365 days per year. The TCR is operated by one control person and two operators. The multi-displays, including large displays, are equipped on the central wall of the TCR. Displays can be switched, and the operating monitor display is equipped with a control table.

FIGURE 6.2-2 TCR OPERATED BY MNTC

Four multi-displays located on the upper part of the large display show the NLEX network. The location of the patrol vehicles can be easily be identified with the Automatic Vehicle Locator System (AVLS). The present locations of patrol vehicles are identified through GPS and, when a traffic accident occurs, the nearest patrol vehicle is informed of that accident. The expressway is shown by each lane, and roadside facilities are also clearly displayed.

All vehicle detectors are loop-coil systems and they are installed one by one between ICs. The vehicle detectors can detect the number of passing vehicles and the vehicle running speed as well as the length of vehicle by each lane. The information can be identified on the monitoring displays. The data are collected at intervals of 6 minutes for each lane.

FIGURE 6.2-3 AVLS AND TRAFFIC CONDITION BY EACH LANE

CCTV is installed on the entire stretch of the expressway and CCTV control equipment can be operated on the operators' desk in order for the operators to change displays. There are 63 CCTV cameras which include fixed and movable types.

Emergency telephone equipment is likewise installed in the entire stretch of the expressway. When a report from the emergency telephone comes, the telephone call can easily be detected in the TCR. In addition, so as to report to the TCR even by a cellular phone, the hotline telephone number is shown along the expressway.

As for communication for business use, special radio system and telephone can be used. Communication with a patrol vehicle is done by using such radio system.

FIGURE 6.2-4 TELEPHONE AND RADIO SYSTEM FOR BUSINESS USE

Traffic information is provided at a toll booth and on a roadside small information board. An operator inputs text data from the monitoring display into the information board, and such display pattern as on-off is selected. The contents of the information provision on the information board can be identified through pop-up windows. Thirty-one Variable Message Signs (VMS) are installed. Traffic information is provided via twitter (https://twitter.com/nlextraffic).

FIGURE 6.2-5 SMALL INFORMATION BOARD AND MONITORING DISPLAY

Violation of a vehicle speed limit is detected by portable speed guns, and pictures of the violated vehicle are sent to the patrol vehicle. The patrol vehicle chases the violating vehicle on the basis of such information.

Overloaded large vehicles are detected by a weighing machine, which is installed at the toll gate. A vehicle detected as overloaded is not allowed to pass through the expressway and has to exit through the side road located at the toll gate.

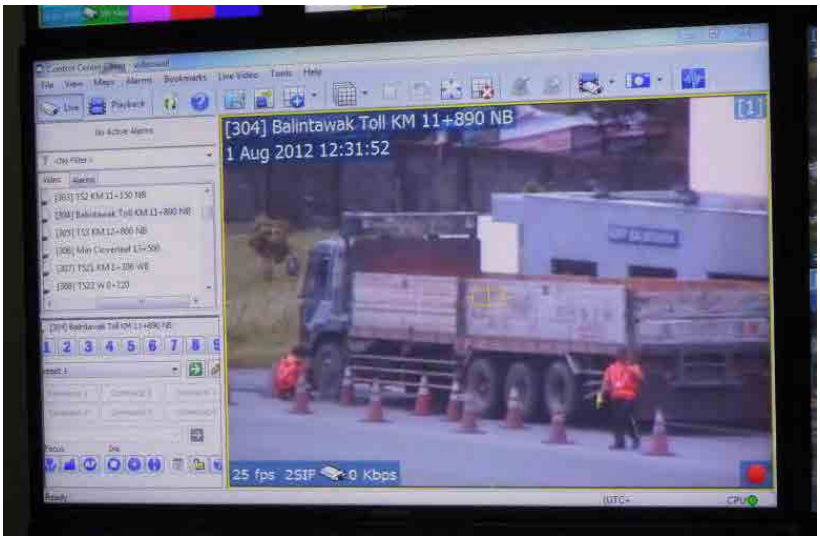


FIGURE 6.2-6 PORTABLE MEASURE OF WEIGHT OF A LARGE VEHICLE

The NLEX has launched its real-time online travel advisory system called “NLigtas” to enable motorists to monitor traffic situations along the expressway.

“NLigtas” features color coding for different traffic conditions. The green marking on the point of location means “light traffic,” while yellow signals “moderate traffic.” Yellow-red indicates “moderate heavy traffic,” and red notifies “heavy traffic” situation.

The NLEX’s online traffic manager covers the whole stretch of NLEX, from Balintawak to Dau, until SCTEX’s Sta. Ines exit.

Through sensors installed at strategic points at NLEX, the NLEX control room can detect and measure the actual speed and travel conditions. These are processed in real time by “NLigtas.”

Source: www.tollways.net.ph

FIGURE 6.2-7 NLIGTAS (REAL-TIME ONLINE TRAVEL ADVISORY SYSTEM) ON WEB IMAGE

Future Plan

- Introduction of automatic provision functions (for the five VMSs located before the event spot, for example) is now under preparation.

Others

- It seems that traffic information on the highway of the south side of Metro Manila is not urgently needed at this time. However, it is desirable to make the traffic information (including street information) available for the future.
- Newsletters (NLExpree/free papers) are distributed to the subscribers as a user service. They are also distributed in the service area and administrative offices.

(1) Overview of Facilities

1) ETC lane (mixed-use lane of ETC and cash)

ETC lane (or mixed-use lane of ETC and cash) facilities consist of ETC Beacon, Optical Vehicle Separators, Sign Board, Traffic Control Gate (TCG), Classification Repeater Sign (CRS) and Amber Light.(**Figure 6.2-8**).

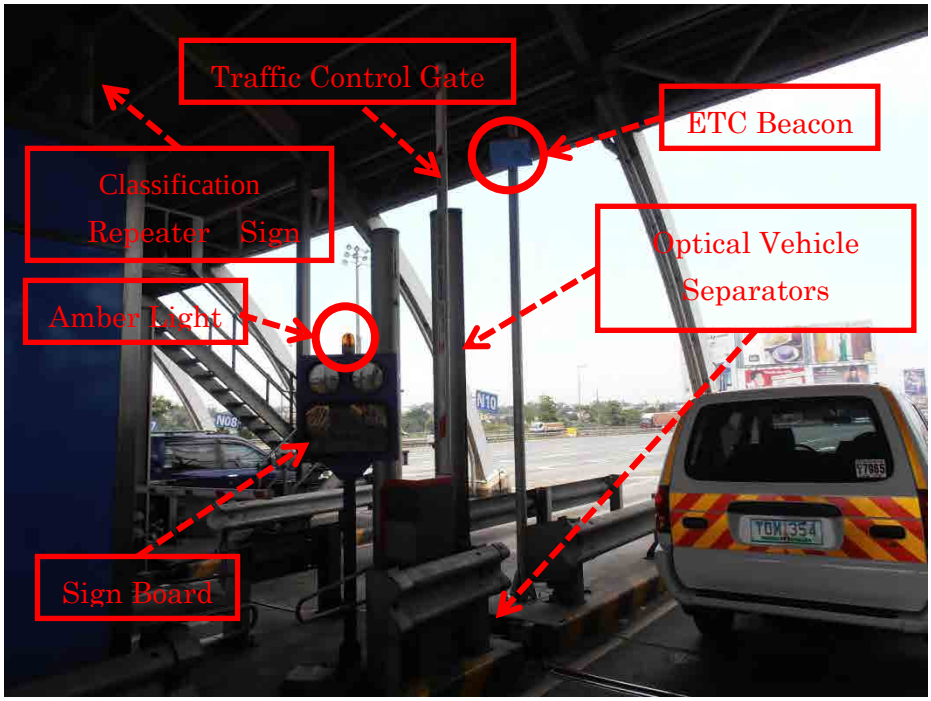


FIGURE 6.2-8 ETC LANE

a) ETC Beacon

- 5.8 GHz frequency band is utilized. Transmission standards with On-board Unit are subject to CEN.
- Remaining Balance is checked by reading information of Tag-ID, entry gate and time from Tag.
- Entry gate information is written in the Tag at entry in the zone where a Distance-based toll system is adopted. Toll fee is calculated by reading entry gate information at exit which was written in the Tag.
- Remaining Balance Information is stored in the database of servers at the Center and each toll plaza on ID-to-ID basis. Then, Remaining Balance is checked by matching the ID which has been stored in the database on the server and the Tag-ID which was read by the antenna. Remaining Balance Information is not recorded in the Tag.
- Red lamp of the Sign Board lights up when Remaining Balance is zero. Yellow lamp of the Sign Board lights up when Remaining Balance is scarce.
- Some drivers hold their Tag over the car window probably because road-to-vehicle communication is unstable.

b) Optical Vehicle Separators

- This equipment includes vehicle height sensor, axis detection sensor, vehicle intrusion detection sensor（at the Presence Loop）, and leaving vehicle detection sensor （at the Passage Loop）. Then the vehicle type is automatically classified based on the detection result of vehicle height sensor and axis detection sensor. If the classification result is different from the vehicle class information stored in the tag, such information is to be adjusted later.
- A tread board had been adopted to count the number of axles but it was replaced by an infrared sensor due to repeated problems with the tread board.

FIGURE 6.2-9 OPTICAL VEHICLE SEPARATORS

- Currently, a sensor with both vehicle height detection function and axis counting function is introduced. (**Figure 6.2-10**)

FIGURE 6.2-10 VEHICLE HEIGHT DETECTOR

- The vehicle intrusion detection sensor is buried beside the toll booth and the leaving vehicle detection sensor is buried behind the toll both. The toll gate bar initiates an action of closing based on the sensing signal of leaving vehicle detection sensor.

c) Traffic Control Gate (TCG)

FIGURE 6.2-11 TRAFFIC CONTROL GATE

- The toll gate bar is made of steel and it moves only by opening and closing directions.
- If a vehicle bulldozes through the gate bar, damage remains on the vehicle body due to the solidness of the gate bar.
- Vehicle transit speed will slow down since opening and closing of the gate bar is as slow as 1.5 seconds. Vehicles are almost stopped there. Another cause of the slowdown is that the positions of the antenna and gate are almost the same.
- The toll gate bar initiates closing based on the sensing signal of the leaving vehicle detection sensor; however, it stops the closing movement and initiates to open or remains open if the charging process of the following vehicle is already finished.

FIGURE 6.2-12 TOLL GATE BAR

d) Sign Board, Amber Light

- Vehicle class, toll fee and guidance information are displayed.

FIGURE 6.2-13 SIGN BOARD AND AMBER LIGHT

- Amber Light automatically turns on if the Remaining Balance is scarce or violating vehicle is passing through.
- Guidance information includes safe driving enlightenment messages.
  (**Figure 6.2-13** Upper sentence in the above picture says “Thank you” and lower sentence says ”Take care.”)

e) Classification Repeater Sign (CRS)

- Vehicle Class determined by a teller is displayed
  (**Figure 6.2-14** : left (Class 1) right (Class2))

FIGURE 6.2-14 VEHICLE CLASS REPEATER SIGN

2) ETC-only lane

A simple gantry is placed ahead of ETC-only lane to prevent entry of class 2 or class 3 vehicles. This is because basically ETC-only lane had been available only for class 1 vehicles. Then, Tags for class 2 and class 3 vehicles were issued. Even now, ETC-only lane only permits entry of class 1 vehicles. However, all vehicles can use such lane under present circumstances.
(**Figure 6.2-15** shows the situation without simple gantry)

FIGURE 6.2-15 ENTRANCE OF ETC ONLY LANE

Installed equipment is not much different from that of mixed lane. However, Lane Traffic Light (LTL) and Alarm Security Device (ASD) are installed instead of Sign Board because everything is processed automatically.

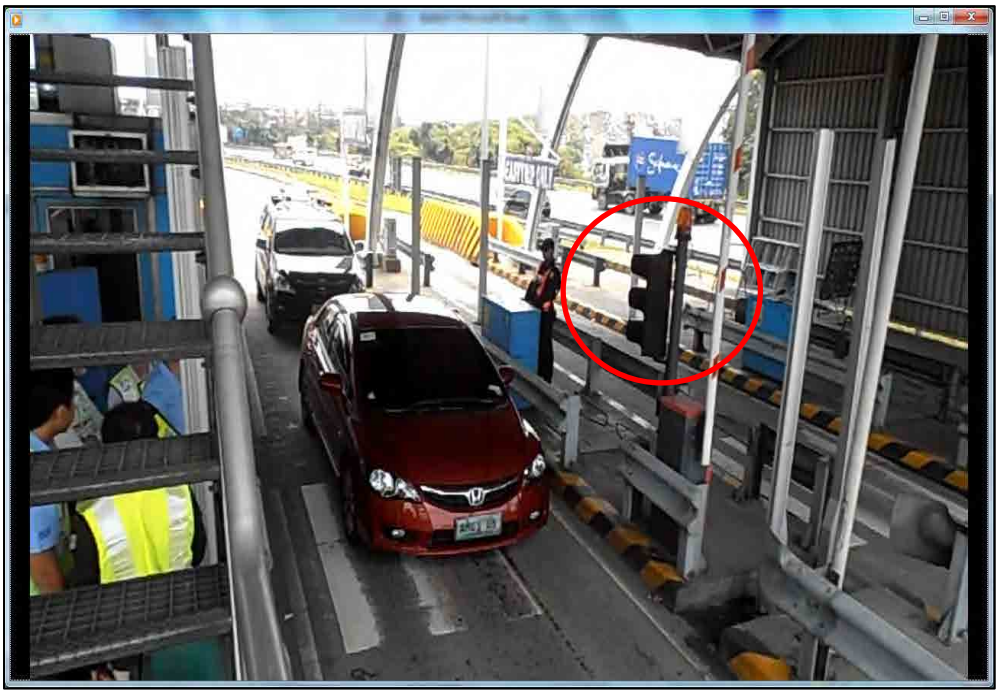


FIGURE 6.2-16 TRAFFIC LIGHT AT TOLL GATE

3) Toll booth monitoring room

- At all times, there are two staff members (one supervisor and one operator) in three eight-hour shifts around the clock at the toll booth monitoring room.
- The toll plaza can be seen from the toll booth monitoring room.(**Figure 6.2-17**)

FIGURE 6.2-17 MAIN TOLL PLAZA

- There is one monitor for operation of building surveillance camera and another monitor for operation of surveillance camera monitoring inside of the booth. Both can be remotely operated.

FIGURE 6.2-18 TOLL BOOTH MONITORING

- There is one monitor which shows toll receiving status (e.g., status of vehicle classification and opening or closing of the gate, etc.) of each lane in real time.

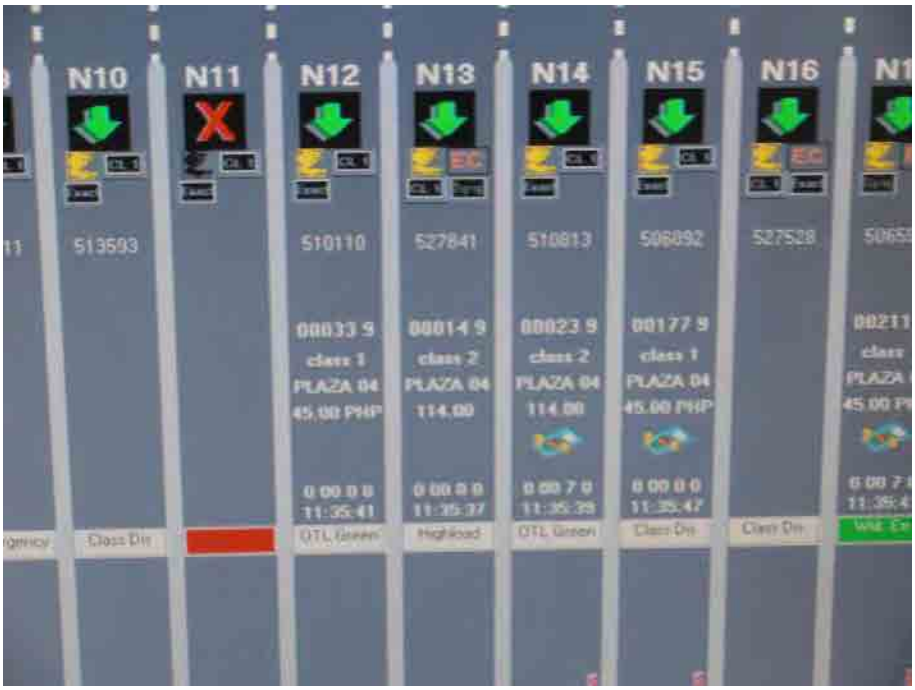


FIGURE 6.2-19 TOLL BOOTH MONITORING DISPLAY

- Tellers go through exclusive path(s) in the toll collection area when moving from toll plaza (toll booth) to toll booth (toll plaza). Stairs to the booth are installed approximately one in four lanes. A bar is provided to prevent tellers from popping out of the lane.

FIGURE 6.2-20 TELLER MOVING PASS

6.2.3 SKYWAY

SKYWAY traffic control is conducted by the SKYWAY O & M Corporation. In the TCR, one control person and two operators are in charge for 24 hours a day and 365 days a year. Forty four CCTVs are installed on the roadside area and 6 multi displays are equipped in the TCR.

Three PCs are in operation on the control desks, and change of multi displays and camera control is available through these PCs.

FIGURE 6.2-21 TCR OPERATED BY SKYWAY O & M CORP.

CCTV camera image adopts High-Definition Video (HDV) technique, and images are recorded through a recording system.

In addition, by using some CCTV images, CCTV is utilized as a Motion Detector for vehicle detection. As for vehicle detection, such vehicle information as size, running speed and length are detected for each vehicle.

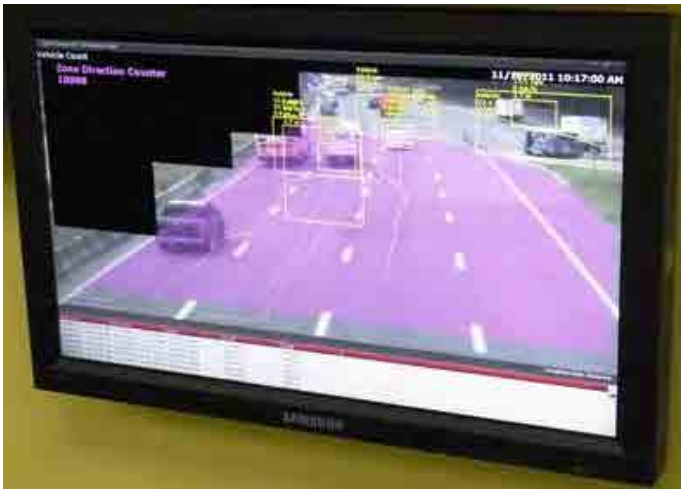


FIGURE 6.2-22 MOTION DETECTOR

An emergency telephone is not equipped on the roadside area, instead, the hot-line phone number: 776-7676 is provided and a special telephone is installed in the TCR for receipt of emergency calls. A telephone and radio system for business use is equipped in the TCR so that operators can communicate with patrol vehicle drivers by using these telephone and radio. Traffic information, which includes amount of toll and traffic condition, is provided on variable information display board installed at two locations at the toll gate. Traffic information is also provided through the web site every 15 minutes. The web site is managed by the Metro Manila Traffic Navigator which is operated by TV5 and MMDA. Twitter is available as well.

FIGURE 6.2-23 PC FOR WEB SITE OPERATION

6.3 MMDA: METROPOLITAN MANILA DEVELOPMENT AUTHORITY

6.3.1 Outline of MMDA

Metro Manila, also called the National Capital Region, constitutes the core of Mega Manila and is given clear statutory authority as the metropolitan region. The Metropolitan Manila Development Authority (MMDA) is responsible for the formulation of cross-sectional development plans, road traffic management and formulation/implementation of measures against disasters in the Metro Manila region comprising one municipality and 16 cities.

6.3.2 Present Status and Future Vision Concerning ITS

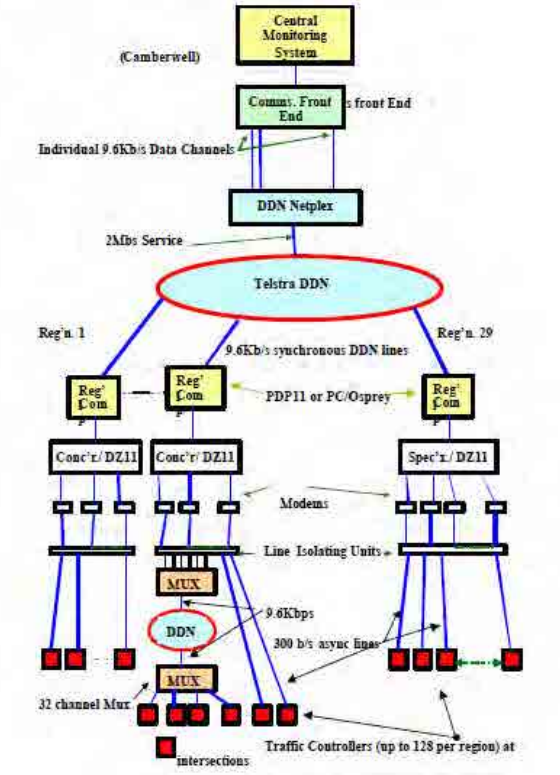
Urban highways in Metro Manila are controlled through the Traffic Engineering Center (TEC) managed by MMDA. TEC consists of the Traffic Signal Control Department and of the Information Provision Department. By utilization of CCTV, TEC is operated for 24 hours a day and 365 days a year. The following description is about traffic signal control and CCTV monitoring:

(1) Present Situation of Traffic Signal Control and Vehicle Detector

As for traffic signal control, Japanese systems ("National" products) were adopted in the past. However, the system was taken over by an Australian system called Sydney Coordinated Adaptive Traffic System (SCATS) 13 years ago. SCATS is now still in the operation. However, since the spare parts now are not produced any more, procurement of spare parts is quite difficult.

Traffic signal control is done on the basis of centralized control scheme. Traffic control is conducted every morning, noon and evening based on traffic demand in each time.

The coverage areas of traffic signal control are four regions, and each region has at least one control system. The four coverage areas are Region 1: Southern Area of City of Manila, Region 2: Northern area of City of



source : http://www.patrec.org/web_docs/atrf/papers/2002/Zabrieszach%20&%20Petridis%20(2002).pdf

FIGURE 6.3-1 SYSTEM COMPONENT FOR SCATS

Manila, Region 3: Quezon City and Region 4: Makati City and Pasig City. Supervision and control of the control system is conducted through monitoring traffic signal control systems equipped in each region. The control is done on the command line basis. Therefore, user interface is not effectively applied.

Allocation of racks for traffic signal control

Allocation of racks for traffic signal control

DATAPLEX and PLC※1

※1：Programmable Logic Controller

Modems and regional computers

FIGURE 6.3-2 ALLOCATION CONDITION OF TRAFFIC SIGNAL CONTROL SYSTEM

Most of the traffic signal control systems adopt loop-coil type vehicle detectors, which are embedded under ground. There are3,130 vehicle detectors. Of these, however, 1,588 detectors are in operation, while the remaining 1,542 detectors are broken down. Out of a total of 455 intersections, 388 are controlled by traffic signal control systems.

The number of signal controlled intersections and related facilities are shown as follows:

TABLE 6.3-1 NUMBER OF INTERSECTIONS, TRAFFIC SIGNAL CONTROL SYSTEMS AND VEHICLE DETECTORS

Breakdown	Region 1	Region 2	Region 3	Region 4	Total
Number of total intersections	112	113	110	110	445
Number of controlled intersections	(90)	(103)	(100)	(95)	(388)
Number of traffic signal control systems	108	104	104	101	417
Number of vehicle detectors	805	860	603	862	3,130

Vehicle detectors which are now in operation are counting the number of passing vehicles, while other collected data for vehicle types, vehicle running speed and so forth cannot be said to be sufficiently reliable.

As for the communication cable, which is connected with the control center and the signal control unit at the intersections, the contract for lease the communication cable was made with Philippines Long Distance Telephone Company (PLDT). The communication is made on an analog basis.

(2) CCTV camera

MMDA has installed about 130 CCTV cameras, and the image data is transmitted by WiMAX lines owned by MMDA. These images are used for determination of traffic conditions, traffic surveillance (surveillance on illegal vehicle operations) and Traffic Navigator which will be discussed later.

Source: JICA Study Team

FIGURE 6.3-3 USE OF CCTV

(3) Digital Road Map (DRM)

MMDA's DRM does not cover the entire Metro Manila but only a part of it.

(4) Traffic database

MMDA collects and manages traffic volume and trip time on highways.

Details of materials related to this topic are still under investigation.

(5) MMARAS: Metro Manila Accident Research and Analysis System

MMDA maintains a database of traffic accidents. MMDA is responsible for making a traffic accident occurrence chart, whereas the Traffic Police is responsible for investigating and logging traffic accidents.

Details of materials related to this topic are still under investigation.

(6) Communication and Command Center

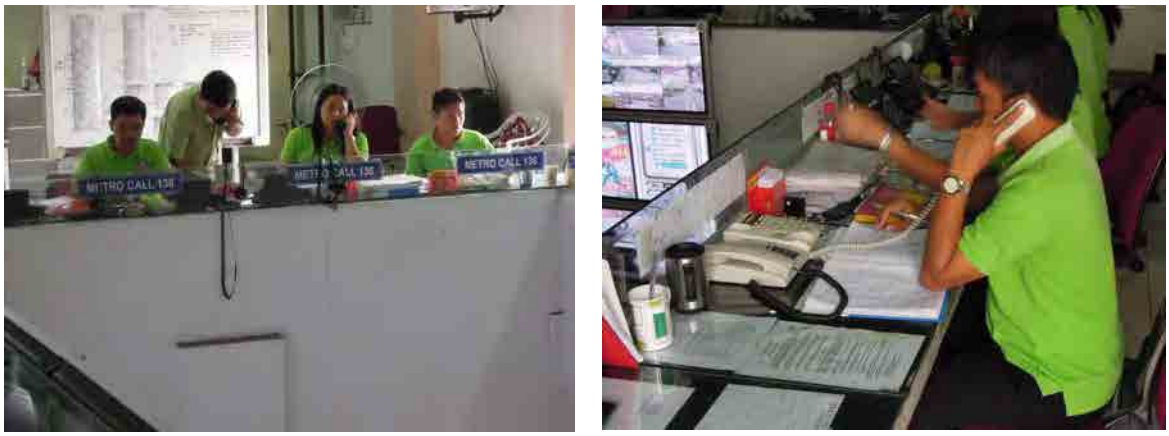
MMDA operates traffic management and information provision at the Communication and Command Center.

Source: Study team

FIGURE 6.3-4 COMMUNICATION AND COMMAND CENTER

<u>Call center</u>

MMDA has a call center similar to that of DPWH to handle inquiries from the users. Comments received at the call center are recorded and stored on paper.



Source: JICA Study Team

FIGURE 6.3-5 CALL CENTER

Traffic Navigator

MMDA operates Traffic Navigator, a web-based information provision system. On the MMDA official website, there is a link to Traffic Navigator, which is available not only on PCs but also on smart phones. The system provides information based on "CCTV image," "comments from Twitter followers," and "information from the MMDA traffic enforcers."

There are no judgment criteria for the congestion status provided on Traffic Navigator, and the level of congestion is determined by the surveyors' sensory judgment based on the CCTV image. For data cleansing of the information provided by the Twitter followers, there is a mechanism to classify the comments according to the reliability of the user's past comments.

When there was a flood during the rainy season, Traffic Navigator (Twitter) was very effectively utilized jointly by the public and private sectors in sharing information on flooding conditions. MMDA currently has the following plans:

- Early October 2012: "provision of CCTV images by video streaming," "provision of Twitter information of other organizations."
- Late November 2012: "provision of information on events under the jurisdiction of other organizations (e.g. floods, fires, crimes) on Map View."
- Early March 2013: "expansion of routes covered by the traffic information provision (expansion of routes covered by the traffic information provision based on the user comments, provision of information based on accumulated past data and utilization of GPS tracking data)."

In the meantime, MMDA does not seem to consider using smart phones as a medium to collect location information, since most of the smart phone users do not have flat-rate subscriptions.

Source: http://www.mmda.gov.ph/

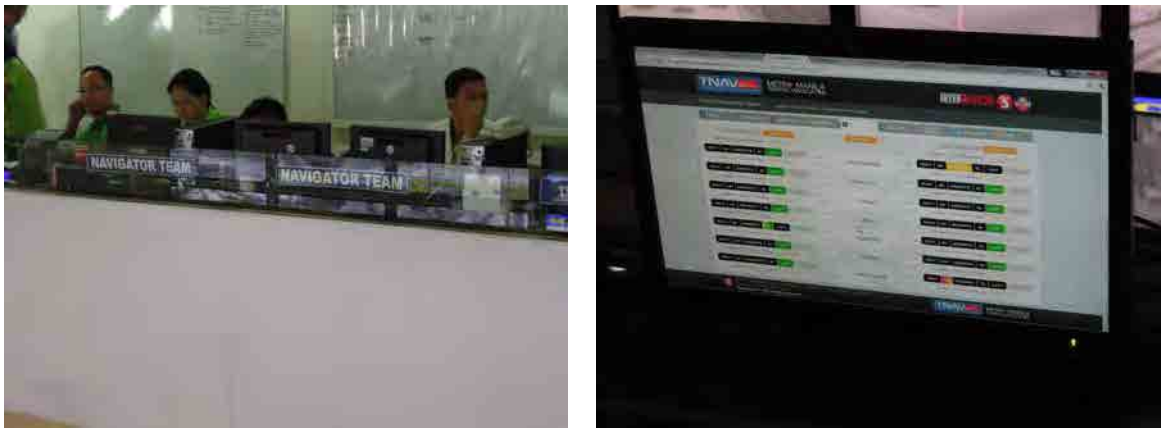
FIGURE 6.3-6 SCREEN SHOT OF TRAFFIC NAVIGATOR ON MMDA WEBSITE

Source: http://mmdatraffic.interaksyon.com/system-view.php

FIGURE 6.3-7 SCREEN SHOT OF TRAFFIC NAVIGATOR

Source: http://www.mmda.gov.ph/

FIGURE 6.3-8 INFORMATION ON TRAFFIC NAVIGATOR FOR SMART PHONES

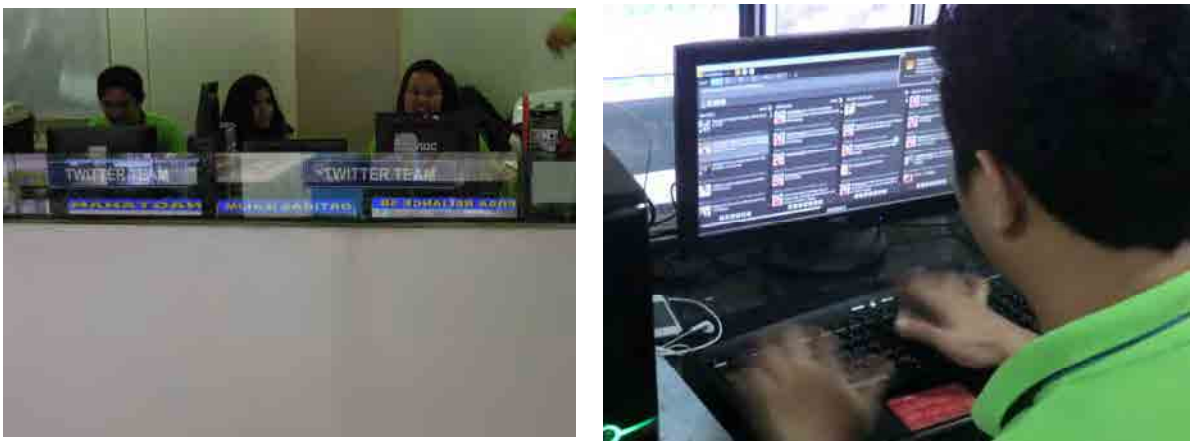


Source: Study team

FIGURE 6.3-9 NAVIGATOR TEAM

Source: MMDA website

FIGURE 6.3-10 SCREEN SHOT OF TWITTER



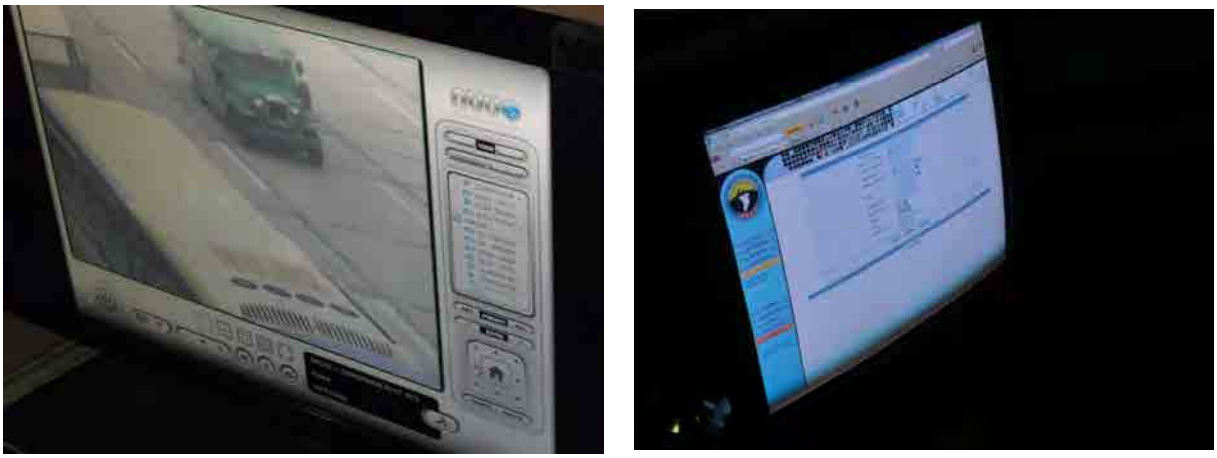
Source: JICA Study Team

FIGURE 6.3-11 TWITTER TEAM

Crackdown on illegal bus operations

In order to solve the issue of severe traffic congestion, MMDA uses the CCTV images and the tag (number) indicated on the bus roof to crack down on illegal buses driving outside the permitted routes.

As an administrator, MMDA wishes to keep track of operational conditions of the buses and is interested in introducing the menu regarding the use of a bus location system.



Source: Study team

FIGURE 6.3-12 SURVEILLANCE ON ILLEGAL BUS OPERATIONS

(7) Flood Control Information Center

As a part of measures against floods that frequently occur during the rainy season, MMDA provides flood information through the Flood Control Information Center.

Source: Study team

FIGURE 6.3-13 FLOODED STREETS

Source: Study team

FIGURE 6.3-14 FLOOD CONTROL INFORMATION CENTER

(8) Status of installation of variable message signboards (VMS)

MMDA has installed VMS along EDSA to provide information as needed.

Source: Study team

FIGURE 6.3-15 VMS

6.4 DEPARTMENT OF TRANSPORTATION AND COMMUNICATION (DOTC)

6.4.1 LRT - MRT / PNR

6.4.1.1 Transport Operation Information

(1) Existing Situation

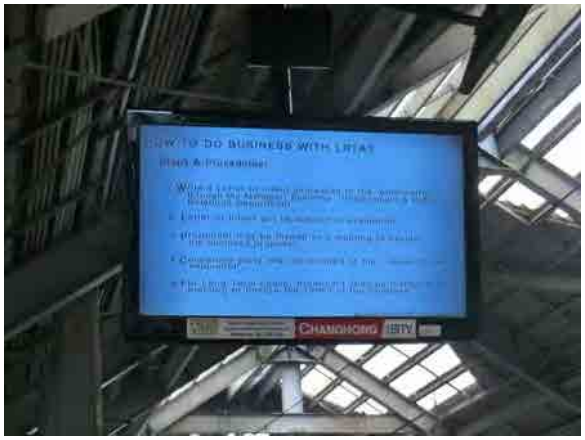
There is no overall train time schedule, and there is nothing to publish on the website or to transmit to Smart Phone's application officially. Passengers of public transportation just wait. There are LED displays in some LRT stations saying the train is coming in 3 minutes, probably just to allow people to decide if they can still buy something or whether to go near the loading area already. There is no hour-by hour schedule. Also, there are some LCD displays (see **Figure 6.4-1**); however, they disseminate advertisements only. Time schedule is disseminated on the website of each operator.

Also, some announcements are made through print media like Xpress Libre and other dailies, especially when there are changes in schedules during typhoons/calamities. These dailies are made available in the station.

(2) Future Plan

According to the minutes of meeting with DOTC, LRT - MRT operators do not have a plan for the improvement and implementation of transport operation information yet. This plan may be included in the Line extension projects.

Information board at LRT station

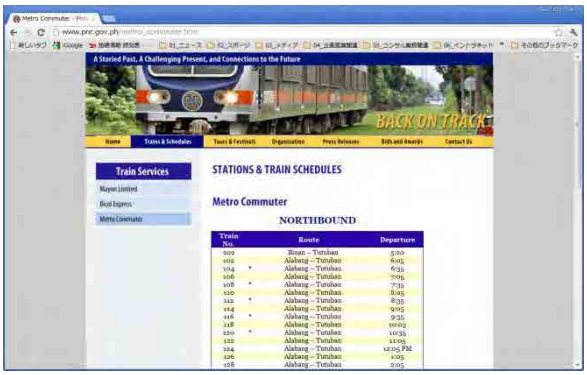


Advisement board at LRT station

Source: Study team

FIGURE 6.4-1 DISSEMINATION EQUIPMENT AT LRT STATION

Operating Schedule on LRTA Homepage



Operating Schedule on PNR Homepage

Source: LRTA / PNR website

FIGURE 6.4-2 DISSEMINATION OF OPERATING INFORMATION

Concourse of LRT

Congestion Situation

Source: JICA Study Team

FIGURE 6.4-3 DISSEMINATION EQUIPMENT AT LRT STATION

6.4.1.2 Automated Fare Collection (AFC)

(1) Existing Situation

Passengers can enter the LRT paid areas with either a single journey or stored value magnetic stripe plastic ticket. On the LRT1 and MRT Line, tickets are sold at ticket booths (see **Figure 6.4-4**); on the LRT2 Line they can also be procured from ticket machines.

There are two types of tickets for LRT/MRT, viz., a single journey ticket and a stored value ticket. Single journey tickets are for one-way use, while stored value tickets are for multiple use. Single journey tickets are only valid on the day of purchase and will be unusable afterward. Stored value tickets are usable on either LRT1 or LRT 2.

There used to be a Flash Pass ticketing system. It could be used on either LRT or MRT for an unlimited number of rides per day during a week. Access and control was through the staff/service gates where station personnel would check the validity and authenticity of the Flash Pass. However, the Flash Pass ticketing system has been discontinued.

Single journey ticket

Ticket gate

Ticket-vending booth (at Taft Ave. Station)

Ticket-vending booth (at Central Station)

Source: Study team

FIGURE 6.4-4 TICKETING SYSTEM OF LRT1

(2) Future Plan

Except for Stored Value Ticket users of LRT 1 and LRT 2, passengers transferring from one line to the other are required to purchase separate tickets resulting in multiple queuing times and boarding fees.

To remedy the inconveniences associated with a non-interoperable ticketing system, the DOTC is now pushing for the implementation of a common contactless AFCS that will be operable by January 1, 2015.

The feasibility study was done in July, 2012 under the Public-Private Partnership Center (PPP Center) and DOTC. This was called Transaction Advisory Services for the Automatic Fare Collection System Project and studied by Rebel (Netherlands), Allen & Overy (UK), Crisil (India), Royal Haskoning (Netherlands) and PJS Law (Philippines).

According to the feasibility study report, the main features of the proposed system are as follows;

LEVEL 0 : The contactless smartcards and tokens shall be ISO 14443-compliant and of either type A or type B. The contactless smartcards do not have to be fitted with a contact interface; it is not required in the public transport domain, and this contact interface would increase the price of the card and furthermore would have a negative influence on the durability.

LEVEL 1 : The automatic gates of LRT1 and LRT2 shall be equipped with contactless readers. Each contactless reader must have at least 4 ISO/IEC 7816 SAM-slots (Secure Application Module) supporting high baud rates.

LEVEL 2 : Station level equipment. All front-end equipment is connected to the Station Computer System.

LEVEL 3 : Line level equipment. All station level equipment along a metro line is connected to a Central Computer System.

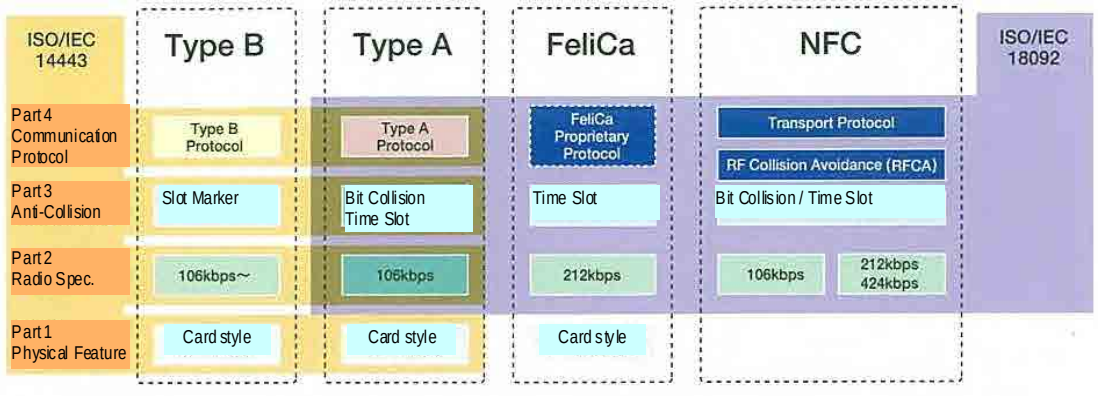
LEVEL 4 : Central Clearing House System (CCHS). This will oversee the card issuer and the owner of the stored value product (and therewith responsible for the float account). Each of the Central Line Systems connects with a single Central Clearing House System.

- A successful contactless AFCS implementation may lead to a wider application within the public transport sector through rollout into buses, toll roads, etc. and outside of the public transport sector (e.g. into retail applications), inducing wider economic benefits.
- In case the system fully conforms to the ISO 14443 standard, future extensions of the system in terms of media are warranted. This means that acceptance of, e.g., NFC capable devices (such as mobile phones) is not prohibited.

Implementation Schedule and Indicative Timelines of the project as follows;

- Start of bidding process ·····November / December, 2012
- Notice of Award·····2nd Quarter, 2013
- Construction/Installation Completion Date (Full Systems Acceptance) ····· Sometime, 2014
- Start of AFCS Operation ·····1st January, 2015

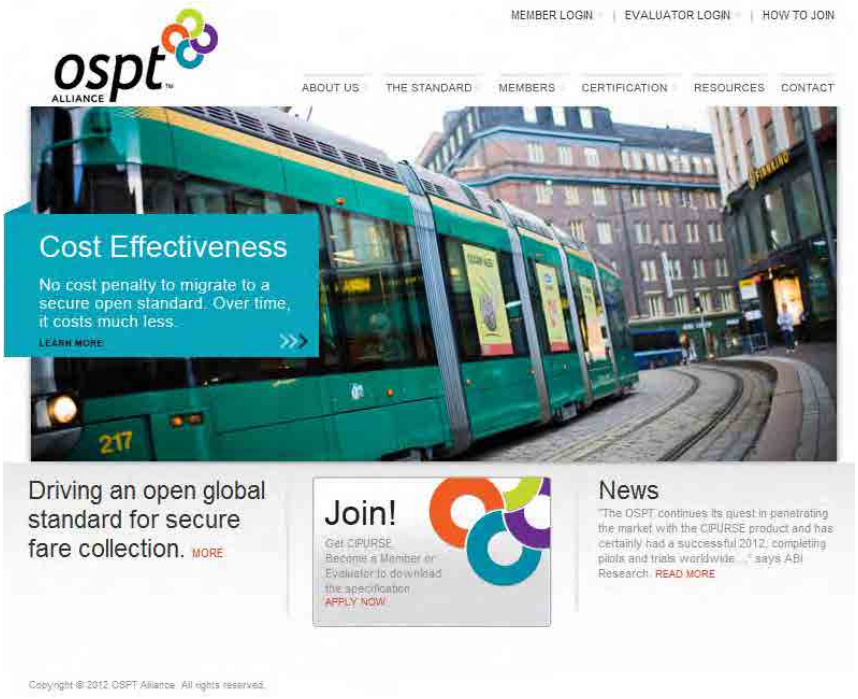
Additionally in the report, fully conforming to the ISO 14443 standard, it is not prohibited to apply any type of media, such as mobile phone. However, the type of media is defined in the ISO 14443. Therefore, a system fully conforming to other standards, namely, ISO 18092 and Near Field Communication (NFC) is better for multimedia support.



Source: SONY

FIGURE 6.4-5 RELATIONSHIP BETWEEN ISO/IEC14443 AND ISO/IEC18902

Also, there is the newest standard namely, the Open Standard for Public Transport (OSPT) or CIPURSE. It is an open security standard for transit fare collection systems. It makes use of smart card technologies and additional security measures. However, the standard is still under consideration, and a draft standard was issued December, 2010.



Source: OSPT website

FIGURE 6.4-6 WEBSITE OF OPEN STANDARD FOR PUBLIC TRANSPORT (OSPT) ALLIANCE

6.4.2 LTO / LTFRB

(1) Vehicle Register Information

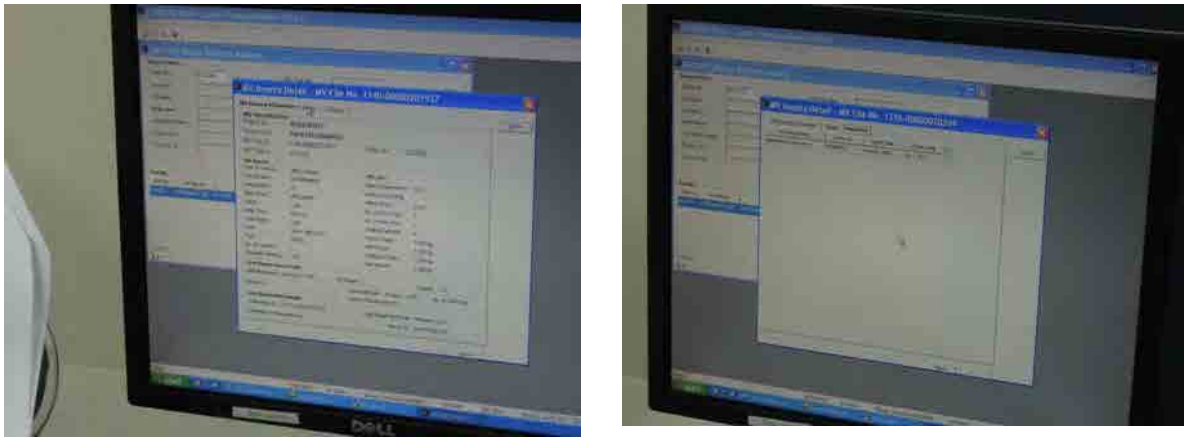
1) Existing Situation

Each of the attached agencies of DOTC, viz., such as LTO, LTFRB, LRT-1, LRT-2, MRT-3, and PNR, has its own database. These bases, however, are not connected on-line and not combined.

The existing data network set-up of LTO for the registration of motor vehicles is shown in **Figure 6.4-7**. The system is capable of providing such data as owner, inspection history, insurance history, and information about the franchise owner/operator and his vehicles, among others. However, the database is controlled by a private firm, namely, STRADCOM. Therefore, LTO does not have direct control over the database and has no immediate access to specific information in the database.

2) Future Plan

DOTC has initiated the bidding for a Road Transportation IT Infrastructure Project that will include, a new Motor Vehicle Registration System, combination for the each databases and interconnect with other organizations.



Source: JICA Study Team

FIGURE 6.4-7 USER INTERFACE OF MOTOR VEHICLE DATABASE

6.5 PRIVATE SECTOR

6.5.1 Parking Information

Parking information systems provide information on vacant parking spaces. The systems combine traffic monitoring, communication, processing and variable message sign technologies to provide the service. The system at Makati provides the parking information of Glorietta. (see **Figure 6.5-1**) The parking information is not provided by using internet website or other tolls. This system is implemented by the private sector developer of this area.

FIGURE 6.5-1 PARKING INFORMATION SIGN AT MAKATI

6.5.2 GPS Tracking

There are some GPS Tracking service providers in Philippines. GPS Tracking service uses satellite information combined with Digital Map (e.g. Google Map) to provide real-time locations and record historical vehicle activities. For the service, the specific equipment will be installed in a vehicle, and contains a GPS antenna and a wireless communication unit. The equipment transmits the location data to center servers via wireless communication network (e.g. GSM, 3G). According to the brochure of the service provider, there are many users such as Local Government, Logistics Company, Ambulance and Private user.

If the GPS tracking information of all users can be collected, then the data are useful for the observation of traffic conditions.

Source: PHILGPS website

FIGURE 6.5-2 EXAMPLE; LOCATION MAP AND SPECIFIC EQUIPMENT

STARCOMM

Source: http://www.starcomm.com.ph/

PHILGPS

Source: http://www.philgps.com/index.html

FIGURE 6.5-3 EXAMPLE; GPS TRACKING SERVICE PROVIDER IN PHILIPPINES

6.5.3 Car Navigation

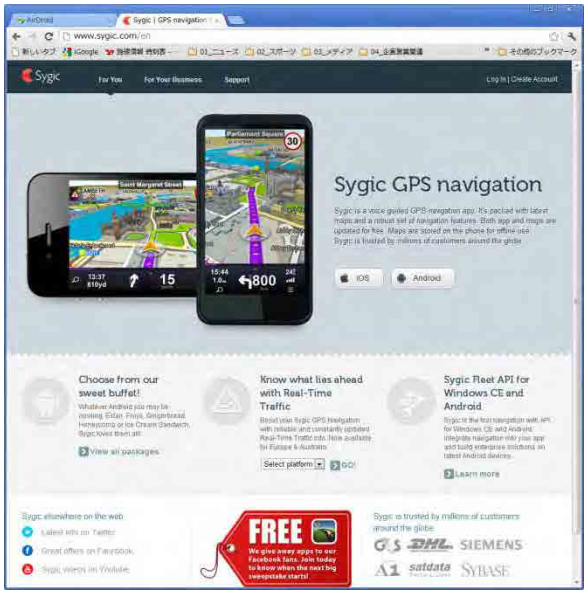
Car navigation system is sold at some hardware shops in the Philippines. Exactly, it is called Portable Navigation Device (PND), imported from overseas. (see **Figure 6.5-4**)

The car navigation is installed in approximately 20% of vehicles in Manila, according to the responses to the questionnaire survey of the Study Team. Additionally, approximately 24% of mobile phone users are using Smart Phone in the Philippines. Also, PDA will be rapidly integrated into Smart Phones (see **Figure 6.5-5**). Therefore, the market of PDA will be expanding rapidly in the Philippine.

Source: http://www.car-navi.ph/

Source: Study team

FIGURE 6.5-4 CAR NAVIGATION USING SPECIFIC EQUIPMENT



Source: http://www.sygic.com/en

Source: Study team

FIGURE 6.5-5 EXAMPLE; CAR NAVIGATION APPLICATION USING SMART PHONE

CHAPTER 7
ITS NEEDS SURVEY RESULTS

7.1 GENERAL

In order to identify the issues and needs, it is necessary to consider not only the present users' requirements but also traffic issues in the near future and changes in user needs. An ITS needs survey was conducted with the following users.

TABLE 7.1-1 ITS NEEDS SURVEY

Subjects of a survey	Interviewee		No. of Sample	
			(Target)	(Accomplish)
Road Traffic Users	Non-Toll Road Users	Drivers coming at LTO office in Metro Manila	1,000	1,137
	Toll Road Users	Drivers coming the in NLEX and SLEX	1,000	1,022
Public Traffic Users	Bus Users		1,000	412
	LRT, MRT Users			365
	Jeepney Users			297
Private Companies	Expressway Concessionaire	CAVITEX, NLEX, SLEX, Skyway, STAR and SCTEX	6	5
	Public Transport Operators	Bus company	10	10
		Taxi company	4	5
	Trucking company and Distributor		10	14
	TV and radio company,		5	5
	IT company		5	2
	Car supplier, Dealer		10	13
	Key Informants		20	15

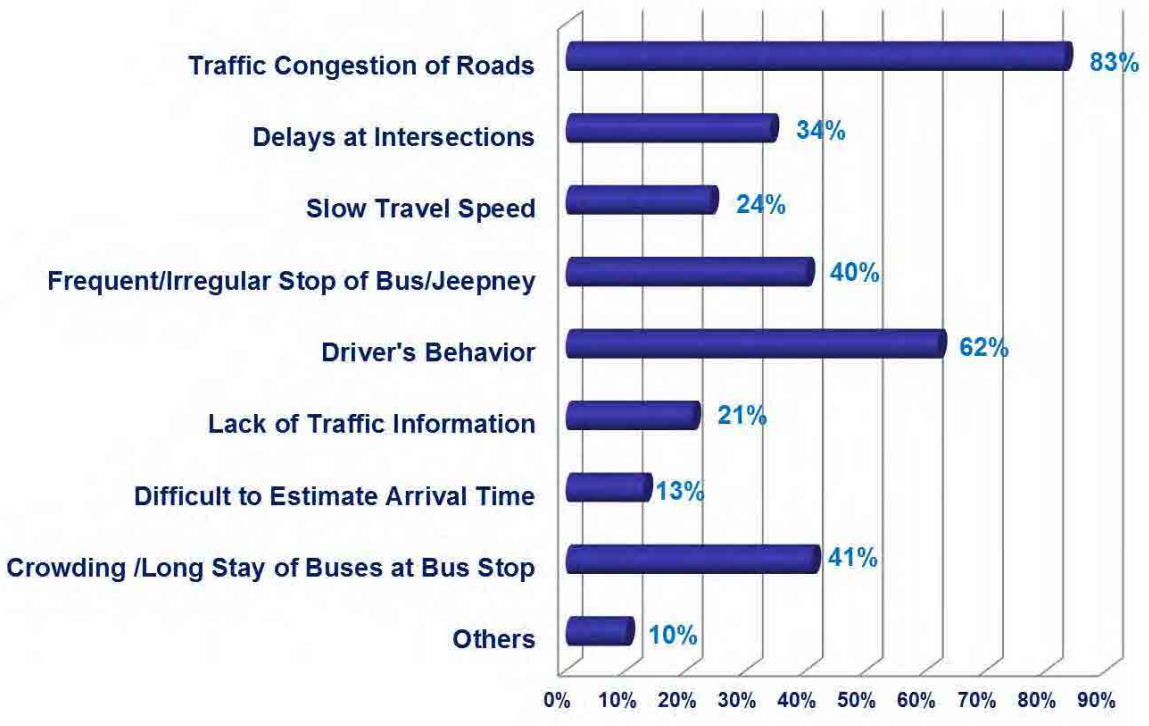
Source: JICA Study Team

7.2 SUMMARY OF NEEDS SURVEY FOR ROAD TRAFFIC USER AND PUBLIC TRAFFIC USER

Interview survey results are described in **Annex 7-1 ~ 7.3**. The main results are summarized below.

(1) Traffic Problems of Urban Roads:

Major traffic problems of urban roads are "Traffic Congestion of Roads", "Driver's Behavior" and "Crowding/Long Stay of Buses at Bus Stop".

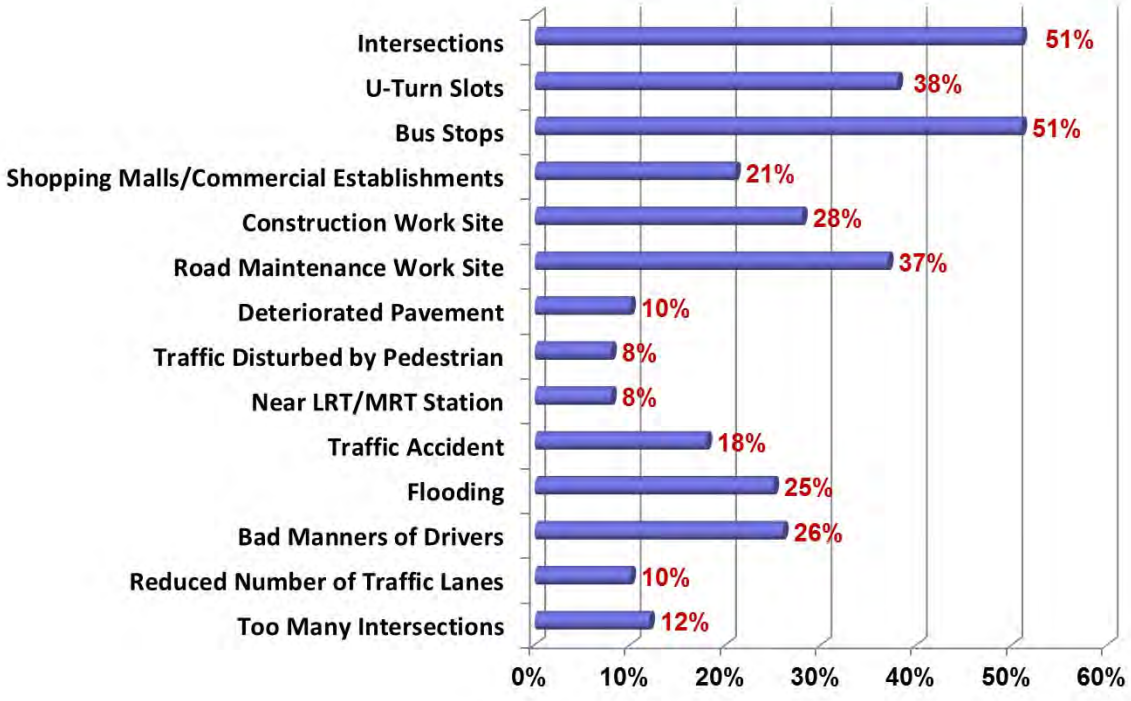


Source JICA Study Team

FIGURE 7.2-1 TRAFFIC PROBLEM EXPERIENCED IN METRO MANILA

(2) Traffic Bottlenecks of Urban Roads

As perceived by the respondents, the major bottlenecks in Metro Manila are "Intersections", "Bus Stops", "U-Turn Slots", and "Road Maintenance Work Site".

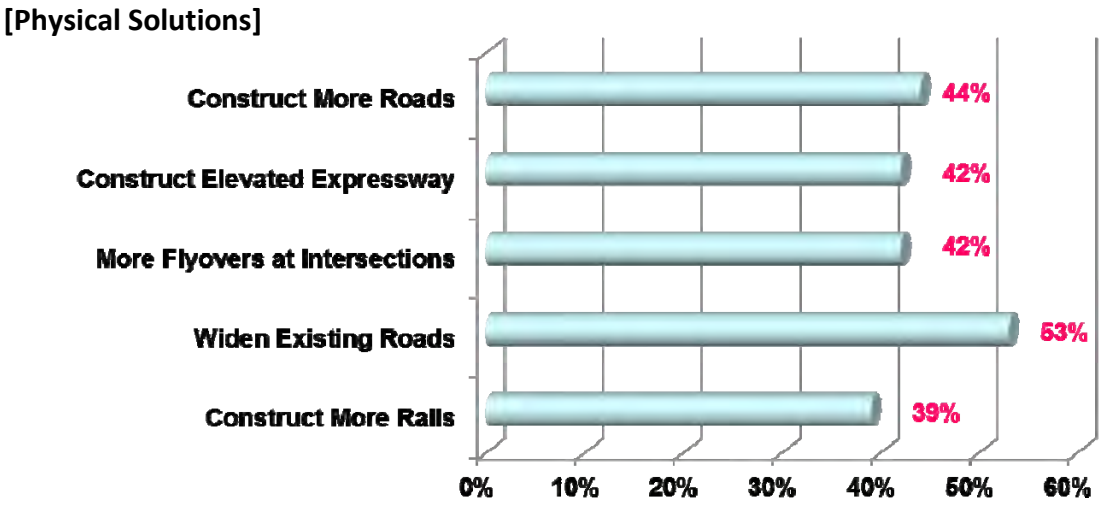


Source JICA Study Team

FIGURE 7.2-2 MAJOR BOTTLENECK IN METRO MANILA

(3) Road Users Opinions for Possible Solutions

Respondents suggest all kinds of physical solutions Since physical solutions needs much cost and time, software solutions will be necessary.



Source JICA Study Team
※ Road Users Interview (2,989 samples)

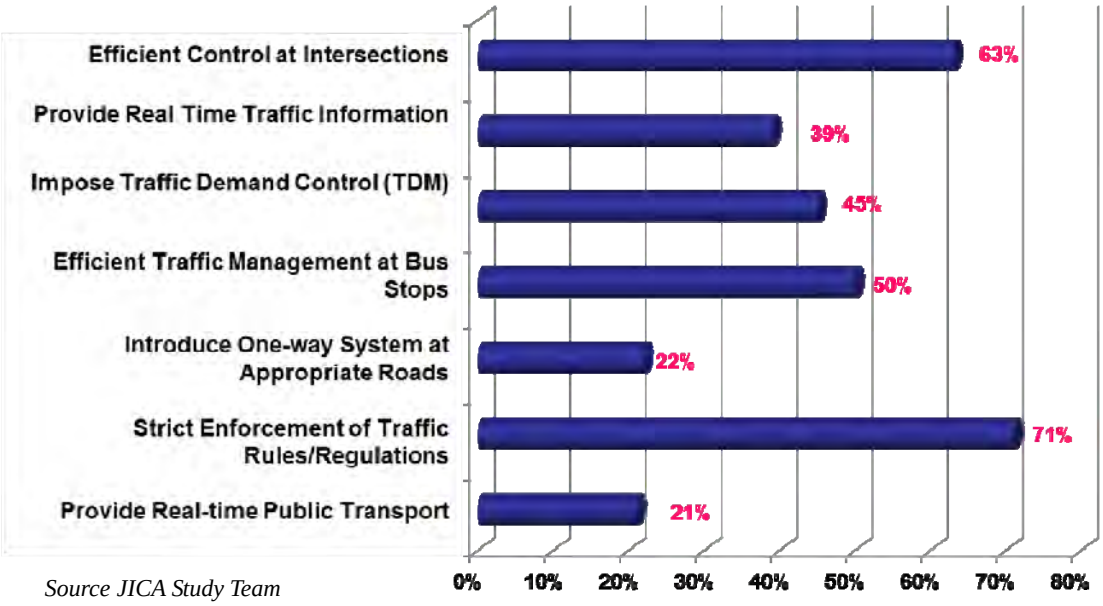
FIGURE 7.2-3 SUGGESTIONS FOR PHYSICAL SOLUTIONS TO METRO MANILA'S TRAFFIC PROBLEM

Physical Solutions

- ROW Acquisition quite difficult
- Huge Investment needed
- Needs several years to complete

Respondents suggest, as major software solutions, "Strict Enforcement of Traffic Rules/Regulations", "Efficient Control at Intersections" and "Efficient Traffic Management at Bus Stops".

[Software Solutions]

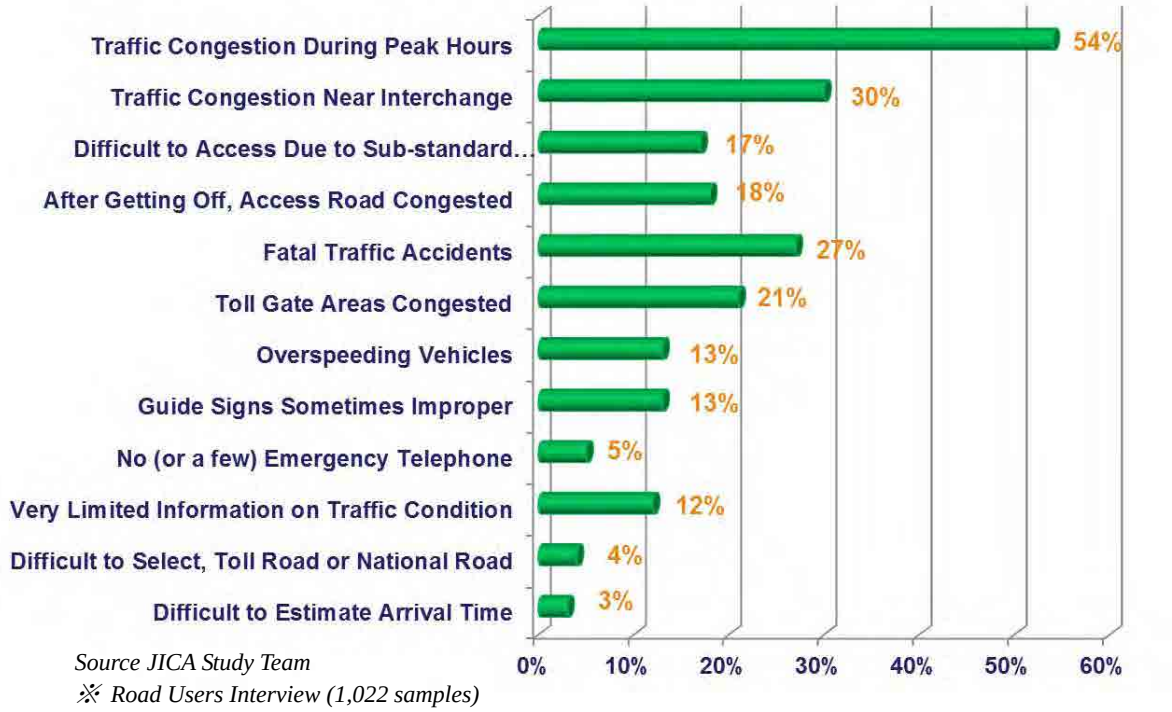


Source JICA Study Team
※ Road Users Interview (2,989 samples)

FIGURE 7.2-4 SUGGESTIONS FOR SOFTWARE SOLUTIONS TO METRO MANILA'S TRAFFIC PROBLEM

(4) Traffic Problems of Expressways and Possible Solutions

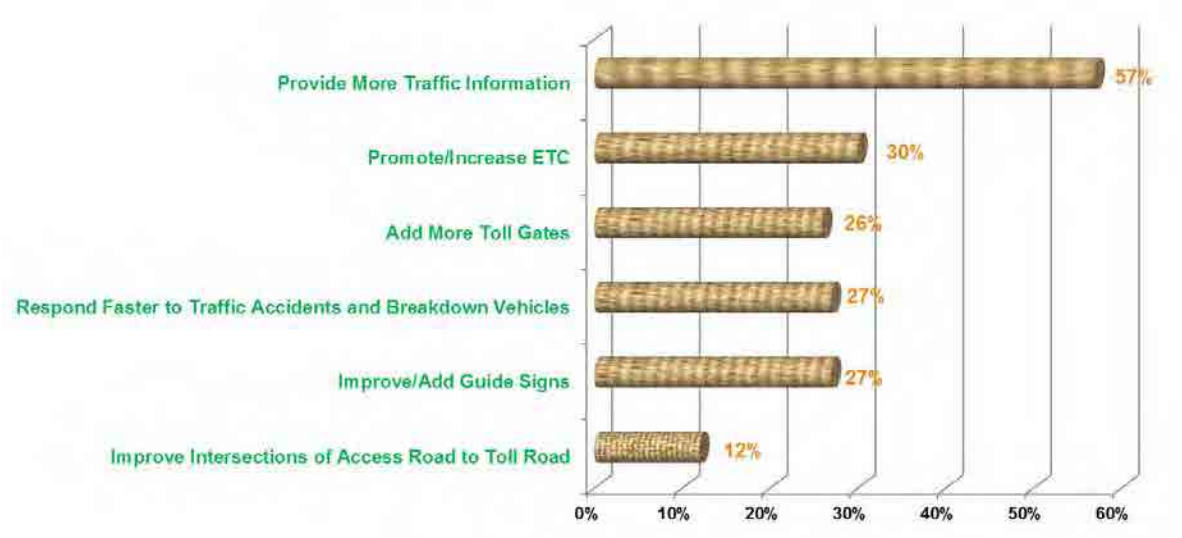
- Major Traffic problems of expressways are "Traffic Congestion During Peak Hours", "Traffic Congestion Near interchange" and "Fatal Traffic Accidents".
- "Toll Gate Areas Congested" was only 21%.



Source JICA Study Team
※ Road Users Interview (1,022 samples)

FIGURE 7.2-5 TRAFFIC PROBLEMS EXPERIENCED IN EXPRESSWAYS

- Respondents' key suggestion is to "Provide More Traffic Information" for the expressway, as shown in **Figure 7.2-6**.



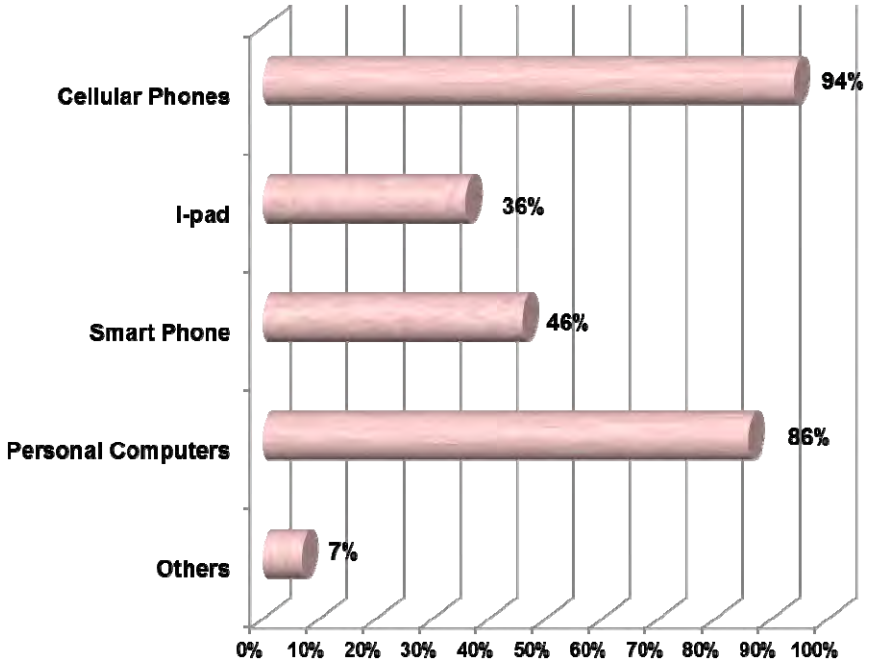
Source JICA Study Team
※ Road Users Interview (1,022 samples)

FIGURE 7.2-6 SUGGESTED SOLUTIONS FOR EXPRESSWAYS

(5) ITS Application Environment

1) Communication Tool Penetration Rate (Car Users)

Forty six (46)% of car users already has Smart Phone (iphone, android, blackberry and so on). This user rate will increase in the future.



Source JICA Study Team
※ Road Users Interview Survey (2,159 samples)

FIGURE 7.2-7 CURRENT PENETRATION RATES OF COMMUNICATION TOOLS

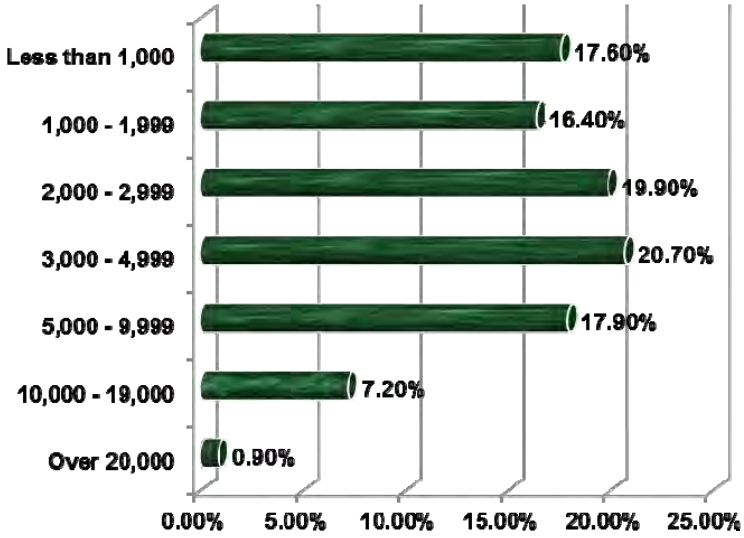
2) Car Navigation Utilization

Though willingness to purchase for car navigation is quite high (61%), most respondents do not want to buy an expensive one (less than 5,000 pesos).

- Do you install a car navigation instruments? (1,990 samples)

  Yes : 22%

- Do you want to install a car navigation? (1,562 samples)
- Yes : 61%
- How much are you willing to pay for a car navigation? (1,034 samples)



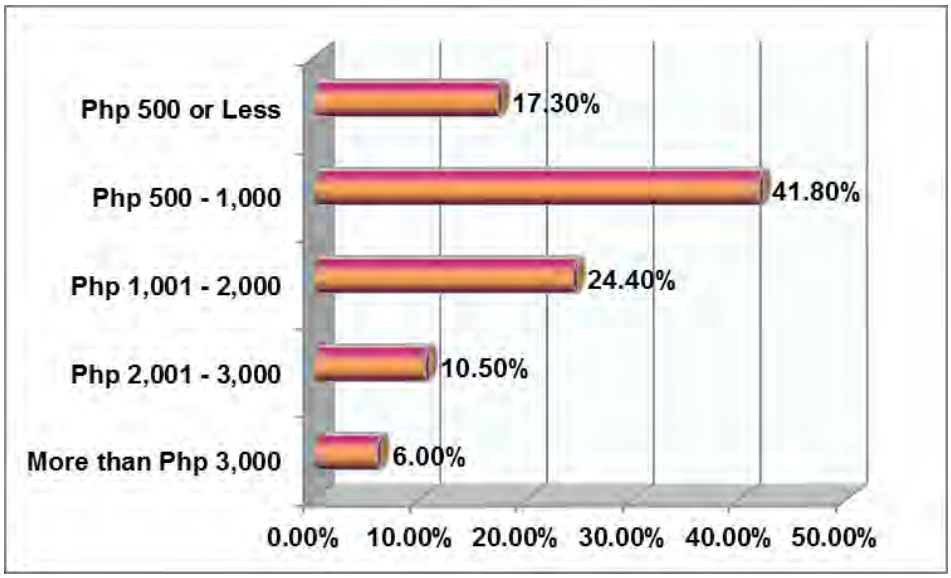
Source JICA Study Team

FIGURE 7.2-8 WILLINGNESS TO PAY FOR A CAR NAVIGATION

3) ETC Utilization

Willingness to purchase an ETC On-Board Unit is high (61%) if a common ETC system will be established. Most respondents are willing to buy an ETC OBU if the cost is less than Php 1,000, which is the half price of current ETC OBU.

- Current ETC users: 35% (1,022 samples)
- If common ETC system will be established, will you use ETC? (1,002 samples)
  Yes: 61% No: 32% No Answer: 14%
- How much are you willing to pay for ETC on-board unit? (345 samples)



Source JICA Study Team

FIGURE 7.2-9 WILLINGNESS TO PAY FOR ETC OBU

7.3 GOVERNMENT AGENCIES

The following Government agencies shown in **Table 7.3-1**, were interviewed. The interview results are summarized in relevant sections of **Chapter 5** and **Chapter 6**.

TABLE 7.3-1 LIST OF INTERVIEWED GOVERNMENT AGENCIES

Agencies	Section	Interview date
DPWH	PMO-Team	26 July 2012
	Planning Office	26 July 2012
MMDA	Traffic Discipline Office	24 July 2012
	Planning Office	5 September 2012
DOTC	Planning Service	30 July 2012
Transportation Office (LTO)	Operation Division	25 July 2012
Land Transportation Franchising & Regulation Board (LTFRB)		25 July 2012
TRB		31 August 2012
LGU	Pasig City	19 September 2012
	Makati City	20 September 2012
	Quezon City	25 September 2012
	Manila City	17 September 2012
National Telecommunications Commission (NTC)		29 November 2012
Information and Communications Technology Office(ICTO) of DOST		29 November 2012

Source: JICA Study Team

This is the summary of LGUs' Traffic monitoring system. Out of four cities, three have a traffic monitoring system.

Quezon City	～	Traffic monitoring System, CCTV cameras were installed on major roads
Pasig City	～	Traffic monitoring System, 165 CCTV cameras were put up at different strategic places of Pasig. Their purpose is not only to monitor traffic, but also to help in crime prevention.
Makati City	～	Traffic monitoring System, CCTV
Manila City	～	NOT installed traffic monitoring system

7.4 PRIVATE SECTOR

(1) O&M Companies

Six expressway O & M companies were interviewed. This interview result is reflected in **Section 6.2** "Toll Expressway Operators".

Currently, a traffic control center is operated in each of NLEX, SLEX and SKYWAY. An ETC system is also operated by the same three expressways. **Table 7.4-1** shows the summary of the expressways' traffic control centers and ETC installations.

TABLE 7.4-1 SUMMARY OF PRESENT EXPRESSWAYS' ITS INSTALLATIONS

	NLEX	Skyway	SLEX	STAR	SCTEX	CAVITEX
Traffic Control Center	Yes	Yes	Yes	Not yet	Not yet	Not yet
ETC System (approx % of ETC)	Easy-trip (20%)	E-pass (35%)	E-pass (35%)	Not yet	Not yet	IC-Card, EC-tap (7,000 cards were sold out)
ETC System planning to install or update	Yes, we are in the process of mitigating to a new toll collection system	No answer	No answer	No answer	Yes, depends on the available system during the time of implementation	
Promote utilization of ETC system?	Yes	Yes	Yes	Yes	Yes	
Agree to adopt one on-board unit that can be used on all expressways?	Yes	No answer	No answer	No answer	Yes	
What are the issues to be resolved?	Clearing house				Toll collection	

Source JICA Study Team

(2) Bus Companies

Ten (10) bus companies were interviewed (see **Table 7.4-2**). These consisted of five (5) city bus companies, four (4) provincial bus companies, and one company operating both city bus and provincial buses.

- Many companies undertake monitoring and inspection for buses by field inspection using cell phone.
- Two companies are using MPOS device. Once sync at the end of the day, they can have all the information they want to know, including the area/location of passengers pick-up and number of passengers at certain areas, but not in real time. One company uses a GPS device.
- One company wants to undertake monitoring through GPS in the future.
- One company said: "We are now in our final stage with Google and its counterpart, we will start soon as pilot study for cashless fare collection using prepaid card."

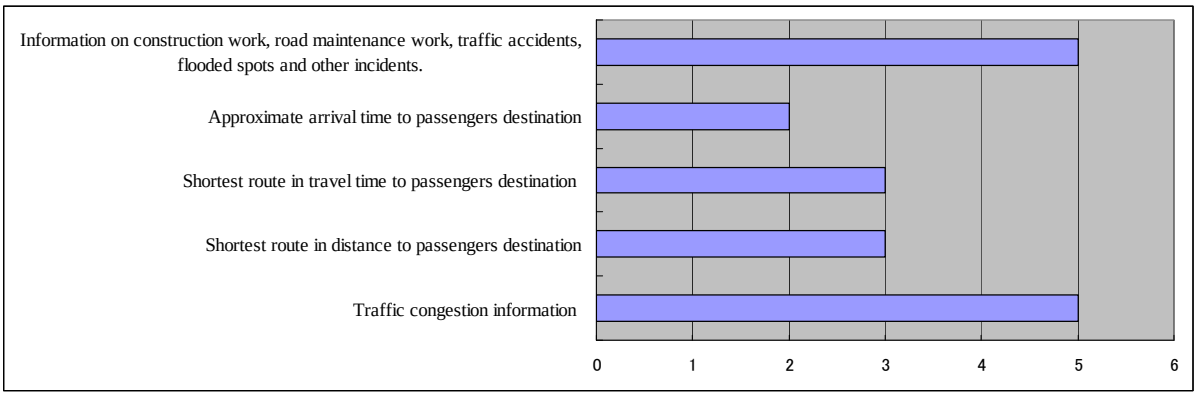
TABLE 7.4-2 BUS COMPANY INTERVIEW RESULTS

	No. of Buses		Problems	Salary	Monitoring	GPS	Pre-paid Card, Cashless for Future
	City	Provincial					
A	81	158	• Colorum/ Numerous Jeepneys • Undisciplined motorist/pedestrian • Flood • Road Problems	Daily	• Dispatchers • Supervisors • Inspectors	No	No
B	-	850	• Lack of discipline of drivers • Illegal terminals of FX • Inside lane (should be outside bus lane)	Basic Pay+ % of collection	• Record of dispatch	Monitoring thru GPS	No
C	22	-	• Not to allowed to use underpass/overpass • Enforcers allows for some buses longer to stay • Road digging	Daily + %	• Inspectors • Dispatchers	No	Yes. Final stage for cashless with Google and its counterpart
D	66	-	• Colorum buses, jeepneys, taxis and FX's • Kabit System (?)	Daily + %	• Inspectors	No	Yes. Prepaid Card
E	-	119	• Defective road • Narrow roads • Congested with private vehicle	%	• Cellphone Landline	No	Yes
F	-	700	• Accident • Cutting of lines • Swerving	Commission basis	• Phone	No	Yes
G	113	-	• Competition with other companies • Heavy traffic • Road Construction	Daily	• Field Inspector	No	No
H	Yes (No No.)	-	• Ineffective traffic system • Duplication of Bus/Jeepney routes • Lack of roads • Reinforce loading/unloading • Hazardous blockage along roads	Daily	• Field Inspector	No	Yes
I	Yes (No No.)	-	• Too many Jeepneys/Tricycle • Narrow roads • Road construction • Drivers discipline • Enforcer	%	• No	No	No
J	-	87	• Traffic congestion due to private cars	%	• Field Inspector by cellphone	No	No

(3) Taxi Companies

Five taxi companies were interviewed (see **Table 7.4-3**). Out of the five companies, one is a small taxi company which owns only five taxis, and the other companies own 45-90 taxis each.

- As a driver pays a fixed amount to the taxi company to use a taxi, there is no incentive for taxi companies to boost sales. There is no influence of increase or decrease of the driver's sales (passenger fares) on the company's income.
- All taxi companies conduct monitoring and inspection by two-way radio and/or cell phone. No one uses a GPS unit.
- Four companies listen to radio and TV news in order to get traffic information, and then inform their drivers through two-way radio or cell phone.
- Though two companies are interested in ITS technologies, they answered that whether they will utilize ITS or not depends on the cost. Very useful traffic information are "Traffic congestion information" and "information on construction work, road maintenance work, traffic accident, flooded spots and other incidents," as shown in **Figure 7.4-1**.



Source JICA Study Team

FIGURE 7.4-1 USEFUL TRAFFIC INFORMATION (TAXI COMPANY)

(4) Trucking /Distributer Companies

Though target samples were ten (see **Table 7.4-1**) trucking companies, a total of fourteen (14) trucking companies were actually surveyed.

- Since many truck companies are small, they communicate with drivers by cell phone. Three companies use GPS. As they own less than fifty trucks each, they do not have any problem/issues regarding the current operation. They hesitate to introduce ITS application because it might cost too much for them.

(5) TV and Radio Companies

Target samples were three radio companies and two TV companies. A total of three radio companies were actually surveyed. This is the summary of the interview results.

- All three radio companies are providing traffic information to the public. They get traffic information from MMDA metro base, LGU traffic departments, NLEX, SLEX, MRT, LRT operators, and some website concerns for the transportation.
- Two interviewees answered that their problems are that traffic reports are limited to metro roads, and that they have limited access to NLEX and SLEX reports.
- All companies answered that demand of traffic information from people is very high.

TABLE 7.4-3 TAXI COMPANY INTERVIEW RESULTS

Company	No. of Taxi	Salary	Problem	Monitoring of Operation	Taxi Location	ITS System Introduction	Introduction of Demand Call System
A (Airport Taxi)	50	Driver pays fixed amount	• Congestion • Bad road surface • Undiscipline bus drivers • Pedestrians bad manner	• 2-way radio • Cellphone	• Cellphone	No	• Wants to introduce
B	50	Driver pays fixed amount	• Damaged road • Tricycle • Illegal parking • Old Cars • Weak enforcement	• Cellphone • 2-way radio	• No	Yes if affordable	• Wants to introduce
C	90	Driver pays fixed amount	• Traffic volume • Traffic accident • Road condition • Improper use of loading/unloading bays	• Cellphone • 2-way radio	• 2-way radio	(Transportation)	• Wants to introduce
D	45	Driver pays fixed amount	• Traffic congestion • Bad pavement • Narrow roads	• Cellphone	• No	-	• Wants to introduce
E	5	Driver pays fixed amount	• No discipline • No computerized traffic management • No loading/unloading • Enforcement	• Cellphone	• Cellphone	Wants to introduce operation system	• Wants to introduce

TABLE 7.4-4 TRUCK COMPANY INTERVIEW RESULT

Name	No. of Trucks	From/To To/From	Pick-up Time	Problem	Overweight Trucks	Call Center	Operation Problem	ITS
A	13	• Port • Warehouse	• Specified pick-up/delivery time	• Heavy traffic • Poor road condition	• Customers force the company	No	• Cellphone	• No (no budget)
B	4	• Port • Warehouse	• Specified pick-up/delivery time • Penalized	• Location of weighing scale • Poor road • Old traffic signal • Corruption • Accident	• Cannot manage, customers force the company	No	• Cellphone	• No due cost
C	5	• Port • Warehouse	• Specified pick-up/delivery time	• Traffic signal malfunction • No enforcer at some locations • Damaged road	• Coordinate with customers	No	• Cellphone	• No
D	3	• Port • Warehouse	• Specified pick-up/delivery time	• Narrow roads • Lack of traffic enforcer • Heavy traffic	• Customer should control	No	• Cellphone	No need a few trucks only
E	Confidential	• Port • Warehouse	• Specified pick-up/delivery time • Penalized	• Many private cars • Traffic congestion	-	No	• Cellphone	No comment
F	46	• Port • Airport • Factory	• Delivery time	• No traffic enforcer at night and during rain	-	No	• Cellphone	Yes. Testing some units.
G	1	• Port • Warehouse	(No answer)	• Few traffic police • Mixed traffic on a same lane	-	No	• Cellphone	No
H	18	• Various Costumers (San Miguel, Jollibee)	• Specified pick-up/delivery time	• Heavy traffic • No enforcers	• Do not overload	No	• Cellphone	No idea about ITS.
I	16	• Port • Warehouse	• Specified pick-up/delivery time • Penalized	• Road obstruction • Illegal parking • Road congestion	• Advice clients		- GPS - Trucking devices	• Truck monitoring and locators
J	19	• Port • Warehouse	• Specified pick-up/delivery time • Penalized	• Lack of discipline • Road network • Overloaded trucks • Pedestrian discipline	• Do not overload • Label x No. of the boxes	Yes	- Cellphone - Labelled	Yes
K	25	• Warehouse • Shopping Center • Houses	• Specified pick-up/delivery time • Penalized	• Lack of driver's education • Discipline • Impose higher penalty for violations		Yes		No
L	143 (pick-up)	• Port, Airport, Factory, Shopping Center, Warehouse, Offices, Houses	• Specified pick-up/delivery time • Penalized	• Truck ban, no. coding • Traffic volume • Undisciplined driver • Road signs markings • Bad road	• Controlled using shipment manifest	Yes	- GPS - 2-way radio - Cellphone	
M	34 (2-axle) 8 (lease) 42	• Various Costumers	• Specified pick-up/delivery time	• Traffic Jam • Flood • No. coding • Defective traffic signal	• Control	Yes	- GSH thru GPS	
N	2	• Various Costumers	-	• Congestion • Flood	-	Yes	- Cellphone	Yes

TABLE 7.4-5 TV/RADIO COMPANY INTERVIEW RESULTS

Name	Traffic Information	Information Source	Problem of Providing Information	How do you provide	Any plan to get information	Demand of People	When do you start DTB
A (Radio)	• Yes • Live update from MMDA every hour • Every top of the hour	• MMDA Metro Base • NLEX • SLEX	• No.	• Broadcast	• Already doing	• Very high	
B (Radio)	• Yes • Traffic situation of major roads • Traffic accidents • Commentary on traffic management • 2-4 times a day	• MMDA Metro Base • LGU traffic department • NLEX, SLEX • Listener feedback • SMS message as verified • Text message • Twitter • Phone call • Reporter feedback	• Limited to Metro roads • Limited access to NLEX, SLEX	• Broadcast • Twitter	• Now limited to phone inquiries • Would like to see video and re-broadcast real time.	• Very high	
C (Radio)	• Yes • Congestion • Severe flooding • Weather Watch • MRT/LRT Operation • As often as possible	• MMDA Metro Base • MRT/LRT • Websites • Phone call	• Limited to Metro roads • Limited access to NLEX, SLEX	• Broadcast		• Very high	
D (TV)	• Yes • Traffic congestion • Traffic accidents • Flood section • Multiple times	• CCTV of GMA Traffic Camera system • MMDA CCTV • Twitter account of MMDA • Trapik.com	• Lack of real-time traffic videos on internet/website and phone	• Airing traffic updates • Internet via GMA online website	• Real time traffic video on internet website and on phone	• Very high	• We are not privy to these plan
E (TV)	• Yes • Traffic congestion • Traffic accident • Events and special events • Flooded roads • Storm conditions • Multiple times	• CCTV camera of ABS-CBN Traffic System • MMDA CCTV cameras • Twitter account of MMDA • Trapik.com	• Lack of real-time traffic information thru video	• News program • News break • TV and radio broadcasting • abs-cbn.news.com		• Very high	

(6) IT Companies

Though target samples were five IT companies, only two IT companies were actually surveyed. The interviewers found it difficult to get the replies of three other companies.

(7) Car Maker/Dealer

Car Maker/ Car Dealer and Car shops were interviewed. Study Team could not get reply from car manufacturing companies. Total samples were thirteen (13) (see **Table 7.4-6**).

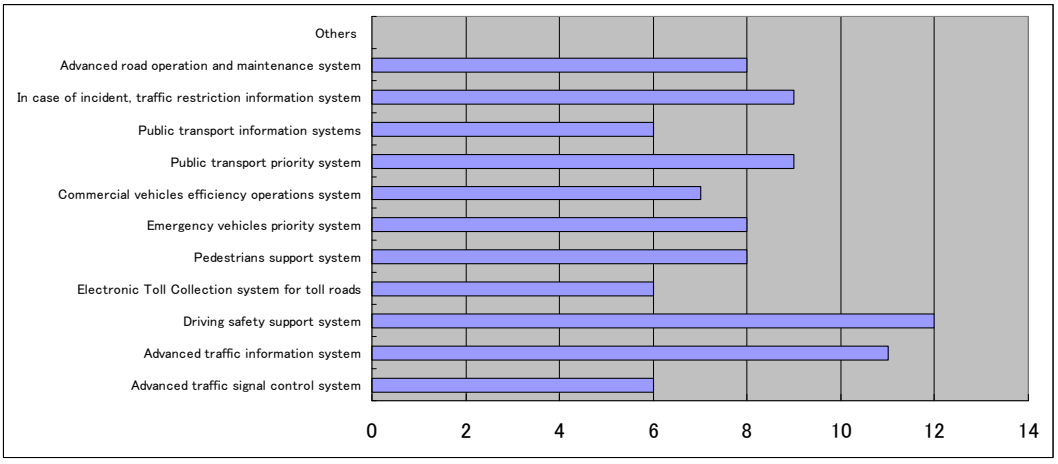
- All car dealers and shops sell car navigation systems. Car navigation prices are shown in **Table 7.4-7**. They rated the prospects of car navigation in the Philippine as follows: "high prospect" – 2 respondents, "medium prospect" - 9 respondents, and "low prospect" – 2 respondents. The major reasons cited for medium or low prospect are "expensive" and "most owners know the place well".
- Six companies sell "Automatic Breaking System to avoid traffic accident". Though they did not mention the price of this system, they answered high prospect.
- Only one company sells "ETC unit".

TABLE 7.4-6 CAR NAVIGATION PRICE RANGE

Average price of car navigation	No. of respondents
Less than php 10,000	1
Php 10,001 ~ 20,000	3
Php 20,001 ~ 30,000	5
Php 30,001 ~ 40,000	4
Total	13

Source JICA Study Team

- They think all kinds of ITS applications are necessary. Especially, "Driving safety support system" and "Advanced traffic information system" were rated higher than others as shown in **Figure 7.4-2**.



Source JICA Study Team

FIGURE 7.4-2 NECESSARY ITS APPLICATION (CAR DEALER OPINIONS)

TABLE 7.4-7 CAR DEALER INTERVIEW RESULT

Company	Car Navi	On-board unit for ETC	GPS	Automated Breaking System	Warning System to detect obstacles
A	• Yes 20,000-30,000 Pesos • Suppliers - Winterpine • Medium prospect since they have other preference	• No	• No	• No	• Yes 5,000-8,000 Pesos • High prospect
B	• Yes 35,000-40,000Pesos • Medium prospect - Expensive - Knows the place well	• No	• Yes • 35,000-40,000 Pesos • Medium prospect • Expensive	• No	• No
C	• Yes 20,000-40,000Pesos • Medium	• Yes • High prospect	• Yes • High prospect	• Yes • Medium prospect	• Yes • Medium prospect
D	• Yes 20,000-30,000Pesos • Medium prospect	• No	• Yes • 20,000-30,000 Pesos • High prospect	• Yes • High prospect	• No
E	• Yes 20,000-25,000 Pesos • Supplier Winterpine • High prospect	• No	• Yes • 20,000-25,000 Pesos • High prospect	• Yes • High prospect	• No (Traction Control)
F	• Yes 20,000-25,000 Pesos • Medium prospect	• No	• Yes • 20,000-25,000 Pesos • Medium prospect	• Yes • High prospect	• No (Backing Sensor)
G	• Yes 20,000-25,000 Pesos • Medium prospect	• No	• Yes • 30,000-40,000 Pesos • Medium prospect	• Yes • High prospect	• No
H	• Yes 30,000-40,000 Pesos • Medium Prospect	• No	• Yes • 20,000-25,000 Pesos • Medium prospect	• Yes • High prospect	• Yes • High prospect (Parking Sensor)
I	• Yes 35,000-40,000 Pesos • Medium prospect - Drivers are familiar with places	• No	• Yes • 30,000-40,000 Pesos - Roadmax - Garmen • Medium prospect	• No	• No (Tracking Device/Monitor of Speed 20,000-25,000 pesos)
J	• Yes 8,000-15,000 Pesos • Medium prospect - Expensive	• No	• Yes 8,500-10,000 Pesos • Medium prospect	• No	• No (Parking Sensor)
K	• Yes 7,800-9,800 Pesos • High prospect	• No	• Yes • 7,800-10,000 Pesos - Pioneer • High prospect	• No	• Yes 1,850-2,800 Pesos • Medium prospect (Tracker 6,500-14,500) (Back-up horn 400 pesos)
L	• Yes 19,000 Pesos • Low prospect - Expensive	• No	• Yes • 19,000 Pesos • Low prospect	• No	• No (Back-up sensor, 2,800 Pesos) (Lighting lab. 1,500 pesos)
M	• Yes 6,500-18,000 Pesos • Low prospect	• No	• Yes • 6,500-18,500 Pesos • Low prospect	• No	• No (Sensor with buzzer, 1,500 Pesos) (- Sensor with buzzer and indicator 2,000 pesos)

7.5 KEY INFORMANTS

Key informant interview results are described in **Annex 7.4**.

Table 7.5-1 shows the results of addressing transport issues in the Philippines through the promotion of ITS based on the experience in other countries.

TABLE 7.5-1 ADDRESSING TRANSPORT ISSUES IN THE PHILIPPINES THROUGH THE PROMOTION OF ITS BASED ON EXPERIENCES IN OTHER COUNTRIES

Serious Transport Issues	Promotion of ITS Fields to Address Issues
Very serious - road crashes and traffic congestion	ITS for public transportation system to make them efficient and safe. ITS used in transportation management.
Lack of seamless transport system connectivity	Utilize all mobile phones, work with mall owners and private companies
Congestion, Accidents, Road quality	Congestion pricing, Auto detection of overspeeding vehicles/violations/etc
Traffic safety and driver education as explained above.	
Franchising of public transport	Provide funding support, Provide maintenance budget, Provide technical staff
Proliferation of motorcycles	Information dissemination and educating motorists
We have very few transport/traffic experts. Poor maintenance of ITS technology, and hence after a few days/months, these ITS gadgets would not work anymore. Better put ITS projects under the PPP program of the government.	Should be under the PPP program of the government and let those who get these projects promote their technology/product.
Undiscipline drivers specially the public transportation	
Congestion Road crashes/accidents	Road congestion pricing Public transport planning and operation Freight/commercial vehicle route network planning and operation
-	Show historical data, 5 decades ago volume of vehicles vs. now, population and roads Do not focus on present, plan ahead, 20-40 years from now
Congestion Volume of buses	Advertisement on TV, radio and newspapers
Congestion	explain the benefits and uses of ITS
Undisciplined drivers especially public transport	explain the benefits and uses of ITS
Motor vehicle driver behaviour - not all drivers drive safely; special concern is the large vehicles Large vehicles with poor maintenance - make them more likely to cause or be involved in an accident	Make a local evaluation of the potential economic benefits against the costs - and educate the potential users on this.

CHAPTER 8
IDENTIFICATION OF TRANSPORT PROBLEMS/ISSUES

8.1 SUMMARY OF TRANSPORT PROBLEMS/ISSUES

A summary of transport problems/issues in Metro Manila and Mega Manila Region excluding Metro Manila is shown in **Table 8.1-1** and **Table 8.1-2.**

TABLE 8.1-1 SUMMARY OF TRANSPORT PROBLEMS/ISSUES: METRO MANILA

Problems/Issues		Current Countermeasures	Possible Additional Countermeasures
Urban Structure	– **Concentration of Central Business Districts (CBDs) along EDSA and C-5 corridors.** – **CBDs are ever growing and becoming huge traffic generation/attraction centers.** – **Slow development of transport facility expansion.**	– **Existing road ROW has been already used for travel ways and no more room for widening.** – **Vertical utilization (i.e. flyovers, elevated expressways, etc.) of existing ROW is being implemented.** – **TDM measures (regulation of car usage, truck ban, regulation of jeepneys entering into major roads) are being implemented.**	– **The Government needs to continuously implement transport facilities expansion projects (physical measures).** – **At the same time, the Government needs to take all kinds of measures to fully utilize the existing transport facilities by adopting software measures.**
Road Transport: Urban Roads	– **Traffic congestion of roads and low travel speed (lack of traffic capacity of roads).**	– **Existing road ROW has been already used for travel ways and no more room for widening.** – **MMDA provides to road users traffic congestion status through internet, smart phone, etc. (MMDA/TV5 Traffic Navigator).** – **Construction of NLEX-SLEX Connector and Skyway Stage 3, and planning of Missing C-3 and C-6 to relieve congestion on main routes.**	– **All kinds of efforts need to be done for full utilization of all existing roads.** – **Provide real-time traffic information in order to guide drivers to less congested routes.** – **MMDA/TV5 Traffic Navigator needs to be up-graded by covering more roads, improving accuracy, etc.**
	– **Delay at intersections.** – Traffic signal controlled intersections **Operational:** 374 intersections (86%) **In-operational:** 62 intersections (14%) **Total:** 436 intersections (100%) – Loop coil traffic detectors: 1,542 detectors (49%) out of 3,130 are not functioning. – Spare parts are no longer available. – Traffic signal phasing is not based on traffic demand, but is based on pre-determined phasing.	– **MMDA entered into a contract for the provision of advanced traffic signal control for 85 intersections.**	– **Remaining 351 traffic signals need to be upgraded.** – **Other intersections need to be identified for traffic signal control.**
		– **DPWH is planning to construct flyovers/grade separation at critical intersections.**	– **Additional flyovers/grade separations need to be implemented with due consideration of future transport projects.**
	– **Traffic congestions at bus stops.** – Long stay of buses at bus stops – Long queue at bus stops – Double or triple parking at bus stops blocking other vehicles	– **Enforcement of rules and regulations by traffic enforcers.**	– **MMDA will start "Bus Management System" in 2013.**
	– **Road Crashes.** – Average 33 road crashes per day on only 7 major roads in Metro Manila.	– **Enforcement of rules and regulations by traffic enforcers.**	– **Drivers' education.** – **More strict traffic enforcement.** – **Review of drivers' licensing system.**

Problems/Issues	Current Countermeasures	Possible Additional Countermeasures
– Road Crashes also cause traffic congestion.		– **Monitoring/surveillance by CCTV, etc.** – **Quick response system to Road Crashes to be employed.**
– **Bad driving manners of drivers.** – Blocking traffic flow – Causing Road Crashes – Traffic mess at non-signalized intersections, U-turns, and round-abouts. – **Weak traffic enforcement.** – Laxity and discretion in detecting and penalizing violations – Kotong and other corrupt practices	– **Enforcement of rules and regulations by traffic enforcers.**	– **Drivers' education.** – **Intensive training (including moral reformation) and higher compensation of enforcers to professionalize them.** – **Stricter and more aggressive traffic enforcement.** – **Monitoring/surveillance by CCTV, etc. of traffic conditions and enforcement** – **Review of drivers' licensing system.** – **Review of penalty/fines for violation of traffic rules.**
– **Temporary traffic bottlenecks.** – Construction work sites – Road maintenance work sites – Road Crashes – Flooding – Road diggings for underground public utilities.	– **MMDA is providing most of the information to the public.**	– **Present information provision system to be upgraded including information on possible detour routes.**
– **Slow travel speed due to bad pavement condition, particularly along heavy truck traffic routes.** – Overloaded trucks controlled by portable weighing equipment **DPWH:** weighing **Police :** Stop trucks **LTO :** Apprehension	– **Manual weighing by portable weighing equipment.** – **Major rehabilitation of EDSA and other main roads.**	– **Installation of Weigh-in-motion equipment and stricter anti-overloading enforcement system.** – **Outsourcing of weighbridge installation and operation.** – **Intensive and sustained preventive maintenance of major roads.** – **Close monitoring of road conditions including roughness index.**
– **Transport Demand Management (TDM).** – Color coding – Truck ban – Bus priority lane	– **Degree of enforcement depends on City Government (some are strict while some are not).**	– **Road pricing may be necessary in the future.**
– **Aggravation of environment due to traffic congestion.**	– **Flyover or underpass construction.** – **Elevated expressway construction.**	– **Introduction of ITS measures to achieve smooth travel.**
– **Low ranking of the global competitiveness**	– **Transport facility development**	– **Provision of efficient transport system for**

Problems/Issues		Current Countermeasures	Possible Additional Countermeasures
	due to inefficient transport system.	– **Traffic information provision.**	**smooth travel flow.**
	– **Frustrating travel due to unpredictable arrival time to the destination.**	– **Traffic information provision.**	– **Upgrading traffic information provision system including route guidance.**
	– **Traffic is paralyzed by natural disasters, particularly by frequent floods.**	– **Events information provision system.**	– **Upgrading events information provision system with route guidance.**
Bus Transport	– **Illegal bus operations.** – Trip cutting – Operation at the route with no franchise (out of franchised route) – Operation of buses without franchise (colorum buses)	– **LTO/LTFRB/MMDA drive to apprehend drivers and operators of colorum and out-of-line buses.**	– **MMDA will start "Bus Management System" in 2013.** – **On-line linkages of LTO, LTFRB, and MMDA databases to prevent and detect illegal bus operations.**
	– **Many bus terminals of both city buses and provincial buses along EDSA. In-and-out-buses to bus terminals disturbing traffic flow.**	– **The Government is planning to establish the Integrated Terminal System Projects, thereby prohibiting provincial buses to come in Metro Manila.**	– **Efficient operation system of integrated terminals.**
	– **Too many buses on high-passenger demand routes like EDSA.**	– **LTFRB is reviewing franchise allocation to each bus route.**	– **Combine LTFRB and LTO databases.** – **Develop monitoring and enforcement system.**
Rail Transport	– **There are 3 rail lines.** – **LRT-1 and LRT-2 are adopting same (or interoperable) ticket system but not MRT-3.**	– **Common ticketing system is being studied.**	

Source: JICA Study Team

TABLE 8.1-2 SUMMARY OF TRANSPORT PROBLEMS/ISSUES: MEGA MANILA REGION OUTSIDE METRO MANILA

Problems/Issues		Current Countermeasures	Possible Additional Countermeasures
Urban Structure	– **Urbanization is rapidly progressing in Metro Manila periphery (provinces of Bulacan, Rizal, Cavite and Laguna)** – **Due to concentrated job opportunities in Metro Manila, commuting trip distances are becoming longer and longer.**	– **Widening of existing expressways completed.** – **Construction \of new expressways to cater to growing traffic by PPP instead of constructing ordinary national roads.** – **LRT Line-1 south extension, LRT Line 2 extension, and MRT-7 are planned and implemented soon.**	– **Efficient bus transport system** – **Improvement of MRT-3 capacity** – **Common ticketing system for rail lines.**
	– **Regional cities are growing rapidly (Clark, Subic, Tarlac, Cabanatuan, San Fernando, etc. in the north and Dasmariñas, Carmona, Sta. Rosa, Calamba, Sto. Tomas, Lipa, Batangas, etc., in the south of Metro Manila.** – **Remaining areas are still rural in nature.**	– **Widening of existing expressways completed** – **Construction of new expressways to link Metro Manila and regional cities.** – **Construction of bypasses along major national road corridors is planned.**	– **Expressways proposed in the Master Plan should be realized.**
Road Transport: Major National Road Corridors	– **Traffic congestion of national roads within urban areas.**	– **Plaridel Bypass is being implemented..** – **DPWH is planning to install five (5) CCTV at major intersections along Manila North Road and monitoring center.**	– **Expressways proposed in the Master Plan should be realized.** – **Install traffic control center, new traffic signals with traffic detectors, CCTV for urban roads sections of major national road corridors.**
	– **Delays at intersections**	– **Traffic signal control along Manila North Road.**	– **Installation of advanced traffic signal control.**
	– **Road Crashes**	– **Enforcement of rules and regulations by traffic enforcers.**	– **Driver's education** – **More strict traffic enforcement** – **Review of driver's licensing system**
	– **Bad driving manners of drivers**	– **Enforcement of rules and regulations by traffic enforcers.**	– **Drivers' education** – **More strict traffic enforcement** – **Monitoring/surveillance by CCTV, etc.** – **Review of drivers' licensing system.** – **Review of penalty/fines for violation of traffic rules.**
	– **Slow travel speed due to bad pavement condition.** – **Overloaded truck controlled by weighing equipment at weigh bridges.** **DPWH: Weighing**	– **Manual weighing by portable weighing equipment**	– **Installation of weigh-in-motion equipment and stricter anti-overloading enforcement system.**

Problems/Issues		Current Countermeasures	Possible Additional Countermeasures
	Police: Stop Trucks **LTO: Apprehension**		
	– **Frustrating travel due to unpredictable arrival time to the destination**		– **Traffic information provision system including route guidance to be developed.**
	– **Traffic is paralyzed by natural disasters, particularly by frequent floods.**		– **Flood Events Information Provision System to be developed.**
Bus Transport	– **Illegal bus operations** – Operation at routes with no franchise – Operation of buses without franchise (Colorum buses)		– **Bus Monitoring and Control System to be developed.**
Toll Expressway Transport	– **Traffic congestion at toll booths** – ETC utilization rate is only 20%. – Two incompatible ETC systems (Easytrip on NLEX and E-Pass on Skyway/SLEX and E-tap (A touch-and-go system) for CAVITEX)	– **O & M companies are adopting their own system and no common standards are adopted.**	– **Introduce a common ETC system for interoperability.** – **Introduce a various payment system, prepaid, post-paid or debit card, etc. with commonly applicable system to all toll expressways.**
	– **A few traffic information as well as different level of traffic information provided to expressway users.** – Eight (8) toll expressways are operated by 6 different toll expressway operators. Toll expressway operators are adopting their own standards for traffic information collection and provision system. – **No traffic information sharing among operators.**	– **NLEX started the provision of real time information on the website, "Niligtas" (24 Oct. 2012).** – **Skyway provides traffic information to MMDA, whereby road users can receive Skyway traffic congestion status through internet, smart phone, etc. (MMDA/TV5 Traffic Navigator).**	– **Install a standard traffic collection and provision system for all expressways.** – **Establish an integrated traffic information center.**
	– **Toll expressway users are stopped at connection point from one toll expressway to another. No interoperability operation is possible except between Skyway and SLEX.** – **Toll road network will be formed in 5 years, thus interoperability system covering all toll roads is urgently needed.**	– **Interoperability summit will be held with TRB and all expressway O&M companies before the end of year 2012.**	– **Establishment of Interoperability System**
	– **Fatal road crashes**	– **Automatic Vehicle Locator System (AVLS) is installed in NLEX for faster dispatch of patrol**	– **Install a fast emergency vehicle operation system for all expressways, such as AVLS.**

Problems/Issues		Current Countermeasures	Possible Additional Countermeasures
		cars to the site. The present location of patrol vehicle is identified through GPS and when road crash occurs, the nearest patrol vehicle is informed of occurrence of the road crash. **– Overspeeding is detected by a speed gun along NLEX.** **– Overspeeding is detected by the times of entry and exit of toll booths along SLEX.**	**– Intensify over speeding control.**
	– Premature pavement/bridges deterioration due to overloaded trucks.	**– Overloaded large vehicles are detected by a measurer of weight which is installed at the toll gate of NLEX.** **– NLEX is installing weigh-in-motion equipment.** **– Portable weighing equipment is used by SLEX.**	**– Installation of Weigh-in-Motion equipment and stricter anti-overloading enforcement system for all expressways.**

Source: JICA Study Team

CHAPTER 9
GLOBAL TREND OF INTELLIGENT TRANSPORT SYSTEM

9.1 SUMMARY

Global trends of ITS are summarized and details are set forth in succeeding sections. Global trends are fully considered in the formulation of the Master Plan.

TABLE 9.1-1 SUMMARY OF CHAPTER 9

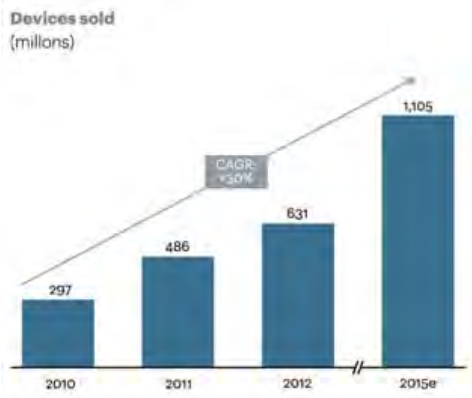
Title	Global Trend of ITS
9.2 Introduction	• Smartphone user penetration is sharply increasing • Smartphone will be actively used not only as a device to receive information but also as a device to provide traffic data to a Traffic Center.
9.3 Traffic Information Collection/ Provision	• Floating Car Data (FCD) from smartphones will be actively used as a means of traffic data sources. • Installation of roadside equipment will be minimized. • Roadside equipment will be highly functionalized.
9.4 Road Operation Management	• Various devices to collect road conditions are being developed. • Accurate information necessary for road management will be easily collected. • Utilization of such devices will achieve effective utilization of limited budget and man-power.
9.5 Transport Fare Collection	• Contactless IC Cards are being used for many areas such as rail/bus fare payment, toll payment, shopping, etc. • Mileage based tolling on public roads is being tested, which can be adapted to road pricing.
9.6 Communication Infrastructure	• Wired and wireless communication networks are being utilized depending upon respective characteristics. • Commercial based wireless communication infrastructure is actively used. • Vehicle itself will be used as a part of communication network/infrastructure.
9.7 Partnership with Private Sector for ITS Development	• Participation of the private sector in ITS development is becoming more important.

9.2 INTRODUCTION

The world is now shifting from a time of mass production and mass consumption (disposal) to a low-carbon society based on global material-cycle, as exemplified by the MOTTAINAI movement (http://mottainai.info/english/) promoting 3R (Reduce, Reuse, Recycle). In order to improve the traffic environment as part of such efforts, it is necessary to utilize ITS.

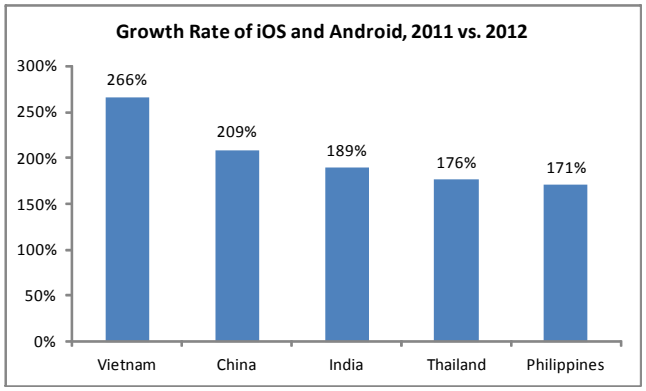
With this background, the ITS (Intelligent Transport Systems) has gone under technological evolution, reorganization and integration and has entered into a new dimension, shifting its position from "systems" utilized as a tool to user-friendly "services".

In fact, element technologies for ITS such as ICT (Information Communication Technology) are becoming more and more advanced. Above all, Smartphones are obtaining widespread popularity in the global market as a communication tool for providing information as well as for collecting location and time data. This trend is also visible in Asian countries, and the users of the two dominant Smartphone operation systems, i.e. iOS and Android, have rapidly grown by 171% in the Philippines (growth rate from 2011 to 2012; see **Figure 9.2-2**).



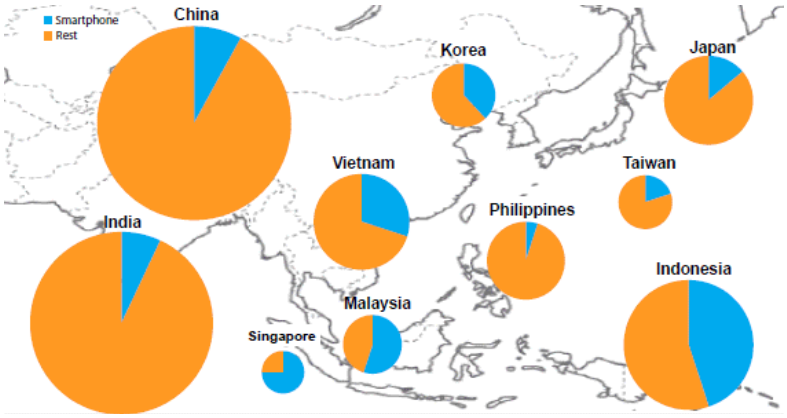
Source: AT Kearney http://www.atkearney.com/

FIGURE 9.2-1 SMARTPHONE SALES 2010 TO 2012, AND 2015 (ESTIMATION)



Source: Flurry Analytics: http://blog.flurry.com/default.aspx?Tag=smartphone

FIGURE 9.2-2 GROWTH RATE IOS AND ANDROID IN ASIA, 2011 VS. 2012



Source: ROA Holding Analysis: http://japan.roaholdings.com/index.html

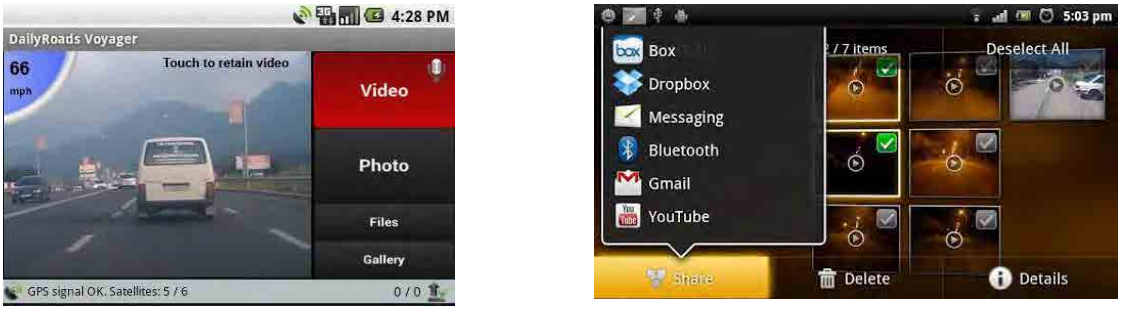
FIGURE 9.2-3 SMARTPHONE PENETRATION IN ASIA

With different applications installed, a Smartphone can become a GSP device for data collection or a tool for providing information as a navigation system. The advent of Smartphones is making dramatic changes in the landscape of traffic data collection and traffic information provision. In the future, it is expected that Smartphone-based approaches will be further accelerated in all the areas of ITS.

The following section introduces several examples of the practical applications of Smartphones.

Source: iOnRoad(Google Play) http://www.ionroad.com/

FIGURE 9.2-4 INTER-VEHICLE GAP WARNING APPLICATION



Source: Daily Road Voyager (Google Play) http://www.dailyroads.com/

FIGURE 9.2-5 DRIVE RECORDER APPLICATION

As solutions utilizing Smartphones, there have been interesting approaches beyond collecting and providing various types of useful information. A great example of such approaches is the

use of “Gamification” (pursuit of fun) for road navigation, away from the traditional problem of how to identify the shortest possible route between the two points, as an attempt to help improve social benefits with fun elements and create a better traffic society.

Source: waze http://www.waze.com/

FIGURE 9.2-6 VISUAL SAMPLE OF WAZE

Meanwhile, it should not be appropriate to leave all traffic data collection and information provision to Smartphones, which are essentially personal equipments. Each device has its own advantages and disadvantages. We should not forget that Smartphones are one of the appropriate devices that can serve specific purposes and conditions.

Source: JICA Study Team

FIGURE 9.2-7 DATA COLLECTION EQUIPMENT

It is unquestionable that at the time of major disaster the movement of people and materials must be executed quickly and without fail. However, the failsafe operation of the social traffic infrastructure at the time of major disaster is not necessarily ensured well enough. ITS have made significant contribution as an essential technology for condition check and information provision to identify the optimal (passable) route.

Source: HONDA http://www.honda.co.jp/

FIGURE 9.2-8 VISUAL SAMPLE OF BIG DATA

It seems that the role that the government and administrators are expected to play in the future will be shifted to ensuring privacy and enhancing reliability in handling the vast amount of data collected and accumulated as described above and promoting the establishment and enhancement of a system that enables the effective use of such data.

Moreover, despite the changes in society and technological developments, the original purpose of ITS will always be to “create a better traffic society” through “reduction of accidents”, “reduction of traffic congestion”, “improvement of environment”, etc.

The following section introduces the trend of the key element technologies that are being developed around the world to achieve this original purpose of ITS.

9.3 TRAFFIC INFORMATION COLLECTION/PROVISION

Before the widespread use of mobile data collection enabled by advanced ICT, most traffic data was collected through vehicle detectors installed by the government (traffic/road administrators). Such data was collected for the purpose of traffic light control, provision of traffic information, analysis of secular changes in roads and traffic conditions, etc., and, for this reason, traffic amount and vehicle speed data were collected from all passing vehicles.

Afterwards, while data management and utilization got more and more consolidated instead of separate data handling by each administrator, the time has come when the data collected by the

government with fixed equipment and the data collected by private companies through mobile objects exist concurrently.

Furthermore, the GPS-based technology has been established to acquire information from mobile objects, enabling the acquisition of rich traffic data in parallel with the traditional data collection methods.

Under these circumstances, while unified usage guidelines have been provided for provision of traffic information to avoid confusion of users, the method for traffic data collection is left to the independent operations of each data-collecting agent.

GPS-based mobile object traffic data can be extremely detailed and enables the identification of the movement of each individual. When combined with the traditional data collected with vehicle detectors for overall traffic flow, not only does it become possible to choose the optimal traffic data collection method for specific needs, but also it leads to the possibility of business application based on traffic data utilization. Moreover, detailed data improves the accuracy of traffic simulation and therefore enhances information provision and traffic operations / management as well.

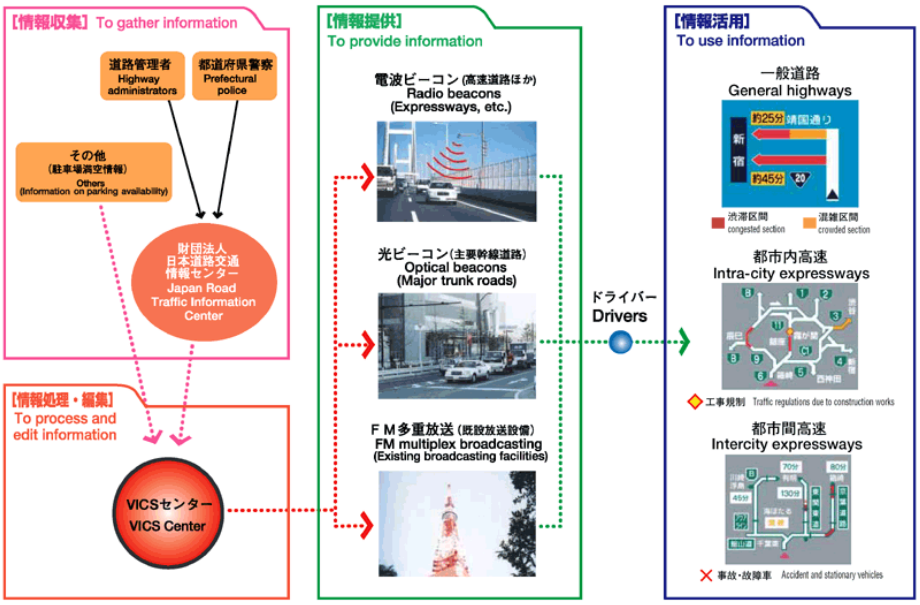
The following sections introduce the initiatives on traffic data management / operations and the methods for collecting traffic data.

9.3.1 Traffic Data Management in Japan

The collection, processing and provision of traffic information in Japan are mainly managed by Japan Road Traffic Information Center (JARTIC).

Authorities for road maintenance / management are categorized by road type: intra-urban expressways are managed by Metropolitan Expressway Company Limited, Hanshin Expressway Company Limited, etc.; inter-city expressways by East Nippon Expressway Corporation (E-NEXCO), Central Nippon Expressway Corporation (C-NEXCO) and West Nippon Expressway Corporation (W-NEXCO). For other roads, key national routes are managed by Ministry of Land, Infrastructure, Transport and Tourism (MLIT) while other national routes, prefectural roads and city/word/town/village roads are managed by Prefectural and City governments.

However, traffic data collection (speed and condition) is operated by expressway administrators and traffic administrators, and all information provision outside the control of expressway administrators and traffic administrators is operated by JARTIC under the jurisdiction of National Police Agency (NPA) and MLIT. (See **Figure 9.3-1**).



Source: ITS Handbook, Highway Industry Development Organization

FIGURE 9.3-1 FRAMEWORK OF TRAFFIC DATA COLLECTION IN JAPAN

In Japan, traffic management was originally conducted under the Road Traffic Law, with its spirit to ensure that "the national government shall be ultimately responsible for ensuring the safety and smooth flow of road traffic." Therefore, the only way for expressway administrators and traffic administrators to obtain traffic information beyond their management authorities was to use the services provided by JARTIC or Vehicle Information and Communication System (VICS) Center.

However, in December 2000, Traffic Information Consortium (TIC) was established, with various members including academic experts, private bodies, NPA, MLIT, Ministry of Internal Affairs and Communications (MIAC) and Ministry of Economy, Trade and Industry (METI), to discuss how traffic information should be utilized in the private sector. The consortium concluded that it would be important to foster a healthy development of traffic information provision business by the private sector to realize comfortable road traffic and to promote aligned efforts among the relevant ministries and agencies to establish an environment for the development of private business. Furthermore, in March 2002, TIC proposed the "Policy Related to the Modality of Road Traffic Information Provision" to set the direction for the provision of road traffic information by private businesses, the Prefectural Public Safety Commission and road administrators, enabling private businesses to launch full-fledged services to provide traffic information.

As a result, in addition to car manufacturers such as HONDA (InterNAVI), TOYOTA (G-BOOK) and NISSAN (CARWINGS), traffic information providers such as NAVITIME Japan (NAVITIME), ZENRIN DataCom (Its-mo Navi) and Nomura Research Institute, Ltd. (Zenryoku-Annai) now purchase traffic data collected by road and traffic administrators from

JARTIC, and consolidate and analyze the data together with the floating car data (FCD) they collect independently to offer their own traffic information provision services.

9.3.2 Collection and Utilization of Floating Car Data

(1) InterNavi (Honda)

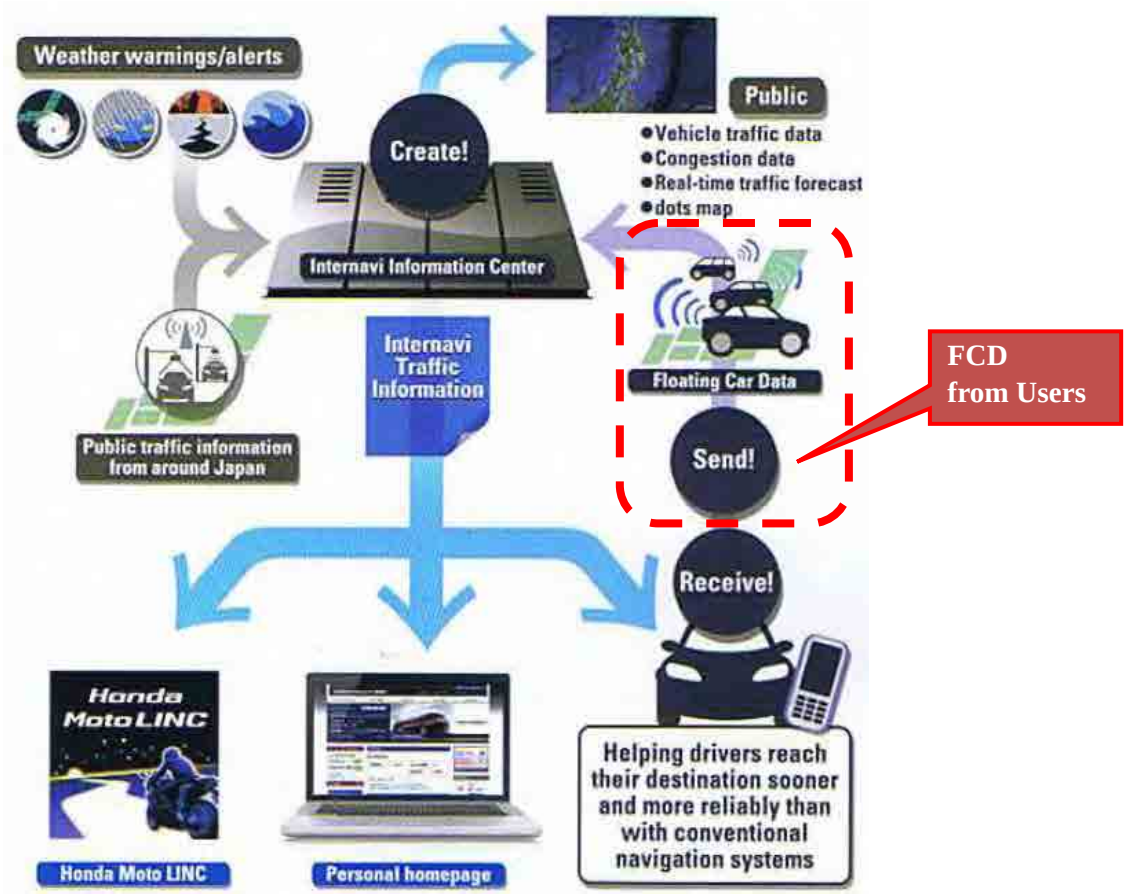
InterNavi is a service provided for users of Honda vehicles with an InterNavi-capable navigation system. The user must also have membership of InterNavi-Link-Premium Club.

InterNavi utilizes data automatically collected from the members who agreed to send their FCD to the information server. The service provides optimum route guidance in consideration of projected traffic jams. It also provides optimal route guidance based on various other conditions such as environment and driving safety. Examples include providing a route with least energy consumption and travelable routes at the time of a disaster/emergency. It also generates a Near-miss Map (a map which indicates locations with a potential risk of traffic accidents).

The FCD is statistically processed and sold to third parties.

Figure 9.3-2 shows the collection and provision of FCD via Honda's InterNavi system.

The traffic information is generated based on FCD collected via InterNavi, which is combined and analyzed together with various public traffic information (purchased from JARTIC; Japan Road Traffic Information Center) and weather forecast data.



Source: Brochures of Honda InterNavi

FIGURE 9.3-2 IMAGINARY OF THE COLLECTION AND PROVISION USING FLOATING CAR DATA IN INTERNAVI

(2) INRIX

INRIX is a traffic information provider which integrates various FCD collected from Smartphone applications and GPS tracking equipment, etc. and construction and other information collected via vehicle detectors held by public organizations. It has branch offices in over 30 countries including the US and Canada, and collects and provides traffic information in cooperation with over 130 partner companies/organizations, such as automobile manufactures (e.g. Audi, BMW, Ford, Mazda, Toyota, Land-Rover, and Mercedes-Benz) and public organizations (e.g. Department of Transportation of each state). (See Figure 9.3-3).

Unlike other private sector companies such as Waze (to be referred in the later section), INRIX ensures quality of its traffic information by having a partnership with public organizations, and the data is also used for policy assessment such as effectiveness of public works.

INRIX conducts predictions up to one year ahead of time based on the accumulated historical data and information on incidents, road closures and weather, and captures information regarding traffic-influenced routing, travel time and traffic bottlenecks.

Source: INRIX http://www.inrix.com/

FIGURE 9.3-3 IMAGINARY OF THE COLLECTION AND INTEGRATION IN INRIX

(3) Waze

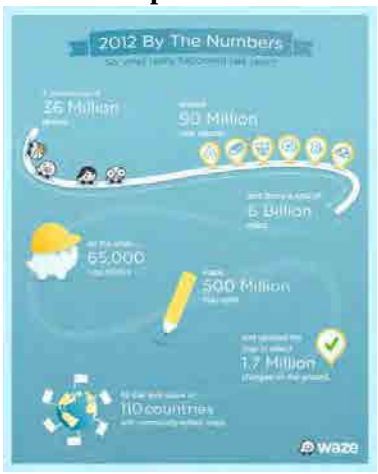
Waze is a social mobile application which combines a mobile navigation system and a SNS. On top of sharing FCD based on GPS information, the users are also able to share traffic information such as congestions and accidents among others. The service also has a function to edit road information such as city/suburb name, street number, street name, and a digital road map. For example, selecting “Pave” function in Waze and making multiple travels on a road which is not on the existing digital road map, a new road is generated based on the FCD and reflected in the digital road map.

The number of Waze users around the world is approximately 36 million (Source: Waze, as of the end of 2012), although the number of users within the Philippines is not known. See **Figure 9.3-4** for Waze user interface screens.

Navigation User Interface

Menu of Report

Purchase Point



Waze (2012)

Source: Waze HP http://www.waze.com/

FIGURE 9.3-4 WAZE

9.3.3 Vehicle Detection

There are many types of vehicle detectors which can be categorized into in-road, over-road and road-side sensors. Loop-coil type is mainly used in in-road sensors whereas Microwave / Ultra-sonic type are mainly used in over-road and road-side sensors.

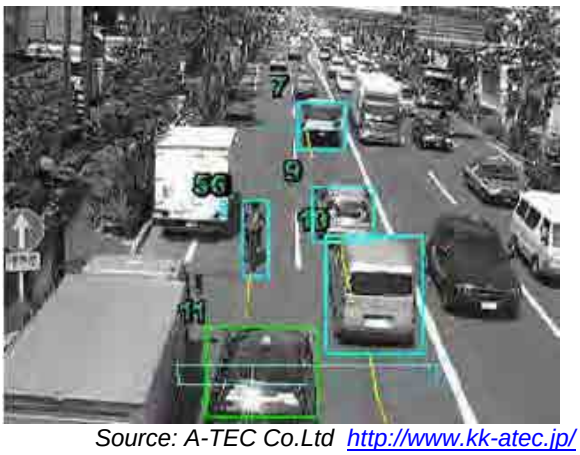
The drawbacks of loop-coil type detectors include disruption of traffic for installation and repair, and failures associated with installations in poor road surfaces and use of substandard installation procedures. Microwave / Ultra-sonic type resolved the drawbacks of loop-coil type; however the implementation cost is more expensive than loop-coil type comparatively.

Recently, the vehicle detector of high value is utilized such as Image Recognition and Wi-Fi Detector.

(1) Image Recognition

There are multi-categories of Image Recognition system. Image Recognition system on highway requires vehicle detection position on the road, and the system requires that the vehicle identification technique shows a suitable image. Image Recognition techniques for the last 10 years have met with difficulties in analyzing when having both vehicle and motorcycle objects move on one screen in many different ways. However, with present analysis technique, there is improved accuracy when Image Recognition and for many vehicle types.

Source: Traficon http://www.traficon.com/



Source: A-TEC Co.Ltd http://www.kk-atec.jp/

FIGURE 9.3-5 SAMPLE PICTURE OF IMAGE RECOGNITION

(2) Wireless Detector using Wi-Fi / Bluetooth

Along with the widespread use of the Internet, various products have become compatible with IP (Internet-Protocol-based) network and even CCTV and vehicle detectors used for road operation management have been integrated into IP network.

Also, as technologies for wireless connection to IP network such as Wi-Fi and Bluetooth have evolved, roadside monitoring and observation devices and the communication network are now connected through Wi-Fi and other wireless technology. With the use of wireless communication, electric construction for wiring is no longer necessary. For example, there are cases in which a Wi-Fi spot is set up around a crossroad to connect CCTV, signals and vehicle detectors wirelessly through Wi-Fi.

Today devices such as Smartphones and car navigations have a MAC address, or a unique ID, to connect to IP network, which can be collected and read for the purpose of vehicle detection (refer to **Figure 9.3-6**).

As devices such as Smartphones and car navigations have wireless communication functions including Wi-Fi and Bluetooth, it is now possible to execute vehicle detection by installing Wi-Fi and Bluetooth antennas alongside the road and reading their MAC addresses. Of course, this requires Wi-Fi or Bluetooth function to be activated on Smartphones or car navigations, so the

consumption of electricity has been a challenge. However, less power-hungry Wi-Fi and Bluetooth components are being developed today.

Source : http://www.deepbluesensor.com/

Source: http://www.clearviewtraffic.com/golden-river/

FIGURE 9.3-6 VEHICLE DETECTOR USING BLUETOOTH

9.3.4 Conclusion

(1) Decrease the Burden of the Road Authority

It is expected that, along with the wider adoption of Smartphones, detecting devices will be optimized and roadside equipment will be reduced.

(2) Reliable Information

While most of the data collected in the past could only detect Euler Velocity, it has become possible to obtain Lagrange Velocity from GPS-based continuous space information. This also means that it becomes possible to obtain OD (Origin-Destination), which is expected to help promote the spiral-up of traffic data and traffic information through the accelerated elaboration and sophistication of traffic analysis as the backbone of traffic information provision.

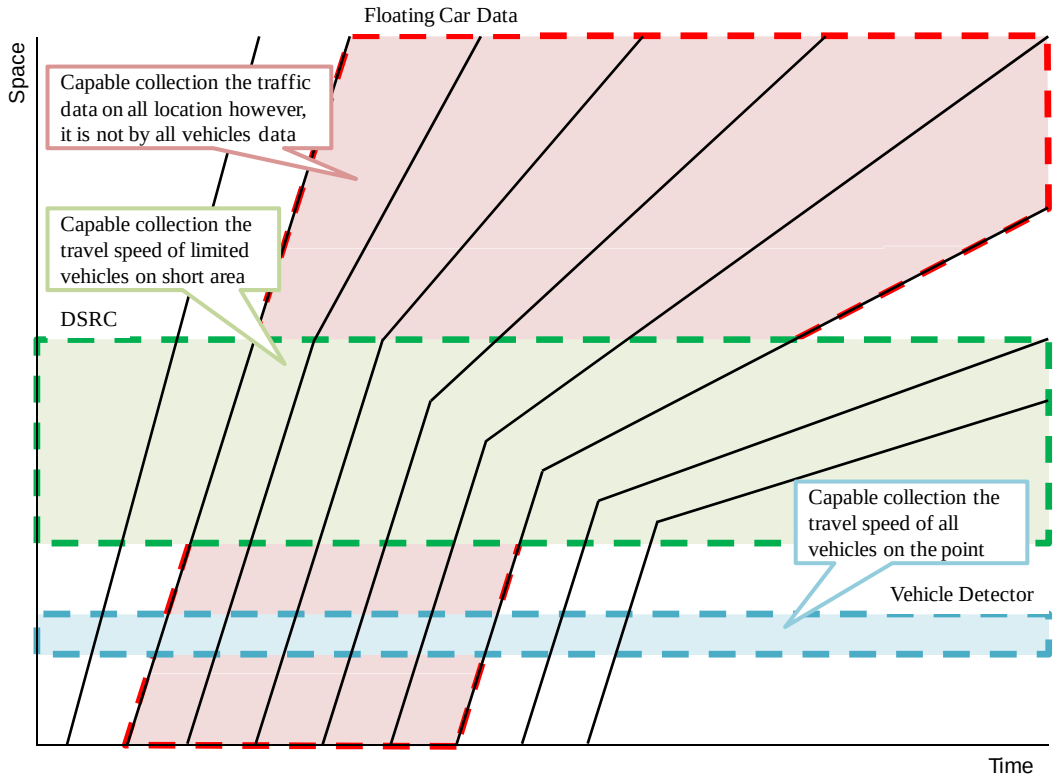
(3) Comparison of Traffic Data Collection Technique

Each traffic data collection method has its own advantages and disadvantages. It is impossible to cover all needs with one method, and it is therefore necessary to choose the optimal device according to the purpose or the situation. The comparison of different methods as shown **Table 9.3-1, Figure 9.3-7.**

TABLE 9.3-1 COMPARISON OF TRAFFIC DATA COLLECTION TECHNIQUE

	Fixed Equipment	Mobile (GPS) Equipment	Crowd sourcing (Text)
Typical Equipment	CCTV Detector (Ultrasonic, Loop Coil)	Probe Car Smart Phone	Internet Mobile Phone
Data for Congestion	Many: All Vehicle	Limited: GPS	Traffic Congestion (Sensory)
Data for Incident	Impossible *Can be estimated	Impossible *Can be estimated	Possible *The need for location information
Covered Area	Limited: Installation Position(Road)	Wide: driving area using GPS	Wide: Mobile coverage area
Immediacy	No Problem	No Problem	Depend on crowd
Cost	High (due to construction)	Middle - Low	Minimal
Cost Burden	Road Authority	Road User, PUV Owner	Crowd (only Text Expenses)
Achievement	Many @World	Many @Some Developed Country	Many @Manila
Preparation Period	Long (due to construction)	Short (due to non-construction)	Very Short (already in used)
Remarks	Quantitative Objective Continuity of Time	Quantitative Objective Continuity of Time and Space	Qualitative Subjective Incidental

Source: JICA Study Team



Source: JICA Study Team

FIGURE 9.3-7 TIME-SPACE DIAGRAM FOR TRAFFIC INFORMATION COLLECTION

(It is shown coverage vehicle depend on type of equipments)

9.4 ROAD OPERATION MANAGEMENT

The deterioration of aged infrastructure is a serious problem all over the world. In order to ensure the soundness of road infrastructure, road asset management, especially vehicle overload control, is an important challenge.

It is beyond argument that it is an important mission for road administrators to reduce damage caused by overloaded vehicles and to take other measures to implement asset management for road infrastructure, which is a socially shared asset to be passed on to the future generations. Now efforts are being made to introduce the systems designed to execute these tasks effectively. The following sections outline the concept of road asset management and its practical applications.

9.4.1 Road Operation and Maintenance

(1) Image Recognition for Incident Detection

In each country, road maintenance / management is implemented with limited budget and manpower through the utilization of ICT. Such activities include monitoring roads with CCTV, measuring road conditions, monitoring road structures, routine inspection patrol, etc.

As for the monitoring of road conditions with CCTV, the number of the devices has increased with the expansion of monitored areas and it takes significant manpower to manually check all the recorded images. Therefore, the major trend today is to use image recognition to automatically detect road incidents such as traffic accidents, left obstacles and breakdown vehicles. (See **Figure 9.4-1**).

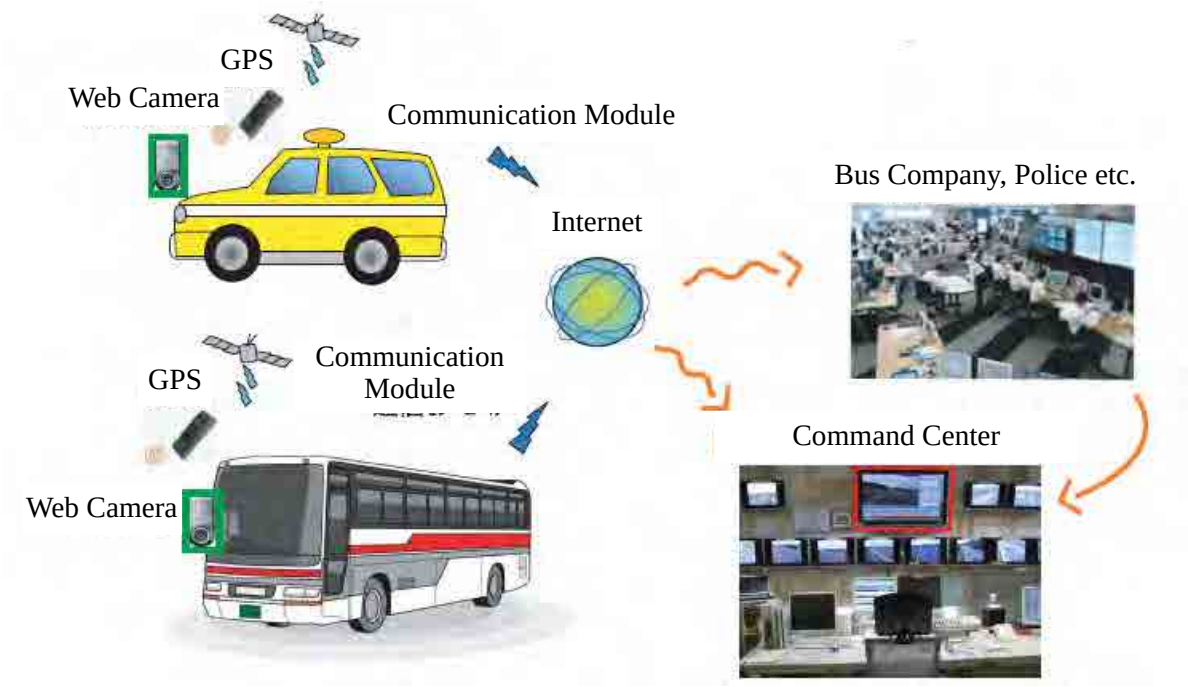
Source: eurotransport magazine http://www.eurotransportmagazine.com/

FIGURE 9.4-1 IMAGE RECOGNITION FOR INCIDENT

(2) Capture Line for Improvement and Sophistication of Patrol

The data collected through patrol vehicles for road traffic inspection or through devices installed on route busses (web camera: records images when running; GPS: Floating Car Data) is sent through mobile phone network to road administrators and Bus Company, Police, etc. (**Figure 9.4-2**).

As for web camera images, GPS receivers recognize specific positions (regularly at each of the kilometer posts located at 200-meters intervals) and acquire still images on a regular basis. These images are automatically processed at the Command Center and visibility at each location is calculated. The calculated visibility information is used for road management and also shared by bus companies, the police, etc.



Source: Nexco-Engineering Hokkaido Co. Ltd http://www.e-nexco-engiho.co.jp/index.html

FIGURE 9.4-2 CAPTURE LINE SYSTEM

(3) Road Infrastructure Monitoring System

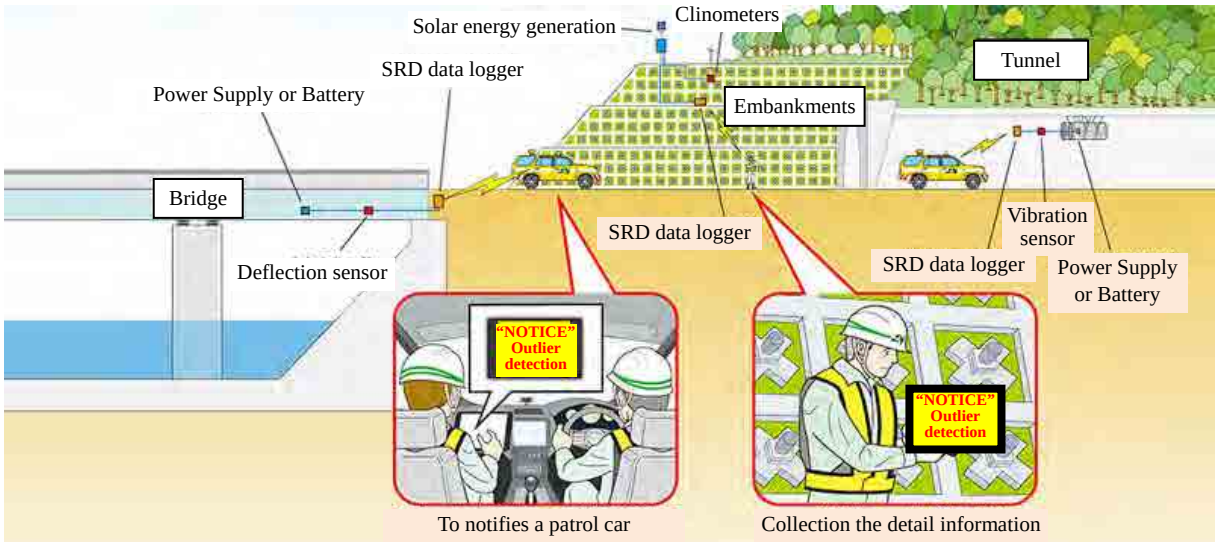
System-backed solutions have also been introduced for the monitoring of road structures. Nexco East Engineering Co., Ltd. has developed “Yume-Sys (Ubiquitous Road Maintenance Information System)” using several sensors, wireless communication, RFID technology, etc., and is now conducting field tests. The system utilizes deflection sensors, etc. for bridges, subsurface clinometers, subsurface nilometers, load meters, etc. for embankments, and vibration sensors, etc. for tunnels.

Data obtained through these sensors are collected and accumulated using short-range wireless communication (920MHz frequency) called “SRD data logger” containing Unique Code

(ucode), and, when an unusual value is detected, the system notifies a patrol car running at a high speed (about 80km/h) of the location and details of the unusual condition. The detailed data measured and accumulated can also be collected at a distant road shoulder or under the bridge through sensors and SRD data loggers.

Though final inspection and investigation work needs to be done by humans, this system enables early detection of abnormal conditions or damages, making inspection tasks more efficient.

To power these sensors and SRD data loggers, solar energy generation, vibration energy generation and other resources are used in addition to commercial power supply and battery.

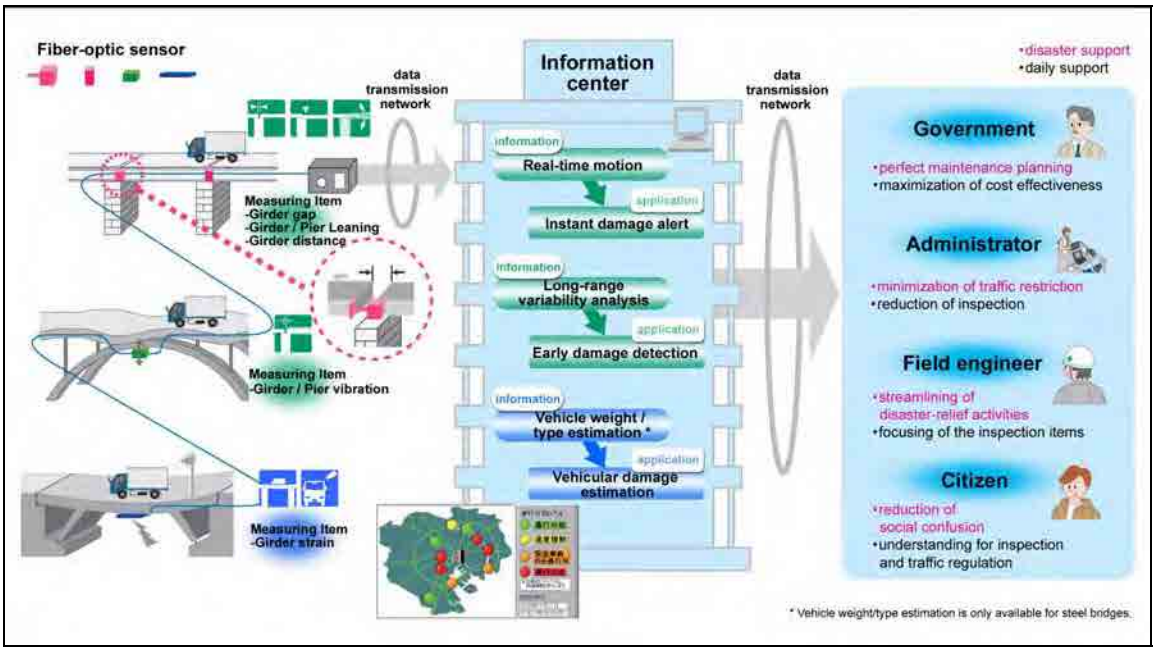


Source: Nexco-East Engineering Company Limited http://www.e-nexco-engi.co.jp/

FIGURE 9.4-3 UBIQUITOUS ROAD MAINTENANCE INFORMATION SYSTEM

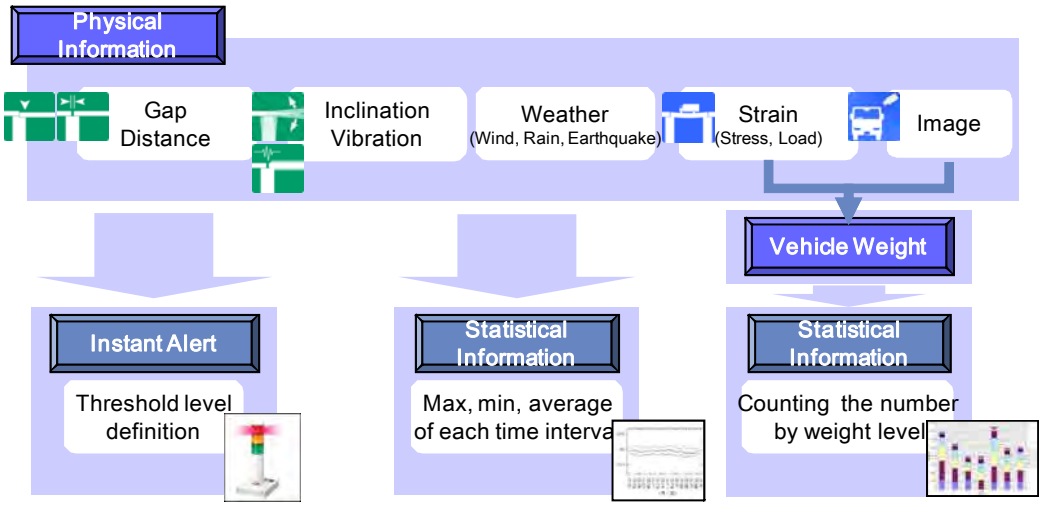
NTT DATA, in collaboration with Tokyo Institute of Technology (http://www.titech.ac.jp), has developed BRIMOS (Bridge Monitoring System), a solution specialized in monitoring bridges, and is now conducting field tests not only in Japan but also in foreign countries including Vietnam.

BRIMOS is a bridge monitoring system that continuously monitors the conditions of a bridge on a real-time basis using various types of sensors installed on the bridge, for the purpose of supporting activities such as the detection of unusual conditions at the time of disaster, the monitoring of deterioration level and the early detection of unusual conditions at normal times, the quality check at the time of construction and repair, the prioritization of inspection and repair tasks based on analysis of vehicle traffic and the monitoring of overloaded vehicles. (See **Figure 9.4-4**, **Figure 9.4-5**)



Source: NTT DATA http://www.nttdata.com/global/en/index.html

FIGURE 9.4-4 BRIDGE MONITORING SYSTEM



Source: NTT DATA http://www.nttdata.com/global/en/index.html

FIGURE 9.4-5 SEVERAL SENSOR FOR MONITORING IN BRIMOS

9.4.2 Overloading Enforcement

Damage to road structures and serious incidents due to overloaded vehicles are a serious problem all over the world, and ITS is utilized to enhance the control overloaded vehicles.

In France, the Ministry of Transport (Department for Sea and Transport, DGMT) began to implement WIM (Weigh-In-Motion) for national roads and motorways in 2007, based on the detail specifications defined by Laboratoire Central des Ponts et Chaussées (LCPC), etc. (See **Figure 9.4-6**)

The WIM systems are supplied by Sterela (http://www.sterela.fr/), a French company which won the call for tender, and use two piezo-ceramic strip sensors per lane, an inductive loop, a CCTV, and in some case an additional Automatic Number Plate Recognition (ANPR) system.

Source: Laboratoire Central des Ponts et Chaussées
(5th International Conference in WIM, French)

FIGURE 9.4-6 WIM NETWORK IN FRANCE

In Europe, many other countries including Slovenia, United Kingdom, Sweden and Hungary, are promoting, or plan to promote, the introduction of WIM, as stricter control for overloaded vehicles which has become an urgent task to be executed.

In Japan, axle load scales are installed on expressway toll gates to measure axle load and identify vehicles with potential overload. The load weight of a vehicle identified as potentially overloaded is measured at the Statistic Weight Station installed in the same facilities to enforce strict control. (See **Figure 9.4-7**)

The basic measure for enforcing control is to measure the weight of potential overloaded vehicles at Strategic Weight Stations, but WIM is also installed at 39 locations across the nation for the purpose of raising public awareness of overloading. (See **Figure 9.4-8**)

Moreover, enhancements are being made to the activities to identify illegitimate road use by overloaded vehicles, specialized vehicles and hazmat vehicles based on floating car data and vehicle registration information.

Source: JICA Study Team

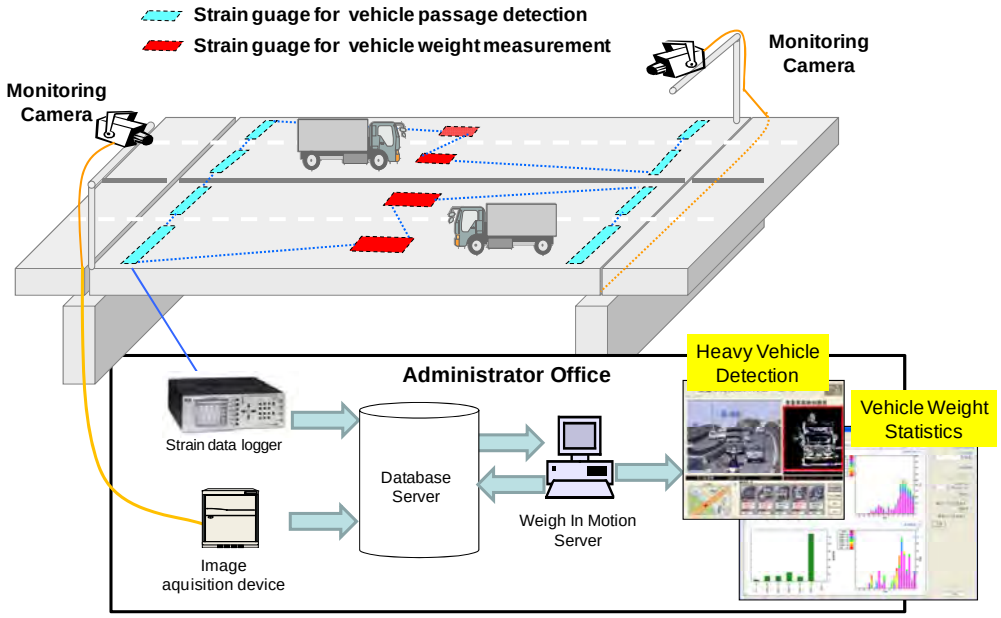
FIGURE 9.4-7 AXLE LOAD SCALE AT TOLL GATE IN JAPAN

Source: VITTRANS2 Report (JICA)

FIGURE 9.4-8 WEIGH-IN-MOTION IN JAPAN

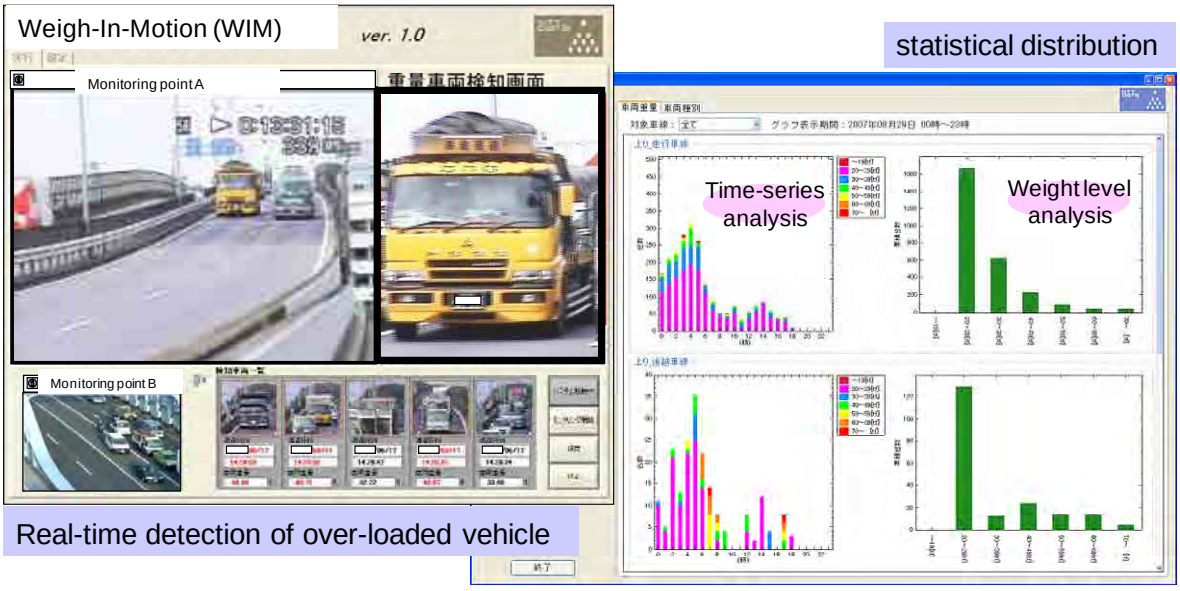
Also under development is Bridge Weigh-In-Motion (B-WIM) to measure vehicle weight based on the amount of strain of the bridge, etc., caused by vehicle passage. B-WIM is already in the application stage for steel bridges, but it is still in the development phase for concrete bridges. In order to implement the detection of overloaded vehicles at various locations, it is required to develop B-WIM designed for concrete bridges.

Recently, field tests are underway at concrete bridges to measure vehicle weight as well as monitoring the deterioration of the structure. While the construction of Strategic Weight Station requires a certain size of land, it is possible to measure vehicle weight on the road with B-WIM, so its future utilization is highly anticipated.



Source: NTT DATA http://www.nttdata.com/global/en/index.html

FIGURE 9.4-9 BRIDGE WEIGH-IN-MOTION (B-WIM)



Source: NTT DATA http://www.nttdata.com/global/en/index.html

FIGURE 9.4-10 SAMPLE OF B-WIM MONITORING

9.4.3 Traffic Accident Inspection

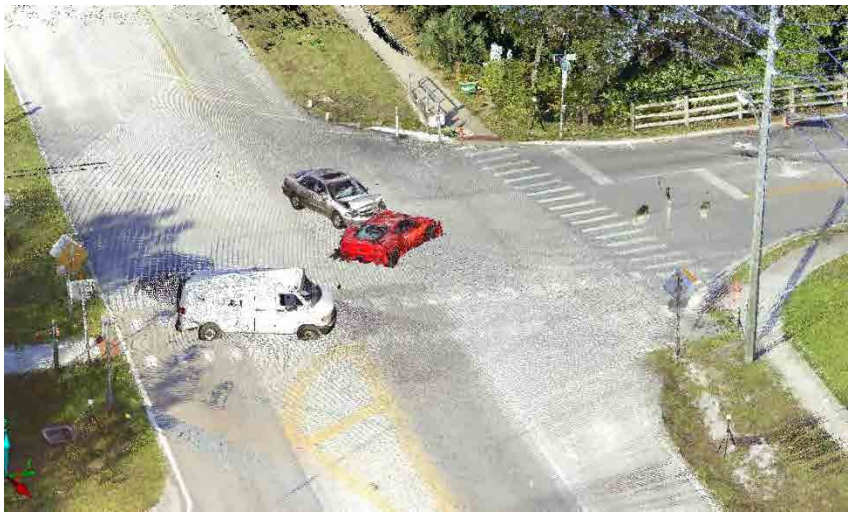
When a traffic accident happens, the entire road or part of it is blocked for accident inspection. Traffic congestion caused by this slows down traffic flow much more significantly than normal congestion caused by heavy traffic, so it is required to release the road closure as soon as possible.

In United Kingdom, according to the Department for Transport (DfT), there were more than 18,000 full or partial motorway closures lasting a total of more than 20,000 hours in 2010. The government hopes that its strategy will help drive down the £ 1 billion (PHP 63 billion approx.) annual cost to the economy.

DfT has started using 3D Laser Scanner to speed up the process of traffic accident inspection in the case of an accident.

Source: ITS International http://www.itsinternational.com

FIGURE 9.4-11 TRAFFIC ACCIDENT INSPECTION BY USING 3D LASER SCANNER



Source: Atlantic Laser Scanning Service http://www.atlanticlaserscanning.com/

FIGURE 9.4-12 SAMPLE OF 3D LASER SCANNER DATA ON TRAFFIC ACCIDENT

9.4.4 Conclusion

The management and maintenance of age-old road structures have become an urgent issue around the world, and ICT has been utilized to monitor road structures in order to manage and maintain them efficiently within limited budget and human resource.

As the required management / maintenance level varies from country to country and also by road type, it is not necessarily mandatory to implement ITC-based road structure monitoring for all roads.

However, since roads are infrastructure that supports the whole social and economic activities, it is critically important to properly manage and maintain at least the expressways and major roads that serve as the core logistic network for the national economy.

Therefore, it is desirable to identify the core road network that supports logistics and to introduce ITS for these key roads in order to set the appropriate management / maintenance level and monitor conditions such as deterioration.

Overloaded vehicles do not only cause damage to road structures but also other significant impacts on the society such as serious accidents. Moreover, competition has been growing among logistic companies, thus heightening the pressure from freight owners to increase load as much as possible. Therefore, cracking down on overloaded vehicles will help protect those companies that comply with appropriate load weight, which should eventually promote healthy competition among companies.

However, if it is required to measure vehicle weight at the Strategic Weighing Station for direct enforcement with limited budget and human resource, it is impossible to enforce comprehensive control.

With other countries facing similar challenges, it is desirable to work with the relevant institutions such as DOTC, DPWH and MMDA and to introduce WIM to major roads in the Philippines while establishing laws and regulations to enable enforcement through non-physical contact.

9.5 TRANSPORT FARE COLLECTION

There are multiple types of Electric Toll Collection (ETC) with different communication and payment methods, and the optimal system has been chosen and introduced in each country according to their situation and conditions. Each system has advantages and disadvantages, but their basic configuration, which consists of a card and an on-board unit, is common and seems

to be a matured function.

The recent trend indicates increased attempts to broaden the range of toll collection beyond the use of expressways or other roads with controlled entrance and exit. There have been toll measures to reduce traffic congestion such as time-zone based fares, but the key difference lies in the fact that the new attempt is to generate revenue to cover the cost for the maintenance and preservation of roads as social infrastructure. What drives such initiatives behind is the widespread popularity of environmental-friendly vehicles such as Electric Vehicle (EV) and Hybrid Vehicle (HV) in those countries dependent on fuel taxes. For this reason, planning and testing are underway toward the shift from fuel taxes to Vehicle Miles Traveled (VMT) fee. This system enables charging flexible fare by combining multiple parameters such as vehicle type, road type and time, while prompting users to be aware of the need to pay for the value gained from road use as well as maintenance cost to be borne according to the usage level. Also, there has been a proposal that this new system should help realize a shift from charge for the ownership and running of a vehicle to charge according to road use to promote shift to public transportation (Modal Shift).

In EU, a fare system targeting trucks has been introduced for the purpose of reducing air pollution and noise. Many countries have widely adopted a system with Vignietto (certificate attached to the windshield) to charge by the units of the day, week, month and year. Now some countries have replaced the time units such as the day or week with the travelled distance recorded with an on-board GPS unit for this truck charge, and countries such as France and Czechoslovakia have already started to use a system that adopts not only GPS-OBU (On Board Unit) but also 5.8GHZ DSRC (Dedicated Short Range Communication).

9.5.1 Electric Toll Collection on Expressway

Each country has introduced ETC System for expressways and toll roads. There are a variety of communication methods such as 5.8GHz Active DSRC, 5.8GHz Passive DSRC. 2.45GHz Passive DSRC, Infrared and RFID Passive/Active, but many of the countries that introduced ETC have adopted DSRC. RFID Passive (ISO18000-6C), based on the UHF band, which was internationally standardized recently, is being adopted in countries such as the U.S. and India because, unlike DSRC, the RFID unit installed on the vehicle is very cheap and does not require electric power.

However, whether to choose one method or another depends on functionalities including the accuracy level required for the system, toll system, road structures (with or without full access control) and how to charge road users.

ETC used for expressways and toll roads have various forms in terms of how the system is

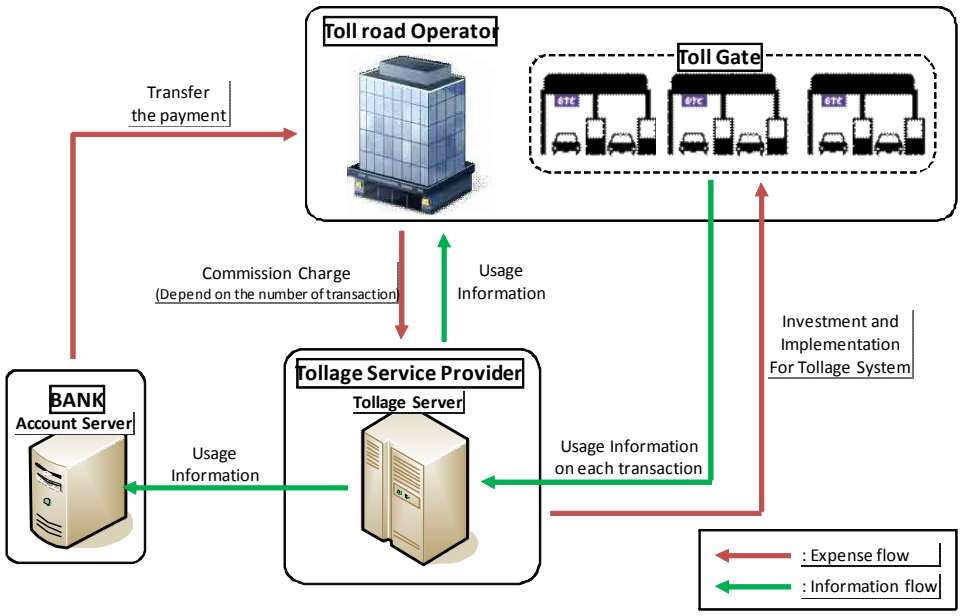
introduced rather than in terms of choice of technology.

While expressway operators in Japan operate and maintain their roads by themselves, road operators in countries such as Australia consign the task of collecting toll to an outside service provider together with the installation of ETC equipment. They first set the budget for a 10-year contract package covering the installation, maintenance and inspection of ETC equipment, tasks related to toll collection and countermeasures for those who do not make payment and choose the service provider through a bid tender. Take note, the budget includes the fee for the disposal of ETC equipment after 10 years, so that the whole ETC system can be upgraded in case a more appropriate system is to be available in the future due to technological innovation. It is also possible to continue using the existing ETC if it is decided at the time of expiration that it is still an appropriate system.

Another model developed recently is that an outside service provider bears the cost for the installation of ETC equipment and the expressway operating company makes payment according to the number of ETC transactions for toll charge. In this model, the expressway operator is charged per ETC transaction at the set unit price, but it is beneficial for both companies, enabling the outside agent to generate more revenue with higher ETC usage and the expressway operator to resolve toll gate congestion and reduce necessary toll gates manpower. The ETC system for the North Luzon Expressway (NLEX) in the Philippines is also constructed with this model.

In either of these models, the choice of ETC technology is often up to the outside service provider. Therefore, in case there are multiple road operators that are privately-owned, there are often multiple service providers as well and therefore multiple ETC technologies, which makes it difficult to realize interoperability.

For this reason, it is desirable that a government agency or a related organization should define standard requirements for interoperability, at least for the ETC technology to be adopted.



Source: JICA Study Team

FIGURE 9.5-1 SAMPLE OF IMPLEMENTATION/OPERATION SCHEME OF ETC

9.5.2 Automated Fare Collection on Public Transport

(1) Contactless IC-Card Type

There are three (3) major types of IC-cards for 13.56MHz. These are “TYPE-A”, “TYPE-B” and “Felica”. But, there are some variety of “TYPE-A”, such as “Mifare” and Others. Therefore, compare with between “TYPE A + Mifare”, “TYPE A”, “TYPE B” and “Felica”.

TABLE 9.5-1 SPECIFICATION COMPARISON FOR CONTACTLESS IC-CARD

			TYPE A + Mifare	TYPE A	TYPE B	Felica
Comparison	Transaction Speed		> 106kbps (depend on Variety)	> 106kbps	106kbps	212kbps
	Production Cost		Low	Low	Middle	High
	Crypto-graphy	RSA	Applicable	Applicable	Applicable	Applicable
		AES	Applicable (depend on Variety)	Applicable	Applicable	Not applicable
	Supplier		A few	Many	Many	A few
Notes	Operation for Transportation		Asia, Europe	Asia, Europe	Europe	Asia
	Inter. Standard	ISO 14443	Compliant	Compliant	Compliant	Not compliant
		ISO 18092	Compliant	Compliant	Not compliant	Compliant

Source: JICA Study Team

(2) Operational Experience (for transportation)

1) Asian Region

Asian region is one of the globally advanced example for the spread of Contact-less IC-card, such as “Octopus Card” in China and Hong Kong and “EZ-link” in Singapore.

In Soul, Korea, “T-money” IC-card was introduced as a new concept based on the revision of urban transport system in July, 2004.

Recently, the city of Shenzhen, Guangzhou, Shanghai, Dalian in China with its rapid economic development, promote Contactless IC-card as a transportation card.

In Asia, TYPE A or Felica techniques are applied at many cities.

2) European Region

In European region, IC-card is popularized as an additional function with Debit Card (ATM card) in order to be realized “Coinless Payment”, such as “Geldkarte” in Germany, “Danmont” in Denmark, “Proton” in Belgium, “Moneo” in France, and “Chipkaart” in Netherland.

The transport agencies in France, Italy, Portugal and Germany are under study on introduction of contact/contactless IC-card and box type terminal units for exchange from contact IC card to contactless IC card.

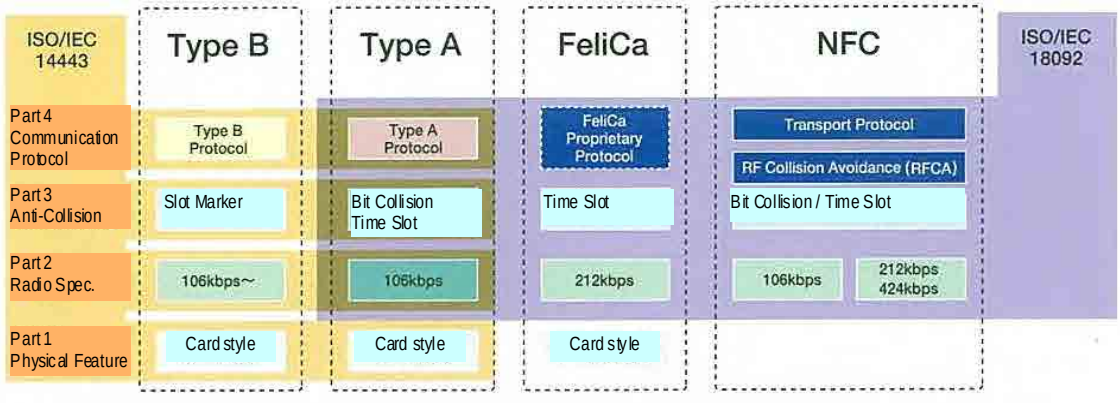
In the European region, TYPE A and TYPE B are applied at many cities.

3) International Standard

International standards for contactless IC-card are ISO/IEC1443 and ISO/IEC18092 issued.

ISO/IEC1443 and ISO/IEC18902 realizes contactless IC-card to communicate the data transaction each other by 13.56MHz radio wave within 10 cm of each IC chip. Transaction speed can be selected from 106K/212K/424K/848Kbps.

ISO/IEC18092 defines only standards for communication method between equipments, and not the specific physical figure and sizes. Therefore, there are flexibility for products figure and sizes.



Source: Brochures of Felica, SONY http://www.sony.net/Products/felica/

FIGURE 9.5-2 RELATIONSHIP BETWEEN ISO/IEC14443 AND ISO/IEC18902

9.5.3 Fare Collection on Road Pricing, etc.

In Europe, after Norway became the first country in the world to introduce automatic toll collection for road usage in 1986, many countries implemented traffic demand control by way of road fare. However, since each country adopted their own toll system, the EU has faced the question of how road users should bear social cost appropriately across the member countries since the establishment of EU as the regional economy has been unified based upon free movement of people and goods.

In order to address this issue, efforts have been made to standardize the system to charge road users with social cost across the whole EU region while considering the existing systems adopted by each country, based on the directives from European Commission such as "Eurovignette Directive" (see **Table 9.5-2**) and "The European Electronic Toll Service (EETS)."

According to these directives, it is desirable to shift to a mileage-based toll system that allows flexible tolling according to the travelled distance and the degrees of air pollution and traffic congestion. After the first launch in Switzerland in 2001, Germany, Australia and Czechoslovakia have introduced a mileage-based toll system for heavy freight vehicles in expressways and other similar roads. More recently, in 2010, Slovakia introduced a system similar to the German model that combines GPS, GSM and DSRC, and in 2012, France also introduced a similar system. (See **Figure 9.5-4**)

Also, in September 2011, "Toll2GO" service was launched to provide the interoperability of toll systems for heavy vehicles between Germany and Australia, enabling 12-ton or heavier vehicles with a German Toll Collect on-board unit to pay the toll both in Germany and Australia with only one ETC unit. This became the first example of interoperability implemented according to the EETS directive.

Moreover, countries such as the Netherlands, Sweden, England, Belgium and Hungary are planning to introduce a mileage-based toll system based on GPS technology in order to achieve policy objectives such as realization of appropriate road cost allocation, resolution of traffic congestion and improvement of the environment. Czechoslovakia also plans to shift from the current DSRC-based system to a GPS-based system as it will expand the target roads by 2017.

EETS requires each country to ensure their toll system should be compatible with one or more of the following technologies:

－GNSS (GPS, EGNOS, Galileo)

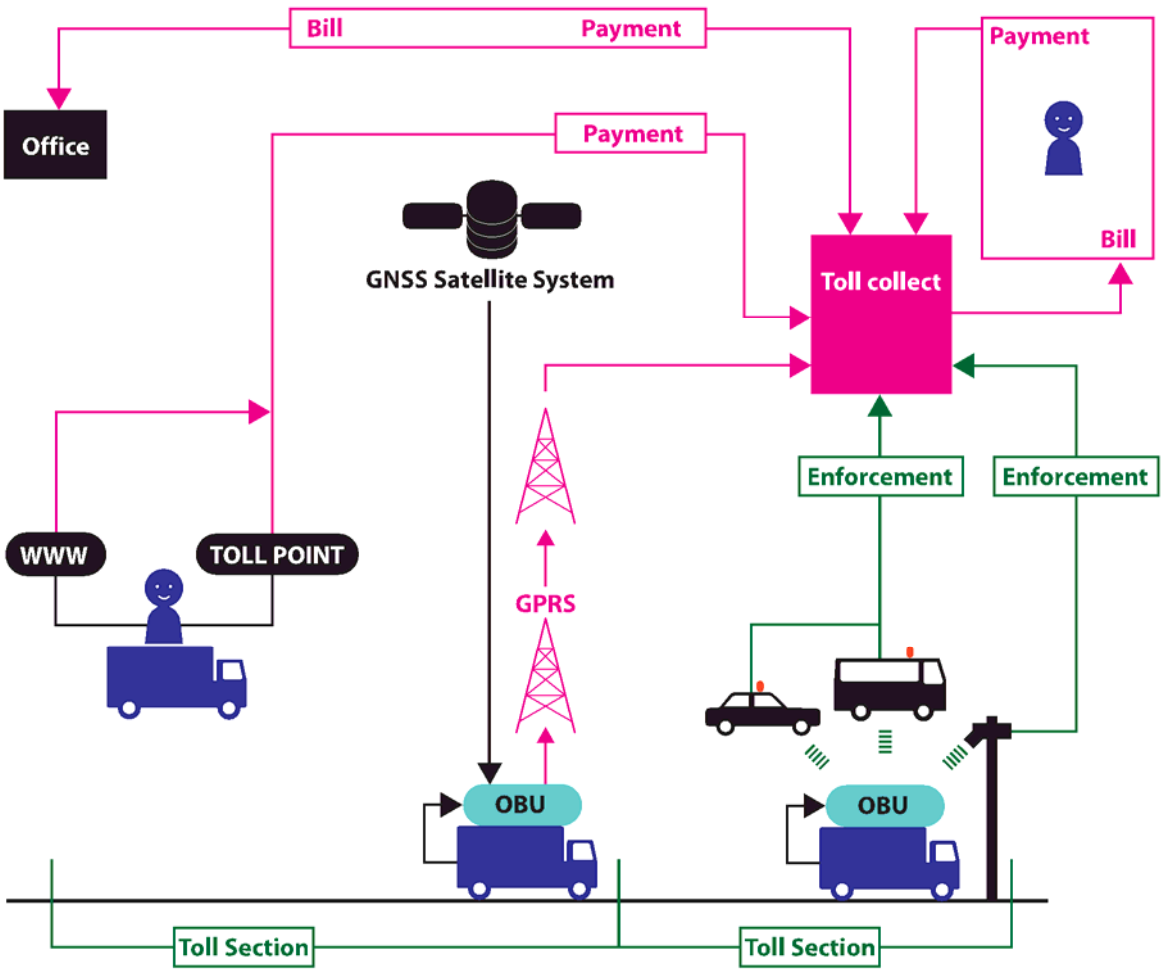
－DSRC (5.8 GHz CEN Standard)

－GSM/GPRS (General Packet Radio Service)

TABLE 9.5-2 SUMMARY OF EUROVIGNETTE DIRECTIVE

			Eurovignette Directive (Directive 1999/62/EC of the European Parliament and of the Council of 17 June 1999 on the charging of heavy goods vehicles for the use of certain infrastructures)
Toll type			・Fare for road use (specific amount for specific distance travelled on the road)
Time of introduction			・1999 and after
Background behind the introduction of the Directive			・In 1993, the Directive defining Eurovignette (fixed fare) to charge large freight vehicles running on expressways and other similar roads (1993/89/EEC) was promulgated. ・In 1995, Denmark, Netherlands, Belgium, Luxemburg, Sweden and Germany introduced Eurovignette.
Toll scheme	Objective of the toll		・Resolution of imbalance in competition in transportation business among member states ・Appropriate sharing of infrastructure cost by freight carriers
	Target of the toll	Route/part	・Trans-European road network or part of it and other roads, especially roads running in parallel with Trans-European road network (to be decided by member states) ・[This Directive does not prohibit member states from charging for the use of other roads.]
		Vehicle	・Freight vehicles with maximum pay load of 12 tons or more ・From 2012, road use fee will be applied to freight vehicles with pay load of over 3.5 tons and below 12 tons [This Directive does not prohibit member states from charging other vehicles.]
		Day/time	・Toll rate should be changed according to the time zones of the day
	How to set the amount of the toll		・Must be solely based on the principle of collecting the infrastructure cost (construction, operation, maintenance and management) ・Toll rate can vary within a certain range according to emission class, time zones, heavy-traffic roads and for freight vehicles that cause significant damage to the environment.
	Toll rate		・Toll rate is set by each country as suggested by “How to set the amount of the toll” above
	Owner of authority to charge		・Member states (cooperation among two or more countries are permitted), (Paragraph 1, Article 8)
	Method for charging and collecting toll		・Toll should be collected in a manner that avoid interfering with free traffic flow and circumvents the security checkpoints at borders within the European Union (Paragraph 5, Article 7)
			・GPS+GSM-GPRS, 5.8GHz microwave technology
	How to use collected toll		・To be decided by each member stat ・Should be used for the benefit of optimizing the traffic sector and the whole traffic system.
Transition from the introduction to the current time and the background behind it			・The Directive was revised in 2006, with the scope of the toll expanded both in target roads and target vehicles; maximum toll that can be charged was raised; it became possible to set toll rate with the intention to internalize the external cost.

Source: Task of Examining the Applicability of Information Communication Technology in Traffic Demand Management (National Institute for Land and Infrastructure Management, 2012)



Source: Road Pricing in Europe https://www.ereg-association.eu

FIGURE 9.5-3 CONCEPT OF TOTAL TRANSPORT FARE COLLECTION SYSTEM

Source: ITS International http://www.itsinternational.com

FIGURE 9.5-4 ON-BOARD-UNIT FOR ECO TAX IN FRENCH

In the US, Congestion Pricing Pilot Program was launched under the jurisdiction of Department

of Transportation (DOT) and Federal Highway Administration (FHWA) for the purpose of examining feasibility of reduced congestion by charging for the use of roads and parking lots. This program was renamed as “Value Pricing Pilot Program” in 1998 and has continued to this day with expanded coverage. (FHWA2008)

Since 1990, the programs have provided High Occupancy Toll (HOT) Lane as a new measure that charges for the use of a specific lane in heavily-congested freeways utilizing the existing High Occupancy Vehicle (HOV) Lane in order to maintain the service level of the lane. (See **Figure 9.5-5**)

Moreover, as it is expected that the revenue of fuel taxes will decrease along with the widespread use of hybrid vehicles and electric vehicles and that road maintenance/management costs will increase, a mileage-based toll collection is now under discussion.

From 2005 to 2007, a GPS-based pilot program for mileage-based tolling was conducted in the state of Oregon and the Seattle metropolitan area as part of the Value Pricing Pilot Program. In Oregon, the program adopted a GPS+DSRC-based system which calculated toll rate by utilizing a gas-station system, while in the Seattle metropolitan area it adopted GPS-GSM-based system without DSRC. The results confirmed the technological reliability of the two systems.

Moreover, from 2008 to 2010, the University of Iowa took the initiative in conducting a proof-of-concept experiment in 12 regions across the US for a mileage-based toll system, using GPS+GSM-based system as tested in the Seattle metropolitan area. Also from July 2011 to December 2012, DOT and the University of Minnesota conducted a joint experiment with 500 participants for a mileage-based toll system with a GPS+GSM-based system utilizing Smartphones with GPS as an on-board unit. (See **Figure 9.5-6**)

Source: ITS International http://www.itsinternational.com

FIGURE 9.5-5 HOT LANE

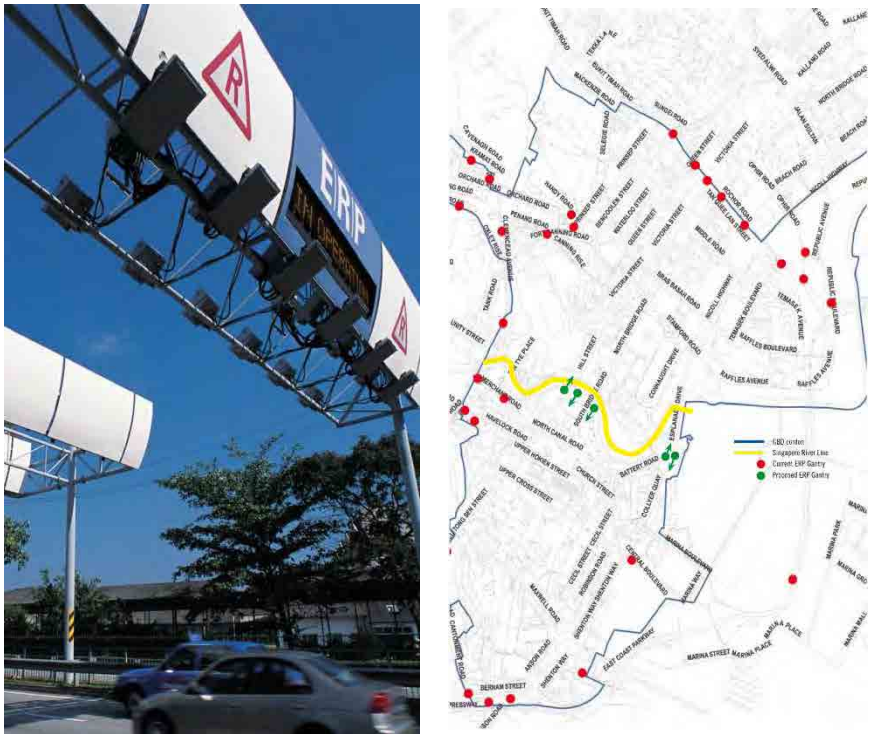
Source: ITS International http://www.itsinternational.com

FIGURE 9.5-6 EXPERIMENTATION OF MILEAGE BASED TOLL COLLECTION BY USING SMARTPHONE

In Singapore, EERP (Environment Electronic Road Pricing) has been in place since 1998 using DSRC with gantries, and turned out to be functional enough. However, as it is expected that the number of vehicles will keep growing for a long term and that road congestion will be further expanded into larger areas, the introduction of toll collection across Singapore based on GPS＋GSM＋IEEE.802.11p (WAVE) is now under consideration.

In June 2011, the country's Land Transport Authority (LTA) designated four (4) groups including Mitsubishi Heavy Industry as service providers of a proof-of-concept experiment.

Now, each group is developing a system and conducting an evaluation test.



Source: Land Transport Master Plan in Singapore

FIGURE 9.5-7 ROAD PRICING IN SINGAPORE

9.5.4 Conclusion

Generally speaking, under the current condition, either DSRC method or RFID method is chosen as a means to charge fare for expressways and toll roads with full access control. Considering the number of applications, DSRC method has been adopted in a higher number of systems. Also, with a mileage-based toll system, it is desirable to retain entry information on the vehicle side, so DSRC method seems to be relatively advantageous as it enables retaining entry information on the vehicle side.

However, as discussed earlier, there are many cases in which the installation of ETC equipment is not conducted by the road operating company but by an outside agency after a bid tender, etc., and therefore, in order to ensure interoperability, it is preferable to define standard specifications (recommended specifications) for ETC systems to be used in the same country.

As for toll collection for road network including public roads as well as toll roads, the basic requirement should be to collect GPS-based mobile object information because it is necessary to acquire the entry and exit locations and the travelled distance.

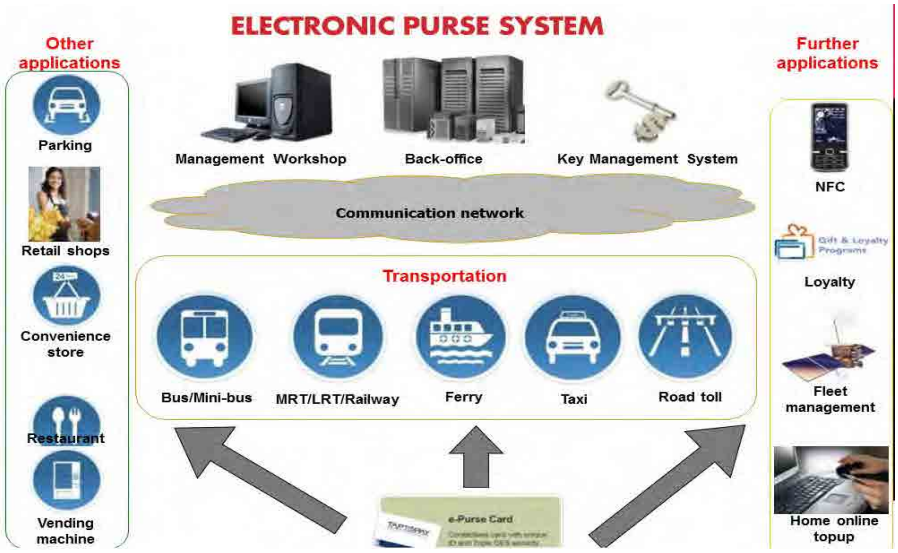
Currently, various forms of field tests are underway to verify GPS-based toll collection systems.

Especially as for the model combining GPS and toll collection using DSRC-based gantries, it should be desirable to utilize the authorization with fixed equipment solutions such as DSRC and ANPR, as it is difficult to obtain accurate location information for enforcement only by means of GPS. The model combining GPS and DSRC (ANPR, etc.) seems to be a feasible near-future solution for a comprehensive fare-collection system with coverage of toll roads.

In the future, this trend is expected to accelerate along with policy-related decisions.

Meanwhile, systems that promote seamless utilization of public transportation have been introduced in many countries around the world. Some companies now offer an integrated transportation card that covers railways, buses, ferries and even rental motorcycles. It is expected that the trend of integrated fare collection will be further accelerated.

Unfortunately, there is no practical example of a fare-collection card combining public transportation and toll road use (ETC), taking into account Park and Ride (P&R) applications. It would be perfectly feasible from technological viewpoints, and there have been specific proposals to implement the concept. Initiatives to introduce such a system for social benefits are highly anticipated.



Source: Multi Tech Engineering http://mtecheng.co.za/

FIGURE 9.5-8 CONCEPT OF UNIFIED TRANSPORT FARE COLLECTION SYSTEM

9.6 COMMUNICATION INFRASTRUCTURE

9.6.1 Wired/wireless Communication Network

Communication infrastructure is the realization of ITS. As all information is sent and received through wired or wireless communication network, it would be difficult to realize ITS without

communication infrastructure.

In the Philippines, construction work is now underway to establish a backbone optical-fiber network, and according to the hearing with telecommunication companies such as PLDT, an optical-fiber network is also being constructed along with major roads.

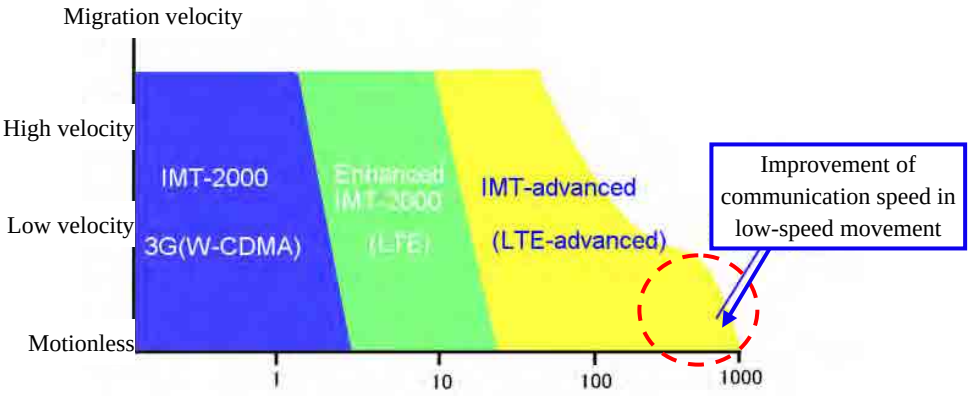
Even for wireless communication networks such as GSM/3G, the network connecting base stations require the installation of optical fiber cables. Therefore, it is essential to ensure wired communication through optical fibers.

When constructing a wired communication network with optical fiber cables, either overhead wiring or buried wiring can be chosen. Considering the risk of overhead wires being damaged by strong wind, it is preferable to embed wires underground. However, civil engineering work to bury wires takes a significant amount of cost.

Japan has conducted construction work to build space for burying optical fiber cables underground along with road construction and road improvement, for the purpose of establishing high-capacity high-speed communication infrastructure at lower cost, not only as the foundation for ITS but also as a national project, and rented the space for optical fiber cables to a private telecommunication company. Moreover, Japan has built an optical fiber network as communication network for road management under a road building project and has utilized it as the foundation for ITS and rents part of the unused optical fiber to private companies.
Wireless communication technology is advancing at an amazing rate, and now the type of large data transmission that would not have been possible without an optical-fiber network is now feasible with the latest wireless communication technology that can handle a large amount of data over an extensive distance. Examples of such technology are WiMAX and LTE.

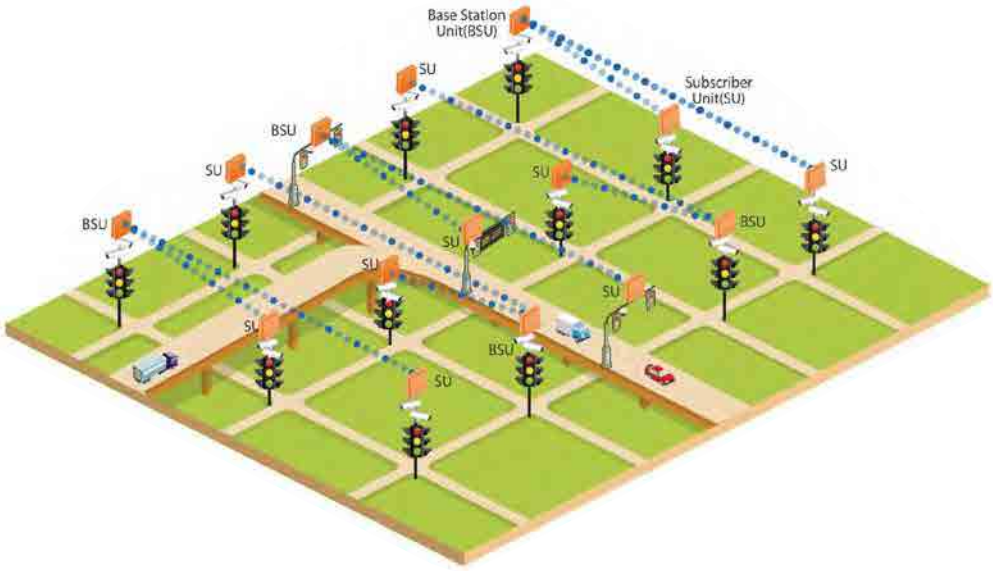
WiMAX is used by MMDA as their self-operated line, and now WiMAX2 (IEEE802.16m) has been introduced as the next-generation communication technology, especially for the purpose of enabling high-speed wireless mobile communication. IEEE802.16m includes technology related to handover to retain connection when switching between base stations in transit, and was approved as an international standard in March 2011. The nominal transmission rate is 160Mbps, and it is also capable of maintaining connection during travel at 350km/h.

LTE has already been launched in the Philippines by SMART, with the 42Mbps high-speed communication at the nominal rate. Moreover, LTE-Advanced has been announced as the next-generation of LTE, with the nominal transmission rate reaching 1Gbps.



Source: Impress Watch http://k-tai.impress.co.jp/

FIGURE 9.6-1 RELATIONSHIP BETWEEN TRANSMISSION SPEED AND TRAVELING SPEED IN LTE-ADVANCED



Source: Brochures of Proxim wireless http://www.proxim.com/

FIGURE 9.6-2 IMAGINARY OF WIRELESS COMMUNICATION FOR TRAFFIC CONTROL (LTE OR WIMAX)

9.6.2 Telematics

(1) Communication for Vehicle

Information Communication for Vehicles is an innovation of networks for vehicles and roadside units. It provides the information, such as safety warnings and traffic information on each others. There are several technologies for the information communication for vehicles.

For Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I), Dedicated Short Range

Communications (DSRC) will be used in United States and Europe according to “Car 2 Car Communication Consortium”. The communication technology is derived from the standard IEEE 802.11, also known as Wireless LAN and a frequency spectrum in the 5.9 GHz range has been allocated on a harmonized basis in Europe in line with similar allocations in USA. As the range of the technology is limited to a few hundred meters, every vehicle is also router and allows sending messages over multi-hop to farther vehicles and road side units.

The standardization of technology is in competition between advocacy groups, such as Japan, United States, Europe, South Korea which are key countries of car manufactures.

Source: Department of Transportation, USA http://www.dot.gov/research

FIGURE 9.6-3 IMAGINARY OF V2V AND V2I

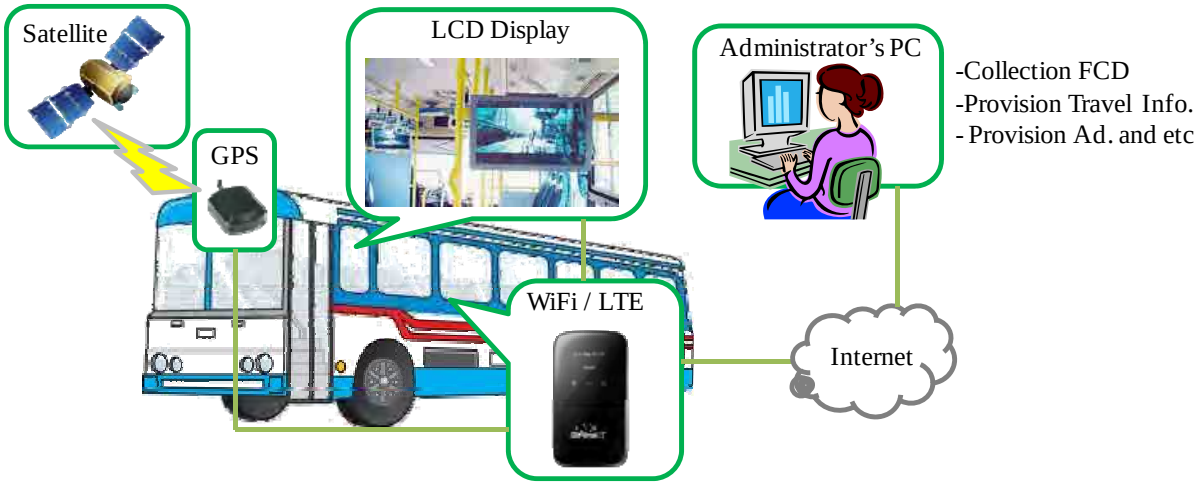
For Inner Vehicle, WiFi or Bluetooth will be used substantively. At present, the communication technology for Inner vehicle is not unified, it is selected depending on car manufacturers. However, vehicle is equipped by a lot of sensors. Therefore, it shall be computerized and networked. Thus, it needs high-capacity communication technology such as WiFi and Bluetooth.

Source: ITS International http://www.itsinternational.com

FIGURE 9.6-4 VEHICLES WILL HAVE ACCESS TO WEB IN IMMEDIATE FUTURE

In case of public transport, WiFi networking is being implemented. In an age where social media is a part of many people's everyday lives, more and more transport operators are beginning to realize the benefits of social media in communicating with their customers to improve service. The innovation is for the dispersion of communication traffic volume from an existing communication such as 3G network. Also, the communication infrastructure is utilized for the provision of travel information to passengers, advertising, digital signage and so on. (See **Figure 9.6-5**)

There are some Wifi buses for inter-city line in Philippines however; it is operated without digital signage scheme. (See **Figure 9.6-6**)



Source: JICA Study Team

FIGURE 9.6-5 SYSTEM ARCHITECTURE OF BUS DIGITAL SIGNAGE USING WIFI/LTE

Source: JICA Study Team

FIGURE 9.6-6 WIFI BUS IN MANILA

(2) Diagnostic Module: OBD2

A vehicle is equipped with an interface called OBD2, a device that obtains vehicle information, through which it is possible to acquire information from the on-board computer (ECU) that records travelled distance, fuel consumption, engine rotation, emission temperature, etc.

Originally, OBD2 is designed as a tool to obtain diagnostic information at a car dealer, etc., but it also enables obtaining the travelled distance. A number of companies have already sold terminal devices as shown in **Figure 9.6-7.**

Nevertheless, although the hardware interface of OBD2 is largely standardized globally and widely used in Europe and the US, models sold in Asia regions do not have unified software interface for CAN interface, and in Japan, there are only a limited number of vehicles offering this function.

Source: ITS International http://www.itsinternational.com

Source: Study Team

FIGURE 9.6-7 OBD2 MODULE

9.7 PARTNERSHIP WITH PRIVATE SECTOR IN ITS

9.7.1 Implementation Network of ITS in Japan

(1) Upper Level Plan

In July 1993, Five-Ministry Liaison Conference was established as a place to exchange opinions and make adjustments among working-level officers for the purpose of efficiently addressing various ITS-related issues while making joint efforts with the academic circle, the business circle and foreign experts (renamed as Four-Ministry Liaison Conference).

In August 1994, the Advanced Information and Telecommunication Society Promotion Headquarters was established, with Prime Minister serving the Director-General, in order to promote comprehensive measures toward the establishment of an advanced information and telecommunication society in Japan and to actively cooperate as a nation with international efforts related to advancement of information and telecommunication.

In 1996, Comprehensive Plan for ITS (Intelligent Transport Systems) in Japan was developed and presented as the long-term vision for the basic concept concerning the development and deployment of ITS with the intention to promote ITS through collaborative efforts among industry, government and academe.

In the same year, the “Basic Guidelines on the Promotion of an Advanced Information and Telecommunications Society” (revised in November 1998) was presented, and in April 1999, based on the guidelines, “Basic Guidelines on the Promotion of an Advanced Information and Telecommunications Society-Action Plan” was developed.

Moreover, in January 2000, “Basic Law on the Formation of an Advanced Information and Telecommunications Network Society” was enacted, with the promotion of IT positioned as an important national policy.

In January 2001, the “Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society (IT Strategic Headquarter)” was established within Prime Minister’s Cabinet, while e-Japan strategy was developed with the goal to become a world leading IT nation by 2005.

As shown above, in the promotion of ITS in Japan, industry, government and academe have been working together with Four-Ministry Liaison Conference headed by Prime Minister taking the initiative in collaboration among ministries and agencies and ITS Japan (ex-VERTIS) leading industry and academic circle.

In establishing an advanced information and telecommunications network, the Ministry of Land, Infrastructure, Transport and Tourism was assigned to the key role in building an information highway and promoted the construction work together with road construction and road renovation projects.

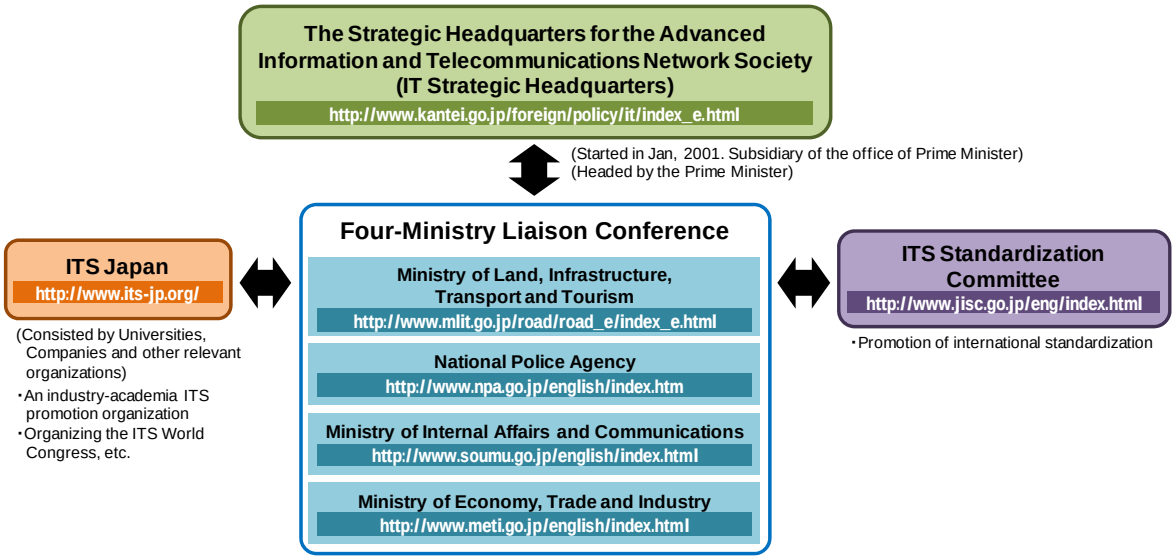
The promotion of ITS led to the creation and development of a new industry and market centering on the road infrastructure, with numerous electric and electronic manufacturers in Japan. An example of such efforts is the creation of a new industry/market by utilizing information and telecommunication network built along expressways. At the end of 1983, about 3,500km of communication line and its accommodation space for road information were constructed along expressways in Japan, and the “Information Highway Initiative” was underway to realize an advanced information and telecommunication network by installing high-capacity optical fiber cables in this space. In the same year, Highway Industry Development Organization (HIDO) was established as an institution to create a new industry / market by utilizing road infrastructure, and in the following year of 1984, TWJ (Teleway Japan Corporation) was established mainly to build electric telecommunication facilities such as optical fiber cables in expressways, etc., and rent them to telecommunication companies. In 1998, TWJ was merged into KDD (current KDDI). KDDI is one of the largest telecommunication companies.

(2) Four-Ministry Liaison Conference

In Japan, four governmental bodies concerned with ITS, namely Ministry of Land, Infrastructure, Transport and Tourism (MLIT), National Police Agency (NPA), Ministry of Internal Affairs and Communications (MIC), and Ministry of Economy, Trade and Industry (METI), are involved in promoting ITS under the Strategic Headquarters for the Advanced Information and Telecommunications Network Society (IT Strategic Headquarters), which is

spearheading the IT revolution in Japan.

The IT Strategic Headquarters was established in January 2001, headed by the Prime Minister. In addition, the four governmental bodies also collaborate in the promotion of ITS with ITS Japan, which is an industry academic ITS promotion organization, and ITS Standardization Committee that promotes international standardization of ITS.



Source: ITS Handbook, Highway Industry Development Organization

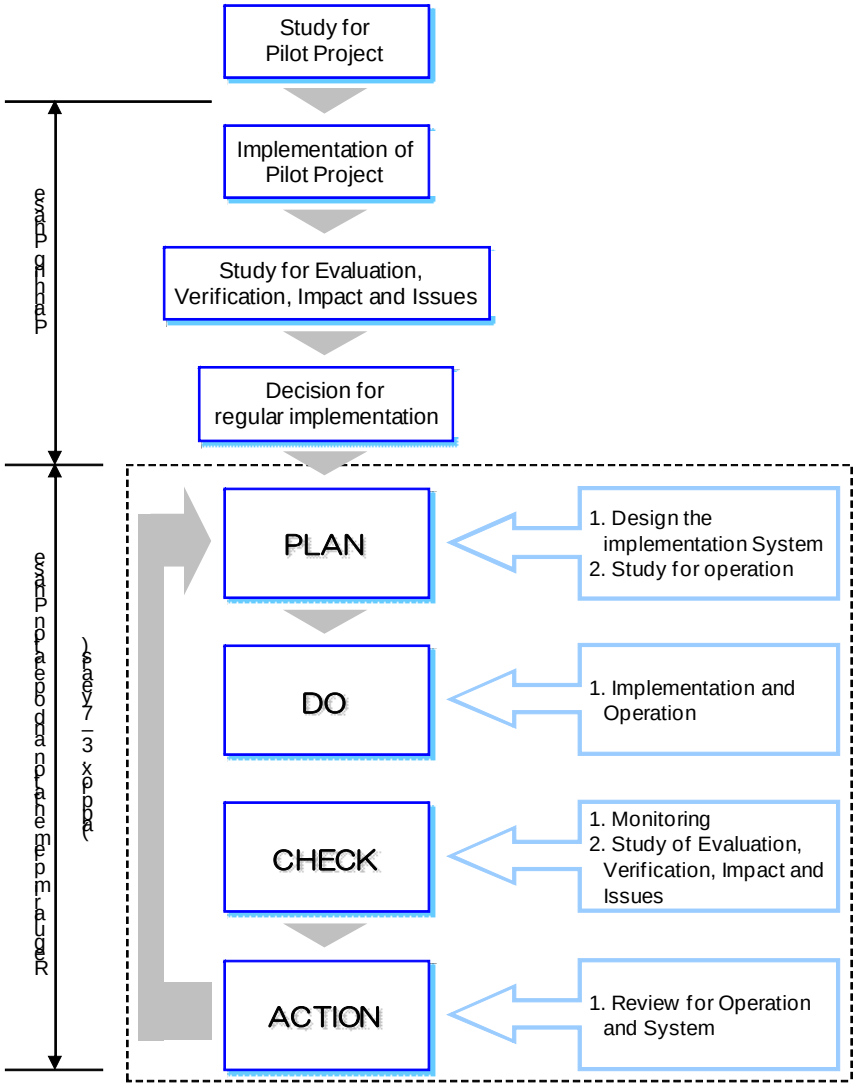
FIGURE 9.7-1 IMPLEMENTATION FRAMEWORK OF ITS IN JAPAN

9.7.2 Cooperation with Private Sector for Sustainable ITS

Even though there are practical challenges with certain ITS services today, future progress in ICT technology may make it possible to turn them into practical use for expanded benefits. Therefore, as indicated below, it is crucial to establish a PDCA cycle with regular check / action for each ITS service in order to continuously produce benefits from its development and operation toward technological spiral-up.

Moreover, unlike civil engineering infrastructure, the service life of ITS equipment is often about 3-5 years, requiring the regular renewal of the equipment.

In order to implement system renewal and improvement, it is required to continuously secure budget, but it is assumed that budget allocation may be difficult considering the current status of the Philippines. With this background, it seems to be desirable to realize sustainable ITS services by establishing ITS services as private enterprise.



Source: JICA Study Team

FIGURE 9.7-2 PROJECT CYCLE OF ITS SERVICE

(1) Collection of Floating Car Data

Establish a company of "FCD analysis service provider" to provide various ITS services based on FCD for each vehicle.

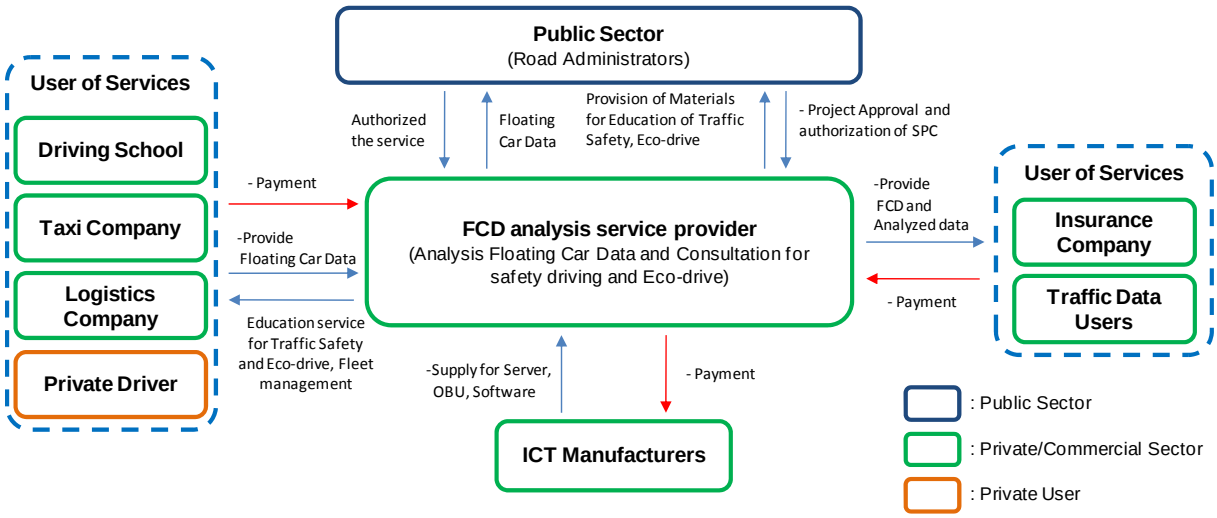
Specifically, the "FCD analysis service provider" will provide the following services based on floating car data (including information about acceleration):

- Provide services such as evaluation of the safe driving skills of each driver, provision of instruction materials to improve driving skills, management of vehicle movement, eco-drive diagnosis for drivers' school, taxi companies and freight carriers (paid services).
- Sell the results of statistic analysis to automobile insurance companies (as basic materials for insurance premium), etc.

Public sectors will receive the provision of FCD or statistically processed data for free of charge in return for support in acquiring business license, the promotion of the said services for the commercial vehicles or the authorization of the said service (e.g. “Authorized by MMDA) and the provision of subsidies for initial cost.

The maintenance / management and renewal of the whole system will be covered by the profit of the said service-providing company.

Examples of the business scheme are shown in **Figure 9.7-3**.



Source: JICA Study Team

FIGURE 9.7-3 BUSINESS SCHEME: SELLING OF DATA COLLECTED BY FLOATING CAR

(2) Traffic Information, Toll and Fare Collection Service

Traffic Information service and Toll and Fare collection services are correlated highly. Traffic Information to be provided are traffic volume, traffic speed, OD (Origin-Destination) data and etc. Even, toll and fare collection service needs the usage data such as volume of vehicle/passenger, OD data and etc. In this chapter, describe the business scheme for traffic information, toll and fare collection in case of by using an electronic payment only.

For toll and fare collection, Tollage Service is conducted by Private/Commercial sector in Expressway and Public Transport (such as LRT/MRT) usually. The establishment of Clearing House is absolutely imperative for unified payment system of toll and fare collection on different expressway, different public transport Line. Clearing House shall be capable of integrating the usage data, which is transmitted from each tollgate and each ticket gate. Even, aggregate the fee allocation to each operator as occasion demands. And, Clearing House submits the billing statement to Financial Agency (such as Bank, Credit Card), it is calculated based on historical data of usage of each users (or each Card-ID).

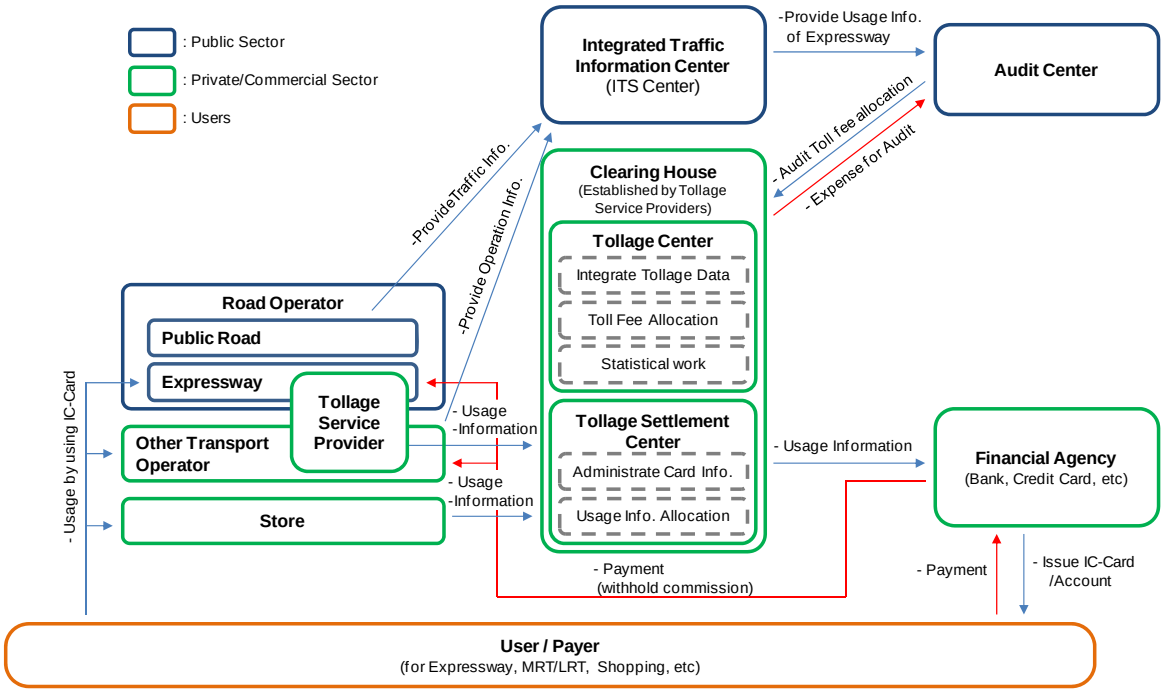
Clearing House is established and conducted by the investment of Tollage Service Providers. However, it is necessary to audit the operation of Clearing House such as fee allocation, etc by Public Sector. Therefore, extensive data of traffic volume, usage of ridership are collected from each operator via Integrated Traffic Information Center. Then, audit the calculated result of Clearing House by Audit Center.

Financial Agency shall transmit the amount required from user's account to operator's account based on the billing statement by Clearing House. At that time, withhold the commission charge according to contractual coverage by Financial Agency. (See **Figure 9.7-4**)

For traffic information, Traffic Information Provision Service is conducted by Private/Commercial sector such as "Traffic Information Provider", it is for reduction the budget of the implementation cost related to information provision, operation cost.

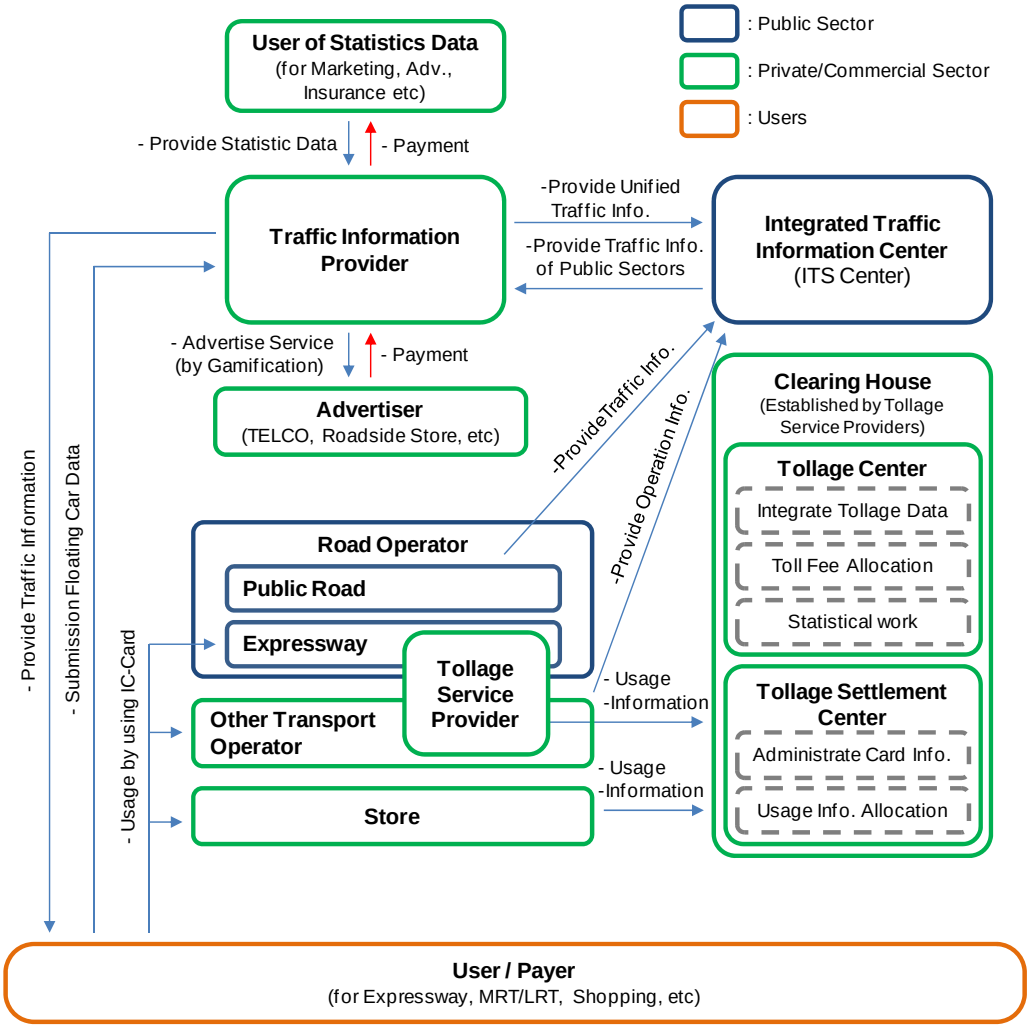
Integrated Traffic Information Center collects and manages the extensive traffic volume, usage of ridership, operation information, incident/accident information from each operator and Tollgate Service Provider. Traffic Information Provider shall build the Traffic Information Provision/Generation System, it is utilized Public Traffic Data which is provided from Integrated Traffic Information Center. Even, to collect the FCD from users by using Smartphone application cooperate with other Private Sectors.

Traffic Information Provider generate the Traffic Information for provision based on FCD and Public Traffic Data, the Traffic Information is disseminated to users and related agency such as Integrated Traffic Information Center, each operators via Internet. It is capable done that such as ad-support using Gamification, sales of statistical traffic data on Traffic Information Provision Service which is provided by Traffic Information Provider. (See **Figure 9.7-5**)



Source: JICA Study Team

FIGURE 9.7-4 BUSINESS SCHEME: TOLL AND FARE COLLECTION SERVICE



Source: JICA Study Team

FIGURE 9.7-5 BUSINESS SCHEME: TRAFFIC INFORMATION SERVICE

(3) Utilize of Duct and Dark Fiber Service

It is possible to rent the optical fiber or its accommodation space built by the road administrator or the combination of both to private telecommunication companies.

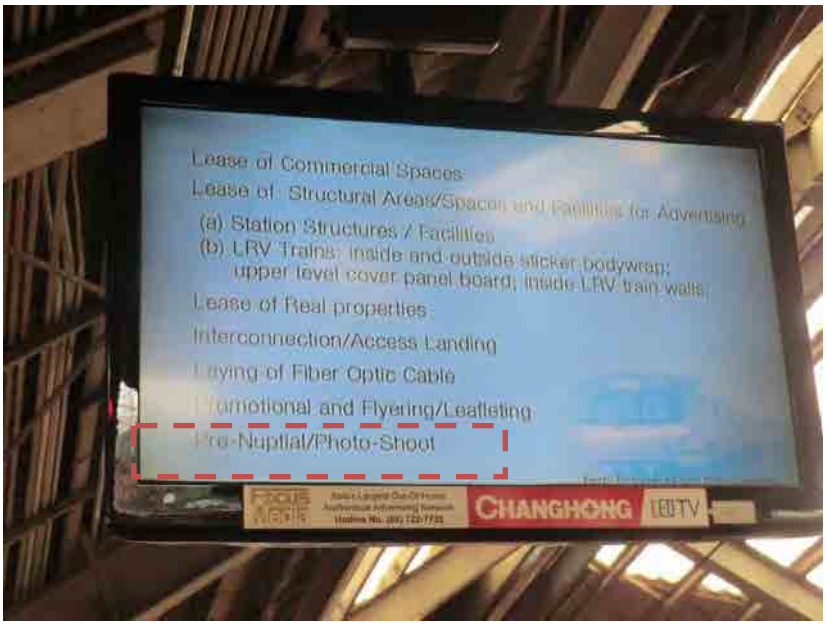
The road administrator builds information and telecommunication infrastructure including optical fiber for the foundation of ITS services. In constructing an optical-fiber information infrastructure, most of the cost will be spent for civil engineering work such as drilling or installing tubes, and the cost of optical fiber itself will be about the same whether it is 16-strand or 48-strand. Therefore, when constructing the network, as many strands as possible should be used, to prepare for the future expansion of renting services.

Rent duct lines as space for private cellular phone companies / telephone companies to install their own optical fiber.

Also, rather than using all the built optical fiber for the purpose of managing roads, rent part of it private cellular phone companies / telephone companies to collect construction cost.

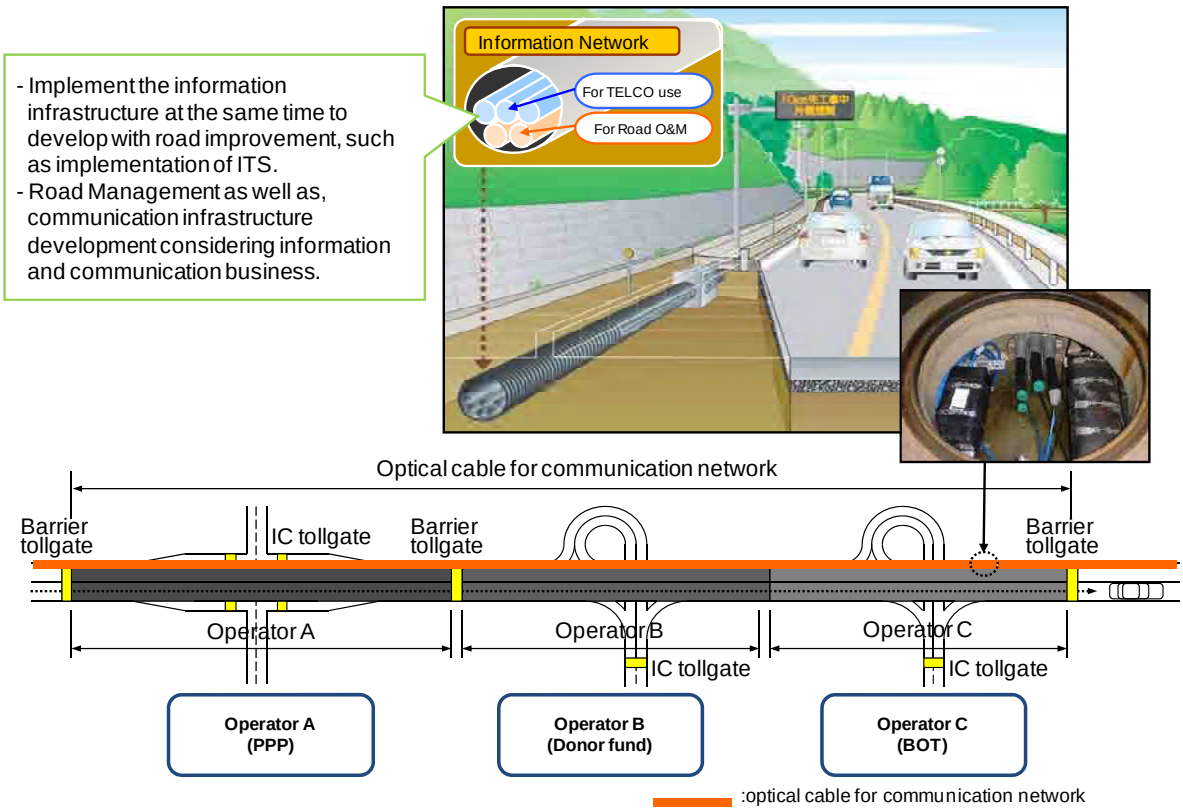
Profit generated from these leasing businesses can be allocated to cover maintenance/management cost.

Additionally, LRTA has implemented a laying service for optical fiber in Metro Manila. The image of the business model is shown in **Figure 9.7-7** and **Figure 9.7-8**.



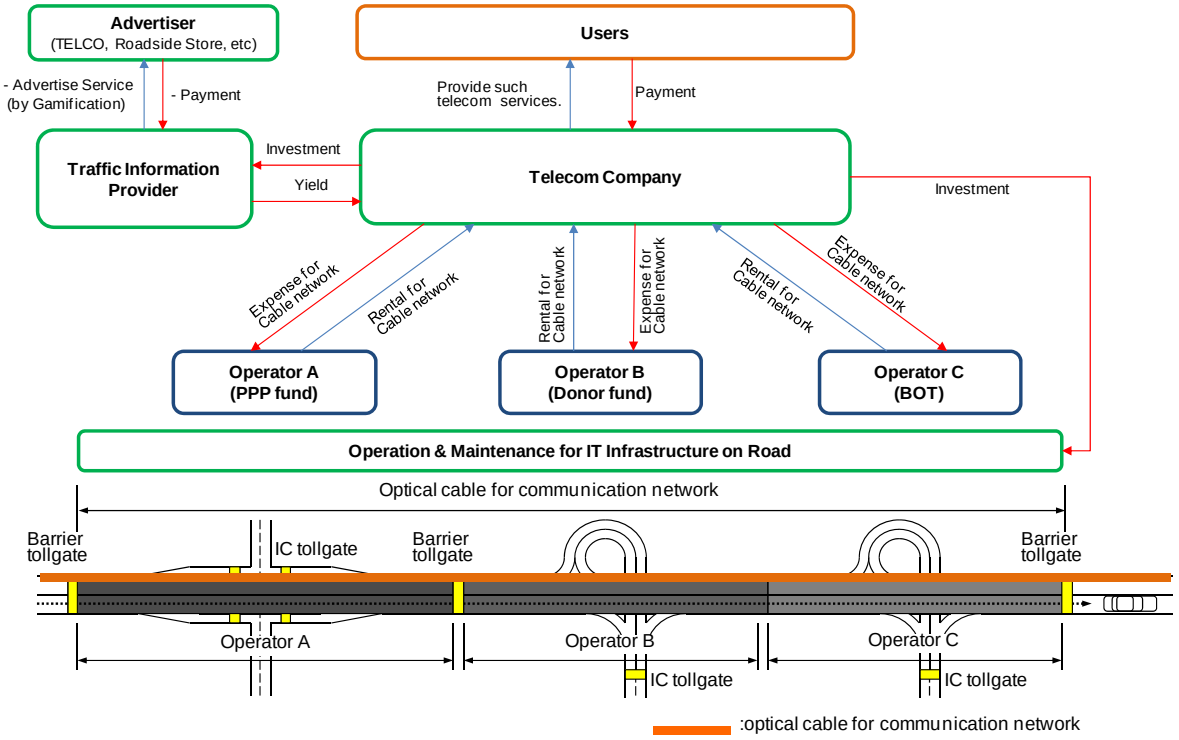
Source: JICA Study Team

FIGURE 9.7-6 NOTICE OF LRTA SERVICE INCLUDED THE LAYING SERVICE FOR OPTIC FIBER



Source: JICA Study Team

FIGURE 9.7-7 CONSTRUCTION OF OPTIC FIBER CABLE DUCTS FOR BUSINESS



Source: JICA Study Team

FIGURE 9.7-8 BUSINESS SCHEME: LEASE OF OPTIC FIBER CABLE DUCT

CHAPTER 10
MASTER PLAN FRAMEWORK

10.1 PROCEDURE FOR MASTER PLAN FORMULATION

The procedure to formulate the ITS Master Plan is shown in **Figure 10.1-1**. This chapter discusses the goals and strategies of ITS Service. ITS Master Plan in Metro Manila is discussed in Chapter 11, and ITS Master Plan in Mega Manila is discussed in Chapter 12.

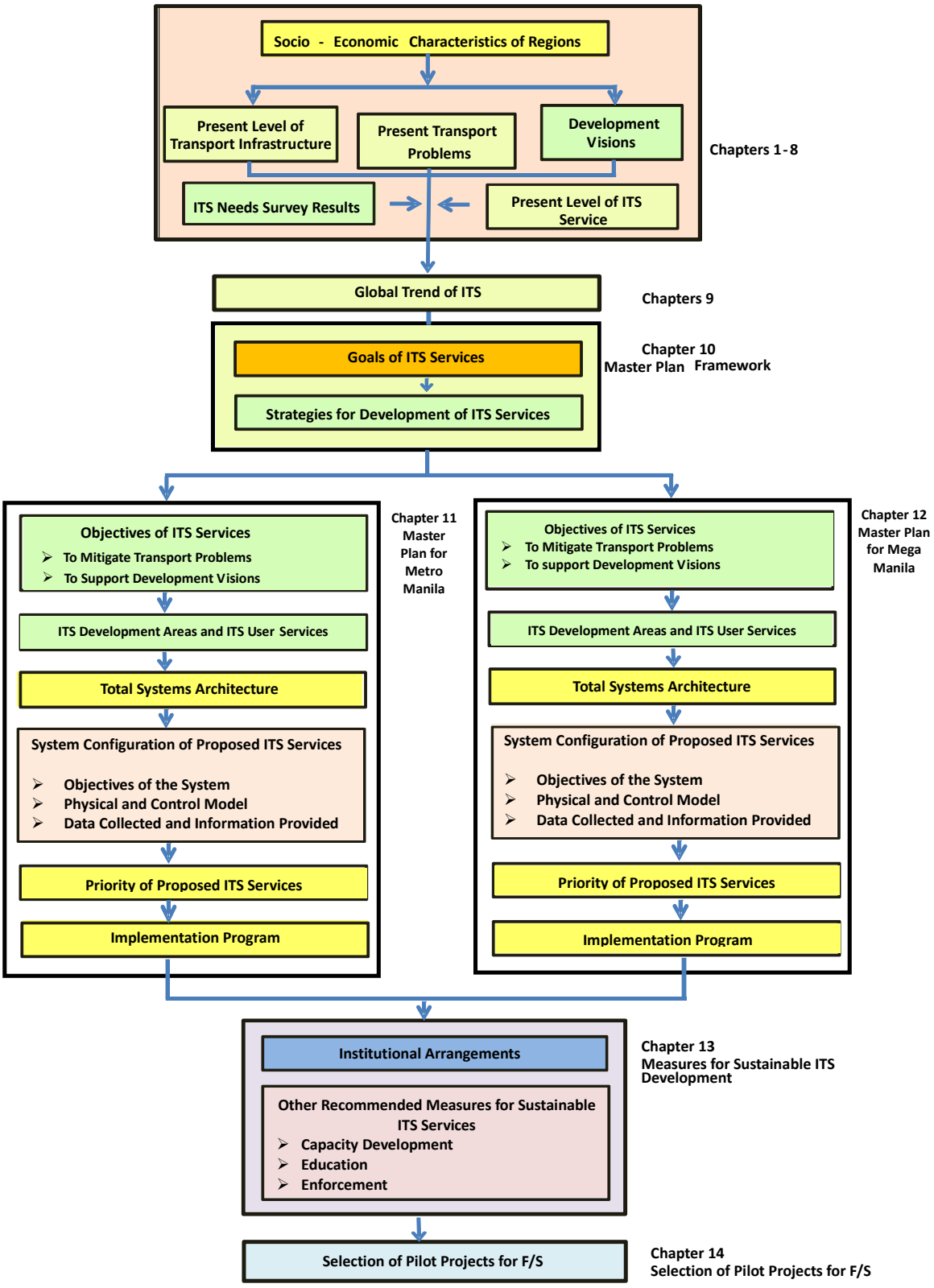


FIGURE 10.1-1 FLOW CHART FOR ITS MASTER PLAN FORMULATION

10.2 OVERALL GOALS OF ITS SERVICES

10.2.1 Metro Manila

In order identify the goals of ITS services, future urban development visions and transport targets are summarized in **Table 10.2-1.**

TABLE 10.2-1 DEVELOPMENT VISIONS AND TRANSPORT TARGETS

Development Visions[1)]		Transport Targets in relation to Development Visions[2)]
Towards a Competitive, Inclusive and Resilient Metropolis	**Business and Knowledge Outsourcing** "To be a global center for knowledge processing, specializing in outsourced services, moving toward higher-value activity through continuous wide scale upgrading of human resources, with a particular emphasis on poor youth, creating ladders of upward mobility."	• **To provide faster, safer, more comfortable and economical transport means**
	Green Large-Scale City Building "To trigger massive public-private investment that addresses the backlog of housing, mobility, and environmental infrastructure needs, thereby creating a second city building engine of economic growth." "Based on recognition of the strengths of Metro Manila's multi-centered (polycentric) structure, and the potential of current & selective new functionally specialized urban centers to drive localized growth." "Capitalizing on the potential of the current spatial structure to be green and time saving by enhancing energy efficient connectivity among/within urban centers."	• **To provide efficient transport system with greater mobility and environment-friendly transport** • **To reduce energy consumption and pollution by transport systems for reduction of global warming**
	Peri-Urbanization as an Opportunity "Recognizing the very rapid population growth on the periphery (>3% p.a.) coupled with poor peri-urban mobility and limited livelihood opportunities by increasing mobility and livelihood opportunities." "Increase mobility through investment in peri-urban public transit corridors linking peripheral areas to Metro Manila's core centers while locally integrating peri-urban jurisdictions." "Enhancing the benefits and inclusiveness of such development by aligning stations and affordable housing." "Dramatically increasing livelihood opportunities in peri-urban Metro Manila by targeting public policy/ investment support to globally competitive activities, particularly manufacturing clusters of promise, such as higher value electronics."	• **To achieve efficient public transport system** • **To integrate communities between Metro Manila and its periphery by providing efficient transport system interconnecting them**

Development Visions[1)]		Transport Targets in relation to Development Visions[2)]
	Retrofitting Communities "Leverage benefits associated with the current socio-economic mix of communities surrounding urban nodes through dramatic upgrading of housing and communities by: 1. Increasing densities outward from urban centers where appropriate 2. With a bias towards in-situ redevelopment of low-income communities based on win-win land readjustment techniques proven elsewhere.	• **To provide efficient transport system serving target communities**
	Reducing Vulnerability "Recognizing that Metro Manila is one of the most vulnerable metropolitan regions in the world to natural hazards and climate change." "Build and retrofit Metro Manila to reduce vulnerabilities by investing in Flood Control infrastructure, enabling and enforcing risk sensitive land use planning, and upgrading and implementing building codes, supporting community adaptation, and establishing early warning and emergency response systems."	• **To provide access routes for evacuation and relief operations**
	Attracting Newly-Rich Regional Neighbours "Make Metro Manila the destination of first choice for the newly emerging affluent citizens of East Asia, a middle class soon numbering more than 1 billion people by 2025." "Focusing on shopping, conventions and meetings (MICE), entertainment, **attracted by a secure and affordable environment, where its more fun."** "Capitalizing on Metro Manila's potential as a staging point for Philippine's world class beach tourism."	• **To provide safe, comfortable, reliable and efficient transport services to major activity areas**
	Reclaiming High-End Service "Reclaim Metro Manila's past role as a leading high-end services center in Asia by focusing on selective aspects of Higher Education, Medical Services/Tourism, and the Cultural Economy (Advertising, Animation)."	• **To provide safe, comfortable, reliable and efficient transport services**

Source: 1) Metro Manila Greenprint 2030
2) JICA Study Team

In consideration of the above, ITS services should target to achieve the following from the viewpoint of development visions:

TARGETS FOR ITS SERVICES: METRO MANILA

- **Improvement of mobility**
- **Sound environment**
- **Safe and comfortable life with less traffic accidents**

10.2.2 Mega Manila Region outside Metro Manila

Development visions and transport targets of Region III are summarized in **Table 10.2-2**.

TABLE 10.2-2 DEVELOPMENT VISIONS AND TRANSPORT TARGETS: REGION III

Vision	Development Goals and Objectives[1)]	Transport Targets in Relation to Visions and Goals/Objectives[2)]
"A Sustainable and Caring Global Gateway through Public-Private Partnership and Growth for All".	**(1) High Sustained and Inclusive Growth** **(2) Globally-competitive. Progressive and Resilient Citizenry** **(3) World-Class passenger mobility and cargo distribution network** **(4) Sustainable Land-Using Activities** **(5) Socially Responsible Property Rights** **(6) Effective, Responsive and Transparent Governance**	• To provide high standard transport means (toll expressways and high-speed rail) • To provide faster, safer, more comfortable, more reliable and economical transport services

Sources: 1) Region III Development Plan 2011-2016
2) JICA Study Team

Development visions and transport targets of Region IV-A are shown in **Table 10.2-3.**

TABLE 10.2-3 DEVELOPMENT VISIONS AND TRANSPORT TARGETS: REGION IV-A

Development Visions[1)]	Transport Targets In Relation to Development Visions[2)]
• Be the leading global economic hub of the country • Be a model, livable industrial region, highly urbanized with well-planned own clusters • Ideal for sustainable living • Have a vibrant countryside offering an excellent alternative place to live, work and seek recreation • Have a modern intermodal system and digital infrastructure integrating the region within, to the country, and to the global community • Be complemented by high quality social service amenities accessible region-wide • Have a citizenry whose high creativity and competitive spirit, genuine concern for the environment and fellowmen, and love of country is inspired by their affinity to the region's heroes and unwavering faith in God	• To provide high standard transport means (toll expressways and rail transit) • To provide faster, safer, more comfortable, and more reliable and economical transport services

Sources: 1) Region IV-A Development Plan 2011-2016
2) JICA Study Team

In consideration of the above, ITS services should target to achieve the following from the viewpoints of development visions:

TARGETS FOR ITS SERVICES: MEGA MANILA REGION OUTSIDE METRO MANILA

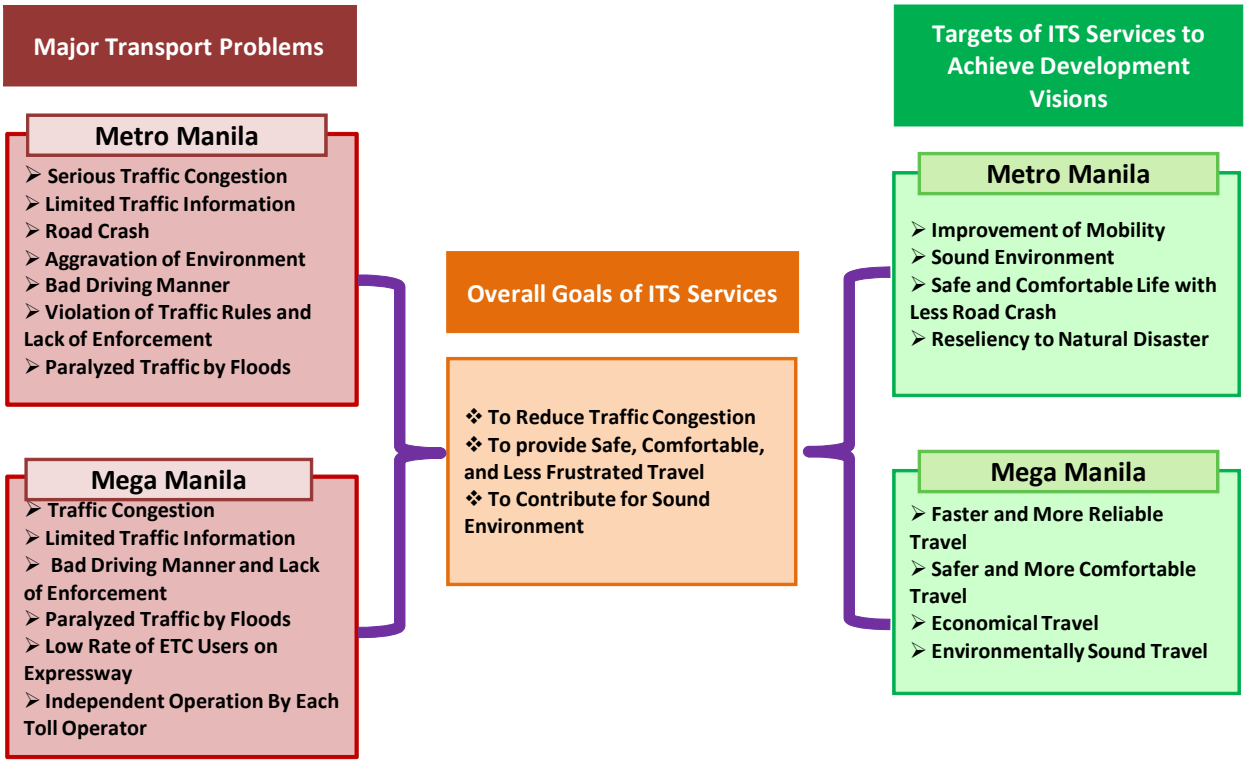
To achieve:

- **Faster and more reliable travel**
- **Safer and more comfortable travel**
- **Economical travel**

10.2.3 Overall Goals of ITS Services

To achieve above targets for ITS services in Metro Manila and Mega Manila and to mitigate existing transport problems, overall goals of ITS services are:

- **To reduce traffic congestion**
- **To provide safe, comfortable and less frustrating travel**
- **To contribute to sound environment**



10.3 STRATEGIES FOR DEVELOPMENT OF ITS SERVICES

To achieve goals of ITS service, strategies for development were established as follows:

ITS DEVELOPMENT STRATEGIES

1. Expansion of existing ITS services
The existing ITS Services shall be based and upgraded continuously
E.g., Metro Manila Traffic Navigator ⇨ Automated NAV ⇨ 3rd Generation

2. Expansion of coverage area
ITS Service Coverage Area shall be gradually expanded.
E.g., Metro Manila ⇨ Metro Manila Periphery ⇨ Mega Manila ⇨ Nationwide

3. Consideration for existing problems, visions and user needs
Selection of ITS Services shall fully consider existing problems, development visions and needs.

4. Minimization of data collection cost
Utilization of information from road users, floating car/vehicle, etc., shall be maximized and information collection devices/tools shall be minimized.

5. Maximization of historical data utilization
Utilization of historical data shall be maximized.

6. Consideration for fast IT development
Information technology (IT) development is quite fast. Master Plan shall be flexible to adopt the latest feasible IT.

7. Business Model
There are many fields where the private sector's initiative can be sought. The Government should advocate the private sector for active usage of ITS technologies.